

*“Understanding is the greatest triumph anyone can experience.  
Every time a new piece of the world is illuminated I feel joy.”  
- Lucas Winstrom, Mathematics and Physics, Junior*

**University of Washington’s**  
**Fourth Annual Undergraduate Research Symposium**  
*A Celebration of Undergraduates in Research*

4 May 2001  
**MARY GATES HALL**  
12:00 to 5:00 pm

*Sponsors: Office of Undergraduate Education, Office of Research, Office of the President*

## *DEDICATION*

*To students and faculty who,  
with passion, discipline, and imagination,  
pursue knowledge.*

University of Washington's  
Fourth Annual Undergraduate Research Symposium  
**PROCEEDINGS**

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*“Amist our daily toils, we students sometimes forget just how priviledged we are.  
As students, we have ‘backstage passes’ to meet and speak with some of the  
greatest men and women of their respective fields – our professors.”  
- Paul Loriaux, Bioengineering, Senior*

# POSTER SESSION

*“Before I met my mentor, I did not know anyone who was living the kind of life I might want to lead and who had any time left to help me learn how to live it.”*  
*- Emilyn Alejandro, Biochemistry, Senior*

## POSTER SESSION<sup>?</sup>

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### MUTAGENIC ANALYSIS OF PROTEIN FOLDING AND INTRAMEMBRANE OLIGOMERIZATION OF A MULTIPROTEIN COMPLEX

**ASHLEY ALWOOD**  
*Senior, Microbiology*  
MARY GATES SCHOLAR

**BETH TRAXLER**  
*Professor, Microbiology*

In the Traxler lab, we are studying the biogenesis and structure of membrane proteins using the *E. coli* maltose transport complex as a model. The maltose transport complex is a useful model for assembly of multimeric proteins because of its simplicity of structure and the ease of manipulating *E. coli* through various genetic tools. The maltose transport system also has wider applications as a model for membrane protein complexes. It can be used as a tool to better understand the ATP binding cassette superfamily, which hydrolyzes ATP to facilitate transport of specific membrane impermeable solutes. Related proteins in this family include the CFTR protein, which is defective in humans with cystic fibrosis. This protein has domains similar to the different subunits of the maltose transport system in *E. coli* but is composed of a singular protein. The maltose transporter is composed of three distinct proteins that assemble in a 1:1:2 ratio. These proteins are MalF, MalG, and MalK respectively. All of the proteins fold and insert in the membrane independently. We are mutagenizing the *malF* gene to identify candidates that produce proteins that are specifically defective in complex oligomerization. Mutants can also be found that lead to complex formation but not maltose transport. We are particularly interested in MalF mutants that are unable to fold and therefore cannot form a functional complex. Similar mutants have already been found in the MalG and MalK subunits. These mutants can then be studied to further understand how protein subunits recognize one another and oligomerize within the membrane in a multiprotein system.

### THE "CHRISTMAS TREE" *bp* MUTATION OF *ARABIDOPSIS THALIANA*: REGULATOR OF STEM ELONGATION PATTERNS

**MEGAN ANDERSON**  
*Senior, Cellular & Molecular Biology*

**KEIKO TORII**  
*Professor, Botany*

I have been working with a plant called *Arabidopsis thaliana*. It is a model plant, ideal for botany and genetic research because it is a relatively small organism, has a short generation time, and can be easily manipulated by cross-pollination. Moreover, the DNA sequence of *Arabidopsis* is available, allowing investigation of underlying genetic mechanisms controlling plant development. My research focuses on genetic mechanisms regulating plant organ elongation. It is known that an *Arabidopsis* mutant, *brevipedicellus* (*bp*), shows reduced organ elongation. The *bp* mutant plant is significantly shorter than its wild type counterpart. Its fruit is much more compact on the stem, they are pointed downward, and its pedicels are considerably shorter. We identified a new mutant, tentatively named *bp-2*, which resembles the *bp* mutant. I began my research to investigate the nature of this mutation. My questions are: (1) Are the *bp* and *bp-2* phenotypes a result of mutations in two loci or one? (2) Are the *bp* and *bp-2* mutants recessive or dominant? (3) What is happening at the cellular level in these mutants? In order to answer these questions, I performed cross-pollinations between *bp* and *bp-2* mutant plants, as well as between *bp-2* and wild-type plants, and observed the phenotypes of the following generations. I found that *bp* and *bp-2* are allelic, meaning they have mutations within the same locus. I also found an additional locus, *ERECTA*, whose mutation enhances both the *bp* and *bp-2* phenotypes. The *erecta* mutation was originally present as a background mutation both in the *bp* and *bp-2* mutant alleles. Further experimentation suggests a genetic interaction between two loci, *BP* and *ERECTA*. This spring quarter I will begin sectioning a plant homozygous at both loci for the mutant recessive genes to see what their visible effect is at the cellular level.

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<sup>?</sup> Abstracts of students also participating in a presentation session are listed by their presentation session.

## POSTER SESSION

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### THE RELATIONSHIP OF POST-TRAUMATIC STRESS DISORDER TO THE FREQUENCY AND SEVERITY OF SELF-MUTILATION IN BORDERLINE PERSONALITY DISORDER

**ONA ANICELLO**

*Senior, Psychology*

*EIP PRESIDENTIAL SCHOLAR*

**KATHERINE COMTOIS**

*Professor, Psychiatry and Behavioral Sciences*

The relationship between post-traumatic stress disorder (PTSD) and self-mutilation was examined in the population of borderline personality disorder (BPD). Previous investigations have suggested PTSD as an intermediate between trauma history and the frequency and severity of self-mutilation in BPD, yet no studies have been carried out solely investigating this relationship. The current study hypothesized that diagnosis of PTSD would predict the frequency and severity of self-mutilation behaviors above and beyond trauma history among people with BPD. Participants included those who met full BPD criteria from the Personality Disorders Examination (PDE) scale (N=36). Trauma history and PTSD was measured using the PTSD module of the Structured Interview for the DSM-IV (SCID-I). The frequency and severity of self-mutilation was analyzed through the Parasuicide History Index (PHI). Results and conclusions are still being determined.

### *BRICOLAGE, A LITERARY AND ARTS JOURNAL*

**HOLLY ATKINSON**

*Senior, Zoology*

**GRANT BREITHAUPT**

*Junior, English*

**KIMBERLY SWAYZE**

*Academic Counselor, English*

**NICK CRISAFULLI**

*Senior, English*

**ANDREA EBERLY**

*Sophomore, Biochemistry*

*MARY GATES SCHOLAR*

**CORT LEININGER**

*Senior, English and Comparative  
Literature*

**BLYTHE SUMMERS**

*Senior, English*

Due to the nature of the publication industry, and considering print publication in particular, it is difficult for artists and authors to gain the validation and exposure provided by publication in a conventional journal or collection of works. *Bricolage*, an annual journal of literature and visual art as well as a Registered Student Organization sponsored by the English Department, endeavors to provide that opportunity for publication to all members of the University of Washington community. The publication is produced via a three-stage process: In the fall, *Bricolage's* all-undergraduate staff members solicit high quality content with a competitive call for submissions from UW students, staff, faculty, and alumni. The pieces slated for inclusion in the journal are selected during the winter quarter. *Bricolage* is always comprised of an eclectic selection of works, including photography, poetry, one-act plays, lithographs, short stories, and essays. In the spring, the staff assembles a professionally-bound book and sponsors a well-attended reading as the journal's presentation. Published quarterly and now annually for nearly twenty years at the University of Washington, *Bricolage* has evolved from a simple folio serving English majors to a substantial volume featuring the creative efforts of the entire University community. Given a reciprocal relationship between art and culture, *Bricolage's* encouragement of art causes a cognate progression of local culture. Two decades of support by *Bricolage* have aimed to draw attention to the University of Washington's status as possessing not only a strong contribution to research in science and technology, but also a rich and varied culture of creativity through communication of literature and the arts.

## POSTER SESSION

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### THE EFFECT OF INHIBITORS OF DNA BREAK REPAIR ON CHROMOSOME INSTABILITY IN HUMAN LYMPHOBLAST CELLS

**RENA BAEK**

*Senior, Biology*

**JEFFREY SCHWARTZ**

*Professor, Radiation Oncology*

**YASUKO TAMURA**

*Junior, Biochemistry*

Genetic instability is defined as a condition where spontaneous mutations develop at high rates. It is a common characteristic of tumors and can lead to resistance to chemotherapy and radiation therapy. The goal of our project is to find ways of eliminating unstable cells. In our model system, instability is characterized by the formation of dicentric chromosomes. These can break as cells grow and must be repaired or cells will die. We want to determine if unstable cells can be eliminated by the addition of a chemical inhibitor of DNA repair. The drug we will test is called Wortmannin. It has been shown to prevent the repair of chromosome breaks, by specifically binding to the C-terminus of DNA Protein Kinase (DNA-PK). We will culture stable and unstable clones derived from human lymphoblasts and Chinese hamster ovary (CHO) cells in Wortmannin and measure toxicity and instability. We hypothesize that unstable cells will be more sensitive to Wortmannin because they have lots of spontaneous breaks. We also expect Wortmannin to selectively kill unstable cells. Therefore, we should see the frequency of dicentrics decrease over time because cells with unrepaired breaks will not grow. If our hypothesis is correct, we may try to apply this concept clinically.

### IDENTIFICATION AND CHARACTERIZATION OF THE THIRD BINDING REGISTER OF MYELIN BASIC PROTEIN

**EMILY BAIRD**

*Junior, Biochemistry*

*MARY GATES SCHOLAR*

**CRAIG BEESON**

*Professor, Chemistry*

Multiple sclerosis is an autoimmune disease that deteriorates and inflames the nerves of the central nervous system. The immune system attacks the myelin sheath, an insulating layer of proteins that surrounds the nerves and makes rapid conduction of nervous signals possible. One of these proteins is known as Myelin Basic Protein (MBP). In order for the immune system to respond to MBP, the protein must bind in a specific transmembrane protein called a Major Histo Compatibility complex and must then be presented on the surface of an antigen presenting cell. Here the complexes may activate highly specific T-cells that will elucidate a specific immune response against that protein. Protein fragments bind the MHC in defined registers that are capable of activating specific T-cells. Recent experiments have shown a peptide from the MBP has two or possibly three binding registers. This highly unusual diversity may be a common thread connecting many autoimmune diseases. Our project, which is in close collaboration with Joan Governman's lab in the Immunology department, is to identify and characterize this third binding register. This is accomplished through synthesis of native and mutant peptides of the MBP (1-18) including MBP(5-16), which we believe to be the specific sequence of the third binding register. Kinetic experiments have shown that the MBP(5-16) binds tightly with the MHC complex IA<sup>u</sup>. Stability of the complex is reduced when a proposed binding contact is mutated but it is not affected when mutations in potential T-cell contacts are made. T-cell activation assays, performed by Joan Governman's lab, are still underway. Continued work with other types of MHC complexes and extending the sequence of the MBP register to see how the flanking regions of this peptide will affect kinetics with the MHC and T-cell activation will help further define this third register.

## POSTER SESSION

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### GENE AMPLIFICATION AND OVER-EXPRESSION IN THYROID CANCER

**MISSY BARNES**

*Junior, Zoology*

**ROBERT KIMMEL**

*Teaching Associate, Clinical Research*

**DOAN NGUYEN**

*Junior, Biochemistry*

*MCNAIR SCHOLAR*

Thyroid cancers, in general, and post-Chernobyl pediatric papillary thyroid cancer, in particular, have been found to exhibit genomic instability. Genomic instability, defined as loss, rearrangement, and/or gain of genomic DNA, is a major characteristic of cancer. The least studied of these phenomena in thyroid cancer is gain of gene copy number. The development of cDNA microarray technology has made feasible the detection and mapping of DNA copy-number changes at a global, genomic level, and the correlation of these changes with alterations in gene expression. Thyroid cancer exhibits genomic instability, but little is known about how radiation exposure might induce instability in these tumors. We have identified candidate-amplified genes in both sporadic and post-radiation thyroid tumors. These candidates fall into two classes, those that vary from tumor to tumor, and those that are common to many tumors. Mapping overlapping amplicons identifies the common candidates. Such common amplicons are thought to be the most likely to harbor genes driving oncogenesis. Ongoing studies are aimed at independent verification of candidate amplicons by quantitative PCR. Subsequent work will employ the same cDNA microarrays to detect which of the amplified genes is over-expressed. This will be followed by immunohistochemical assessment of tumors for the expression of specific protein products of the amplified genes. In addition to contributing to our fundamental understanding of solid tumor biology, results from post-Chernobyl cases will enable the correlation of such variables as radiation dosimetry, iodine intake, and specific tumor pathology and aggressiveness to gene amplification. Such information also could lead to improvements in diagnostic and prognostic accuracy of fine-needle biopsies of thyroid tumors through the development of specific PCR-based or immunohistochemical assays suitable for such small specimens.

### FISHES ASSOCIATED WITH DRIFT HABITATS IN THE SAN JUAN ISLANDS, WASHINGTON

**KRISTAN BLACKHART**

*Senior, Fisheries*

*MARY GATES SCHOLAR*

**BRUCE MILLER**

*Professor, Aquatic & Fishery Sciences*

Drift habitats are common features of nearshore and offshore habitats. These assemblages of detached algae and other floating debris may serve as important habitats for many species of fish. Marine fishes and invertebrates are widely known to associate with drift habitats for a variety of reasons, including increased food source, protection from predation, shelter, structure in the pelagic environment, and a possible mechanism for dispersal. This study assessed the importance of drift habitats to fishes in the San Juan Islands, Washington. Drift habitats and associated fishes were collected with a large dip net; snorkeling surveys of drift habitats were also conducted. Thirteen species of fishes at various life history stages were found in association with drift habitats in October and November 1999. Fish abundance and diversity was greater in association with drift habitats than in open water or near attached algae. Drift habitat use differed between individual species of fishes. It was expected that fish abundance would have a positive correlation with drift habitat size; however, no such significant relationship was found. Comparisons with previous studies conducted in the summer months indicate that fish assemblages around drift habitats may be seasonally variable. It is concluded that drift habitats play a significant role in the life histories of some local fish species, and this habitat warrants additional attention for management and study.

## POSTER SESSION

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### EFFECT OF HEARING AID FREQUENCY RESPONSE ON MUSIC PERCEPTION

**STEPHANIE BOR**

*Senior, Speech & Hearing Sciences*

**PAMELA SOUZA**

*Professor, Speech & Hearing Sciences*

Sound quality of speech amplified by hearing aids has been investigated extensively, but there is little information on the perception of music amplified by hearing aids. Newer hearing aids provide specialized settings for music listening, but it is unclear if these settings offer any advantage over the standard hearing aid setting. Another area of interest is if the hearing aid users' own musical background influences their opinion of music quality. Two groups of listeners, hearing-impaired and a normal hearing control group will listen to a selection of jazz, classical, country and rock music through a hearing aid set to either the standard listening program or the music program. The subjects will make perceptual judgements of brightness versus dullness, fullness versus thinness, sharpness versus softness, clarity, loudness, and total impression for each hearing aid setting. Depending on the results, the responses given in these perceptual dimensions will allow for continuing discussions in the efficacy of the music setting. Progress to date has been the design of the experiment, preparation of the music samples, testing the hearing of the normal group and literature review of relevant experiments done on sound quality.

### THE CORRELATION BETWEEN THE POLITICAL PARTY IN POWER AND TRENDS IN LEGISLATION

**NATHAN BORGFORD-PARNELL**

*Senior, Political Science*

**BRYAN JONES**

*Professor, Political Science*

It is commonly understood that Republicans and Democrats come from two, often conflicting, political viewpoints. The general population of the United States assumes and accepts that these two viewpoints lead to differing policies and laws. For example, it is commonly assumed that Democrats support a strong central government whereas Republicans support stronger state governments. Representatives are elected because of the particular viewpoints that they represent during their campaigns; it is automatically assumed that the representatives will champion these views after the elections are completed. Those viewpoints will be manifested as bills presented to the legislative body. Based upon these assumptions, it would follow that any shift in the number of representatives in either of the two major political parties would lead to a corresponding shift in the types of legislation presented. The hypothesis is that there will be a direct correlation between a shift in the number of representatives in a political party, and a shift in the types of bills presented. The independent (predictor) variable will be the number of Republicans and Democrats in each Congress. Data for this variable will come from the Congressional Record, and possibly other public records. The dependent (outcome) variables will be the major and minor topic codes for each bill. This data will be found in the Congressional Legislative Database that is currently being developed at the University of Washington. Possible control variables could be: major world events and their corresponding major topic codes; the political affiliation of the President; and the political party with which the bill originated. Data for these variables will come from appropriate literature and the data itself.

### FRINGING ELECTRIC FIELD SENSORS FOR USE IN MOBILE POWER CABLE MONITORS

**DINH BOWMAN**

*Senior, Electrical Engineering*  
*MARY GATES SCHOLAR*

**ALEX MAMISHEV**

*Professor, Electrical Engineering*

An economically efficient method of monitoring the physical state of large cable power networks is becoming of significant importance in today's power industry. An effective means of monitoring large cable networks is by using individual cable "crawlers" which are equipped with various sensing devices. This poster will present how multi-depth fringing electric field probing devices can be used in such "crawlers" to scan for incipient failures and estimate insulation aging status.

## POSTER SESSION

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### PLASMA INITIATED GRAFTING OF POLYSACCHARIDES TO REDUCE CELL ADHESION

**DANIEL BROWN**

*Sophomore, Aerospace Engineering*  
*MARY GATES SCHOLAR*

**DENICE DENTON**

*Dean, College of Engineering*

Non-fouling surfaces reduce cell adhesion and protein adsorption. One method of fabricating a non-fouling surface results from the immobilization of a polysaccharide onto the substrate surface. A multi-step immobilization technique is investigated in this study. The polymer surface is first activated in a glow discharge, followed by submersion in an ammonia/dioxane solution to aminate the surface. Then the aminated surface is submersed in a sugar solution to covalently immobilize polysaccharides to create a non-fouling surface. Cell culture experiments and ESCA analysis were conducted to evaluate the non-fouling characteristics and surface chemistry of modified poly ethylene teraphthalate (PET).

### FACTORS INVOLVED IN THE DIVISION OF LABOR IN BUMBLE BEES

**AMELIA BRUNSKILL**

*Senior, Psychology and Art*  
*MARY GATES SCHOLAR*

**SEAN O'DONNELL**

*Professor, Psychology*

The goal of this study was to assess whether body size and ovary development influence what role an individual bumble bee plays in the colony. We weighed and individually marked worker bumble bees from four colonies of *Bombus bifarius*. The colonies were then placed outside so that they could forage freely. The in-nest behavior of the bees was recorded by videotape, and the foraging patterns of the bees were documented during daily ninety-minute observation periods. All bees exiting and entering the colony were identified, along with what the bees brought back to the colony (nectar, pollen). After five to six days of observations, the bees were collected. Their wings were mounted on microscope slides and scanned into computer images. The rigid anterior vein (costa) of the forewings was measured for all of the collected workers. The workers were then dissected, and the size of their egg cells was measured. We found that large wing size was correlated with more foraging behavior, and that developed ovaries were correlated with more nest activity. This suggests that bees with large wings may be utilized for their foraging capabilities while bees with developed ovaries are discouraged from undertaking the risks associated with foraging and instead take care of the colony. These correlations also suggest that reproductive competition may be occurring among workers, and is manifested through division of labor. The analysis of the in-nest behavior is not yet complete, and will hopefully provide us with more information on reproductive competition within the nest. We conclude that physiological factors influence the division of labor in *Bombus bifarius*, and that reproductive competition may explain the manner in which labor is divided.

## POSTER SESSION

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### PLAYING SOCCER WITH FOUR-LEGGED ROBOTS

**JONATHAN BURNS**

*Senior, Computer Science & Engineering*

**DIETER FOX**

*Professor, Computer Science & Engineering*

**DAVID DUNHAM**

*Senior, Computer Science & Engineering*

Playing soccer involves a variety of skills, including agility, ball handling, and strategy, making it one of the most challenging sports for humans to play. To teach robots how to play soccer is even more of a challenge and introduces significant research opportunities in artificial intelligence. The fifth annual Robo-Cup soccer tournament provides a dynamic, real-time forum to test our research, which focuses on programming a team of legged robots the size and shape of small dogs to play soccer using only on-board computational power and dynamic programmed strategies. One of the most significant research problems our team faces involves teaching a robotic system how to see and understand its environment. In this soccer domain a robot's vision system is vital to its performance. If our robots cannot locate and follow the soccer ball, if they cannot see and understand where they are on the playing field, and if they cannot see and understand where the opponent dogs are on the field, then success will be next to impossible. Our research involves the development of low computational algorithms to be used in this dynamic environment in which speed is of essence. We will be conducting research on selective color detection schemes to locate objects and landmarks on the soccer field. A selective color detection scheme assigns priorities to the different objects and landmarks our robots will see during a soccer match; for example, the soccer ball is designated as a high priority color, whereas the field lines are given a low priority. We hope that this ranking of importance will help our robots' performance during match play. The vision applications developed from our research will be aggregated into our team of three soccer playing Sony Aibo dogs that will compete this August in the Robo-Cup 2001 tournament.

### CONSTRUCTION OF AN HSV-2 UL47 DELETION VIRUS TO DETERMINE THE IMMUNODOMINANCE OF THE UL47 GENE PRODUCT

**RANDAL CEVALLOS**

*Senior, Cellular & Molecular Biology*  
*MARY GATES SCHOLAR*

**DAVID KOELLE**

*Professor, Lab Medicine*

The cellular immune response to herpes simplex virus type 2 (HSV-2), a chronic infector of humans, is important in controlling infection. One goal in studying the immune response to an infectious pathogen is to find out which viral proteins and which constituent peptide epitope the immune system recognizes. Recently, it had been found that the gene product of HSV-2 gene UL47 is recognized by human CD8 T-cells in an infected person. The long-term goal of my project is to find out how well the UL47 gene product is recognized by the immune system in relation to other HSV-2 genes. To do this, I proceeded to create a new HSV-2 virus lacking the UL47 gene as well as a revertant "rescue" virus. To create the UL47 deletion virus, we used a green fluorescent protein (GFP) gene both as a selection marker and to replace most of the UL47 gene sequence. The GFP gene was inserted in between two flanking pieces of viral DNA. The targeting construct was introduced into mammalian cells, which were then infected with HSV-2. During the process of viral replication, the construct DNA recombined with viral DNA, introducing the GFP gene, while deleting the UL47 gene. Cells infected with this deletion virus fluoresce green under UV light and were selected for with the use of a UV microscope. To make a revertant virus, regaining UL47, a similar strategy was used but selection was for non-fluorescent infected cells. The viruses have been successfully made, as verified through immunological assays, southern, and northern blotting. We plan to use these deletion viruses in experiments to see if UL47 is recognized by the immune systems of a variety of people, possibly making a target gene for an HSV-2 vaccine.

## POSTER SESSION

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### PREDICTING OPTICAL ROTATION IN ORGANIC COMPOUNDS

**KACEY CLABORN**

*Senior, Chemistry*

**WERNER KAMINSKY**

*Professor, Chemistry*

**BART KAHR**

*Professor, Chemistry*

Predicting optical rotation in organic crystals remains a challenging problem inadequately addressed by the existing theories based on inorganic crystals. To develop a tool to treat organic crystals with the existing theory, we considered a series of isostructural tetraphenyl substituted carbon, silicon, germanium, tin, lead, and osmium compounds. This unique series provides a simple basis for comparison, while preserving the crystal symmetry. To achieve this goal, large crystals of the tetraphenyl compounds were grown from readily available compounds or were synthesized. The refractive indices were obtained using the three height method, and optical rotation was measured using the tilter method. To compare the results with calculations the absolute configuration was assigned using x-ray diffraction. We have found thus far that the values of refractive index for these compounds are not constant, but vary with the identity of the central atom. The calculated value of optical rotation in tetraphenyltin was large. This was confirmed by measurements using the tilter method. Eventually, we hope to establish a method for treating the optical rotation of organic compounds based on x-ray structure alone. This will be valuable in interpreting the optical rotation from helical proteins and oligonucleotides.

### THE UNIVERSALITY OF INTRINSIC F<sub>0</sub> SUPPORTED BY JAMAICAN CREOLE VOWELS

**ANGELA CLABOTS**

*Senior, Speech & Hearing Sciences*

**ALICIA BECKFORD WASSINK**

*Professor, Linguistics*

In every language that has been examined concerning this phenomenon, a relationship has been found between fundamental frequency (F<sub>0</sub> or "pitch") and vowel height. The tendency is for high vowels such as [i] and [u] as in "beet" and "shoe" to have significantly higher F<sub>0</sub>s than lower vowels such as [a] in "hot." If this is universal, then it must be an intrinsic part of vowels and not optional during production. This phenomenon, referred to in experimental phonetics as "intrinsic F<sub>0</sub>," has been found in 31 languages (Whalen & Leavitt, 1995). Intrinsic F<sub>0</sub> has not been well-researched, however, in languages purported to use tone or pitch to distinguish words. Jamaican Creole, the language studied in this project, is one such language. This presentation will investigate the operation of intrinsic F<sub>0</sub> in Jamaican Creole, and explore the physiological basis for it. When producing vowel sounds, the muscles of the tongue occupy the space in the oral and pharyngeal cavities differently for different vowels. For example, as the genioglossus muscle produces [i] by pulling the tongue up and forward the larynx is pulled upward causing increased tension in the vocal folds which then vibrate faster creating a higher F<sub>0</sub> than when other muscles of the tongue are used. As the size of the oral and pharyngeal cavities varies for each vowel, the sound coming from the vocal folds is shaped differently making high and low vowels have significantly different F<sub>0</sub>s. With Jamaican Creole we examined the F<sub>0</sub> of digitized speech signals for words in isolation. From the data collected we found a statistically significant difference between the F<sub>0</sub>s of high and low vowels. Our findings suggest that F<sub>0</sub> is an intrinsic part of vowels, and not a parameter selected by some of the world's languages to enhance the perception of speech.

## POSTER SESSION

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### ANTIGENIC PROPERTIES OF MUTATED HIV-1 ENVELOPE GENE

**BRADLEY CLEVELAND**  
*Senior, Biochemistry*

**SHIU-LOK HU**  
*Professor, Pharmaceutics*

The purpose of this project is to characterize the function of specific mutations within the HIV-1 envelope-encoding gene. The human immunodeficiency virus (HIV) is the causative agent of AIDS, acquired immune deficiency syndrome. Thus far, there is no known vaccine to prevent HIV infection and disease. This may in part be due to the structure of the HIV-1 viral envelope, enabling the virus to escape recognition from the host immune system by shielding important immunological sites on its surface. The surface glycoprotein gp120 of the HIV-1 virus is likely a key component in the immunogenic and antigenic properties of the virus. Using a chimeric simian/human immunodeficiency virus, SHIV 89.6, which contains the envelope gene of HIV-1 isolate 89.6, Dr. Yun Li in Dr. Shiu-Lok Hu's laboratory has demonstrated that removal of specific glycosylated sites within gp120 leads to enhanced antigenicity. Specifically, single mutations in glycosylation sites in variable loops 2 (N6 and N7) and variable loop 3 (NV3) increases recognition of the virus by cross-reactive neutralizing antibodies. These mutants therefore represent potential targets for vaccine development. In the present work, we aim to examine the effect of combined mutation at these sites. We obtain double and triple mutants containing these N6, N7, and NV3 sites through the use of site-directed mutagenesis. All mutations have been confirmed by DNA sequencing. By complementation assays, we confirmed that the mutant proteins still can mediate virus infection, albeit to different extents, indicating varying degrees of structural integrity. We are currently determining the effect of the double and triple mutations on the antigenic and immunogenic properties of the envelope proteins.

### SPECIFIC INTERACTIONS WITH D-PARKIN GENE

**RASHMI DAYALU**  
*Senior, Cellular & Molecular Biology*  
*MARY GATES SCHOLAR*

**LEO PALLANCK**  
*Professor, Genetics*

A subset of Parkinson's disease victims exhibits a juvenile onset by age 20, or even as early as the teen years. Recent evidence indicates that the majority of these juvenile onset cases are caused by defects in the Parkin gene. The sequence of parkin has an obvious "ring-finger motif" which suggests that parkin is involved in tagging "junk" proteins with a signal called ubiquitin that allows the cell to degrade it. Recent experiments on mammalian systems have demonstrated that parkin does indeed possess this activity. In order for parkin to tag an "old" protein, it must first interact with a ubiquitin conjugating enzyme (known as an E2 enzyme) to get an activated ubiquitin from it. Once it receives this activated ubiquitin, parkin will then be free to ligate (tag) it onto the protein that is to be degraded. A likely explanation for the neuropathology underlying the parkin gene defect is that the substrates normally degraded by parkin may instead accumulate and damage neurons. In order to find unknown D-parkin/protein interactions, I will be setting up a process known as the yeast 2-hybrid system as my major tool. Yeast colonies containing other specific *Drosophila* proteins will be mated with yeast carrying the D-parkin gene. If there is a protein-protein interaction, the colonies that give a positive result can be isolated for further studies. One of the genes to be tested with Dparkin is the fly homolog of UbcH7, which is an E2 enzyme. If a positive interaction is found between D-UbcH7 and D-Parkin as expected, then it will be safe to say that the fly is an accurate model with which to study Parkinson's disease pathology. Other proteins that may interact with D-parkin can consequently be studied in a similar manner, thus shedding some light on the normal function of Parkin in humans.

## POSTER SESSION

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### HOW DOES CONFLICT AFFECT A MARRIAGE?

**GENESEE DOUGE**  
*Senior, Psychology*

**SYBIL CARRERE**  
*Research Scientist, Psychology*

**JOHN GOTTMAN**  
*Professor, Psychology*

This study examines the relationship between marital satisfaction and emotional communication patterns. One hundred and thirty-three married couples were selected for this research. Each spouse individually filled out questionnaires about their satisfaction in the marriage (Locke-Wallace Marital Adjustment Test). After this initial self-report measure, the couple participated in a taped 15-minute discussion about an area of conflict within their marriage. Coders recorded the amount of seconds that each individual displayed certain emotions such as criticism, affection, joy, or defensiveness. I tested whether individuals' report of marital satisfaction influenced the total seconds of negativity or positivity (a total derived by summing across various specific codes). Self-report of marital satisfaction was not related to either of these totals. Reported marital satisfaction was related to the amount that certain individual emotion codes were displayed. Contrary to popular belief, a happy relationship is not dependent merely on the overall tone of the relationship; there are several specific behaviors that corrode or bolster a relationship. Couples who express certain negative affects and still report high marital satisfaction evidence this finding.

### LIGHT LENGTH VARIATION EFFECTS ON GRAZER/PLANT INTERACTIONS IN CLOSED ECOLOGICAL SYSTEMS

**KRISTEN DURANCE**  
*Junior, Botany*

**FRIEDA TAUB**  
*Professor Emeritus, Aquatic & Fishery Sciences*

**PATRICK CHEUNG**  
*Senior, Biology*

Small scale, closed ecological systems can be used as models to demonstrate species interactions in a bio-regenerating system. Using 75mL tissue culture flasks, marine ecosystems were developed using algal species *Nannochloropsis*, *Isochrysis* and *Tetraselmis* and a small invertebrate grazer *Tigriopus*. Each system had seawater and algal nutrients and was inoculated with algae and allowed to grow. The flasks contain approximately 63mL of liquid and 12mL of air space. Grazers were inoculated into half the ecosystems and the containers were sealed at day five. Daylength was varied from 18, 12, 6 and 0 hours light (24 hour light cycles; 33uE/m<sup>2</sup> s light intensity). Results 4 weeks after closure show that different algal species dominate ecosystems at differing hours of light. *Tigriopus* survival in zero hours of light suggest that there may be slight light leaks within the system allowing some oxygen production, or that respiration has not depleted the initial dissolved oxygen. Oxygen diffusion rates will be measured using similar containers. At daylengths of 18 and 12 hours there are more algal cells present and a shift in dominance from the algae dominant in 6 and zero hours. *Tigriopus* at daylength of 12 and 18 hours had not hatched out any eggs at the end of week 4, suggesting that the increased amount of light was affecting the *Tigriopus* survival either directly or indirectly. The presence of babies at 6 hour daylength suggests that this may be a more optimal amount of light for the grazers. Differences in the *Tigriopus* survival and hatching could be an effect of the amount of oxygen produced by the algae, ability of animals to sustain at low oxygen levels, or could be an effect of the different spp. that the *Tigriopus* feed on. Data is continuing to be recorded to confirm early and further results.

## POSTER SESSION

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### EFFECTS OF FORMULATION CONSTITUENTS ON EPOXY PASTE ADHESIVES

**CARL FREDRICKSON**

*Junior, Chemical Engineering*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**JAMES SEFERIS**

*Boeing/Steiner Professor of Polymeric Composite*  
*Materials, Chemical Engineering*

**BRIAN HAYES**

*Professor, Chemical Engineering*

Adhesives are used for a variety of purposes, from holding book spines together to bonding parts of an airplane wing. Their base composition can consist of a number of monomers or polymers, including starches, proteins, rubbers, and epoxies. Application methods include sprays, one-part liquids, two part pastes, and films. While much research has been done on adhesives in general, it is believed that room for improvement exists in higher-performance applications, including aerospace and automotive. Our research investigated the effects of the base constituents in epoxy-based paste adhesives. A commercial system consisting of a low molecular weight amine-cured epoxy was chosen for evaluation. Several model systems were developed to try to replicate this system by varying types and concentrations of epoxy, curing agent, and other additives that affect the handling and final properties of the adhesive. The systems were characterized thermally using dynamic mechanical analysis and differential scanning calorimetry, and mechanically using rheology, lap shear, and peel tests. Though none of the model systems were strong enough to meet industry standards, it was shown that epoxy selection had the greatest effect on the final results, especially in reference to the glass transition temperature and lap shear strength. The effects of curing agents and other additives were less pronounced.

### AN INVESTIGATION OF KARMELLAE IN YEAST

**ROBYN GREABY**

*Sophomore, Pre-Engineering*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**ROBIN WRIGHT**

*Professor, Zoology*

The endoplasmic reticulum (ER) is one of the membrane bound organelles found in all eukaryotes. One of the interesting features of the ER is its ability to change structure to meet the needs of the cell. Unfortunately, the mechanism of this change is not understood in even a single case. In an attempt to gain some understanding, the Wright Lab is performing experiments involving karmellae in yeast (*schizosaccharomyces cerevisiae*). In normal yeast, karmellae form in reaction to high levels of the ER membrane protein HMG coA reductase. The Wright Lab is studying how increased levels of HMG CoA reductase induce karmellae production. A part of this research deals with mutant yeast that are either unable to assemble normal karmellae or are inviable when karmellae are present. My project was to transform IRE, VAC7, and VAC8 mutants with several different plasmids and to perform tests to determine if the presence of karmellae affected viability. The project determined the relative viability of the transformed and untransformed yeast at different temperatures and with karmellae being induced or not induced. My research concluded that mutations in the IRE, VAC7, and VAC8 genes do not appear to cause yeast to be unviable when karmellae are induced. By compiling the results of this and other similar projects we hope to gain an understanding of exactly how and why increased levels of HMG-CoA reductase induce karmellae in yeast.

## POSTER SESSION

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### ORGANIC GEOCHEMISTRY OF EFFINGHAM INLET, VANCOUVER ISLAND, BC

**JAIME GROCOCK**

*Senior, Biological Oceanography*

**RICK KEIL**

*Professor, Chemical Oceanography*

Effingham Inlet is a small coastal fjord extending from Barkley Sound on the Western side of Vancouver Island, British Columbia. Little is known about Effingham Inlet. With its unique glacial formation of two inner lying sills, varying marine environments, and isolation from any large cities, it is a natural setting with many opportunities for future investigation. A narrow and shallow sill at the opening restricts circulation resulting in deep waters within the inlet that are depleted and/or devoid of dissolved oxygen. This results in the innermost basin being anoxic, the middle basin is suboxic, and the outermost is oxic. Sediment samples were collected from all the various regions of the inlet, with a gravity core, or a Van Veen Grab. Sediment sizes range from large pebbles, found on the sills to mud, found in the basins. Sediment surface area measurements (using BET method) give a range of 2-40 m<sup>2</sup>/g. Total carbon and nitrogen contents range from 3.4-9.4 % and 0.27-2.5 %, respectively.

### CHARACTERIZATION P38 ISOFORMS AND THEIR ROLES IN NEURONAL APOPTOSIS

**JAMES HAM**

*Senior, Biochemistry and Economics*  
*MARY GATES SCHOLAR*

**ZHENGUI XIA**

*Professor, Environmental Health & Pharmacology*

**JANE CAVANAUGH**

*Postdoctoral Fellow, Environmental Health & Pharmacology*

Programmed cell death, or apoptosis, is a normal process that occurs in all cells. It is an important process in development and neurogenesis and for homeostasis in the adult brain. Disregulation of apoptosis has been implicated in many diseases such as cancer and Alzheimer's. Apoptosis is regulated by several pathways involving many different protein interactions. A specific signaling protein known as p38 is one of several proteins in the mitogen-activated protein kinase family. Previous studies have uncovered four distinct isoforms of p38: alpha, beta2, gamma, and delta. More recently, p38-alpha has been shown to be activated by specific cellular stresses leading to apoptosis, while p38-beta2 has been shown to be activated by pro-survival stimuli including growth factors and neurotrophins. Furthermore, all isoforms of p38 contain the same threonine/tyrosine dual phosphorylation site. From these observations, we seek to further characterize the p38 signal transduction pathway in different neuronal and non-neuronal cell types so that we may propose a mechanism in which the different isoforms are regulated. Elucidating upstream inhibitors and activators and downstream targets of p38-alpha and p38-beta2 may lead to the characterization of other isoforms and may further reveal the intricacies of programmed cell death in the brain.

## POSTER SESSION

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### ADVANCED RESIN TRANSFER MOLDING SENSORS

**JACLYNN HIRANAKA**

*Senior, Electrical Engineering*  
*MARY GATES SCHOLAR*

**ALEXANDER MAMISHEV**

*Professor, Electrical Engineering*

Advanced Resin Transfer Molding (ARTM) is an advanced polymer composite-molding processes that produces many lightweight and high-strength parts of aircraft, satellites, automobiles, and propulsion engines. The ARTM process uses trackifier technology that takes fabric plies, runs them through a powder resin, and then injects the resin at high pressure into the molds. This technology allows for the production of parts that cannot be manufactured with the traditional resin transfer molding process. The ARTM process, however, is highly susceptible to defects that include fiber misalignment, dry spot formation, and uneven curing. The development of a polymer fiber optic sensor system that is used to monitor filling and curing during the process is needed to aid against the defects that this molding process is prone to and provide an element of quality assurance. In order to build this sensor, testing will be essential. I have used Labview to write the programs that were necessary for testing. Labview is a software package that allows the user to create virtual instrumentation systems that can digitize sensor signals, process acquired data, measure parameters of interest, and generate control commands to manufacturing equipment. I will utilize this program in order to test sensors, measure physical properties of resin, and visualize resin flow pattern. Alexander Mamishev is my faculty supervisor and the project is part of the Sensor, Energy, and Automation Laboratory (SEAL).

### STUDIES ON THE CONTROL OF GRAVITROPISM IN ROOTS

**MELISSA HORNBEIN**

*Senior, Botany and Anthropology*

**ROBERT CLELAND**

*Professor, Botany*

Gravity induced curvature in plant roots is a result of both the perception of and response to the gravitational stimulus. The curvature is due to unequal rates of cell elongation in the different cellular layers of the root. To determine which layers are controlling growth and hence curvature, roots of corn (*Zea mays*) were bisected. They responded by displaying inward curvature of the bisected tips, indicating that the outer layers of the root, including the epidermis and possibly the cortex are under compression while the inner stele is under tension. This relationship between the inner and outer portions of the growing root indicates that the outer layers are responsible for growth, while the stele is a growth-limiting factor. The belief that perception of gravity occurs in the root cap via starch-statoliths called amyloplasts is supported by experimental evidence, but the mechanism by which this perception is translated into the response of gravitational curvature is as yet unknown. In order to determine the conditions under which gravitational curvature is induced, and the nature of the growth response, bisected roots were exposed to a number of treatments, including varying pH levels, nutrients, and hormone inhibitors.

## POSTER SESSION

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### THE RELATIONSHIP OF MILITARY INTERVENTION AND TERRORISM

**JAMIE HOWE**

*Senior, Political Science*

**BRYAN JONES**

*Professor, Political Science*

Does United States military intervention overseas trigger lethal acts of terrorism against American citizens? The decision of when, how, and if the United States should intervene in regional and ethnic conflicts is often based on the ideal that American casualties are unacceptable. When determining the risks of intervention should decision-makers look at more than just the immediate danger placed on troops? Should they also take into account the casualties that may arise from terrorist retribution? I will investigate the hypothesis: U.S. military intervention overseas causes an increase in the amount of lethal incidents of terrorism directed at Americans. I will use lethal acts of terrorism against American citizens (from data collected by the United States Department of State) as my dependent variable and military intervention overseas (data from a congressional research report) as my independent variable, to determine if there is a statistically significant relationship between U.S. military intervention and lethal acts of terrorism against Americans.

### DEPARTMENT OF CLASSICS LANTERNSLIDES PROJECT

**YIN HUNG**

*Senior, Classical Studies, Accounting, and  
Community & Environmental Planning*

*MARY GATES SCHOLAR*

**PAUL SCOTTON**

*Professor, Classics*

The objective of this study is to create an online lanternslides library to the Department of Classics collection of antique lanternslides. Currently, there are 1400 lanternslides of archaeological sites and artifacts in the collection. The Classics Department, however, does not have the necessary equipment to project these slides. In order to utilize this extremely valuable resource, the project makes it accessible by digitizing the lanternslides and creating an online library that can facilitate and enrich teaching, learning, and research.

The project is a two-part process. First, the lanternslides are documented, catalogued, and labeled accordingly, and the information is saved in a database for referencing the images. Second, the slides are digitized and stored using the existing scanning and digital storage facilities at CARTAH and UWired.

I have already documented and labeled all of the lanternslides and have also completed a working database catalogue of the images which I will continue to improve and refine. Now I am working on cleaning these fragile, glass slides and experimenting with different scanning methods to obtain archive-quality images.

What is so impressive about the lanternslides project is that it will not only bring new life to the antique slides but also benefit many users in fields like art and architecture. Students, instructors, researchers, and others who are interested in Classical art and archaeology will be able to access the extensive collection via the online slides library. As for me, the participant and learner, the project has been an incredible educational opportunity. In addition to learning new technology and applications, I have benefited so much from the process of categorizing and scanning lanternslides. This hands-on experience allows me to study the sites and artifacts closely and truly gain a comprehensive understanding of Classical art and its development.

## POSTER SESSION

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### NEUROTRANSMITTERS AND PROTEIN KINASES IN EARLY BRAIN DEVELOPMENT

**NICHOLAS HUNTER**

*Senior, Biochemistry and Neurobiology*

**WILLIAM J. MOODY**

*Professor, Zoology*

The formation of the brain is one of the most complicated processes in development. The main focus of the Moody lab is the effect of electrical activity on early brain development. My research has focused on two aspects of early activity. The first is the effect of the neurotransmitter GABA. GABA inhibits electrical activity in the mature animal, however in the embryo it promotes activity. GABA has multiple developmental effects. It influences cell division, axonal pathfinding, and electrical development. The second focus is protein kinase G (PKG). PKG is activated by electrical activity via Ca<sup>++</sup> entry which causes an increase in cyclic GMP. PKG is an enzyme that affects multiple targets, including ion channels. Its ability to affect ion channels allows PKG to regulate electrical activity.

### REGULATION OF ANGIOGENESIS AND MATRIX REMODELING BY LOCALIZED, MATRIX-MEDIATED ANTISENSE GENE DELIVERY

**GRACE HUYNH**

*Senior, Bioengineering*

**THEMIS KYRIAKIDES**

*Senior Fellow, Biochemistry*

**PAUL BORNSTEIN**

*Professor, Biochemistry*

Implantation of biomaterials, such as glucose sensors, leads to the formation of a poorly vascularized collagenous capsule that can lead to implant failure. This process, known as the foreign body reaction (FBR), develops in response to almost all biomaterials and consists of overlapping phases similar to those in wound healing. Implantation of porous biomaterials, such as polyvinyl alcohol sponges, also leads to granuloma formation within the interstices of the sponge prior to encapsulation by the FBR. We asked whether delivery of an antisense cDNA for the potent angiogenesis inhibitor, thrombospondin (TSP) 2, would enhance blood vessel formation and alter collagen fibrillogenesis in the sponge granuloma and capsule. Collagen solutions were mixed with plasmid to generate gene-activated matrices (GAMs), and applied to biomaterials that were then implanted subcutaneously. Sustained expression of plasmid-encoded proteins was observed at two weeks and a month following implantation. In vivo delivery of plasmids, encoding either sense or antisense TSP2 cDNA, altered blood vessel formation and collagen deposition in TSP2-null and wild-type mice, respectively. Non-treated implants, implanted next to GAM-treated implants, did not show exogenous gene expression and did not elicit altered responses, suggesting that gene delivery was limited to implant sites. This method of antisense DNA delivery has the potential to improve the performance and lifespan of implantable delivery devices and biosensors.

## POSTER SESSION

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### EXERCISE COMPLIANCE IN COMMUNITY RESIDING ALZHEIMER'S DISEASE PATIENTS

**MELODY JAMES**

*Senior, Nursing*

**REBECCA LOGSDON**

*Professor, Psychosocial & Community Health*

The use of exercise therapy as a viable treatment for promoting improved physical functioning and mobility in individuals with Alzheimer's disease (AD) has recently come under study. Although the potential benefits of such a program for cognitively intact older adults are well documented, little is known about how to apply an exercise intervention to community residing individuals with AD. Possible impediments to participation include the cognitive and behavioral manifestations of the disease, which necessitate the involvement of a family member or other partner to carry out the program. Another potential complication that could affect cooperation with an exercise program is depression, which affects approximately 30% of AD patients. This investigation explored factors associated with compliance in a community-based exercise intervention for individuals with AD and their caregivers. The intervention was part of a larger UW investigation to reduce disability in AD, and involved having mildly to moderately cognitively impaired participants engage in a caregiver-supervised walking program for at least 30 minutes three days a week. It was hypothesized that depressive symptoms in the person with AD would be associated with decreased exercise compliance. In addition, since the program involved extensive caregiver involvement, higher levels of caregiver depression and burden were expected to negatively impact exercise compliance. Preliminary results indicate that although neither patient nor caregiver depression was significantly associated with exercise compliance, the patients whose caregivers reported higher levels of burden were significantly less compliant. This implies that in AD patients, it is important to evaluate both patient and caregiver characteristics in developing an exercise intervention. Future plans include analyzing the influence of demographic, cognitive, physical, and behavioral factors in patient exercise compliance.

### CONTROLLED SUBSTANCE RELEASE THROUGH THE DEGRADATION OF BIODEGRADABLE PLASMA DEPOSITED PLA(POLY LACTIC ACID) THIN FILMS

**NELS JEWELL-LARSEN**

*Sophomore, Mechanical Engineering*

*MARY GATES SCHOLAR*

**VICKIE PAN**

*Bioengineering*

**DENICE DENTON**

*Dean, College of Engineering*

A new method of controlled substance release, utilizing plasma polymerized Poly Lactic Acid (P-PLA) as a controlled release mechanism, is investigated in this experiment. Disks of poly ethylene terephthalate (PET) are loaded with methyl blue dye, and coated with a P-PLA thin film which is plasma deposited at either 2, 5, or 10 watts. Release studies are done through degradation of the P-PLA thin films in de-ionized water. In addition, P-PLA thin films, were analyzed with Electron Spectroscopy for Chemical Analysis (ESCA), Atomic Force Microscopy (AFM), and acid release studies. Dye release studies indicate uniform release by all films regardless of the applied Radio Frequency (RF) power. As the RF power increases, the P-PLA coating's deposition rate decreases, surface roughness decreases, and hydro carbon content increases.

## POSTER SESSION

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### MATHEMATICAL MODELING OF CLOSED ECOLOGICAL SYSTEMS

**GAVAN KAIZAWA**  
*Sophomore, Physics*

**HANS ISERN**  
*Junior, Electrical Engineering*

**FRIEDA TAUB**  
*Professor Emeritus, Aquatic &  
Fishery Sciences*

**FLORA NISANOVA**  
*Senior, Biology*

A closed ecological system is an isolated environment in which all materials are contained within itself, and no exchange of any substance is made with the outside world. These systems are of use to humans, as they allow us to examine the different conditions and complexity of the processes enclosed in the system. One can study the governing effects occurring in a microcosmic closed system—small enough to hold in one's palm—and apply it to ideas as grand as the colonization of Mars. Our research addresses the question: how do the initial conditions in a closed system of algae and *Daphnia* affect their growth and population, and what are the mathematical relationships among these conditions? Of course it is not possible to know all the stimuli affecting the system; therefore we have chosen to consider only a few that we feel have the most significant influence over the *Daphnia* at later times (i.e. initial population, nutrient levels, incident light). Thus far, the three of us have developed a computer program modeling the population of *Daphnia* as a function of time. At this moment we are testing different data sets to various equations we have selected, to see which model best predicts future populations. Statistical analysis will enable us to decide which equations fit our particular closed system. We hope to model a roughly accurate depiction of the evolution of the *Daphnia* population representative of small closed systems, based on initial factors and incident energy.

### COMPARISON OF THE *TREPONEMA PALLIDUM* REPEAT GENE FAMILY IN *TREPONEMA PARALUISCUNICULI* AND *TREPONEMA PALLIDUM* SUBSP. *PALLIDUM*

**THOMAS KEHL-FIE**  
*Senior, Microbiology and Biochemistry*  
MARY GATES SCHOLAR

**SHEILA LUKEHART**  
*Professor,*  
*Medicine, Allergy & Infectious Diseases*

*Treponema paraluis-cuniculi* (Tpc) is a pathogenic spirochete closely related to *Treponema pallidum* subsp. *pallidum* (Tp), the causative agent of syphilis. Both organisms are capable of causing infection in rabbits, however, only Tp is capable of causing infection in humans. We propose that a careful comparison of genes encoding potential virulence factors, from Tpc and Tp, will identify differences that allow Tp to infect humans while Tpc cannot. Previous work has identified a family of genes known as the *T. pallidum* repeat (*tpr*) genes, which encodes targets of opsonic antibodies and may be involved in antigenic variation and immune evasion. Our PCR data suggest that there are significant sequence differences between the two organisms. Primers in conserved regions of the genes fail to produce amplicons for *tpr* C/D, E, F, I, J and L in Tpc; primers in flanking regions of the genes also fail to produce amplicons. Control Tp DNA amplifies readily. These data suggest sequence differences both within the *tpr* genes and in the flanking regions. To sequence the genes in Tpc, *tpr* genes are being selected by screening a Lambda Zap II library using *tpr*-specific oligonucleotide probes based initially on the Tp sequence. Tpc *tpr* sequences will be compared to those for Tp, and unique Tpc *tpr* genes will be cloned, expressed and purified. Antibody and T-cell responses to these antigens will be analyzed in animals infected with Tpc or Tp, looking for proteins that elicit an immune response only from Tpc infected animals. Subsequent studies will investigate the function of the proteins and may provide clues to the pathogenesis of rabbit and human syphilis.

## POSTER SESSION

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### **DISTRIBUTED DIAGNOSIS AND HOME HEALTHCARE (D<sub>2</sub>H<sub>2</sub>): A HOME TELEMEDICINE SYSTEM FOR ORTHOPAEDICS**

**JANICE KIM**

*Senior, Bioengineering and Biochemistry*  
*MARY GATES SCHOLAR*

**YONGMIN KIM**

*Professor and Chair, Bioengineering and Electrical Engineering*

Distributed Diagnosis and Home Healthcare (D<sub>2</sub>H<sub>2</sub>), or E-Medicine, is an emerging field which could revolutionize the practice of medicine in a society where an aging population and an overloaded healthcare system push for an improvement in our current delivery of healthcare. D<sub>2</sub>H<sub>2</sub> combines information technologies with medicine to produce internet-based home telemedicine systems that make healthcare more accessible to patients without decreasing the quality of care. Using such systems, patients and doctors are able to access each other from any site and at any time, corresponding through a web-based e-mail and video-mail site that also has the capability for biosensor information to be transmitted as well. Our laboratory's research is in a prototype application of E-Medicine to monitor patients recovering from shoulder arthroplasty. A secure website has been created for communication between patients and their surgeon, allowing doctors to monitor their patients' progress through short videos of patients performing their assigned physical therapy exercises and through weekly standard health and shoulder status surveys the patients complete. My role in this project has been through direct participation in the clinical trial, beginning in January 2001, of this E-medicine prototype I train the patients as to how to use the system as well as collect feedback from patients regarding their experience and satisfaction following their six-week participation. I will also help to make website improvements following this study to better facilitate ease of use by both patients and physicians and improved information transfer between them.

### **EFFECTS OF URBANIZATION ON STREAM FLOW**

**SEAN KING**

*Sophomore, Pre-major*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**DEREK BOOTH**

*Professor and Director, Center for Urban Water Resources Management*

The purpose of this project was to determine how we alter the flow patterns of nearby streams when we alter the landscape to make it suitable for construction. These changes come about because urbanization, and the resulting construction, pollution, etc. can change the rate and volume of water entering the stream system as well as the climate itself. However, not much is actually known about what the final effects are, hence these studies. In order to study the effect of urbanization on stream systems, I am collecting data from USGS flow stations, government operated devices that measure the flow of water through streams over time. The data collected is entered into a database so it can be analyzed and long-term trends revealed. In this project, I am working under Dr. Derek Booth and a graduate student named Chris Konrad. There are two main ways in which rainwater reaches a stream: surface and subsurface flows. Urban development increases surface flow, which rapidly enters streams and reduces subsurface flows that once seeped through dense soil and then slowly seeped into the stream system. The storm-scale effect on stream flow is an increase in the peak discharge. In developed areas, less water is captured by the soil, and more flows over the surface to enter the streams. Over annual scales, the result is that stream flow exceeds the mean discharge more often and by a greater amount, but for shorter durations. This strips away sediment and flow inhibitors such as logjams that normally slow water progress. With fewer impediments to flow, the streams will run faster still, resulting in a cycle that propagates itself. However, like in many areas of environmental sciences, there is always uncertainty as to the long-term effects and opposition to reform.

## POSTER SESSION

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### ERECTA RECEPTOR-LIKE KINASES IN ARABIDOPSIS

**NELSON LAU**

*Senior, Cellular & Molecular Biology*  
*MARY GATES SCHOLAR*

**KEIKO TORII**

*Professor, Botany*

*Arabidopsis*, a weed that belongs in the mustard family, is widely used by plant biologists for the experimental study of how genes control plant development. With a small generation time of only six weeks and a tiny genome, *Arabidopsis* also proves to be an excellent model organism for genetic studies done in the laboratory. Receptor-like kinase ERECTA helps control and regulate the elongation of plant organs in *Arabidopsis*. The Torii laboratory investigates the signal transduction pathway mediated by the receptor-like kinase ERECTA to view how mechanisms link certain stimuli to respond in cells. The undergraduate researcher, Nelson Lau, has been working with Dr. Keiko Torii to address the structure and function relationship of the ERECTA receptor-like kinase, by studying newly isolated alleles of *erecta*. Since the spring of 2000, Nelson Lau has been studying various *Erecta* mutant alleles to discover the nature of the molecular lesions that affect the functional pathway of the protein kinase. Through his research, he and his colleague, Rob Schuster, have been able to sequence the DNA of more than 10 different *erecta* mutant alleles. Through the methods of DNA extraction from plants, PCR, gel electrophoresis, DNA sequencing, and RT-PCR, Nelson has found varieties of point mutations that alter the genetic makeup in various mutant alleles. These mutations result in certain alterations, which include silent, missense, or frameshift mutations. Due to the severity of the mutation, the modification could lead to certain effects such as encoding of truncated or lengthened amino acid and protein chains. This is done through mutated splicing sites of the intron or the encoding of premature stop codons through translation. These specific alterations of amino acids both in the receptor domain and kinase domain compromise the activity of ERECTA in stimulating organ growth.

### DESIGN AND SYNTHESIS OF LUMINESCENT TERBIUM COMPLEXES

**DAVID LEE**

*Senior, Chemistry*

**LARRY DALTON**

*Professor, Chemistry*

A new luminescent material based on a terbium cored complex was made. The terbium is surrounded by polycyclic aromatic ligands. The polycyclic ligand system was designed to act as a site-isolation moiety as well as a light harvester. The ligand was designed to have effective overlap between the emission spectra of the ligand and the absorption spectra of the metal. The ligand was prepared from the Claisen condensation of the methyl ester and methyl ketone form of a polycyclic sensitizer. This approach allows us to design ligands specific to a number of different Lanthanide metals.

## POSTER SESSION

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### THE DISTRIBUTION AND REGULATION OF GALANINE-LIKE PEPTIDE (GALP) mRNA IN THE BRAIN OF THE MOUSE

**DOROTHY LI**

*Senior, Biochemistry*  
MARY GATES SCHOLAR

**ROBERT STEINER**

*Professor, Physiology and Biophysics*

Galanin-like peptide (GALP) is a newly-discovered neuropeptide that shares a partial sequence homology with galanin (which is also a neuropeptide). In the rat, GALP neurons are located in the arcuate nucleus of the hypothalamus, where GALP mRNA levels are regulated by metabolic factors such as fasting and leptin (a hormone secreted by adipocytes). The role of GALP in other species is unclear. In this study, we mapped the distribution of GALP mRNA in the brain of the mouse and tested the hypothesis that GALP gene expression is regulated by the adipocyte-derived hormone leptin. We identified GALP neurons and measured GALP gene expression through the use of *in situ* hybridization, using a partial cDNA of mouse GALP as the probe. We found that GALP mRNA is expressed exclusively in the arcuate nucleus and median eminence of the mouse brain. To determine whether GALP mRNA is regulated by leptin in the mouse, we compared both the number of GALP-expressing cells and the intracellular content of GALP mRNA in the arcuate nucleus among three groups of mice: 1) wild type (WT); 2) leptin-deficient, vehicle-treated *ob/ob*s; and 3) leptin-treated *ob/ob*s. We found that vehicle-treated *ob/ob*s mice had 70% fewer identifiable GALP mRNA-containing cells and 20% less GALP mRNA per cell than WT controls. In addition, the leptin-treated *ob/ob*s group had nearly 5 times more GALP mRNA-containing cells and 40% higher levels of GALP mRNA/cell than the vehicle-treated *ob/ob*s group. These data indicate that 1) the distribution of GALP neurons in the mouse brain is similar to that in the rat and 2) the transcription of the GALP gene is regulated by leptin in the mouse, as it is in the rat. The localization of GALP to the arcuate nucleus and its regulation by leptin in both species suggest that GALP plays a role in mediating the effects of leptin on the neuroendocrine axes controlling body weight and the hypothalamic-pituitary axis.

### APPLICATION OF NON-FOULING SURFACES TO BIOCOMPATIBILITY AND PATTERNED BIOLOGICAL ADHESION

**RYAN LIPSCOMB**

*Junior, Physics*  
MARY GATES SCHOLAR

**Yael HANEIN**

*Professor, Electrical Engineering*

With the recent rapid explosion in biotechnology toward  $\mu$  cell on a chip $\mu$ ± devices, the necessity of non-fouling (resistant to protein absorption) surfaces has become evident and critical. The applications of non-fouling surfaces as elements in  $\mu$  cell on a chip $\mu$ ± devices are vast and varying, expanding out of resistance to protein absorption and cellular adhesion, a significant aspect of biocompatibility. In particular, this project's aim is to exploit the non-fouling characteristics of plasma polymerized Tetraglyme ((CH<sub>3</sub>-O-(CH<sub>2</sub>-CH<sub>2</sub>-O)<sub>4</sub>-CH<sub>3</sub>), PP4G) surfaces in selective protein absorption patterning. Specifically, the goal is to control bio-fluidic transfer through micro-channels and chambers by means of a PP4G coating, while maintaining isolated areas of specific biological adhesion, such as those on sustained patterned cell cultures. The surfaces to be studied will be created by means of photolithography, chemical etching, and plasma deposition on silicon substrates, with silicon dioxide and silicon nitride as passivation layers.

## POSTER SESSION

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### OPTIMIZATION ALGORITHMS OF UNIVARIATE LIPSCHITZ FUNCTIONS WITH APPLICATIONS IN SCIENCE AND ENGINEERING

**JANA LITTLETON**

*Senior, Industrial Engineering and Applied  
Computational & Mathematical Sciences*

**ZELDA ZABINSKY**

*Professor, Industrial Engineering*

**JENNIFER TEMPLE**

*Senior, Industrial Engineering and Applied  
Computational & Mathematical Sciences*

Optimization of functions is an important topic in science and engineering because often we need to maximize or minimize functions based on a small number of evaluation points. Examples include maximizing profit and minimizing the load under which a structure fails. The points we choose to sample are critical because often the computational times are significant. Therefore we want to gain as much information as possible when we choose an evaluation point. We study the case of optimizing a function that adheres to the Lipschitz condition, which assumes a bound on the derivative of the function. Using a worst case approach we prove that sampling at the midpoint of a given interval is the best place to sample in order to minimize the maximum error. This is in contrast to a popular method of sampling the deepest point. Using our midpoint sampling scheme, the number of function evaluations, and hence computation time is minimized in the worst case.

### THE ROLE OF SPECIFIC BASIC AMINO ACIDS IN SAA-MEDIATED ARTERIAL WALL LIPID RETENTION: MUTAGENESIS AND THE GENERATION OF SAA ADENOVIRAL VECTORS

**ROLAND LOPEZ**

*Senior, Biochemistry*

**KEVIN O'BRIEN**

*Professor, Medicine*

**KIM ENG**

*Research Technologist I, Medicine*

Serum Amyloid A (SAA), a 102 amino acid protein expressed by the liver in response to inflammation, has long been known to be associated with lipoproteins, specifically high-density lipoproteins (HDL). Recent studies have shown that SAA-containing HDLs are retained in atherosclerotic plaques. It is believed that the mechanism of SAA-containing HDL retention in plaques is through ionic interactions between positively-charged SAA amino acids and negatively-charged glycosaminoglycans (GAGs) of arterial wall proteoglycans. Research will focus on determining the specific amino acid residues on SAA that mediate this interaction with proteoglycan GAGs. One potential application of this project would be to design a drug that interferes with this interaction, thereby decreasing lipoprotein retention in developing atherosclerotic plaques. In this project the following will be performed: 1) perform PCR-based site-directed mutagenesis to generate a mutant SAA, isoform 2 (SAA2), cDNA that encodes for alanines rather than basic amino acids at the 6 residues thought to mediate SAA2 binding to proteoglycans; 2) ligate the 6 amino acid mutant and a 3 amino acid mutant SAA2 into shuttle plasmids; and 3) insert shuttle plasmids into adenoviral vectors containing zinc activated metal responsive elements.

## POSTER SESSION

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### CLONING AND EXPRESSION OF A NEW GENE FROM THE *TRYPANOSOMA BRUCEI* PARASITE

**KAREN LU**

*Senior, Microbiology*

**FREDRICK BUCKNER**

*Acting Instructor and Senior Fellow, Medicine*

African trypanosomiasis (sleeping sickness) is caused by the protozoan *Trypanosoma brucei*. Current drugs used to treat this disease are extremely toxic and do not completely eradicate chronic infection. The need for better drugs to treat African trypanosomiasis has motivated interest in pursuing novel drug development for *T. brucei*. Protein prenylation has been shown to occur in *T. brucei* and represents a good target for drug therapy against this parasite. Protein prenylation involves the attachment of either a 15-carbon farnesyl or 20-carbon geranylgeranyl group to the carboxy terminus of proteins and is specified by the amino acid sequence motif CaaX. My project involves the study of CaaX protease, the enzyme that removes the terminal three amino acids (aaX) from the carboxy-terminal cysteine following prenylation. Fragments of the CaaX protease gene were identified in the *T. brucei* Genomic database. Degenerate PCR was used to amplify the gene, which was next cloned and sequenced. The final stage will be to express the gene in a baculovirus/SF9 cell expression system to produce recombinant protein for enzymology and structural studies. Such information will help design novel drugs for the treatment of parasitic infections.

### DESIGNING A FORCE-FEEDBACK, 5-DOF SIMULATOR FOR ENDOSCOPIC SURGERY

**MITCHELL LUM**

*Senior, Electrical Engineering*

*MARY GATES SCHOLAR*

**BLAKE HANNAFORD**

*Professor and Associate Chair, Electrical*

*Engineering*

**JACOB ROSEN**

*Research Associate, Electrical Engineering*

Minimally Invasive Surgery (MIS) is performed by making small incisions through which endoscopic tools and a video camera are inserted into the body. MIS results in reduced trauma to the patient, which leads to quicker recoveries than traditional surgery. The cost to train a medical student in the OR for MIS procedures can be as high as \$100 per minute. At a cost of \$6000 per hour there exists a substantial need for a more cost-effective alternative. Much as pilots use flight simulators, we propose that medical students could use surgical simulators to reduce costs while still receiving worthwhile training. Our research focuses on developing a force-feedback user interface for surgical simulation. With computer models based on *in-vivo* tissue measurements, this system will provide meaningful and realistic training for endoscopic surgery. Training advantages include the ability to record the surgeon's motions, and to simulate a wide range of surgical scenarios, such as complications. Our approach is to provide 5 degrees of freedom to the user: tool yaw and pitch; tool insertion; tool rotation; and grasper-handle/tool-tip actuation. Pulleys and other linkages to couple all five degrees of freedom to motors and sensors will yield natural feelings of surgery to the student. Conceptual development of this device using CAD software is nearly complete. These designs will be further optimized and a prototype device can then be fabricated. The future of medical education lies in the ability to train doctors more cost effectively. The use of surgical simulators may allow medical students to receive better training at a reduced cost.

## POSTER SESSION

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### CREATING A HYDROGEN ECONOMY: INTEGRATING ALTERNATIVE ENERGY TECHNOLOGY INTO SOCIETY

**LISA LURIE**

*Junior, Environmental Studies and Biology*

*MARY GATES SCHOLAR*

**JOYCE COOPER**

*Professor, Mechanical Engineering*

Much research has gone into developing the hydrogen fuel cell as an alternative energy carrier. The purpose of this project is to investigate the feasibility of creating a hydrogen economy - transitioning away from a dependency upon depleting fossil fuels to an economy based on hydrogen as the primary energy carrier. Such a transition has technical, political, economical, and environmental implications. Utilizing an interdisciplinary perspective, I seek to understand how hydrogen fuel cell technology can move beyond the lab and into society. Through literature review and personal interviews, I have compared dialogues surrounding the idea of hydrogen energy from the 1970's (when the concept originated) and today to see what the perceived barriers were, which have been overcome, and what development remains in order for a hydrogen economy to become a reality. After analyzing conference proceedings from the 1970's, I found that the perceived barriers to creating a hydrogen economy dealt with the primary energy source, storage and transmission, cost, infrastructure changes, public perception, and safety. Transition scenarios that involved further research followed by demonstration projects were proposed. Fuel cell technology and development boomed in the 1990's due to partnerships between government, oil companies, automakers, and fuel cell developers. Only recently have some of these partnerships gone beyond demonstrations of individual vehicles to whole system infrastructure pilots. By interviewing representatives of these projects, I hope to be able to identify the critical issues that have not yet been addressed or barriers that remain to determine the feasibility of creating a hydrogen energy economy.

### EVALUATION OF CARBORANE PHENYLIDONIUM SALTS AS PENDANT GROUPS FOR RADIOHALOGENATION REACTIONS

**HIEP LY**

*Senior, Biology*

**SCOTT WILBUR**

*Professor, Radiation Oncology*

**DONALD HAMLIN**

*Research Scientist, Radiation Oncology*

Radiohalogenated biomolecules are currently being investigated as reagents for diagnosis and therapy of cancer. However, direct insertion of anionic radiohalogens into biomolecules is not readily accomplished. While electrophilic substitution reactions involving radiohalogens have been widely used, nucleophilic substitution reactions require much more stringent conditions. Thus, these reactions are more problematic in their use with biomolecules. Because radiohalogens are available as anions, we are attempting to develop a new method, which utilizes carborane phenyliodonium salts as pendant groups for radiohalogenation reactions. Preliminary experiments have been conducted involving the ortho, para, and meta isomers of dicarbon carborane. Mono-iodination reactions were performed on these isomers. Afterwards, the synthesized iodocarboranes were used as the starting reagents in the preparation of the carborane phenyliodonium salt intermediates. Upon completion of the syntheses, the intermediate products were purified and analyzed. The evaluation process involved collecting data obtained through: Boron Nuclear Magnetic Resonance, Infrared Spectroscopy, Mass Spectrometry, and HPLC analysis. After checking the purity of our carborane phenyliodonium salt intermediates, we intend to examine various non-radioactive reactions. More specifically, non-radioactive halogenations will be performed by cleaving the boron-iodine bond. In addition, halogens (chlorine, bromine, and fluorine) will replace the iodine in our intermediate salts. As before, the characteristics of these compounds will be evaluated. In the final portion of our study, we will evaluate radiohalogenation reactions involving our carborane phenyliodonium salts and radioactive iodine and fluorine. From the data obtained we will determine the efficiency of radiohalogenation reactions and determine which carborane phenyliodonium isomer is best suited for this application.

## POSTER SESSION

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### AUDITORY BRAINSTEM RESPONSE – THRESHOLD RESPONSE (IN MICE)

**AMITOZ MANHAS**  
*Senior, Undeclared*

**DAVID MILLS**  
*Professor, Otolaryngology*

**EDWIN RUBEL**  
*Professor, Otolaryngology, Bloedel Hearing  
Research Center*

The ABR is generated by the onset of an acoustic signal. It is the far-field reflection of electrical events generated within the auditory pathway on its course to the brain. ABR's clinical use is enhanced by its independence of state variables such as attention, sleep state, and sedation. Observations of the relationships between stimulus intensity and ABR latency and amplitude have been the impetus for studying its contribution to the clinical evaluation of auditory function. Audiometric applications depend on just such universality and limited variability. The auditory brainstem response, the measurement of which minimizes participation on the part of the subject, provides a tool for further study of auditory function in various animals, including those that are ill (as in Down's syndrome). The response consists of a series of five to seven small amplitude waves occurring within the first 10 milliseconds of stimulus onset, and is referred to as the auditory brainstem response (ABR). ABR testing has been used in various animals to better understand their acoustic responsiveness and overall range of hearing. The hearing response measured in this experiment was of the mouse. Establishing parameters by which testing of this animal could be more quickly and easily done was the purpose of the experiment. More specifically, securing a threshold value (amplitude) at which hearing response is first generated in mice was the exact proposition of this research.

### HAPLOTYPIC ANALYSIS OF CD81 GENE, THE PUTATIVE RECEPTOR FOR HEPATITIS C

**TAYA MARQUARDT**  
*Conservation Biology and Applied Computational  
& Mathematical Sciences*

**CARL TON**  
*Medical Genetics*

Hepatitis C virus (HCV) is a widespread health problem affecting nearly 3% of the population worldwide. It has been shown that HCV binds to the major extracellular loop of CD81, suggesting a mechanism for viral entry into the cell. The aim of this study is the analysis of the CD81 gene to ascertain its ethnic haplotype distribution. This was achieved through a screening of approximately 300 individuals from 20 ethnic groups.

The significance is there is evidence that CD81 is a cellular receptor for HCV suggests that genetic variation in CD81 gene structure, expression, and regulation could impact host resistance to the virus, or progression of the disease. This would be analogous to the protective effect of polymorphisms in CCR5, CCR2, and SDF1 against HIV-1. As the first haplotype analysis of CD81, our work may facilitate a better understanding of the varying response to HCV infection and treatment shown by different ethnic groups.

The study was of genomic sequencing of exon-derived PCR products. The study population included a panel of 10 members each from 20 ethnic groups and a 100-member panel of African Americans (both panels commercially available from Coriell), and 30 Caucasians. Sequences were aligned using the programs Phred/Phrap, and polymorphic sites (SNPs) identified as deviations from the consensus sequence. We sequenced approximately 4 kbp of the CD81 gene, with a strong emphasis on the exons, flanking intronic DNA, and splice sites. We found a total of 36 polymorphic sites, including 6 coding SNPs (one non-synonymous) and 1 intronic SNP within 10 bp of a consensus splice site. The non-synonymous coding SNP is located in exon 3 near a conserved transmembrane site, and results in conversion of an alanine to threonine; this creates the possibility for a functional change in the protein. Taken together, these SNPs define several distinct haplotypes, generally distributed along ethnic lines.

## POSTER SESSION

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### PUBLIC OPINION V. CONGRESSIONAL RESPONSIVENESS

**MICHAEL MCGRATH**

*Senior, Political Science*

**BRYAN JONES**

*Professor, Political Science*

There have been numerous polls conducted since the 1930s that asked Americans to identify the most important problem facing our nation. There is a general assumption in American politics that congressmen are responsive to the public's desires as articulated through various public opinion polls. However, this supposed connection between the public's concerns and Congress's actions remains untested in any systematic statistical way. The purpose of this project is to take multiple public opinion polls (including Gallup, Roper et al) where the public identified their most important problem (whether it be national security, crime, the economy, etc.), then to compare these poll results with the responsiveness of Congress. Responsiveness of Congress to the economy is measured in this study by the relative distribution of hearings held by Congress concerning macroeconomics. These hearings will be taken from the Policy Agendas dataset compiled by the Center of American Politics and Public Policy. Controls are envisioned for partisan distributions in the House and Senate, the party of the President, and actual variations in economic performance (changes in Gross Domestic Product (GDP), inflation, and unemployment). This project will examine polls and hearings beginning in the late 1930s and early 1940s. My hypothesis is that there will be a positive correlation between the public's important problems polls and Congressional responsiveness.

### SURVEY OF INTESTINAL PARASITES IN FERAL LONG-TAILED MACAQUES

**MARIA MCMILLAN**

*Senior, Anthropology*  
*MARY GATES SCHOLAR*

**RANDALL KYES**

*Professor, Psychology*

It has been documented that parasite infection is one of the most common health afflictions among non-human primate species. The conditions of captivity often serve to exacerbate the extent of parasite infection in non-human primates. The purpose of the present research project was to assess internal parasite infection of a feral population of long-tailed macaques (*Macaca fascicularis*). The study was conducted on Tinjil Island located 16Km off the south coast of West Java, Indonesia. The island functions as a Natural Habitat Breeding Facility (NHBF) for *M. fascicularis* and is supported through a collaborative program between the Washington Regional Primate Research Center (RPRC) and Bogor Agricultural University (IPB) in Indonesia. Fecal samples were collected and analyzed on 107 animals between the months of August and October of 2000. Preliminary analysis showed a strong presence of *Balantidium coli*, a protozoan parasite, and *strongyloid* eggs, a nematode parasite; 50% of animals in the total sample were infected with *B.coli* and 55% exhibited *strongyloid* infection. When the data was partitioned into age/sex classes, differences in the levels of infection occurred.

## POSTER SESSION

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### MICROFABRICATED GLUCOSE SENSOR

**KRISTEN MENDENHALL**

*Senior, Electrical Engineering*

**KARL BÖHRINGER**

*Professor, Electrical Engineering*

**Yael HANEIN**

*Professor, Electrical Engineering*

Common methods of glucose monitoring are invasive, usually requiring blood samples. For diabetic patients these tests can be painful and inconvenient since multiple tests are needed every day. This research project combines advanced microfabrication techniques with enzyme reactions to create a painless glucose sensor. Ongoing research at the Georgia Institute of Technology is using micromachined needles for painless drug delivery based on the fact that 50-100mm penetration of the skin accesses the viable epidermis without stimulating nerves. The viable epidermis has a much higher permeability than the outer layer of skin, which will make drug absorption possible at this depth. Based on this principle, a microfabricated glucose sensor that is long enough to access a blood supply, but not long enough to encounter nerves will be painless. The Micro Electrical Mechanical Systems (MEMS) group in Electrical Engineering has developed a microfabrication process to create an array of Silicon needles on the order of 100mm in length. The purpose of this research project is to develop the capability of immobilizing the Glucose Oxidase enzyme (GOD) on the tips of the silicon needles and to collect preliminary measurements of the sensor. The GOD enzyme reacts with glucose to create a current proportional to the concentration of glucose in the solution, thereby allowing a measurement of the glucose level. Developing a process to create this glucose sensor involves electroplating the silicon needles with platinum and then immobilizing the enzyme on the tips of the electrode. This project is focused on minimizing the noise of the sensor in a glucose solution and maximizing the life of the device.

### DETERMINATION OF NANOMECHANICAL PROPERTIES OF CARBON-NANOTUBE-PAPER BY ATOMIC FORCE MICROSCOPY

**CHRISTOPHER MOLINA**

*Senior, Metallurgical Engineering*

*MARY GATES SCHOLAR*

**MEHMET SARIKAYA**

*Professor, Materials Science & Engineering*

The goal of our senior research project is to evaluate quantitatively certain mechanical properties of carbon nanotube papers with potential high technology applications. The approach we take for accomplishing this task is using a nanoindentation system attached to an atomic force microscope (AFM), which allows nanoscale measurements. The measurements involve determination of modulus of elasticity, nanohardness, and deformation behavior of carbon nanotubes. To facilitate these measurements, the carbon nanotubes have been formed into 1 mm thick sheets that are approximately 3 cm square. The thickness of the papers and the nanoscale size of the randomly oriented carbon tubes prohibit the use of traditional measurement techniques. Also, readily available sharp AFM tips are not conducive to making such measurements. Therefore, we have designed and developed a technique to fabricate blunt nanoindentation tips for achieving ultra-low loads (down to 1 nanoNewton), necessary to for the measurements, and statistically significant areas for measurements. These newly engineered tips are produced by electropolishing a W (Tungsten) wire so that it has a tip radius of approximately 20  $\mu$ m or larger. The tips are calibrated by indentations on standard samples, e.g., gold films on unsupported substrates. In addition, commercially used polyethylene (PE) and polystyrene (PS) will also be tested in thin film form as standards. The research is expected to result in determination of nanomechanical properties of piezoelectric carbon nanotubes that would allow the data to be incorporated into engineering design for potential use in high technology applications (e.g., smart skins).

## POSTER SESSION

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### NEW METHOD FOR MONITORING TUMOR DEVELOPMENT IN A MOUSE MODEL

**CHRISTINA MORK**

*Senior, Biochemistry*

**ANDRE LIEBER**

*Professor, Medical Genetics*

A new method is needed for monitoring tumor development as well as the effect of anti-tumor treatments over time without invasive surgery. The human tumor cell lines, HeLa (a cervical carcinoma cell line) and LOVO (a colon carcinoma cell line) form liver metastasises in immunodeficient mice after transplantation into the portal vein. Mice naturally react differently to these cell lines. Some mice will form large tumors while others will form small tumors and therefore a baseline measurement is needed. HeLa and LOVO tumor cell lines were modified with a gene that expresses a secreted marker protein (hAAT, human alpha antitrypsin), which can be detected in the serum of mice after transplantation of tumor cells into the liver. Retrovirus vectors were used to stably transfer the hAAT gene into the HeLa and LOVO cell lines. Retrovirus vectors were used to stably transfer the hAAT gene into the HeLa and LOVO cell lines. To measure the amount of tumor present a simple blood serum sample can be taken and the concentration of hAAT can be measured using the ELISA technique. Blood samples are a much simpler way of standardizing and measuring tumors *in vivo* than surgery or the difficult technique of computer tomography (CT). ELISA (enzyme-linked immunoabsorbant assay) confirmed the absence of production of endogenous hAAT in HeLa and LOVO cells. The concentration of hAAT was measured by ELISA in seven retrovirus producer cell lines I 6 and A CO were chosen. HeLa and LOVO retrovirus infected cell lines were exposed to different concentrations of G418. A concentration of G418 that killed most of the cells was selected. HeLa and LOVO cells that were exposed to this concentration of G418 and the surviving cells were selected and tested for hAAT production. Cell clones were then chosen with the highest concentration of hAAT and injected into mice. Blood samples were taken every three days for two weeks and the concentration of hAAT was measured and compared to the actual tumor development. If the concentration of hAAT decreases over time with treatment, then it is known that the tumor is regressing. This new method allows for an initial baseline tumor measurement as well as the ability to monitor treatment through simple blood sample serum tests.

### ISOLATION AND CHARACTERIZATION OF A RHABDOVIRUS FROM STARRY FLOUNDER (*PLATICHTHYS STELLATUS*) COLLECTED IN THE SAN JUAN ARCHIPELIGO OF WASHINGTON, USA

**CHRISTINA MORK**

*Senior, Biochemistry*

**JIM WINTON**

*Professor, Aquatics & Fishery Sciences*

A viral survey was conducted of marine fish collected from the San Juan Archipeligo of Western Washington, USA. Of the 131 fish examined by cell culture, one starry flounder (*Platichthys stellatus*) tested positive for virus. Experiments were performed to determine the physical characteristics of the virus that included relative size, stability to freezing and thawing, optimal growth temperature, and the presence of a lipid-containing envelope. In addition, infected cells were stained using Giemsa, H & E, and acridine orange and the virus was observed by electron microscopy. These assays combined with polyacrylamide gel electrophoresis of the structural proteins, polymerase chain reaction assays using primers specific for infectious hematopoietic necrosis virus, viral hemorrhagic septicemia virus and spring viremia of carp virus as well as limited sequence analysis indicated that the virus isolated from starry flounder appeared to be a previously undescribed rhabdovirus of marine fish.

## POSTER SESSION

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### UNDERGRADUATE RADIO ASTRONOMY

**JEREMIAH MURPHY**  
*Senior, Physics*  
MARY GATES SCHOLAR

**PAULA SZKODY**  
*Professor, Astronomy*

While the UW Astronomy Department is outstanding in many fields, its involvement in radio astronomy is minimal at the moment. Despite this encumbrance, we have a desire to learn about this aspect of astronomy. Thus we have applied for and received a grant to construct a radio telescope for use by the department and the public. Our eventual goal, through undergraduate initiative and coordination, is to develop a remotely operable research grade radio telescope.

### VARIATIONS IN MOTOR PERFORMANCE DURING fMRI AND THEIR EFFECTS ON BRAIN ACTIVATION

**HOANG NHAN**  
*Junior, Biochemistry*  
MCNAIR SCHOLAR

**STEVEN CRAMER**  
*Professor, Neurology*

Brain maps are then probed using some form of a boxcar functions and this approach assumes uniformity of motor behavior. Individual motor performances vary over short intervals, however. We hypothesized that variability in motor behavior occurs during the course of a motor fMRI study, and is related to different patterns of brain activation. BOLD fMRI was used to perform 53 studies in 48 subjects (22 healthy, mean-age=50) at 1.5 T using 14 axial 7-mm slices and TR=2000. Subjects alternated between 20 second epochs of rest and tapping. The study lasted 3:20 with 5 tapping epochs. Movements were restricted to index fingers, 25°, and were recorded with a force transducer. Tapping force and frequency were determined, filtered (0.5-5.0 Hz) and decimated to 100 points. In the 9 control tapped right index finger at 2 Hz., univariate activation maps were generated depicting correlation with either the tapping recording or boxcar function; r values were converted to z-scores. Overall, 34/45 studies showed a significant correlation ( $p < .05$ ) between force/time. Left precentral gyrus was evaluated in 9 control subjects. Positive correlations were mapped at z threshold of 2.4. Activation maps using the boxcar function (B) showed stronger correlation than maps using tap data as input function (T). Multivariate maps were concordant with this: boxcar was a much stronger predictor of activation than was tapping data. In 8/9 subjects, force correlated significantly with time. Activation maps for the 4 subjects with (+) and 4 other with (-) correlation were transformed into Talairach space and averaged. P-N showed activation in a network that contained different foci from N-P. Both normal controls and stroke patients exhibit non-uniform motor behaviors during the course of an fMRI study, particularly in force generation. Subjects who increase force during an fMRI study recruit different motor regions as compared to subjects who decrease force.

## POSTER SESSION

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### MARINE CLOSED ECOLOGICAL SYSTEM RESPONSES TO SALINITY

**FLORA NISANOVA**  
*Senior, Biology*

**FRIEDA TAUB**  
*Professor Emeritus, Aquatic & Fishery Sciences*

**JESSICA BENTHUYSEN**  
*Sophomore, Pre-major*

The ecosystems studied in the lab include a marine copepod (*Tigriopus californicus*) and three species of algae. The copepod is a filter feeder; consuming algae, microorganisms, and detritus. In 75 ml culture flasks, the ecosystems are 65 ml of enriched marine medium prepared using Instant Ocean and deionized water. The three types of algae used include *Isochrysis*, *Tetraselmis*, and *Nannochloropsis*. The algae were added on day 0. The invertebrates were added on day 5 and then the flasks were sealed. Salinity was varied from 8-64 ppt. The experiment was started on February 6, 2001. The question was asked: What is the influence of salinity on population dynamics of *T. californicus* and algae? The normal Puget Sound seawater density is 32 ppt. It is hypothesized that at higher and lower levels of salinity the populations of the invertebrates will decrease. At the same time, because species of algae compete with each other for nutrients, they can exhibit a range of responses to varying levels of salinity. The algae are expected to become abundant as populations of the *Tigriopus* decrease. The systems have been sealed for 22 days and all have live *Tigriopus*. At this point the quantitative results show that the algal density is low in all treatments. Systems at the lower than normal level of salinity show formation of small clumps of algae. Consistent with the hypothesis, the populations of *Tigriopus* are greatest at 16 and 32 ppt and decreasing at higher and lower salinity. The studies will continue for three more weeks. Data will be collected and further analyzed and presented at a HEDS-UP (Human Education and Development Space-University Partners) conference in Houston, Texas in May 2001.

### CLIENT EXPECTATIONS AND EARLY ENGAGEMENT IN TREATMENT FOR DEPRESSION

**KIM NOMENSEN**  
*Senior, Psychology*  
MARY GATES SCHOLAR

**ROBERT KOHLENBERG**  
*Professor, Psychology*

Major depression is a serious illness characterized by functionally impairing symptoms that can result in harmful consequences such as death by suicide. The World Health Organization, in fact, indicates that major depression is the 4th most leading cause worldwide of loss in disability adjusted life years. Research suggests that both pharmacological and psychosocial treatments for depression are efficacious in providing both acute symptom relief as well as protection against future relapse for a significant percentage of individuals seeking treatment. Unfortunately, however, research to date has failed to address critical questions regarding how these treatments work for some patients but not for others. Research focusing on processes of change in treatment and on patient predictors is necessary to answer these questions. In an effort to examine patient predictors relevant to the process of change in treatment for depression, this study focuses on the role of patient preferences and expectancies in early engagement in treatment. Drawing from data collected as part of the University of Washington Treatments for Depression Study, the largest single site study on treatments for depression conducted to date, this study tests the prediction that congruence between the treatment a patient receives and his or her preferences and expectancies about the treatment process will be related to early engagement. Early engagement is operationally defined by attendance of treatment sessions during the early phase of treatment and positive scores on a measure of therapeutic alliance as rated by the patient. Patient preferences and expectancies include preference for type of treatment and expectancies about effectiveness of treatment. This study builds upon findings reported by Elkin et al. (1999), in which patient predilection scores were found to be significantly associated with early engagement in the NIMH Treatment of Depression Collaborative Research Program. The design of the current study replicates the design of the Elkin et al. (1999) study. Moreover, the results of the current study have significant implications for identifying ways in which treatments for depression work. Most critically, these results suggest ways in which treatments may be effectively matched to particular patient characteristics.

## POSTER SESSION

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### EVALUATING THE USE OF DIAGNOSTIC ULTRASOUND IN A MICROGRAVITY ENVIRONMENT

**RYAN OLLOS**  
*Senior, Physics*  
MARY GATES SCHOLAR

**MICHAEL BAILEY**  
*Research Scientist, Applied Physics Lab*

**STEVE CARTER, M.D.**  
*Professor, Radiology*

Ultrasound may potentially be valuable as both a diagnostic and therapeutic device in manned space travel because of its size, versatility, cost advantage and minimal operational needs. Potential exists to diagnose and treat a number of ailments from kidney stones to internal bleeding. The Center for Industrial and Medical Ultrasound (CIMU) at the Applied Physics Laboratory (APL) of the University of Washington has undertaken an extensive effort to develop technology for space and terrestrial use that would permit minimally trained personnel to utilize diagnostic and therapeutic ultrasound to stop bleeding from injured vessels. The SonoSite 180 is a commercially available diagnostic device developed in collaboration with APL that could be used in space travel. We have proposed to, and will, test the use of the SonoSite in a microgravity environment during parabolic flights aboard NASA's KC-135a. NASA has used ultrasound imaging previously on the KC-135a Reduced Gravity Flight and in space. Shifting of the organs as well as changes in pathology and dynamics of the body present challenges to the use of ultrasound in a microgravity environment. We have undertaken the goal of determining how imaging can be performed in a microgravity environment and how it may differ from its frequent use as a diagnostic device on earth. The experiment consists of two portions: determining the anatomical variations that may be seen when viewing the liver and kidney in differing gravitational environments from zero to 2-g, and evaluating the feasibility of performing a ree-hand diagnostic scan of different portions of the body. We are also presenting this exciting experience to local schools to promote the opportunities of science as part of NASA's dedication to promoting education.

### MALDI-TOF ANALYSIS OF MYCOBACTERIUM AVIUM - "WHAT DO YOU GET WHEN YOU SHOOT A BACTERIA WITH A LASER?"

**CHRISTINE PALERMO**  
*Senior, Biochemistry*  
MARY GATES SCHOLAR  
SPACE GRANT SCHOLAR

**GERARD CANGELOSI**  
*Professor, Pathobiology*

**MURRAY HACKETT**  
*Professor, Medicinal Chemistry*

Isolates of *Mycobacterium avium* have long been known to segregate into transparent, opaque, and rough colony morphotypes that differ from each other in clinically important parameters including drug susceptibility and virulence. We recently described a new morphotypic switch in *M. avium*, termed red-white, that becomes visible when opaque colonies are grown on agar containing Congo red dye (Cangelosi, G.A., Palermo, C.O., Laurent J-P., Hamlin, A.M., and Brabant, W.H., 1999). This switch is also evident in transparent colonies when assayed with a quantitative Congo-red binding assay. White-opaque and white-transparent variants are more resistant to clarithromycin and rifampin *in vitro*, and better able to survive within human macrophages than their red counterparts. However, red variants exhibit the ability to spread on soft agar (sliding motility), a potential selective advantage under some environmental circumstances. Moreover, red-transparent variants of at least one strain are significantly more resistant to chlorine than other morphotypes. In order to better understand the physiological basis for red-white colony type variation, we conducted matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) analysis of whole cells, surface-exposed fractions and extracellular fractions. This analysis revealed significant differences in the cell surface protein profile of red and white variants. The most abundant peak unique to red variants was found at ~6140 Da in all three cellular fractions. This protein was isolated from the extracellular fraction and is being sequenced by liquid chromatography tandem mass spectrometry (LC-MS/MS) to determine its identity. There were additional unique protein peaks at ~8900 Da and ~9500 Da which have yet to be analyzed. The distinct surface protein profiles associated with the red and white morphotypes were reproducible in multiple, independently-isolated red and white clones. Thus, in contrast to opaque-transparent variation, red-white variation is manifested by readily detectable differences in cell surface proteins. Analysis of these proteins will help us to understand the molecular biology of virulence, drug resistance and other important phenotypes affected by the red-white switch in *M. avium*.

## POSTER SESSION

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### SEARCHING FOR A CONNECTION BETWEEN POLAR CAP AREA AND SOLAR WIND

**EILEEN PEERY**

*Freshman, Computer Science*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**MITCHELL BRITTNACHER**

*Research Scientist, Earth & Space Sciences*

The group I worked with was studying the aurora using ultraviolet images (the ones I looked at were taken by the POLAR satellite). The project I worked on was to study the correlation between the polar cap area and solar wind activity. The polar cap is the region in the center of the ring formed by the aurora, which is roughly centered around the magnetic north pole. I looked at data to see if solar winds could possibly cause the polar cap area to change. To analyze this data, I created a program that would take the images and figure out the area of the polar cap. These images were then transformed into polar coordinates around the magnetic pole of the earth. Basically, my program divided this picture into many slices, like a pie, and then drew a line down the middle of each slice. Looking at the intensity of the aurora on these lines allowed a boundary point to be set for the polar cap. Then the points were connected, and this was the boundary of the polar cap, from which it was easy to determine the area. Plotting the resulting area over time for several incidents, we have done preliminary examination of the data. While the results are not certain yet, some patterns have been observed that connect the solar wind to the polar cap area.

### WAVE/MEAN FLOW INTERACTION IN OCEAN CIRCULATION

**DAVID PETERSON**

*Freshman, Pre-engineering*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**PETER RHINES**

*Professor, Oceanography & Atmospheric Sciences*

**LUANNE THOMPSON**

*Professor, Oceanography*

There are many factors that contribute to the circulation of water in the world's oceans. This experiment isolated what is called a coastal trapped wave, one of the factors thought to have a role in the circulation of water along the coastlines of the world's oceans, particularly in the Southern Ocean around Antarctica. The coastal trapped wave is the result of water flowing over ocean basin topography and the Earth's rotation. The rotating fluid flows over the topographic features easily in one direction and resists flowing over the topographic features in the opposite direction. An oscillating wind stress then results in a mean flow. In particular, this experiment studied the relationship between the amplitude of the wind stress causing the coastal trapped wave and the resulting mean flow. Large bowls with four symmetric ridges were used to model an ocean basin. The bowls were placed on a rotating table, the speed of which was oscillated around a mean rotation, simulating the wind stress and the Earth's rotation. The velocity of the flow was measured using a Laser Doppler Velocimeter (LDV). This knowledge will be important when a more complete ocean model is constructed to see what role this phenomenon has in the oceans.

## POSTER SESSION

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### FUNCTION OF WILLIOPSIS SAUVEOLENS 8-KB MTDNA FRAGMENT

**JOHN PHAM**  
*Junior, Biochemistry*

**DELENE OLDENBURG**  
*Research Associate, Botany*

This research project examines the identity and functionality of an 8-kb fragment of mitochondria DNA (mtDNA) in a strain of yeast (*Williopsis sauveolens* 255). In previous experiments, when the mtDNA is treated with the restriction enzyme BamHI, an 8-kb showed up in various amounts. This project attempts to isolate and sequence that specific fragment to obtain more information and hopefully determine its function. So far in this experiment, the 8-kb fragment of DNA has been isolated. Again, the amount of 8-kb mtDNA fragment in each of the preparations has been different. This brings up the question whether this fragment comes from the amplification of an 8-kb region of the mitochondria genome or from nuclear DNA not removed during isolation of the mitochondria. The goal of this project is to determine which one of the above statements is correct.

### WATER GULLIES ON MARS

**DAVID PHILIPS**  
*Junior, Physics and Astronomy*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**CONWAY LEOVY**  
*Professor Emeritus, Astrobiology & Atmospheric Sciences*

The subject of *Water Gullies on Mars* has been catching the attention of many people in the scientific community recently. A large portion of this interest stems from newly released images by the Mars Global Surveyor within the past couple of years. The objective of our research project is to find out whether water can exist on the slopes where these gullies occur as well as to better understand how they may have been formed. Taking Mars' minimal greenhouse effect into account, we will use a steady state equation to determine how daily temperatures on Mars vary over the course of a martian year. Once that is achieved, we then further expand on the true composition of these gullies.

### AUTOMATIC FEATURE EXTRACTION FOR PANCHROMATIC MARS GLOBAL SURVEYOR MARS ORBITER CAMERA IMAGERY

**CATHERINE PLESKO**  
*Junior, Physics and Astronomy*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**CONWAY LEOVY**  
*Professor, Atmospheric Sciences & Astrobiology*

The Mars Global Surveyor Mars Orbiter Camera (MOC) has produced tens of thousands of images, which contain a wealth of information about the surface of this planet. Current techniques using manual analysis or handwritten feature extraction tools are inadequate for such a large database. This project tests the application of Los Alamos National Laboratory GENIE automatic feature extraction software to the MOC narrow angle panchromatic dataset, which has the potential to dramatically increase the speed of data analysis. GENIE is an evolutionary computation software system that uses a genetic algorithm to assemble feature extraction tools from low-level image operators. Each generated tool is evaluated against training data provided by the user. The best tools in each 'generation' are allowed to 'reproduce' to make the next generation until it converges to a solution, or reaches a level of acceptability specified by the user. The panchromatic MOC images were a good test of GENIE's capability to adapt, as GENIE is typically used on multispectral imagery. Craters are some of the most numerous features in the MOC images, and cover a wide range of shapes and resolutions. The first feature extraction tools under development in this project are for craters. Tools for other interesting features will also be explored.

## POSTER SESSION

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### UNITED STATES COPYRIGHT POLICY: AN EXPLORATION OF POLICY TIDES

**COURTNEY POPP**

*Senior, Political Science*

**BRYAN JONES**

*Professor, Political Science*

From the Industrial Age to the Information Age, technological advancement has always maintained a relatively steady pace. Why then do we see bursts of activity on the policies designed to protect these new innovations and their less advanced predecessors from copyright infringement, followed by long periods of near inactivity? What factors contribute to these policy swells? Is it increased media attention to specific issues? Does the current political party in power sway the policy agenda? Does public involvement, specifically consumers' time and money spent on direct use of the new technology, factor in? I hope to examine this largely unexplored topic, uncovering the motivating forces behind copyright policy in the United States. Copyright attention in the media will be traced through use of the New York Times Index, which is a random sample of articles appearing in the New York Times in a given year on a particular topic. To track the issue's relevance to the government agenda, I will determine the number of bills passed in Congress on specific copyright issues using the data-sets of the Policy Agendas Project from the Center for American Politics and Public Policy. I predict that upon comparison of these two data sources, a close parallel between the public and government agendas will be evident, and an explanation of the sporadic attention swells characteristic of US copyright policy will be possible.

### STERIOD HORMONE EFFECTS ON ION CURRENTS IN GnRH-SECRETING NEURONS

**EMILY PRATT**

*Senior, Neurobiology and Biochemistry*  
*MARY GATES SCHOLAR*

**MARTHA BOSMA**

*Professor, Zoology*

Mammalian development is a vast field of study. The nervous system in particular, which consists of thousands of cellular phenotypes with intricate and conserved connections, offers an immense breadth on which to focus. Gonadotropin releasing hormone (GnRH) neurons, numbering less than 1000 throughout the entire central nervous system (CNS) undergo a particularly unusual course of development. The only known neuron to originate in the periphery and migrate into the CNS, their proper development is imperative for hormonal release and sexual maturation. Mature GnRH neurons are known to have a coupled bursting pattern of activity, which mediates the release of GnRH, and is responsible for the subsequent secretion of follicle stimulating hormone (FSH) and luteinizing hormone (LH), two hormones released by the anterior pituitary gland. In addition to the chemical and electrical signals received by GnRH neurons, their makeup of ion channels, both ligand- and voltage-gated, will determine the pattern of activity exhibited. In order to study the electrical and biochemical properties of GnRH neurons, I have used the patch-clamp technique on an immortalized cell line, GT1-7 cells. In particular, I have studied the effects of steroid hormones on outward ion currents. I hope to transfer the information about this system to primary culture as well as utilize the calcium imaging technique as a means of further study.

## POSTER SESSION

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### THE POLITICS OF DEBT

**TODD REICHERT**

*Senior, Political Science*

**BRYAN JONES**

*Professor, Political Science*

No scholar has yet to explain the precise reason why the state of the budget deficit in the early 1990s received so much national attention, both from the public and the United States Congress. Moreover, no scholar has yet to determine whether the public (along with the media) or the actual dollar amount of the national debt and deficit at any given time period is more influential in pressuring Congress into creating legislation aimed to reduce the Federal budget deficit. My research has attempted to answer both of these important questions.

The media, the public and the actual dollar amount of the federal budget deficit should create pressures on Congress to take concerted action to reduce the United States budget deficit and national debt. Hypothesis: The number of congressional hearings and the amount of proposed legislation concerned with the federal budget increases as the media and the general public call attention to the deficit. Further, as the federal deficit becomes larger, the number of congressional hearings and the amount of proposed legislation concerned with the federal budget will increase. Finally, the media and the public are more effective in jumpstarting legislative action aimed to reduce the national debt and the deficit than is the actual dollar amount of the deficit at any given time period.

A time-series analysis of congressional action taken on the federal budget deficit from 1940-2000 was conducted. Furthermore, the Agenda Project database (which consists of a series of comprehensive datasets of U.S. congressional hearings, public laws, Congressional Quarterly Almanac stories, and selected articles from the *New York Times*; created by Professor Baumgartner and Jones) was used in the research process. In addition, the *Gallup Poll's* Most Important Problems facing America surveys (1980-2000) was utilized in this research process.

### DAYSIDE SPLITS OF THE AURORA BOREALIS

**B. RACE ROBERSON**

*Freshman, Physics*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**MITCHELL BRITTNACHER**

*Research Scientist, Earth & Space Sciences*

The Aurora Borealis, also known as the Northern Lights, is a product of energetic electrons interacting with earth's atmosphere. It forms a wide oval or circle around the magnetic poles of the earth. Though usually too faint to see during the day with the naked eye, the Aurora is still present and can be detected with an ultra-violet camera. The side that the sun is shining on is referred to as the Dayside, while the opposite side is called the Nightside. In this project we looked at ultra-violet pictures taken of the Aurora taken from a satellite called POLAR. The goal of the project was to go through images taken of the Dayside Aurora and find individual records of a specific event, referred to by us as a Dayside Split. A Dayside Split is when a section of the Dayside Aurora splits off from the main oval and moves toward the pole. Most of these events are short lived, 5-10 minutes, but some have lasted from 20-60 minutes. I went through POLAR records for one full month and parts of several other months with images usually every 30 seconds, sometimes 3 minutes apart if the camera was switching filters. Each recorded event was then correlated with atmospheric data from other satellites such as FAST and other measuring systems such as ground based radar (at least two of the events had a great deal of outside data to work with). I made a table of each event including the time and a description of its properties to be used by Dr. Brittnacher in further studies.

## POSTER SESSION

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### CURRENT STRUCTURE AS AN INDICATOR OF SEDIMENT TRANSPORT MECHANISMS OFF THE COAST OF NORTHERN CALIFORNIA

**KARI SAUERS**

*Senior, Oceanography*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**ANDREA OGSTON**

*Professor, Oceanography*

During the winter of 1996-1997, continuous measurements were taken from an instrument package deployed on the continental shelf off Eureka, CA at 60 meters depth. Near-bed sediment concentration and temperature data over the winter months were analyzed and correlated with current measurements taken from an RD Instruments Acoustic Doppler Current Profilers (ADCP) to examine the possibility of a new sediment transport mechanism that might play an important role in moving sediment across the continental shelf toward the deep sea. A hypothesis was formulated suggesting that suspended sediment may be trapped in a frontal zone formed by the converging currents from either side of a warm coastal front. As concentrations in the near-bed suspended sediment layer increase, it may detach from frontal trapping mechanism and the layer may migrate seaward under the influence of excess gravity. It was hypothesized that this phenomenon could potentially represent a major mechanism for cross-margin transport of river-derived sediment on continental shelves. Therefore, the objective of this research was to look for evidence of the frontal formation during periods of hypothetical frontal activity and elevated sediment concentrations. Examination of the data showed that wind-driven forcing is a dominant feature for water-column currents at this site. Although at times, the near-bottom boundary layer acted under differing forces than the water column above, possibly from the increased density due to high suspended sediment concentrations. The correlations and lack thereof between the wind, water column current, temperature, salinity, and suspended sediment concentration measurements support the potential for frontal mechanisms to exist and to have great impact on sediment trapping and advection. However, because of the great alongshore current variability, it is difficult to interpret single point changes in the across-shelf velocity profiles. Therefore, the hypothesis cannot be strongly supported with the existing data set. To better assess the effects of coastal fronts, sediment trapping and advection measurements of across-shore spatial variability are necessary.

### CLONING AND MAPPING OF THE DISTRIBUTION OF GALANIN-LIKE PEPTIDE (GALP) mRNA IN THE HYPOTHALAMUS OF THE MONKEY

**JARRAD SCARLETT**

*Senior, Neurobiology and Biochemistry*  
*MARY GATES SCHOLAR*

**ROBERT STEINER**

*Professor, Physiology & Biophysics*

Galanin-like peptide (GALP) is a neuropeptide that shares partial amino acid identity with galanin. GALP was originally isolated and cloned from the porcine, rat, and human hypothalamus and binds with high affinity to two of the galanin receptor (Gal-R) subtypes, Gal-R1 and Gal-R2. Recent studies from our laboratory have demonstrated that in the rat, GALP mRNA is regulated by the hormone leptin. As an initial step to understanding the physiological significance of GALP in the primate, we cloned a partial cDNA for GALP mRNA from the hypothalamus of a monkey. We used this clone to generate a cRNA probe to examine the distribution of GALP mRNA in the monkey brain. To clone the GALP cDNA, we performed RT-PCR on mRNA extracted from the hypothalamus of a male pigtailed macaque (*Macaca nemestrina*) and generated a 315 base-pair cDNA fragment. This fragment showed 95% homology with the human GALP nucleotide sequence and 94% homology at the amino acid level. Using an antisense GALP cRNA probe labeled with <sup>33</sup>P-UTP, we performed in situ hybridization analysis on tissue sections from the hypothalamus and pituitary gland of the male pigtailed macaque (n=3). In the hypothalamus, cells expressing GALP mRNA were found exclusively in the arcuate nucleus and median eminence. Within the arcuate nucleus, GALP mRNA was primarily located along the third ventricle, with the majority of cells located in the caudal region. The presence of GALP mRNA-expressing cells in the arcuate nucleus of the monkey and its overlap with known distributions of receptors for both leptin and gonadal steroids suggests that GALP may play a role in the neuroendocrine control of feeding and reproduction in the primate.

## POSTER SESSION

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### GENETIC HITCHHIKING WITH A MAJOR HISTOCOMPATIBILITY COMPLEX (MHC) GENE IN REDWINGED BLACKBIRDS (*AGELAIUS PHOENICEUS*)

**MEGAN SMITH**  
*Freshman, Zoology*

**SCOTT EDWARDS**  
*Professor, Zoology*

The *Mhc* encodes genes involved in the adaptive immune response and shows high diversity both at the protein and nucleotide levels. Balancing selection, or the maintenance of many alleles in a population, is thought to be the primary source of diversity. With genetic hitchhiking, selectively neutral loci linked to an *Mhc* gene should exhibit uncharacteristically high levels of diversity, which should then decrease with recombination and distance from the *Mhc* gene. We sequenced two non-coding regions approximately 15,000 and 40,000 base pairs away from an *Mhc* class II B gene (*Agh-DAB1*) in Redwinged Blackbirds (*Agelaius phoeniceus*) in order to quantify levels of genetic hitchhiking with increasing distance. Additionally, introns from rhodopsin and  $\alpha$ -fibrinogen were sequenced to establish neutral levels of diversity. Diversity decreased with distance from *Agh-DAB1*, suggesting the presence of genetic hitchhiking, and both loci showed diversity over neutral expectations ( $P=0.002$ ).

### PSEUDOMONAS VARIATION STUDY

**DAVID SPENCER**  
*Senior, Biochemistry*  
MARY GATES SCHOLAR

**MAYNARD OLSON**  
*Professor, Medicine and Genetics*

**BENJAMIN FRANKLIN VOIGHT**  
*Senior, Mathematics and Biology*

*Pseudomonas aeruginosa* is a common environmental bacterium and is also one of the top three causes of opportunistic infection in humans. Its association with the genetic disorder Cystic Fibrosis (CF) has led to the collection and study of many *Pseudomonas* strains, both clinical and environmental. With the completion of the genome project of PA01, the most common laboratory strain, it is now possible to compare this completed reference sequence to both environmental and clinical isolate collections at a molecular level. In such a comparative analysis, we asked two questions: How typical is PA01 to other *Pseudomonas* isolates from both the environment and from affected individuals, and how stable is the *Pseudomonas* genome during long term colonizations of CF affected lungs? To answer these questions we initially employed a whole genome shotgun sequencing scan to randomly sample portions of the genomic sequence of one environmental strain and two clinical strains from two different CF patients. We also used whole genome restriction enzyme digests to fingerprint strains periodically isolated from these two patients over the course of the infection. In addition, a directed PCR - sequencing approach was used to investigate variation between *Pseudomonas* isolates at selected loci. The results from the three methods show that there is significant variation between strains from different environments and different affected individuals, but a comparison between strains isolated from the same patient confirm the hypothesis that long term *Pseudomonas* infections are largely clonal.

## POSTER SESSION

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### CALIBRATING A DEEP SEA SLOW FLOW PROBE

**CLARE STEEDMAN**

*Junior, Geological Sciences*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**WILLIAM WILCOCK**

*Professor, Oceanography*

Mid-ocean ridges are the focus of an exciting but relatively immature field of study being researched by the School of Oceanography at the University of Washington. Many processes are still poorly understood. One area of interest involves hydrothermal circulation of seawater. Although mid-ocean ridges host black smoker vent fields in which 350°C water vents into the ocean at high velocities, most of the circulation occurs at very slow speeds. To study this flow, William Wilcock and Peter Kauffman developed a probe that uses an electrochemical method to measure flow. This method has so far proved to be cheaper, more energy efficient, and more sensitive than previous probes that have used dye or heat to measure flow.

The instrument was deployed at sea on a borehole near the Juan de Fuca Ridge in August of 2000 for initial testing in a deep-sea environment. Before this, it was necessary to test and calibrate the probe in the laboratory. During the summer of 2000, I ran numerous tests and we were able to use the results to determine the best sequence of tests for the seafloor deployment.

### EXAMINING THE RELATIONSHIP BETWEEN EARLY MALTREATMENT AND LATER ADOLESCENT HEALTH-RISK BEHAVIORS

**KATY SULLIVAN**

*Senior, Social Welfare and Dance*

**TODD HERRENKOHL**

*Professor, Social Work*

**BECKY TORRI**

*Senior, Social Welfare*

**EMIKO TAJIMA**

*Professor, Social Work*

Research has shown that some children who have been maltreated engage in behaviors during adolescence which threaten their own well-being and the well-being of others. This project uses an existing longitudinal dataset to examine the relationship between early maltreatment and later substance abuse, violence, teen pregnancy, and school dropout during the adolescent years. Our hypothesis is that children who have experienced early maltreatment are more likely to engage in these types of behaviors. The Lehigh Longitudinal Study is a prospective study of children and families begun in the 1970s. Data were collected from multiple sources at three key developmental points for children (preschool/early childhood, middle childhood/school age, and adolescence). Results from this study should increase knowledge about the developmental impact of early maltreatment on adolescent health-risk behaviors and inform intervention with high-risk youth.

### KINEMATIC MODEL OF BIPOLAR NEBULAE

**TANYA TAVENNER**

*Senior, Astronomy and Physics*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**BRUCE BALICK**

*Professor, Astronomy*

We designed a computer program to study the expansion of bi-polar planetary nebula. The mechanism by which these nebula are able to produce a bi-polar shape is still unknown. By studying the kinematics of the current expansion, we hope to be able to run our findings backwards through time, to see how this shape originated and evolved.

## POSTER SESSION

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### AN INVESTIGATION OF THE PROPERTIES OF FUNGAL MYCELIA AS A FILLER IN PAPER

**NERAYO TECLEMARIAM**  
*Junior, Chemical Engineering*

**J. L. ANDERSEN**

**G. GRAHAM ALLAN**  
*Professor, Chemical Engineering*

**DIDI CLOSE**  
*Freshman, Pre-Engineering*

**ERIC GUYETTE**  
*Senior, Biology*

Due to the fact that forests are limited resources, studies have been directed towards maximizing the uses of harvested timber. Increased use of fillers in paper would decrease the use of wood pulp, subsequently fewer trees would need to be harvested. This study examined if mycelia of *Aspergillus niger* could be used as a filler in paper without a noticeable decline in physical properties. Since the mycelia of *Aspergillus niger* contain the polymer chitin, this biomass may function as a suitable substitute for wood pulp in paper. One virgin and two recycled wood pulps were characterized in terms of burst, tear and tensile strengths. Concentrations of mycelia were varied from zero to twenty percent by mass. The results obtained showed that only minimal decreases in physical properties of the paper resulted as the mycelia content increased to ten percent by mass.

### NEUROCHEMICAL MECHANISMS UNDERLYING THE COGNITIVE DEFICITS IN GALANIN TRANSGENIC MICE

**DAWIT N. TEKLEMICHAEL**  
*Junior, Microbiology*  
MARY GATES SCHOLAR

**ROBERT A. STEINER**  
*Professor, Obstetrics & Gynecology, Physiology & Biophysics*

**DONALD K. CLIFTON**  
*Professor, Obstetrics & Gynecology*

Alzheimer's disease (AD) is characterized by loss of cognitive function. Although the actual cause of AD is unknown, the cognitive deficits seen in people with this disorder may be related to an increase in the expression of the neuropeptide galanin and a concomitant loss of cholinergic neurons in the basal forebrain. Our laboratory has created a line of transgenic mice that overexpress galanin in the basal forebrain (GAL-TG), and these mice display deficiencies in memory reminiscent of those seen in AD. We tested the hypothesis that the cognitive deficit in GAL-TG mice might be attributed to a loss of the cholinergic neurons in the basal forebrain, as in the case of AD. To accomplish this, we used immunocytochemistry and *in situ* hybridization to count and compare the number of neurons containing choline acetyltransferase (ChAT-the enzyme catalyzing the synthesis of acetylcholine) and its mRNA in the basal forebrain of GAL-TG and wild type (WT) mice. We found that there was a 67% reduction of ChAT-containing neurons in the horizontal limb of the diagonal band of Broca (HDB-a subregion of the basal forebrain) of GAL-TG mice compared to controls; however, there were no differences in the number of cells in the HDB expressing ChAT mRNA between the two genotypes (WT:  $144.0 \pm 13$  cells vs GAL-TG:  $138 \pm 8$  cells). These data indicate that although galanin overexpression leads to an apparent disruption of ChAT biosynthesis (as evidenced by the reduced ICC cell counts), it does not cause the actual death of these cholinergic neurons. We conclude that an overabundance of galanin in the basal forebrain may alter the translation of the ChAT mRNA, posttranslational processing, or augment ChAT degradation. Furthermore, our results are consistent with the hypothesis that increased galanin expression contributes to cognitive deficiencies in AD by reducing cholinergic function in the basal forebrain.

## POSTER SESSION

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### PRODUCTION SCHEDULING OPTIMIZATION

**JENNIFER TEMPLE**

*Senior, Industrial Engineering, Applied  
Computational & Mathematical Sciences, and  
Mathematics  
MARY GATES SCHOLAR*

**ZELDA ZABINSKY**

*Professor, Industrial Engineering*

**JANA LITTLETON**

*Senior, Industrial Engineering and Applied  
Computational & Mathematical Sciences*

Production scheduling problems are encountered routinely in industry, yet are notoriously difficult to solve. Scheduling problems are NP hard; they cannot be solved in polynomial time because there are too many possible solutions to examine. Many heuristics exist for solving scheduling problems, but they are usually developed for very simple cases and are difficult to apply to real-world situations. Our research is focused on a real-world scheduling problem at a local electronics company. The company currently has no scheduling practice other than earliest due date. This has led to a very long makespan, the time it takes for all jobs to be completed, as well as the build up of work in process inventory in the production area. We are developing an approximate solution method that will minimize makespan, thereby increasing throughput and reducing lead time. The methodology will be compared to the company's current methods as well as upper and lower bounds for the same problem.

### DOMINANCE, NONVERBAL BEHAVIOR, AND DYADIC INTERACTION

**CHERESSE THOENY**

*Senior, Speech Communication*

**VALERIE MANUSOV**

*Professor, Speech Communication*

Communication research dealing with dominance stresses its inherent interactional component: "[D]ominance and submission are seen as properties of an interpersonal relationship rather than of an individual, and emphasis is on the social skills and communication practices that contribute to dominance rather than on inherited, biologically determined, role-bound, or personality dictated patterns of behavior" (Burgoon et al., 1998, p. 314). This statement assumes that if one person is to be dominant, then there will be one (or more) person who will be subordinate or have less influence. One of the ways dominance is expressed in interaction is through nonverbal means. Guerrero et al. (1999) emphasize the importance of nonverbal communication when they state that it "is all around us." They continue by asserting that nonverbal messages are important because they are more believable than verbal communication, and because they are ways to express emotion, manage impressions, and communicate attraction, liking, distance, and dominance. Nonverbal communication is defined by Guerrero et al. as "all the messages other than words that people exchange in interactive contexts" (p. 5). A way to examine how dominance is displayed through nonverbal means is to look at an interaction between two people making a decision. My study describes various dominant nonverbal behaviors and examines how dominance is displayed through nonverbal behaviors. Therefore, the data provide a clearer picture of dyadic communication. Dominance and nonverbal behavior were examined in two types of relationships: platonic and romantic. Because dominance is apparent in decision-making scenarios, each pair discussed a medical dilemma while being videotaped. Each person then filled out two questionnaires that asked about both their and the other person's actions during the conversation. At that point the individuals were debriefed and the researcher began to analyze information. Data on 29 couples were collected. Data will be analyzed by coding three minutes of discussion per pair. Specific nonverbal behaviors will be coded for dominance in each kind of relationship. The questionnaires will be analyzed using SPSS to find possible significant differences between individuals and relationships. Answers on the questionnaires will be compared with data from the interaction to shed light on perceptions of dominance of those inside and outside of the relationship. This study will supplement the growing body of literature dealing with dominance and relational communication.

## POSTER SESSION

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### HYPORHEIC INVERTEBRATES

**JESSICA TRANTHAM**

*Senior, Zoology*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**HOLLY COE**

*Masters Candidate, Zoology and Center for*  
*Streamside Studies*

This study is investigating aquatic invertebrate communities in a floodplain hyporheic zone. The goal of the overall study is to provide a picture of the hyporheic invertebrate community structure and fluctuations thereof over time. This information is valuable because there is so little known about hyporheic zones, and even less about the life which inhabits these areas. Knowledge of invertebrate community composition in the hyporheic zone could provide a basis for assessing the health of similar rivers which have been subject to more human influence. My particular focus in this project was to try to discover any forthright trends in community structure in relation to season. From preliminary results, there does not seem to be any regular seasonal variance.

### ADSORPTION OF N<sub>2</sub>, H<sub>2</sub>, AND D<sub>2</sub> GASES ON CARBON NANOTUBE BUNDLES

**ADAM TYBURSKI**

*Senior, Physics*

**OSCAR VILCHES**

*Professor, Physics*

The binding energy of N<sub>2</sub> (nitrogen), H<sub>2</sub> (hydrogen), and D<sub>2</sub> (deuterium, an isotope of hydrogen) on the surface and outer ridges of carbon nanotube bundles has been determined by analyzing adsorption isotherms. Carbon nanotubes are sheets of graphite seamlessly rolled into tubes approximately one nanometer (10<sup>-9</sup> m) in diameter. The purpose of this research is to determine the binding sites and energies of gas adsorbed on bundles of these tubes. Possible sites are the spaces between tubes (interstitial channels), the outer ridges between tubes, or the outer surface of tubes. Gases adsorbed in the interstitial channels or outer ridges could possibly behave as a one-dimensional system. The solid, liquid, and vapor phase transitions of 1-D gases could then be determined and compared with theoretical predictions. An adsorption isotherm is a plot of the amount of gas adsorbed on a surface versus pressure at constant temperature. Analyzing several isotherms over a range of temperatures determines the binding energy. These energies are compared to the binding energy on planar graphite. The data collected to date suggests that there are two sites. The stronger site is the outer ridges which has roughly twice the binding energy of planar graphite. The outer surface is also a binding site with a binding energy that is slightly smaller than planar graphite.

## POSTER SESSION

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### ENHANCEMENT OF TIME-OF-FLIGHT SECONDARY ION MASS SPECTROMETRY: OPTIMIZATION IN MOLECULAR ION DETECTION

**MARIE VENDETTUOLI**

*Junior, Chemical Engineering and Biochemistry*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**DAVID G. CASTNER**

*Professor, Chemical Engineering and*

*Bioengineering*

**SALLY L. MCARTHUR**

*Professor, Chemical Engineering*

In the field of biomaterials, one major obstacle is the foreign body response, in which the living system 'walls off' an unfamiliar object by building a layer of tissue around it. The resultant layer of tissue can severely curtail the efficiency of the implanted biomaterial. One proposed solution is to develop biomaterials that mimic the living part they replace more closely. This approach demands that there is a clear understanding of what the environment is at a molecular level. To achieve this end, there is the need for an analysis technique that not only has the sensitivity to look only at the surface layers, but also to correctly identify low concentrations of proteins. A technique that fits these criteria is the Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) also has a theoretically unlimited mass detection range, perfect to analyze the high molecular weight proteins. Ideally, ToF-SIMS should be able to detect the entire molecular ion. The intent of this research project is to optimize the detection of molecular ions by using matrix molecules. This method has proven successful in sample preparation for related mass spectrometry techniques. It is believed that the matrix somehow changes how energy is transferred to the protein, modifying it in a way that allows the entire molecular ion to be 'lifted' off the surface. So far, experiments indicate that there is a significant increase in the amount of molecular ions detected with the use of a matrix. One modification to the matrix that seems to help promote molecular ion detection is removing the salt content. While current research focuses on the use of the protein Angiotensin II in conjunction with the matrix 2,5-dihydroxybenzoic acid (DHB), future goals include: exploring different matrices and determining how the attributes of the protein itself aid in molecular ion formation.

### CROSS CULTURAL FAMILIES PROJECT

**CAM-TU VO**

*Senior, Social Welfare*

**TRACY HARACHI**

*Professor, Social Work*

**CAROLINE JAMES**

*Junior, Social Welfare*

This project seeks to examine the developmental trajectories of Vietnamese and Cambodian children and to better understand why some children develop problem behaviors such as delinquency and why others have more successful outcomes. There has been a substantial increase in violent crimes and gang activity among the Asian Pacific Islander populations nationally and a growing concern about how best to address these issues. It is important to develop a better understanding of how these problems form, as well as an understanding of the factors or conditions that support healthy development. From this information, we can better develop effective and appropriate interventions. The study is funded by the National Institute on Mental Health and National Institute on Child Health and Human Development. It will longitudinally follow a group of 300 Vietnamese and Cambodian families who had initially been contacted in a pilot study in 1998. These are 1st generation, immigrant families with a target child who is currently between 4th and 6th grades. The study will collect data from mothers, the children, and their teachers. In the first phase of the project, we have gone through an extensive process of developing the surveys, translating the surveys, and pretesting the instruments. Additionally, we have begun the process of hiring and training a large group of bilingual interviewers to assist with the data collection. In this poster, I will briefly discuss the steps that we have taken in this start-up phase and discuss challenges to conducting research in a multi-cultural and multi-lingual environment.

## POSTER SESSION

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### EFFECTS OF VARIABLE MESSAGE SIGNS ON VEHICLE SPEEDS AND SPEED DEVIATIONS

**PATRICK VU**

*Senior, Civil Engineering*

**VENKY SHANKAR**

*Professor, Civil & Environmental Engineering*

Variable message signs (VMS) are traffic control devices that provide drivers with roadway information, such as road conditions, congestion, advisory speed limits, and incidents. Studies have been done to analyze effects of VMS on driver response to information, however, limited research has been focused on behavioral effects on vehicle speeds and vehicle speed deviations. Prior studies, including driving simulator-based analyses have hypothesized that both speed and speed differentials significantly affect the frequency and severity of traffic accidents. This research examines real world impacts of VMS on vehicle speeds and speed differentials. Vehicle speeds and speed deviations from a VMS system installed on I-90 over Snoqualmie Pass are compared with a control section on the same freeway. Speed data for both sites were collected, using speed detection loops embedded in the roadway, for a period of 9 months in 1997 and 1998. Mean speed and speed deviations were simultaneously modeled using the method of three stage least squares (3SLS). Examination was also conducted to determine lasting influence from VMS signage between sites. Preliminary results indicate mean reduction in directional vehicle speeds due to VMS to vary from 2 miles per hour to as high as 11 miles per hour. Speed deviations were found to vary from 0.5 miles per hour to as high as 3 miles per hour. In addition, the influence of VMS on vehicle speeds and speed deviations appeared to attenuate within a four-mile distance. Observed vehicle speeds and speed deviations returned to normal levels at locations four miles downstream of the test site. Implications of this research may provide support for more VMS installations to reduce speed differentials and thus create a safer driving environment. Future direction for this research may be examining possible compensatory behavior after driver encounter with VMS.

### EFFECT OF MATRIX METALLOPROTEINASE-9 (MMP9) OVEREXPRESSION IN RESTENOSIS: AN ASSAY OF COLLAGEN GEL CONTRACTION BY SMOOTH MUSCLE CELLS *IN VITRO*

**SAMUEL WAN**

*Junior, Neurobiology*

**ALEXANDER CLOWES**

*Professor, Surgery*

Vascular diseases cause 50% of death in the developed world. Atherosclerosis is a progressive condition in which fibro fatty plaques form in blood vessels, eventually decreasing in lumen size and blood flow. Balloon angioplasty is a popular treatment for atherosclerosis. However, such treatment produces injury and induces a repair process that leads to restenosis in 30-50% of patients. The mechanism of restenosis or negative remodeling, which is the loss of the lumen size after angioplasty, is not clear. However, it is known that the loss of lumen is the result of decrease in the cross sectional area of the artery, but not an increase in the intimal area. It has been shown that the overexpression of matrix metalloproteinase-9 MMP9 may prevent the decrease in lumen area in the injured rat carotid artery normally observed over a 2 week period. It is hypothesized that one way MMP9 can prevent the negative remodeling is by competing with hyaluronate acid in binding to the cell receptor CD44. To study the effect of overexpression of MMP9 on negative remodeling, a collagen gel contraction model is used. The collagen gel contraction in a dish is similar to normal skin wound healing which has been shown to be analogous to the remodeling of the vessel after injury. Fisher rat smooth muscle cells that have been transfected to express MMP9 are suspended in collagen gels and their contractions are assayed and the results will be compared to a control set up (gels with non-MMP9 expressing cells). If the overexpression of MMP9 decreases collagen gel contraction, the mechanism of this effect will then be further investigated by determining the role of hyaluronate and CD44 by using known antibodies.

## POSTER SESSION

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### COMPETITIVE BALANCE IN MAJOR LEAGUE BASEBALL

**EILEEN WANG**  
*Senior, Economics*

**NEIL BRUCE**  
*Professor, Economics*

The lack of competitive balance in Major League Baseball (MLB) detracts from the enjoyment of fans and followers of the sport. People are less likely to support losing teams, thus affecting revenues across the league. Unfortunately, many teams enter spring training with no hopes of reaching post-season play. The widening disparity between local revenues of teams greatly contributes to the inability of many teams to successfully bid on high quality players.

My research studies the determinants of local revenue during the revenue sharing plan and competitive balance tax (or luxury tax). I also examine the performance of MLB teams in recent years as a result of local revenue disparities. The root of this study involves creating an arena in which all teams have equal opportunity of participating in post-season play. Both revenue sharing and the competitive balance tax attempt to redistribute funds from teams with high payrolls and high local revenue to those teams with lower payrolls and lower local revenue. However, the most recent implementations of competitive balance devices did not produce the intended results. Salaries continue to skyrocket, teams continue to lose money, and the Yankees continue to win the World Series.

For the past six months, I have collected data pertaining to the historical framework, team revenues, team payrolls, and win/loss percentages in order to perform analyses to probe into these devices and related proposals. Working towards restoring competitive balance would create a greater sense of hope to fans and players of professional baseball as well as increase the credibility of our national pastime.

### CALCIUM DEPENDENCE OF ACUTE ISCHEMIC CELL DEATH IN IMMATURE WHITE MATTER GLIA STUDIED *IN SITU*

**SCOTT WILKE**  
*Senior, Neurobiology*  
MARY GATES SCHOLAR

**ROBERT FERN**  
*Professor, Neurology*

A number of factors predispose the neonatal infant to conditions of reduced cerebral blood flow. The resulting ischemic conditions can lead to a variety of injuries with CNS white matter exhibiting the highest sensitivity. This preferential lesioning of central white matter tracts can lead to a number of debilitating neurological conditions, principal of which is cerebral palsy. Cerebral palsy is the most common human birth disorder affecting greater than 2 per every 1000 live births and as such is an important topic of research. Our work has utilized an *in situ* technique to study acute ischemic injury of oligodendroglia and astrocytes in the P10 neonatal rat optic nerve. The optic nerve is a central white matter tract and at this stage of development closely approximates the tracts most susceptible to injury in the human infant. Here we have used imaging techniques to detect intracellular calcium concentration changes during a standard 55 minute period of ischemia (oxygen and glucose withdrawal). Although ischemia evoked increases in intracellular calcium in both cell types, oligodendroglia and astrocytes responded in different ways. Dye retention was used to measure total cell death which occurred at a greater rate in oligodendroglia (48.2%) than astrocytes (21.8%). Eliminating calcium from the extracellular medium prevented the rise in intracellular calcium levels reducing oligodendroglial cell death to 32.4%. However, astrocyte cell death under similar conditions increased to 50%. These results indicate ischemic calcium influx is harmful to oligodendroglia but attenuates cell death in neighboring astrocytes. Determining sensitivities and mechanisms of cell death is an important first step in the development of preventative treatments for these injuries. A protective effect of calcium influx has been reported previously in cultured neurons, but this is the first report of this phenomenon *in situ*.

## POSTER SESSION

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### MINI-MAGNETOSPHERIC PLASMA PROPULSION (M2P2)

**LUKE WINSTROM**

*Junior, Mathematics and Physics*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**MISTY BENIZ**

*Senior, Physics*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

*MCNAIR SCHOLAR*

**ROBERT WINGLEE**

*Professor, Earth & Space Sciences*

**BEN WARRICK**

*Senior, Mechanical Engineering*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

The M2P2 (Mini-Magnetospheric Plasma Propulsion) is an advanced spacecraft propulsion system designed by Professor Robert Winglee of UW. The M2P2 uses the solar wind to propel the spacecraft through the solar system at much higher speeds than presently possible with chemical propellants while eliminating the need to carry large amounts of propellant or large power units in space. The prototype development, which is funded by NASA's Institute for Advanced Concepts (NIAC) and NASA Marshall Space Flight Center, is taking place in the Space Sciences group in UW's Geophysics Program. Participation and developments made by undergraduate students in the prototyping are described.

### EXTENSION OF A TWO-DIMENSIONAL ANATOMIC CONTOURING ROUTINE TO GENERATE THREE-DIMENSIONAL FORMS

**J. LEE ZEMAN**

*Junior, Computer Science*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**IRA KALET**

*Professor, Radiation Oncology*

An alternative to chemotherapy for cancer patients, radiation therapy uses high-intensity directed beams of beta particles, alpha particles, or neutrons to destroy the cells of a malignant tumor. The goal of radiation therapy planning is to select a set of beam intensities, orientations, and durations that will maximize radiation delivered to the tumor and minimize radiation delivered to surrounding innocuous tissue. The locations of organs and tumors are calculated from CT or MRI scans of the patient using an intensity-based contouring routine and a start point indicated by a human user. This is time-consuming and not always accurate. An automatic contouring routine based on a combination of Otsu thresholding and fixed thresholding was implemented to calculate, without human input, the three-dimensional set of contours for a patient's bone, skin, and other structures.

*“This lab job is the best thing I have ever done here at the U...I hope every undergraduate, especially female students, are able to get the experience I have and learn that they truly can do anything.”*  
*- Kristen Durance, Botany, Senior*

*“When you feel like life is weighing you down and you have taken on more than you can handle, go to [my mentor’s] office...To all his students, he gives the faith and strength to undertake their own life-projects, and to fight off the forces that slow us down in life. I am so grateful for everything [my mentor] has taught me; thing that will guide me for my entire life.”*

*- Clay Josephy, Anthropology, Senior*

# **PRESENTATION SESSIONS**

*“Usually people can’t really pinpoint the aspect of their education that made the biggest difference. I can. It is strange to think that if I had not had the privilege of working with [my mentor], my years at the UW would not have been even half as successful as they are now.”*

*- Rashmi Dayalu, Biology, Senior*

# PLANTS! THE PRIMARY PRODUCERS OF PLANET EARTH

Session Moderator: Dina Mandoli, Botany  
Session Discussant: Vicente Garcia, Botany, Senior

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## DYNAMIC CELL WALL OF *ACETABULARIA ACETABULUM*

**ERIN DUNN**

Senior, Biochemistry  
MARY GATES SCHOLAR

**DINA MANDOLI**

Professor, Botany

The Mediterranean alga *Acetabularia acetabulum* is a giant unicell that makes a mannan-based cell wall during vegetative growth of the diplophase. It produces a cell wall with elaborate morphology whose composition typifies a group of algae called the "mannan weeds." Little is known about the chemical composition, structure and growth dynamics of mannan-based cell walls compared to cellulosic cell walls. We hypothesize that regional morphological differences may result from chemical and protein changes in wall composition. This unicell heals breaches in its cell wall quickly and grafts well to other individuals of the same species, implying that the wall can undergo dynamic remodeling. Solid-state broadband proton magnetic resonance and biochemical analysis of polysaccharides and proteins has been combined with sugar and methylation analyses of various cell wall regions to determine their chemical composition. We treated cell wall regions with various chemicals to expose the wall structure to Fourier transform infrared spectroscopy. We are using time-lapse movies to visually record the process of cell wall healing in a graft. In addition, we have used PCR with degenerate primers to search for Rho GTPase and expansins. These are proteins known to be involved in cell wall differentiation and remodeling in other plants. The NMR analysis was completed by collaborators at the University of British Columbia. The sugar analyses have been completed and the methylation analyses are in progress. The spectroscopy will be completed this summer. Time-lapse movies of cell wall healing are currently being produced. We continue to search for expansins and Rho GTPase with new degenerate primers.

## EVOLUTIONARY RELATIONSHIPS OF THE AUSTRALIAN TRIBE ANTHOCERCIDEAE (SOLANACEAE) BASED ON CHLOROPLAST DNA SEQUENCES

**VICENTE GARCIA**

Senior, Botany  
MCNAIR SCHOLAR

**RICHARD OLMSTEAD**

Professor, Botany

Tribe Anthocercideae (in the Solanaceae or potato family) consists of seven genera with 31 species endemic to Australia. Past classification of the group resulted in the placement of the seven genera into several tribes. The group was later unified into tribe Anthocercideae, and is now placed as sister to *Nicotiana*. By looking at variation in the *ndhF* gene and *trnL-trnF* intron and spacer region, an evolutionary framework (phylogeny) for the tribe was created. This phylogeny allowed us to look at character evolution and rates of gene evolution. Tribe Anthocercideae, without genus *Symonanthus* forms a well-supported, monophyletic group. Each genus in the tribe also forms a monophyletic group, except for *Cyphanthera*, which remains unresolved. *Symonanthus* is found to be more closely related to *Nicotiana* than to the rest of the tribe. It was found that bilocular stamens are the ancestral condition, and unilocular stamens are evolutionarily derived. A more extensive look at floral character evolution will be performed and the rates of gene evolution will be evaluated once all the sequences are obtained.

**VACUOLE DEVELOPMENT IN A GIANT UNICELLULAR ALGA**

**PHILLIP GARLAND**

*Junior, Botany*

**DINA MANDOLI**

*Professor, Botany*

The giant unicellular alga *Acetabularia Acetabulum* presents a unique opportunity to study the development and physiology of vacuoles. We used neutral red dye (3-Amino-7-dimethylamino-2-methylphenazine hydrochloride) to visualize the position of the vacuole during the three phases of development of *Acetabularia*: juvenile, adult, and reproductive, to measure the rate of diffusion of small particles within the vacuole, and to elucidate the development of the hair vacuole during hair senescence. The vacuole extends throughout the entire cell in juvenile phase. During the vegetative development, most of the rhizoid stains, as well as the entire stalk and younger hairs. Older hairs do not stain. The stain has a heterogeneous appearance during vegetative phase which can be divided into three categories: a "grainy" pattern in the stalk, small spheres in the hairs and stalk, and large flocculent bodies in the stalk vacuole. During reproductive phase the vacuole exists in each of the cap's gametophores and is incorporated into gametangia. The gametangia differ in the appearance of the stain and we suggest a few possible interpretations of this. Errors are sometimes made in incorporating the vacuole into gametangia. With regard to movement within the vacuole, we found that dye moves at different rates in each region of the cell and the movement in all regions is slower than diffusion within reverse osmosis water. We found that younger hairs move dye into the stalk but older hairs do not. The upper angle between the hair and stalk correlates with the age of the hair. We suggest that these two facts together imply that the hair and stalk vacuoles disconnect during hair senescence.

**IDENTIFICATION OF PHYSIOLOGICAL TRAITS RESPONSIBLE FOR INCREASED YIELD IN  
MODERN CORN HYBRIDS<sup>?</sup>**

**NICHOLAS STEPHENS**

*Junior, Biology*

**ELIZABETH VAN VOLKENBURGH**

*Professor, Botany*

Corn crop yields have increased over the past 60 years due to hybridization by classic breeding procedures with little attention paid to the genetic basis of this improvement. Today, with advancements in genetic technology, understanding how these modern hybrids are more successful could accelerate further improvements. Our task is to compare three genotypes - 1930's, 1960's and 1990's varieties - and determine which traits have led to their improved success. Ultimately, we wish to identify the genes responsible for these traits. Successful crops have been determined to be able to withstand density stress and to maintain productivity in dense plantings. Our hypothesis is that the 1990's varieties are less sensitive to density, characterized by the lack of response to far-red light emitted by neighboring plants and a root system capable of thriving with less water. In my experiments, I have compared the growth rate of the three genotypes in both watered and dry conditions, as well as compared their root/shoot ratios. In addition, leaf segments have been placed in red, far-red, and dark growth chambers with and without the hormone auxin and measured for growth of the third leaf. Corn seedlings are currently being raised in red, white, and green light rooms for morphological comparison. I am also using position transducers to measure the effect of light stimulation on the growth of the third leaf.

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<sup>?</sup> Throughout the proceedings this indicates that the project is also being presented in the poster session.

***ACETABULARIA ACETABULUM: A NOVEL MODEL FOR ARSENIC TOXICITY\****

**LYNNE TOWNSEND**

*Senior, Neurobiology  
MARY GATES SCHOLAR*

**DINA MANDOLI**

*Professor, Botany & Developmental Biology*

**NIMA DEJBOD**

*Freshman, Zoology*

Arsenic is a ubiquitous environmental carcinogen. While fatal at high doses, chronic low-dose exposure to arsenic can lead to skin lesions, gangrene, and cancers of the internal organs. Millions of people in Bangladesh and West Bengal are in danger of developing arsenic-related illnesses as a consequence of drinking contaminated groundwater. In the United States, widespread industrial activities have caused large quantities of arsenic to leach into the soil, air, and water. The mechanisms of arsenic-related disease are poorly understood. At the root of this ignorance is the fact that no adequate models have been developed to fully explore the effects of arsenic in living biological systems. When *Acetabularia acetabulum* is exposed to arsenic, migration of secondary nuclei is inhibited. Interestingly, we have found a putative mutant that phenocopies the arsenic-induced response. This suggests that it will be possible to use *Acetabularia* to dissect a genetic pathway of arsenic toxicity. The dose-response of *Acetabularia* to three key arsenicals (arsenite, MMAV, and MMAIII) indicates that the comparative lethality of these three arsenicals in *Acetabularia* mimics that in humans. 2,3-Dimercapto-1-propanesulfonic acid (DMPS) is thought to form a non-toxic complex with MMAIII, and has the potential to be an effective arsenic antidote. DMPS significantly delays the onset of MMAIII-induced death in *Acetabularia*, providing evidence for a MMAIII-DMPS complex. Based on these results, we believe that *Acetabularia* has the potential to serve as an excellent model system for arsenic toxicity and the development of arsenic antidotes. Results on arsenic-induced phenotypes, the cell biology of the arsenic response, and the actions of putative protectants will be presented.

*“Besides the numerous accolades I can say about [my mentor’s] knowledge and expertise in the realm of transportation engineering, I want to recognize him for caring and expanding the minds of his students...He goes up and beyond many professors in instilling the passion for learning.”*  
*- Patrick Vu, Civil Engineering, Senior*

# MODELING & SCIENTIFIC COMPUTING

*Session Moderator: J. Nathan Kutz, Applied Mathematics*

*Session Discussant: Kristin Spaulding, Applied Computational & Mathematical Sciences, Senior*

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## PERFORMANCE OF OPTICAL FIBER TRANSMISSION SYSTEMS WITH IN-LINE FREQUENCY FILTERING

**DEREK BENTSEN**

*Senior, Applied Computational & Mathematical Sciences, Economics, and Political Science*

**J. NATHAN KUTZ**

*Professor, Applied Mathematics*

Dispersion-managed soliton transmission control has proven to be a technological breakthrough for return-to-zero optical fiber transmission systems. To keep the bit-error rate below a given threshold, ultra-long distance communications require some form of pulse control. In-line filtering has proven to be the necessary mechanism. In particular, in-line filtering provides a restoring force to the propagating soliton pulse that keeps its central-frequency, and corresponding time shift, from growing too large, thus making ultra-long distance communications practical. Dispersion-managed propagation presents a unique and subtle problem when considering filtering. Although some efforts have been made to understand the role of filtering, previous works have not addressed the most fundamental aspects of the in-line filtering. Our research is devoted to the study of filtering in dispersion-managed soliton communications. In particular, we determined the most effective placement of the amplifier and filter within a dispersion map period. The proper placement of the amplifier and filter will allow for increased performance from communications systems by improving bandwidth and improving data integrity. We have used two approaches for characterizing performance. First we developed a reduced model that captured the salient features of the dispersion-managed pulse dynamics. Second, we have performed full numerical simulations using an exact solution of the dispersion-managed system. The reduced model is significantly faster and yields qualitatively correct pictures with weak to moderate strength dispersion maps. The reduced model predicts a reduction in the timing and amplitude jitter of 760% and 750% respectively. The full solution predicts these reductions to be 790% and 780% respectively. The reduced model also shows that the filter placement within the dispersion map can reduce the amplitude and timing jitter a further 725% and the full solution predicts a reduction of 750%. Thus our reduced model serves as a valuable guide for predicting the behavior and performance enhancement of a given optical transmission system.

## DIRECTED MOTION FROM BROWNIAN FLUCTUATIONS IN NON-EQUILIBRIUM STEADY-STATE: THE BROWNIAN RATCHET REVISITED

**GILBERT MARTINEZ**

*Senior, Physics*  
*MARY GATES SCHOLAR*

**HONG QIAN**

*Professor, Applied Mathematics*

Experiments have shown that the polymerization of actin filaments is related to important cellular phenomena including motility, mitosis, and propulsion of bacteria through a cell [1,2]. A recent model referred to as the 'Brownian ratchet' was developed by Peskin, et al that showed how Brownian fluctuations can lead to directed motion. Recent experiment has argued against the relevance of the Brownian ratchet model. However, it is believed that the disagreement of the experimental data to the theory stems from two considerations: (1) misconceptions of the model's fundamental principles, and (2) the model lacks the crucial, realistic feature of ATP hydrolysis-driven polymerization. Using principles of macromolecular mechanics, a new model of the Brownian ratchet augmented with nucleotide hydrolysis is developed. The new model includes an additional mechanism related to the hydrolysis of ATP, which can lead to dynamic instability (i.e. non-equilibrium fluctuation). An analysis of the new model will be presented and its predictions will be compared to experimental data. [1] Robbins, J.R., et al, *Listeria monocytogenes Exploits Normal Host Cell Processes to Spread from Cell to Cell*, *J. Cell Biol.* 146, 1333-1349 (1999). [2] Borisy, G.G. & Svitkina, T.M. Actin machinery: pushing the envelope. *Curr. Opin. Cell Biol.*, 12, 104-112 (2000).

### COMPUTING THE ABEL TRANSFORM

**MATTHEW PATTERSON**

*Junior, Physics*

**BERNARD DECONINCK**

*Research Associate, Applied Mathematics*

A Riemann surface is a generalization of the complex plane, which is useful for describing multi-valued functions. Topologically, a Riemann surface is a two-dimensional surface with  $g$  holes. The Abel transform is a transformation from a Riemann surface to a  $2g$ -dimensional torus. It arises in many considerations in algebraic geometry, but also has applications in such diverse areas as fluid mechanics and string theory. In this presentation, I will discuss a computational implementation using Maple of the Abel transform. The concept of a Riemann surface will also be explained. The implementation relies on such diverse areas as graph theory and complex analysis.

### MODE-LOCKING IN AN OPTICAL FIBER LASER

**KRISTIN SPAULDING**

*Senior, Applied Computational & Mathematical  
Sciences*

**J. NATHAN KUTZ**

*Professor, Applied Mathematics*

*MARY GATES SCHOLAR*

The continued demand for increased optical bandwidth for the rapid transfer of information via the internet, email, ftp, and facsimile, has created the need for high performance all-optical devices which are robust, compact, and inexpensive. We consider a passive optical fiber laser which satisfies these criteria and which is of interest as a source of pulse trains for lightwave communications systems. The basic ring laser considered here consists of a loop of birefringent optical fiber along with a passive polarizer. Because the cross-section of an optical fiber is more elliptical than circular in shape, birefringence is induced in the fiber and polarization effects become important. In addition to the effect of birefringence on pulse propagation, the intensity of the pulse produces a nonlinear rotation in the polarization state of the pulse. A passive polarizer inserted into the ring and set to a particular angle effectively attenuating 99% of pulse energy not aligned with the polarizer. The net effect of the nonlinear rotation of the polarization state, birefringence, and the presence of the polarizer can possibly produce stable and uniform pulse trains. Thus, the primary interest of this research is to determine the existence of polarization angles for which it is possible to obtain uniform pulse trains. This process is known as mode-locking. The pulse propagation in the optical fiber laser is modeled by the coupled nonlinear Schrödinger equations (CNLS). We utilize a variation method to reduce the CNLS equations to a set of four coupled nonlinear differential equations. The key parameters for understanding the pulse train uniformity include the polarization state, phase, amplitude, and phase chirp. We consider settings for the polarizer that minimize pulse amplitude fluctuations and produce a uniform mode-locked pulse train. Using perturbation techniques and nonlinear dynamics theory, we completely characterize the performance of the ring laser.

**DYNAMICS OF BOSE-EINSTEIN CONDENSATES**

**BRANDON WARNER**

*Senior, Applied Computational & Mathematical  
Sciences*

**J. NATHAN KUTZ**

*Professor, Applied Mathematics*

**BERNARD DECONINCK**

*Research Associate, Applied Mathematics*

Recent experiments on dilute-gas Bose-Einstein condensates (BECs) have generated great interest in macroscopic quantum phenomena in both the theoretical and experimental physics community. Such BECs are experimentally realized when certain gases are super-cooled below a critical temperature and trapped in electromagnetic fields. Such BECs have been used to study matter-wave diffraction and have also been predicted to apply to quantum logic and matter-wave transport. In this presentation, I consider the dynamics and stability of multi-species BECs trapped in standing light waves. The results imply that a large number of condensed atoms of every species is sufficient to form stable, periodic condensates.

*“[My mentor’s] example is something I will always remember and, when it’s my turn to be the mentor, I will be lavish with my encouragement and hearty with my praise.”*

*- Carrie Fahtke, Biology, Senior*

# PATHOGENESIS AND GLOBAL HEALTH – BIOMEDICAL & CLINICAL

*Session Moderator: Daniel Dorsa, Psychiatry & Pharmacology*

*Session Discussant: Suzanne Powell, Biology, Senior*

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## SIGNIFICANT PREVALENCE OF AUTOANTIBODIES TO GAD65 AND IA-2 IN NEW ONSET SARDINIAN TYPE 2 DIABETES PATIENTS

**EMILYN ALEJANDRO**

*Senior, Biochemistry  
MCNAIR SCHOLAR*

**AKE LERNMARK**

*R. H. Williams Professor of Medicine*

The objective of this project is to investigate the frequency of GAD65 and IA-2 autoantibodies in adult Sardinian patients newly classified with type 2 diabetes. GAD65Ab and IA-2Ab were tested in 1,942 unrelated patients enrolled from Sassari, Cagliari, Oristano, and Nuoro and divided into two groups: 476 non-diabetic (ND) patients with normal OGTT but at type 2 diabetes risk, and 1466 patients classified with type 2 diabetes. Controls were 1,184 Sardinian subjects (493 Nuoro school children, 204 subjects without diabetic family history older than 50 years of age and 487 non-diabetic subjects, 12-80 years of age) to establish the 99<sup>th</sup> percentile cut-off values. In non-diabetic patients (ND), 1.3% were positive for GAD65Ab and 1.2% for IA-2Ab. None had antibodies to both GAD65 and IA-2. In Type 2 Diabetes patients 5.6% had GAD65Ab and 2.7% IA-2Ab. GAD65Ab positive type 2 diabetes patients had lower BMI ( $p < .001$ ). A total of 1% were positive for both antibodies. Both age ( $p < .0037$ ) and BMI ( $p < .0022$ ) were lower in double positive type 2 diabetes patients. The type 1 diabetes character of autoantibody positive in type 2 patients is suggested by the significant prevalence of not only GAD65Ab but also double antibody positivity compared to the ND subjects. Newly diagnosed Sardinian patients classified with type 2 diabetes have an increased frequency of GAD65Ab which may reflect the high incidence of type 1 diabetes in this population.

## EVIDENCE FOR PHYTOESTROGEN SUPPLEMENTATION IN THE URINARY HORMONE PROFILES OF MENOPAUSAL WOMEN\*

**KASIA BENSON**

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MARY GATES SCHOLAR*

**KATHLEEN O'CONNOR**

*Professor, Anthropology*

Phytoestrogens are believed to curb discomforts associated with the transition into menopause, and to reduce the risks of reproductive cancer in menopausal women. These plant-derived diphenolic molecules, found in foods such as soy and flaxseed, closely resemble known estrogens in structure, molecular weight and stereospecificity, and have thus been shown to exhibit varying degrees of estrogen receptor affinity. Despite the lack of understanding of their role in reproductive health, the use of dietary or supplemental phytoestrogens has become widespread in the U.S. In this paper we examine the ability of an enzyme-immunoassay (EIA) for urinary estrogen metabolites to detect phytoestrogen use in menopausal women. The hormonal data are from a five-year longitudinal study examining four reproductive hormones (estrogen, progesterone, follicle stimulating hormone and leutenizing hormone) in daily urine samples from female subjects. Five menopausal participants, providing daily urine samples, recorded having implemented some type of phytoestrogenic substance in their diet for up to one year, and provided samples of a baseline, as well as before or after the baseline. Levels of estrogen were estimated using an EIA specific for the main metabolite of estradiol, estrone-3-glucuronide (E3G). Additionally, one menopausal participant provided 60 days of daily samples and alternated weekly periods of baseline and soy supplement interventions. Graphical methods are used to examine effects of soy supplementation on E3G profiles. Results are suggestive that phytoestrogen substances, such as non-prescription herbal tablets, may have subtle effects on urinary levels of E3G. In contrast, prescription estrogens have very clear effects. Although the effects appear to be subtle, and are unlikely to significantly alter general patterns of reproductive hormones within or across women, these data suggest that urinary measures of endogenous estrogen can be confounded by this widespread exogenous hormone source.

**SALIVARY CORTISOL MEASUREMENTS IN PREOPERATIVE NEONATES WITH  
CONGENITAL HEART DEFECTS\***

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**SHARON PARKMAN**

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With an interest in decreasing the stress response in neonates with congenital heart defects, further research is necessary to accurately evaluate the neonates' stress response. The magnitude and importance of the stress response and cortisol in the neonate has been described extensively in the literature. High levels of cortisol result in poor patient outcomes (1). The pathophysiologic stress response indicated by the adrenocortical status is measured through salivary cortisol levels in the neonate with congenital heart defects prior to repair (2). Implementing both the RIA and ELISA assays replicable results yield high correlations between serum cortisol levels and salivary cortisol levels (3). Methods concerning the collection of saliva in infants have been described. To control for standard error and confounding variables, the protocol for salivary collection must be explicit. Researchers should refrain from utilizing any chemical or food product to stimulate salivary production, and infants' mouths must be cleaned prior to collecting the sample as breast milk, formula, and chemicals generate inflated results (4). By developing a baseline level of salivary cortisol in neonates with congenital heart defects a normal curve may be established. Implementing these normal values to evaluate nursing interventions will provide indications for research-based protocols that decrease the neonatal stress response in the presence of only congenital heart defects.

References: 1. Economou, G., et al. (1993). Cortisol Secretion in Stressed Babies during the Neonatal Period. *Hormone Research*, 40, 217-221. Hughes D., et al. (1987). Blood spot glucocorticoid concentrations in ill preterm infants. *Archives of Disease in Childhood*, 62, 1014-1018. Watterburg, K., et al. (2000). Links Between Early Adrenal Function and Respiratory Outcome in Preterm Infants: Airway Inflammation and Patent Ductus Arteriosus. *Pediatrics*, 105,(2), 320-324. 2. Anand, K. (1990). Hormonal-Metabolic Stress Responses in Neonates Undergoing Cardiac Surgery. *Anesthesiology*, 73, 661-670. Kindelan, A., et al. (1994). Relationship between Hemodynamic Changes and Blood Hormone Concentrations after Cardiac Surgery in Children with Congenital Heart Disease. *Critical Care Medicine*, 22, (11), 1754-1761. Peters, K., (1990). Neonatal Stress Reactivity and Cortisol. *J of Perinatal Neonatal Nursing*, 11, (4), 45-49.3. Aardal, E., et al. (1998). Salivary Cortisol an Alternative to Serum Cortisol Determinations in Dynamic Function Tests. *Clinical Chemistry and Laboratory Medicine*, 36,(4), 215-222. Lo, M., et al. (1992). Clinical Applications of Salivary Cortisol Measurement. *Singapore Medical Journal*, 33, 170-173. Shimada, et al. (1995). Determination of Salivary Cortisol by ELISA and its Application to the assessment of the Circadian Rhythm in Children. *Hormone Research*, 44, 213-217. 4. Schwartz, et al. (1998). Assessing Salivary Cortisol in Studies of Child Development. *Child Development*, 69,(6), 1503-1513.

**CHARACTERIZATION OF RAPID ESTROGEN SIGNALLING\***

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Estrogen replacement therapy has been shown to delay the onset of and decrease the severity of Alzheimer's disease. In fact, estrogen is known to be neuroprotective against a variety of neurotoxic insults in primary neuronal cultures. Estrogen mediates gene expression via its nuclear receptors, estrogen receptor  $\alpha$  (ER $\alpha$ ) and ER $\beta$ . In addition, estrogen also initiates rapid non-genomic effects that have been shown to be important for estrogen neuroprotection. The mechanisms of rapid non-genomic effects of estrogen are not well understood, and it has been hypothesized that these effects are initiated by a plasma membrane ER. Therefore, in this study we begin to characterize the mechanism of growth factor effects of estrogen involving rapid mitogen activated protein kinase (MAPK). We are working in two cell models, Rat-2 fibroblast and mouse neuron hippocampal derived HT22 cells, which stably express either ER $\alpha$  or ER $\beta$ . It has been previously shown in these cell lines that estrogen induces MAPK phosphorylation within 15 minutes. We have shown in both Rat-2 and HT22 ER $\alpha$  and ER $\beta$  expressing cells that MAPK activation is blocked by PPI, an inhibitor of the Src family of non-receptor tyrosine kinases, demonstrating that MAPK activation by estrogen may involve a member of this family of non-receptor tyrosine kinases. Src family non-receptor tyrosine kinases are normally involved in signaling pathways initiated by growth factors at their respective plasma membrane receptors and have been shown to be found in specialized plasma membrane domains called caveolae. We, therefore, isolated caveolae fractions from rat-2 ER $\alpha$  cells, and found they contained ER $\beta$ . This suggests that ER $\alpha$  and ER $\beta$  may initiate rapid non-genomic effects from the plasma membrane by interacting with other plasma membrane proteins. Further studies are ongoing to identify interactions between ER and Src family non-receptor tyrosine kinases.

**ULTRASOUND CONTRAST AGENTS IN SENTINEL NODE BIOPSY**

**ERIN WATANABE**  
*Junior, Biology and English*

**KIRK BEACH**  
*Professor, Department of Surgery & Medicine*

Currently in the management of breast cancer, sentinel node biopsy procedures are conducted as an alternative to the previously standardized axillary node dissection. Axillary node dissection was the standard for care in determining whether metastases were present in the lymphatic system, which could be determined through nodal pathology. However, axillary node dissection often leads to lymphadema, which makes sentinel node biopsy a more favorable course in determining the node status. Sentinel node biopsy involves the determination of the primary node of lymphatic drainage from the tumor. Currently, two methods are being used to map out the location of the sentinel node: lymphoscintigraphy, which is using a radioactive tracer along with a gamma camera and an intraoperative gamma probe to detect levels of radioactivity in either the axillary or internal mammary nodes, and the blue dye technique, which involves injecting a blue dye (Lymphazurin) near the tumor site and making an incision to visualize the node or nodes to which the dye flows via the lymphatic channels. However, a primary shortfall is that the current techniques are unable to determine the exact amount of radioactive tracer or blue dye that is taken up by the node or nodes, and the extent to which the nodal region as a whole is interacting with the tracers. This uncertainty could lead to some nodes being missed or others being incorrectly biopsied. Thus, we propose that ultrasound contrast agents could be a viable alternative in sentinel node biopsy procedures. Ultrasound contrast agents would propagate through the lymphatic channels to nodes in the same fashion as the radioactive tracers, but would allow the surgeon to have a more complete visual of the lymphatic flow and uptake by nodes through comprehensive ultrasound images. We will experiment on a feline, with the ultrasound contrast agents paralleling the lymphoscintigraphy, as well as the blue dye technique to determine the efficacy of ultrasound contrast agents in imaging the sentinel node.

**PRENATAL ALCOHOL EXPOSURE DAMAGES WHITE MATTER IN CENTRAL VISUAL  
PATHWAYS OF FETAL SHEEP BRAIN\***

**HIROFUMI WATARI**

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**DONALD BORN**

*Professor, Neuropathology*

**CHRISTINE GLEASON**

*W. Alan Hodson Professor and Head of  
Pediatrics, Division of Neonatology*

Fetal Alcohol Syndrome (FAS) is one of the leading causes of mental retardation in the United States. Strikingly, up to 90% of children with FAS have clinical visual defects. These include small eyes, cataracts, and changes in the optic nerve and retina. The mechanism for alcohol's effects on the developing retina and optic nerve have been studied in animal models, but no studies have been done on visual pathways within the brain. We therefore investigated whether prenatal alcohol exposure causes lesions in the central visual pathway of the developing fetal sheep brain. We studied 3 groups of fetal sheep brains at 125 days gestation (term=145 days). Alcohol group mothers (n=7) received daily 2 hour IV alcohol infusions at 30-60 days gestation (average blood alcohol concentration=0.2%; DWI=0.08%); Saline group mothers (n=4) received the same-volume infusion of normal saline; Control group mothers (n=10) received no infusions. We stained brain tissue sections with an immunocytochemical marker for macrophages and analyzed the sections using computer-assisted microscopy. Our preliminary results showed a greater area of macrophage marker in the white matter of alcohol and saline group fetuses compared to controls. These lesions were localized caudolaterally, specifically in the optic radiation, occipital white matter, and temporal white matter. The anatomical location of the lesions suggests that prenatal alcohol exposure damages the white matter in the ventral stream of the visual pathway of the developing fetal brain. Such lesions in the central visual pathways may cause defects in higher order visual processing in postnatal brain and hence, may affect visual perception. Further studies are indicated to determine the relationship between these visual system lesions and the clinical visual defects seen in children with FAS. *Supported by the Arc of Washington Trust Fund.*

## DISCOVERING & UNCOVERING CULTURE

*Session Moderator: Mark Patterson, English*  
*Session Discussant: Emily Beyer, Creative Writing, Senior*

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### ARCHAEOLOGY OF THE PERSIAN EMPIRE 224-651 AD

**BRYAN AVERBUCH**

*Senior, Journalism and Near Eastern Languages &  
Civilizations*  
MARY GATES SCHOLAR

**JOEL WALKER**

*Professor, History*

Our research is focused on creating an online resource detailing the fledgling archaeological exploration of the Persian Empire of the Sasanian dynasty, which lasted for more than 400 years and stretched from Turkey to India. The history and culture of these people is very little known, for though they left cities, palaces, and temples behind as testaments to their power, most of it remains unexcavated and unexplored. Professor Joel Walker and I are creating an online archaeological map of these sites, in the hope of providing students and scholars with information about a civilization previously little known to all but a few specialists.

### BACKGROUND RESEARCH ON THE ARCHAEOLOGY OF CULTURE CONTACT AND COLONIALISM: EARLY JESUIT MISSIONS IN BAJA CALIFORNIA, MEXICO

**JOHN BLISS**

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MARY GATES SCHOLAR

**PETER LAPE**

*Professor, Anthropology*

The undergraduate role in this project was to provide library research and to ponder some fascinating research questions. We focused on the archaeology and history of culture contact; Pierre researched East Timor and Bliss researched the Baja peninsula of Mexico, both as potential locations for Professor Lape's future fieldwork. The goal of this research is to better understand the effects of early colonization attempts, such as religious and political impacts on indigenous people. The aim of our library research was to evaluate what research had been done in the given areas. We sought to understand to what degree Professor Lape's research questions had been addressed, and note those conclusions which other searchers had come to in related field work. The gathered information will be considered by Professor Lape as he develops his own field work purposes and focus.

In Baja Mexico, we found that there has been an abundance of field work, but not much that directly applies to our research questions on culture contact. Unfortunately, many existing archaeological materials were only analyzed and published after they had been removed from their archaeological context. The published archaeology done in the past few decades has taken a particular interest in the study of rock art. I'd be fascinated to find a way to tie the rock art studies in with our research. But, most directly pertinent to questions of culture contact have been the less frequent excavations and surveys of early Jesuit missions. The early missions were central to religious contact. It may be possible to compare historical descriptions of missions, written by early Jesuit missionaries, with the archaeological studies of mission locations for a deeper understanding of how people interacted.

## DISCOVERING & UNCOVERING CULTURE

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### ANNOTATIONS ON TONI MORRISON'S *SONG OF SOLOMON*\*

**KRISTIN LEWIS**

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**DAVID GOLDSTEIN-SHIRLEY**

*Professor, Interdisciplinary Arts & Sciences  
(UW- Bothell)*

Prof. Goldstein-Shirley's project, for which I have conducted original research, is a book-length set of annotations for Toni Morrison's landmark novel, *Song of Solomon*. Essentially a detailed, close reading of the novel, the project provides readers with a line-by-line explication of Morrison's allusions. We provide three kinds of annotations. First, we explicate references to things, people, events, themes, and motifs that become clearer later in the book (eg., the first black child born at Mercy Hospital is later revealed to have been the protagonist, Milkman). Second, we explicate references to things, people, events, themes and motifs that have some connection to other Morrison novels (eg., the ghost motif also figures significantly in *Beloved*). Third, we explicate references to things, people, events, themes and motifs that have some connection to the extra-textual world (e.g., a reference in chapter 1 to Charles Lindbergh). My contribution to the project is the research for, and explication of, the novel's crucial, penultimate chapter, which completes the search for identity that the protagonist undergoes. The protagonist's ancestry is explained to him in detail, tying together the book's characters. Also, the protagonist's childhood urge to fly is realized in the story of his great-grandfather's flight. Using academic databases, traditional scholarly books and articles on Morrison and on the topics about which she writes, and widely-cast Internet searches, I have uncovered rich bodies of information that illuminate the Nobel laureate's difficult novel. This work thereby contributes to our understanding of Morrison's literature and its trenchant commentary upon American culture. The project as a whole is being negotiated for publication by a major academic press.

### BACKGROUND RESEARCH ON THE ARCHAEOLOGY OF CULTURE CONTACT AND COLONIALISM: EAST TIMOR

**TRACEY PIERRE**

*Senior, Archaeology*

**PETER LAPE**

*Professor, Anthropology*

As undergraduate research assistants in archaeology, John and I are conducting preliminary library research for two archaeological studies based on culture contact and colonialism, but in different geographical zones, Baja California and East Timor. Our mentor, Dr. Peter Lape, archaeologist, professor, and curator of archaeology at the Burke Museum, is interested in re-analyzing historical documents and oral traditions against new archaeological evidence, challenging historic assumptions about settlement, religion, trade networks, and cross-cultural interaction. Before survey, excavation, and further interpretations can occur, preliminary research is the first step in any archaeological study. Like the research questions, our methodologies have developed along the same lines. To put things into perspective, we began by mapping out our respective regions, both historically and contemporarily. Thereafter, we focused on developing a bibliography with Dr. Lape, initiating with sources pertaining to previous archaeological studies and excavations to gain insight on sites formerly examined. At present, we are concentrating on historical documentation and cultural aspects, including religious change and political dynamics. East Timor, formerly a Portuguese colony from the sixteenth century until 1974, had for centuries before European contact engaged in long-distance trade and cross-cultural interaction with Southeast Asia and the Far East. The pre-colonial record is fragmentary, though, and archaeological analyses thus far have been based primarily on paleolithic sites, making this region an ideal location for the study of culture contact and colonialism. Previous archaeological research conducted by Dr. Lape in the nearby Banda Islands presents data that supports this theory, such as the presence of pottery assemblages associated with Chinese cultures, and the absence of pig bones suggesting Islamic occupation before and throughout the colonization process. In conjunction with re-analyzed historical documentation and oral histories, new evidence about Southeast Asian cultures, such as East Timor, can be re-evaluated.

**NATIVE AMERICAN CULTURAL IDENTITY & FEMININITY: AN EXPLORATION OF  
CONTEMPORARY NATIVE AMERICAN WOMEN'S LITERATURE**

**CHRISTINA ROBERTS**

*Senior, English and Comparative History of Ideas*

*MCNAIR SCHOLAR*

**ALICIA WASSINK**

*Professor, Linguistics*

**CONSEULA FRANCIS**

*English*

Contemporary Native American women's literature is wrought with issues facing the Native American community today. One of the most fascinating and problematic aspects of this literature is the way in which Native American female identity is expressed. This research project addresses the complexities of Native American female identity as it is presented through the texts written by Native American women. The primary question that this project addresses is: What does Native American female identity consist of today? More specifically: Is there one essential identity expressed through this literature or are there a multitude of identities? The results of this project proved to be as complicated as the questions. Native American women today have a unique identity, but this identity is in the middle of a transformation. The Native American women who are writing these texts are in the midst of redefining themselves and their communities. These women are combining the past with the present in order to produce a truly unique, future identity.

*“There are certain people in everyone’s live that help you understand new ideas, motivate you to work harder, give you hope, and help you start your future. [My mentor] had gone above and beyond to help me progress.”*  
*- Jamie Grocock, Oceanography, Senior*

# MIND & BODY INTERACTION

*Session Moderator: Paul LePore, College of Arts & Sciences*  
*Session Discussant: Aaron Clefton, Political Science, Women Studies,*  
*and Comparative History of Ideas, Senior*

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## HOMOSEXUAL MATE SELECTION: A TEST OF THE SOCIOBIO ARGUMENT

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*Senior, Anthropology*

**LAURA NEWELL**  
*Professor, Anthropology*

**JAMES HA**  
*Research Scientist, Psychology*

It has been well documented that humans seek certain biobehavioral characteristics when choosing a mate. The characteristics are gender-specific, and studies have suggested that they are linked to differing reproductive strategies and future reproductive success. In view of this hypothetical framework, an interesting question arises about male and female homosexuals for whom reproduction is not the primary basis for the selection of partners. Here we test the null hypothesis that there are no differences in characteristics sought by male and female homosexuals. The data were drawn from personal ads placed in a Seattle newspaper (200 lesbian, 200 homosexual men). Desirable attributes (n=35) sought and offered were collapsed into categories (e.g. physical attractiveness, age, resource acquisition, etc.). Intergroup differences were tested using chi square analysis (p level less than .05). Homosexual men sought physical attractiveness (facial characteristics and body shape) more so than did lesbians, while lesbians sought sincerity of relationships and resources more than homosexual men. Our results are generally consistent with those reported by studies using heterosexual personal ads. Our results raise issues about the interaction of biology and culture.

## THE DIVISION OF HOUSEHOLD LABOR IN FOUR TYPES OF COHABITING COUPLES : LESBIAN, GAY MALE, NON-MARRIED COHABITING HETEROSEXUAL, AND MARRIED\*

**LISA J. HAGEN**  
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MARY GATES SCHOLAR

**SYBIL CARRÈRE**  
*Research Scientist, Psychology*

**LAURA LITTLE**  
*Professor, Psychology*

This study examines the division of household labor in four types of cohabiting couples: lesbian, gay male, non-married heterosexual, and married. I hope to learn how the four couple types perceive themselves as dividing household labor, and I am particularly interested in whether these perceptions differ between couple types. Also, I would like to determine whether different labor divisions lead to different perceptions of satisfaction for members of each couple type. I plan to recruit 50 couples of each type to take an online questionnaire about how they divide household labor and whether they are satisfied with the division. Members of each couple will complete the questionnaire separately to ensure the confidentiality of each person's responses. Dividing household labor is a source of conflict for many married couples, and probably is for other types of cohabiting couples as well. The findings from the present study could be utilized to develop couple-type-specific methods of reducing conflict. These strategies could be useful in couples-therapy, particularly for lesbian, gay male, and non-married heterosexual couples, who traditionally have been underrepresented in psychological research.

**EARLY EXPERIENCE WITH ATYPICAL PEERS: A MACAQUE (MACACA NEMESTRINA)  
MODEL OF MAINSTREAMING\***

**TRISTAN NICHOLSON**

*Senior, Anthropology*  
*MARY GATES SCHOLAR*

**JOAN LOCKARD**

*Professor, Psychology*

**JAMES HA**

*Research Scientist, Psychology*

Studies of normal and special needs human children have consistently reported modest increases in peer interaction when children with special needs are mainstreamed with typically developing peers. The present study addressed the impact of early experience with atypical peers on the social development of infant pigtailed macaques (*Macaca nemestrina*) from 1 to 10 months of age. The subjects were 217 normal, healthy infant pigtailed macaques, reared singly and socialized for 30 minutes per weekday according to nursery protocol at the Infant Primate Research Laboratory (Seattle, WA) between 1975-1998. Normal infants in four member social groups containing all normal peers were compared to infants mainstreamed in social groups with one or two atypical peers, who had naturally occurring congenital or genetic defects, or experimentally induced developmental problems. Social interactions were assessed with focal-animal, 4-digit mutually exclusive and exhaustive real-time behavioral codes. Analyses consisted of cluster regression with robust standard error estimates. Infants mainstreamed in social groups exhibited more behavior changes and increased behavioral diversity. These mainstreamed infants also initiated and reciprocated affiliative social interactions, particularly social exploration and socially passive contact, more frequently at all ages compared to infants with only typical peers. The finding that social experience within a diverse peer group results in increased affiliative interaction and behavioral complexity, support the use of this macaque model for children with whom developmentally disabled peers have been mainstreamed.

**FASCINATION WITH THE FACE: fMRI AND THE FACILITY WITH WHICH THE HUMAN  
MIND FATHOMS FACES \***

**JENNIE PARK**

*Senior, Psychology*  
*MARY GATES SCHOLAR*

**ELIZABETH AYLWARD**

*Professor, Radiology*

Our ability to recognize each other's faces is a talent at once experientially effortless and scientifically perplexing. A cognitive psychological explanation of the human mind's ability to recognize human faces is inspired and orchestrated by the question of the relative uniqueness of the human face among other visible entities. Does the human mind consider human faces distinct and qualitatively different from objects and words, as a modular or faculty model of cognition would purport (Fodor, 1983), or does the mind use similar strategies in recognizing all visual entities, as a more parsimonious, shared-systems view of visual recognition would purport (Farah, Wilson, and Tanaka, 1998)? Empirically, we have addressed this question by comparing functional magnetic resonance imaging (fMRI) scans of study participants' brains taken during tests of memory for objects and for faces. Blood flow to the fusiform gyrus at the juncture of the occipital and temporal lobe in the brain increases significantly during tasks of face recognition relative to tasks of object recognition. Related literature, however, qualifies this result in employing face-like stimuli (e.g., Gauthier, Behrmann, and Tarr, 1999, employ densely contoured clay figurines) to the effect of similar fusiform gyrus activation; such studies suggest that one's fusiform gyrus will respond comparably to all sufficiently complex stimuli with which one is sufficiently familiar. Hence, the question of the uniqueness of human face perception and recognition in the mind remains unresolved. Promising are studies being done toward uncovering correlations among brain areas involved in the imagining and viewing of faces (O'Craven and Kanwisher, 2000). Particularly interesting is the question of the developmental course of face perception and imagination in the human mind; our present study seeks to address this question by comparing the perception and imagination of faces and houses in children to results existing for adults in the literature.

**THE MEANS OF IMPROVEMENT: CLIENT EXPECTATIONS FOR SUCCESSFUL  
PSYCHOTHERAPY TREATMENT\***

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**HSIANG-HWA CHEN**  
*Senior, Psychology and  
Biology*

**LAURA LITTLE**  
*Professor, Psychology*

**KATHERINE M. GECHTER**  
*Senior, Psychology*

**SARAH REYNOLDS**  
*Psychology*

**MARSHA LINEHAN**  
*Professor, Psychology*

Given a population of women diagnosed with Borderline Personality Disorder (BPD), and the various options for treating that disorder, we addressed which treatment options the population expected to be most effective prior to treatment. The question is relevant because client expectancies have long been a predictor of treatment outcome. Among clients who expected treatment, we are interested in whether there was a tendency to expect greater improvement by means of one strategy or focus over others. This question was addressed in a population of 123 women diagnosed with BPD who were entering individual psychotherapy. For treatment, participants were randomly assigned to a therapist who provided anything from medication and psychoanalysis or cognitive-behavioral therapy - or even a combination of all three. Participants were aware they would receive any of a number of treatments. The self-report instrument, "Client Expectancies," was tailored to the clients of our clinic. This measure asks what treatment types participants think will be most effective for their improvement, and the degree to which they think treatment will affect their condition (better, same, worse). At this assessment, clients had no information about the orientation and experience of their assigned therapist. It was hypothesized that participants would expect to improve significantly more in a therapy that focused on working through childhood traumas or improving interpersonal relationships, than by any of the other listed treatment foci: changing biochemistry through medications, providing insight into the way the client thinks, or changing the client's way of coping and problem solving. These results will have important implications both for clinicians and researchers working with individuals diagnosed with BPD.

*“You’ve changed my life at the University of Washington and showed me a path with endless possibilities.”*  
*- Daniel Brown, Aeronautics & Astronautics, Sophomore*

# BIOLOGICAL CHEMISTRY

*Session Moderator: Paul Hopkins, Chemistry*  
*Session Discussant: James Ham, Economics and Biochemistry, Senior*

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## NMR STRUCTURAL STUDIES OF $Mg^{2+}$ BOUND CALMODULIN\*

**DANIEL JAROSZ**

*Senior, Chemistry and Biochemistry*  
MARY GATES SCHOLAR

**RACHEL KLEVIT**

*Professor, Biochemistry and Biomolecular*  
*Structure Center*

Calmodulin is a multipotent signal transduction protein involved in numerous biological processes. Upon binding of calcium, the protein undergoes a change in conformation to reveal hydrophobic surfaces that interact with other proteins. At resting physiological conditions, however, the intracellular concentration of calcium is low, while the concentration of magnesium is relatively high. Calmodulin from *S. cerevisiae* (yCaM) has been shown to bind three  $Mg^{2+}$  ions at resting intracellular conditions. The structure of  $Mg^{2+}$  bound yCaM is unknown, yet important as it represents the resting physiological state of the protein. The  $Mg^{2+}$  bound form of yCaM has been purified and characterized. Multidimensional heteronuclear nuclear magnetic resonance spectroscopy (NMR) is employed to study structural differences between the apo (lacking  $Mg^{2+}$ ),  $Ca^{2+}$  bound, and the  $Mg^{2+}$  bound forms of yCaM.

## THE FORMATION OF THE (6-4) PHOTOPRODUCT\*

**LISA JONES**

*Senior, Chemistry and Biochemistry*

**NATIA FRANK**

*Professor, Chemistry*

The depletion of stratospheric ozone is expected to lead to increased exposure to UV light. This is of great importance because UV light is the portion of sunlight that causes a considerable increase in the formation of mutagenic and carcinogenic photoproducts in DNA. Though a number of these photoproducts have been identified and studied one photoproduct in particular has been receiving recent attention, the pyrimidine dimer, (6-4) photoproduct. This recent interest stems from the fact that even though this lesion is believed to be formed less frequently than other lesions it has been theorized that it is more likely to lead to harmful mutations. Unfortunately, at this time very little is known about the formation of this lesion. It has been shown that it progresses through an intermediate compound that decomposes at -80C. We are using organic synthesis and spectroscopy to determine the mechanism of the (6-4) photoproduct formation. The information gained could then be applied to the (6-4) photolyase an enzyme not present in humans that repairs this lesion. Understanding both the photoproduct and its repair mechanism are crucial steps in the fight against skin cancer.

### FACILITATING CELL AND MOLECULAR MODELING WITH BIOINFORMATICS\*

**PAUL LORIAUX**

*Senior, Bioengineering*

**BOB FRANZA**

*Professor and Director of Cell Systems Initiative,  
Bioengineering*

The immune system is an integrated cellular network whose function is to delineate "self" from "non-self" and to expunge the latter, typically an invading organism, whenever present. The ability of the immune system to perform this function is contingent upon a transient yet critical interaction between two cells, the antigen presenting cell (APC) and the T cell. Specifically, it is the role of the APC to present foreign peptides (antigens) on its surface where they may be recognized by T cells. Obliging T cells become activated, differentiates and proliferate such that they acquire the capability to direct an immune response specifically against the source of the antigen. The mechanism of this recognition must be exquisitely sensitive if the T cell is to detect the small amounts of antigen present on the APC, yet it must also be sufficiently robust to avoid "false positives" that would result in destructive autoimmune responses. Thus, understanding this mechanism at a molecular level will be instrumental in developing our understanding of autoimmunity, as well as HIV and other disorders of the immune system. In order to obtain interpretable data on many of these issues, new experimental techniques have been developed, but they isolate the questions of interest. Now it is necessary to integrate these data and the theories that explain them and to assess their validity using a rigorous mathematical model. It is the focus of this research effort to facilitate the construction of just such a model. Specifically, a computational tool will be developed that will illustrate a preassembled database of existing knowledge on the molecules that govern the T cell/APC interaction. The functional connectivity between molecules will be captured as a directed graph, which will then be embedded in a visual, navigable environment. Additional structure will be imposed on the graph by subjecting it to currently available graph decomposition algorithms that group together molecules that are functionally "similar". These groups of molecules may then be modeled independently, which is a much more attractive alternative to modeling the entire system all at once. As time permits, the tool may be augmented with additional features. Feedback control loops can be elucidated using a simple graph-traversal algorithm, and missing functional connectivity can be inferred from empirical data by making the tool compatible with pre-existing simulation software.

### ADSORPTION OF POLAR MOLECULES ONTO PAMAM DENDRIMER

**MANAT MACLEOD**

*Senior, Chemical Engineering*

**SHAOYI JIANG**

*Professor, Chemical Engineering*

Dendrimers are three-dimensional, highly branched polymeric compounds formed through reiterative additions to an initiator core. The use of the Third Generation Polyamidoamide (PAMAM) dendrimer placed onto a (111) Au surface may prove valuable as a highly sensitive, highly selective chemical/biochemical sensing device. Using molecular modeling software (POLYGRAF and CERIOUS 2), GCMC (Monte Carlo) simulations were used to obtain the adsorption isotherms for two polar molecules, water and methanol, onto PAMAM at 300K. In an isolated system, water displays higher adsorption onto the dendrimer whereas in a water-methanol mixture, methanol exhibits higher adsorption. The primary mechanism for adsorption onto the PAMAM dendrimer appears to be through hydrogen bonding.



*“You started me on the path I walk today. You opened up wide, new frontiers for me to explore. I can never repay you for the knowledge and confidence you have given me.”*

*- Tanya Tavenner, Physics, Senior*

# UNDERSTANDING THE PHYSICAL WORLD

*Session Moderator: John Wilkerson, Physics*  
*Session Discussant: Paul Blainey, Physics, Senior*

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## BETA-DECAY IN THE A=132 NEUTRON RICH MASS REGION

**JEFFREY GIANSIRACUSA**

*Sophomore, Physics and Mathematics*  
MARY GATES SCHOLAR

**B. ALEX BROWN**

*National Superconducting Cyclotron Lab, Michigan*  
State University

We present a systematic nuclear shell model study of the properties of the neutron-rich nuclei near the doubly-closed shell nucleus Sn132. A precise determination of the half-lives of these nuclei is crucial in understanding the r-process, which is responsible for the synthesis of 50% of all elements heavier than iron. Much of this region is beyond the reach of current experiment so theoretical methods must be employed. Our calculations represent the first self-consistent study of these nuclei.

## DENSITY OF SULFIDE LIQUIDS; THE THERMODYNAMICS OF SULFUR IN MAGMATIC SYSTEMS\*

**LORI GREENE**

*Senior, Chemistry and Geology*  
MARY GATES SCHOLAR

**VICTOR KRESS**

*Professor, Earth & Space Sciences*

Sulfide liquids are important players in determining the processes of earth formation and differentiation of planetary bodies. Using thermodynamic properties one can express the chemistry of sulfur in magmatic systems. Some volcanoes are major contributors to aerosol emissions of sulfur dioxide (SO<sub>2</sub>), therefore understanding the sulfur in magmatic systems is vital for the study of adverse effects of a volcanic eruption on the global environment. Detailed thermodynamic models exist for sulfide liquids at one atmosphere. These models can be extrapolated to high pressures by knowing the partial molar volumes of the components. Our research deals with determining the density of sulfide liquids at temperatures to 1450°C in a controlled atmosphere. To do this we use the double bob Archimedean method for measuring the buoyancy of the object of known density and volume. This allows us to measure the density of the displaced liquid. Sulfide liquids at the experimental conditions are very corrosive, making these experiments difficult to perform.

In August 2000, University of Washington graduate students made preliminary temperature and pH measurements of the crater lake of Mt. Pinatubo, Philippines. The lake had a temperature and pH profile which suggested the possibility of an unstable density profile in the water column. This could potentially lead to a catastrophic overturn liberating dangerous quantities of carbon dioxide (CO<sub>2</sub>) gas. In addition to the density of sulfide liquid research, we researched the geochemistry of the crater lake in January 2001. Our research consisted of taking CO<sub>2</sub> profiles at different localities on the lake. The data showed CO<sub>2</sub> to be well under-saturated. This data, in conjunction with temperature and pH data taken by others in the group, suggested an overturning event some time between the two sets of measurements.

### **PERTURBATION DYNAMICS IN SEPARATED BOUNDARY LAYERS\***

**JESSICA SMITH**

*Senior, Applied Computational & Mathematical  
Sciences*

**WILLIAM CRIMINALE**

*Professor, Applied Mathematics*

Separated boundary layers is a problem that arises in many fluid flow systems in the physical world, for example, airflow over the wing of an airplane in an adverse pressure gradient. When the airflow over the wing separates, wing lift characteristics are negatively affected. This phenomenon has been demonstrated many times experimentally but an understanding theoretically remains to be done. Understanding the dynamics allows for possible control of the boundary layer and prevention of separation. For this project we are taking the continuous model mean flow for distinct stages of the boundary layer and modeling them piecewise linearly in the appropriate variable. Initial value problems for each situation are specified by initial vorticity. The full dynamics of these systems is possible by using an inviscid model and linear perturbation equations. The results are in terms of both transient and asymptotic temporal behavior of each solution.

### **THE emiT EXPERIMENT**

**KYLE SUNDQVIST**

*Senior, Physics and Astronomy  
MARY GATES SCHOLAR*

**JOHN WILKERSON**

*Professor, Physics*

The emiT experiment is a search for a violation of time-reversal (T) invariance in the beta decay of free neutrons. The experiment utilizes a beam of cold (2.7 meV), polarized neutrons from the Cold Neutron Research Facility at NIST. emiT probes the T-odd triple correlation (between the neutron spin and the momenta of the neutrino and electron decay products) in the neutron beta-decay distribution. The coefficient of this correlation,  $D$ , is measured by detecting decay electrons in coincidence with recoil protons while controlling the neutron polarization. The emiT apparatus was shipped to the University of Washington after a successful run at NIST in 1997. Significant upgrades to the detector hardware, electronics, and data acquisition software are underway in anticipation of another run in late 2001. Since Spring 1998, my research work at the UW Nuclear Physics Lab has consisted of a variety of activities pertaining to emiT's preparation. In emiT's first run, a problem faced was the energy loss of protons experienced in the experiment's particle detectors. A project I have embarked upon is to measure the detector "dead layers" responsible for this energy loss. Using a vacuum setup and alpha source, I have been measuring dead layers on a number of detectors. The purpose has been to characterize how and why dead layers form along the detector surface. To observe protons resultant from beta decay, portions of emiT must be held at a high negative voltage in order to accelerate the protons to detection level energies. Many of my tasks involve the construction and testing of hardware and electronics upgrades to emiT that are intended to help remedy the many problems associated with running at high voltage. Such upgrades include new focusing tubes and detector hardware, and the installation of fiber-optic links to isolate sensitive electronics.

# GOVERNMENT, PUBLIC POLICY, & SOCIAL CHANGE

*Session Moderator: Bryan Jones, Political Science*  
*Session Discussant: Maret Kane, Geography and Latin American Studies, Senior*

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## THE RISE OF MODERN PSYCHOLOGY AND THE DECLINE OF SOCIAL CAPITAL\*

**MERRIT DUKEHART**

*Senior, Speech Communication*

**JOHN GASTIL**

*Professor, Speech Communication*

In *Bowling Alone* (1998), Robert Putnam argues that social capital is in decline in the United States. The strength of our social networks and our levels of social trust have dropped significantly since the early 1960's. There is no adequate explanation for this decline, however, and this project explores one possible contributor. This study posits that Americans' interest in turning inward (e.g., finding happiness through individual self-improvement), coincides with the decline in social capital. This movement was fueled by the emergence of modern psychology, which recommends psychiatric or self-analytic solutions to problems that were traditionally addressed through social involvement. To support this claim, this project has compiled evidence on the precise timing of the psychological turn in American culture. Examination of historical trends in bestseller lists, total book sales, and new titles in self-help/psychology will reveal whether the consumption of psychological publications coincides with the decline in social capital. For the same purpose, this project reviews other historical data: survey results on how people feel and think about mental health, total admissions to mental hospitals, and professional statistics on psychology Ph.D.s and American Psychological Association membership. If successful, this project will not be able to prove definitively that modern psychology has undermined social capital, but it will clarify the strength of the psychological turn. The study will also be able to demonstrate whether this explanation fits the historical trend in social capital, making it another possible cause of this important shift in social networks and trust.

## THE IMPACT OF HIGH STAKES GRADUATION TESTS ON HIGH SCHOOL DROPOUT RATES

**MELANIE R. EDWARDS**

*Senior, Sociology and Spanish*

*MARY GATES SCHOLAR*

**JOHN ROBERT WARREN**

*Professor, Sociology*

Despite the existence of high stakes graduation testing programs for nearly three decades, the relationship between high stakes graduation testing programs (often called minimum competency tests) and high school dropout is still unknown. The purpose of this paper is to identify whether or not there is a link between minimum competency testing programs and dropout rates and to investigate for whom the consequences are most severe if indeed a relationship does exist. We will analyze data from the National Educational Longitudinal Study of 1988 (NELS:88) using SPSS computer software in an effort to assess the independent impact of high stakes graduation tests on high school dropout. Our review of the limited literature that exists on minimum competency programs has given us motivation to explore the productivity and fairness of minimum competency testing programs. Specifically, there is evidence that high stakes graduation testing requirements are more common in schools located in the southern and western parts of the United States, urban schools, schools located in low socio-economic areas, and schools with a high percentage of minority students. It is important to note these trends because if we find that dropout rates are affected by minimum competency testing programs, we will be able to suggest that this accountability mechanism at least perpetuates (and most severely cultivates) inequality. Thus, our research has important implications for policy makers as it questions the productivity and fairness of minimum competency testing programs.

## GOVERNMENT, PUBLIC POLICY, & SOCIAL CHANGE

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### EDUCATING CHILD WORKERS IN THE URBAN INFORMAL SECTOR, CENIT - QUITO, ECUADOR\*

**MARET KANE**

*Senior, Geography and Latin American Studies*  
*GEOGRAPHY UNDERGRADUATE RESEARCH GRANT*

**MICHAEL BROWN**

*Professor, Geography*

Adverse poverty, lack of employment opportunities for adult workers, and low accessibility to education ultimately cause the abandonment of school to work longer hours for more than 250 million children in developing nations, according to the International Labor Organization. Educational programs for working children, like the non-governmental organization, CENIT (Center for the Working Girl) in Quito, Ecuador, have not yet been evaluated intellectually and need to be studied further for a better understanding of the current situation many child workers in the urban informal sector face and the need for educational programs that accommodate to special work schedules and consider current and past child labor experiences. The purpose of this research is to discover the effects the CENIT organization has on working children's education. The research design includes evaluation research through content analysis. I have done a participant observation at CENIT in which I kept diaries and I am using those diaries in a content analysis to evaluate three of CENIT's programs and their effects on working children's education. The operationalized independent variables or programs I am evaluating, which are housed within the CENIT organization, include the street outreach education program, the alternative elementary school, and the vocational training program for adolescents and parents of child workers. I will also do a content analysis of published literature about CENIT to reflect on its teaching methodology and specific goals for each program. Considering these goals and using the content analysis from my diaries, I will determine specific ways the children's education has been impacted through CENIT's presence and whether goals have been met in each program.

### THE EFFECTS OF WELFARE ON ETHIOPIAN IMMIGRANT FAMILY RELATIONS\*

**CHRISTINE LAMBINO**

*Junior, Political Science*

**JOSEPH SCOTT**

*Professor, Sociology*

Within the Puget Sound area, Ethiopians make up a large percentage of the immigrant population. As of this date however, there have not been any studies done on this group's assimilation into American society. My study examines the assimilation of Ethiopian immigrants into American society. More specifically, I focus on whether or not welfare affects the likeliness of marriage and family tension or conflict. This research will attempt to identify how welfare affects husband-wife relations, parent-child relations, and intra-personal feelings, beliefs and values. Approximately fifty interviews were completed with Ethiopian immigrants from the Puget Sound area. Respondents consisted of 64 % male, 36 % female; 46.5 % were married, 37.2 % were single, 14 % were divorced and 2.3 % were widowed. Then, using the computer program Folio views, a program for qualitative analysis, all references made to family relations as well as welfare relations were printed out. Within these computer generated selections, references made only to welfare were further selected and categorized into specific subjects such as: the corruption of welfare, welfare being a cause of divorce, and welfare in parent-child relations. Finally, findings for all of these subjects were analyzed and conclusions were drawn.

**THE DISCRETIONARY POWER OF THE PRESIDENCY: EXECUTIVE ORDERS, PUBLIC POLICY, AND GOVERNING, 1945 - 2001\***

**STEPHANIE MCNEES**

*Senior, Political Science and History*

*MARY GATES SCHOLAR*

**BRYAN JONES**

*Professor, Political Science*

Through executive orders the President of the United States establishes commissions, committees, programs, and agencies within the executive branch, writes and modifies bureaucratic rules and procedures, carries out legislative intent and other executive powers, both enumerated and implied. Although executive orders are not laws in themselves they have the force of law and are critical to the legislative role of the presidency. Executive orders in themselves are not controversial but become controversial when they are perceived as making rather than administering laws. Yet, little attention has been paid to executive orders in a systematic way. In this study I examine what characteristics of government influence the frequency of executive orders. For example does the occurrence of executive orders increase or decrease when government is divided? This study also analyzes the substance of executive orders, for instance, are executive orders primarily policy or administrative specific? Do they deal more with domestic or foreign policy? In addition, this study explores the salience of issues in executive orders by asking whether or not the issues dealt with in executive orders correspond with the salience of the issues in congress, public opinion, and the media. Overall, this study seeks to understand the implications shaping and making public policy through executive orders has for policymaking in a democratic society.

This study is part of larger research enterprise being conducted by the Center for American Politics and Public Policy (CAPP) here at the University of Washington. Together, the five data sets constituting CAPP's Policy Agendas Project and this data set will help scholars study agenda setting processes, policymaking procedures and outputs in a more comprehensive way. In addition, this study will contribute to the literature on the American Presidency, especially, the literature that seeks to understand the importance of individuality in the presidency, presidential policy making, and administrative aspects of the executive branch.

**RACE, POLITICS, AND STRATEGY: A COGNITIVE ROADMAP OF MEDIA EFFECTS**

**ERIN SHEA**

*Senior, Communications*

**BENJAMIN AMSTER**

*Junior, Communications*

**DAVID DOMKE**

*Professor, Communications*

**PHILIP GARLAND**

*Senior, Communications and Political Science*

Strategy, maneuvering, and behind-the-scenes deals have been found to be a central aspect of news media coverage about politics. "The strategy frame [in news coverage] emphasizes who is ahead and behind, and the strategies and tactics of campaigning necessary to position a candidate to get ahead or stay ahead," write Joseph Cappella and Kathleen Hall Jamieson in *Spiral of Cynicism* (1997). Regina G. Lawrence in a 2000 issue of *Political Communication* found that as Election Day approaches, both total coverage and strategy framed coverage increase. The implications of this coverage are substantial. Cappella and Jamieson have found "strategic frames describe the behavior of politicians, make salient the self-interests of those actions, invite negative character attributions, cue stock stories about 'politics as usual,' and reinforce cynicism (as mistrust)" (pg. 60). We are interested in expanding this argument to encompass a specific issue domain - race relations. We hypothesized that subjects would exhibit increased cynicism about politics and race/ethnic relations when presented with a strategy framed news article about immigration. During fall quarter 2000, we, along with Professor David Domke in the School of Communications, conducted an experiment and survey hybrid on the Washington State ferry system. We collected data from 369 individuals who were randomly assigned one of three media packets and a questionnaire: one condition was a control group with no stimulus and the remaining two conditions contained either a strategy or policy framed news article. The articles focused on immigration, more specifically, the then-recent rise in the number of high tech H-1B visas issued. Our data suggest that the strategy frame did in fact trigger political cynicism and subsequently affected people's evaluations of (a) race relations in general and (b) political leaders' ability to positively influence race relations.

*“Her door is always open, like has nothing better to do than help me...She is not only generous with her time but also her resources. She is positive, upbeat, and encourages me to stretch in areas where I might be timid...She is a guide and an inspiration.”*  
*- Melody James, Nursing, Senior*

# DESIGNING FOR THE 21<sup>ST</sup> CENTURY

*Session Moderator: Roxanne Hamilton, Landscape Architecture*  
*Session Discussant: Julie Johnson, Art and Comparative History of Ideas, Senior*

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## WHO WILL BENEFIT FROM THE REDEVELOPMENT OF BREMERTON?\*

**MARIT BOCKELIE**

*Sophomore, Communications and Community & Environmental Planning*

**JOHN CARUTHERS**

*Professor, Community & Environmental Planning*

This project examines the purpose, direction, benefits, and conflicts of the ongoing economic development program in the town of Bremerton, Washington. The work pieces together a clear and comprehensive picture of the motives behind the project as well and the implications that it holds for the future of the area in local and regional terms. Through discussions with developers, planners, government, and residents there has emerged an image of sustainable development, leading me to also look at Bremerton as a model. What emerge are several lessons that may be used to inform urban planners and local governments in other areas. Nationally acclaimed planner Peter Calthorpe has been a major influence on redevelopment plans for the area. Plans have recognized Bremerton as a low-income area. Planners are in the process of rezoning in an effort to diversify the downtown area; Bremerton has been trying to attract artists and families. In order to increase the vitality of Bremerton a goal of the project also has been to increase jobs in the downtown area, giving new life to hopes of increasing investment, visits, and residents from across the water, via the Washington State Ferry System. A step in this direction has been a controversial proposal to move the county seat to Bremerton, from its current position in Port Orchard. Calthorpe's vision of local planning is focused on pedestrian use of public space and public transit, something that Bremerton is trying to incorporate into its master plan. The view has been: If Bremerton is to succeed then so too will go the whole of Kitsap County. This project has taken on the task of defining, analyzing, and critiquing that success and the progression towards it.

## ROBOTIC VISION IN A SOCCER ENVIRONMENT

**JONATHAN BURNS**

*Senior, Computer Science & Engineering*

**DIETER FOX**

*Professor, Computer Science & Engineering*

Playing soccer involves a variety of skills including agility, ball handling, and strategy, making it one of the most challenging sports for humans to play. To teach robots how to play soccer is even more of a challenge and introduces significant research opportunities in artificial intelligence. The fifth annual Robo-Cup soccer tournament provides a dynamic, real-time forum to test our research, which focuses on programming a team of legged robots the size and shape of small dogs to play soccer using only on-board computational power and dynamic programmed strategies. One of the most significant research problems our team faces involves teaching a robotic system how to see and understand its environment. In this soccer domain a robot's vision system is vital to its performance. If our robots cannot locate and follow the soccer ball, if they cannot see and understand where they are on the playing field, and if they cannot see and understand where the opponent dogs are on the field, then success will be next to impossible. Our research involves the development of low computational algorithms to be used in this dynamic environment in which speed is of essence. We will be conducting research on selective color detection schemes to locate objects and landmarks on the soccer field. A selective color detection scheme assigns priorities to the different objects and landmarks our robots will see during a soccer match. For example, the soccer ball is designated as a high priority color, whereas the field lines are given a low priority. We hope that this ranking of importance will help our robots' performance during match play. The vision applications developed from our research will be aggregated into our team of three soccer playing Sony Aibo dogs that will compete this August in the Robo-Cup 2001 tournament.

**HIGHLINE BOTANICAL GARDEN, PHASE TWO\***

**GREG BUTLER**

*Senior, Landscape Architecture*

**IAIN ROBERTSON**

*Professor, Landscape Architecture*

87 year old Elda Behm's 35 year old "Paradise garden" lies in the path of SeaTac's proposed third runway. Working with Landscape Architecture Dept. Chair Iain Robertson, my project has been to assist the Highline Botanical Garden Foundation (HBGF) in building a new garden at North SeaTac Park. The new Highline Botanical Garden will be centered on a space that recaptures the spirit of Elda's "Paradise Garden," using hundreds of plants moved from the path of the Port's bulldozers.

**CIVIC ARCHITECTURE\***

**JUSTIN COOK**

*Senior, Architecture and English*

**JENNIFER DEE**

*Professor, Architecture*

**ISAAC SPINELL**

*Senior, Architecture*

We propose an architectural investigation of the Seattle School District's new paradigm for high school education. Superintendent Joseph Olchefske announced this project in December and since then, the idea has been partly funded by the Bill and Melinda Gates Foundation. The Seattle School District intends to create small high schools throughout the city that provide a focused learning environment for 150 - 300 students. These schools will meet all of the general education requirements for a Washington State High School, however the focus will vary from school to school and each will work to promote the specific skills and talents of its students. As students of Architecture, we will research this problem through design, rather than education or curriculum theory. Different school and classroom typologies create distinct learning environments and affect the way students learn. We believe that responsible architecture is an essential component of the educational environment. The space must engage its occupants on physical and intellectual levels, creating a place better suited to developing a student's talent, responsibility, and social awareness. The proposed size and curriculum is a departure from Seattle's neighborhood schools. The new schools will attract students from the city at large, thus raising questions and issues concerning the role of architecture in fostering civic place-making and the power of choice in school selection. Our research will explore how this shift alters the community, and how architecture will frame a successful transition to this model. With the announcement of the first new school came its proposed site in Seattle Center. Our investigation will focus on this unique site and the problems and opportunities it raises for high school education in Seattle. We will use the existing alternative school to define programmatic elements and then apply history, modeling, theory, and critical questioning to develop an architectural space.

**SEMAHMAH RESTORATION AND MEMORIAL PROJECT**

**REBECCA DEEHR**  
*Senior, Landscape Architecture*

**BARBARA BARNES**  
*Senior, Landscape Architecture*

**ROXANNE HAMILTON**  
*Professor, Landscape  
Architecture*

**NATHAN BIRD**  
*Senior, Landscape Architecture*

**ANGELIQUE DAMITZ**  
*Senior, Landscape Architecture*

**CINDY MARTIN**  
*Senior, Landscape Architecture*

**MASAKO OTA**  
*Senior, Landscape Architecture*

**SHI PARK**  
*Senior, Landscape Architecture*

**JANET SALSBUURY**  
*Senior, Landscape Architecture*

**BARBARA SMITH-STEINER**  
*Senior, Landscape Architecture*

**AUDREY SWANSON**  
*Senior, Landscape Architecture*

**GEORGE WITTREN**  
*Senior, Landscape Architecture*

On August 3, 1999, members of the Lummi Nation discovered that history had repeated itself again with the desecration of the Semiahmah burial ground on the Semiahmoo Spit near Blaine, Washington. The deeply saddened community formed the Semiahmah Restoration Committee to lead the repatriation efforts at Semiahmah. In April of 2000, representatives of the Semiahmah effort invited the services of the University of Washington's Department of Landscape Architecture to create restoration and memorial plans for Semiahmah. In the fall of 2000, these Landscape Architecture students, led by Roxanne Hamilton and T.A. Michael Hankinson, began researching the complex cultural and environmental issues surrounding the desecration and proposed reburial at Semiahmah. This cross-cultural communication and research effort involved community and social issues but also included a strong environmental restoration component intended to heal, restore, and protect the land that exists, as well as the ancestral spirits that belong with the land. These research efforts would later inform their design process. The research topics were focused on relevant and useful areas, including: Natural, Human, and Perceptual Factors On Site, Cross-Cultural Communication, Lummi Traditions (Seasonal Movement Through the Landscape), Study on Tribal Family Systems, Art of the Coast Salish Indians, Architecture, Fishing Practices, Philosophical Views of Death and Burial Practices, Spirituality and Religion, Precedent Studies of Native Groups, and American-European Memorials. The influence of research is apparent in each design response created. Both the research and design proposals are documented in *Semiahmah Restoration and Memorial Project*, which has been presented to the Lummi Indian Nation. It is our hope that this effort has made a strong and positive impact on the Lummi Indian Nation, and that it will be an invaluable resource for them.

### ROBOTIC SOCCER SKILLS

**DAVID DUNHAM**

*Senior, Computer Science & Engineering and  
Linguistics*

**DIETER FOX**

*Professor, Computer Science & Engineering*

Playing soccer involves many skills, including agility, ball handling, and strategy. Complicate this with learning how to walk and figure out where one is and one can begin to see the complexities in teaching robots how to play soccer. One of the major challenges faced in our research is teaching the robots the proper skills. Our legged autonomous robots must be able to move quickly and accurately in order to face the challenges of the soccer game. In order to do so, they need to be able to move quickly, handle the ball, block opponents' shots, and work as a team. This is complicated by the limited computational power and speed of the on-board processor, and the limited communication abilities of the hardware platform. Using Sony AIBO legged robots as a hardware base, our team is developing compact software with low computational requirements that will allow our robots to play soccer in real time. The applications developed in our research will be used in our team of three soccer playing robots that will compete in August at the 2001 Robo-Cup tournament against 15 other teams of Sony AIBO robots.

### HEALING GARDENS AT THE UW MEDICAL CENTER

**JENNIFER SZABO**

*Senior, Landscape Architecture  
MARY GATES SCHOLAR*

**DANIEL WINTERBOTTOM**

*Professor, Landscape Architecture*

The field of "healing" or "restorative" gardens has become one of great interest in recent years. The recent upsurge in the publication of books, research studies, and articles on this topic is testimony to the fact that it is one of importance for designers and healthcare professionals, as well as the layperson interested in the qualities of his or her own environment. Beginning in January 2000, a research team led by Daniel Winterbottom and Dr. Anne Kearney explored the potential development of garden spaces at the University of Washington Medical Center. A portion of this research focused on designing and implementing a survey of patients, visitors, and staff to gather data in three main areas of inquiry. First, the survey explored the potential development value of gardens in relationship to current perceptions of the hospital as well as future perception with the addition of garden space. Second, possible design criteria were analyzed through respondent preferences for both aesthetic qualities and physical activities with regard to garden space. Finally, the survey provided possible future research opportunities suggested by the data. This research is currently being edited for publication as well as being used in the design of garden space within the hospital complex. In addition, further research is being explored based on this initial work. Most importantly, it reinforces the idea that research may be used as a means for improving the quality of life for people dealing with seemingly unrelated issues—it is the job of the researcher to find these connections.

# PATHOGENESIS AND GLOBAL HEALTH - GENETICS

*Session Moderator: Robin Wright, Zoology*  
*Session Discussant: Jessica Hughes, Microbiology, Senior*

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## APOPTOSIS IN CONGENITAL NEUTROPENIA

**COURTNEY CLARK**  
*Senior, Biochemistry and French*

**ANDREW APRIKYAN**  
*Professor, Hematology & General Internal  
Medicine*

**DAVID DALE**  
*Professor, Hematology & General Internal  
Medicine*

Our research is focused on pathogenesis of severe neutropenia. There are 2 forms of the disease, cyclic neutropenia (CN) and severe congenital neutropenia (SCN). CN is characterized by periodic 21-day oscillation of peripheral blood neutrophil level from almost zero to near normal levels, whereas consistently low levels of neutrophils are observed in SCN. Symptoms of these diseases include recurrent fevers, large oral ulcers, gingivitis, and severe sometimes life-threatening infections. SCN patients may also develop leukemia. Recent studies indicated that all patients with cyclic neutropenia, and more than 90% of patients with severe congenital neutropenia, have mutations in the neutrophil elastase gene. It was also reported that lack of neutrophils in these disorders is due to accelerated apoptosis of bone marrow progenitor cells. Therefore, we hypothesized that expression of mutant neutrophil elastase (NE) results in impaired survival of bone marrow progenitor cells and subsequent failure of neutrophil production.

To test our hypothesis, we co-expressed mutant or wild type elastase with enhanced green fluorescent protein (EGFP) in human and murine myeloid progenitor cells. After transfection, the cells were cultured for several days at 37°C in a CO<sub>2</sub>-incubator. The cell survival characteristics of EGFP-positive cells labeled with Cy-5 conjugated annexin V were periodically assessed by flow cytometry. To correlate the rate of apoptotic cell death with the level of elastase expression, we analyzed the cell lysates in western blotting using neutrophil elastase specific antibody.

Thus far, transfection and subsequent analysis of cell cultures has demonstrated that expression of mutant but not normal NE contributes to a higher rate of apoptosis in these cells. These data support the hypothesis that expression of mutant elastase in bone marrow cells of both SCN and CN patients triggers accelerated apoptosis and contributes to inability of these cells to differentiate to mature neutrophils.

**EVALUATION OF T CELL IMMUNITY TO MELANOMA**

**THUY DOAN**

*Senior, Neurobiology*  
*MARY GATES SCHOLAR*  
*MCNAIR SCHOLAR*

**CASSIAN YEE**

*Professor, Immunology & Medical Oncology and*  
*Fred Hutchinson Cancer Research Center, Clinical*  
*Research Division*

Malignant melanoma is the most serious form of skin cancer. The incidence of melanoma has increased at a rate greater than any other cancer. The mortality due to melanoma continues to grow at a rate of 2% a year. Early experimental approaches of cellular immunotherapy resulted in modest and short-lived responses. Identification of tumor antigens recognized by T cells has enabled the design of more specific and improved therapeutic strategies such as adoptive T cell therapy. One of the many hurdles to the successful application of T cell adoptive therapy has been identified as the short survival rate of transferred T cells *in vivo*. Murine experiments suggested that IL-2 treatment might have a role in sustaining T cell clones. We are conducting Phase I/II clinical trial of adoptive T cell therapy using antigen-specific T cell clones for the treatment of patients with malignant melanoma. This is designed to determine if exogenous IL-2 will enhance the survival of adoptively transferred CD8+ T cells. To track the transferred CD8+ T cells in the patient's peripheral blood, clone-specific sequences are identified using a combination of RT-PCR, multiplex PCR and DNA sequencing methods. Quantitative PCR is used to evaluate the frequency of the transferred T cell clones in peripheral blood. We have successfully identified potential clone specific regions for 10 different clones (used for the adoptive therapy of 7 patients). We have tested 3 primers for specificity, and have begun to quantify infused T cells in one patient. In future work, we hope to analyze the persistence of T cell clones for 10 patients who received T cell infusions with and without IL-2. These results will enable us to determine the influence of IL-2 on the survival of adoptively transferred T cells in the peripheral blood and facilitate the design of more effective strategies.

**GENETIC CHARACTERIZATION OF HIV-1 IN CD14+ MONOCYTES: EVIDENCE FOR IN VIVO COMPARTMENTALIZATION BETWEEN CD14+ MONOCYTES AND CD4+ T LYMPHOCYTES\***

**JENNIFER FULCHER**

*Senior, Biochemistry*  
*MARY GATES SCHOLAR*

**TUOFU ZHU**

*Professor, Laboratory Medicine & Microbiology*

While CD4+ T lymphocytes and tissue macrophages account for the major HIV-1 pathogenicity *in vivo*, little is known about the role of monocytes in HIV-1 infection and replication. Previous studies showed that HIV-1 could not replicate in freshly isolated blood monocytes *in vitro*. However, recent results from our laboratory indicated that HIV-1 could indeed replicate in CD14+ monocytes *in vivo*, suggesting that monocytes may play a significant role in HIV-1 pathogenesis. In the present study, which is a part of our large efforts to define the roles of CD14+ monocytes in HIV-1 infection, we examined the *in vivo* genotypes of HIV-1 in purified CD14+ monocytes and CD4+ T lymphocytes. Using positive and/or negative selection, we isolated the CD4+ T lymphocytes and CD14+ monocytes from peripheral blood mononuclear cell samples from a cohort of HIV-1 infected patients without treatment. The HIV-1 gp120 envelope was amplified using PCR technology, cloned, and then sequenced. Phylogenetic analysis has shown HIV-1 sequences in CD14+ monocytes were distinct from those in CD4+ T lymphocytes in all three patient samples obtained years after the acquisition of HIV-1 infection, and in the one patient sample obtained months after infection, suggesting compartmentalization of HIV-1 among CD14+ monocytes and CD4+ T lymphocytes during the course of infection. Further studies are being conducted to determine the role of CD14+ monocytes as a source of virus that will dominate in the later stage of HIV-1 infection. Findings from these studies may provide great insights to developing new therapeutic strategies to eradicate HIV-1.

**A NOVEL SECRETION SEQUENCE IN THE CARBOXY-TERMINUS OF FLIC**

**JESSICA HUGHES**

*Senior, Microbiology*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

*EIP PRESIDENTIAL SCHOLAR*

**BRAD COOKSON, M.D.**

*Professor, Laboratory Medicine*

A novel secretion sequence in the carboxy-terminus of FliC *Salmonella typhi* infection causes the disease typhoid fever and in developing countries leads to more than 600,000 deaths each year in untreated patients. Laboratory studies are performed using a close relative, *Salmonella typhimurium*, which causes a similar enteric fever in mice. Both species produce the protein FliC that is exported via a type-III secretion system and polymerizes at the tip of a growing whip-like structure called the flagellar filament. Rotation of these organelles allow the organisms to be motile and move either toward or away from a chemoattractant or repellent, respectively. The extracellular localization of FliC makes it a key target for host immune cells. To better define the region of FliC required for extracellular secretion, we created deletion strains lacking sequence encoding various portions of the FliC carboxy terminus. Analysis of these and other similar mutant strains for 1) motility, 2) resistance to a flagella-binding bacteria virus, phage chi, and 3) FliC localization identified a small region in the carboxy-terminus necessary for secretion. We hope these findings will help us better understand the infectious lifecycle of and the host immune response to *Salmonella typhi* infection.

**STRAIN TYPING OF CMV**

**LING-YU KUAN**

*Senior, Medical Technology and Biochemistry*

**DAVID KOELLE**

*Professor, Medicine and Lab Medicine*

Cytomegalovirus (CMV) is a herpesvirus with a linear DS DNA genome. CMV infection typically has minimal clinical consequences for immunocompetent persons. However, it may cause severe disease in immunosuppressed patients, and in the fetus if the pregnant mother undergoes primary infection. It is transmitted through saliva, blood, transplanted organs, and by sexual contact. Our preliminary data also suggest that CMV shedding in the female genital tract is associated with shedding of HIV-1, even among patients on highly active antiretroviral therapy. Previous studies have shown that specific CMV genotypes are associated with disease severity within certain patient groups. Genotyping has also shown that some individuals can be co-infected with multiple CMV strains. The goal of my work is to develop genotyping methods at three widely spaced loci in the CMV genome. Each locus has three to five alleles. These genotypes are thought to segregate independently in the population. By typing at all three loci, a "molecular fingerprint" can be derived for the CMV DNA in clinical specimens. DNA sequencing and PCR (polymerase chain reaction) followed by RFLP (restriction fragment length polymorphism) analysis are being used as typing tools. This typing system will be used to study the association, in genital tract specimens, between CMV genotypes, the number of infecting CMV strains recovered from female subjects during multiple sampling, and the magnitude and frequency of genital tract shedding of HIV-1 in women.

**THE ROLE OF BRCA1 IN SPORADIC EPITHELIAL OVARIAN CANCER\***

**SARITA MAHTANI**

*Junior, Cellular & Molecular Biology*

**ELIZABETH SWISHER**

*Professor, Obstetrics & Gynecology*

5-10% of epithelial ovarian and breast cancer cases arise in women who have inherited a germline mutation in the tumor-suppressor genes BRCA1 or BRCA2 located on chromosome 17 and 13, respectively. Currently there is little known regarding the mechanism occurring in sporadic cases of epithelial ovarian cancer. This investigation sought to look at deletion events in the region of the BRCA1 gene in sporadic epithelial ovarian cancer patients. Deletions of one BRCA1 allele were identified by loss of heterozygosity (LOH) at 3 sites within the BRCA1 gene. This data was compared to clinical information and protein expression of BRCA1 in order to determine whether a relationship existed. LOH in the BRCA1 gene was tested for with normal and tumor pairs with the intragenic markers D17S855, D17S1322, and D17S1323 using polymerase chain reaction (PCR) and gel electrophoresis. If a tumor showed >50% loss of intensity at one allele compared to its normal DNA, it was considered LOH. A collaborator in the lab tested for BRCA1 protein expression with immunohistochemistry using the BRCA1-specific antibody MS110. Approximately 2/3 of tumors showed reduction in BRCA1 protein. Clinical information regarding patients' family history, survival information, histology, grade, and stage of cancer are currently being collected. To date, 90% of informative patients have LOH at 1 or more markers, which does not appear to correlate with protein expression of BRCA1 or any clinical factors except grade. A correlation between LOH and tumor grade still has to be elucidated by further investigation. The high rate of loss in the region points to the involvement of BRCA1 in sporadic ovarian cancer.

**MUTATIONS IN DNA POLYMERASE  $\eta$ : IMPLICATIONS FOR CANCER\***

**KELLIE VIGNA**

*Senior, Biochemistry*

**EITAN GLICK**

*Professor, Pathology*

**LAWRENCE LOEB**

*Professor, Pathology, and Director, Gottstein Memorial Laboratories*

Cancer has always been a perplexing issue for researchers. Starting from the discoveries that human cancers contain multiple mutations, many mechanisms for mutagenesis have been studied. Our research focuses on the accuracy during DNA replication with respect to a specific protein, Pol  $\eta$ . This DNA polymerase is encoded by the Xeroderma pigmentosum variant (XPV) gene, and mutations in this gene are associated with Xeroderma pigmentosum syndrome, a disease characterized by hypersensitivity to sunlight and high incidence of skin cancer. Pol  $\eta$  belongs to the bypass lesion DNA polymerase family and is distinguished in its ability to accurately bypass adducts known as thymine-thymine (T-T) dimers in template DNA, which are caused by sunlight's UV radiation. In contrast to its accuracy in bypassing T-T dimers, Pol  $\eta$  has a strikingly low fidelity. Our main objectives are to better characterize this polymerase in terms of its structure-function relationship, test mutants in their ability to bypass different adducts caused by other environmental carcinogens, and to determine if overexpression in the cell leads to an increase in mutations, contributing to the development of cancer. Specific Pol  $\eta$  mutants selected from a library of 150,000 independent mutants, harboring only slight variations at their active sites (1-3 amino acid substitutions on average) were selected based on UV resistance. These mutant polymerases were also tested for their ability to bypass other adducts caused by environmental carcinogens. We were able to find a number of mutants that display activity different than wild type. Comparison of the fidelity and bypass properties of the mutant polymerases should allow us to further understand the correlation between structure and function. If mutant polymerases are found having special bypass properties, this could offer potential for protection of cells against chemotherapeutic agents used in cancer therapy.

**EXPRESSION OF A PUTATIVE OUTER MEMBRANE PROTEIN OF THE SYPHILIS  
SPIROCHETE\***

**SUSANNAH WEYTE**  
*Junior, Molecular Biology*

**CAROLINE CAMERON**  
*Professor, Medicine, Division of Allergy &  
Infectious Diseases*

**WESLEY VAN VOORHIS**  
*Professor, Medicine, Division of Allergy &  
Infectious Diseases*

Syphilis, a serious disease that is also a significant risk factor for HIV transmission, is caused by the spirochete *Treponema pallidum* subspecies *pallidum*. Several independent efforts are underway to develop a protective vaccine including the identification of proteins exposed on the organism's outer membrane which are most likely to stimulate a protective immune response. My research is focused on a protein designated Tp0751. We hypothesized that Tp0751 is exposed on the outer membrane of *T. pallidum* based on predictions of its location by computer analysis (PSORT program). Starting with bacterial genomic DNA, one full-length sequence and two fragments of the gene were amplified using the polymerase chain reaction. These amplified DNA sequences were then ligated into the pGEM-T cloning vector, which was then used to transform *E. coli* XL-1 blue cells. These constructs were subjected to restriction enzyme digestion and subcloned into pRSETc, a prokaryotic protein expression vector. This vector was used to transform *E. coli* XL-1 cells and the resulting expression constructs were sequenced. The sequences were verified against the sequence deposited in the Los Alamos National Laboratory STD database to make certain that PCR had not induced errors. Competent *E. coli* BL-21(DE3)pLysS cells were transformed with the constructs and cultures were grown from the resulting clones. A protein expression time course was used to determine the optimal conditions for efficient protein expression. The cultures were then re-inoculated in a large volume and the desired proteins were purified from these cultures. Currently, the N-terminal fragment of the gene for Tp0751 expressed well, while the full-length construct and the C-terminal fragment expressed poorly; further attempts to express from these two constructs will be made. When expressed, these proteins will be used to immunize rabbits. The rabbits' sera will be harvested and antibodies to Tp0751 will be used to immunolocalize this protein. If Tp0751 is found to be on the outer membrane as hypothesized, the rabbits will be challenged with *T. pallidum* to determine whether they are protected by immunization with Tp0751.

*“[My mentor] is one of the rare people that you meet throughout your life that you know you will remember forever. You remember these people not just because of who they are, but because of who they helped you become. As a mentor and student she has shown me what it looks like to love the work you do and to lead yourself toward your goals.”*

*- Nels Jewell-Larsen, Mechanical Engineering, Sophomore*

# CULTURE, COMMUNITY, & COMMUNICATION

*Session Moderator: Ana Mari, Psychology and Honors Program*  
*Session Discussant: Laël Weis, Political Science and Philosophy, Senior*

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## ACTIVE LEARNING THROUGH COURSE COLLABORATION IN COMMUNITY AND ENVIRONMENTAL PLANNING\*

**LINDSAY DELECKI**

*Sophomore, Community & Environmental Planning*

**LUCAS DEHERRERA**

*Junior, Community & Environmental Planning*

**JOHN CARRUTHERS**

*Professor, Community & Environmental Planning*

**ROBYN WELCH**

*Junior, Geography*

Community and Environmental Planning is an innovative undergraduate major at the University of Washington that seeks to promote active learning and student participation in the education process. Among other activities, students gain experience in facilitation and leadership by acting as collaborators for CEP 120, Introduction to Community and Environmental Planning, which serves as an important source of recruitment for the major. This spring (2001) quarter, the three of us will be working as collaborators with CEP instructor John Carruthers. Our objectives are threefold. First, we will be helping to guide other students' learning experiences by facilitating discussions on several books that we have selected for use in the class, including *An American Wilderness*, *There are No Children Here*, *8-Ball Chicks*, *The Ecology of Fear*, and *Fast Food Nation*. We believe that these books speak to many important issues, including equity, socioeconomic change, and environmental degradation, and hope that they will serve to broaden people's perspectives on American communities. Second, we will be working with John to write essay questions based on readings and class discussions and to grade student responses. Finally, each of us will take responsibility for one full class session, acting as the main facilitator for the class that day. These "teaching units" are likely to involve specialized exercises aimed at examining specific aspects of the readings. We have developed these objectives by working with John this quarter and we have prepared for the class by meeting to discuss the books, articles, movies, and guest speakers that will form the curriculum. Our presentation at the University of Washington's Undergraduate Research Symposium will provide an overview of our experience as student collaborators, highlighting the important role that active learning and student facilitation play in contemporary undergraduate education.

## CALLIGRAPHY IN THE PEOPLE'S REPUBLIC OF CHINA\*

**JENNIFER HOLMES**

*Senior, Art History*

**JEROME SILBERGELD**

*Professor, Art History*

Calligraphy in China is not just writing that expresses ideas. It is the embodiment of a cultural heritage that spans over two millennia and unites all of the Chinese community regardless of dialect or region. Unlike the Western languages that use the Roman alphabet, calligraphy transcends verbal communication, each piece being an act of self-expression. During the dynastic end of China, the practice of calligraphy for artistic purposes was limited to the educated elite. Among the rulers and upper class it was collected and studied. But with the founding of the communist government in 1949, officials began to discard practices that were associated with the oppressive ruling class. Yet, Mao Zedong kept calligraphy at the high social status that it occupied for centuries before him, using it for his own purposes and to promote Marxist theory. This project has two objectives 1) to explain how the communist government used calligraphy to establish their legitimacy; 2) to examine the counter-dialogue of expatriates, as well as contemporary artists in China. We are doing this by studying the change in ideology through the evaluative approaches to calligraphy.

NEGOTIATING SEXUAL ORIENTATION IN PRIMARY AND SECONDARY EDUCATION: THE  
EXPERIENCES OF LESBIAN TEACHERS

VANESSA HUBBARD  
*Freshman, Women Studies*

KARI TUPPER  
*Professor, Women Studies*

This study examines the experiences of K-12 teachers who are lesbians and teach in Seattle, Washington. I am currently in the process of completing detailed, in-person interviews with 6 lesbian teachers. These interviews focus on the teachers' relationships and interactions with students, parents, and co-workers. The objective of this research is to better understand how lesbian teachers negotiate their sexual identity (either closeted or not) in the context of their jobs. Clearly, being gay or lesbian has consequences in a variety of jobs, and this is particularly true for teaching. Homophobia, misinformation, and negative stereotypes can make it particularly difficult for gays and lesbians to engage in work that involves children. Prior research has shown that some gay and lesbian teachers experience negative attitudes and discrimination, which can be extremely damaging both personally and professionally and can result in both physical and emotional symptoms. Other studies have shown however, that experiences vary widely, and that a variety of factors can impact attitudes and experiences of discrimination. My ethnographic research is demonstrating that lesbian teachers face the greatest hurdles not in their interactions with children, but with parents and co-workers. They employ a variety of complex strategies to avoid and/or deal with suspicion and discrimination. In order to better understand these strategies, I have posed a series of interview questions such as "What survival strategies have you developed in your life as a lesbian teacher?" and "Have you ever experienced discrimination because of your sexual orientation?" These questions have provided substantial information about how educators negotiate the tension of dual identities--lesbian and teacher--in both public and private schools. Patterns are emerging that illustrate, among other things, that lesbian teachers in Seattle who are 'out' with their co-workers and/or the school principle do not usually experience discrimination that is directly based on sexual orientation. Rather, they find that problems emerge, and they become easily viewed or labeled as 'trouble makers', when they try to create curriculum or policy changes within the school. Sexual orientation becomes most relevant or salient when it intersects with other types of non-normative behavior.

ARCANA MUNDI – PATHWAYS IN THE HISTORY AND STUDY OF MAGIC\*

ALEX JASSEN  
*Senior, International Studies (Jewish Studies)*  
MARY GATES SCHOLAR

SCOTT NOEGEL  
*Professor, Near Eastern Languages & Civilization*

Magic has traditionally been understood to represent the manipulation and coercion of hidden powers in order to act on specific events (e.g. a battle, the weather) or individuals, manipulating these hidden powers in order to benefit or heal people or to cause them harm. However, societies and individuals that are labeled "magical" rarely view themselves or their behavior as such. Intimately connected with this phenomenon is the relationship of magic and religion. Earlier scholars have tended to view these two social realities in opposition, specifically designating magic a pernicious delusion representative of an early developmental stage of all religion-based societies. Close examination of texts and archaeological remains from diverse cultures have enabled the scholar to rethink these distinctions, after which it becomes apparent that these categories of religion and magic are culturally bound. One society's magician is another's miracle worker.

As we move from the ancient world into late antiquity, a new set of concerns emerges. Scattered amongst these newly discovered archaeological and literary remains is a wealth of material emanating from the lower strata of these civilizations. These, too, serve as an impetus for scholars to rethink long held notions about ancient civilizations. In the societies of late antiquity, magic and occult arts were exceedingly marginalized, its practitioners branded as asocial. This understanding is fashioned out of the literature of the aristocratic elite, whose literary remains have until recently been our only source for reconstructing the historical discourse of these societies. However, as we further explore the "other" texts, it becomes poignantly clear that the occult pervaded nearly every aspect of daily life. What also becomes evident is that those of lower socio-economic status were quite often engaging in the same "occult" practices as the aristocracy. Even within a single civilization, classifications of "magic" are culturally bound categories.

**THE IU-MIEN ETHNOMEDICINE PROJECT**

**CLAYTON JOSEPHY**

*Senior, Anthropology and Molecular Biology*

*MARY GATES SCHOLAR*

**CAREY JACKSON**

*Professor, General Internal Medicine*

**CLARKE SPEED**

*Professor, American Indian Studies*

Traditionally, in the mountains of Laos and Vietnam, Iu-Mien herbalists were experts in locating, harvesting and preparing plant medicines for a wide range of ailments. Many Iu-Mien were dislocated by the Vietnam War, during which members of dozens of ethnic groups were displaced from their towns and villages, made refugees in their own lands, and forced to flee toward Thailand in search of safety. While political resettlement immediately transformed their location, their beliefs and practices have changed less. Today, Seattle is home to a strong and numerous Iu-Mien community.

Our research is designed to address two main questions. The extent to which the herbal medicine tradition has been continued and modified among members of the Iu-Mien in Seattle will be estimated based on observed consumption patterns. Secondly, we want to address the possibility of adverse drug-herb interactions that might be occurring when Iu-Mien concurrently employ herbs and western pharmaceuticals to treat illness.

After human subjects approval, data collection will begin with the collection and documentation of medicinal plants, grown in gardens or harvested from the wild, which are commonly used among Iu-Mien in Seattle. This data will be accessed in the field through semi-structured interview and participant-observation. The processing of the specimens will allow for proper identification of their genus and species; the plants will be systematically keyed. Once a list of the most common plants is established, a literature review will be conducted in search of any known drug-herb interaction implicating the active compound in these species.

The outcomes of this study will be a written report on the practice and usage of herbal medicines among the Iu-Mien and a collection of herbarium specimens. Side products may include a public garden of Iu-Mien herbal medicines to showcase their knowledge. Additionally, a simple guide to common drug-herb interactions will be made available to health practitioners via the internet, which will help curb the incidence of harmful drug-herb interactions.

DANCE AND CULTURE

**SUNMIET MINNICK**  
*Senior, Dance*

**PETER KYLE**  
*Professor, Dance*

Dance is often the part of a culture that is overlooked. It is the part of the culture that is there to fulfill social and sometimes spiritual obligations, but is not needed for survival. Dance is constantly changing with the evolving society surrounding the culture. However, just because the society is changing and the need for dance changes, should the old dances be forgotten? Dances should not be forgotten. They have their place in history and can be linked to specific eras. For example, the "Charleston" can be linked to the 1920's and the "Jitterbug" can be linked to the 1950's. Dance can also be linked to or identify a specific culture. "Hula" provides the example for being linked to a culture. Finally, dance can be used as a spiritual aspect and can keep a culture alive and united. This would be the example of the Native Americans. The Native Americans are a minority that struggles everyday to keep their culture alive. They have found a union within their dance, but at the same time sacrificed dances that have distinguished the tribes. It should be important for these tribes to hang on to the different dances of their separate cultures so they can keep alive some of the past. Within the United States and Canada, there are approximately 500 tribes. More than half of the tribes are settled within the United States. Those tribes make up around 2% of the population of the United States. That makes them a huge minority within the country. That can make it a challenge to maintain their culture within their homeland, when they don't even have the advantage. Most tribes were very distinct from one another. They spoke different languages and had different customs. That would also make them have different dances. Many of the customs, dances, and even languages were lost when the non-Native Americans settled the land. The non-Native Americans were scared of the customs because they did not understand them. Rather than let the Native Americans continue their practices, they banned them and punished the Native Americans if they were caught practicing their customs. This caused many Native Americans to lose much of their heritage. The few things that survived, did so because they would continue the practices in secret. Ceremonies were held deep within forests in the middle of night so they would not be caught. After all, the Native Americans have been through and have managed to keep some of their practices alive, and it would be an awful shame to allow them to die out now. Many cultures around the world have been able to maintain ancient, traditional dances, and maintain their cultures. They have a place in the world. Native Americans do not. They have become the minority in their homeland and have been forced to give up their traditional ways of life and adopt different methods of living. Native Americans spend a lot of time dancing. They dance for everything. They dance for social gatherings, they dance for religious purposes, and they dance for a time of mourning. Some of the dances date back hundreds of years. With the change of society around the Native Americans, there has been change around their dances. Many religious dances continue, but they have lost many social dances that tied them together as one tribe.

## CULTURE, COMMUNITY, & COMMUNICATION

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### A LEGACY OF PRIDE: THE AMERICAN INDIAN WOMEN'S SERVICE LEAGUE, SEATTLE, WA\*

**TERESA POWERS**

*Senior, Fine Art: Painting & General Studies,  
American Indian Studies  
MARY GATES SCHOLAR*

**MARY WRIGHT**

*Professor, American Indian Studies*

I am researching the mid-to-late twentieth century history of American Indian women activism in Seattle, Washington. A handful of women from the Makah, Lummi, and Clallam tribes of the Pacific Northwest began to reach out to Alaska Native and American Indian people coming to Seattle to look for jobs in the aftermath of World War II. Pearl Warren, a Makah woman, led the American Indian Women's Service League. She and other women sought to improve the community and identity of American Indian people by helping them navigate and succeed in city life. The AIWSL incorporated in 1959 and had 400 members from various tribes across the US at the height of membership. I am directing and editing a documentary video on this group, called *A Legacy of Pride: The American Indian Women's Service League, Seattle, Washington*, produced in the American Indian Studies Center's Native Voices program. My research centers on the Seattle Native American Indian communities, revealing issues, oral histories and stories from a Native American viewpoint. As of today, I have interviewed sixteen individuals from the Seattle Indian community who have set aside time to talk with me about the history and experiences of various members of the AIWSL. Their history is one found through the memories and recollections of the AIWSL members, daughters, friends and protégés. The Seattle Indian Center, Seattle Indian Health Board, United Indians of All Tribes Foundation, and the Seattle Indian Services Commission are here for us today because of the Native women from different tribes and backgrounds who nurtured them. I will share clips from the video and give an overview of my research results at the symposium.

### INTERGROUP DIALOGUE AND LEARNING THROUGH CONTRAST

**YAFFA TRUELOVE**

*Senior, International Studies and Comparative  
History of Ideas  
MARY GATES SCHOLAR*

**BIREN (RATNESH) NAGDA**

*Professor, School of Social Work*

My research with Professor Biren "Ratnesh" Nagda focuses on the process of intergroup dialogue as a means of communication about race and oppression. As we live in a world that is still marred by racism and other forms of oppression, dialogue provides a unique way to communicate about these often painful issues in hopes of creating positive social change. Our research specifically looks at dialogues held in Social Work classes at the University of Washington. In particular, our research analyzes the reflection papers of students who participated in eight weeks of dialogues in order to determine the content of student learning, as well as the unique ways in which the dialogue process facilitated this learning. Our research has found that, as students from differing backgrounds engage with each other in a safe environment, the contrasts of experience and conflicts raised in the dialogues help students to go back and reflect on their own identities and ideas about race and racism. The majority of students emerged from the dialogues with enhanced understanding of racism and privilege, inspiring students to continue their growth and engagement with these issues. Through our analysis, Professor Nagda and I have developed a theory of *learning by contrast*, which analyzes student learning as a product of the contrasts created by the dialogue process. These contrasts include: the unique and safe environment of dialogue (as contrasted to other forms and environments of communication), the experiential contrast (placing students from both privileged and disadvantaged groups together), and the process of dialogue (promoting a different type of classroom learning that encourages personal stories, listening, and discussion of conflict and discomfort).

*“[My mentor] has opened my eyes to the beauty  
and intricacies of research.”*  
*- Nerayo Teclemariam, Chemical Engineering, Senior*

# TECHNOLOGY & SOCIETY

*Session Moderator: Daniel Schwartz, Chemical Engineering*  
*Session Discussant: Gilbert Martinez, Physics, Senior*

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## THE STABILITY OF SELF-ASSEMBLED MONOLAYERS FOR DNA SYNTHESIS\*

**ERLEINE BAUTISTA**  
*Senior, Biology*

**BUDDY RATNER**  
*Professor, Bioengineering & Chemical Engineering*

**DANIEL GRAHAM**  
*Graduate, Bioengineering*

With the completion of the Human Genome Project, a massive set of genetic data must now be deciphered. To accomplish this, new analysis tools are being developed such as DNA chips or genosensor microarrays. Due to their reproducibility and ease of synthesis and derivitization, we studied self-assembled monolayers (SAMs) as an alternative solid support for use in DNA chip technology. In particular, we investigated the stability of SAMs during DNA synthesis via the phosphoramidite method. Electron Spectroscopy for Chemical Analysis (ESCA) and Time of Flight Secondary Ion Mass Spectrometry (TOF-SIMS) revealed that the SAM-oligonucleotide layer is stable until the oxidation step. This is due to the standard I<sub>2</sub> oxidizing agent degrading the gold surface. Therefore, we looked at an alternative oxidizing agent in which the SAMs are stable.

## INTERNET DATABASE CLIENT AND SEQUENCING ANALYSIS SOFTWARE DESIGN\*

**JOHN CALHOUN**  
*Senior, Cellular & Molecular Biology*

**PETER MYLER**  
*Professor, Pathobiology*

**DAVID CHOU**  
*Professor, Laboratory Medicine*

My research addresses the issues of information retrieval and the analysis of DNA sequences. The issue of information retrieval was a part of my work on an internet database client. An internet database client involves three main steps: data entry (via web), a review process of raw data, and storage of finalized data into a database. The second part of my research involves the analysis of DNA sequences. I am currently part of a project whose goal is to write a package of sequence analysis tools that are similar to the GCG Wisconsin Package.

**THIN FILM CATALYST APPLICATIONS\***

**DUSTIN FRAME**  
*Senior, Mechanical  
Engineering*

**RAY BERTSEN**  
*Sophomore, Pre-  
Engineering*

**RAVI MIKKELSEN**  
*Freshman, Pre-  
Engineering*

**GRETCHEN KALONJI**  
*Kyocera Professor  
Materials Science &  
Engineering*

**TIM ROOT**  
*Freshman, Pre-  
Engineering*

*Joe Schmeller*  
*Sophomore, Pre-  
Engineering*

**BRIAN FLINN**  
*Professor, Materials  
Science & Engineering*

The fuel cell has the potential to be a powerful tool in reducing the environmental impact of producing power for today's energy hungry populations in the US and around the world. However, there is much research to be done on this new technology before it can reach its potential. We are experimenting with the thickness of platinum on fuel cell membranes in the hopes of improving the performance of the fuel cell and the cost of its production. Our research focus is decreasing the thickness of the platinum catalyst layers through sputter deposition while sustaining a maximum level of power density. Platinum is five-hundred dollars per ounce, so decreasing the amount deposited will greatly lower the cost of production and make fuel cells a more viable consumer source of energy. This research is taking place within the UW Worldwide collaboration program with Sichuan University.

**AUTONOMOUS HIGH IMPEDANCE FAULT (HIF) DETECTION ALGORITHM USING  
WAVELET ANALYSIS\***

**MY HUA**  
*Senior, Electrical Engineering*  
*MARY GATES SCHOLAR*

**ALEXANDER MAMISHEV**  
*Professor, Electrical Engineering*

The demand for uninterrupted power delivery is increasing as more and more high-tech companies establish themselves in the Pacific Northwest. This increase in demand is understandable because most of these companies base their operations on highly sensitive computerized equipment that may be damaged if there should be an interruption during power supply delivery. Worst of all, the important non-replicable data would be lost and the companies would not be able to continue processing. Most causes of interruption in a power supply are detectable and preventable by convention techniques and devices, but one of the few exceptions is high impedance fault (HIF). Most conventional techniques such as fuses and relays are incapable of detecting and preventing all interruptions in power supply delivery. As a matter of fact, most of the power utilities are incapable of detecting and preventing HIFs using their conventional techniques. Therefore, to protect the power industry and the local businesses from potential economic damages, this research project will develop an algorithm to detect high impedance faults. This algorithm will use wavelet analysis, a new and highly promising tool used in 2D and 3D image processing such as brain-mapping and EEG signal processing (in the medical field), to detect HIFs. If we are successful, then the power utilities will be able to serve all their clients without interruptions in the power supply due to high impedance faults. The long-term goal of this research project is to develop a methodology and to build a program capable of discriminating different power-related events such as transients, transformer tap operations, in-rush currents, etc.

**HIGH BLOOD ETHANOL CONCENTRATIONS AND DRIVING IMPAIRMENT**

**FAINA PULVERMAKHER**  
*Senior, Medical Technology*

**FIONA COUPER**  
*Laboratory Medicine*

The objective of this study was to examine the relationship between extremely high blood alcohol concentrations and the ability to safely operate a motor vehicle. 120 drivers were arrested for driving under the influence in Washington State during an 18-month period, with blood alcohol concentrations &#8805; 0.30 g/dL. The drivers were aged between 24 and 75 years (median 41 years), and 80 % were male. Blood specimens from these cases were initially submitted to the Washington State Toxicology Laboratory for alcohol analysis. All specimens were additionally analyzed for other drugs that may interfere with driving, or compound the effects of ethanol on driving performance. Screening for drugs of abuse and several prescription drug classes was performed using Enzyme Multiplied Immunoassay Technique (EMIT), which screened for cocaine metabolites, opiates, amphetamines, carboxy-tetrahydrocannabinol, methadone, phencyclidine, propoxyphene, barbiturates, benzodiazepines and tricyclic antidepressants. Gas chromatography-mass spectrometry (GC-MS) was used to confirm EMIT positives and identify other weakly acidic, neutral, and basic compounds. By EMIT, 39 samples (33%) were positive for illicit and/or prescription drugs. By GC-MS, 27 samples (23%) were positive for illicit and /or prescription drugs. Overall, 65 samples (55%) were negative for all drugs except for BAC &#61619;0.30 g/dL, and the corresponding police arrest reports were evaluated for signs and indicators of driving impairment. The relationship between high blood alcohol concentrations and driving impairment will be discussed.

**TOWARD A WHOLE WIDE WORLD OF CONNECTIVITY: IMPLICATIONS OF THE INTERNET FOR THE GLOBAL SYSTEM\***

**MEREDITH SUMPTER**  
*Junior, International Studies and Internet Studies*  
*MARY GATES SCHOLAR*

**DONALD HELLMANN**  
*Institute for International Policy - Center for Internet Studies*

**REX HUGHES**  
*Institute for International Policy*

The rapid spread of the Internet has created a revolution affecting not only business, but all aspects of the global political economy: cultural identity; interactions between states and markets; sovereignty and civil society. Established at the University of Washington in 1999, the Center for Internet Studies is part of an international consortium of universities working to coordinate a global study of the Internet revolution through the leading academic institutions/high tech hubs in the United States, Europe, and Asia. As a fellow researcher for the Center, Meredith works directly with scholars, exploring resources and analyzing information concerning the 'Internet Political Economy.' She was instrumental in the researching of a recently published paper assessing the e-development of Ireland and Singapore. Currently, Meredith is helping to facilitate the first Internet course offered at the University by the Center. She is in the process of writing two major papers resulting from her work at the CIS: the first exploring the use or need of information technology in aiding country socio-economic development; the second analyzing the future of foreign democracy promotion programs in relation to the Internet Age. Future research interests revolve around the role of culture and indigenous communities in the evolution of the Internet: Does the network fundamentally change cultural society? Or will these respective societies 'own' the technology, shaping the Internet into a more culturally receptive form?

**OPTICAL FIBER ENDOSCOPE: MODELING RESULTS FOR PROTOTYPE APPLICATION**

**MICHAEL WHELAN**

*Freshman, Mechanical Engineering*

**PER REINHALL**

*Mechanical Engineering*

The medical field is limited in its use of flexible endoscopes. Current micro-fiber bundled endoscope diameters (4-12 mm fiber bundles) restrict endoscope use in small access areas such as sinus cavities, artery interiors and tumor regions within the brain. In minimizing optic bundle size, conventional endoscopes suffer a reduction in picture resolution and or a reduction in the size of the endoscope field of vision (FOV). To create an adequate two-dimensional picture of the region, the optical fiber must cover every portion of the region. By generating motion of a single optical fiber in one direction, a complete scanned two-dimensional pattern of the region can be produced. The testing platform, analysis of the conducted fiber scans, and unique dual-mode optical fiber dynamics at particular frequencies are reviewed. From this research, a fiberoptic endoscope requires three principles for size optimization. To decrease the size of the endoscope for small entry points, a reduction in the fiber displacement of motion and a maximizing of the fiber angular displacement are necessary. When the voltage signal generated is modulated at the frequency producing the maximum angular displacement, the widest FOV would be generated. Applying these principles of fiber control, a single fiber flexible endoscope appears feasible in the future.

# LIVING SYSTEMS

*Session Moderator: Thomas Daniel, Zoology*  
*Session Discussant: Carlos Moreno, Zoology, Senior*

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## **MIGRATORY BEHAVIOR OF THE WHITE-CROWNED SPARROW, ZONOTRICHIA LEUCOPHRYS GAMBELII: REGULATION IN AN UNPREDICTABLE ENVIRONMENT**

**RENEE AGATSUMA**

*Senior, Zoology*  
*MARY GATES SCHOLAR*

**MARILYN RAMENOFSKY**

*Professor, Zoology*

White crowned sparrows are long distance migrants that cover between 2000 and 4000 km each migratory season. In captivity birds display behavior and physiology characteristic of migratory species including hyperphagia, fattening, and intense directional flight at night termed migratory restlessness, MR. However, there has been behavior displayed by caged birds during fall migration from 46 hours of videotape captured with an infrared camera. This supplemented data was collected from birds held in activity-monitored cages. MR was qualitatively different from behavior during the day. It consists of intense flight often associated with skyward-peering, collectively call "look-up flight." Daytime behaviors included feed, jump, and rest, generally energy enhancing activities. Next, I tested the effect of food restriction on migratory behavior. Feeding en route is critical for restoring resources lost during MR. Increased daytime flight may represent an attempt to "move-out" and forage more actively to maintain high energy required for migratory flight. The stimulated environmental crisis appeared to redirect the activity from energy conservation to active foraging.

## **BIODIVERSITY AND DISTRIBUTION OF MARINE SHORE FISHES OF THE KURIL ARCHIPELAGO**

**KRISTAN BLACKHART**

*Senior, Fisheries*  
*MARY GATES SCHOLAR*

**THEODORE PIETSCH**

*Professor, Aquatic & Fishery Sciences*

The International Kuril Island Project (IKIP) is an on-going, international effort to survey and inventory the biota of the Okhotsk region in the Russian Far East. One aspect of the project has focused on the marine shore fishes of the Kuril Archipelago. Over the course of the seven-year project (1994-2000), nearly 7,300 specimens from sixteen families of marine fishes have been collected and retained for study. From these records, a preliminary study has been conducted comparing species diversity with island size and distance from mainland Russia (Kamchatka) and Japan (Hokkaido). This investigation will reveal any patterns in the distributions of marine shore fishes in the Kuril Islands.

**GENETIC STRUCTURE OF NORTHWEST POPULATIONS OF THE WESTERN GRAY  
SQUIRREL\***

**JANIE COGEN**  
*Senior, Zoology*  
MARY GATES SCHOLAR

**JIM KENAGY**  
*Professor, Zoology, UW Burke Museum*

**BRIAN ARBOGAST**  
*Research Associate, Zoology, UW Burke Museum*

Phylogeography deals with how the genetic makeup of contemporary populations is distributed as a result of historical alteration of their geographic range. Genealogical trees of distributed populations are built based on molecular markers, or specific regions of genetic material. One can tease out the effects of historical changes in habitat distributions based on geoclimatological changes. Of particular interest to evolutionary biologists are the consequences of the last few million years of intermittent glaciation. At least 20 different periods of glacial growth and retraction have served to separate and later reunite populations. In the Mammalogy Section of the UW Burke Museum, current projects across local mammal taxa are exploring the effects of these processes on relationships between and within species. The Western Gray Squirrel, *Sciurus griseus*, presents an interesting opportunity for phylogeographic analysis. Not to be mistaken for its ubiquitous introduced counterpart, the Eastern Gray Squirrel, *Sciurus carolinensis*, the Western Gray is rare in Washington State. *Sciurus griseus* is found in small, disjunct populations and appears to be declining in local abundance. The present analysis is the first phylogeographic study of these squirrels. In fact, no DNA sequences have been published for the species. The analysis is based on frozen tissue sample from the Burke Museum covering the Northwest. DNA was extracted from the tissues and the control region of the mitochondrial DNA was amplified using conserved primers. After sequencing the selected regions of DNA, the data were subjected to computational analysis and phylogenetic trees were constructed. The final analysis demonstrates a moderate degree of genetic differentiation among populations around the Northwest. We hope to use this analysis to address not only the past evolutionary history of this species, but also conservation issues based on genetic variability. These new genetic data may play a role in a pending consideration of "endangered" status for *Sciurus griseus* in Washington State.

**IDENTIFICATION OF THE SPATIAL DISTRIBUTIONS OF SOCKEYE SALMON BASED ON  
CHARACTERISTIC AGE COMPOSITIONS: AN ANALYSIS OF THE PORT MOLLER TEST  
FISHERY IN BRISTOL BAY\***

**LUCY FLYNN**  
*Senior, Aquatic & Fisheries Science*

**THOMAS QUINN**  
*Professor, Aquatic & Fisheries Science*

**RAY HILBORN**  
*Professor, Aquatic & Fisheries Science*

The Port Moller test fishery is located offshore from Port Moller on the Alaskan peninsula. Abundance data from a series of sampling stations along the transect are used to calculate an in-season forecast for the Bristol Bay sockeye salmon fishery, which provides valuable information both for salmon processors and for fishery managers. The fishery consists of four major commercial fishing districts, which are separately managed. The test fishery operates on the assumption that the fish homing to each district are thoroughly mixed across the transect and issues a forecast for the four districts combined. However, it is possible that the stocks may already have begun to separate enroute to their home districts, and that the test fishery could be used to predict incoming runs to one or more individually. We assumed that the density of each individual district stock along the transect is normally distributed, with a mean and standard deviation which may or may not be identical to the others. Given arbitrary values for those means and standard deviations, we used the probability density function to estimate the expected proportion of fish at each station sampled. We multiplied those expected proportions by the actual returns of each age to each district to predict the proportion of fish of each age at each sampling station. We used the multinomial probability function to determine the likelihood of observing the actual catches based on those proportions. Finally, we used a Bayesian statistical method called sampling importance resampling to compare 500,000 randomly selected sets of means and standard deviations for those consistently yielding the greatest likelihoods.

**VISUAL-MOTOR FEEDBACK IN THE TRACKING BEHAVIOR OF HOVERING MANDUCA  
SEXTA**

**CARLOS MORENO**  
*Senior, Zoology*  
MARY GATES SCHOLAR  
MCNAIR SCHOLAR

**THOMAS DANIEL**  
*Professor, Zoology*

**MICHAEL TU**  
*Professor, Zoology*

Insight into the complex interplay of sensory information, musculoskeletal mechanics, and aerodynamic forces is critical for understanding the dynamics of insect flight performance. While feeding at flowers in the wind, hovering hawkmoths must track a moving target in a spatially complex environment. Although the visual system can detect motion in different directions, characteristics of the musculoskeletal system could constrain the precision of directional control. Moreover, frequency tuning in the visual system may not account for the frequency response of tracking behavior at the organismal level. To understand the constraints that emerge from sensorimotor integration, we used 30 Hz video to record hovering moths as they fed at artificial flowers. We oscillated the flowers sinusoidally at 1, 2, and 3 Hz, and three amplitudes (~ 1, 2, 3 cm) for motion in the looming (forward-backwards), vertical (up-down) and lateral (side-to-side) directions. For each feeding bout, we calculated the gain of the moths' tracking behavior as the amplitude of moth motion relative to flower motion at the driving frequency. For all three directions, the gain was lowest at 3 Hz. Tracking behavior, however, had the greatest match of animal motion to flower motion at 2 Hz for both looming and lateral motions. Moreover, there is strong coupling between these components at all frequencies. Future studies will explore the limits to hawkmoth sensorimotor integration.

**GROUND INSECT ABUNDANCE, DIVERSITY AND COLD-HARDINESS IN THE UNION BAY  
NATURAL AREA AT THE UNIVERSITY OF WASHINGTON\***

**COULTER SMITH**  
*Senior, Conservation Biology*

**JOHN EDWARDS**  
*Professor, Zoology*

**CHARLES NELSON**  
*Senior, Zoology*

**RICK SUGG**  
*Professor, Zoology*

Our study establishes base-line data on the relative abundance and diversity of local ground dwelling beetles in an urban setting. We also sought to determine the degree of cold-hardiness for select species active during the winter season. Beetle diversity and abundance was sampled using pitfall traps in the Union Bay Natural Area. Twenty pitfalls were placed in a 4x5 grid that included a habitat gradient from woody vegetated wetland to open grassland. Cold hardiness was determined for more abundant species using freezing point depression (supercooling point) as a physiological measure. The majority of surface-active insects collected were beetles in the families Staphylinidae and Carabidae. Initial samples showed Staphylinid abundance (2.8/pitfall) greater than Carabid (0.8/pitfall), but both families showed similar species number (6 species). A majority of the species collected (4 to 6 for Carabids and at least 3 of 6 for Staphylinids) are non-native, introduced from Europe. Our initial data for two species show that supercooling point was only moderately depressed. While a non-cold adapted insect may supercool to around -5 degrees C, the average was -8 degrees C for the most abundant Staphylinid (*Staphylinus* sp) (n=6), and -7 degrees C for the Carabid *Pterostichus melanarius* (n=2). For both species, individuals recovered the treatment, indicating some level of freeze tolerance. Our findings show that a number of species are active in late winter with a moderate depression of freezing point, and ability to survive at least short term freezing, and a significant fraction of introduced species. Since Seattle represents an urban, disturbed habitat with a history of port traffic, we expected to find introduced species. This finding raises questions about the effect of urban disturbance on habitat loss for native animals due to displacement by non-native animals. Furthermore, with the acquisition of this baseline data, there will be an opportunity for future biological monitoring of the area.

**FOREST FIRE AND SUBSEQUENT GROWTH OF SURVIVING TREES ON ORCAS ISLAND,  
WA**

**JASON SMITH**

*Senior, Conservation of Wildland Resources*

**DOUGLAS SPRUGEL**

*Professor, Ecosystem Sciences Division, College of  
Forest Resources*

**LINDA BRUBAKER**

*Professor, Ecosystem Sciences Division, College of  
Forest Resources*

My research addresses the role of fire in forest stands. The primary question of interest is how fire severity, as inferred from relative survivorship after the fire, influences the post-fire growth of surviving trees. Trees suffering from direct injury as a result of the fire may exhibit reduced growth in the years following the fire. However, if the fire causes tree mortality in the stand, then surviving trees could experience growth increases due to reduced competition. Four stands showing evidence of fire were analyzed: two each representing low and high fire severity. Tree cores were used to date of the most recent fire within each stand through use of fire scars and tree ages. To analyze growth trends of surviving trees the width of each annual growth ring was measured and periods of growth surge and suppression were identified. Individual tree response to fire is highly variable. Some trees show abrupt suppression of growth, others experience a growth surge and some show no significant change in the decades following the fire. It is not obvious why there is such variability in tree response within stands. Synchronous declines in growth at the stand level suggest climatic events affecting all the stands concurrently such as the "Dust Bowl" drought of the 1930s. Multiple stands showed a synchronous period of decline in the 1850s while another was relatively unaffected in this period. The unaffected stand experienced a fire fifteen years before, suggesting the possibility that reduced competition in the fire-affected stand allowed the surviving trees in that stand to avoid the severe growth reductions that occurred in the other stands.

# NEUROBIOLOGY – FROM GENES TO BEHAVIOR

*Session Moderator: Ilene Bernstein, Psychology*  
*Session Discussant: Tristan Nicholson, Anthropology, Senior*

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## REGULATION OF THE C-JUN MITOGEN-ACTIVATED PROTEIN KINASE PATHWAY IN HYPERTHERMIA-EXPOSED DAY 9 MOUSE EMBRYOS

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*EIP PRESIDENTIAL SCHOLAR*

**PHILIP MIRKES**

*Professor, Pediatrics*

Previously this lab reported that c-JUN N-terminal kinase (JNK), a mitogen-activated protein kinase in the stress activated JNK pathway, is rapidly but transiently activated (phosphorylated) in day 9 mouse embryos exposed to hyperthermia (43°C for 15 minutes). In the present study we have assessed whether the upstream kinase (SEK1) in the JNK pathway and a downstream transcription factor (c-JUN) are also activated. Using antibodies specific for serine 63 and serine 73 phosphorylated c-JUN and western blot analysis, we show that c-JUN is rapidly but transiently activated (phosphorylated) in day 9 mouse embryos exposed to hyperthermia. Activation is maximal 1 hour after embryos are exposed to hyperthermia with the phosphorylation level of c-JUN returning to baseline by 5 hours post heat shock. Using antibodies to total c-JUN, we also show that hyperthermia induces an upregulation of total c-JUN levels in day 9 mouse embryos exposed to hyperthermia. Thus, hyperthermia induces not only the activation of pre-existing c-JUN but also an increase in the level of c-JUN within the embryo. Using an antibody specific to phosphorylated (active) SEK1 and western blot analysis, we show that this upstream kinase is not activated at any time during the first 5 hours after day 9 embryos are exposed to hyperthermia. Thus, the activation of JNK and its downstream target, the transcription factor, c-JUN, are not regulated by hyperthermia-induced activation of SEK1. Our data are consistent with recently published reports suggesting that JNK activation by hyperthermia is regulated by heat-induced inhibition of a putative JNK phosphatase. *Research supported by NIEHS grants ES07026 and ES 08744.*

## THE ROLE OF IMMEDIATE EARLY GENES IN TASTE AVERSION LEARNING

**ALISON DRAGNICH**

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**ILENE BERNSTEIN**

*Professor, Psychology*

The rapid acquisition and long lasting nature of conditioned taste aversion learning (CTA) make it a good model for studying molecular mechanisms of learning and memory. CTAs are established by pairing a novel taste, the conditioned stimulus (CS), with a nausea-inducing agent, the unconditioned stimulus (US). Animals, such as rats, learn to associate the taste of the CS with the nausea caused by the US and therefore alter their behavior by avoiding subsequent exposure to the CS. Research has focused on the involvement of Immediate Early Genes (IEGs) in CTA learning. IEGs, such as c-Fos and Arc, are thought to mediate synaptic plasticity via their rapid, selective expression in recently activated neurons. The present studies focused on the role that Arc may play in CTA learning. Arc (Activity Regulated Cytoskeletal-associated) encodes a protein that localizes selectively in recently activated dendrites. The unique expression patterns and localization of Arc protein make it a likely candidate for involvement in learning and memory. An initial study examined the effects of the CS and US on Arc expression in the amygdala and parabrachial nucleus (PBN), brain regions thought to be involved with CTA learning. Results indicate that Arc expression in the amygdala is similar to that previously seen with c-Fos with a strong induction of Arc by the US but not the CS. In contrast, Arc expression in the PBN was influenced by the CS but not the US, a different pattern than the one seen with c-Fos. This finding is important because it represents the first evidence of an IEG selectively affected by the CS and it provides a tool for studying patterns of convergence of CS and US neural pathways during CTA learning.

**ALTERED REGULATION OF BRAIN WATER CONTENT FOLLOWING TRAUMATIC BRAIN INJURY\***

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*Senior, Neurobiology*

**RAIMONDO D'AMBROSIO**  
*Professor, Neurosurgery*

It is known that brain edema is a life-threatening consequence following traumatic brain injury (TBI). Yet, the basic mechanisms of edema formation are not fully understood. It is known that post-traumatic impairment of cerebral blood flow is involved in the onset of edema. However, other mechanisms are likely to be involved: post-traumatic alteration of ion-buffering mechanisms may contribute to post-traumatic edema. In this study we focus on the brain homeostasis of K<sup>+</sup>. Glial cells have been shown to perform K<sup>+</sup> homeostasis through three distinct cellular mechanisms: (1) K<sup>+</sup> spatial buffer, (2) the Na<sup>+</sup>/K<sup>+</sup> pump, and (3) the Na<sup>+</sup>/K<sup>+</sup>/ 2Cl<sup>-</sup>-cotransporter. The impairment of these mechanisms may affect cellular and extracellular osmolarity and, thus, brain water content. It has been shown that acutely following trauma, tissue ATP is decreased and the neuronal and glial Na<sup>+</sup>/K<sup>+</sup>-pump activity is diminished. In the present study we aim to determine 1) whether the post-traumatic changes in K<sup>+</sup>-buffering mechanisms may be a contributing factor to post-traumatic brain edema, and 2) what the mechanism is by which their impairment results in increased water content. To this end, we utilize the fluid percussion injury model, a clinically relevant animal model of TBI, and measure the water content of rat brain slices. We then compare these results to water content measurements resulting from pharmacological blockade of each of the K<sup>+</sup> homeostatic mechanisms. In control brain slices water content was 83.06±0.35%. Pharmacological blockade of the Na<sup>+</sup>/K<sup>+</sup> pump caused an increase in water content to 86.86±1.7% (p<0.01; n=5), while pharmacological blockade of the cotransporter yielded a water content of 82.97±0.33% (p=0.7; n=9). In summary, our data shows that decrease Na<sup>+</sup>/K<sup>+</sup>-pump activity results in brain water content increase, and may partially account for post-traumatic edema.

**THE ROLE OF THE CB1-CANNABINOID RECEPTOR IN BETA-ARRESTIN RECRUITMENT\***

**MARY LEE**  
*Senior, Biochemistry*

**KENNETH MACKIE**  
*Professor, Anesthesiology*

Tolerance rapidly develops with chronic use of cannabis and its derivatives. The active chemical constituents of cannabis are cannabinoids. The psychoactive effects of cannabinoids are mediated by the CB1-cannabinoid receptor. This receptor is a cell-surface receptor that is a member of the large family of receptors that couple with G-proteins (GPCR's). For some GPCR's, including the CB1-receptor, tolerance may be caused by desensitization of the receptor following its phosphorylation by Gprotein receptor kinases. Once the receptor is phosphorylated, it binds beta-arrestin, disrupting interactions with G-proteins, and shutting off receptor signaling. Thus, beta-arrestin is a major regulator of GPCR signaling. Normally, beta-arrestin is found throughout the cytoplasm of the cell, but during desensitization, it must interact with cell-surface receptors. How does it get there? The primary question I address is: What is the role of the CB1-receptor activation in recruiting beta-arrestin to the membrane? My main approach was to track the receptor and beta-arrestin using cells transfected with CB1-receptors and beta-arrestin green fluorescent protein chimeras. Experiments were done in both fixed and living cells using confocal microscopy. My experiments show that within minutes of stimulation by a cannabinoid receptor agonist, WIN 55,212-2, beta-arrestin migrates rapidly to the membrane. The association with the membrane is transient and after 10 minutes of agonist stimulation, beta-arrestin returns to the cytoplasm. Cannabinoid receptor agonists also cause CB1-receptor internalization - the receptor moves from the membrane toward the center of the cell. However, beta-arrestin recruitment to the membrane and back to the cytoplasm is much faster. Little is known about the factors that govern the movement of beta-arrestin to the membrane. I identified the carboxy-terminus as an important domain for beta-arrestin recruitment using CB1-receptor mutants. The results of this project will help us understand desensitization of the CB1-receptor and other GPCR's.

**ROLE OF THE APURINIC/APYRIMIDIC ENDONUCLEASE DNA REPAIR ENZYME IN  
MALIGNANT BRAIN TUMOR CHEMOTHERAPY RESISTANCE**

**KATHRYN SCHOELER**

*Senior, Cellular & Molecular Biology*

**JOHN SILBER**

*Professor, Neurosurgery*

Malignant brain tumors become resistant to the cytotoxicity of DNA alkylating agent-based chemotherapy within weeks to months. Apurinic/apyrimidic endonuclease (APE) is a DNA repair enzyme that facilitates the removal of abasic sites, cytotoxic DNA lesions produced by alkylating agents. My hypothesis is that APE contributes to alkylating agent resistance in malignant human brain tumors. To test this hypothesis, I have used antisense oligonucleotides to suppress APE activity in the human brain tumor-derived cell line SNB19. Suppression of activity 2-fold produced a 2-fold reduction in resistance to temozolomide and to 1,3-bis(2-chloroethyl)-1-nitrosourea, two alkylating agents used to treat malignant brain tumors. Importantly, suppression of APE was also accompanied by increased abundance of abasic sites. These data indicate that APE contributes to brain tumor resistance to alkylating agents by repairing lethal abasic sites.

**SACCADE-RELATED PROJECTIONS FROM THE CENTRAL MESENCEPHALIC RETICULAR  
FORMATION (cMRF) TO BURST NEURONS OF THE PONS\***

**LYNNE TOWNSEND**

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*MARY GATES SCHOLAR*

**CHRIS R.S. KANEKO**

*Professor, Physiology & Biophysics*

Saccades are rapid eye movements that reorient the fovea to a peripheral visual target. Although the neural network that generates saccades has been studied extensively, many aspects of saccadic control are still unknown. The medial pons is the anatomical location of the horizontal burst generator, which directly activates the motor neurons that produce horizontal saccades. One of the primary inputs to the horizontal burst generator is the superior colliculus. When the superior colliculus is lesioned, however, the ability to execute saccades is not severely impaired. Therefore, it is likely that the burst generator receives other inputs besides those from the superior colliculus. The central mesencephalic reticular formation (cMRF) of the midbrain contains saccade-related cells, and has been hypothesized to provide input to the pontine burst generator. The purpose of this study is to provide histological and electrophysiological evidence for this connection. We have injected horseradish peroxidase (HRP), a retrograde tracer, into the rostral pons of a rhesus macaque. HRP was transported to cell bodies in the cMRF, providing direct anatomical evidence for a cMRF-pontine connection. In two additional monkeys, we have surgically implanted chambers in the skull to permit chronic extracellular recording from neurons in the cMRF and the rostral pons. While a monkey is performing a visual task, saccade-related cells in the two key areas are identified. When both areas in an animal have been defined, we will electrically stimulate neurons at one site while simultaneously recording neural activity at the second site. We hope to antidromically activate cells in the cMRF from a stimulating electrode located in the pons and characterize their functional discharge. Successful activation would provide compelling corroborative electrophysiological evidence for a cMRF-pontine connection. Demonstration of this connection would have significant implications for current models of the saccadic system.

**SPIKE-FREQUENCY ADAPTATION OF HYPOGLOSSAL MOTONEURONS\***

**MARC YONKERS**

*Senior, Neurobiology*

*MARY GATES SCHOLAR*

**MARC BINDER**

*Professor, Physiology & Biophysics*

**RANDALL POWERS**

*Professor, Physiology & Biophysics*

Neurons respond to the synaptic inputs they receive with a complex pattern of action potentials. This pattern determines how the neuron affects the next cell in its circuit. In our lab, we examine how motoneurons translate synaptic inputs into an action potential pattern to control muscle cells. One notable response pattern in motoneurons is a reduction in action potential firing frequency in response to a constant excitatory stimulus, termed spike-frequency adaptation. The exact cellular mechanisms responsible for creating this adaptation are unknown. To examine the mechanisms of adaptation in motoneurons, we inject a sustained depolarizing current into rat hypoglossal neurons to record adaptation patterns. Next, we pharmacologically alter the membrane properties of the neuron to determine how a specific current influences adaptation. To alter the membrane properties, we use phenytoin, a drug that modifies the gating of the sodium channels responsible for the action potential. We then examine the effects that decreasing the inward sodium current has on the action potential frequency and the action potential waveform. The experimental data to date show that all trials with phenytoin exhibit an increase in adaptation. However, the change in adaptation and action potential waveform have not been consistently correlated, leaving the mechanism by which inward sodium current influences adaptation still undetermined.

# PATHOGENESIS AND GLOBAL HEALTH – CELLULAR

Session Moderator: Craig Beeson, Chemistry  
Session Discussant: Bjorn Kafsack, Biochemistry and Philosophy, Senior

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## MMP-9 OVEREXPRESSION INHIBITS SMOOTH MUSCLE CELL MEDIATED COLLAGEN GEL CONTRACTION

DAN CHOI

Senior, Biochemistry and Psychology  
MARY GATES SCHOLAR

ALEXANDER CLOWES

Professor, Surgery

Studies on matrix metalloproteinase-9 (MMP-9) have demonstrated a role in vascular remodeling and intimal hyperplasia after vascular injury. In particular, MMP-9 overexpression increased carotid artery luminal area after injury by preventing negative arterial remodeling (a decrease in total arterial area). To investigate the mechanism of this effect, we have studied the usefulness of cell-mediated collagen gel contraction as an *in vitro* model of vascular remodeling. Fischer rat smooth muscle cells (FRSMC) were stably transfected with rat MMP-9 under the control of a tetracycline-regulated promoter. These FRSMCs overexpress MMP-9 in the absence of tetracycline. The cells were suspended in collagen (Vitrogen), which was then polymerized at 37°C in the presence of CO<sub>2</sub>. The collagen gels then received 10% FBS DMEM with or without 1 µg/ml tetracycline. After 24 hours, the collagen gels were detached from the wells and contraction was determined every 24 hours by measuring the area of the gel. Contraction began in the control SMC (Tet<sup>+</sup>) gels at day 3, reaching values of about 80% contraction at day 5. In contrast, MMP-9 expressing (Tet<sup>-</sup>) SMCs did not begin contracting the gels until day 4 (day 3: 44 ± 19% and 0 ± 0% contraction for Tet<sup>+</sup> and Tet<sup>-</sup>, respectively; day 4: 55 ± 3% and 39 ± 3%, respectively; day 5: 78 ± 7% and 52 ± 9%, respectively). Overproduction of MMP-9 by Tet<sup>-</sup> cells was confirmed by gelatin zymography. We conclude that MMP-9 delays the contraction of collagen gels by FRSMC, thus providing a model with which to study the mechanism of the effect of MMP-9 on arterial remodeling.

## PHENOTYPIC CHANGES IN AORTIC SMOOTH MUSCLE CELLS FOLLOWING EXPOSURE TO MACROPHAGE-CONDITIONED MEDIA\*

NATACHA CHOUGH

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This project aims to analyze long-term changes in cultured aortic smooth muscle cells (SMCs) following exposure to conditioned media from macrophages given cytotoxic levels of oxidized low density lipoprotein (LDL). This is being conducted to better understand the role of macrophage death in advanced stages of atherosclerosis (hardening of the arteries). In lesions from older, atherosclerotic mice, SMCs surrounded by dead, LDL-loaded macrophage debris begin resembling chondrocytes (cartilage cells). This phenotypic switch, accompanied by increased collagen production, seemingly stabilizes lesions and reduces plaque hemorrhages and ruptures. We hypothesize that, as with other chronic inflammations, factors produced by dead and dying macrophages stimulate SMCs to heal atherosclerotic lesions. To test this hypothesis and model *in vivo* observations, mouse macrophages were incubated with cytotoxic concentrations of LDL for (1) 3 days, (2) 1 day, or (3) 1 day, followed by 2 days without LDL. These conditioned media were then administered in various concentrations to rodent SMC cultures to hopefully induce the phenotypic switch to chondrocyte-like cells. Markers used for studying this change include morphometric analysis of cell appearance, mRNA expression of chondrocyte-specific genes, namely type II collagen, and production of this protein. Currently, significant SMC death has been observed in cultures administered 10% conditioned media from preparation (1). Surviving cells had a low growth rate and were markedly elongated compared to cells in normal media. Cells grown in a higher percentage of conditioned media were less confluent than those grown in a lower percentage of the same media, and they were larger and less circular than control cells. In the future, we hope to see increased mRNA expression for type II collagen using Northern blotting, and type II collagen secretion in Western blots. This could provide targets for the pharmaceutical industry and for healing atherosclerotic lesions in patients suffering from cardiovascular disease.

**THE ROLE OF WNT SIGNALING IN WOUND HEALING\***

**CARRIE FATHKE**  
*Senior, Biology*

**FRANK ISIK**  
*Professor, Surgery*

During wound healing a number of coordinated events need to take place in order to reestablish skin integrity. These events are coagulation, inflammation, cell migration, cell proliferation, and matrix remodeling. Angiogenesis is the process by which new blood vessels are formed from existing vessels to restore blood supply to the wounded region and is a necessary event in wound healing. Our lab is interested in identifying the origins of the cells that will constitute the new vasculature formed during wound healing and the cell signals required for that process. Molecular and protein data from our lab showed several Wnt family members that may be responsible for the cell differentiation signal. We also have evidence that undifferentiated hematopoietic stem cells that have migrated to the wound site may form the new vessels in response to the Wnt signal. To test the role of Wnt signaling in wound angiogenesis, we activated the Wnt pathway in a mouse wound healing model using retroviral mediated infection of cells. We then evaluated the structural and temporal changes that occurred in the wounds in response to the constitutive Wnt signal. These wounds were evaluated at different stages of wound healing by immunohistochemistry, microscopy, and flow cytometry to identify the effects on angiogenesis due to the alteration in Wnt signaling.

**INDUCTION OF THE MOLECULAR COCHAPERONE P58<sup>IPK</sup> DURING THE UNFOLDED PROTEIN RESPONSE**

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*Senior, Cellular & Molecular Biology*  
*MARY GATES SCHOLAR*

**MICHAEL KATZE**  
*Professor, Microbiology*

The 58-kilodalton inhibitor (P58<sup>IPK</sup>) of the interferon-induced protein kinase (PKR) is a molecular co-chaperone that is involved in translational regulation through its inhibitory influence on the eIF-2 $\alpha$  kinase, PKR. P58<sup>IPK</sup> also has anti-apoptotic and oncogenic properties suggesting it may play a role in cellular growth control. To gain a better understanding of the cellular functions of P58<sup>IPK</sup>, we are looking at the promoter region for elements that may regulate P58<sup>IPK</sup> expression. Database and literature searches revealed a cis-acting element termed the Endoplasmic Reticulum Stress Response Element (ERSE) in the promoter region. The element is a binding site for transcription factors that are recruited upon ER stress, which is induced when unfolded or misfolded proteins accumulate in the ER lumen. The transduced signal results in the attenuation of translation and the transcription of ER resident chaperones, which unburden the ER of unfolded proteins. This process is called the unfolded protein response (UPR). Luciferase reporter assays have shown that the P58<sup>IPK</sup> promoter was up-regulated upon treatment with tunicamycin, an ER stress inducing drug. However, the P58<sup>IPK</sup> promoter was still inducible by tunicamycin after the mutagenesis of the ERSE, suggesting alternate or additional elements are responsible for the induction. Studies are in progress to identify the element responsible for the upregulation. We speculate that P58<sup>IPK</sup> may function in the UPR through its ability to regulate translation, possibly through PKR or a related eIF-2 $\alpha$  kinase, PKR-like ER kinase (PERK).

**METABOLIC FLUX AS A FUNCTION OF THE CELL CYCLE IN HEART MYOBLASTS**

**RACHEL KUHN**

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*MARY GATES SCHOLAR*

**CRAIG BEESON**

*Professor, Chemistry*

The purpose of this project was to study the metabolic processes of a population of heart myoblast cells as they progressed through the cell cycle. These metabolic activities are relevant to the study of the behavior of heart cells during and immediately after heart attacks, and consequently in the development of new drug therapies. These changes in metabolic activity were measured using a microphysiometer, a device that relies on changes in pH and on the relative outputs of different waste products to determine what proportion of a cell's metabolic activity is channeled through specific metabolic pathways. The requirements for this project were: a) A synchronous population of cells progressing normally through the cell cycle. The activity of one cell is too small to be measured, so it is necessary to develop a population that is progressing in synchrony and effectively behaving as one large cell. b) The ability to measure their metabolic activity on the microphysiometer. This project proceeded in several stages: a) initial attempts at synchronization, b) synchronization attempts revisited, c) the development of a defined tissue culture media that would allow for the measurement of metabolic activity on the microphysiometer without perturbing the activity of the population studied.

At the end of this research period, many effective synchronization techniques for use with H9c2 cells (the heart myoblasts studied) had been developed, along with a defined media that allowed for normal cell growth and the serial passage of subsequent generations. However, this media did not seem sufficient for the progression of cells through the cell cycle after synchronization. While the primary goal of the project has not yet been realized, the development of the defined media allows for more controlled studies of this cell line in general, and on the microphysiometer in particular.

**SPARC AS A MODULATOR OF ENDOTHELIAL CELL BEHAVIOR\***

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*SPACE GRANT SCHOLAR*

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SPARC (secreted protein acidic and rich in cysteine) is a multifunctional glycoprotein that modulates cellular interaction with the extracellular matrix (ECM), inhibits cellular proliferation and regulates the activity of several growth factors such as vascular endothelial growth factor (VEGF), basic fibroblast growth factor, and platelet-derived growth factor. The expression of SPARC in the adult is limited largely to sites of tissue remodeling, such as tissues undergoing wound healing, inflammatory disease, or tumor development. Angiogenesis, the development of new blood vessels from preexisting ones, is an important component of the tissue remodeling process. Angiogenesis involves the activation, migration and proliferation of endothelial cells, the cells constituting the inner lining of blood vessels. Bovine aortic endothelial cells (BAE) grown *in vitro* respond to exogenous SPARC by changing their shape, which results in cells with a 'rounded' morphology. SPARC also induces an increase in the permeability of BAE monolayers *in vitro*. We have been applying both of these activities to examine the interaction of SPARC with VEGF, another potent permeability and survival factor for endothelial cells. Although SPARC has been shown to block VEGF-induced proliferation of endothelial cells, preliminary results suggest that SPARC does not inhibit VEGF induced permeability of BAE cells. Additionally we are using *in vitro* rounding and permeability assays to screen a panel of monoclonal anti-SPARC antibodies for the ability to inhibit the effect on SPARC function. Through characterization of these antibodies we aim at creating tools to further elucidate the varied nature of SPARC function and its role in angiogenesis.

**C1Q REGULATES TOLL-LIKE RECEPTORS OF FIBROBLASTS\***

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*Senior, Cellular & Molecular Biology*

**SANDRA BORDIN**

*Professor, Periodontics*

**FRANK ROBERTS**

*Professor, Periodontics*

Periodontitis is the most widespread human infection and the major cause of tooth loss in the adult US population. The initial bacterial infection progresses to a chronic inflammation. The host inflammatory mediators irreversibly destroy bone and connective tissues supporting the teeth. The outcomes of current therapies are inconsistent, because we do not fully understand interactions among components of the host inflammatory response. In order to facilitate periodontal therapies, we study the molecular and cellular activities of cell types that are affected by periodontitis. Periodontal bacteria produce a virulence component, lipopolysaccharide (LPS). LPS triggers cell surface Toll-like receptors (TLR)-2 and -4 to activate the host inflammatory response. Protein C1q is present in tissues at sites of infection and inflammation. We are examining whether C1q affects expression of TLR2 and TLR4 of cultured human periodontal fibroblasts cells. Our goal is to advance the understanding of how the host inflammatory response is regulated. The TLRs begin as molecular messages copied from the TLR gene within the cell. These messages are then used to construct the protein surface receptors. I assessed expression of messages for TLR2 and TLR4 in LPS-stimulated and non-stimulated (control) fibroblasts to which physiologic quantity of human C1q was added. First, the submicroscopic amounts of TLR message were amplified in each sample to a visible level at an equal rate to maintain the percentage difference of TLR message among the test groups, then assessed. The data indicate that C1q down-regulates expression of TLR2. Regulation of TLR4 under the same experimental conditions is in progress. My results suggest that C1q inhibition of TLRs may cause fibroblasts of periodontal lesions to become less responsive to periodontal bacteria. Therefore, the host inflammatory activity may subside. Further studies may aid in the design of novel therapeutic approaches to periodontitis.

**GENE PROFILING OF HISTONE DEACETYLASE ACTIVITY IN  
HUMAN MALIGNANT ASTROCYTOMAS\***

**LORNE WALKER**

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*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**PIERRE MOURAD**

*Senior Applied Mathematician, Applied Physics Lab*

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The mechanisms and pathways of oncogenesis are extremely important topics in the health sciences today. One key process implicated in tumor formation is the silencing of tumor-suppressor genes. Our research has focused on one such gene-silencing process, activated by the enzyme histone deacetylase. In normal human transcriptional regulation, acetyl groups are bound to the histones in order to unwind the chromosome. This allows the transcriptional machinery to transcribe mRNA's from a specific gene. In many tumor cells the enzyme histone deacetylase removes these acetyl groups, preventing translation, and "silencing" the effected gene. Trichostatin A (TSA) is a specific histone deacetylase inhibitor that has been shown to have powerful tumor-arresting activity. In our experiment we treated several malignant astrocytoma tumor cell lines, as well as several unrelated cell lines with TSA. We then co-hybridized fluorescent-labeled cDNA probes synthesized from these cell lines along with cDNA probes from non-TSA treated lines to a DNA microarray chip. By this method, we are able to identify genes that changed expression level due to treatment with TSA. It is our hope that by analyzing these expression profiles we can better characterize the genetic changes that take place in human oncogenesis.

# EXTRAORDINARY APPROACHES TO ORDINARY PROBLEMS

Session Moderator: Chen-Ching Liu, College of Engineering  
Session Discussant: Derek Inaba, Aeronautical & Astronautical Engineering, Junior

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## OKHOTSZIA, TAXONOMIC DATABASES, AND BIOINFORMATICS\*

**TREVOR ANDERSON**

*Senior, Zoology*

**THEODORE PIETSCH**

*Professor, Aquatic & Fishery Sciences*

After seven years of field research and curation of specimens, members of the Okhotskia project have completed a biotic survey of the Kuril Archipelago in the Russian Far East. In these seven years a large amount of taxonomic data has been generated. These are primarily data on the specimens collected, along with locality, habitat, and other information that makes the specimens useful for scientific research. In order to provide this information in a timely fashion to the scientific community, the Internet has been used to distribute project data in the form of online searchable databases. The current goal is to convert these online data to a standard format in order to access a common protocol developed for libraries, that has been modified for biological data. This protocol is being promoted by the National Science Foundation in order to make taxonomic data from different institutions searchable from one location on the web. This will make data, that are in general restrictive in their access and difficult to work with, readily available for research and environmental policy decisions. It will also allow different perspectives and ideas into the research process as people from anywhere in the world have access to data that have been languishing in institutions. As information from multiple institutions is combined, it will then be possible to analyze the consolidated data with powerful tools such as GIS programs or to download these in a useable format such as Excel. The work done thus far for the Okhotskia project has focused on the technical problems of implementation and the possible applications upon completion. Representative taxa from the Okhotskia database have been analyzed using the tools that will be available to demonstrate the exciting potential of applying bioinformatics to taxonomic data.

## INVESTIGATION OF PYRUVATE AND SUCCINATE METABOLISM IN METHYLOBACTERIUM EXTORQUENS AM1\*

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*Senior, Microbiology*  
MARY GATES SCHOLAR

**MARY LIDSTROM**

*Associate Dean for New Initiatives, Chemical  
Engineering and Microbiology*

*Methylobacterium extorquens* AM1 is a Gram-positive, pink-pigmented, facultative methylotroph, which primarily utilizes methanol as both a carbon and energy source. Similar C2, C3, and C4 compounds also may be utilized for energy production. However, the pathways involved in these processes are poorly understood and many of the genes remain unidentified. As part of an ongoing effort to understand the metabolic pathways and flow of carbon compounds through them, a metabolic flux analysis model has been developed. In order to refine this model, constraints based on the metabolic genotype of *M. extorquens* AM1 mutants must be determined. My research utilizes random insertion mutants, which are grown on methanol, to identify mutants with poor growth on pyruvate, succinate, or both. The genes from these growth-deficient mutants are being amplified via PCR, sequenced, and compared to the partially completed *M. extorquens* AM1 genome in an attempt to determine which mutants will help elucidate the metabolic pathways of interest. To date, more than 11,000 mutants have been screened and 85 genes have been identified. A small subset of closely related genes will be chosen to be cloned, over-expressed, and their activity assessed. From these studies, a better understanding of the metabolic pathway will enable constraints to be added to the metabolic flux model. Based on a complete understanding of the metabolic flow, *M. extorquens* may eventually be fed simple carbon sources as a starting point for the production of industrially relevant compounds such as amino acids, biodegradable plastics, and vitamins.

## EXTRAORDINARY APPROACHES TO ORDINARY PROBLEMS

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### INVESTIGATION OF A MINI-MAGNETOSPHERIC PROPULSION SYSTEM (M2P2) FOR A MANNED MISSION TO MARS

**DEREK INABA**

*Junior, Aeronautics &  
Astronautical Engineering*

**PAUL CHOE**

*Senior, Aeronautics &  
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**ADAM BRUCKNER**

*Professor and Chair, Aeronautics  
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**HILLARY CUMMINGS**

*Junior, Physics  
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*Senior, Aeronautics &  
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**ALLEN YOO**

*Senior, Aeronautics &  
Astronautics*

The Department of Aeronautics & Astronautics at the University of Washington proposes to participate in the Annual UW Undergraduate Research Symposium. A multidisciplinary team of 11 students have been performing feasibility studies on utilizing an advanced propulsion system developed here at the UW, the Mini-Magnetospheric Plasma Propulsion system (M2P2), for a manned mission to Mars. The students have been performing this work as an independent study project since the Fall of 2000. The principal faculty adviser for the project is Prof. Adam P. Bruckner, Chair of Aeronautics & Astronautics; co-advisers are Prof. Robert Winglee of Geophysics, the originator of the M2P2 concept, and Prof. John Slough of Aeronautics and Astronautics. A group of students and a faculty member will attend the HEDS-UP Forum in Houston, TX on May 3-5, 2001 to present their results to a group of NASA scientists at the Johnson Space Center. It is proposed that the remaining students present their findings at the Undergraduate Symposium.

## EXTRAORDINARY APPROACHES TO ORDINARY PROBLEMS

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### ENERGY OF THE FUTURE: UW STUDENTS DEVELOP FUEL CELLS\*

**JUSTIN MAHAFFA**  
*Senior, Chemical Engineering*  
MARY GATES SCHOLAR

**AARON HARRIS**  
*Junior, Mechanical*  
*Engineering*

**ERIC STUVE**  
*Professor, Chemical Engineering*

**RUTH HALTER**  
*Senior, Chemical Engineering*

**JON MORTON-ASLANIS**  
*Senior, Chemical Engineering*

Students from the Chemical and Mechanical Engineering Departments at the University of Washington are currently studying and building fuel cells to promote alternative energy sources. The recent power shortages highlight the need for new energy sources to meet our increasing energy needs. Fuel cells are one of the prime candidates for new energy sources. A fuel cell is similar to a battery. It converts chemical energy into electricity. However, unlike a battery, a fuel cell will run continuously when supplied with fuel. The fuel used in a fuel cell can be hydrogen, methanol, or even automobile gasoline. To obtain increased power the individual fuel cells are connected together in series, to make up a fuel cell stack. Our goal is to construct a working proton exchange membrane (PEM) fuel cell based on technology currently used in industry. We strive to obtain valuable experience in manufacturing, assembling, and testing of PEM fuel cells. Two groups share the responsibility of research and development. The first group is comprised of chemical engineering students focusing on single cell performance. This group applies concepts from chemical engineering laboratory and lecture courses, such as reactor design and heat and mass transfer. The second group consists of mechanical engineering students addressing stack design. This group uses a mechanical engineering perspective involving knowledge of materials, fluid analysis, and manufacturing to develop a fuel cell stack. The single cell group has steadily improved fuel cell performance. The single cells currently perform at 60 percent of industry standards. A fully operational test stand, created by the students, allows a full range of tests to be performed. The stack design group has completed designs and developed computer models for fluid flow.

### A NOVEL APPROACH TO SOUND DETECTION\*

**HARI SHROFF**  
*Senior, Bioengineering*  
MARY GATES SCHOLAR  
SPACE GRANT SCHOLAR

**JAMES CALLIS**  
*Professor, Chemistry*

**GAMAL KHALIL**  
*Professor, Chemistry*

Last summer, the Callis Research Group developed the Phosphorescent Microphone (PM). This device consists of a resonant tube with a speaker at one end and a thin layer of pressure sensitive paint at the other. Resonant frequencies of the tube occur when the frequency of sound generated by the speaker is equal to an odd integer multiple of the speed of sound divided by four times the tube length ( $n = nc_s/4L$ ,  $n=1,3,5$ ). When the tube resonates, the PM senses the oscillating pressure changes in the sound wave by the variations in oxygen pressure. These dynamic changes in pressure cause changes in the phosphorescent intensity of the paint. The PM was originally constructed to test a pressure sensitive paint capable of detecting the lift pressure generated by a honey bee in hovering flight. We have shown that the PM is sensitive enough to detect pressure changes as small as 0.15 torr at frequencies up to 2.5 kHz. Although the PM can be used to determine the properties of pressure sensitive paints, it may also provide a novel way to image sound fields.

## EXTRAORDINARY APPROACHES TO ORDINARY PROBLEMS

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### FINDING NEW APPLICATIONS OF PRESSURE SENSITIVE PAINT\*

**MARK STEEDMAN**  
*Freshman, Undecided*  
*MARY GATES SCHOLAR*  
*SPACE GRANT SCHOLAR*

**GAMAL KHALIL**  
*Professor, Chemistry*

**MARTIN GOUTERMAN**  
*Professor, Chemistry*

In the early 1990s, the Gouterman Research Group at the University of Washington developed Pressure Sensitive Paint (PSP). The paint consists of three components: a metallic porphyrin, an oxygen permeable polymer, and a solvent. The paint emits a bright red luminescence under ultraviolet light, but in the presence of oxygen the paint's luminescence is quenched. The amount of oxygen in the air is sensitive to pressure: lower pressure leads to fewer oxygen atoms. Thus, at lower pressures the paint's luminescence is quenched much less than at higher pressures. PSP was originally developed for airplane design. PSP is sprayed onto an airplane wing, which is then placed in a wind tunnel. With air rushing over the wing, a special camera can record and map out the different pressures on the wing. Now, a decade later other applications of PSP have come into effect. I have looked at two of these applications. My research involved using PSP to study the effects ice has on an airplane wing. I did the preliminary work of spraying PSP onto small pieces of aluminum coated with ice. I would then look at the paint under a special fiber optic instrument and record how the paint reacts in environments with different amounts of oxygen. In the second application PSP becomes an oxygen sensor. The sensor would be used to detect the amount of oxygen used by a person breath-by-breath. This would make a very sensitive indicator to a supply/demand imbalance of oxygen used by a patient, and could lead to the possible early detection of cardiac arrests and hypoxemia, as well as many other possible health problems. I am testing different combinations of porphyrins, polymers, and solvents as well as different methods of fabrication of the sensor to see which combination gives the best results.

### PATTERN DESIGN FOR SELF-ASSEMBLY OF MEMS\*

**CAMERON TOM**  
*Freshman, Pre-Engineering*

**NATE JACOBSON**  
*Freshman, Pre-Engineering*

**KARL BÖHRINGER**  
*Professor, Electrical Engineering*

**ASHIS VAIDYA**  
*Freshman, Pre-Engineering*

Micro Electro Mechanical Systems have different functions, such as sensing, actuation, computation, and communication into a single system. Their sizes range from one micrometer to over a millimeter. Mechanical assembly of MEMS requires complicated and specialized micro-tools and robots. Self-assembly of MEMS provides a potential method of a low cost, simple batch process with a wide range of applications. One method of self-assembly relies on the strong attraction between hydrophobic surfaces in water. The parts and the substrate are both patterned with hydrophobic surfaces. When both the parts and substrate are placed in water, the parts are attracted to hydrophobic areas on the substrate and align themselves with certain agitation. When the hydrophobic surface on the part contacts the hydrophobic surface on the substrate, they stick, and will slide into place as long as the overlapping area between them keeps increasing, since the hydrophobic surfaces seek to avoid contact with water. A lubricant acts to reduce sticking. Our approach on this project is to simulate the attraction force as a force proportional to the overlapping area between the hydrophobic surfaces. We have implemented simulations including both translation and rotation. The translation behavior at each specific rotation should not contain local maxima of attractive force. The parts should align onto the substrate in a unique way. Thus, the overlapping area between surfaces at each rotation should increase as the part rotates toward the ideal alignment. We are also working to design a process to find the best match to a given shape, since parts usually come manufactured in a standard shape already.

# ENVIRONMENT, CHANGE, & PUBLIC POLICY

*Session Moderator: John Palka, Zoology and Program on the Environment*  
*Session Discussant: Jillian Kinghorn, Environmental Studies, Senior*

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## DETECTION OF ANALYTES IN SEAWATER USING SURFACE PLASMON RESONANCE (SPR)

**LUCINDA DUNLAP**

*Senior, Zoology and Conservation Biology*

**CLEMENT FURLONG**

*Professor, Medical Genetics*

**ALEXEI NAIMUSHIN**

*Senior Fellow, Medical Genetics*

Surface plasmon resonance (SPR) sensors have the capability of monitoring analytes in real-time. Until recently SPR technology has been quite expensive and non-portable. Systems previously manufactured cost approximately \$200,000. Our collaborators at Texas Instruments (TI) have developed miniaturized, portable, and inexpensive SPR devices. We have developed temperature stabilization for these systems and surface derivatization protocols for detection of specific analytes. We are currently evaluating the sensitivity of detection and limitations associated with three prototype SPR devices, including two developed by TI and one laboratory-scale system designed at the University of Washington. Our aim is to develop real-time detection systems for different classes of analytes in the marine environment, including toxicants such as pesticides, small proteins, viruses, and whole cells. The system has been designed to be portable, inexpensive, and easy to operate. Initial experiments show that we are able to detect sub-nanomolar concentrations of *Staphylococcus* enterotoxin B in complex matrices, such as seawater, as well as urine, milk, and buffer solutions. The incorporation of a reference channel in these systems serves to compensate for any problems with non-specific binding and any temperature changes not controlled by the Peltier control device. This technology has many other applications in medicine, research, commercial industries, and detection of biowarfare agents.

## EFFECTS OF TIMBER HARVEST ON BRYOPHYTES

**BRIAHNA KALIL**

*Senior, Botany and Comparative Literature*

*MARY GATES SCHOLAR*

*SPACE GRANT SCHOLAR*

**CHARLES HALPERN**

*Professor, College of Forest Resources*

Few studies of forest fragmentation have considered the effects of timber harvest and creation of forest edges on under-story bryophytes (mosses and liverworts). These nonvascular plants contribute significantly to the diversity and functioning of Pacific Northwest forests. Because they are sensitive to disturbance and to changes in microclimate, bryophytes may serve as indicators of environmental change. I have studied the short-term responses of ground-layer bryophytes to timber harvest and creation of edge habitat in Douglas fir forests of the western Cascade Range, Washington. Sampling was conducted in two, 13-hectare harvest units in which 40% of the original forest was retained in 1-hectare circular patches (aggregates). The abundance (cover) of each bryophyte species was estimated in small, permanent plots spaced at 5-10 m intervals along 100-m-long transects that extended from the interior of a forest aggregate into the adjacent harvested matrix. Plots were sampled both before (1996) and 1 year after harvest (1998). I compared changes in species richness and abundance between plots in forest aggregates and adjacent harvested areas, and assessed gradients in bryophyte response as a function of distance from the forest edge. The results of this study will add to our understanding of the ecology and dynamics of bryophytes in managed forests of the Pacific Northwest.

**WATCH YOUR STEP: EFFECTS OF HUMAN TRAMPLING IN THE INTERTIDAL HABITAT  
AT SAN JUAN COUNTY PARK**

**ASHLEY OLSON**

*Senior, English*

**JENNIFER RUESINK**

*Professor, Zoology*

Intertidal habitats around the world are being destroyed by various activities, such as collection and harvesting of organisms, trampling, and boulder flipping. It is because humans use the intertidal constantly, as a source of recreation and education, which creates the need for a clear understanding of the effects of trampling in the intertidal. Rocky intertidal habitat at San Juan County Park, Washington, was experimentally trampled to assess risks of human visitation to ecological communities. For six weeks in spring, six 5 m vertical transects were subjected to augmented trampling (250 steps three times a week) in the zone dominated by the brown alga *Fucus gardneri*, and six additional transects received low levels of trampling from park visitors. Densities of five taxa were recorded throughout this period and for three months thereafter. Repeated observations were made at three tide heights along each transect using fixed quadrats (20 x 20 cm). Trampling reduced cover of *Fucus* to 30% of its original value within six weeks, and cover remained lower in trampled than control quadrats throughout the "recovery" period. Trampling also resulted in a short-term decline in species richness, from an average of 8 to 7 species per quadrat. The turf-like alga *Endocladia muricata* did not respond to trampling, nor did barnacles. Mobile gastropods (limpets and whelks) also remained similar in trampled and control areas. Bare space showed a delayed response to trampling, increasing 1 month after trampling ceased. This study highlights a management challenge of protecting natural habitats in parks and reserves while still encouraging public access and appreciation.

**THE EFFECT OF HABITAT ON FISH AND CRAB SPECIES ABUNDANCE, DIVERSITY, AND  
SIZE IN TEMPERATE COASTAL MARINE COMMUNITIES\***

**JESSICA RAAUM**

*Senior, Biology*

**DONALD GUNDERSON**

*Professor, Aquatic & Fishery Sciences*

**DAVID FLUHARTY**

*Professor, School of Marine Affairs*

This study examines the effect of different habitat variables such as surface currents, depth, and vegetation, on the abundance, and species richness of crab and fish species in the Puget Sound, WA. Four sites were sampled from September to November 2000 using a beam trawl and/or a beach seine. Site selection was based on accumulation of drift cards (Klinger, 2000) and includes Argyle Bay, Davis Bay, South Griffin Bay, and Cattle Point (two high and two low accumulators respectively). The habitat at each site was mapped using an underwater camera, (Trnka 2000), and regions of specific vegetation were selected for sampling. Data collection included recording all fish and crabs caught, and measuring the length of all fish and Dungeness crab. Depth, time, location, and the amount and percentage of vegetation found in the tows were also recorded. Results demonstrated that neither density nor species richness was correlated with accumulation of drift cards by surface currents, and both density and species richness were highest in the 0 to 5 ft depth zone. Density was highest in Ulva and eelgrass combined, and diversity increased with vegetation complexity. Eelgrass seemed to be important in determining both abundance and species richness. Specific analysis was also done for the five most abundant or commercially important species: helmet crab, Dungeness crab, buffalo and great sculpin, staghorn sculpin, white spotted greenling, gunnels, and juvenile copper rockfish. The presence of eelgrass correlated with high densities of helmet crabs. High densities of gunnels, Dungeness crab, and juvenile copper rockfish were found in the combination of eelgrass and Ulva. This vegetation type also held a high density of buffalo and great sculpins, but eelgrass and Laminaria together held high densities of this species pair as well. Most white spotted greenlings were found in complex vegetation. Vegetation including Ulva correlated with the presence of staghorn sculpins, with highest densities found in Ulva and Laminaria together.

**SORPTION STUDIES OF ORGANIC MATTER FROM VARIOUS PHYTOPLANKTON TO  
MULTIPLE MINERAL SURFACES**

**JESSI SATTERBERG**

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**RICK KEIL**

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**EVELYN LESSARD**

*Professor, Oceanography*

The organic remains of phytoplankton form a primary signature in sedimentary systems that allow for the evaluation, and reconstruction of past events. The integrity and comprehensiveness of this signal is determined, in part, by the interactions between organic matter and mineral. This study was designed to assess if the organic matter of different phytoplankton taxa (diatoms, dinoflagellates, and prymnesiophytes), sorb differently to sediments. An additional objective of this study was to evaluate the hypothesis that what determines the degree of adsorption is the sediment structure itself. Cytoplasm from four phytoplankton species, *Phaeocystis globosa*, *Gymnodinium sanguineum*, *Scrippsiella trochoidea*, and *Ditylum brightwellii* was repeatedly exposed to three minerals montmorillonite, kaolinite, and chlorite, in order to quantify sorption. Results indicate that the organic matter of various phytoplankton species absorbs differently to different sediments. The most reactive species also varies for each mineral. The total amount of organic matter adsorption also ranged, with montmorillonite being the most reactive sediment and kaolinite being the least reactive.

**ATTITUDES TOWARD CURRENT AND ALTERNATIVE MANAGEMENT STYLES IN  
ALASKA'S LIMITED ENTRY ROE HERRING FISHERIES\***

**GEORGE STEARNS**

*Senior, Fisheries*

**DANIEL HUPPERT**

*Professor, School of Marine Affairs*

A survey of permit-holders in Alaska's southeast commercial roe herring purse seine fishery was conducted to determine attitudes toward current and alternative management styles. Survey respondents indicated for the most part that current management is addressing issues pertaining to the fishery adequately. Most respondents felt to some degree that it would be a good idea to implement an individual fishing quota (IFQ) management style in their fishery. Ownership of halibut or sable fish IFQ's seemed to polarize respondent's opinions on implementing an IFQ management style for their herring fishery. Respondents consistently indicated that an equal quota sharing system would be best for issues that respondents deemed most important for herring management to address (conservation of the resource, fish quality, and safety). A majority of the respondents felt that implementing an IFQ management system in their fishery would have a negative effect on someone, but were mixed on whether implementing an equal quota sharing management system would hurt someone.

**CHARACTERISTICS OF MAJOR RIVER FLOODING EVENTS IN WESTERN WASHINGTON\***

**VICTOR STEGEMILLER**

*Junior, Atmospheric Sciences*

**DOUG MCDONNAL**

*National Weather Service, Seattle, WA*

**CLIFF MASS**

*Professor, Atmospheric Sciences*

If you have lived in Western Washington for any amount of time and watch the evening news, you have probably heard predictions in the late winter that the spring and early summer there will be serious floods when the heavy snow pack in the mountains melts. This make sense, as precipitation turns to rain and temperatures rise in high elevations, the snow pack melts and flows into rivers. If it were unusually warm or rained a lot, it would stand to reason precautions should be made for heavy floods in river basins. This is really not the case in Western Washington. Floods are more prone from late fall through the wintertime, most noticeably in November and December, rather than May to June, when we have our snow pack melt. What then causes these flooding events in Washington? Heavy rain events are solely to blame. Major flooding events occur a certain time after a heavy rain. Relying on this direct relationship, a "classic" synoptic pattern of a flood causing storm could be made, making a great tool meteorologists and hydrologists could use to forecast floods in Western Washington. We took flow rates from nine different river gauges on nine rivers in three sectors of Western Washington, found the 20 worst events in each sector, and made composite synoptic maps for each sector. The composites turned out nicely, with little deviation.

*“He opened the door and lead me into the realm of the atomic nucleus.  
With patience he taught me--as one intimately familiar with a landscape  
would teach a foreigner--what rules to follow and what words to speak, in  
a land smaller and stranger than I could imagine.”*  
*- Jeffrey Giansiracusa, Physics, Senior*

*“[My mentor] has been a tremendous inspiration for me and many other undergraduates of the astronomy department. She patiently presents challenges and encourages us to accept and progress with them in our individual ways. She will always be my inspiration as I continue my astronomical career.”*  
*- Jeremiah Murphy, Astronomy and Physics, Senior*

**UNDERGRADUATE ART IN MARY  
GATES HALL**

*“Research is important so people don’t think of their world as just a narrow box, and they expand their view of the world. Without having my mentor’s help working on my thesis I don’t know if I would have been able to express what I had learned to others.”*

*- Maret Kane, Geography and Latin American Studies, Senior*

## UNDERGRADUATE ART

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### *MAIN STAIRCASE AND ENTRANCE*

**RICHARD JOHNSON**

*Untitled*

*Untitled*

*Untitled*

**DWIGHT JONSSON**

*Untitled*

### *BACK STAIRCASE, ENTRANCE, AND COFFEE CART*

**PAUL KOMADA**

*A Roma*

*Ad Arezzo*

*Red, Yellow, and Blue #1*

**KRISTA MAXWELL**

*Ladies*

**BECKY SMURR**

*Tall and Dark*

### *CAREER COUNSELING SERVICES*

**HELEN QUACH**

*Suzallo Entrance*

**J. QUIN**

*Suzallo Reading Room*

**SERGIO GONZALES**

*Untitled*

*Intercourse*

*Untitled*

**KAREN LAMB**

*Rainbow Canna I*

*Lily*

*Open Up XI*

**MELISSA OSBORNE**

*The Day Pat's Demons Got Out of the Box*  
*August*

**YVONNE PEDERSEN**

*Arcade*

*Untitled*

*Dutch Master*

## UNDERGRADUATE ART

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### **GATEWAY CENTER**

#### **RICHARD JOHNSON**

*Examination VII*

*Examination III*

*Examination VI*

*Examination*

#### **TOVA PETERSON**

*Suitcase Series (series of six)*

#### **SETH SEXTON**

*Ovoid*

*Study 1*

*Study 3*

#### **DANA STRICK**

*Untitled*

*Untitled*

*Untitled*

### **SECOND FLOOR HALLWAY**

#### **JOHN BURKETT**

*Untitled, 1*

*Untitled, 2*

*Untitled, 3*

#### **JONATHON CANCRO**

*Alizarin*

*Portrait*

*Thalo*

*Cream and Red*

*Orange Square*

*Landscape*

*Cherry Trees*

*Blue and White*

#### **RICHARD JOHNSON**

*Monolith I*

*Blue Heart*

*Monochrome Heart I*

*Untitled*

*Untitled*

#### **DWIGHT JONSSON**

*Still Life*

*Kitchen*

#### **PAUL KOMADA**

*Conte Ugolino*

## UNDERGRADUATE ART

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### *SECOND FLOOR HALLWAY (CONT.)*

#### **KAYLA MOHAMMADI**

*Spring*  
*Solitude*

#### **SETH SEXTON**

*Untitled Series, III*  
*Untitled Series, II*

#### **VANNESSA TRAN**

*Untitled 24*  
*Untitled 20*  
*Untitled 21*  
*Untitled 23*  
*Untitled 34*  
*Untitled 32*  
*Untitled 22*

#### **JEANNE YEASTING**

*Untitled*

### ***HONORS PROGRAM***

#### **KENYON COOKE**

*Royal Creek*  
*Fishcer Creek II*  
*Shadow Creek*  
*Tenaya Canyon*  
*Vulgar Fractions*  
*Hemlock Quileute*  
*Paradise River*  
*Ruby Beach*  
*Longmire Meadow*  
*Kelp, Brown's Point*  
*Luetkea Falls*  
*Bandon Beach*  
*Sungod Cove*

#### **JEFF DEGOLIER**

*Untitled*  
*Untitled*  
*Untitled*  
*Untitled*

#### **JULIAN EPPS**

*untitled series of twelve*

#### **LAURA HANSEN**

*La Conner Slough*

#### **MONIKA SABOL**

*Protective Shell*  
*Physical Protection Blanket*

## UNDERGRADUATE ART

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### *OFFICE OF THE DEAN OF UNDERGRADUATE EDUCATION*

#### **KENYON COOKE**

*Brown's Point*  
*Chiton Cove Brown's Point*  
*Madrone*  
*Chiton Cove*  
*Haro Strait*  
*Sun God Cove*

#### **BRADFORD CROWDER**

*Lanterns*  
*Through the Smoke*

#### **ANA FERNANDEZ**

*Trampled*  
*Discharge*  
*Recently Released*  
*Woman Under Scrutiny*  
*Void*

#### **SERGIO GONZALES**

*Untitled*  
*Untitled*

#### **RICHARD JOHNSON**

*Examination -I*  
*Untitled*  
*Untitled*  
*Untitled*

#### **YVONNE PEDERSEN**

*Untitled*  
*Untitled*

#### **TOVA PETERSON**

*Untitled series of three*

#### **VANNESSA TRAN**

*Untitled 12*  
*Untitled 25*  
*Untitled 4*

**UNDERGRADUATE ART**

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***PROGRAM ON THE ENVIRONMENT***

**KENYON COOKE**

*Pond*

*Big Lagoon*

*Rialto Beach*

***UWIRED***

**BRADFORD CROWDER**

*Understanding Pandora*

*Undercurrents*

*Fire in the Underbrush I*

*Fire in the Underbrush*

**PAUL KOMADA**

*Ad Assissi*

*Il Castello San Angelo*

*“It is [my mentor’s] infectious enthusiasm that makes this project so  
fun and exciting.”  
- Marie Vendettuoli*

# **ACKNOWLEDGEMENTS**

*“Not only is [my mentor] an exceptional mathematician and but his keen interest in both teaching and research are reflected in his endless energy and enthusiasm...more importantly, as a mentor [he] has provided me with essential skills such as communication skills and self-confidence that I will carry throughout my life, beyond my academic career.”*

*- Kristin Spaulding, Applied Computational & Mathematical Sciences, Senior*

*We wish to thank all of the faculty members, staff, and graduate students who have contributed to the education of the undergraduate researchers featured in this symposium. None of this would have been possible without you.*

*We would like to thank all of the volunteers who helped to organize and run this event. Dina Mandoli, J. Nathan Kutz, Daniel Dorsa, Mark Patterson, Paul LePore, Paul Hopkins, John Wilkerson, Bryan Jones, Roxanne Hamilton, Robin Wright, Ana Mari Cauce, Dan Schwartz, Thomas Daniel, Ilene Bernstein, Craig Beeson, Chen-Ching Liu, Johnny Palka, Harry Hayward, Fred Campbell, Jodene Davis, Ken Etzkorn, Kim Johnson-Bogart, Pat Wrobel, Steve Olswang, Chris Ozubko, Shawn Wong, Hari Schroff, Vicente Garcia, Kristin Spaulding, Suzanne Powell, Emily Beyer, Aaron Clefton, James Ham, Paul Blainey, Maret Kane, Julie Johnson, Jessica Hughes, Lael Weis, Gilbert Martinez, Carlos Moreno, Tristan Nicholson, Bjorn Kafsack, Derek Inaba, Nancy Hennes, Beret Kirshner, Mona Pitre-Collins, Michaelann Jundt, Brenda Humphrey, Debbie Weigand, Jason Johnson, Jason Boyd, David Sayrs, Cynthia Caci, Kay Ballston, Jim Scott, Christine Stickler, Lauren Struck, Josh Gibbs, George Quibuyen, Kevin Gould, Jennifer Dow, Jessica Beyer, Irene Chin, Irene Svete, Roy Chan, Hagar Shirman, Judi Clark, Dwight Jonsson, Judy Robertson, John Linse, and Cathy Beyer. We would also like to thank all of the professors who either released or moved their classes for the symposium. Special thanks to: Holli Riebeek, Walter Ruzzo, Tai-Chang Chen, Thomas Horbett, Galen R. Shorack, Thomas S. Richardson, Laurie Blackburn, Brian Curless, Steve Seitz, Stephen L. Tanimoto, Philip Malte, Allyson Carlyle, Raymond Jonas, L. Bushnell, and Dan Suciu. There are also many, many others who have made this event possible. Your dedication has helped to nurture the talents of these student researchers, and foster the accomplishments they present today.*

We express appreciation for leadership in the integration of research and teaching at the UW provided by the Office of the Vice Provost for Research, the Office of Undergraduate Education, and the Office of the President. Lastly, we thank these offices for the financial support necessary to stage the symposium.