

Fostering a Community of Student Scholars

UNIVERSITY OF WASHINGTON'S
Eleventh Annual Undergraduate Research Symposium
Celebrating Undergraduate Scholarship and Creativity

16 May 2008

MARY GATES HALL

12:00 – 5:00 PM

PROCEEDINGS

*Created by the Undergraduate Research Program with the support of
Undergraduate Academic Affairs, the Office of Research,
the Mary Gates Endowment for Students, and the UW Alumni Association.*

The Eleventh Annual Undergraduate Research Symposium is organized by the Undergraduate Research Program (URP), which facilitates research experiences for undergraduates in all academic disciplines. URP staff assist students in planning for an undergraduate research experience, identifying faculty mentors, projects, and departmental resources, defining research goals, presenting and publishing research findings, obtaining academic credit, and seeking funding for their research. Students interested in becoming involved in research may contact the URP office in Mary Gates Hall Room 120 for an appointment or send an email to urp@u.washington.edu. URP maintains a listing of currently available research projects and other resources for students and faculty at:

<http://www.washington.edu/research/urp/>.

Janice DeCosmo, Director

Jennifer Harris, Associate Director

Tracy Nyerges, Special Programs Coordinator and Adviser

Jessica Salvador, Graduate Student Assistant

James Hong, Staff Assistant

Hazelruth Adams, Staff Assistant

*The Undergraduate Research Program is a unit of the
UW's Undergraduate Academic Affairs*

UNIVERSITY OF WASHINGTON'S
ELEVENTH ANNUAL UNDERGRADUATE RESEARCH SYMPOSIUM
PROCEEDINGS

TABLE OF CONTENTS	PAGE
POSTER SESSION 1	10
PRESENTATION SESSION 1.....	67
1A. MICRO TO MACRO: SENSING AND ACTUATION FROM DNA TO HUMANS	68
1B. EVALUATING NON-INVASIVE IMAGING AND SURGICAL TECHNIQUES IN IN-VIVO MODELS.....	70
1C. SOCIAL ACTIVISM AND COMMUNITY EMPOWERMENT	72
1D. IDENTITY, RELIGION, AND THE ARTS	74
1E. NANO- AND MICRO-STRUCTURED BIOENGINEERING DEVICES.....	76
1F. COMMUNITY DEVELOPMENT, LAND RIGHTS AND IDENTITY	78
1G. DYNAMIC EARTH: EARTHQUAKE DETECTION, ENVIRONMENTAL CONTAMINATION, THE PALEOCLIMATE RECORD, AND EDUCATION	80
1H. INNOVATIVE METHODS OF EVALUATING AND TREATING ILLNESSES	81
1I. MEDIA, POWER, AND THE POLITICAL SYSTEM: COMPARING ACROSS NATIONS	83
1J. MOLECULAR INSIGHTS INTO EVOLUTIONARY PROCESSES.....	85
1K. DIACHRONIC EXPRESSIONS OF RELIGIOUS AND LITERARY CONCEPTS	87
1L. ECOLOGY	89
1M. BIOPHYSICAL CHEMISTRY: MODELS AND APPLICATIONS	91
1N. DESTRUCTION AND RECONSTRUCTION IN LITERATURE, ARTS AND THEATRE	92
1O. MEDICAL THERAPEUTICS AND DEVICES	94
POSTER SESSION 2	98
PRESENTATION SESSION 2.....	157
2A. THE LIVES TO COME: BODIES, BELIEFS, AND SOCIAL JUSTICE	158
2B. SENSING THE OUTSIDE WORLD AND DOING SOMETHING ABOUT IT	160
2C. ANTHROPOGENIC FORCES IN NATURE: MITIGATING THE MESS.....	162
2D. PSYCHOLOGICAL PERSPECTIVES ON SELF, IDENTITY, AND CULTURE	164
2E. MOLECULAR DETERMINANTS OF TRANSMISSION, RESISTANCE AND VIRULENCE IN SEVERAL SIGNIFICANT HUMAN PATHOGENS	166
2F. LOOKING AT PROBLEMATIC AREAS IN THE FORMULATION OF AMERICAN FOREIGN POLICY	168
2G. THE PERFORMANCE OF SOCIAL RESPONSIBILITY	170
2H. RELATIONSHIPS BETWEEN BIOLOGICAL AND ENVIRONMENTAL SYSTEMS.....	172
2I. MICROSCOPIC STRUCTURES: CELLS, CHROMOSOMES AND GENES	174
2J. NOVEL APPROACHES TO BIOLOGICAL PROBLEMS.....	176
2K. OPTICS, ATOMS, AND NUCLEI.....	178
2L. ADVANCES IN MATERIALS AND STRUCTURES.....	179
2M. COMPUTATIONAL MATHEMATICS.....	181
2N. INNOVATION AND CHANGE IN EDUCATIONAL PROGRAMS	182
2O. NEURONAL SYSTEMS IN DEVELOPMENT AND DISEASE	184
2P. PERFORMING RESEARCH: EXPLORING ISSUES OF ECONOMICS, AESTHETICS AND SITE IN CONTEMPORARY DANCE AND THEATRE.....	186
INDEX	190
ACKNOWLEDGEMENTS	202

PLEASE NOTE: Abstracts are listed alphabetically by the presenter's last name, unless otherwise noted.

ADDITIONAL OPPORTUNITIES FOR UNDERGRADUATE RESEARCHERS!

Undergraduate Research Program

To learn more about how to get involved in undergraduate research, the Undergraduate Research Program maintains a listing of current research opportunities available, including Levinson Emerging Scholars awards and Washington Research Foundation fellowships (Deadline: Monday, June 2, 2008) at: <http://www.washington.edu/research/urp>. URP staff offer individual advising to undergraduates; email urp@u.washington.edu for an appointment.

Travel Awards for Undergraduates to Present Research

These awards help make it possible for undergraduates to extend their research experience by contributing to important discussions of current research at professional conferences. Students who have had a paper or poster accepted to a conference may apply for funding for travel expenses and registration fees. Applications are accepted on a continuing basis. For more information visit the Undergraduate Research Program website: <http://www.washington.edu/research/urp/students/urta.html>.

Sponsored by the UW Office of Research, the Undergraduate Research Program and the Mary Gates Endowment for Students.

Mary Gates Research Scholarships

Through participation in research, undergraduate students learn about the essential role of inquiry in a vital society. These competitive research scholarships are available to enhance the educational experiences of students across campus who are engaged in research with faculty. Application deadlines are in autumn and winter quarter for each academic year. For more information visit the Mary Gates Endowment website: http://www.washington.edu/oue/mge/becoming_research.shtml

Funded by the Mary Gates Endowment for Students.

Library Research Award for Undergraduates

The University Libraries, in cooperation with the Undergraduate Research Program, is sponsoring the “Library Research Award for Undergraduates” competition, recognizing University of Washington students who produce significant inquiry requiring use of information resources, the library, and its collections. Application deadline: May 19, 2008. For more information visit the Odegaard Undergraduate Library website: <http://www.lib.washington.edu/researchaward/>

Library Research awards are funded through the Kenneth S. Allen Library Endowment and the Friends of the Libraries.

STUDENTS SUM UP THEIR RESEARCH EXPERIENCE IN A WORD

***Phenomenal:** Like no other experience in my undergraduate career.*

Amazing **Extrabular** Pyrotechnic

***Extrabular:** extensively extra-curricular, rambunctiously brutal,
and spectacularly life-changing.*

EYE-OPENING **Pivotal** Memorable

CAPTIVATING: *all of the setbacks, late nights, smelly mud, and exhaustion produced results that captivated me in a way that I didn't know they could. Numbers in a spreadsheet turned out to be so much more.*

***Energizing:** because I had a chance to work with really smart people on some really cool technology about some really neat physics.*

EXHILIRATING **Integrating** Galvanizing

***Involved:** doing research that matters to oneself and community.*

TEAMWORK SELF-DISCOVERY

TRANSFORMATIVE *Now we are taking responsibility for our own education, sharing our personal achievements with our communities.*

**The Undergraduate Research Program and UW Alumni
Association
Congratulate the 2008
Undergraduate Research Mentor Awardees**

For excellence in guiding undergraduates to become scholars and researchers.

Bryan D. Jones
Professor of Political Science

Suzie H. Pun
Assistant Professor of Bioengineering

Angelina Snodgrass Godoy
Associate Professor of Jackson School of International Studies/Law,
Societies, & Justice

Kristin R. Swanson
Associate Professor of Pathology

Rachel M. Ceballos
Postdoctoral Associate in Health Services

Christian S. Hendershot
Graduate Student in Psychology

Kate Stoll
Graduate Student in Biomolecular Structure and Design



*Undergraduate Research Mentor Awards are sponsored
by the University of Washington Alumni Association*

Undergraduates Honor Their Faculty Mentors

Dr. Jones is an exceptional mentor. His enthusiasm and constructive criticism have made my research fun and exciting. I've learned so many new research skills from him and I feel well prepared for graduate school as a result. ... When I walked into Professor Jones' office one year ago, I was unsure of my future. When I walked out of his office a world of possibilities lay open before me. He convinced me to pursue research and has offered invaluable assistance and support since then. I had never dreamed that a PhD was a possibility and would never have considered going to graduate school had it not been for this mentor.



Dr. Suzie Pun has an amazing understanding of the needs of an undergraduate researcher. First, she makes sure that any undergraduate has a graduate mentor to provide guidance and technical support. It's wonderful to always have someone to go to for everyday problems. Second, if you need to talk to her, she will make time and is always willing to talk. This makes me feel like I am part of the lab and not just passing through. Third, undergraduates work on important projects. I love knowing that I am contributing to the productivity of the lab and gaining a much better understanding of the research process.



Professor Angelina Godoy has proven herself an outstanding mentor in her role as faculty advisor for the first-ever transnational Task Force at the UW. Within the space of 10 weeks, students did extensive background research, conducted dozens of interviews, traveled to Guatemala, and compiled a 50-page report, which was presented to UW President Mark Emmert. Throughout this intensive process, Professor Godoy supported students in innumerable ways and always encouraged students to take initiative, responsibility, and ownership of this project.



Dr. Swanson is one of the most committed mentors at the UW. She devotes immense time and energy in training students to become scientists. Dr. Swanson engages in one-on-one meetings with students to discuss not only research goals, but also the students' personal goals. She has ensured that my projects are aligned with my interests so that I have a solid foundation for future pursuits in medicine and medical research. She promotes collaborative work, which results in research that is multi-dimensional. Furthermore, she provides exposure for her students by taking them to research conferences and workshops, and initiating collaborative work with other principal investigators.

Undergraduates Honor Their Postdoctoral Associate and Graduate Student Mentors

I have been fortunate to have Dr. Rachel Ceballos as a mentor. During our regular meeting, she provides her undivided attention to my questions and concerns. She never hesitates to explain demanding laboratory work and guide me in the right direction by showing details of each step and providing specific examples in other studies. She is also willing to introduce me to others in her network. This actually helped me find a full-time research position that I will be starting after summer. Perhaps the greatest assistance comes from the Biology Journal Club. The Club is a weekly meeting group she created, in which she and her undergraduate students review and discuss statistical methods, findings and writing qualities of recently published papers. She is not only a knowledgeable scientist but also a good role model who is conscientious and hardworking.



I applied for the Research Symposium on Christian Hendershot's suggestion that he felt I was motivated and dedicated enough to start an individual research project and subsequently follow through successfully. This type of encouragement is characteristic of Christian, who takes the time to attend to all of the undergraduates under his supervision. He ensures that they are given the opportunity to take on new challenges and projects, and push themselves beyond a comfort zone to make their own achievements. His ability to motivate others stems from his leading by example. He has guided me through the entire research process for this symposium, and has always made himself available for even the simplest questions.



I admire Kate Stoll much, either as my academic mentor or as a graduate student. Kate is a great mentor and has made my experiences as an undergraduate researcher fun, fantastic, intriguing, and productive. Kate fosters my creativity, encourages my thoughts and ideas for my research project, and also helps me troubleshoot technical problems. She always thinks positively and smartly, takes risks while doing her own research project, and is not afraid to propose and discuss her new research ideas. In addition, Kate is also an excellent leader. She holds an officer position in the Forum of Science Ethics and Policies. Kate shows me that a responsible scientist should value the important relationship between conducting research and the community, which sometimes scientists tend to forget.

**The Undergraduate Research Program and UW Alumni
Association**
Congratulate the 2008
Undergraduate Research Mentor Nominees

For excellence in guiding undergraduates to become scholars and researchers.

Chip Asbury ~ Dave Bacon ~ James Bassuk ~ Andrew Becker ~ Bonnie J. Becker
~ Celeste A. Berg ~ C. Anthony Blau ~ Rajendra Bordia ~ Gundula Bosch ~ Jody
Bourgeois ~ Toby Bradshaw ~ Michael T. Brett ~ Shawn Brixey ~ Candice Brown
~ Sarah Bryant-Bertail ~ Frederick S. Buckner ~ Tyler Budge ~ Gina Cardillo ~
Rachel Ceballos ~ Randal Ching ~ Laura Chrisman ~ Mark Cooper ~ Carolyn
Crockett ~ Tom Daniel ~ Sian Davies-Vollum ~ Jason Davis ~ Veronica Di Stilio ~
Norman Dovichi ~ Janet Eary ~ Owen Ewald ~ James Feathers ~ Paolo Feraboli
~ Jerry Finn ~ Brian Flinn ~ Kirsten Foot ~ Norval Fortson ~ Batya Friedman ~
Angelina Godoy ~ Layne Goldsmith ~ Heidi Lois Gough ~ Martha Groom ~ Jens
Gundlach ~ Benjamin Hall ~ Johnathan C. Hamm ~ Kristin Hendershot ~ David
Hendry ~ Gareth Holman ~ Mark Holmes ~ Horacio de la Iglesia ~ Christine
Ingebritsen ~ Andy Jocuns ~ Bryan Jones ~ Matt Kaeberlein ~ Cheryl Kaiser ~
Sarah Keller ~ David Koelle ~ Randall Kyes ~ Mary Larimer ~ Kari Lerum ~ Janxin
Leu ~ Mary Lidstrom ~ Kim Lindstrom ~ Zi-Jun Liu ~ Anne M. Manicone ~ John
Marzluff ~ Tom Matula ~ Ryan Miller ~ Brooks Miner ~ Samuel Moskowitz ~ Bruce
Nelson ~ Elizabeth Nesbitt ~ Chuck Nittrouer ~ Kathleen Noble ~ Peter Noble
~ Jaime Olavarria ~ Richard Olmstead ~ Margaret O'Mara ~ Brian Otis ~ Kalyn
Owens ~ Babak Parviz ~ Steven Pfaff ~ Deborah Porter ~ Suzie Pun ~ Georgia
M. Roberts ~ Russell Rockne ~ Jennifer Ruesink ~ Julian Sachs ~ Gerald Seidler
~ Julie Shayne ~ Kimberly Sheldon ~ Elizabeth Skovran ~ Kristie Spencer ~ Kate
Stafford ~ Kate Stoll ~ Kristin Swanson ~ Joshua Tewksbury ~ Kevin Urdahl ~ Wei-
Chih Wang ~ Sara Jane Webb ~ Dawn Wenzel ~ Ursula Whiteside ~
Derek W. Wood ~ Craig ZumBrunnen

POSTER SESSION 1

12 NOON - 1PM

POSTERS WILL BE ON DISPLAY UNTIL 2:30PM

PLEASE NOTE:

Abstracts are listed alphabetically by the presenter's last name.

Changes in Impact Factor across fields and over time

Benjamin Althouse, Senior, Mathematics and Biochemistry

Mary Gates Scholar

Mentor: Carl Bergstrom, Biology

Thomson Scientific's Impact Factor (defined as the number of incoming citations to a given scholarly journal in the previous two years divided by the number of articles published in that period) is still the standard for judging the quality of scholarly publications. We quantify the differences in Impact Factor (IF) scores across fields and quantify the rate of inflation of scores over time. Using a mathematical model we decompose the IF score into four separate variables and analyze the response in score due to each variable. We found an overall inflation rate of 2.6% in IF score over the period 1994-2005, and found the largest contributor to IF score differences between fields to be the fraction of a paper's outgoing citations into other journals listed by Thomson. These differences in IF make it difficult to compare the quality of journals either across fields or over time.

Lead Selenide Quantum Dots in Organic Polymer Blends for Use in Photovoltaic Devices

Nicholas Anderson, Junior, Chemistry

Mary Gates Scholar

Mentor: Kevin Noone, Chemistry

Mentor: David Ginger, Chemistry

Organic photovoltaics offer an inexpensive alternative to current silicon technologies owing to their ability to be processed from solution. Semiconductor quantum dots (QDs) have been studied recently due to their broad absorption spectra and size-tunable energy levels. In addition, ultrafast spectroscopy studies have indicated that charge multiplication is possible in the QDs, suggesting higher possible charge generation efficiencies. The near infrared bandgaps of lead selenide QDs allow for the fabrication of photodiodes sensitive to a broader range of wavelengths than devices made from purely organic materials. Our lab synthesized QDs via the hot injection method with reaction time controlling the size, and therefore the bandgap, of the particles. A range of sizes was synthesized and characterized by absorption and photoluminescence. Large, bulky ligands act as a barrier to charge separation and charge mobility. These bulky ligands must be exchanged for smaller ligands to incorporate the QDs into bulk heterojunction devices. In preparation for future spectroscopic studies and device fabrication, thick films of QDs were processed with high optical densities in the visible and near infrared. Initial device studies have been carried on the established blend poly[2-methoxy-5-3(3',7'-dimethyloctyloxy)-1,4-phenylene vinylene (MDMO-PPV)/ [6,6]-phenyl-C₆₁-butyric acid methyl ester (PCBM), while future work will focus on blends incorporating PbSe QDs.

Photocatalytically Active Oxides for Clean Water

Brent Apgar, Senior, Materials Science & Engineering

Mentor: Cliff Lesli, Materials Science & Engineering

Mentor: Rajendra Bordia, Materials Science & Engineering

Titanium dioxide (TiO₂) and sodium bismuthate (NaBiO₃) are two materials that may be used for photocatalytic decomposition of organic molecules in water. Nitrogen doping of TiO₂ has been shown to increase the active spectral range. Nano-sized particles of pure and nitrogen-doped TiO₂ were synthesized by the sol-gel process. The nitrogen doping of lab-synthesized and commercial TiO₂ was compared to determine the mechanism and effectiveness of doping by annealing in ammonia gas. Characterization by XRD and SEM showed that the doped and undoped lab-synthesized TiO₂ particles differed in size, morphology, and phase composition. Thermodynamic and kinetic analysis revealed that the differences were due to the different annealing temperatures used. The lab-synthesized TiO₂ specimens showed a much greater specific surface area by BET analysis than the commercial TiO₂, consistent with the particle size. UV-vis spectrography was performed on all samples to confirm the photophysical properties. Organic and biologically-active molecule decomposition experiments were conducted to measure the photooxidation and photodecomposition properties. The effectiveness of N-doped TiO₂ and NaBiO₃ as photocatalysts will be compared.

Identifying Potential Drug Targets for African Trypanosomiasis Therapy

Jennifer A. Arif, Senior, Biochemistry and Chemistry

Mary Gates Scholar

Mentor: Frederick S. Buckner, Medicine

African Trypanosomiasis as a tropical disease has not gotten much attention. However, this disease causes 500,000 cases every year in Africa with at least 50,000 deaths per year. In order to develop better medicines to treat *Trypanosoma brucei* infections, four genes were selected as possible drug targets: uracil-DNA glycosylase (UDG), dehydrodolichyl diphosphate synthetase (CPT), 6-phosphogluconolactonase (PGL), and nucleoside phosphorylase (NP). I am conducting RNA interference (RNAi) experiments to test the hypothesis that these proteins are essential for normal growth of *T. brucei*. RNAi involves engineering the expression of double-stranded RNA to inhibit the expression of the gene of interest with complementary nucleotide sequences. I first use molecular biology methods to engineer plasmids that express double stranded RNA, then I transfet these plasmids into *T. brucei* cells grown in culture. The messenger RNA of the targeted gene will be rapidly degraded – a process known as gene knockdown. In these methods, I perform PCR, DNA cloning, plasmid purification, DNA sequencing and electroporation of *T. brucei*. To quantify the effect of

the gene knockdown, I will measure the growth rate of the transfected parasites. Lastly, I will perform Northern blots to validate whether the RNAi method has succeeded in knocking down the target genes. Currently, the RNAi knockdown construct is being engineered and the results of the knockdown experiments will help establish if the genes, UDG, CPT, PGL, and NP are essential in *T. brucei*. If those target genes are essential, I will have advanced our research toward designing new drugs for African Trypanosomiasis.

Validation of PGC-1 α as a therapeutic target in HD

*Johnny Au, Senior; Neurobiology and Biochemistry
Mentor: Taiji Tsunemi Laboratory Medicine*

Huntington's disease (HD) is a progressive and fatal neurodegenerative disease that despite increasing knowledge, is still an ailment without significant therapies. HD, a genetic mutation, arises from a trinucleotide repeat expansion that encodes for an elongated glutamine tract within the huntingtin (htt) protein. While several molecular mechanisms have been proposed to account for HD's pathological nature, all are unable to link directly a causative relationship between mutated htt protein and neuronal degeneration and death. However, recent research in our laboratory strongly implicates mitochondrial dysfunction and a mediator protein, a transcriptional coactivator peroxisome proliferator-activated receptor γ coactivator 1 α (PGC-1 α), as a possible key to HD's characteristic pathology. Our project stems from the fact that PGC-1 α , a protein responsible for mitochondrial biogenesis and oxidative phosphorylation, is down regulated in the HD transgenic mouse model and that over expression of PGC-1 α functions as a protective agent for HD infected cells. We aim to validate PGC-1 α as a therapeutic target *in vivo* utilizing the mouse model. We have developed triple transgenic mice that allow both temporal and spatial control of PGC-1 α overexpression in HD mice. Behavioral assays are being used to chart disease progression while differing morphological techniques are being implemented to characterize cellular pathologies. Behavioral tests, including temperature, rotarod, weight, and ledge of triple transgenic mice show promising trends suggesting HD pathology as dependent on PGC-1 α expression levels. Preliminary histological data are currently being collected. If PGC-1 α is shown to reverse or stop HD progression, a large window will open for therapy developmental research, bringing medicine one step closer to a cure.

Marriage in Black and White: Approval Of Interracial Marriage Among Black and White American Women, 1972-2006

*Madeline Baars, Senior; Sociology
Mentor: Stewart Tolnay, Sociology*

The incidence of interracial marriage has been steadily increasing over the past fifty years. As interracial marriages

have become more common, tolerance for these unions has also increased. One of the most interesting aspects about interracial marriage is the variation in approval that occurs among racial, regional, and gender lines. Among black-white couples, the most common combination is a white wife and a black husband. Black men that marry outside of their race often have higher levels of education, income, and career status when compared to average black males. This, along with other factors such as institutionalized racism, high mortality, and high rates of incarceration for black males, have lead to a shrinking marriage market for black women. This trend is particularly salient for well-educated black women. One would expect this squeeze to reflect in rates of support for interracial marriage, and that is what I plan on exploring. For my research project, I am going to use data from the General Social Survey. This public opinion data dates from 1972 to 2006, and has survey questions about public opinion regarding interracial marriage. I am planning on constructing a comparison of white and black females and their opinions about interracial relationships, and tracking how these trends have changed over the past thirty years. I will be using variables such as level of education, geographic region, and urbanicity to identify differences in public opinion among these two groups of women over time.

Unipolar Brush Cells in the Tbr2 Mutant Cerebellum

*Amelia Bachleda, Senior; Neurobiology
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Robert Hevner, Neurosurgery*

Unipolar Brush Cells (UBCs) are a class of interneurons that modulate excitatory input to specific regions of the cerebellar cortex where balance and other functions of the vestibular system are directed. In mice, UBCs are born from embryonic day 14.5 to embryonic day 19.5 in the rhombic lip, an embryonic structure home to a pool of progenitor cells. They then migrate from the rhombic lip, to their final location in the adult cerebellar cortex. UBCs express Tbr2, a protein known as a transcription factor, that activates expression of other genes. In the cerebellum the expression of Tbr2 can be used as a marker for UBC identification in the adult. This study examines the effect on UBC population when Tbr2 is genetically removed or knocked out. These knockout mice appear to lack UBCs completely. We are examining several explanations for the apparent absence of UBCs. It is possible that UBCs are born and then fail to migrate appropriately. This can be determined by using BrdU, a nucleotide analog that is incorporated into the DNA of actively replicating cells, marking the day of their birth. We can then examine the migration patterns of cells born during the period of UBC birth to see if there are any abnormalities. In conjunction, we will look at the expression of other proteins (calretinin, mGluR1 α) that serve as UBC markers to positively identify the cell type. Another possibility is that UBCs in the mutant animal show an increased rate of programmed

cell death, or apoptosis. Brain tissue from mutant mice can be stained with a fluorescent antibody (TUNEL or caspase-5) that marks apoptotic cells allowing us to determine if there is an increase in this population. These experiments will allow us to better understand the role of Tbr2 in the development and proper functioning of UBCs.

Congressional Attention to the Education of Underprivileged Children

Jayme Ballard, Senior, Political Science

McNair Scholar, Safeco Diversity Scholar

Mentor: Bryan Jones, Political Science

Underprivileged students are an undeniable sector of the American public school system. These children come from families that tend to be poorer and have less education than a majority of their peers. From the beginning, these students are at a disadvantage compared to others their age. They have to work harder to overcome the pressing societal factors that could pose barriers to obtaining education. Despite widespread recognition that familial and societal factors impact educational attainment, the academic achievement gap continues to widen. My research centers on shifts in congressional attention to the education of underprivileged students. I utilize data on congressional hearings drawn from the Policy Agendas Project, an NSF-funded research program that collects data on a wide range of governmental activities across time. I coded congressional hearings on the basis of two approaches to education reform, environmental factors related to educational achievement and incentive-driven, standards based reform. Through my coding system I have been able to pin point shifts in congressional attention by studying observable patterns in the spectrum of policies that have been created in an effort to close educational achievement gap. I also considered bipartisan congressional control to determine if this factor can contribute to the observable shifts in policy focus. As a result of studying congressional control, I have determined that policy creation is directly linked to who congress invites as expert witnesses. This led me to analyze the types of witnesses being called for educational hearings. I determined that the type of witnesses called correlate to the types of policies that are being considered and created.

Thermodynamics & Mechanical Physics In Public Policy Systems: The U.S. Federal Budget 1993-2006

Steve Baxter, Senior, Political Science

Mentor: Bryan Jones, Political Science

The decision-making process that is involved with setting the annual U.S. Federal Budget includes a complex set of interactions and competing interests. An analysis of the distribution of the annual changes seen in the U.S. Federal Budget since 1947 by Bryan Jones & Frank Baumgartner has been found to be highly leptokurtic. According to Punctuated Equilibrium Theory, friction operates as

one of the mechanisms within the policy system that inhibits congress from responding proportionally to the various environmental signals that exist due to the effect of selective attention, institutional rules, and cognitive limitation. As a consequence of this friction, they argue that annual changes are predominantly incremental, but as some signals are overlooked or ignored, over time pressure can accumulate within the system leading to large punctuations. The primary purpose of my research project is to quantify the force of friction within the budgetary process. In order to accomplish this I've translated the budget process into what is essentially a physical process governed by thermodynamic and mechanical laws. By interpreting external variables, such as media attention and public opinion, as forces acting upon the budgetary system, it is not only possible to interpret the degree to which these variables influence the budget process, but also provides a methodology for understanding how changes occur in public policy systems and subsystems. I intend to demonstrate that budget outcomes operate as a function of both friction at different points within the system and the net effect of external and internal forces acting upon the system.

The Search for Genetic Suppressors of Transdetermination in *Drosophila melanogaster*

Matthew Becker, Sophomore, Pre-Major

Mentor: Gerold Schubiger, Biology

Mentor: Anne Sustar, Biology

In nature, the occurrence of determined cells switching fates is rare. However, extensive regeneration studies of the imaginal discs of *Drosophila melanogaster* have characterized these switches in a process called transdetermination. Imaginal discs are found in larvae and are the precursors to adult appendages. Transdetermination can be induced during the fragmentation and subsequent regeneration of imaginal discs, and occurs through a specific region of the disc called the weak point. Such fragments regenerate first, and then undergo transdetermination. Furthermore, ubiquitous expression of the wingless gene also induces transdetermination in the weak point, without fragmentation. DNA microarray was used and 143 genes were upregulated in transdetermined cells. One such candidate gene, the regeneration (*rgn*) gene, is expressed specifically in cells that transdetermine, as shown through *in situ* hybridization experiments. Two mutant alleles of this gene, *rgn1* and *rgn2*, reduce the frequency of transdetermination in imaginal discs. Both *rgn1* and *rgn2* are recessive lethal P-element insertions with some adult escapers, indicating that both are potentially hypomorphic alleles. In genetic studies, null alleles more clearly assess the function of a gene than hypomorphs. Therefore, the Schubiger lab conducted numerous imprecise excisions of the P element found in *rgn1* in the hopes of creating a null recessive lethal allele of *rgn*. Through complementation tests, which are used to define whether alleles are of the

same gene, we found that all 16 of the newly generated recessive lethals complemented with *rgn1*. We decided to conduct complementation tests among these 16 alleles to define the different complementation groups within them. Preliminary results show that the 16 new lines define at least two complementation groups. Once complementation groups are defined, each will then be tested by ubiquitous wingless expression to determine if any of the new alleles occurred in a gene that suppresses transdetermination.

Thermoelectric Properties of NiMnSn Alloys at Phase Transitions

Kevin Bell, Sophomore, Physics

*Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Fumio Ohuchi, Materials Science & Engineering*

Heusler alloys have recently drawn a great deal of attention for numerous physical phenomena. We are studying thermoelectric properties of NiMnSn alloys of various compositions to better understand the underlying materials physics, which may lead to further studies or new applications. A martensitic (austenite-martensite) phase transition is known to occur in NiMnSn alloys at ~100K-350K depending on composition. One way to observe this structural change is through a change in electrical resistivity. We are using a 4-point probe to measure the resistivity of arc-melted bulk samples over various temperatures. For metals, a plot of resistivity v. temperature is usually a smoothly increasing curve, but a phase transition should appear as a significant anomaly in this curve. This data will be compared with magnetization measurements and x-ray diffraction data from a parallel study to gain further insight into the physical and structural properties of the NiMnSn system.

An accelerometer using bondwires as inertial sensors

William Biederman, Senior, Electrical Engineering

Mary Gates Scholar

Mentor: Brian Otis, Electrical Engineering

This project investigates the sensing functionality that can be performed using completely standard integrated circuits (ICs) with no process modifications. Currently, the state-of-the-art in microscale inertial sensing is almost exclusively performed by microelectromechanical system (MEMS) accelerometers. The downside to these accelerometers is their relatively large cost and size due to the specialized process and package required by a dedicated MEMS process. Bondwires are the wires that connect an IC to a printed circuit board (PCB) and are the only free moving component in a standard process. By using bondwires of different materials, the amplitude of deflection of each from a fixed acceleration can be controlled. In order to detect the relative deflection between the bondwires, a prototype board was created with a voltage controlled oscillator (VCO) using the bondwires as an inductor. When acceleration is applied, the two VCO bondwires

deflect a different amount and their mutual inductance changes. This change in mutual inductance causes a change in oscillation frequency of the VCO. Calculations have shown that a minimum frequency change of 1 MHz is necessary for detection from a specialized readout architecture. Using a centrifuge it was found that a 5g force results in the required frequency change using one gold bondwire (1mm) and one aluminum bondwire (1mm). In the following months, tests will be conducted using a 3mm bondwire length to increase the maximum acceleration sensitivity and the entire sensor and readout architecture will be implemented on a prototype IC.

The Role of CHF1 in Vascular Injury

*Tiffany Blair, Senior, Biochemistry and Biology
(Physiology)*

Mentor: Michael T. Chin, Cardiology

In the vascular disease arteriosclerosis, cholesterol molecules in the blood are deposited within the arterial wall. The deposition of cholesterol leads to various responses by surrounding arterial tissue. A typical response involves the migration of macrophages to the inner layer of the artery to engulf the deposited cholesterol. This is followed by the migration and proliferation of vascular smooth muscle cells from the middle layer to the inner layer of the artery, resulting in the buildup of plaque within the artery. Eventually, the accumulation of plaque leads to a reduction of blood flow through the artery. We are investigating how the protein CHF1 is involved in this process. Previous research has indicated that CHF1 is involved in regulating the proliferation and migration of the vascular smooth muscle cells within the artery. To further the understanding of how CHF1 is involved in this process, we are studying the loss of function of CHF1 in vascular smooth muscle cells by knocking down CHF1 expression with siRNA's. By understanding how CHF1 functions in the proliferation and migration of vascular smooth muscle cells in the vascular response to injury, it may be possible to design new treatments, which slow down the deleterious effects of arteriosclerosis.

Cumulate xenoliths as indicators of tholeiitic magma chamber processes at Mauna Kea Volcano, Hawaii

Eli Bloch, Senior, Earth & Space Sciences

Mary Gates Scholar

Mentor: Stewart McCallum, Earth & Space Sciences

During the capping-lava stage of their evolution, Mauna Kea Volcano in Hawaii ejected a relatively high concentration of xenoliths (chunks of rock not genetically related to the lavas which transport them to the surface) through alkalic basalt cinder cones near the summit of the volcano. A plausible hypothesis for the origin of these xenoliths is that they formed as cumulates during the main shield-building evolutionary stage during which large volumes of tholeiitic magma were produced and the main

volcanic edifice was constructed. Processes occurring within the magma storage regions are believed to produce cumulate rocks by processes of crystal accumulation, magma replenishment and mixing. During September 2007 xenolith samples were collected from five cinder cones on Mauna Kea; two cones at the summit, and three along the southwest flank. In addition to wehlrites (rocks consisting of olivine and clinopyroxene) and pyroxenites (rocks consisting of >90% pyroxene), these samples comprise several dunites (rocks consisting of >90% olivine) and gabbros (rocks consisting of clinopyroxene and plagioclase) which have been analyzed with the University of Washington's electron microprobe. Dunite samples are approximately 92% olivine, 5% chromite and 3% clinopyroxene. The composition of olivine within dunite samples is approximately Fo86 with almost no variation; clinopyroxene and chromite within the dunite samples have not yet been analyzed. Many gabbros contain substantial amounts of olivine (~Fo72, 10-15 modal %) in addition to clinopyroxene (Wo45 En43 Fs12), plagioclase (An76), biotite and Fe-Ti oxides (not yet analyzed). Modal percentage of minerals within gabbros is highly variable. Although these xenoliths likely formed as cumulates, in thin section most of them show thorough annealing which suggests that these samples have undergone substantial recrystallization. In addition, the presence of biotite within some samples indicates at least 2-3 wt. % water within some tholeiitic Hawaiian melts.

How to analytically determine some stability spectra of integrable equations

Nate Bottman, Junior, Mathematics

Mary Gates Scholar

Mentor: Bernard Deconinck, Applied Mathematics

Recent years have seen a lot of activity around the stability analysis of stationary periodic solutions of integrable equations. Some of this work has been analytical, some numerical, but all approaches would benefit from a method for analytically determining the stability spectra of periodic stationary solutions of integrable equations. In this talk I will discuss a method to completely determine these stability spectra. This method relies on the squared-eigenfunction connection between the stability spectrum and the Lax pair spectrum, so often used in the soliton case. I will present complete determinations of the stability spectra of these periodic stationary solutions of the defocusing nonlinear Schrödinger equation and the Korteweg-de Vries equation, and I will present partial results towards analytically determining the stability spectra of periodic stationary solutions of the focusing nonlinear Schrödinger equation.

Committee Power and Budgetary Change

Andrew Bouta, Senior, Political Science and Sociology

Mentor: Bryan Jones, Political Science

Earmarks are a prolific product of the Congressional committee system. This is no doubt true when dissecting proposed projects like the “bridge to nowhere.” Unlike the “bridge to nowhere,” most projects of the same magnitude pass through committees and Congress uneventfully and without deliberation. Some powerful committees and their members are adept at dispensing earmarks to fund special projects. These earmarks will ultimately adjust the budget, resulting in change. My study examines the relationship, in multiple policy-areas, between committee power and budgetary change. I assert that powerful committees exert more control over budgetary change than weak ones. What impact might powerful committees have on budgetary change? What dynamic of the committee system leads to small or large budgetary change? Given the evolution of committees and their jurisdictions across time, we would expect the extent to which they influence budgets to vary. To answer such questions, and to build my constructs of budgetary change and committee power, data was retrieved from the Policy Agendas Project. Budgetary change expresses an adjustment in the commitment of government to some objective. Committee power expresses the capacity of committees to dominate a policy-area. Determining whether a committee is powerful or weak relies on the allocation of their interest and the ability to preserve their jurisdiction from outside committee intrusion. From annual correlations measuring the two constructs, results suggest that powerful committees generate stable, incremental budgets in policy-areas under their own jurisdiction. Moreover, powerful committees promote erratic and unstable budgets in policy-areas under the jurisdiction of weaker committees. These powerful committees thrust their earmarks upon the jurisdictions of weak committees, and with little power to impede or fight back; weak committees must adhere to demand. These findings confirm that committees are an important source of institutional friction and punctuation in the budgetary process of American politics.

Inferring the Biogeographical History of Malagasy Primates Using Viral Fossils

Nicholas Bromen, Senior, Biology, The Evergreen State College

Mentor: Clarissa Dirks, Microbiology, The Evergreen State College

The aim of this study is to better resolve the phylogenetic and biogeographic history of the endemic primates of Madagascar using endogenous retroviruses (ERVs) as genomic fossils. Discrepancies have surmounted among studies addressing the origins of the Lemuriform Strepsirrhines. Madagascar provides an ideal system for establishing a model wherein the biogeographic origins

of taxa may be inferred from past retroviral infections. Characterizing ERVs from lemurs and other organisms found in different regions of the world enables us to better resolve their origins through viral homologies. We are currently analyzing previous work that compares the morphological and molecular phylogenies of Malagasy mammals to build a foundation upon which we will base our retroviral studies. The origins of lemurs can be addressed through our study of their ERVs and those of closely related viruses from other organisms clustering in particular geographic regions. We are using behavioral, ecological, morphological, genetic, fossil, geologic, and geographic information to guide laboratory research that aims to sequence ERVs from relevant species of interest. Synthesis of this information will provide supporting evidence for the divergence and origins of Lemuriform Strepsirrhines over the span of geologic time.

A Physiological Threshold for Motivated Behavior

Sarah Brown, Senior, Neurobiology

Mentor: Paul Phillips, Psychiatry

Cost-benefit analysis is a decision making process used by humans and animals to guide motivated behavior. Expected utility is a prediction of future reward that is an important factor in cost-benefit analysis. During cost-benefit analysis the expected utility of future rewards is compared with the costs required to obtain them. A possible neural correlate for expected utility exists in dopaminergic projections from the midbrain to the limbic system (prefrontal cortex and ventral striatum / nucleus accumbens.) These dopamine (DA) neurons have been shown to increase firing in response to rewards and reward-predicting cues. These responses are also implicated in motivated, reward-seeking behavior, but the exact relationship between DA and behavior is unclear. Our hypothesis is that there is a threshold level of cue-evoked DA release in the nucleus accumbens that dictates a motivational tipping point for reward-seeking behavior. In order to test this hypothesis we trained rats to lever press for food rewards and we recorded sub-second DA release in the nucleus accumbens using fast-scan cyclic voltammetry. Our behavioral results show that rats' probability to lever press abruptly decreases as they become satiated. This behavior follows the economic principle of diminishing marginal utility, a decline in the amount of effort that a subject is willing to exert to acquire an additional unit of a commodity. The abrupt decline in behavior supports the existence of a DA threshold below which rats will not lever press to obtain food rewards. Our DA recordings will more directly test this hypothesis.

Hereditary Neuralgic Amyotrophy and Mutations in the Septin 9 Gene

Jillian Buchan, Senior, Molecular, Cellular and Developmental Biology

Mentor: Phillip Chance, Department of Pediatrics

Mentor: Mark Hannibal, Department of Pediatrics

Hereditary Neuralgic Amyotrophy (HNA) is an autosomal, dominantly inherited disorder primarily affecting the peripheral nerves of the brachial plexus. It is characterized by episodes of severe pain followed by muscle atrophy in the shoulders and arms. The recurrent attacks are thought to be a result of an autoimmune response; however, the mechanism of disease is unknown. Our lab previously mapped the gene responsible for HNA to chromosome 17q25 and more recently, identified mutations in the septin 9 gene (SEPT9) in six HNA families. SEPT9 encodes at least 7 different mRNA products through alternative splicing, forming 6 unique polypeptides. Known SEPT9 mutations are found in coding regions of some transcripts and the 5' untranslated region of others. However, these mutations are only present in a small percentage of HNA patients. Disease associated mutations were not identified in SEPT9 coding regions in a number of families with HNA, despite being linked to chromosome 17q25. Genetic linkage studies indicate that several HNA individuals share a common disease haplotype in a 1 Mb region that includes SEPT9. At least nine HNA families share this haplotype, suggesting that these individuals may have inherited the same ancient mutation and providing evidence for a founder effect. Therefore, further analysis of this region is warranted. We have discovered two previously unidentified SEPT9 transcripts, bringing the known number of mRNA transcripts to nine. We are genotyping to categorize new families that may possess the shared haplotype. This will help us to strategize our investigation for HNA mutations. We are also analyzing a more than 225 Kb genomic region within the shared haplotype, surrounding the SEPT9 gene, in two individuals. Identification of mutations through these other alternative mutation screens of SEPT9 may yield more insights into the pathogenesis of SEPT9 alterations and HNA.

Quantification of a Myocardial Infarction and the Associated Decrease in Ventricular Function.

Kate Buckley, Sophomore, Bioengineering

Mary Gates Scholar

Mentor: Michael Regnier, Bioengineering

Mentor: Steven Korte, Bioengineering

Heart disease is the world's leading cause of death. Due to the ubiquity of this health crisis, research into the causes of heart disease is currently at the forefront of modern science. One of the current areas of research is an attempt to better understand the underlying causes of heart disease and the remodeling that occurs after a heart attack. In addition, new cell-based and gene based therapies aim to prevent further decline into cardiac failure that results after an infarction or other heart related illness. The success of these therapies requires comprehensive measurements of function in infarcted hearts before and after the therapies are administered. However, without a quantitative method to assess the size of an infarction and the associated functional decrease of heart tissue, a definite assessment

of the results of any treatment is impossible. Cardiac function after an infarction is inherently dependent on the amount of damaged tissue, and as such, needs to be quantified. This project aims to quantitatively assess the percent of ventricular damage due to a cardiac infarction and to correlate the damage to cardiac function from the subcellular to the whole organ level in a rat model. After inducing infarctions in the sample group, we assayed function using echocardiography, an in-vitro perfusion system for isolated working hearts, and muscle strip mechanics which we then correlated to the histologically measured size of the infarction. The conclusion of this study will provide important baseline data for measuring the results of other therapies from the subcellular to the in-vivo organ level. This will mark an important step towards the solution to the serious health crisis of heart disease.

An Acoustic Description of Santiago Tamazola Lowlands Mixtec

Maria Burgess, Senior, Linguistics

Mentor: Richard Wright, Linguistics

This poster is an acoustic description of Santiago Tamazola Lowlands Mixtec (STLM) focusing on voice quality (contrastive articulation of a segment by changing the vocal production type). STLM is a dialect of Mixtec, which belongs to the larger Otomanguean family of languages. Recent estimates put the number of all Mixtec speakers at about 500,000, concentrated in southern Mexico in the states of Oaxaca, Guerrero and Puebla. STLM has roughly 3000 speakers with a notable diaspora in California, Washington and New York. Mixtec languages are typologically complex, as they are register tone languages and have a four-way voicing contrast in that oral, breathy-voiced, nasal and laryngeal vowels are all possible. Despite this fact, Mixtec languages do not receive much academic attention and are therefore poorly documented. For this project, three native speakers of STLM were recorded using a professional quality digital recorder reading word lists, passages and during natural speech. This data was analyzed specifically looking at: tone, by measuring changes in F0 (the lowest frequency in a complex series of frequencies); laryngealization by jitter (irregular glottal pulses), amplitude (sound wave pressure) and spectral tilt (the slope of the amplitudes of frequencies); vowel space by measuring F1 and F2, or the first and second resonances of the vocal tract, which are correlates of vowel categories in human language. The results of this project show that in the speech of these three consultants: laryngealization surfaces as a drop in amplitude and has measurable jitter, the three tone register system works in conjunction with laryngealization by surfacing after the drop in amplitude and the acoustic vowel space shows a vowel that is not included in some scholarly literature. This research and contribution by the consultants will add to the knowledge base in academia valuable information about the phonetic variations of human language.

Bardet-Biedl Syndrome and the Pathology of Protein Inclusions of Polyglutamine Neurodegenerative Disease

Heidi Burke, Senior, Biochemistry

Mentor: Albert La Spada, Medicine & Neurology

Bardet-Biedl syndrome (BBS) is a genetically heterogeneous disorder characterized primarily by developmental and learning disabilities, retinal dystrophy, obesity, post-axial polydactyly, and renal dystrophy¹. Eleven genes with mutations have been implicated in BBS including BBS4. We have obtained and characterized a mouse model of BBS in which the gene for BBS4 has been knocked out. In addition to phenotypes typical of BBS, these mice demonstrate a previously undescribed neurological phenotype strikingly similar to what has been characterized in transgenic mice with polyglutamine neurodegenerative diseases. These symptoms include limb clasping and failure to stabilize on the ledge of a cage. A hallmark of many neurodegenerative diseases is the accumulation of protein aggregates in inclusion bodies in both the nucleus and cytoplasm of neurons. The formation of these inclusion bodies involves a microtubule-dependent organelle called the aggresome³. It is known that BBS4 interacts with the dynein-dynactin microtubule-based molecular motor². This suggests that the molecular function of BBS4 may include regulation of intracellular transportation of misfolded proteins to aggresomes. Due to the appearance of neurological phenotype in Bbs4 mice, we are currently investigating whether neurons of these mice contain proteinaceous inclusions using immunohistochemical techniques. While it has not yet been determined if these inclusion bodies are protective or detrimental to the neuron, further examination of BBS4 null cells may help explain the mechanism by which misfolded proteins accumulate in the aggresome. Thus expanding our understanding of the pathology surrounding various neurodegenerative diseases.

Weather on Extra-solar Planets

James Bushong, Junior, Astronomy

Mentor: Eric Agol, Astronomy

Apart from the Sun, there are many other stars in the galaxy that have planets of their own. A large fraction of the planets that have been detected so far are large Jupiter-size planets that orbit extremely close to their host star. These are known as 'Hot Jupiters'. Since these planets are much fainter than their host star, and are typically 50-100 light years away, they cannot be observed directly. In a handful of rare cases a Hot Jupiter will pass directly behind its parent star, causing a brief decrease in the brightness of the system as the planet disappears from view and allowing astronomers to estimate the brightness of the planet's day-side. We combine a series of such 'snapshots' of the planetary system HD 189733 taken with the Spitzer Space Telescope and manipulate a simple model to test whether

or not the planet's day-side exhibits any variability (storm cycles, etc.) over a period of days, weeks or months.

Using PCR to Identify Coliform Sources in Urban Wetlands

Nancy Bussman, Sophomore, Pre-Pharmacy, North Seattle Community College

Mat Solomon, Sophomore, Oceanography, North Seattle Community College

Julia Purdy, Sophomore, Marine Biology, North Seattle Community College

Yana Kazak, Sophomore, Biology, North Seattle Community College

Clayton Cluff, Sophomore, Pre-Major, North Seattle Community College

Mentor: Ann Murkowski, Biology, North Seattle Community College

Mentor: Kalyn Owens, Chemistry, North Seattle Community College

Recent studies suggest that Thornton Creek, like many of Seattle's urban creeks do not meet Washington State's standards for water quality; contamination of this waterway from point and non point source pollution has resulted in degradation of water quality and aquatic habitats. Point sources such as municipal and industrial wastewater have been easier to identify, whereas little attention has been directed towards non point sources such as fertilizers, storm runoff, and fecal contamination. Advances in molecular microbiology such as PCR amplification and DNA sequencing provide new methods to address non point sources. For example, fecal coliforms can be traced back to an origin, by using primers with specific DNA sequences unique to its species. We used PCR to identify the source of coliforms in the wetlands of Thornton Creek at North Seattle Community College. Specifically, we are interested in comparing the coliform communities at the entrance and exit to this system to determine the relative contributions of human, pet and wildlife bacteria. To do this, water samples were collected at three sites including high flow and low flow input days. All samples were then cultured on high and medium nutrient plates in order to quantify the bacteria present. PCR amplification was performed on fecal coliform colonies, using a universal 16S primer in addition to forward and reverse primers designed for specific sequence markers of human, pet and wildlife feces. Results from this study will not only clarify the source of fecal coliforms present in this urban wetland, but also allow the city of Seattle to develop an action plan to address such non point source pollutants.

Risk Assessment of Invasive Species through the Aquarium Trade in Washington State

*Phil Campbell, Senior, Aquatic & Fishery Sciences
Wilbert McLeod Chapman Memorial Scholarship*

Mentor: Julian Olden, Aquatic & Fishery Sciences

Invasive species have increased immensely over the past century resulting in great harm to the economy and the natural world. They can clog and disrupt irrigation ditches causing agricultural harm as well as decrease species diversity of the regions that these non-native species come to occupy. There are many pathways for the spread of aquatic invasive species but here I focus on the aquarium trade, responsible for about a third of the world's worst aquatic invasive species. This study involves an analysis of spatial and temporal trends in the popularity of freshwater fish, invertebrate and plant species in the pet aquarium trade in the Puget Sound region of Washington State. For the spatial trend, I surveyed 30 fish retail stores covering approximately 500 mi² and all within 5 miles of local streams, rivers and lakes. The freshwater animals were enumerated and identified to the species while all freshwater plants were identified and presence or absence was noted. A temporal trend was figured using the aquatic invoices from a single fish retail store from 1/22/2007 through 1/21/2008. Scientific names were gathered by researching the common names found on the invoices followed by time trend analysis. By collecting data on the critical thermal requirements of each species, my study will provide important insight into the potential invasiveness of popular aquarium species according to their potential to invade Washington fresh waters. The analysis of a time trend of popularity could lead to knowing during which time period there would be the greatest potential for an organism to survive if released. These findings will build upon other invasive species research as well as provide insight into potential invaders of areas with similar climate and environments, allowing for policies and regulations to be made before a problem occurs.

Creation of a new genetic system for Kaposi's Sarcoma-associated herpesvirus

Emily Cedarbaum, Junior, Biochemistry and Neurobiology

Mary Gates Scholar

Mentor: Michael Lagunoff, Microbiology

Kaposi's sarcoma (KS) was the first described AIDS-defining illness. Not only is it the most frequent tumor in AIDS patients, but it is also the most common tumor in many parts of Africa. KS is an endothelial cell tumor characterized by high levels of vascularization. The infectious cause of KS is Kaposi's sarcoma-associated herpesvirus (KSHV), which is the eighth human herpesvirus. KSHV is a 165kbp virus encoding more than 90 genes. Contraction of the virus results in lifelong infection and there is currently no cure or effective treatment for KSHV. Many labs work on KSHV and much has been discovered about the virus's mechanisms and genetics. However, faster and more effective genetic systems are needed. Here I propose to create a new genetic system using bacterial artificial chromosome (BAC) technology. This technology can be used to clone large DNA fragments, including many

herpesviruses, which makes them easier to manipulate genetically. I propose to create a new BAC that contains the whole KSHV genome, allowing genetic manipulation and one-step removal of the non-viral BAC sequences. This KSHV BAC will be used to mutate specific KSHV genes. The role of these genes in KSHV infection will be determined by analyzing mammalian cells infected with the mutant virus. The primary gene that I will analyze encodes KSHV's G protein-coupled receptor (vGPCR), which I will delete from the KSHV genome using BAC recombination technology. The effect of this deletion on signal transduction pathways in infected cells, as well as the successful use of the BAC system, has implications for KSHV treatment and future research involving the mechanisms of herpesviruses.

Yeast Vacuole Fusion: A closer look at the SNARE Domain of Vam7p

*Howard Chang, Senior; Biochemistry and Biology
(Molecular, Cellular, & Development)*

Mentor: Alexey Merz, Biochemistry

Membrane fusion is a fundamental process in eukaryotic cells, required for intracellular vesicle trafficking and regulated exocytosis, including synaptic transmission. SNARE proteins are hypothesized to catalyze membrane fusion by forming α -helical complexes between membranes, forcing them together. However, there are many proteins that regulate SNARE function and are not well understood. We study the homotypic fusion of yeast vacuoles. This process requires four SNARE proteins including Vam7, a soluble SNARE that can be purified in recombinant form and added to vacuoles in vitro to drive fusion. Furthermore, our lab has developed mutant forms of Vam7, which trap fusion reactions at a pre-fusion stage, when SNARE-regulatory protein interactions are presumed to occur. Since vacuoles are relatively large in size ($32\mu\text{m}$), this system also allows us to utilize fluorescence microscopy to study the fusion process. My goal is to create Vam7 mutants carrying single cysteines, which can be derivitized with optical probes to monitor Vam7 function and molecular interactions within the pre-fusion stages. I have developed a method to rapidly screen Vam7p mutants for function in vivo. I then generated individual Vam7 mutants with single cysteine substitutions in several regions of the molecule, including the SNARE domain, and have subsequently labeled these Vam7 mutants with fluorescent probes at the cysteine residues. Ultimately, our goal is to examine the fusion reaction with these Vam7 constructs using fluorescence microscopy and other fluorescence-based assays.

Access to Mental Health Services among Mexican/Mexican American Women in Seattle

Natividad Chávez, Senior; Psychology

Ronald E. McNair Scholar

Mentor: Dellanira Valencia-Garcia, Psychology

Mentor: Jane Simoni, Psychology

The population of Latinos, the largest ethnic minority group in the United States, is continuing to grow exponentially. This is especially true for Latinos of Mexican descent. Despite being the largest Latino subgroup in the US, research among Mexicans/Mexican Americans has not received much attention. This group is often at high risk for several disorders (e.g. major depression, dysthymia, substance/alcohol abuse/dependence, but access to mental health services has been disproportionate in Latino populations. Using a cross-sectional study, two hundred women of Mexican descent, who are over the age of 18, and who reside in the Puget Sound area will be recruited. We will examine the differences among women who perceived mental health need and received treatment or help and their income, education, and years of residence in the United States. Via correlational analysis we will examine the relationship of these various factors among Mexican Women. We predict that women with more years in the United States, a higher income and more education will have a stronger relationship with a perceived need for mental health services. We hope to better understand the sociocultural factors associated with women who perceive a need for mental health services and those who actually receive treatment.

When the Spirit Moves the Ground

Kimberly Collett, Junior; Interdisciplinary Arts and Sciences, UW Bothell

Mentor: Kanta Kochhar; Interdisciplinary Arts and Sciences, UW Bothell

When the Spirit Moves the Ground, a performance project, will draw its research from a variety of cultural and spiritual practices in relation to the earth. In collaboration with diverse student teams as well as with community partners, we will investigate how we speak to the land and how it speaks to us through our music, dancing, visual arts, and stories. We will focus, in particular, on how diverse cultures tell stories of connection to the earth as well as ways movement between spiritual and scientific stories can be charted. This process will lead to the completion of a performance, film, and a replicable model that can be used for creating work at other sites. Primarily, drawing on arts-based research methods (theatre, dance and film) the work will also draw on ethnography and oral histories, and it will be developed through collaborative development, rehearsal and editing processes. The key research questions revolves around 1) how can we develop storytelling and performance as forms of mapping space, 2) how can art-based methods help us understand more about our relationship to the land and transform it, and 3) how can performance be used to build new communities as both the local and global levels?

Novel binding partners of α -dystrobrevin-1 and -2 in skeletal muscle

Jay Conhaim, Senior; Neurobiology

Mary Gates Scholar

Mentor: Stanley Froehner; Physiology and Biophysics

A critical component of skeletal muscle is the protein scaffold known as the Dystrophin Glycoprotein Complex (DGC) which physically links the actin-cytoskeleton with the extracellular matrix. The DGC also aids in proper skeletal muscle function by anchoring and localizing neurotransmitter receptors underneath motor neurons, and supporting intracellular signaling proteins. The elucidation of these protein interactions within the DGC has been a critical step in understanding how this scaffolding aids in proper motor signal transduction and muscle function. The loss or mutation of proteins within the DGC results in various forms of muscular dystrophy. Using a unique method of protein-purification, known as a TAP-tag, I have been able to investigate novel binding partners of the DGC proteins α -Dystrobrevin-1 and -2 that could not be recognized using traditional immuno-purification techniques. The TAP-tag system utilizes the expression of a protein sequence not found in wild-type Dystrobrevin. This implemented sequence has an extremely high affinity binding partner (antibody) allowing for efficient purification that is not possible without the TAP-tag. The discovery of novel α -Dystrobrevin-1 and -2 binding partners will shed light on functional, structural, and signaling roles of the DGC in muscular dystrophy.

Effects of climate change on *Eriophyllum lanatum* and *Camassia Quamash*

Shilpa Coorg, Senior; Biology

Mentor: Janneke Hille Ris Lambers, Ecology

Global warming is an issue that is of increasing concern in the present time to scientists attempting to predict how life on our planet will respond to changing environments. One of the effects that generally accepted effect of climate change has on this planet is that it may contribute to a change in phenology, i.e. the timing of early flowering of several plant species and fruiting, in plant species. For example, researchers found that cherry trees in Japan bloomed an average of five and a half days earlier over a twenty five year time span due to an increase in temperature of 1.8 degrees Celsius. Although much effort has been put into conducting fieldwork to document these phenological changes, herbarium specimens are a virtually untapped resource as of yet for information on how phenology has changed over time. The herbarium at the University of Washington has over 100,000 vascular plant species in its collection. For many species, the collection can span many of them spanning a time range of over 100 years and can be used to determine the effects of environmental factors on flowering plants. I am currently looking at herbarium specimens of *Camassia quamash* and *Eriophyllum lanatum*

lanatum and categorizing the stage in their life cycle at the time of collection to determine an approximate flowering date. Upon comparison of these records by comparing this information with corresponding climate records in Washington and Oregon, I can determine whether or not climate change global warming has affected these two species over the last 100 years, and if so, how. Results show that increasing temperatures has indeed affected the time of flowering. This could possibly affect other factors such as insect pollination and species distribution, which still remains to be determined upon further investigation, but further research is needed to examine this possibility.

Luminescence Dating of the Archaeological Site at Aramus

Amie Cuhaciyan, Senior; Anthropology

Mentor: James Feathers, Anthropology

Excavations in Armenia are being conducted by the University of Innsbruck, Austria. Their focus is on a Hill Fort in the modern village of Aramus. The fortress is said to have belonged to the Urartian Kingdom which dates to the Iron Age. The University of Washington's luminescence laboratory is solving the archaeological site's depositional problems. The depositional problems at Aramus (and other sites in Armenia) concern the continual inhabitation of the settlement. The site was inhabited roughly from the Iron Age until the Middle Ages. The inhabitants were constantly reusing building materials from older constructions. The result from this was a mixed deposition and a skewed chronology. The dating of ceramic sherds from different layers of well defined strata should clarify the amount of mixing that occurred. In addition, by dating the ceramic sherds the typology of Armenian pottery styles will have a more defined age.

GEAR UP project: Workshop for Youth: Facilitating Student Voice

Arianna Beck, Senior; Philosophy and Classical Studies

Mary Gates Scholar

Jennifer Cushing, Senior; Anthropology and French

Mary Gates Scholar

Farah Nousheen, Senior; Comparative History of Ideas

Mary Gates Scholar

Anya Pavlovic, Senior; Political Science and Communication

Mary Gates Scholar

Mentor: Craig Jeffrey, Geography

Our group partnered with the University of Washington State GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Programs) to engage in research on the lack of student voice in secondary schools and the structural factors that hinder students' success. Our collaborative praxis-based research took the form of developing a workshop for facilitating student voice. Through the development and practice of the workshop as well as

scholarly research we sought to discover the importance of and possibilities for facilitating student voice. The poster will present our findings based on the workshop; it will also pose questions about issues in secondary education and GEAR UP's role in addressing them.

The p53-mediated stress response is associated with Cd-sensitivity in Mouse Embryos undergoing Neurulation

Davide De Masi, Senior, Environmental and Conservation Biology

Mentor: Elaine M. Faustman, Environmental and Occupational Health Sciences

Mentor: Xiaozhong Yu, Environmental and Occupational Health Sciences

Mentor: Joshua F. Robinson, Environmental and Occupational Health Sciences

Teratogenic metals such as cadmium (Cd) induce neural tube defects (NTDs) in mouse embryos when exposed during critical periods of gestation. Common laboratory mouse strains, as exemplified in previous studies of the C57BL/6 (C57) and SWV, exhibit differing degrees of sensitivity to Cd-induced NTDs. Previous studies have shown that in response to Cd, p53 and p53-related downstream mediators are induced in embryos undergoing neurulation. These genes are implicated in cell cycle regulation and apoptosis as a result of environmental-induced stress. Differential sensitivity to Cd between C57 and SWV mouse strains is characterized by differential gene expression response of p53-downstream mediators (p21, pmaip1, ccng1) in the C57 but not in the SWV. This suggests that the role of p53-mediated response is associated with sensitivity to Cd-induced NTDs. In this study, we will assess whether observed differences in Cd-induced RNA expression between C57 and SWV embryos translate into differential protein expression of p53-mediated cell cycle regulation and apoptotic response. In C57 and SWV embryos, comparing Cd-treated with controls, 12 and 24 hrs post-maternal injection (GD8.0, ip), we will assess protein expression of p53 and known p53-mediated regulators of cell cycle regulation (p21, ccng1) and apoptosis (c-casp3, pmaip1) via western blot. Protein will be isolated from homogenized embryos and probed using specific antibodies. Preliminary results suggest differential expression of p53 and cleaved caspase 3 in C57 and SWV mouse embryos correspond to observed differential sensitivity to Cd. Based on our results, we will discuss alterations in expression of p53 regulated mechanisms (cell cycle arrest and apoptosis) and their association with increased sensitivity to Cd-induced perturbations in neural tube closure.

SpectrUW: Computing Spectra of Linear Operators

Danae Delacruz, Senior, Applied & Computational Mathematical Sciences (Discrete Math and Algorithms)

Brent Sandona, Freshman, Computer Engineering

Anennya Veeraraghavan, Junior, Applied & Computational Mathematical Sciences (Mathematical Economics) and Economics

Mentor: Bernard Deconinck, Applied Mathematics

Spectra of linear operators play an important role in various aspects of applied mathematics. Such instances where it is necessary to determine the spectrum include stability analysis of equilibrium solutions and the theory of vibrating strings and membranes. For all but the simplest operators, the spectrum cannot be determined analytically. We will demonstrate the software package SpectrUW (pronounced "spectrum"), which computes spectra numerically, using an efficient black-box numerical method. SpectrUW is a Java-based package that relies on either Maple or Mathematica as its computational engine. Users interact only with SpectrUW's interface while calculations are done internally. To date SpectrUW has been downloaded over 500 times by different researchers worldwide.

North Puget Sound Ecological Assessment through Marine Microbiota Assemblages

Julian Dillon, Senior, Earth & Space Sciences

Mary Gates Scholar

Mentor: Elizabeth Nesbitt, Earth & Space Sciences

Foraminifera, diatoms and ostracods collected from sampling stations in North Puget Sound each year for the last 10 years have provided a substantial database for assessing ecological health of inland coastal waters. Benthic foraminifera are very sensitive to the environment in which they live, and provide good data on environmental perturbations due to population changes. Previously, foraminifera populations have been unknown in Puget Sound and its inlets, with isolated studies which have ignored various species. By mapping foraminifera populations, changes can be better observed and analyzed for dangerous levels of pollution. Deformation in shell morphology are also indicative of pollution. Foraminifera were picked from washed sediment samples under a microscope, identified and counted, and compared with other environmental factors, including water depth, salinity and sediment type. Foraminifera from 2 permanent and 25 rotating stations were processed with 20 species recognized with 4 numerically dominate assemblages. Assemblages consist of a combination of species from colder, high latitudes (*Elphidium frigidum*, *Bucella frigida*) as well as species that are common along the California coastline (*Elphidiella hannai*, *Trochammina inflata*). Deformed shells occur in higher frequency in shallower Bellingham Bay waters. Foraminifera from 75 samples sites have been processed and 20 sites have been taxonomically and statistically analyzed for species abundance and diversity richness. Further analysis and continued monitoring are necessary to determine changes in marine ecology.

The Color of Opportunity: Racialization of Welfare Reform

Hala Dillsi, Senior, Political Science and Near Eastern Languages & Civilization

Mary Gates Scholar

Mentor: Bryan Jones, Political Science

Contemporary welfare has reshaped the relationship of low-income families with government at all levels. Since the major welfare reform of 1996, has shifted to focus to immediate work and heterosexual marriage and two-parent family structure as a way out of poverty. This new program has left states with wide discretion in determining eligibility, while still sharing some the cost of the program with the federal government. This, in turn, brings up questions how significantly welfare reform reduced aid poor families as well shaped which families may receive assistance, further limiting access to public assistance programs. Increasingly, the racialization of welfare recipients has incorporated the black laziness stereotype as well as the sexual irresponsibility stereotype that has contributed to lower support for welfare public assistance and how has it shaped societies questions of behavior regulation versus recipient rights. Most importantly, such research can help extract the aggregate outcomes of welfare policy shifts and begin further exploration of how this has affected the quality of life of for low-income African Americans. Utilizing datasets from the Policy Agenda Project, I track who participated in and what is said in Congressional hearings on welfare reform. Mapping out implicitly racial and gendered language within Congressional hearings and newspaper editorials around the 1996 welfare reform within discussion of welfare and poverty connect to racial language around crime in the U.S. This is crucial in reexamining our welfare system and to critically analyze how punitive and restrictive measures of welfare reform have contributed to the failure of recipients to support their families and pay for the necessary resources for their family.

Structural studies of V-ATPase by observed rotation of synaptic vesicles

Byron Doepper, Senior, Neurobiology, Chemistry, and Biochemistry,

Mary Gates Scholar

Mentor: Daniel Chiu, Chemistry

Mentor: Peter Allen, Chemistry

Synaptic vesicles (SVs), small compartments which store and release neurotransmitters (NTs), are the fundamental units of interneuron communication. A more complete knowledge of these vesicles could have broad implications for understanding the processes of cognition and learning. One of the largest and most studied proteins imbedded in SV membranes is the Vo-ATPase. This protein uses the energy from lysing ATP to pump protons into the vesicle, creating a gradient which is in turn used to load the vesicle

with NTs. Recent studies have shown a remarkable rotary behavior in multiple types of ATPase, suggesting that they are the smallest known rotary motors, but experiments have thus far failed to conclusively show the exact nature, rate, and stoichiometry of their action. We attempt to address these properties in V-ATPases still imbedded in the SV membranes. By securing the proteins to an antibody-coated slide, the goal is to observe the subsequent rotation of the entire synaptic vesicles, by virtue of their containing aligned fluorophores. This approach grants us sufficient sensitivity to observe the action of single V-ATPase molecules, which has thus far yielded some insight into the nature of this molecular motor.

Bone Histomorphometry of Metastatic Prostate Cancer

Alexander Dowell, Senior, Biology

Mentor: Colm Morrissey, Urology

The American Cancer Society estimated that in the US, 27,350 men died of prostate cancer (PCa) in 2006. In 90% of patients with advanced disease, PCa metastasizes to the bone, leading to pain, impaired mobility, spinal compression and bone fractures. The dynamic process of bone remodeling occurs throughout a person's life. Bone homeostasis is maintained by osteoblasts (bone forming cells) and osteoclasts (bone resorbing cells). Bone turnover is altered when PCa cells populate the bone marrow, with bone response being predominantly osteoblastic (bone forming). Targeting the biochemical communication pathways between PCa in the bone marrow and the cells responsible for bone remodeling may provide palliative treatments for relieving the tremendous morbidity associated with PCa metastases. To characterize PCa mediated bone remodeling, we assessed osteoblast (bone forming) and osteoclast (bone resorbing) activity in numerous bone sites ($n=20$) from a large cohort ($n=50$) of patients that have died of PCa. Bone samples were obtained through a rapid autopsy program. Sections of plastic embedded tissue ($5\mu m$) were mounted on slides and stained using Mason's Trichrome (bone morphology), alkaline phosphatase (number of osteoblasts) or tartrate-resistant acid phosphatase (number of osteoclasts). The Bioquant Nova Prime image analysis program was used to determine bone volume in tissue volume, tumor volume in tissue volume, trabecular thickness in μm , trabecular number per mm, trabecular separation in μm , the ratio of osteoblast perimeter to bone perimeter and the ratio of osteoclast number to bone surface. Correlation analysis was performed using the statistical analysis package PROSMTM version 3.0. These studies present the most complete picture to date of the bone remodeling process in patients with PCa bone metastases.

Is the Loudness of a Tone Altered by Noise in the Opposite Ear?

*Shiboney M. Dumo, Senior, Speech & Hearing Sciences
Mentor: G. Christopher Stecker, Speech & Hearing Sciences*

Binaural summation of loudness refers to the observation that a sound presented binaurally will be perceived louder than the same sound presented monaurally. This research explores binaural summation of loudness when the two ears receive qualitatively different sounds. Target stimuli consisted of a 1000 Hz tone in combination with either a pure tone [control condition] or narrow-band noise [experimental condition]. Subjects adjusted the level of a monaural reference stimulus (a 1000 Hz tone presented to one ear) that alternated with the target presentation. Consistent with previous studies, we expected increased loudness in the control condition relative to the monaural 1000 Hz tone. If binaural summation of loudness simply reflects between-ear combinations of acoustic energy within a restricted frequency range, then an equivalent shift should be observed in the experimental condition. On the other hand, if binaural summation requires fusion of perceptually similar sounds at the two ears, loudness in the experimental condition should be similar to the monaural reference stimulus. The results have potential implications for clinical measurements involving contralateral masking noise presented to a non-test ear.

Droplet movement on a vibrating asymmetrical hydrophobic surface

*Todd Duncombe, Sophomore, Electrical Engineering
Mary Gates Scholar
Mentor: Karl Bohringer, Electrical Engineering*

Development and characterization of a method for droplet movement is the primary objective of research. This method can achieve droplet movement on a hydrophobic surface using random vibrations and surface texture asymmetry. The ratchet design microfabricated onto the silicon wafers has repeating curved ridges and outside of the ridges are uniform circular pillars (30 μ m in diameter). The wafer is chemically treated to increase the silicon's hydrophobicity; the resulting high contact angles (125-140 degrees) put the droplet in a very stable state that can handle vibration. When a water droplet (~ 5 μ l to 25 μ l in volume) is placed upon the ridges and randomly vibrated, droplet movement results. During the recession of the drop's footprint there is more friction on the side of the drop that aligns with the ridge's curvature, the resulting drop movement is in this direction. Droplet movement is predictable in each cycle, from one expansion and recession of the drop's footprint to the next. High predictability enables drop movement to be thoroughly characterized and controlled. In this method of droplet movement there is no energy gradient, a droplet can move for long periods of time just with the random vibrations present (this has been shown in circular designs).

Computer Model Explores the Potential for Tracking HIV Infection via the Noninvasive Use of Infrared Spectroscopy

*Anthony Evans, Post-Baccalaureate, Bioengineering
Mentor: Kalyn Owens, Chemistry
Mentor: Ann Murkowski, Biology*

Many people with chronic health conditions such as diabetes, Human Immunodeficiency Virus (HIV) disease and cancer would benefit from easy access to inexpensive, noninvasive monitoring. One significant challenge in utilizing common spectroscopic techniques for noninvasive monitoring is the low concentrations of disease related analytes found in bodily fluids. Proteins associated with HIV for example, occur in serum at concentrations in the femtogram/milliliter range, many orders of magnitude below the detection thresholds of modern spectrophotometer hardware. In order to determine the feasibility of monitoring HIV with infrared spectroscopy, we modeled the error in quantification of an HIV p24-like protein in a dermal interstitial fluid (DIF)-like matrix at p24's expected concentration in the DIF of infected persons as a function of instrumental uncertainty (mean white noise level.) We chose p24 because its concentration roughly correlates with disease progression. We correlated the characteristics of several modified infrared protein spectra with the structural characteristics of their associated proteins. Several spectra were then computer-generated; each one representing an aqueous solution of thousands of proteins similar in structure and concentration to those in DIF. Finally, we attempted to quantify a simulated protein with characteristics and at concentration levels that were equivalent to p24 for several different instrumental uncertainty values. As expected, quantification resolution dropped as instrumental uncertainty increased. Only attenuated total reflectance and transmission spectra were available for this study. Future studies will test the implications of our model on a hypersensitive prototype instrument in a wet lab.

Sexual Differences in Pelvic Variance of *Macaca nemestrina* and *Macaca mulatta*

*Carolynn Fitterer, Senior, Anthropology
Mentor: Patricia Kramer, Anthropology*

Sexual dimorphism of the pelvis has long been an area of strong evolutionary interest. It is well documented that *Macaca nemestrina* and *Macaca mulatta* both have a sexually dimorphic pelvis. However, much less data is available in regards to sexual differences in pelvic variance of these two species. This study tests for sexual dimorphism in phenotypic variability of the pelvis of the two species *M. nemestrina* and *M. mulatta*. In both sexes, the pelvis is subject to selection for locomotor efficiency. Females have the added selection pressure of childbirth, which is a plausible cause of death. Because of the added selective pressure on females, it is hypothesized that they

would have a less variable pelvis than males. This study analyzes 12 male specimens and 8 female specimens. Data was collected using 11 pelvic measurements of only adult specimens. Statistical analysis was conducted using Levene's univariate test for relative variation. Results show that the females did not differ significantly between the males in pelvic variability. The females were only marginally more variable. This study replicates former studies, which found little sexual difference in pelvic variance or marginally stronger variance in females. Although the sample size of this study is not large enough to be conclusive, the results may suggest that the added differential selection of death from childbirth on females is not a strong selective pressure.

Comparative spatial analysis of seven bivalve species' spawning times as a function of surface water temperature along the United States Pacific Coast using ArcGIS

Lindsay France, Senior, Environmental Science, UW Tacoma

Mentor: Bonnie Becker, Environmental Science, UW Tacoma

The impacts of climate change have recently become more evident and, as a result, understanding the consequences of surface water temperature changes on marine biota also becomes essential. Marine bivalves were selected for this analysis as they are common indicators of ecosystem health. This study is a large scale comparative analysis designed to examine the relationship between surface water temperature and spawning times of seven bivalve species along the United States Pacific coast using ArcGIS software. Primary literature was referenced to identify ideal spawning times for bivalve species: *Nuttallia obscurata*, *Crassostrea gigas*, *Macoma balthica*, *Crassostrea virginica*, *Mytilus edulis*, *Mya arenaria*, and *Siliqua patula*. The data describing these species' ideal spawning times were stored in an Access database and then applied in ArcGIS. This allowed for the creation of a spatial representation that illustrates annual spawning times and temporal variation along the pacific coast. The results of this analysis are expected to show a distinctive correlation between surface water temperature and individual species spawning time across their geographic range. Analysis is near completion and the results will be presented.

Greenhouse Gas Assessment for Snohomish County: A Case Study

Don Fraser, Post Baccalaureate, UW Bothell

Mentor: Martha Groom, Interdisciplinary Arts & Sciences, UW Bothell

Snohomish County conducted a greenhouse gas emissions assessment in late 2007 to support a goal of a 20% reduction in overall emissions below 2000 levels by 2020. This case study followed the progress from the

Assessment Team formation through report out, with the goal of understanding the methodology used to conduct a community level emissions assessment and establishing a target that could be used in developing reduction strategies. Snohomish County contracted with the Cities for Climate Protection (ICLEI) to use their software and process guidelines. There was no existing system to account for County emissions so decisions on what factors to measure and how to gather data needed to be made by the Assessment Team in collaboration with other departments and private companies. The Assessment Team estimated that there were 5.29 million tonnes of CO₂ equivalent gases emitted in Snohomish County in the year 2000; 50% from transportation, 25% from residential energy use, commercial 15%, industrial 9%, and waste 1%. Under a business as usual scenario annual emissions would grow to 6.90 million tonnes by 2020, requiring a plan to reduce annual emissions by 1.6 million tones through prevention or mitigation in the next 12 years. The Team elected not to count emissions from such factors as residential consumption or land use changes, as impacts from those factors would be small compared to the effort to gather the necessary data. It is more useful to develop measurement criteria from principle sources using repeatable techniques than to expend limited resources trying to generate a precise and comprehensive measurement that is of little practical value.

Comparing growth rates and mechanisms in two species of oysters from Puget Sound

Katie Fulkerson, Senior, Aquatic and Fishery Sciences

Mentor: Steven Roberts, Ocean & Fishery Sciences

The Pacific oyster, *Crassostrea gigas*, is the most valuable commercial species in Puget Sound in the state of Washington. While of less commercial value, the Olympia oyster, *Ostrea conchaphila* still holds significant importance in being native to Washington State. To better understand the differences in these two species as it relates to growth, this study 1) compared growth rates in both species grown at the same site and 2) characterized gene expression patterns during oyster juvenile development. Oysters were purchased as seed and grown in Agate Pass in Kitsap County. Growth measurements were taken once a month beginning in August 2007 and ending in December 2007. Tissue samples of the mantle, muscle, and gills were taken during the months of September and November for quantitative PCR analysis. Bioinformatic techniques were used to identify growth-related genes in *C. gigas* and *O. conchaphila* by mining expressed sequence tags (ESTs). Growth rates were significantly higher in the Pacific oyster compared to the Olympia oysters, over the course of the experiment. Several genes putatively involved in growth were identified and quantified including 14-3-3 protein gamma, a kazal proteinase inhibitor, mGDF, and an insulin-induced gene-2 protein. The differential expression patterns observed suggest some of these

genes are involved in oyster development and could be associated with the different growth rates observed in these two species. Obtaining a better understanding of the mechanisms involved in growth will provide further knowledge of the biology of oysters and has the potential to assist the aquaculture industry in selecting broodstock.

Peripheral Blood Effector and Regulatory T Cell Responses to Chlamydial Antigens in Gambian Trichiasis Cases and Controls

*Alevtina Gall, Senior, Biology (Cell, Molecular & Developmental) and International Studies
EIP Presidential Scholar, Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: Martin Holland, MRC Laboratories, The Gambia
Mentor: Chris Wilson, Department of Immunology*

Chlamydia trachomatis is the leading cause of infectious blindness world-wide. In this study in vitro cellular immune responses were assessed using peripheral blood obtained from thirty-seven Gambian study participants with advanced stage conjunctival scar tissue (Trachomatous Trichiasis) and 37 age, sex and village matched controls. Cultures of whole blood or lymphocytes were stimulated with a panel of 8 recombinant Chlamydia trachomatis antigens, C. trachomatis elementary bodies and controls. Cell division was measured by ^{3}H -thymidine incorporation and cytokine production in culture supernatants was assessed using a multiplex bead suspension array (IL-5, IL-10, IL-12 (p70), IL-13, IFN γ and TNF α). In a subset of participants (17 case-control pairs) the phenotype of the responding cells was determined after stimulation by cell surface and intracellular labeling with immunofluorescent antibodies and the cells enumerated using a 4-color flow cytometer. Using flow cytometry we detected a significant increase in the frequency of cells bearing regulatory T cell markers such as FOXP3, CTLA4 and GITR, as well as, increased frequencies of IFN γ and IL-10 producing cells in response to stimulation with C. trachomatis elementary bodies and a limited number of the recombinant antigens. We found that neither the intensity of proliferative response nor the cell-mediated immune response profile segregated with the disease status of these subjects. Our study confirms that disease progression is largely independent of the adaptive immune response at this stage in the disease process. We propose that a better understanding of fibrogenesis, particularly, on a genetic level can help to explain the tendency of Trachomatous Trichiasis to advance to corneal opacity and eventually blindness.

Are We Tight? Homophily and Triadic Closure in Facebook Networks

Marianne Goldin, Junior, Sociology

Mary Gates Scholar

Nathan Cermak, Junior, Sociology and Applied & Computational Math & Sciences

Mary Gates Scholar

Mentor: Katherine Stovel, Sociology

The tightness of social networks has been shown to originate from the similarity of its members. However this likeness, or homophily (the tendency of like individuals to prefer like) has also been shown to be both an input and outcome for a dense network. Empirical studies of networks have been largely limited by the nature of their measurement: a personal survey. Only recently have virtual social networks such as Facebook been tapped for their potential to provide large and dynamic data sets of user interaction. By creating a custom Facebook application and randomly enrolling participants to use it, we will amass a robust transcript of our participants' data: who their friends are, how far they are from each other, and how alike they are. We analyze an element of network density, triadic closure, by addressing the relationship between homophily (distance, age, gender, and other measures) and the tendency for participants' friend chains to be diverging or tightly connected. We predict that likeness in personal attributes, not geographic distance or location, has the greatest effect on triadic closure. We are interested in discovering the temporal sequence in which homophily affects the tightening of a network, that is to say, is the correlation stronger when homophily has been an input or an output? We move beyond analyzing individual-level attributes by structuring our inquiry to look at the interaction between these attributes. This research is aided by the straightforward manner in which Facebook deconstructs the social self, in codified data fields and other binary markers of no uncertainty.

Measuring recombination efficiency in *Agrobacterium tumefaciens*

Ashley Gregoire, Junior, Biology

Mentor: Derek Wood, Biology

The genome of Agrobacterium tumefaciens C58 was sequenced by Wood et. al. 2001. This bacterium causes crown gall tumors on many wooded plants. This Gram-negative bacteria stimulates the formation of tumors by transferring parts of its T-DNA from the tumor-inducing (Ti) plasmid into the cell nucleus of the plant. We are developing constructs using the Gateway system developed by House et. al. in order to improve the recombination efficiency in Agrobacterium. This project establishes a functional genomics toolbox in Agrobacterium that will provide the ability to delete genes, tag them for expression and immunological studies and many other applications.

The Separation of Particles with Dielectrophoresis in a Microfluidic Channel

Stanley Gu, Junior, Bioengineering

Amgen Scholar, Mary Gates Scholar

Mentor: Lih Y. Lin, Electrical Engineering

Mentor: Joseph Peach, Electrical Engineering

Dielectrophoresis (DEP) is a phenomenon that occurs when a particle is subject to a non-uniform electric field. The electric field induces a dipole in the particle and produces an interaction with it and the surrounding medium. Differently sized particles under different frequency of electric fields experience different amounts of DEP force. In our lab, our goal is to separate differently sized particles, such as DNA strands, by using this force. Our experiments involve flowing particles of interest suspended in solution through a microfluidic channel lined with various electrode arrays. Thus far, we have demonstrated that microbeads with diameters of 200 and 500 nanometers are able to be separated using DEP. By flowing these beads into an array of V shaped electrodes and setting the AC to 2.9 volts and 2.85 megahertz, we saw 200 nanometer beads drawn and trapped to the sides of the channel while the 500 nanometer beads continued to flow down the middle of the channel. These results show promise for separation of other particles, such as DNA, in the future.

Assessment of Cellular Changes Resulting from Functional Electrical Stimulation Therapy in Spinal Cord Injured Mice

Hale A. Hansen, Senior, Neurobiology

Mary Gates Scholar

Faezeh Talebiliasi, Junior, Neurobiology, Physics

Mary Gates Scholar

Mentor: Philip Horner, Neurological Surgery

One of the leading clinical therapies in use today to assist patients with spinal cord injuries (SCIs) is a treatment known as Functional Electrical Stimulation (FES). In FES, an artificial source is used to provide the targeted muscles with the appropriate electrical stimulation needed to elicit a contractile response. Previous work demonstrated significant patient recovery in motor and sensory functions with FES treatment five years after initial injury but fell short of explaining any physiological changes in the spinal cord as a result of the FES¹. Due in part to its non-invasive, low risk application FES treatment has been used in patient therapy without significant study or knowledge of the underlying cellular changes it elicits, especially neuronal. My current work aims to answer some of the questions, using a mouse model, of what happens at a cellular level in the spinal cord of SCI patients treated with FES. My research examines two populations, acutely and long-term injured SCI mice who are treated with two weeks of twice daily FES therapy. Through utilization of various labeling and staining methods and comparison to

controls, I hope to identify regions of change in cellular morphology and proliferation in the spinal cord that are induced by the FES therapy. These changes include axonal branching and sprouting, novel cell production, changes in synapses at and around the site of injury, and changes in supporting cells (astrocytes) and neural growth factors (neuregulin-1). Preliminary studies show indirect evidence that FES therapy can cause adaptive plasticity in the neural circuitry as demonstrated through long lasting behavioral and reflexive modifications in the mouse model². Through my work I hope to more explicitly identify the cellular origins of this neural plasticity. Better understanding of this therapy will eventually provide for a more focused and efficient treatment of SCI patients with FES.

Precision of Imitation as a Function of Preschoolers' Understanding of the Goal of the Demonstration

Marielena Lotz, Junior, Psychology

Hillary Havlina, Senior, Psychology

Mentor: Rebecca A. Williamson, Institute for Learning & Brain Sciences

Imitation is a quick and easy mode to acquiring information, free from the sometimes daunting trial-and-error process. Previous research has shown that even infants have the capabilities to observe and precisely copy others' actions (e.g. Meltzoff 1998). The overall goal of this psychology research project was to investigate whether 2-year-olds will imitate actions more precisely when the goal and purpose of the action is unclear. Conversely, when the intent is apparent, the toddlers might be more likely to use their own methods of task completion. This poster presents a specific coding-scheme that we developed to consistently quantify the toddlers' imitation. Each child saw a model place a piece into a meaningful or meaningless puzzle-like array using a very specific sequence of separate actions (i.e. using only one finger, sliding the piece into place, hopping the piece, etc.). Participant's actions were judged on a scale of 0-2 (no imitation to perfect imitation). Specifications as to how many fingers on the piece, the duration of time the piece was slid, etc. were organized in detail to maximize consistency between blind coders. The model slid the puzzle piece with one finger and participants using any one finger or their index and middle finger were coded with a "2", perfect imitation, to allow for varying levels of motor development. Models also demonstrated a hopping motion and participants received a score of "2" only if the piece was hopped two, consecutive and intentional times. If participants were focusing attention on the piece, intentionality was assumed. The results of this project were used to establish that the children in the experimental group had significantly higher imitation scores than controls in support of the hypothesis that when intent is unclear, children imitate more precisely than when the task purpose is evident.

Mode-locking lasers on a finite waveguide array

Hannah Hedeen, Electrical Engineering

Mary Gates Scholar

Beth Carey, Junior, Pre-Major

Mentor: J. Nathan Kutz, Applied Mathematics

Mode-locking lasers are lasers which produce a series of high intensity pulses rather than a steady, lower intensity stream of energy as in common continuous wave (c.w.) lasers. Mode-locking lasers are advantageous in that the intensity of each individual pulse is much higher than the intensity of c.w. laser output, while the total energy (the area under the intensity curve) used to produce each of these lasers is the same. My group's goal is to model the behavior of a mode-locking laser on a finite, rectangular domain, with an intensity-discriminating waveguide structure. This particular structure stems from our goal of containing the laser within an electronic chip. We are currently attempting to model the mode-locking laser using numerical analysis methods in MATLAB. Our governing equation includes a complete model of the desired system, taking into account the effects of dispersion, bandwidth-limited gain, self-phase modulation, attenuation and spatial coupling. Parameters such as gain and loss must be found such that mode-locking behavior is produced in one of the five waveguides in our model.

Parametric Investigation of Picoliter Droplet

Interfacial Tension

Joel Harness, Senior, Chemistry

Amgen Scholar, Mary Gates Scholar

Mentor: Daniel Chiu, Chemistry

The study of microfluidic droplets as microscale reaction systems has been essential to the study of subcellular biochemistry. To better understand the droplet formation process, a thorough understanding of interfacial tension (IFT) dynamics is necessary. This project seeks to correlate changes in IFT as a function of oil type, ion concentration, surfactant concentration and surfactant type. System conditions were varied and measurements of the IFT were made by flowing droplets through a microfluidic channel constriction and observing the deformation and relaxation. Fast imaging techniques were used to gather images that were then analyzed using software coded with the program Labview. Additionally, this project investigated the ability of this system to detect biomolecular accumulation at the oil-aqueous interface. By linking accumulation of these biomolecules to IFT, the researcher gains a rapid and non-invasive technique for probing the dynamics of their biochemical system. These results should allow future researchers to anticipate necessary changes in microfluidic geometries as the system being investigated changes.

Isolating and Sequencing the genomic binding site of Fibroblast Growth Factor 10

Bryson Hicks, Junior, Biochemistry

Mary Gates Scholar

Mentor: James Bassuk, Urology

The mitogen Fibroblast Growth Factor 10 (FGF10) is crucial to the regulation of cell growth in urothelial cells. It has been shown that FGF10 is produced in the lamina propria, and induces proliferation of urothelial cells. However, little is currently known about the mechanism by which FGF10 operates. Understanding this mechanism would be useful for tissue engineering and bladder repair, and treating urological diseases such as hypospadias. To learn more about this mechanism the Chromatin Immunoprecipitation method (ChIP) will be used. This involves harvesting human urothelial cells fed with FGF10, cross-linking the FGF10 to the DNA with formaldehyde, isolating the nuclei, and then sonicating the isolated nuclei to shear the chromatin. Mouse anti-FGF10 antibodies, human anti-mouse antibodies, and Protein A-agarose are then used along with centrifugation to recover DNA-FGF10 complexes. The sample is then boiled in Chelex (which protects the DNA) to free the DNA from the protein-antibody complex. After that, PCR is used to amplify the region of DNA to which FGF10 binds. Once this region of DNA is understood, we will better understand which gene(s) FGF10 interacts with. As of yet, we have isolated samples of chromatin with FGF10, and are in the process of validating our shearing efficiency and antibodies for quality control purposes.

ATR inhibition diminishes UV-induced skin cancer development *in vivo*

Erin Higgins, Senior, Microbiology, Spanish

Mentor: Paul Nghiem, Dermatology

ATR (Ataxia Telangiectasia- and Rad3-related) is a protein kinase that plays an integral role in DNA replication by recognizing stalled replication forks at sites of DNA damage. ATR prevents progression to early stages of mitosis by binding DNA, phosphorylating targets and causing cell cycle arrest in order to allow for damage repair. In the normal cell cycle, replication checkpoints are critical for DNA damage repair. ATR is required for one such checkpoint, helping to maintain genomic fidelity of dividing cells. Cancer cells, which are typically deficient in p53, an important tumor suppressor gene, often lack early cell cycle checkpoints. It has been shown *in vitro* that inhibition of ATR in p53-deficient cells promotes erroneous mitotic entry and premature chromatin condensation. As a result, the damaged cells undergo apoptosis. We are interested in the role that the inhibition of ATR plays in the development of skin tumors. We used transgenic mice expressing kinase-dead ATR (ATR-kd) to study *in vivo* low-level inhibition of ATR. We induced DNA damage in control and transgenic mice via treatment with UV-B light.

The quantitative and temporal development of tumors in the mice were observed and documented. We found that ATR-kd transgenic mice showed longer latency to first tumor development in comparison with wildtype mice and also demonstrated development of fewer tumors per mouse. This suggests that ATR kinase inhibitors may be useful in tumor prevention. Future studies include models of human skin cancer syndromes and eventual progression to human trials.

Increased demand on DNA replication resources in *S. cerevisiae* through the addition of exogenous origins, and its effects on the cell cycle and chromosome segregation

Emily Higuchi, Senior, Biology (Cell, Molecular & Developmental)

Mary Gates Scholar

Mentor: Bonita Brewer, Genome Sciences

Mentor: Gina Alvino, Genome Sciences

All of the instructions that a cell requires for survival and reproduction are located inside of its genome, which is made up of DNA. Before a cell divides, it must accurately and efficiently replicate these instructions so that they may be passed on to daughter cells. Replication begins at specific locations within DNA called origins. Origins do not become activated simultaneously, but begin to replicate in a temporally staggered pattern. While there are several hypotheses that seek to explain this phenomenon, my research asks whether there is a component for origin activation that is present in cells in a limiting amount, necessitating the temporal staggering of origin activation. Demand for replication resources was experimentally increased in *S. cerevisiae* strain RM14-3a through the addition of exogenous origins located on a high copy number plasmid. Using this construct, several questions about the effects of increasing demand for replication resources are being asked. Differences in the loss rate of a second plasmid (YCpGAL-ARS1) present in a single copy per cell was monitored over twenty-one generations to determine if the multiple-copy plasmid out-competes YCpGAL-ARS1 for limiting resources. In addition, cells are being monitored to determine the time it takes for cells to complete chromosome replication when the cells contain the multi-copy plasmid. It is expected that heightened origin number will have a negative effect on the maintenance of YCpGAL-ARS1, and will lengthen the time necessary to complete DNA replication. Because DNA replication is a fundamental process that is shared by all living organisms, information about how it occurs is relevant to a broad range of disciplines, including the study of diseases such as cancer and developmental processes such as X-chromosome inactivation.

R-Trees: The Dynamic Solution to Multi-Dimensional Data

Seth Hill, Senior, Computing and Software Systems, UW

Tacoma

Mentor: Isabelle Bichindaritz, Institute of Technology, UW Tacoma

In recent years, the number of applications and computer systems dealing with large volumes of multi-dimensional data has significantly increased. Multi-dimensional data, as it pertains to this research, is any data object that contains multiple indexable attributes, such as the (X,Y) coordinates of geographical data; this definition applies to various data types used in modern applications including Geographical Information Systems (GIS), Global Positioning Systems (GPS), multimedia, and data warehouse applications. Due to the large volume of multi-dimensional data that must be accessed in current applications, an index of this data must be created to allow fast lookups of relevant data as they relate to a specified query. By using an index, worst case scenarios, such as checking all the data in the system for its relevancy to a specific query, are avoided. The R-Tree was presented as a dynamic data structure designed to index multi-dimensional data based on the “minimum bounding rectangle” of the data, and the spatial relationship between data. This research: explains why the R-Tree is a useful data structure for multi-dimensional indexing in comparison to traditional indexing and query methods; discusses several variants of the R-Tree that could be applied to various types of multi-dimensional data; details this project specific implementation of the data structure, as a class library in the C# language; evaluates this R-Tree for indexing the geographical data of a GIS software application.

Bi-functional peptide design: Combining two GEPIs via a linker using molecular modeling tools

Pranoti Hiremath, Freshman, Bioengineering

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: Ersin Emre Oren, Materials Science and Engineering

Mentor: Mehmet Sarikaya, Materials Science and Engineering

The form and function of biological hard tissues is due to the unique interactions between proteins and inorganics. Genetically Engineered Poyptides for Inorganics (GEPIs) have recently been selected through phage and cell-surface display combinatorial biology protocols to bind specifically to desired inorganic substrates. Many short peptide sequences specific to metals, oxides, and semiconductors have been discovered and used in synthesis and assembly of inorganics as building blocks for future engineering materials. Using molecular dynamics tools to understand the peptide inorganic interaction, we will predict structures of gold and quartz binding peptides and then create hybrid molecular constructs. Ideally, the binding peptides will bind to respective substrates, but will not interact with each other due to the presence of a designed linker used to attach the two peptides. After predicting the overall structures,

we will synthesize those with optimal conformation, and test them to determine their binding efficacy. Our results will provide a greater base and opportunity to harness the potential of GEPIs through applications in nanotechnology, biotechnology, and medicine.

PedalPaths: A Direction Mapping Service for Bicyclists

Dustin L. Hodge, Senior, Informatics and Applied Computational Mathematical Sciences

Mentor: Batya Friedman, Information School

Mentor: David Hendry, Information School

A national survey by the US Bureau of Transportation Statistics shows that, in Seattle, only 25% of people who say they want to cycle actually do. The long-term goal of the PedalPaths project is to lower the entry barriers for cycling and make it a more attractive – and more used – option for commuting and exercise. The current work focuses on designing an interactive route planning system for bicyclists, which addresses the issues of safety, time, convenience, and rider comfort. The system is being implemented with Google Maps. To better understand how different levels of cyclists perceive and get past entry barriers, we conducted seven open-ended interviews (four experienced cyclists, three non-cyclists). In addition, we posted an open survey on Information School listservs, Facebook, and the Cascade Bicycle Club forums; more than 140 responses have been returned. We found that riders vary not only by experience, but also by type (e.g., recreationalists, commuters, etc.). We have concluded that our system should facilitate cautious cyclists. Further, not only has our research shown the need for a different algorithmic solution using bicycle paths and cuts through city parks, topographic data, and avoiding dangerous cycling areas, but it has given us insight into how to present this information on a map in a way that is meaningful to cyclists. In addition, we believe that this tool will become more useful when placed in a social context, such as an online social networking community. Informed by this analysis, we have designed a prototype of a web-based service, which lowers the barriers to enter into the cycling subculture in the Seattle area, and specifically improves route finding for people new to cycling. Future work will seek to improve the usability and usefulness of the system and to promote social interaction and bicycle advocacy.

Studies on the Role of MAP Kinase-induced Phosphorylation of Connexin 43 in the Disruption of Gap Junctional Communication by Platelet Derived Growth Factor

Semoni K. Hossain, Sophomore, Pre Sciences

Mary Gates Scholar

Mentor: Paul Lampe, Pathobiology

Gap junctional channels, believed to be involved in the transmission of signal molecules regulating cell

proliferation, are generally closed in cancerous cells. To understand the molecular mechanism, an investigation was initiated to determine the role of the phosphorylation of a gap junctional protein, connexin 43, at specific sites during the down-regulation (closure) of gap junction communication by platelet derived growth factor (PDGF). To answer this question, human embryonic kidney cells expressing wild-type and mutant (lacking phosphorylation sites) connexin 43 were utilized. Western Blot analysis showed that as expected, PDGF treatment resulted in the activation of mitogen-activated protein kinase (MAP-K) and phosphorylation of connexin 43 in these cells. Interestingly, dye microinjection studies showed no down-regulation of gap junctional communication in PDGF-treated cells. These results showed that the phosphorylation of connexin 43 is not sufficient for the down-regulation of gap junctional communication in human embryonic kidney cells, and suggests a more complex regulatory system for the control of gap junctions.

Building an Precision Grammar of St'at'imcets/Lillooet

Joshua Hou, Senior, Linguistics

Mentor: Emily Bender, Linguistics

The LinGO Grammar Matrix is a framework developed by researchers at the University of Washington and Stanford University for developing broad-coverage, precision, implemented grammars of different languages. It takes existing analyses of linguistic universals and grammatical structures common in the world languages and allows computational linguists developing precision grammars to have a starting point to work from, rather than having to start from scratch. These grammars can then be used to parse sentences in the target language, mapping from an input sentence to a semantic representation called MRS (Minimal Recursion Semantics). These semantic representations can then be used to translate between the target language and other languages with grammars with the same style of semantic representation. I am using the Grammar Matrix to develop a grammar of St'at'imcets/Lillooet, a language of about 200 speakers in Southern British Columbia in Canada. I am modifying the rules and analyses already present in the Matrix to handle linguistic phenomena specific to Lillooet. The phenomenon the grammar handles includes argument optionality, verbal inflection, modification, yes/no questions, embedded clauses, and aspect. This grammar will be able to parse Lillooet sentences, and generate them from an MRS.

Optimization of Thermal Electric Cooling Elements Design

Pei-Yu Hou, Junior, Electrical Engineering

Mary Gates Scholar

Mentor: Karl F. Bohringer, Electrical Engineering

Mentor: Rajashree Baskaran, Electrical Engineering

Hot spots are generated and reduce the performance of the integrated circuit when current runs through it. Thermo-Electric Cooling Elements (TECs) are being proposed as a means to cool down an IC chip to maintain its performance [1]. TECs consist of thermo-electric couples, which are pairs of p- and n-type semiconductors, connected with thin metal films and powered by a DC source. According to Peltier's effect, when current passes a TEC, heat from one side of the TEC will be transported to the other side. The objective of this research is to calculate the optimal geometry of the TEC that reduces the temperature at the hot spot on an IC chip. We investigate a one-dimensional micro-scale TEC model with all the couples electrically in series and thermally in parallel. Using MATLAB and the governing equations of the TEC, we found that maximum cooling power density increases, and the optimal TEC length decreases as the heat resistance or the electrical contact resistance decreases. For the particular case presented in our research, with copper heat sink, optimal thickness of TEC elements are in the range of 26 μ m to 39 μ m. We are able to predict the optimal TEC length and the maximum cooling power for a range of temperature differences, heat resistances and electrical contact resistances. In the future, we could like to build a more refined model by investigating other effects such as TECs compactness, contact area between metal and semiconductor and thermal contact resistance.

Finding Transiting Planets with LSST

Ivan Huang, Freshman, Pre Major

Samir Rajani, Freshman, Pre Major

Mentor: Eric Agol, Astronomy

Mentor: Mark Claire, Astronomy

Mentor: John Bochanski, Astronomy

While the Large Synoptic Survey Telescope (LSST) prepares to begin in 2014, astronomers from around the world have been simulating the observations that will be generated by this telescope. With the ability to accurately survey the entire sky every three days, LSST observe millions of stars and galaxies and will open new windows on the Universe. Our project sought to estimate how many transiting planets LSST will detect. In order to simulate planetary transits, we started by using IDL to write a program that will generate data for various exoplanet systems. The data points are filtered through an LSST simulator, mimicking actual sky conditions in 6 different filters. With these simulated observations, we attempt to determine the period of the planet. We then test the accuracy of the program, comparing our input period to the period measured by this program.

Role of the Gcn4 homolog Atf-5 in aging of *Caenorhabditis elegans*

Alexander Huh, Sophomore, Biochemistry

Mary Gates Scholar

Mentor: Matt Kaeberlein, Pathology

Humans have always made an effort increase their longevity. At the genetic level, research is done to determine which genes are responsible for increasing the lifespan of an organism. Because of the complexities and intricacies with the human model, it is believed that studies in model organisms that possess genetic similarities can provide insight into the pathways that influence aging in more complex organisms. One protein that we have recently found to play a role in life span extension in the budding yeast *Saccharomyces cerevisiae* is the nutrient-and stress-responsive transcription factor Gcn4. The goal of this project is to determine whether Gcn4 plays a similar role in the aging of more complex organisms. We are therefore examining the importance of the Gcn4-related protein Atf-5 in aging of *Caenorhabditis elegans*, a multicellular eukaryote commonly used for aging-related research. We are constructing transgenic reporters of Atf-5 expression and we will examine whether Atf-5 is induced in response to different stressors and life span extending interventions, such as dietary restriction. We will also use RNAi-interference to knock-down Atf-5 expression and examine the resulting effect on life span and stress resistance. Finally, we will construct transgenic nematodes overexpressing Atf-5 and ask whether life span is increased in these animals. If Atf-5 is found to modulate aging in *C. elegans* in a manner similar to Gcn4 in yeast, future efforts will be directed toward determining whether mammalian Gcn4-like proteins affect longevity in mice and humans.

Effects of Exogenous Osteopontin on Vascular Calcification in a Mouse Model of Chronic Kidney Disease

Carly Ingalls, Senior, Biology

Mentor: Cecilia Giachelli, Bioengineering

Osteopontin (OPN) is a multifunctional protein expressed in many tissues throughout the body, in a wide range of animal species. Much is still unknown about OPN, but many believe that OPN plays an important role as a mediator of the inflammatory response. OPN has also been found to be associated with elevated concentrations of calcium salts in bodily fluids. This association indicates that OPN may inhibit precipitation of calcium salts, and therefore also inhibit the calcification of soft tissues. Calcification of blood vessels is a very common and sometimes serious complication of diabetes, atherosclerosis, and renal failure. Using a mouse model of Chronic Kidney Disease (CKD), this study investigated whether regular injections of purified OPN could prevent vascular calcification. In order to establish the CKD model, mice were subjected to two renal surgeries, followed by the institution of a

high-phosphate diet. After one week of the high phosphate diet, half of the mice were injected three days a week with sterile phosphate buffered saline (PBS), while the other half were injected three days a week with OPN suspended in sterile PBS at a dosage of 450 µg/kg. All mice were terminated after three weeks of injections. Calcium assays and histological analysis were performed on various vascular tissues. Prior *in vitro* studies have shown that OPN was able to inhibit calcification of vascular smooth muscle cells. Accordingly, the hypothesis for this *in vivo* study was that the mice injected with OPN would show reduced calcification compared to the mice injected with only PBS. The results of this study could provide additional insight into the roles of OPN, as well as prompt further examination into a possible treatment for human chronic kidney disease patients.

Biological and Molecular Functions of gp130 during Renal Fibrosis

Johanna Christa Javier, Senior, Biology Cell & Molecular Development

Mentor: Jesus Lopez-Guisa, Pediatrics

Our research has focused on understanding the molecular mechanisms of renal interstitial fibrosis using the unilateral ureteral obstruction (UUO), protein overload, and diabetic mouse models. Extensive research is being conducted on genes that are regulated during the fibrotic stage where damage is irreversible and not enough work has been focused on the inflammatory stage. At the beginning of renal fibrosis (RF), cellular inflammation triggers immune responses that activate fibroblasts, macrophages, and other cell types to secrete growth factors, cytokines, and interleukins in an attempt to prevent or slow the damage to the tubules and the surrounding interstitium of the kidney. The interleukin-6 (IL-6) protein has been used as a biomarker for renal abnormalities, and although many studies have been done to determine its role in the kidneys, no clear results have emerged. IL-6 belongs to the IL-6 family of genes, which has nine members that share two receptors: LIFR and gp130. Using the UUO mouse model, we compared gp130 (+/-) heterozygous transgenic mice with wild type gp130 (++) mice. The gp130 (+/-) mice developed less fibrosis, based on lower collagen levels. The IL-6 gene family plays an important role in the inflammatory process, and it is possible that the lower level of fibrosis observed is the outcome of lesser inflammation and subsequently, indicates lessened fibrogenesis. To prove the role of IL-6 gene family involvement in the renal inflammation-fibrosis process it is necessary to discern the mechanisms. Our objective is to measure the gp130's interaction with ligands on the IL-6 family of genes and their expression levels. These changes in expression levels may up- or down- regulate the transcription of genes that are part of the pro- and/or anti- inflammatory pathways during CKD and ESRD. We will test our hypothesis that is important gp130 in the inflammatory process preceding fibrosis.

Understanding Union Democracy: The ILWU Case Study

Kristin Ebeling, Sophomore, Sociology

Nicholas Kato, Junior, Political Science and Economics

Brandon McDavid, Sophomore, History

Michael Rodriguez, Junior, History

Lila Zucker, Sophomore, Pre Major

Mentor: Margaret Levi, Political Science

The American labor movement has manifested itself in an array of unions, ranging from corrupt crime rings to democratic social movements. This ongoing study seeks to understand and model the apparent dichotomy between "bread and butter" unions, such as the Teamsters, and social unions, like the ILWU (International Longshore and Warehouse Union). Although similar in demographics, time period, and industry, these unions have historically exhibited stark contrasts in both structure and practice. Why do similar people make such divergent decisions? We have hypothesized that these differences stem from organizational cultures and the influence of various labor leaders. In particular, the organizational culture of a union may cultivate a change in the ordering of preferences of its constituents--from immediate material gains to commitments to broader social causes. We have conducted a thorough analysis of primary source documents related to specific locals of the ILWU in Tacoma and San Pedro. Interviews, newsletters, and individual memoirs supplement and contrast larger coast-wide movements for social justice. Differences in individual attitudes exemplify members' willingness to comply with union values and decisions. This in turn provides evidence for the model's ability to analyze and predict changes in member preferences due to union feedback. By determining the reach of union influence, we can predict the effect of the addition of new members into the union. The ILWU's significant departure from traditional hiring practices lessens the exclusiveness of union jobs and the union's direct ability to recruit members of similar ideology. A population of more diverse union members may influence the political environment of the union and may themselves become more political from the social justice background of the union itself. Continuing research will measure the union's effectiveness of creating an environment conducive to grassroots, social organization.

The Effect of Avian Insectivore Loss on Agriculture in Guam

Tara Kenny, Senior, English

Howard Hughes Medical Institute Biology Fellow

Mentor: Joshua Tewksbury, Biology

Mentor: Haldre Rogers, Biology

Birds make up a small percentage of the biomass of forest ecosystems, yet are thought to provide several essential ecosystem services including control of insect herbivores. Birds have been found experimentally to limit densities of arthropods on a very small scale; however, few studies have measured the importance of insectivorous birds on a large scale or in an un-manipulated setting. The Mariana Islands of Guam, Tinian and Saipan offer a unique opportunity to study this topic since virtually all avian insectivores were extirpated from Guam between 1945 and 1990 by the introduction of the Brown Treesnake whereas the nearby islands of Saipan and Tinian support relatively healthy bird populations. This study investigates how this bird loss has affected insect abundance and plant growth by comparing common agricultural crops grown inside and outside of bird exclosures on Guam, Saipan and Tinian. Because many people of the Northern Mariana Islands use small farming to supplement their income, if the loss of birds affects the agricultural outcome, there could be serious economic consequences for the people of Guam. Although there are differences in soil and rainfall between islands, the equality between exclosure and control treatments on Saipan and Tinian indicates that, despite these differences, insect abundance as a factor of bird population can be observed and measured. The equality between exclosure and control treatments measured within islands (as opposed to between islands) and the fact that plants did not grow better in the control areas on Saipan and Tinian than on Guam suggests that birds do not exhibit top-down control of insects. Preliminary results suggest that the abundance of spiders greatly increases within areas where birds are absent, possibly compensating for the top-down control of insects by birds.

Simutaneous Isolation of Purified Genomic DNA and Total RNA from Buccal Cells

Hee Yeon Kim, Senior, Biochemistry

Mentor: Elaine Faustman, Environmental & Occupational Health Sciences

Mentor: Xiaozhong Yu, Environmental & Occupational Health Sciences

Mentor: Sung Woo Hong, Environmental & Occupational Health Sciences

Mentor: Zachariah Guerrette, Environmental & Occupational Health Sciences

Multiple pesticide exposure and any subsequent toxicity in the agricultural industry may affect an individual's health and is of particular concern for children's learning ability.

Buccal cells, collected easily from the inside of the mouth, are useful biomonitoring tool to study oral exposure from the pesticides. By extracting DNA and RNA from the buccal cell samples, it will be possible to study the effect of pesticide exposure on biochemical, molecular, and exposure mechanisms present in these cells. The goal of this research is to develop an optimized protocol to simultaneously purify genetic DNA and total RNA from buccal cell samples. A commercial kit, QIAGEN's AllPrep DNA/RNA Mini Kit is used with its protocol as reference. It may be difficult to isolate sufficient amounts of genetic DNA and total RNA from buccal cells, thus optimizing the protocol to increase efficiency of extraction that allows the most sufficient concentration and purity is important. Results are evaluated based on the amount of DNA and RNA recovered and the relative purity. Buccal cell samples from volunteers will be used until the optimized protocol is complete. Then isolating pure DNA and total RNA from buccal cell samples from agricultural workers and their children will begin to study pesticide effect on individual's health and children's learning ability.

***Batrachochytrium dendrobatidis* – Role in Amphibian Declines**

Tony Kim, Senior, Biology

Mentor: Joseph Ammirati, Biology

It is well established that some fungi in the phylum Chytridiomycota are parasites of other organisms, primarily invertebrates. However, a notable exception is the vertebrate pathogen *Batrachochytrium dendrobatidis*, which has been linked to the mass deaths of amphibians on every major landmass that is a natural habitat to amphibians, except Asia. Amphibians afflicted by this fatal fungus demonstrate abnormal posture, lethargy, and loss of righting reflex. Current diagnostic methods include the identification of intracellular sporangia and septate thalli within the amphibian epidermis. Recent evidence suggests that *Batrachochytrium dendrobatidis* originated from Africa and its primary host organism was the *Xenopus laevis* frog, which shows little to no clinical effects from infection. It is interesting to note that the trafficking of *Xenopus laevis* frogs out of Africa has led to the introduction of *Batrachochytrium dendrobatidis* into naïve populations of amphibians on almost every major land mass in the world. This has resulted in major declines in amphibians, and some species are believed to now be extinct as a result of this threatening pathogen. Despite being around for decades, this parasite has recently been discovered by humans only a few years ago. Much is still unknown about the fungus, particularly the mechanism it uses to kill the host amphibian. With an interest in learning more about *Batrachochytrium dendrobatidis*, I am planning to study other fungi in the Chytridiomycota taxa and explore their life cycles, structures, and growth conditions.

The Development of Action Planning: Do 12-month-olds Anticipate Object Weight?

Irina Kolobova, Senior, Psychology

Mentor: Jessica Sommerville, Psychology

Planning one's actions involves adjusting one's behavior in response to the observable (e.g. size and shape of an object) and non-observable properties of objects (e.g. weight) in order to complete a task successfully. The few studies examining infants' ability to anticipate an object's weight and plan according have yielded inconsistent results. In the present study, 40 12-month-old infants were trained with two identical blocks that differed only in weight (70g vs. 700g). The experimenter modeled actions during training encouraging infants to imitate these actions in order to learn about the block's weight. During test trials, the lightweight block was placed on the end of a cloth out of the infants' reach and infants were encouraged to get the block. Thus, for half of the infants the block was the same as the training block and for the other half the block was lighter than expected. Data analysis focused on 3 main motor planning variables: block wobbliness, the amount of times the block tipped off the cloth, and the speed that the block traveled on the first pull. Based on the results to date, infants who were trained with the heavy block tended to produce more tips, pulled the cloth faster and the block was more likely to tip off the cloth. These findings suggests that infants remembered the weight of the training block, assumed that an identical looking block on test trials was the same weight as the training block, and adjusted their action in anticipation of the perceived block weight. Findings from this study imply that infants at 12 months of age are capable of adjusting their behavior based on the perceived weight of an object, a much more complex task than adjusting their behavior based on the visible size of an object.

SFM Investigation of Agar Surfaces and Impact on *P. aeruginosa* Biofilm Growth

Ursula Koniges, Senior, Chemical Engineering and Biochemistry

Mentor: René Overney, Chemical Engineering

Pseudomonas aeruginosa is a common bacterium known to cause a variety of human infections, particularly in immunocompromised persons. Infections can involve the formation of biofilms on patient tissues, a particularly troublesome issue due to the resistance of biofilms to antibiotic treatment. *P. aeruginosa* biofilms investigated in a lab setting are commonly cultivated on agar—a gelatinous substance made from algal polysaccharides. A type of bacterial motility known as swarming has been linked to *P. aeruginosa* biofilm formation. Swarming motility is known to occur on 0.4-0.6 weight percent agar when specified proportions of certain medium (FAB) and a carbon source (glutamate) are used. Swarming motility is not generally observed when *P. aeruginosa* is grown on

agar concentrations outside of these parameters for the previously specified media and carbon source. The goal of this investigation was to determine surface characteristics of 0.4% and 0.6% agar and identify differences in characteristics which might contribute to observed variation in bacterial swarming motility between these concentration bounds. Scanning force microscopy (SFM) was used to investigate surface topography, roughness, and adhesion force of agar at the specified concentrations. The results of this investigation were used to assess the potential impact of the observed surface property differences on bacterial swarming motility. Differences were observed between the measured characteristics of the investigated concentrations; however, potential impact of the observed differences is questionable largely due to variation introduced by desiccation and other modifications required for SFM investigation of agar samples.

North Atlantic Bloom Experiment

Elizabeth Korsmo, Sophomore, Chemistry

Mentor: Eric D'Asaro, Applied Physics Laboratory

Mentor: Eric Rehm, Applied Physics Laboratory

The North Atlantic Bloom Experiment, commencing in April 2008, will use mixed layer floats to study biological and chemical processes in the ocean's mixing levels. The floats will gather information about the composition and biological health of the ocean, which has many important applications such as examining the role of the ocean in the global warming phenomenon. The optical sensors on the floats are vital to the success of the mission and thus needed rigorous testing and preparation for their task. During the summer of 2007, twelve sensors were carefully examined in preparation for the mission, with their functionality observed in diverse settings which simulate oceanic environs. They were subjected to controlled temperature changes and to multiple water composition environments, including salt water, freshwater, and salt water containing phytoplankton. Their software components were set to deliver intelligible data. At the completion of testing, the sensors were established to be in known, good working condition. Thus, they will be ready to fulfill their respective missions of determining oxygen, nitrate, or chlorophyll concentrations, or of measuring light refraction or particulate matter density. The sensors' characteristic operational data will also be employed in relevant computational methods.

Template Rotation Curves from Simulated Galaxies

Whitney Kropat, Sophomore, Astronomy and Physics

Mentor: Fabio Governato, Astronomy

Mentor: Charlotte Christensen, Astronomy

Similar to the way planets revolve around the Sun, stellar rotation within a galaxy gives a straightforward way to estimate its total mass. Studies have found that the rotation curves of observed galaxies do not match predictions based solely on the gravitational force from luminous matter, revealing the presence of dark matter – likely exotic particles that interact only through gravity. This discrepancy, between the amount of luminous matter and the rotation curve of a galaxy, has a correlation with the galaxy's mass - namely, low luminosity galaxies have a larger discrepancy than their high luminosity counterparts. There is a distinct trend connecting the dark to luminous matter ratio to both radius and galactic mass. Specifically, while every galaxy has an initially steep velocity curve, at larger radii the slope differs between high and low mass galaxies at larger radii. This suggests different distributions of dark matter throughout the galaxy. To catalog these trends, Catinella et al (2005) created template rotation curves for observed galaxies of differing masses. We will compare these observations to a large set of simulated galaxies created in one cosmological volume using the program Gasoline. Using our program, we found the average rotation curves for simulated galaxies in various mass bins. From this information, we create a corresponding set of templates for the simulated galaxies. These can be used to compare the shape of simulated and observed galactic rotation curves and the distribution of dark and luminous matter as a function of galactic mass.

Quantitative Force and Kinetics Measurements of Cardiac Muscle using a Microneedle and Photodiode-based Force Transducer

Jordan Kuester, Senior, Bioengineering

Mary Gates Scholar

Mentor: Mike Regnier, Bioengineering

Sustained force in muscle requires the constant binding and unbinding (or cycling) of crossbridges between the two key proteins in muscle, myosin and actin. Measurements of this sustained force have been accomplished in the past using actin attached to a micron-diameter glass needle and the measured deflection caused by “pulling” myosin heads on the surface of a glass slide in vitro in various solution environments. My research requires novel development of a dual-photodiode force transducer that increases the temporal resolution hundredfold to also allow measurement of the rates of initial force development as the actin is lowered onto the surface, and the fluctuations caused by the binding and unbinding of individual crossbridges at sites on the actin molecule. Force from myosin interactions with actin deflect a microneedle tip whose magnified image is positioned in the middle of a dual photodiode

array. Photodiodes absorb incident light into voltage; the shadow of a deflected needle increases or decreases this value. A micron-diameter glass needle is very sensitive to force and deflects with the pull of actin. The photodiodes have very rapid response characteristics that enable this force transducer to measure piconewton forces at kilohertz rates of change. By experimentally adding and varying the concentrations of regulatory proteins troponin and tropomyosin, which affect affinity of crossbridge binding sites on actin to bind myosin, I will better understand the multi-millisecond times spent at each of the four steps of the crossbridge cycle and possibly more about how cooperativity between sites works. Successful completion of this research will provide understanding into muscle kinetics at the protein level and greater insight into the rates at which individual steps of the crossbridge cycle occur in actin and myosin.

Indoor air quality and the effects on the respiratory health in children: A study on the urbanization gradient within the Sichuan province of China

Bharath Kumandan, Senior, General Biology

Howard Hughes Medical Institute Biology

Fellow, Mary Gates Scholar

Yuh-Chi Niou, Senior, Molecular, Cellular, & Developmental Biology

Mentor: Stevan Harrell, Anthropology

Previous studies have shown that lung cancer is among the leading causes of death of women residing in southwest rural China. This lung cancer and attendant respiratory problems, the studies showed, were almost entirely caused by inefficient and unventilated stoves used in these areas for heating and cooking, and the highly polluting fuels that power them. While the relationships between ventilation, fuel source, and respiratory health in both male and female adults are well understood, this is not the case with children. This project aimed to address the lack of information by administering surveys to 772 students in five different locations in the Sichuan province of southwestern China. These five locations resided along a developmental gradient, with all five of these locations using fuel types commensurate with their level of development (i.e. wood and coal in the less developed areas to electricity and natural gas in the cities). The surveys asked respondents to self-assess their respiratory health and to provide information regarding the level of indoor pollution in their household as well as the fuels used by their family to heat and cook. These responses have since been subjected to careful and thorough statistical analysis from which a number of significant correlations and relationships have emerged. The analysis thus far has shown a clear relationship between the developmental gradient and the incidence of respiratory distress; i.e. the less developed the location, the more likely the student is to report symptoms of indoor air pollution. The research has also shown that the effect of ambient air pollution

is minimal to non-existent on the respiratory health of these children. In addition, the research has shown that the use of a ventilation system, even more so than using cleaner fuels, is the greatest deterrent to respiratory trauma available.

Effects of Visual Deprivation on the Development of Neuronal Connections in Rat Visual Cortex

Robyn Laing, Senior, Psychology

*Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Jaime Olavarria, Psychology*

My project examines the role that visual experience has on the development of the callosal pathway in primary visual cortex of rats. Preliminary data from our lab show that this pathway organizes into many clusters, or “patches” over the binocular region of visual cortex. These patches form shortly before eye-opening (postnatal day 14), indicating that patterned visual experience is not necessary for their development. Moreover, retinal input is necessary because patches do not form if the eyes are removed neonatally. Retinal input is also necessary for the maintenance of these patches because removing the eyes shortly after their formation causes them to desegregate into a homogenous pattern. However, the specific factors of retinal input that are responsible for maintaining this pattern remain unknown. One possible explanation is that patterned visual experience is necessary for the maintenance of callosal patches. Previous studies have shown that while patterned visual experience is not necessary for the development of visual response properties in visual neurons, such as orientation selectivity, it is necessary for the maintenance of these cell properties. In the present study, we deprived rats of patterned visual experience by suturing their eyelids at the age of eye-opening until the fifth week of life. The callosal layout was visualized in tangential sections cut through the flattened cortex after performing intracortical injections of anterograde and retrograde tracer into the opposite hemisphere. We found that deprived rats had a normal callosal pattern, indicating that patterned visual experience is not necessary for the maintenance callosal patches. Future experiments will determine whether spontaneous retinal activity (i.e., not dependent on visual experience) plays an important role in maintenance. Such experiments would be performed by pharmacologically blocking retinal activity throughout life.

Using combination therapy of statin, extended release niacin, and coleselvam to treat dyslipidemia in subjects with atherosclerotic disease

*Trevor Lane, Junior, Neurobiology
Mentor: Xue-Qiao Zhao, Cardiology*

The use of combination therapies is needed to treat dyslipidemia in patients with both elevated low-density lipoprotein cholesterol (LDL-C) and low high-density lipoprotein cholesterol (HDL-C). We conducted a study

to assess the efficacy of combination therapy with statin plus extended-release (ER) niacin and coleselvam, aimed at lowering LDL-C and raising HDL-C, in subjects with atherosclerotic disease. This 2-year study randomized 123 subjects with atherosclerotic disease to atorvastatin alone, double therapy with atorvastatin plus ER niacin, or triple therapy with atorvastatin, plus ER niacin and coleselvam. Target LDL-C was £80 mg/dL for single and double therapy, and £60 mg/dL for triple therapy. Target HDL-C was an increase of 310 mg/dL for double and triple therapy. Single therapy with atorvastatin alone had a 50% reduction in LDL-C from 156 ± 34 mg/dL to 77 ± 13 mg/dL ($P < 0.001$). The double therapy group had a LDL-C reduction of 52%, from 167 ± 52 mg/dL to 76 ± 20 mg/dL ($P < 0.001$). With the addition of ER niacin, the double therapy had a 31% increase in HDL-C, from 42 ± 11 mg/dL to 55 ± 20 mg/dL ($P < 0.001$). The triple therapy decreased LDL-C by 60%, from 167 ± 33 mg/dL to 64 ± 20 mg/dL ($P < 0.001$), and increased HDL-C by 32% from 39 ± 10 mg/dL to 51 ± 14 mg/dL ($P < 0.001$). As compared to single treatment, with atorvastatin alone, the double and triple therapy groups experienced statistically significant increases in HDL-C ($P < 0.001$). This two year study demonstrated that combination therapy with atorvastatin plus ER niacin and coleselvam can effectively treat dyslipidemia in subjects with atherosclerotic disease to the most current NCEP ATP III recommendations.

Identification and Characterization of the Pacemaker Mediating Spontaneous Synchronous Activity in the Developing Mouse Neocortex

*Lauren Hanson, Junior, Neurobiology and Public Health
Levinson Scholar*

Andrew Latimer, Senior, Neurobiology

Mary Gates Scholar

Joel Weber, Senior, Neurobiology

Mary Gates Scholar

Mentor: William Moody, Biology

Spontaneous electrical activity (SSA) plays central roles in mammalian nervous system development, mediating important processes such as ion channel and receptor development, axon outgrowth, and synapse formation. For SSA to carry out its developmental functions, it must occur only during specific critical stages of development. Therefore, how the timing and generation of SSA are controlled is a major question in neurobiology. SSA can be generated as an emergent property of a network of neurons with uniform electrical properties, or as a result of a specialized subset of pacemaker neurons. Our laboratory has determined that SSA in the mouse cortex is initiated by a specific pacemaker region in the ventrolateral cortex. The goal of our project is to elucidate the specific location, cellular characteristics, and developmental control of this pacemaker region. Using patch clamp recordings in brain slices, we have found indications that neurons of the pacemaker region have spontaneous bursts of activity during SSA that differ from

those in follower regions in ways suggesting a different contribution of NMDA receptors. Using calcium imaging methods, we have found the specific blockers of a putative pacemaker current, I_h , block SSA, suggesting a role for I_h in initiating SSA. Finally, using immunocytochemical methods, we are exploring structural differences between pacemaker and follower regions, and asking whether the expression of NMDA receptors and I_h channels differ in these two regions. Understanding the emergence of the pacemaker function and the ways in which it controls the onset, activity, and cessation of SSA is vital in developing an understanding of the mechanisms of brain development. Continued exploration of the pacemaker region also has the potential to formulate understanding of the mechanisms of pathological forms of synchronous activity, such as seizures.

Presidential Discourse and Political Symbols in Addressing Domestic Terror

*Sophia Le, Senior, Communication and Political Science
Mary Gates Scholar
Mentor: Bryan Jones, Political Science
Mentor: Peter May, Political Science*

Through State of the Union addresses, press conferences, and various other forms of public discourse, presidential administrations use the tools of rhetoric and communication to convey their plans of action to the general public. However, this rhetoric may have the power to evoke emotions in order to persuade citizens in order to bring support towards a particular outcome. This study examines presidential speech transcripts from 1988 – 2006 over the span of twenty years in order to show how rhetoric can affect public opinion in regards to terrorism prevention in the United States and how fearful and emotional language play into that dynamic. By utilizing data from an NSF funded project on presidential attention to domestic terror, these speech transcripts will be analyzed by coding for the tone, scope, and mention of terrorist types. The data is analyzed on a graphical distribution. While the various terrorist events in the United States may evoke different types of threats, it may or may not be that the concept of establishing fear within the population will remain the same.

Identification of Conserved RNA Structures in the Human Genome

*Jonathan Leano, Senior, Biochemistry
Mary Gates Scholar
Mentor: Thomas Leeper, Department of Chemistry
Mentor: Gabriele Varani, Department of Chemistry*

The human genome has approximately 20,000 genes which code for protein, but there are over 100,000 genes that transcribe functional RNAs (fRNAs). This abundant and diverse class of RNA has been found to fulfill many important regulatory, structural, and catalytic roles in

the cell. However, the functions of only a small fraction of fRNAs are known. By understanding their structure, researchers can gain insight into the function of specific fRNAs. Comparative

genomics methods such as EvoFold are being used to identify and predict the structure of some fRNAs. Our study focuses the secondary structures of two fRNAs: Xist & HAR1F, both of which were predicted using the EvoFold method. We have employed gene synthesis and in vitro transcription to prepare RNA samples for analysis by NMR spectroscopy. In determining the conformational structure of these two RNA segments by NMR, we hope to better understand their function and biological mechanisms.

Right Ventricular Volume and Corresponding Cardiac Function Analysis in Ebstein's Patients

*Christopher Lee, Senior, Physiology and Biochemistry
Mentor: Florence Sheehan, Cardiology*

Ebstein's Anomaly is a congenital heart disease manifested physiologically in the failure of the septal and posterior leaflets of the tricuspid valve to ascend into the valve annulus. This morphological defect hampers the ability of the cardiac organ to send blood in a unidirectional path from the right ventricle to the lungs via the pulmonary circuitry. Instead, blood is ejected along a bi-directional path into both the pulmonary and right atrial regions. This inefficient process often results in abnormal cardiac growth to compensate for the increased workload of the heart. In light of this, our lab has discovered a methodology to visualize these changes by generating 3-D computer reconstructions of patient hearts. Our work involves using 3-D cardiac imaging software called Jtrace to map a collection of various two-dimensional MRI slices of an Ebstein's afflicted heart at multiple angles via the manual identification and tracing of these generated planar surfaces. The compilation of these varying two dimensional traces produces a three space image once enough points are plotted at varying slice angles. The various cardiac variables such as ejection fraction and right ventricular volume are then tabulated using the help of a computer. Through this work, we hope to correlate the volume of the right ventricle with the severity of the tricuspid annulus deformation as well as identify the overall changes in heart efficiency resulting from the disease. The data generated will hopefully provide physicians with a much needed diagnostic tool in treating this congenital illness as proper course of action requires a detailed understanding of the three dimensional changes of the heart in question.

The Relationship between Group Identity and

Prejudice: An Objective Experience Account

Elaine Leigh, Senior, Psychology

Mary Gates Scholar, Undergraduate Research

Travel Awardee

Heather Rieck, Senior, Psychology

Mary Gates Scholar, Undergraduate Research

Travel Awardee

Mentor: Cheryl R. Kaiser, Psychology

Prior research examining the positive relationship between group identity and perceived prejudice has either posited that experiences of prejudice cause members of devalued groups to turn to their group for social support, thus increasing group identification (Branscombe, Schmitt, & Harvey, 1999), or that strongly identified people ‘see’ more prejudice because their group membership is chronically activated (Major, Quinton, & Schmader, 2003; Operario & Fiske, 2001). However, a simpler explanation for the group identity-perceived prejudice relationship is that strongly identified members of a devalued group may actually experience greater amounts of prejudice than weakly identified members - the “objective experience account.” In this experiment, 142 White participants rated individuals who were either strongly or weakly identified with being African American or Scottish American. Consistent with the “objective experience account,” we found that Whites rated strongly identified African Americans more negatively than their weakly identified counterparts, but did not differentially rate Scottish Americans based on identity level. This support for the “objective experience account” suggests that strongly identified minorities may claim to experience more prejudice than weakly identified minorities, not necessarily because they are hypervigilant or more prone to perceiving prejudice, but simply because they are reporting the reality of their experiences.

The effect of ciprofloxacin on liverwort plastid biogenesis and chloroplast DNA level

Chee Sheng Leong, Senior, Molecular, Cellular & Developmental Biology

Mentor: Arnold Bendich, Biology

Mentor: Delene Oldenburg, Biology

A focus in our lab is to elucidate the structure, replication, and maintenance of DNA in chloroplasts. Prior research showed that the amount of chloroplast DNA (cpDNA) increases and then declines during proplastid-to-chloroplast development in *Arabidopsis* and maize plants. The objective of this project is to study changes in cpDNA using liverwort (*Marchantia polymorpha*) cell cultures during normal cell growth and after the addition of drugs that may affect plastid biogenesis. Ciprofloxacin is a quinolone drug that inhibits type II topoisomerase and kills bacterial cells. Ciprofloxacin is thought to inhibit the repair of DNA damage, leading to an increase of reactive oxygen species like the hydroxyl radical, resulting in

DNA degradation. Thus it is possible that cpDNA levels would decline faster after treating liverwort cells with ciprofloxacin. To test this, I used DAPI (4’,6-diamidino-2-phenylindole) to stain cellular DNA and fluorescence microscopy to quantify cytosolic and nuclear DNA levels using fluorescence intensities. Results show that cytosolic and nuclear DNA levels peak at the second day of growth after subculturing the cells, which was followed by a gradual decline over time. Comparisons of cytosolic and nuclear DNA fluorescence show that cpDNA levels decrease over time in both the ciprofloxacin-treated (0.1 µg/mL) and untreated samples. A ciprofloxacin dose-response curve shows that concentrations below 1.0 µg/mL result in healthy, green cells, while concentrations above 5.0 µg/mL result in less healthy, yellowish cells. It is possible that cpDNA degradation may increase at the higher concentration of ciprofloxacin. Next, I plan to carry out quantitative analysis to learn the effects on cytosolic and nuclear DNA in liverwort cells when treated with higher concentrations of ciprofloxacin.

Executive Functions in Individuals with Parkinson’s Disease: A Comparison of Two Measures

Rebecca Lewis, Senior, Speech & Hearing Sciences

Howard Hughes Medical Institute Biology

Fellow

Mentor: Kristie Spencer, Speech & Hearing Sciences

Executive functions are the mental processes that direct cognitive, communicative and social behavior. These high-level mental functions are frequently disrupted in individuals with Parkinson’s disease (PD) and can have a devastating influence on day-to-day functioning. The purpose of the current investigation is to compare performance of individuals with PD on two measures of executive function. The Wisconsin Card Sorting Test (WCST; Heaton et al., 1993) is a complex, multidimensional measure of executive function often used by neuropsychologists and in research settings. The Controlled Oral Word Association Test (COWAT; Benton et al., 1983; Ruff et al., 1996), on the other hand, is a basic, generative task often used in clinical as well as research settings. Comparisons of the WCST and COWAT may contribute to theories about the characteristics of executive functions in individuals with PD (Henry & Beatty, 2006). Thirty individuals with idiopathic PD completed both tests of executive function as part of a larger investigation. All participants were screened for dementia, depression, vision difficulties, and hearing impairment, and were in an optimally medicated state. The severity of impairment on both measures of executive function, as well as the relative performance differences between the two measures, will be analyzed via chi-square analyses and t-tests. The results of the study should contribute to theoretical models of executive function in PD and provide insight into the clinical assessment of these processes.

Public TCR use by HSV-2-specific human CD8 CTL

Penny Li, Senior, Microbiology and Anthropology

Mentor: David Koelle, Medicine

As T-cells develop in the thymus, they undergo a massive rearrangement of the beta and alpha locus in germline DNA. This process generates a diverse repertoire of TCR's with the potential to recognize a variety of pathogens such as HSV-2. T-cell with epitopes for foreign agents are signaled to expand and remain in the body as memory cells. In this project the beta and alpha chain of CD8 T cells from subjects with prior exposure to HSV-2 will be analyzed for similarities in the amino acid sequence. Specifically, we are looking at the complementary determining region 3 of the beta and alpha chain since CDR3 determines ligand binding. The beta chain has already been sequenced. So far the results indicate that there are three amino acid sequences that are similar in many of the subjects. We will see if public amino-acid sequences appear in the alpha chain too.

An Exposed Plumbing System for Underwater Hot Springs at the Endeavour Segment, Juan de Fuca Ridge

Matthew Lilley, Senior, Earth & Space Sciences and Anthropology

Mentor: Deborah Kelley, Marine Geology and Geophysics

Two dives using the human occupied submersible Alvin and robotic vehicle ROPOS in 2006-2007 reveal well-exposed hydrothermal upflow zones on the western axial valley wall of the Endeavour Segment of the Juan de Fuca Ridge at a water depth of ~2200 m. Zones similar to these are exceedingly rare in the ocean basins, but are important because they provide critical insights into environmental conditions in the subsurface biosphere and subseafloor hydrogeology. The northern upflow zone is composed of a massive, 200 m across and 100 m high continuous exposure of variably altered and mineralized pillow basalts interspersed with localized lenses of massive sulfide and sulfide breccia. This zone has extremely well defined vertical boundaries between highly altered pillow basalts and less altered flows. The pillows commonly exhibit pronounced mineralization by copper-rich minerals with the interstices between pillows filled with red, iron-oxide phases. Direct observations of this fossilized plumbing system and observations from video and still imagery were used to create a preliminary geological map of the area. Detailed hand sample and petrographic analyses show that fluids within the tectonically active upflow zone were high temperature ($>250^{\circ}\text{C}$) based on the presence of chalcopyrite within the breccias. Pervasively mineralized tube worm casings indicate that the surficial chimneys hosted active biological communities. The Endeavour system offers an unprecedented opportunity to dissect a complete cross section of a recently active upflow zone.

Investigation of associated extinct chimneys and highly lithified metaliferous hydrothermal sediments will be key to answering fundamental questions about metal mass balances, alteration conditions, and the character of the associated subsurface biosphere.

Label Layout for Interactive Exploded Views

Sharon Lin, Senior, Computer Science

Mary Gates Scholar

Mentor: Brian Curless, Computer Science & Engineering

Labels are effective tools for locating and identifying objects in diagrams and illustrations. They are frequently used in educational materials and manuals for both printed and computer applications. The purpose of this project is to develop automatic labeling algorithms for interactive exploded-view diagrams of 3D models. Exploded-view diagrams show the separated components of an object and are often found in assembly manuals. However, in interactive applications, visual clutter and the distance between labels and their associated parts can hinder label interpretation, especially when both the model and labels are moving. We explore labeling methods that group related parts under one label to help reduce visual clutter. In addition, to make labels appear closer to their associated part, we vary the font size of labels to correspond with the distance of their associated part from the viewer. Image subsampling and summed area tables are used to speed up the search for free space to place labels. We believe the results will enhance viewer exploration of the interactive exploded-view diagrams and can be applicable to other interactive visualizations.

Different Perceptions and Attributions of Emotion in Self-Esteem Threatening Situations between Asian and White Americans

Jennifer Liu, Psychology

Kai Chi Yam, Junior, Psychology

Mentor: Janxin Leu, Psychology

Mentor: Jennifer Wang, Psychology

Previous research indicated that foreign born Asian Americans (AA) have consistently shown a better level of physiological health as well as mental health as compared to their White American (WA) counterparts. The purpose of the study was to examine how AA and WA responded to ambiguous interpersonal rejections, how they explained these rejections, and how they reacted emotionally. In our study, participants were 334 undergraduate students (N=181 AA, 153 WA) at the University of Washington. We averaged emotional responses and status-based attributions across 12 different everyday simulated situations for Asian Americans and White Americans. As predicted, differences were found between the two groups. AA showed significantly higher levels of anger, scorn, anxiety, sadness, disappointment, and shame ($p<0.05$) compared to their WA counterparts. Three of the seven

status-based attributions; ethnicity, sex, and nationality were also significant in the direction of Asian Americans. In regards to the individual difference measures, Asian Americans had higher mean levels of depression on the CES-Depression Scale, collective self-esteem, and ethnic identification (MEIM), while White Americans had higher levels of self-esteem and coping behaviors as measured by the John Henryism scale. While our study used a college sample, our results were generally consistent with previous research on non-college participants. The implications of this research are to investigate and learn more about the effects of negative emotions and discrimination on mental health and what, if any, protective factors exist and how these could be implemented and promoted.

Measuring and Correcting for Patient Motion during Freehand 3D Echo

Ruolan Liu, Junior, Molecular, Cellular, & Developmental Biology

Mentor: Florence Sheehan, Medicine and Cardiology

Mentor: Mary Waiss, Cardiology

3D Echocardiography is one of the superior ways to scan the patient and allow for a clear view of cardiac structures. In contrast to 2D echocardiography, 3D echo gives the physicians a much more detailed anatomical assessment of cardiac pathology, particularly valvular defects and congenital abnormalities. In clinical and research fields alike, 3D echo can be used to acquire images of the heart in multiple views. The images are subsequently traced to allow for a 3D reconstruction of the heart chamber that gives physicians the ability to compare and study abnormalities in intracardiac structures. The problem that exists with freehand 3D echo is patient movement during scanning process. Patient movement may cause a major error in registering heart image data in 3D space, confounding attempts at 3D reconstruction and analysis. A preliminary study has been done to track patient movement in 3D echo with image focus on the left ventricle. Our project aims to replicate the study using a tracking system to monitor the patient's motion focusing on the right ventricle which has been known to be more difficult to image because its position in the chest is less accessible to the ultrasound beam. The protocol involves scanning ten patients using a sensor that tracks patient movement. Each patient will undergo a full scan in the left lateral position before being rolled into two different positions. The images will be traced using a 3D reconstruction program. The after motion heart reconstruction will be corrected using the motion detection program and it will be compared and correlated with the image of the heart before movement. A successful correlation of the before and after motion images marks the correct functionality of the motion detection program which can then be used by physicians to detect motion and analysts to correct for motion during freehand 3D echocardiography.

Phylogenetic Relationship of A New Species of Deciduous Rhododendron Azalea with Other Azalea Species and Genetic Variations among Azalea Population

Tingyu Liu, Junior, Biology

Mentor: Benjamin Hall, Biology and Genome Science

A new species of deciduous azalea, *Rhododendron colemanii* was noticed back in 1940s or 50s. Previously, it was labeled as *Rhododendron alabamense* or its hybrids based on the morphological characters and habitats. Recently, phylogenetic relationships based on sequences of nuclear gene RPB2-I showed *Rhododendron colemanii* to be a coherent species in a clade of *Rhododendron* subsection *Pentathera* along with tetraploid rhododendron species *Rhododendron luteum*, *Rhododendron atlanticum*, *Rhododendron austrinum* and *Rhododendron calendulaceum*. This result is consistent with genome content test, which showed *Rhododendron colemanii* to be tetraploid. Variations from plants to plants in the background color of corolla among azalea populations are also noticed. People have speculated how it could be that individual plant within the same species growing in the small area show so many differences. Majority of them tended to believe it is due to hybridization. However, RPB2-d gene DNA sequences of many plants growing in this area found all the plants have identical sequences. There are two haplotypes differing from each other by two single base pairs. To test the hypothesis *Rhododendron colemanii* should be grouped with tetraploid azaleas and the morphological variations in azalea population are due to genetic variations instead of intrabreeding, we employed another nuclear gene E19. Gene E19 sequences of all eighteen species of subsection *Pentathera* azalea were amplified through polymerase chain reaction and sequenced by automated fluorescent DNA sequencing. The prediction is that phylogenetic relationship based on gene E19 agree with the one generated by PRB2-I which supports *Rhododendron colemanii* is a coherent species with other four tetraploid azaleas. Second, DNA sequences of the eighteen species are identical with ceratin haplotypes. That implies genetic variations in genes that control localization and production of pigment exist among azaleas which give rise to the morphological variations.

Custom-Made Contrast Agent for Medical Ultrasonics

Jonathan Lundt, Senior, Physics

Mary Gates Scholar

Mentor: Tom Matula, Physics

The ultrasound contrast agent (UCA) I produce at CIMU is a solution containing approximately 1010 perflutren lipid microspheres / mL, which have a mean diameter range of one to four micrometers. These gas-filled, lipid-shelled microbubbles have a high degree of echogenicity, the ability to reflect ultrasound waves by radially oscillating at harmonic frequencies while (ideally) retaining a spherical

shape. The immense difference in the echogenicity of microbubbles and that of soft tissue enhances the effect of ultrasound backscatter which is essentially an echo reflected off the microbubbles. The reflected waves hit a transducer, and in a manner similar to how a microphone works, the transducer converts the physical energy of the acoustic waves into an electrical signal. This signal is then processed to create a digital image or video called a sonogram, which provides a wealth of information about the fluid dynamics that take place in various vascular structures. The primary motivation for producing this custom, ‘in-house’ UCA is to circumvent issues of availability and cost that hinder medical ultrasonics research at CIMU.

Channel Migration Zone Analysis of the Skykomish River

*Margot Mansfield, Junior, Earth & Space Sciences
NASA Space Grant Scholar, Mary Gates Scholar
Mentor: David Montgomery, Earth & Space Sciences*

The erosion and deposition that accompanies river migration influences ecological processes and human infrastructure throughout the Pacific Northwest. Differences in channel mobility along reaches of a river system depend on different geomorphologies and consequently yield different rates of erosion. By studying the Skykomish River we can produce data that defines the fundamental dynamics of this river in regards to erosion rates, the probability of where it will reoccupy past locations in its floodplain, and investigate how this varies along the river system. With the use of available time-lapsed aerial photographs of the Skykomish dating back to as early as the late 1930s, it is possible to reconstruct river migration and forecast the probability of future floodplain re-occupation. I digitized the Skykomish River from sequential aerial photographs, and then used this digitization to analyze where historically the river has occupied its floodplain and thereby where it is likely to be in the future. From a scientific approach, studying the fundamental river dynamics and mechanics of how rivers have occupied their floodplains in the past will yield an understanding of differences between rivers in different geo-spatial contexts and allow calculation of probabilities of where they will be in the future. The data generated from this project can help counties to locate where their river channels have been in the past and where they might be in the future. This information is essential in regard to river floodplain planning, management, and restoration.

Parameter Sensitivity Investigation of a Mathematical Model of Glioma Tumorigenesis Mediated by Platelet-Derived Growth Factor

*Susan Massey, Senior, Mathematics
McNair Scholar, Boeing Scholar, Amgen Scholar
Mentor: Kristin Swanson, Pathology*

Glioma is the most prevalent form of primary brain tumor in adults. Despite all possible treatment attempts,

including aggressive surgical resection, these tumors are uniformly fatal. Dr. Peter Canoll at Columbia University has demonstrated that rats develop brain tumors closely resembling human gliomas when their glial progenitor cells are injected with a retrovirus expressing platelet-derived growth factor (PDGF). Most notably, at 17 days post infection only 30% of the tumor cells are infected progenitor cells—the other 70% are malignant uninfected progenitor cells, recruited to the tumor by interactions with PDGF. Using the empirical data collected by his lab, we have developed a mathematical model to describe the observed tumor growth in the rat experiment. We used a sensitivity analysis technique incorporating latin hypercube sampling (LHS) and partial rank correlation coefficients (PRCC) to vary parameters against each other and determine which parameters in the model are most influential upon the ratio of uninfected progenitor cells to total (infected and uninfected progenitors) in the tumor. Our investigation revealed that the two most influential parameters affecting the observed tumor growth pattern are proliferation rate of infected progenitors (and thus the amount of extra cellular PDGF available) and rate of consumption of PDGF by nearby uninfected progenitors. This model allows us to predict what would happen if the retrovirus was changed so that the PDGF production by each infected cell increased or decreased. Future work will focus on analyzing the model to look for spatial migration patterns of tumor cell growth influenced by PDGF to compare with observational studies tracking the migration of individual cells over several hours.

The study of *Dendraster excentricus* larval growth and survival in ballast tank simulations

*Lindsay McCormick, Junior, Environmental Sciences,
UW Tacoma
Mentor: Bonnie J. Becker, Environmental Sciences, UW
Tacoma*

Ballast tanks of tanker ships are closed systems and the conditions to support life are very poor. However, successful transport of larvae of non-indigenous species in ballast tanks has been documented multiple times. A research experiment performed at the University of Washington, Tacoma in 2007 centered around the survival and growth rates of bivalve larvae in ballast tanks by examining viability and growth under different feeding regimes. Results indicate that larvae are able to survive with limited amounts of available particulate organic matter (POM) as long as there is sufficient dissolved organic matter (DOM) available. The purpose of this experiment is to parallel the first effort using sand dollar larvae. Specimens of *Dendraster excentricus* will be collected during their spawning season in late March. Spawning will be induced through injections of 0.55M KCl. Cultured larvae will be raised with no light at 14oC. Four different feeding treatments will be applied: no added organic matter, added DOM with no added POM, added

POM with no added DOM, and added POM and DOM. Survival and growth will be monitored every three days for 60 days and results examined using ANOVA. Results of this experiment will indicate if *Dendraster excentricus* can successfully survive under these conditions during transport. Knowing survival and growth rates of species transported within ballast tanks can help scientists better describe ballast tank environments likely to be successful in the transport of non indigenous and invasive species. This study also has implications for understanding of the basic feeding ecology of larvae.

Teaching Mindfulness-based Skills to College Drinkers

Susan McKay, Senior, Psychology

Mentor: Ursula Whiteside, Clinical Psychology

The success at which individuals are able to effectively regulate their emotions and therefore actions may be related to level of alcohol use. Individuals with poor control over self-regulation may be more prone to turn to alcohol as a way to cope with ineffectively managed thoughts and emotions. Mindfulness-based techniques within Dialectical Behavior Therapy (DBT) offer simple, concrete ways to draw an individual into a state of self-reflective awareness of physiological and mental states. Through regular practice, we posit that individuals may be able to regain a sense of personal control and thus strengthen their ability to regulate emotions, such that turning to alcohol as a way to cope may be diminished. The current study explores the relationship between emotion regulation, coping abilities and alcohol use. College students received an intervention for drinking that included DBT mindfulness-based strategies. The degree to which these students experienced difficulties regulating emotions and their levels of alcohol consumption were measured prior to and one month following the intervention. We expect to find a relationship between the acquisition of these DBT mindfulness-based strategies and reduction of alcohol consumption.

Examining the Relationship between Sexual Intimacy Motives and Sexual Behavior Discussions

Christina Meredith, Senior, Psychology

Mentor: Melissa A. Lewis, Psychiatry & Behavioral Sciences

Prior research has found that sexual motives related to intimacy are positively associated with higher age at first consensual intercourse, having fewer lifetime sexual partners, and engaging in less lifetime risky sexual behaviors in college student and community samples (Cooper, Shapiro, & Powers, 1998). To further examine the relationship of intimacy motives with sexual behavior, we evaluated the relationship between intimacy motives and sexual-related discussions. We wanted to determine if there was an association between having sex for intimacy

reasons with talking to one's partner about using condoms, birth control, previous sex partners, as well as engaging in other sexual protective behaviors. Participants ($N = 306$; 49.7% male) were college students from a mid-size public university in the Midwestern United States. Students completed two Web-based surveys, which assessed demographics, sexual motives, and sexual behavior as a part of a longitudinal intervention. We expected sexual intimacy motives to be positively associated with sexual discussions, such that individuals who are higher in sexual intimacy would report planning for and having more discussions about sexual-related topics (e.g., condom use, birth control use, sexual history, etc.). We conducted a multiple regression analysis with sexual-related discussions as the dependent variable and sexual intimacy motives (e.g., have sex to be more intimate with partner, express love, etc.) as the independent variable. Gender and relationship status were included as covariates due to prior research showing their relationships to sexual-related behaviors among college students (Cooper et al., 1998). As expected, results indicate that sexual intimacy motives were positively associated with sexual discussions, $t(201) = 2.94$, $p < .01$, even when taking gender and relationship status into account. Findings suggest that having sex for intimacy reasons is related to having greater sexual-related discussions.

Estimating energy expenditure using a multi-sensor board

Sean Migotsky, Senior, Biology

Mentor: Glen Duncan, Epidemiology and Nutritional Sciences

Excess body weight and lack of physical activity increase risk of developing many health problems, including diabetes and heart disease. With the majority of U.S. adults classified as either overweight or obese, this is a serious and growing problem. Despite the existence of many different approaches to weight loss, it is known that physical activity is a necessary component of any successful weight management program. Once an activity regimen is begun, however, there is still the problem of accurately measuring and recording the level of activity actually taking place. None of the currently available methods are fully satisfactory because of problems related to cost, convenience, and measurement error. Furthermore, most methods only capture a portion of the needed information. This works reasonably well when only a few activities are considered, but when the goal is to determine energy expenditure (EE) over a wide range of activities, a more robust approach must be used. The multi-sensor board (MSB) is hip-mounted and uses multiple sensors to better ascertain what activity is taking place. Once the activity type is determined, the MSB can then use established prediction equations to estimate EE. As part of the current development and validation process, our subjects perform two types of tests while wearing the MSB: one on a

treadmill set at various speeds and grades, and one in the field consisting of various day-to-day activities. During the tests, we measure oxygen consumption to provide a gold standard of actual EE to compare against values estimated by the MSB. In the future, this technology could be incorporated into a device such as a cellular telephone and combined with software to track food consumption, giving a real-time, running energy balance for users – a valuable tool for weight control.

Identification of the DNA Motif that Binds SPARC Using Chromatin Immunoprecipitation

Adam Mina, Junior, Biology

Mary Gates Scholar

Mentor: James Bassuk, Urology

Secreted protein acidic and rich in cystein (SPARC) has been shown to inhibit the proliferation of urothelial cells in culture. Urothelial cells are the epithelial cells lining the ureters, bladder, and urethra. A better understanding of SPARC's inhibitory mechanism may lead to the development of treatments for urological diseases and advancements in tissue engineering. One of the most potential applications of inhibition of cellular proliferation is in the treatment of bladder cancer, the fourth most prevalent cancer in males. SPARC is primarily secreted from urothelial cells, but has also been found to localize to the nucleus. Preliminary data has indicated that it may bind to DNA. The goal of this project is to identify the DNA-binding site of SPARC in the human genome. We will use chromatin immunoprecipitation (ChIP) as a means of isolating DNA from human urothelial cells grown in culture. ChIP utilizes antibody specificity and protein agarose beads to enrich sheared chromatin strands containing the SPARC binding site, and ultimately generating DNA ready for PCR and sequence analysis. We have compiled a stock of sheared chromatin samples and are currently performing quality-control experiments to validate our chromatin, SPARC, and antibody samples. Once adequate validation is complete, we will continue on to the precipitation, PCR, and sequence analysis of the DNA-binding site of SPARC.

N-Terminal Characterization of Spc110

Joshua Morris, Senior, Biochemistry and Neurobiology

Mary Gates Scholar

Mentor: Trisha Davis, Biochemistry

Spc110 is a structural component of the Spindle Pole Body, the microtubule organizing center in yeast and analog of the centrosomes of other eukaryotes. Spc110 has been evolutionarily conserved, even up through humans. Its N-terminal domain localizes to the inner plaque of the Spindle Pole Body, which contacts the nucleoplasm. There, in a cell cycle dependent manner modulated by phosphorylation, it recruits the Tub4 complex, a heteromultimer that serves as the platform for microtubule nucleation. It is

thought that phosphorylation affects the Spc110/Tub4 complex interaction in such a way that increases the cell's microtubule nucleation ability during mitosis. My project aims to determine the affinity with which the N-terminal domain of Spc110 binds the Tub4 complex, measured by binding assays carried out with both phosphorylated and unphosphorylated Spc110 constructs, and also to purify the N-terminal domain of Spc110 with such quality and concentration that structural studies, either NMR or crystallography, are possible.

Investigating A Potential Relationship between Surface Tension and Exclusion Zone Formation at an Air-Water Interface

Christopher Mount, Freshman, Pre Major

Mentor: Gerald Pollack, Bioengineering

The Pollack lab has recently been investigating an unusual phenomenon at air-water interfaces. A colloidal solution of microspheres exposed to ambient light over time will develop a zone at the air-water interface that is devoid of microspheres. This region, referred to as an exclusion zone, is often large enough to be detected without the aid of microscopy. Ongoing research suggests that the structure of water within this zone could differ from bulk water, and this led us to consider the possibility of a link between surface tension at the air water interface and the formation of an exclusion zone there. To investigate this possibility we fabricated a device to apply incremental amounts of force to the surface of the water over time. Because the exclusion zone grows over time, we hypothesized that the surface tension would increase with time as well. While this research is ongoing, preliminary data appears to support our hypothesis. If future data collected follows the same trend, this research could offer a valuable contribution to the understanding of the most common molecule on our planet.

Physical Implementation of Concatenated Code to Facilitate Quantum Error Correction

*Elizabeth Muhm, Senior, Computer Science and
Mathematics*

Mentor: Dave Bacon, Computer Science & Engineering

Quantum computers offer the potential to significantly outperform today's modern computers by exploiting the strange behavior of quantum physics. However, the information storage of these computers is especially vulnerable to noise in the form of corrupting influences from the environment. We hypothesized that mimicking the effect of concatenated coding via the thermodynamics of a system of qubits (quantum bits) would overcome this source of error. Concatenated coding, a classical approach to error correction, is a recursive coding technique that reduces the probability of error in information by encoding it redundantly. We modeled a system of qubits, characterized by a recursive energy function, and simulated

its energetics with a Metropolis Monte Carlo simulation. Each energy function was defined by the relationship of coupling strengths at different levels of concatenation. For systems whose coupling strength decreases exponentially at each level, a temperature threshold emerges. Systems in environments below this temperature experience increased error correction with increased levels of concatenation. This is evidence a physical implementation of concatenated code may be a solution to error correction in quantum computers.

Suppression of Brain Proinflammatory Cytokines by 17b-Estradiol after Lipopolysaccharide Infection

Tara A. Mulcahey, Senior, Biology

Mary Gates Scholar

Mentor: Candice M. Brown, Physiology & Biophysics

Mentor: Phyllis M. Wise, Physiology & Biophysics

17b-estradiol (E2), the most biologically active ovarian estrogen, exhibits powerful neuroprotective properties. Due to improvements in nutrition and medical care, postmenopausal women are living approximately one-third of their lives without the neuroprotective benefits of E2, thus making them more susceptible to neuroinflammatory pathological conditions such as sepsis, stroke, and Alzheimer's disease. Recent studies have shown that E2 may suppress inflammation in the brain and periphery; however, the molecular mechanisms underlying this suppression are unclear. To further elucidate the critical role of E2 during periods when the brain is exposed to inflammation, we induced a systemic inflammatory response using *E. coli* lipopolysaccharide (LPS) to mimic sepsis. We hypothesized that one of the mechanisms by which E2 may be neuroprotective during sepsis is by suppressing proinflammatory cytokine levels in the brain. 10-week old C57BL/6J female mice were ovariectomized (OVX) or OVX and replaced with E2 (OVX+E2), followed by an induced LPS infection one week later. Mice were killed at 0, 3, 6, 12, or 24 hours after LPS challenge to assess brain cytokine levels in the cerebral cortex and striatum. Multiplex cytokine analysis was performed using protein lysates to quantify the expression of sixteen cytokines commonly induced during sepsis. Using two-way ANOVA, our results show that the proinflammatory cytokines, interleukin (IL)-1 α , IL-1 β , IL-6, IL-12p40 and CCL5/RANTES, are significantly suppressed in OVX+E2 mice compared to their OVX+oil treated counterparts. Our results allow us to further investigate the molecular mechanisms underlying E2's role in the brain's inflammatory response by assessing the individual roles of estrogen receptors (ER), ER α or ER β , by conducting experiments using knockout mice for each receptor. Ultimately, these studies will give us insights into the neuroprotective and anti-inflammatory role(s) that E2 and its receptors play in the brain of postmenopausal women.

The effects of mislocalized E-cadherin on cell adhesion

Jessica Nielsen, Senior, Molecular, Cellular, & Developmental Biology

Mentor: Raymond Yeung, Surgery

Mutations in the tumor suppressor tuberin are a common factor in the development of Tuberous Sclerosis Complex (TSC) and Lymphangioleiomyo-matosis (LAM). TSC is an autosomal dominant syndrome characterized by hamartomas in multiple organs. LAM is a cystic lung disease that is characterized by the infiltration of smooth muscle-like cells into the pulmonary parenchyma. The mechanism by which the loss of tuberin promotes the development of LAM has yet to be elucidated, though several lines of evidence suggest it is due to the metastasis of smooth muscle-like cells from tuberin-deficient hamartomas. In this study, we show that tuberin-deficient cells mislocalize E-cadherin. The loss of E-cadherin at the cell membrane has been shown to be a factor in the induction of cell migration and invasion. We have shown this in analysis of LAM lesions which display cytosolic E-cadherin. Therefore, we hypothesize that it is the loss of E-cadherin function at the cell membrane that promotes a migratory phenotype in tuberin-null cells. To address this issue, we constructed mutants of E-cadherin to examine their effects on E-cadherin localization, E-cadherin expression and cell-to-cell adhesion. Our results indicate that tuberin-null cells mislocalize E-cadherin which promotes a migratory phenotype, and which may underlie the development of LAM.

Babel Travel Communicator

Kip Nordby, Senior, Industrial Design

Mentor: Sang-gyuen Ahn, Art

The Babel Travel Communicator is a brand new class of device. The Babel is a personal digital device intended to foster communication between travelers (the primary user) and people native to the country of travel (secondary user). The device can be used in a number of ways, such as a standard PDA, and as the travel communicator, a two sided device with a keyboard for the primary user, and a touch screen keyboard that changes itself depending on what country you are in for the secondary user. Between these two sides is a double-sided screen that allows each user to see the same information in their respective languages. The primary user can access a subway map through wi-fi and point to a station they want to travel to, and the secondary user can see the same map in their language and draw directions to help the primary user. This represents only a small fraction of the ways this device can be used. As mentioned previously, the intended use for this product is to facilitate travel by allowing users to communicate with persons native to the country of travel and gain knowledge and directions.

Identifying Regulatory Complexes in Olfactory Genes

Brady Olsen, Senior, Biochemistry

Mary Gates Scholar

Mentor: Ralf Luche, Fred Hutchinson Cancer Research Center

Eukaryotic gene expression is in part mediated by gene specific promoter and enhancer regions. These regions contain binding sites for regulatory elements that modify gene transcription. The interactions of regulatory elements that mediate such gene expression have, until recently, been largely ignored due to the difficulties in identifying regulatory complexes and the constraints of these interactions. Genes with defective regulatory complexes may express products in inappropriate amounts or not at all. Therefore, regulatory complexes can have significant implications in development and disease. Previous research in mice has indicated that an enhancer regulatory element is involved in the expression of the rapidly evolving olfactory receptors genes responsible for detecting scents. This enhancer, called the H-Box, has also been identified in canines, but the mechanism of enhancer-mediated regulation is still largely unknown. In order to elucidate this regulatory system, we have employed a relatively new technique known as Chromatin Conformation Capture. In this technique, regions of canine DNA that are in close physical proximity are locked together by chemical cross-linking to nearby proteins. The DNA found within cross-linked complexes is digested with a restriction enzyme and religated. After removal of cross-linked proteins, the ligated DNA fragments can be sequenced and DNA fragments that are linked *in vivo* by regulatory complexes can be identified, even though they may be located in completely different chromosomal locations. This allows us to determine which olfactory genes are associated with the H-box enhancer to form a transcriptionally active complex.

06 methylguanine-DNA methyltransferase activity as a prognostic tool for glioblastoma therapy.

Mitchell Onslow, Senior, Neurobiology

Mary Gates Scholar

Mentor: John Silber, Neurological Surgery

Glioblastomas (GBMs) are the most malignant brain tumors in the adult population. The outcome for patients is grim. Recent efforts have been made to develop markers for clinical response to direct patients to the most efficacious therapy. 06 methylguanine-DNA methyltransferase (MGMT) is a DNA repair protein that confers resistance to chemotherapeutic alkylating agents by repairing damage done to the DNA. Alkylating agents such as TEMDAR (TMZ) are frequently used in concert with radiation to treat GBMs and MGMT is a significant contributor to cellular resistance to TMZ. Our findings show that MGMT activity is inversely correlated with GBM progression. We

quantitated MGMT activity in 71 tumors from patients operated on at the University of Washington. Dividing the population into two groups based on their MGMT activity (using 5 fm/106 cells as a cutoff) revealed that the high activity group progressed almost twice as quickly as the group with tumors having low MGMT activity (HR=1.79, p< .022). Dividing the population into tertiles revealed that this trend was continuous with activity. The median group (3-15 fm/106 cells) progressed 1.7 times faster than patients with low activity (< 3 fm/106 cells) (HR= 1.68, p<0.085), whereas the population with the highest activity tumors (> 15 fm/106 cells) progressed 2.5 times faster (HR=2.48, p<0.022). Thus MGMT activity is a useful prognostic indicator of GBM progression.

Comparing Viscous Flow on Mars to Terrestrial Analogues. How convincing is the Water Ice Hypothesis?

Dyan Padagas, Senior, Earth & Space Sciences

Mentor: David Montgomery, Earth & Space Sciences

Mentor: Sanjoy Som, Earth & Space Sciences

Surface features observed East of the Hellas Impact Basin on Mars are indicative of viscous flow, and are likely similar to water-ice or salt glacier flow observed on Earth. Previous published work suggests the Martian flows are water-ice glaciers. Recent discovery of abundant salts on Mars invite this hypothesis to be reconsidered. To differentiate between these two types of glaciers, this research analyzes the topography of those martian flows, and compares them to water-ice and salt terrestrial analogues such as the Malaspina glacier in Alaska, and the salt glaciers of Iran. Well-studied one-dimensional terrestrial equilibrium topographical profiles of water-ice glaciers are accurately modeled using Glen's Flow Law. This equation expresses topographical elevation as a function of downstream distance to some power n (where n = 3 for water-ice glaciers). Martian topographic profiles are measured using the digital elevation model (DEM) obtained by the Mars Orbiter Laser Altimeter (MOLA), an instrument onboard the Mars Global Surveyor spacecraft. The data is then analyzed using Matlab, a powerful computer program used to manipulate arrays. By fitting Glen's Flow law onto Martian data with n as the only variable, a comparison with terrestrial water-ice glacier profiles can be established. Furthermore, measurements of profiles of the salt domes in Iran using terrestrial DEMs allow for a compelling comparative study. Testing martian flow morphology with specific Earth analogues will yield important insights into what material could be potentially flowing on Mars, and contribute to the way we interpret morphological features on Mars.

In God We Trust? Are There Correlations Between Religious Composition and State Legislature?

Elisabeth Page, Senior, Sociology

Mentor: Stewart Tolnay, Sociology

There has been a long-standing relationship between religion and politics in American Government. Previous studies have shown strong associations between the Republican Party and traditionally conservative religious groups such as White Protestants and Evangelical Christians. The Democratic Party has customarily relied on Jewish and Black Protestant voters for support on Election Day. Using data from the General Social Survey and the 2000 Census, I will explore the associations between the varying levels of religiosity of each state and its affect on teen abortion and gun control laws. The variables being considered within the religiosity equation are: percent of state citizens who are Evangelical Christians, percent of residents who define themselves as a particular religion, percent who attend church at least once a week, and percent of state civilians that believe in God. I expect to find a positive correlation between higher levels of religiosity and stricter gun control and teen abortion legislation. In addition to the religiosity of the state, I will control for differences within the states by observing the effects of the following variables: race, region, median family income, education level of citizens over 25, population density, and political party affiliation. Within the controlled variables, I expect that there may also be positive correlations between education level, region, median family income, and political party affiliation with stricter laws of teen abortion and gun control.

Specific Ablation of Regulatory T cells Induces Activation and Expansion of Myeloid Antigen Presenting Cells in Non-lymphoid Organs

'Iris' Kok Shuen Pang, Senior, Molecular, Cellular & Developmental Biology

Amgen Scholar

Mentor: Jeong Kim, Immunology

Mentor: Alexander Rudensky, Immunology

Regulatory T cells (Treg) are a subset of CD4+ T lymphocytes that suppresses the body's immune responses against self-antigens, thereby preventing autoimmune diseases. Our laboratory has identified the X-chromosome-encoded transcription factor Foxp3 as a Treg lineage specification factor and a definitive marker for these cells. However, a molecular understanding of Treg's suppressive function and the mechanisms by which Treg control immune responses remain unclear. Recent microscopy studies have suggested that the interaction between antigen-presenting cells (APC) and Treg is central to the regulation of immune response. In support of this, myeloid APC including dendritic cells and macrophages increase in absolute numbers in the lymph nodes and spleen of Foxp3DTR mice subjected to toxin-induced Treg ablation. In these "knock-in" mice, DNA sequence

encoding the human diphtheria toxin receptor (DTR) was inserted into the Foxp3 locus. Specific ablation of the Treg population can be induced in Foxp3DTR mice by acute diphtheria toxin treatment. By taking advantage of this model, our study aims at understanding the mechanism(s) by which Treg control the response of myeloid antigen-presenting cells. We examined the status of myeloid cells in secondary lymphoid and non-lymphoid organs after inducible ablation of Treg in Foxp3DTR mice. Near complete elimination of Treg resulted in the activation and expansion of dendritic cells and macrophages in the lung and the skin, but to a lesser degree when compared to the spleen. We will next analyze the transcriptional profile of the sorted dendritic cells and macrophages to identify target genes sensitive to the presence or absence of Treg in these organs. The study will provide new insights into the molecular basis of Treg suppressive function and further elucidate how Tregs modulate APC's function to maintain immunologic tolerance.

Methods for Quantitative Fluorescence Microscopy

Shujun Peng, Senior, Chemistry and Biochemistry

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: Dustin Maly, Chemistry

Mentor: Daniel Chiu, Chemistry

Fluorescent tagging of proteins is a powerful means to elucidate the cellular world, but current methods allow efficient analysis only at a bulk level. This project aims to develop and improve current methods for quantitative microscopy, in order to gather greater detail about various systems of interest than current methods allow. Previous work by the Chiu Group used single molecule fluorescence distributions to deconvolute the number of molecules present in a puncta, a spatial cluster of fluorophores. The test system of avidin and Alexa fluorophore bound biotin was used with total internal reflection fluorescence (TIRF) microscopy, but showed a discrepancy between the known binding ratio and the measured ratio obtained by fitting single molecule intensity distributions. The inconsistency resulted from quenching which arose due to the proximity of the fluorophores to each other when multiple fluorophore-biotin conjugates were bound to avidin, a problem that is reflective of real systems in which multiple fluorophores are closely clustered or are bound to the same protein. To eliminate quenching, biotin-fluorophore conjugates with longer spacers between biotin and Alexa are currently being synthesized and will be tested by statistical modeling based on the previously established framework. Future work will involve making the system more robust and accurate, and to expand this model to other types of microscopy, such as confocal and EPI-fluorescence. The ability to reliably relate fluorescence intensity quantitatively to the number of molecules or proteins present can provide a new level of detail about molecular mechanisms, for example by revealing not just whether or not expression occurs, but in what quantities proteins are expressed or trafficked under various external stimuli.

A Molecular Approach to Characterizing Microbial Communities in Local Wetlands

Hanna Yoon, Freshman, Pre-Pharmacy, North Seattle Community College

David Peraino, Freshman, Biochemistry, North Seattle Community College

Micah Herst-Gianol, Freshman, Biology, North Seattle Community College

Jesse Lenihan, Freshman, Material Science, North Seattle Community College

Dustin Evans, Freshman, Pre-Pharmacy, North Seattle Community College

Mentor: Ann Murkowski, Biology, North Seattle Community College

Mentor: Kalyn Owens, Chemistry, North Seattle Community College

The clear correlation between elevating carbon dioxide levels and global warming has created an urgent need to accurately model carbon cycles on both global and local levels. Recent research has suggested that decreased output or conservation of soil carbon is heavily reliant on microbial activity. It is vital that microbial soil communities be characterized to comprehend the role of urban wetlands in the overall carbon cycle. We extracted DNA from four soil samples at pre-selected sites at North Seattle Community College's wetlands with varying water exposure. A PCR was conducted with universal 16S primers. Products were sequenced and compared to known sequences in order to identify bacteria in the samples. These results will help us to look for correlations between carbon dioxide flux of these wetlands (provided by colleagues) and the microbial community composition. Examining the correlations could result in deeper understanding of the relationship between these two factors, allowing us to more accurately model the role of the wetlands in the overall carbon cycle.

Optical viscosity sensor using bend loss of fiber

Alex Perez, Junior, Aeronautics & Astronautics

Mary Gates Scholar

Mentor: Wei-Chih Wang, Mechanical Engineering

The design, construction, and potential applications of a new and novel instrument for the measurement of viscosity, a fundamental property of all fluids, are detailed. Existing viscometers have a number of limiting factors that the proposed instrument has overcome, namely that current technology is bulky and requires samples to be large in quantity. A vibrating optical fiber is immersed in the sample under test and the degree of damping imposed by the fluid is measured and the viscosity of the fluid can then be calculated. A computer controlled signal generator actuates a piezoelectric element that drives the optical fiber at its natural resonant frequency. The light output of a laser is sent through a directional coupler and into the vibrating fiber, where the light is reflected and the intensity is modulated via the bend loss effect. A photo-detector

measures the varying fluctuations of the modulated optical signal while a computer processes the variations and yields a viscosity measurement figure. The instrument under discussion contrasts sharply with existing equipment in that the sample size required is minuscule and the dimensions and weigh of the device is quite diminutive. Besides being an innovative apparatus that adds a valuable tool to the existing range of viscosity measurement instrumentation, this device offers tremendous future potential in the biomedical field, specifically of the viscosity measurement of various bodily fluid samples and how alterations in viscosity of these aforesaid samples may be effective indicative precursors of disease.

Brain AchE Inhibition in Juvenile Rainbow Trout Exposed to Presicide Mixtures within Urban Streams in Western Washington: Reasons for Non-Additive Effects

Yeu-Ru Chou, Senior, Chemistry and School of Aquatic and Fishery Sciences

Billie Perez, Junior, Aquatic and Fishery Sciences and Ecosystem Science and Resource Management

James Syvertsen, Junior, Ecosystem Science and Resource Management

Mentor: Christian E. Grue, School of Aquatic and Fishery Sciences

Recent efforts have documented pesticide concentrations within surface waters of urban streams in western Washington. Although levels reported are low (most <1.0 ppb), the presence of these chemicals has generated concerns, particularly their potential effects on salmonids. Previously, we exposed juvenile (ca. 10 g) rainbow trout (*Oncorhynchus mykiss*) to a chemical cocktail representative of urban streams in western Washington. Nominal concentrations (ppb active ingredient) of 9 herbicides, 3 insecticides (ChE-inhibitors, carbaryl, diazinon, and malathion), an insecticide breakdown product, and a fungicide were the maximum reported during peak storm flow events (hereafter 1X). With the exception of the fungicide and the breakdown product, formulated products (FP, single AI) were used and if possible were selected from those available at retail outlets. Brain AChE activity was not inhibited in fish exposed to the 1X cocktail, but was in the 3.3X (23%) and 10X (84%) cocktails. Enzyme activity was not affected by the 10X concentrations of the individual cholinesterase inhibitors as AIs or FPs, but was inhibited 59 and 78 percent in fish exposed to the mixtures, respectively. We then exposed juvenile rainbow trout of the same size to the same individual cholinesterase inhibitors (10X) as AIs or FPs as well as binary and tertiary mixtures in an effort to identify the combination responsible for the potentiation of AChE inhibition and the underlying physiological mechanisms. Results for the AIs and FPs were similar and indicated that the combination of diazinon + malathion (AChE inhibition = 85-88%) was responsible. Comparisons of the interactions

between plasma BuChE and carboxylesterases (CaE) and the two AChE inhibitors indicate that the potentiation observed is the result of the inhibition of CaE by diazinon. Pathways for the potentiation will be presented as well as the implications of our results to urban streams and the regulation of pesticide mixtures.

Behavioral Sex Differences among Captive and Wild Macaques

Nicolle Perisho, Senior, Psychology

Mary Gates Scholar

Mentor: Randall Kyes, Psychology

Behavioral sex differences in children are often attributed to cultural influence and socialization, yet consistent differences have been found across a wide variety of cultures, ages, and species. Behavioral sex differences among primates may be a product of evolutionary selective pressures, resulting in distinct genetic predispositions for males and females. Sex differences appropriate for the natural history of the species develop from the interaction of these predispositions with environmental factors. By exploring non-human primates' behavioral sex differences for preferences of sex-typed objects, more can be understood regarding primate evolution. This study focused on identifying behavioral sex differences for object preference among both captive and wild macaque monkeys. Laboratory testing with infant pigtailed macaques (*Macaca nemestrina*) assessed proximity frequency, proximity duration, or contact duration. Studies have been completed and the data analysis will be complete in April. A field study involving longtailed macaques (*Macaca fascicularis*) on Tinjil Island, Indonesia allowed investigation of preference for objects using a gross measure: the number of each age/sex class within one meter of an object. For both field and laboratory, a Paired Comparison design was used for the three sex-typed objects. While no sex differences were found in the field study, juveniles were more likely to attend to the objects and a specific hierarchy for object preference existed.

Vowel and Consonant Exaggeration in Infant-Directed Speech

Jennifer Perry, Senior, Speech & Hearing Sciences

Mentor: Patricia Kuhl, Speech & Hearing Sciences

Mentor: Gina Cardillo, Speech & Hearing Sciences

Previous research has suggested that vowels and consonants are exaggerated in infant-directed speech (IDS) compared to adult-directed speech (ADS). However, no study has examined both vowel and consonant exaggeration in the same speakers. The present study investigated vowel and consonant modifications in twenty-seven mothers while speaking to their 11-month-old infants compared to when speaking to an adult. When the first three tokens of each mother were used, results supported the exaggeration hypothesis: 1) vowel space area was significantly greater

in IDS than in ADS, 2) voice onset time (VOT) was significantly longer in IDS than in ADS, mainly due to an increased mean VOT in voiceless stops /p/ and /t/, and 3) the mean VOT difference between /p/ and /b/ was significantly greater in IDS than in ADS, as was between /t/ and /d/. In addition, effect size (d) was explored in order to quantify the size of difference between voiced and voiceless categories while taking variance into account. Effect size (d) was larger in IDS than ADS, but was sensitive to small changes in sample size. Correlation analyses were also conducted to examine how consonant and vowel exaggeration were related to each other in both registers. There was a negative correlation between consonant (d) exaggeration and vowel space area in IDS, while no correlation was present in ADS. Taken together, these results suggest that while mothers in general exaggerate both vowels and consonants in IDS compared to ADS, they may selectively modify one more so than the other in IDS. It is hypothesized that these modifications are adapted to the infant's age or linguistic ability and may influence language development.

Evolution of *Jaltomata* Diversity in the Neotropics

Hanhla Phan, Senior, Biology and Anthropology

Mentor: Richard G. Olmstead, Biology

Mentor: Ryan J. Miller, Biology

Jaltomata is the sister group to *Solanum*, which contains tomato, potato, eggplant and many more species of interest to humans. It is neotropical in distribution, with many species found in the Andes. *Jaltomata* produce colorful, marble sized fruits that range from orange to purple in color and live in diverse environments from humid forests in Central America to the chilly Andes, and from sea level to nearly 5,000 meters in elevation. A few species catalogued decades ago have now apparently become extinct due to habitat modification. Previous work has shown there is little genetic difference in the slowly evolving chloroplast DNA between *Jaltomata* species implying a young age for this genus. Thus, we have sequenced the nuclear gene, waxy, which has a higher substitution rate than chloroplast genes, to infer the evolutionary relationship of these species. A direct sequencing approach has worked for many species, except where there are length polymorphisms between alleles. We have cloned PCR products for these species to separate individual alleles and have examined the pattern of allelic polymorphism. An example of how a molecular phylogenetic approach can answer evolutionary questions involves *Jaltomata biflora*, which is polymorphic for a four base pair deletion in the waxy locus. This species is self-pollinating with semi-clear nectar in the early stage that changes into red as the flower ages. Creating a phylogeny of the waxy gene may help us infer whether *Jaltomata biflora* is closely related to other species with red nectar or white nectar and could indicate whether this transition in color is due to hybridization.

Spatial Variation of Subsistence on the Kuril Islands

Danielle Plante, Senior, Anthropology

Mentor: John B. Fitzhugh, Anthropology

In 2006, a group of archaeologists, geologists, palynologists, volcanologists, tsunamists and zooarchaeologists ventured to the Kuril Archipelago as part of the Kuril Biocomplexity Project (KBP). Among the samples brought back to the University of Washington, was a varying collection of fish fauna, mainly from three sites. This project is focused on comparing the dietary abundance and diversity of fish represented in midden deposits from three sites; Baikova on Shumshu in the north, Vodopadnaya 2 on Simushir in the central islands and Ainu Creek on Urup in the south. Little research has been done on fish consumption and processing in the Kurils, and how it differs between islands temporally and spatially. Numbers of individual specimens (NISP) will be quantified; fish remains will be counted and the abundance of cranial versus pelvic girdle bones calculated, to establish a comparison between sites and occupation levels within each site. Each piece of bone will be identified to element and taxon, using comparative skeletons supplied by the Burke museum. Foraging strategy like river fishing, off shore fishing and the use of boats will be addressed by looking at the types of fish represented in the archaeological record. Pottery and radiocarbon dates will be used to associate fish fauna with a cultural group, to further understand the dynamics of diet, fish processing and foraging strategy displayed on the islands.

Curvilinear Relationships between Physical Arousal and Gambling Specificity

Jason Tsun-Yin Poon, Senior, Neurobiology and Psychology

Mary Gates Scholar

Mentor: Mary E. Larimer, Psychiatry & Behavioral Sciences

Mentor: Clayton Neighbors, Psychiatry & Behavioral Sciences

Mentor: Gottheil Edward, Psychiatry

Mentor: Ty W. Lostutter, Psychiatry & Behavioral Sciences

Increased states of arousal have been reported in the studies of different types of gambling including casino games, electronic machine gambling and sports betting. The addictions research literature has begun to focus on physical and psychological arousal and the role it plays in the development of gambling problems. The current project investigates the relationship between gambling severity and the difference between arousal to different gambling types. We propose to examine a curvilinear relationship between gambling severity and physiological arousal. For example, a social cards gambler's physiological responses to card gambling visual cues should be high compared to the gambler's arousal to machines and sports betting cues, thus creating a large difference in arousal between

the different types of gambling. In the case of a non-problematic gambler, the difference in arousal should be small between different gambling types because they have little experience with gambling. Finally, problematic gamblers may have a small difference in arousal between different gambling types because as their gambling has become more habituated to gambling cues. These individuals may generalize to all forms of gambling cues rather than gambling specificity. The current study recruited a random sample of college students based on their gambling severity criteria as measured by the South Oaks Gambling Screen. Participants completed a number of self-report measures, followed by a physiological assessment, which measured electrodermal skin response and heart rate to visual gambling cues. Results will focus on curvilinear relationship between gambling severity and physiological arousal and discuss the possible treatment implications.

Assessing the Performance of Floating Chambers in Monitoring Localized Flux of Carbon Dioxide in Wetlands

Fuad Ayeshalmouley, Freshman, Pre-Major, North Seattle Community College

Amarpal Singh, Freshman, Pre-Major, North Seattle Community College

Brian Ly, Sophomore, Chemistry, North Seattle Community College

Benyam Kahsai, Freshman, Aeronautics and Astronautics, North Seattle Community College

Heidi Yu, Senior, Clinical Health Services, North Seattle Community College

Joshua Porch, Clinical Health Services, North Seattle Community College

Francis Scott, Sophomore, Chemistry, North Seattle Community College

Mentor: Ann Murkowski, Biology, North Seattle Community College

Mentor: Kalyn Owens, Chemistry, North Seattle Community College

Modeling the participation of wetlands in the global carbon cycle has been the focus of much recent research. In many of these studies, a floating chamber attached to an infrared gas analyzer (IRGA) was used as a tool for measuring localized carbon flux. The resultant data has received criticism out of concern that the shape and motion of the chamber itself interferes with the collection of data through an alteration of surface turbulence and wind shear. Our work focused on producing a protocol for consistent use of the chamber that takes into account the potential influence of the chamber on the experiment itself. Consistent use of the chamber will further aid in accurate real-time modeling, which is crucial to the determination of the seasonal role of a wetland in the carbon cycle.

An *in vitro* comparison of Two Models of Infection for Human Immunodeficiency Virus type 1

Nicholas Provine, Senior, Microbiology

Mary Gates Scholar

Mentor: Nancy L. Haigwood, Pathobiology

There are 33 million people living with Human Immunodeficiency Virus (HIV) and 2.5 million new infections occur each year. Efforts to develop antiretrovirals and vaccines rely upon extensive *in vitro* analyses of how viral variation may impact the pathogenesis of the virus. There are currently two commonly used systems for studying HIV *in vitro*: Infectious Molecular Clones (IMC) where the entire HIV genome is placed on a mammalian expression plasmid, and Pseudotyped Viruses where the genome is divided into two expression vectors with the envelope gene placed on a separate plasmid from the rest of the genome. Although the IMC system is believed to better mirror the behavior of wild type virus, the creation of IMCs is technically challenging and time consuming. Pseudovirus is significantly easier to create in the laboratory and is much safer and easier to work with. This study is designed to directly compare the results obtained by these two systems on a number of key parameters. All analyses will be performed on six matched pairs of Pseudoviruses and IMCs. Infectiousness will be determined by titrating viral preparations on an HIV-1 reporter cell line. An Enzyme Linked Immunosorbent Assay (ELISA) will be used to determine the amounts of Capsid protein present in each viral preparation. The relative concentration of Capsid in each viral preparation will then be used to standardize the infectivity curves for viral input. Quantitative western blots will be used to compare the efficiency of viral Envelope processing and virion incorporation. The Pseudovirus production protocol will also be optimized for the ratio of envelope and backbone plasmids in order to recapitulate the results obtained in the IMC system. Understanding the strengths and limitations of these two systems will allow a better understanding of what aspects of each system would translate accurately into an *in vivo* setting. Knowing the details of each systems behavior is therefore critical to vaccine design.

FDG PET in leiomyosarcoma outcome

Stephanie Punt, Junior, Chemistry

Mentor: Janet F. Eary, Radiology

Leiomyosarcoma, a malignant neoplasm of smooth muscle, accounts for 7% of sarcomas. Sarcomas, derived from the mesoderm, are difficult to diagnose, and treatment options are not well investigated. Patients with these tumors generally have poor 5 year survival, and a current lack of leiomyosarcoma research continues poor patient prognosis for this group. We propose to identify a method for imaging leiomyosarcoma and to provide information on the behavior of these tumors non-invasively so that patient outcome on current therapies can be predicted and

poor prognosis can be improved. Improvements made in the clinical treatment of leiomyosarcomas will lead to an increase in patient survival. The purpose of this study is to determine if positron emission tomography (PET) using radiolabeled Fluorodeoxyglucose (FDG) molecule provides a reliable, noninvasive means to predict outcome in patients with leiomyosarcomas. ¹⁸F-FDG PET was performed on the tumors of participating patients, and a tumor standard uptake value (SUV) was calculated. For this study, these results were correlated with tumor grade histopathologic subtype and relapse-free survival. PET scans were obtained prior to neoadjuvant chemotherapy or resection. This data can be used to indicate the effectiveness of FDG PET imaging for predicting patient outcome and survival. In our study, the statistical significance of this prediction will be evaluated. Tumor FDG uptake will likely be correlated to the biologic behavior of leiomyosarcoma tumor patients and their risk for local tumor recurrence and metastatic disease progression.

JAVA In-situ Cosmogenic Isotope Calculator

Christopher Raastad, Sophomore, Mathematics

Mentor: John Stone, Earth & Space Sciences

In-situ Cosmogenic Isotope research deals with calculating the exposure ages and erosion rates of rocks by measuring the accumulation of rare isotopes created by the constant bombardment of cosmic ray particles. The accumulation of cosmogenic isotopes in a rock surface depends on its exposure history including transformations such as erosion and burial of the surface. Predicting the isotope concentrations for a particular exposure/erosion/burial history can be mathematically complicated. My project aimed to create a JAVA computer program providing a simple to use Graphical User Interface (GUI) to enter, process, and display rock samples' isotope data measured with Particle Accelerator Mass Spectrometry. The program provides an aesthetically pleasing, dynamically adjustable, graphical environment to experiment with the Geomorphic History of a group of related samples. These tools allow easier analysis of complicated Geomorphic Histories and provide an interactive means of aligning the necessary graphs to confirm an exposure history of a group of samples. The program alleviates some of the complications associated with standard Mathematica and MatLab techniques. Although choosing an Object Oriented Programming (OOP) approach greatly increased the difficulty of graphing and performing mathematical calculations, invested time and successful implementation allowed the possibility of numerous GUI features impossible with robust calculating software. The portability of JAVA also allows the program to run on any machine and operating system. So far, a successful program has been created that processes data, displays graphs, and implements dynamic GUI features. Future releases will include more accurate calculations and more advanced analysis tools. My hope is this program will allow non-specialists in Cosmogenic Isotope research

to model complicated geomorphic histories and qualify measured isotope data from real geologic situations. In addition, the program can serve as an aid, with graphical elements, to interactively demonstrate and teach the techniques associated with In-situ Cosmogenic Isotope exposure dating.

The importance of Pacific salmon marine derived nutrients to Salmon River streams, Idaho

Zachary Radmer, Senior, Biology and Program on the Environment

Mary Gates Scholar

Mentor: Beth Sanderson, Northwest Fisheries Science Center

Anadromous salmon migrate from salt water to fresh water to mate and lay their eggs in an environment safer for young salmon. Part of this life cycle is to die and decompose in rivers and tributaries that serve as spawning grounds and habitat for the first months or years of a young salmonid's life. This is a massive fertilization event for the oligotrophic (nutrient-limited) streams we study in Idaho. The adult salmon have returned from the ocean, where they accumulated tissue with isotopic signatures distinct from river and stream food webs. Nitrogen and carbon from carcasses are recycled by primary producers, invertebrates, and salmon fry. By tracking these nitrogen and carbon isotopes, we can trace the movement of these marine-derived nutrients through stream food webs. Our goal is to assess the responses of food webs to marine-derived nutrients. Our study sites include streams in the Salmon River basin that (1) currently support populations of Chinook and steelhead and (2) streams that do not have populations of anadromous fishes and act as control sites. Our results have shown that marine-derived nutrients are important inputs to Salmon River streams. Salmon nutrients are rapidly detected in primary producers and invertebrates. Furthermore, isotopic signatures in streams with and without annual inputs of salmon nutrients are quite different. But more research is needed to help managers determine if the anthropogenic introduction of salmon carcasses or nutrients can catalyze the growth of these threatened and endangered fish populations.

Biosynthetic Muscles: Animation of Explanted Muscle Tissue as Actuators for Engineering, Rehabilitation Medicine and Robotics Applications

Monty Reed, Junior, Biosynthetics General Studies

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: Steven Stiens, Rehabilitation Medicine

Mentor: Karen Petersen, Biology

Living muscle tissue is more efficient than traditional actuators and motors currently available. Lightweight, powerful efficient actuators that simulate living muscle tissue would be of great benefit for Rehabilitation, Robotics, and DXARTS projects such as Biosynthetic

living sculptures. In order to design a synthetic muscle I have studied the construction, function, and application of muscles in living systems. The study of explanted muscle tissue from beef cattle, fish, reptiles, poultry and others may find practical applications for use in engineering, rehabilitation medicine and robotics. I started with beef and poultry commonly found at grocery suppliers and as time allows I will further explore other tissues. In the initial stages I studied 'animation' of the tissue using a 40VDC power supply to determine the endurance of the tissue during repeated animation. By cutting different size and shapes of the samples I tested to see how many repetitions each could be used for. The next stage of the project will involve determining the amount of work or power output these motor muscles produce. Future work will include: explanted living tissue, growing muscle tissue to be animated, modified voltage, modified temperature, and a variety of solutions and systems to be used to nourish the samples in an attempt to extend life and function.

The possible persistence of *E. coli* in soils treated with biosolids or septage

Matthew R. Ridgway, Senior, Environmental Science, UW Tacoma

Mentor: Erica T. Cline, Environmental Science, UW Tacoma

Much research has been done recently to find environmentally safe methods of fertilizing forest land to accelerate growth. Two methods that have been attempted recently include the application of biosolids and septage to the Charles L. Pack Experimental Forest in western Washington State; biosolids are dried municipal wastes that were sprayed on the forest in the mid 1980's and septage is waste from portable restrooms that is treated with lime until it reaches a pH of 12 for a period of at least 30 minutes. Our study focuses primarily on the possible persistence of pathogenic *E. coli* (*E. coli* O157) in the forest soils. Eight soil samples were taken in each of three treatments: biosolids, septage, and control. DNA was extracted from each soil sample using a kit and tested for the presence of the *rfbE* O-antigen synthesis gene (specific to pathogenic *E. coli*). Testing was performed using PCR with an *E. coli* O157 specific primer. Soil pH and moisture content were also measured. After analysis, the lowest mean pH and the highest moisture content occurred in the biosolids sites, while the highest pH and lowest moisture occurred in the control sites. Presence/absence tests for pathogenic *E. coli* are ongoing. A presence of pathogenic *E. coli* would indicate that current methods of treatment are inadequate and in need of reevaluation.

The effect of self-affirmation on compensation for stigma

Heather Rieck, Senior, Psychology

Mary Gates Scholar, Undergraduate Research

Travel Awardee

Mentor: Cheryl R. Kaiser, Psychology

Although research has found that heavyweight women are capable of compensating and overcoming some of the negative consequences of weight-related bias by exerting extra effort to make a positive impression, compensation for stigma most likely results in the depletion of cognitive resources. The present study investigated whether self-affirmation could eliminate compensation for stigma while still allowing heavyweight women to make a positive impression due to decreased rejection sensitivity and defensiveness. Eighty undergraduate women who self-perceived as overweight created either an audio (weight bias was not relevant as their weight was not revealed) or video (weight bias was potentially relevant as their weight was known to their partner) response to a dating scenario that was evaluated for general likeability. Prior to creating the response, half of the women were self-affirmed and half were not. Finally, after creating the audio or video recording, participants completed a measure of cognitive resource depletion. The implications of this research go beyond this population in discovering psychological moderators of social identity threat and alternatives to the use of resource costly compensation for stigma.

Development of Chemotaxis Assays for the Photosynthetic Bacterium *Rhodopseudomonas palustris*

Hannah Robbins, Junior, Microbiology

Mentor: Jean Huang, Microbiology

Mentor: Caroline Harwood, Microbiology

Many bacteria show a behavior known as chemotaxis in which they swim towards or away from various compounds present in their environment. *Rhodopseudomonas palustris* is a phototrophic bacterium with a versatile metabolism. Its sequenced genome contains at least 30 annotated chemoreceptor genes (MCPs), which suggests that *R. palustris* potentially has the ability to sense and swim to a variety of compounds. Though *R. palustris* is motile, no reliable method has been found to assay for its chemotaxis behaviors. One hindrance to assessing this behavior is having a consistently motile population of cells. My goal is to develop a reliable assay for chemotaxis and in particular to determine whether *R. palustris* will swim towards the compound thiosulfate, or a recently discovered homoserine lactone-type signaling molecule found to be involved in cell-to-cell communication by *R. palustris*. Chemotaxis to either of these compounds would be interesting for several reasons. Thiosulfate can be used to support growth and *R. palustris* has two MCP genes upstream of its thiosulfate oxidation gene cluster.

Observing chemotaxis to thiosulfate may indicate how *R. palustris* can acquire this compound in nature. If *R. palustris* can swim towards its cell-to-cell communication signaling compound, then this could help cells to more readily congregate into a group and engage in group behaviors. I have examined various strains of *R. palustris* in various growth phases and developed a method to select for a population of highly motile cells. Using succinate, a known attractant, I have compared different methods for assaying chemotaxis including direct microscopy and motility agar. I will present results from the use of these techniques.

AIDS Orphans in Sub-Saharan Africa: The Loss of a Generation Leads to Social Degradation

Sarah Rodger, Senior, Geography and Public Health

Mentor: Craig ZumBrunnen, Geography

The literature regarding AIDS orphans has shown vast economic and social suffering. Recently, ‘developed nations’ have seen more reports of the staggering number of children who have lost one or both parents to this disease. AIDS orphans are subjected to tremendous physical and psychological suffering due to the loss of their older generations. Now this younger generation is left to sustain the remaining households and cultures without oral tradition to provide them direction. The extent of pre-existing poverty and despair has created a cyclic effect, furthering the spread of AIDS and other infectious diseases. Reviewing the literature raised questions such as: What are the suggested measures for providing assistance to these youth? What progress has been made using the current strategies? Have the countries most deeply affected seen improvement with medical and financial development programs? I feel that AIDS orphans are an epidemic within an epidemic. The purpose of my inquiry is to learn more about the types of programs aimed at providing support to children left behind by this disease. I address this research with a spatial approach, asking what are the current global intervention strategies for AIDS orphans in sub-Saharan Africa and why some of these interventions ultimately fail? I will draw upon literature that utilizes both quantitative and qualitative methodologies to address the following research question: Should potential and existing intervention programs be based on a sub-regional scale or designed around the existing economic, political and socio-cultural frameworks of each country within sub-Saharan Africa?

Sloan Digital Sky Survey: Asteroid Search

Amy Rose, Junior, Astronomy and Physics

Amanjot Singh, Sophomore, Pre Major

Kathryn Smith, Sophomore, Astronomy and Physics

Kenza Arraki, Sophomore, Astronomy and Physics

NASA Space Grant Scholar

Mentor: Andrew Becker, Astronomy

Now near the end of its second phase of operations, the Sloan Digital Sky Survey (SDSS) has imaged more than a quarter of the night's sky. SDSS takes successive images of the sky using five different filters, each image seconds away from the last. Taking advantage of this time delay we were able to find moving objects in the data. We subsequently sent the data on these objects to the Minor Planet Center (MPC), who assisted us in determining which of the objects were asteroids and how many we had discovered. Using this method, we detected over 13,000 asteroids, 1,300 of which have never been observed before. We should eventually get to name a large fraction of these new asteroids. Our current research involves further investigating the collective properties of these asteroids, including correlating their orbital properties and colors. The color of a given asteroid is largely determined by its surface composition; by studying their colors we can constrain the materials of which they are made. In particular, we are studying the colors of asteroids in the different asteroid "families", where all members of a family are thought to have derived from the fragmentation of a larger body in a collision long ago. Using previous studies on asteroid families, we cross-reference our asteroids' colors and positions with asteroids belonging to well-established families. By studying the composition and position of each asteroid in a family we can get an idea of the composition and structure of the original parent body.

Origin of Replication Activation in Histone H2A.Z

Deficient *Saccharomyces cerevisiae*

Jennifer Rose, Senior, Biochemistry and Physiology

Mary Gates Scholar

Mentor: Wenyi Feng, Genome Sciences

Mentor: Bonny Brewer, Genome Sciences

Mentor: M.K. Raghuraman, Genome Sciences

To maintain integrity of the genome, DNA must be copied with high fidelity every time a cell divides. During replication, synthesis of new DNA begins at multiple points along each chromosome called origins of replication. Yeast *S. cerevisiae* origins have a common firing pattern established by varying their firing time (early in S-phase or late) and efficiency (whether an origin fires faithfully in multiple rounds of S-phase.) It is still unclear what determines this temporal pattern, but previous research has shown that chromatin structure plays a role in origin activation. Chromatin refers to the structure of DNA wrapped around nucleosome proteins, which serve to compact DNA within the nucleus. Specifically, my

research addresses whether the H2A.Z histone variant—a nucleosome subunit—exerts control over the timing and/or the efficiency of the activation of origins. When replication is initiated at an origin, the DNA in close proximity becomes transiently single stranded, especially in certain yeast mutants in the presence of the drug hydroxyurea (HU). HU acts in the cell to deplete nucleotides, the building blocks of DNA, and halts the synthesis of new DNA strands. In my experiments, these stretches of single stranded DNA (ssDNA) can be labeled with fluorescent nucleotides and visualized on a genome-wide scale using microarray analysis. The amount of ssDNA at origins in yeast cells lacking the H2A.Z histone was compared to that of wild-type cells. The results from this experiment have the potential to clarify chromatin's role in the process of DNA replication.

Dietary Food Cues That Influence Aging in

Caenorhabditis elegans

Jennifer Sager, Senior, Microbiology and Biochemistry

Mentor: Matt Kaeberlein, Pathology

Mentor: Erica Smith, Pathology

Dietary restriction (DR), also referred to as food restriction or caloric restriction, has been found to increase life span in a variety of organisms, including yeast, worms, flies and mice. DR has also been found to increase stress resistance, which has been correlated with longevity. In our studies we are using the nematode *Caenorhabditis elegans*, an important model organism for studying the biology of aging. In the laboratory, *C. elegans* are fed a diet consisting of *E. coli* bacteria grown on a nutrient agar medium. DR can be accomplished by removing the bacterial food source early in adulthood, a process referred to as bacterial deprivation (BD). In prior studies conducted by our lab, it has been found that BD increases both survival and stress resistance by mechanism that is partially independent of food consumption. These studies also demonstrated the existence of soluble components of the bacterial diet that are sensed by the nematodes and which limit longevity. We have hypothesized that bacterial autoinducers, chemicals produced by bacterial cells to communicate with other bacterial cells, may be one such soluble dietary component. We are testing this hypothesis by adding bacterial autoinducers and related compounds to our BD assays and examining the resulting effects on life span and stress resistance. Preliminary data suggests that autoinducers may partially suppress the life span extension by bacterial deprivation and experiments are in progress to confirm this observation. If our hypothesis is correct, future experiments will be directed at characterizing the classes of autoinducers that play a role in life span determination and what genes are required in *C. elegans* for detecting these bacterial chemicals.

Reduced Cage Mesh Size Interferes with Puzzle Ball Manipulation

*Jamie Sanders, Senior, Psychology
Mentor: Carolyn Crockett, Psychology*

As part of the Washington National Primate Research Center (WaNPRC), the Psychological Well-Being (PWB) program oversees the implementation of activities and environmental enrichment designed to promote psychological health in non-human primates housed at WaNPRC. The current study investigated the ability of pigtail macaques' ($n=14$) housed at the University of Washington National Primate Research Center to effectively manipulate an environmental enrichment device, the puzzle ball, when cage configuration limited access to the device. The puzzle ball is unique because it provides continuously available foraging opportunities as mandated by the 1999 USDA requirement and has been an inexpensive, effective device used at the center for ten years. In this study there was a significant decrease in the number of treats monkeys extracted, the rate of tension behaviors was significantly higher and engagement times were significantly longer in the reduced access condition. These data suggest that, despite longer engagement times in the reduced condition, this configuration impairs a monkey's ability to effectively manipulate the puzzle ball and results in significantly more tension displays per minute, compromising the efficacy of the puzzle ball as an enrichment device.

Documenting The Expeditors International Universe

*Stephen Schleh, Senior, Informatics
Mentor: Batya Friedman, Information School
Mentor: David Hendry, Information School*

The modern corporate information system consists of many interdependencies between applications and components that do not necessarily interact directly with each other. The system used at Expeditors International, a Seattle based global logistics company, to manage its shipping operations is highly complex because most of the components have been built within the company and adapted over time. Furthermore, the system is poorly documented. This leads to the following problems: lengthy support time for applications, lack of understanding across groups about how subsystems interact, and a variety of issues with integrating new applications. All of these problems hurt the customer and the profitability of the company. An interactive map of the entire system consisting of all applications and components would allow stakeholders to have a more accurate understanding of the system's components. In order to provide the required level of understanding to all job roles, such as developers and business analysts, I wanted to create a digital system representation that would allow users to progressively narrow their view of the system. To investigate exactly what information would need to be presented, a series of

interviews were conducted with developers, managers, and business analysts at Expeditors International. I first asked participants a series of questions about their use of current system representations and documentation and concerns they had with these. In the second part of the interviews, I had participants perform a concept mapping activity with note cards containing several key components of the system. I used these concepts, along with concerns surrounding current documentation, to develop a working model of the system. Ultimately, the E.I. Universe application should provide not only a better understanding of the systems to the users, but also a better understanding of how the users are viewing the information.

Helping Flowers Look Sexy: Functional Analysis of a Transcription Factor

*Anjelique Schulfer, Sophomore, Biology (Molecular, Cellular, & Developmental)
Mary Gates Scholar*

Mentor: Verónica Di Stilio, Biology

In many floral systems, flower morphology is highly influenced by a gene (MIXTA) that encodes a transcription factor. MIXTA can cause elongated epidermal cells on the surface of many different flower organs, which have been shown to make the flower look richer in color. MIXTA can also lead to increased production of trichomes, little hairs on the epidermis. Since MIXTA was first discovered and analyzed, several related "MIXTA-LIKE" genes have been found and have been shown to have similar functions as MIXTA itself. I am investigating the function of one of these MIXTA-LIKE genes, isolated from the species Thalictrum thalictroides. I want to know if this gene has similar effects to MIXTA or previously investigated MIXTA-LIKE genes from other species. Thalictrum thalictroides is a more basal eudicot compared to the eudicot species that these types of genes have been researched in before. This feature will allow me to compare these transcription factors' functions between more and less derived species, which will indicate their evolutionary relationships. To determine the effect of this specific gene, I will characterize tobacco plants that are over-expressing the Thalictrum MIXTA-LIKE gene using the Scanning Electron Microscope to examine the epidermis of the leaf and of each organ in the flower. If the gene has the function we would expect based on previous research with related genes, we should find conical cells and trichomes that are unusual for tobacco. If I am able to see the effect of the gene using SEM I will verify my results by knocking out the gene in its original species and characterizing these mutants to see if they lack the traits shown in the transfected tobacco.

Analysis of Septin 9 expression in Hereditary

Neuralgic Amyotrophy

Sara Seanez, Sophomore, Biology

Mentor: Megan Landsverk, Pediatrics

Neuralgic Amyotrophy (NA) is a rare peripheral nerve disorder of unknown etiology, primarily affecting the brachial plexus, innervating the shoulder and arm. The typical presentation is characterized by a sudden onset of pain in the shoulder, followed by weakness and muscle atrophy. The pathophysiological mechanism of NA is unknown. However, at least 50% of attacks are preceded by events that may alter immune system homeostasis such as infection, stress, surgery, exposure to cold, immunizations, or pregnancy. Inflammatory infiltrates have also been observed in nerve biopsies of NA patients, further suggesting an immune response. Therefore, we hypothesize that the pain attacks associated with NA may be a result of altered immune function. NA has both an idiopathic (INA) and a hereditary (HNA) form. Patients suffering from HNA have an earlier onset of attacks, a higher recurrence rate, and more severe paresis. Our laboratory recently identified mutations in the gene septin 9 (SEPT9) in six HNA families. SEPT9 is a member of the septin family of GTPases, a conserved family of proteins generally considered to be cytoskeletal components. Through alternative splicing, SEPT9 generates at least seven mRNA transcripts encoding six polypeptides. Interestingly, SEPT9 mRNA transcripts are poorly expressed in peripheral nerve cells, yet highly expressed in immune cells, supporting the hypothesis that the pathogenesis of NA involves non-neuronal cell types. We have identified specific SEPT9 isoforms expressed in immune cells of control patient samples, as well as those expressed in lymphoblastoid cell lines of HNA patients. SEPT9 is phosphorylated in activated T-cells, a process that requires reorganization of the cytoskeleton. Therefore, we hypothesize that HNA mutations may cause an aberrant response of T-cells to the peripheral nervous system. Determining the functional consequences of HNA mutations in SEPT9 in immune cells is essential to understanding the complex clinical presentation at the molecular level.

Using Cosmogenic Isotopes to Determine Isostatic Recovery Rates on San Juan Island, WA

Hope Sisley, Senior, Earth and Space Sciences

Mary Gates Scholar

Mentor: John Stone, Earth and Space Sciences

Mentor: Terry Swanson, Earth and Space Sciences

Isostasy is the process by which the earth's crust reacts to the addition or subtraction of weight above it; like a boat displaces water when cargo is brought on, so the crust rises or falls in response to glaciers or sediment or erosion. Any geologic setting that has undergone crustal loading has also undergone isostatic depression and, following removal of the load, recovery. Following the Last Glacial Maximum,

the Northern Puget Lowland – including San Juan Island, Washington - was isostatically depressed to below sea level. As the lithosphere rebounded, till boulders left on the ocean floor by the retreating glaciers emerged from the water, where they were immediately bombarded with cosmic radiation. This bombardment causes spallation reactions in the atoms of the rock which produce certain element isotopes - ^{10}Be and ^{36}Cl in this case - at a known rate. I collected samples from a sequence of till boulders on San Juan Island and measured the cosmogenic isotope ratios in them using AMS sequencing, thereby acquiring exposure dates which can be used to time isostatic recovery on the island.

Generating a Preliminary Hand Gesture Framework for Human-Computer Interaction

Jin Kim, Senior, Informatics

Amihan Beltejar, Senior, Informatics

Quentin Christensen, Senior, Informatics

Ju Yong Son, Senior, Informatics, Economics

Sonny Skinner, Senior, Informatics, Applied Computational & Mathematical Sciences

Mentor: David Hendry, Information School

Mentor: Batya Friedman, Information School

Rapid development in the size of two-dimensional displays presents an opportunity to investigate new methods of human-computer interaction. The way in which information is presented and visualized to the user directly impacts their physical proximity to the screen. Specifically, large screens used in conjunction with the traditional method of interaction, the mouse and keyboard, limit interactivity by restricting the user to a fixed locale. Hence, this research is an opportunity to explore the use of hand gestures, using a custom-built glove-based peripheral device, as a new gesture-based method of digital communication. We present this study as a three stage design in which we collect, evaluate, and then refine a range of hand gestures for twelve-computer mediated tasks such as point, drag, delete, and undo. In the first stage, a key finding was that six out of the eight participants performed point in the same way using their index finger. The results for the more complex gestures such as undo and delete, however, were more diverse. For example, there were seven out of eight variations for undo and six distinct gestures for delete. Next, eight additional participants will evaluate the top ranking gestures using a test-bed application that will provide detailed performance data such as time, accuracy, and human error. Finally, in the third stage, we will evaluate the framework for a real-world task, where people will immerse themselves in a virtual environment using their bodies and a 'wall-sized' display. The output of this research is a system of functioning hand gestures which can then be presented as a new gesture-based method of interacting with large visual displays.

Characterization of Electronics and Prototype

Detectors for the KATRIN Experiment

Cosmo Smith, Sophomore, Mathematics

Mentor: John Wilkerson, Physics

Mentor: Jessica Dunmore, Physics

KATRIN (Karlsruhe Tritium Neutrino Experiment) is an experiment designed to determine the mass of the neutrino, an elementary particle penetrating enough to pass through any material. The KATRIN detector registers the energy of electrons emitted by the unstable isotope tritium (${}^3\text{H}$) during beta decay, a process that also emits a neutrino. A small deviation in the energy spectrum of these electrons could reveal the mass of the neutrino involved in the beta decay. All of these measurements are extremely sensitive, and the goal of our project is to verify that the electronics and detector used to quantify the results are capable of accurately relaying data. To do this, a known pulse will be transmitted through the electronic system and the resolution (sharpness), live time (the fraction of data acquired compared to the true data input rate), and linearity and gain (variability) of the resulting signal will be measured. It is important these electronics be tested because they are custom-made and operate at up to 20 kV. We will also test two prototype detectors to verify that they behave as expected when mounted and connected to these electronics. A well-calibrated system is needed if we wish to discover the role neutrinos play in our universe.

Web site usage patterns by participants in a shortness of breath self-management program

Steven Song, Senior, Biology

Mentor: Huong Nguyen, Nursing

Dyspnea or shortness of breath (SOB) is the most common disabling symptom in patients with chronic obstructive pulmonary disease (COPD). The increased availability of emerging technologies such as internet based support programs has opened up opportunities to provide convenient support for self-management of dyspnea and related symptoms to a vast majority of individuals. The purpose of this research study is to examine web site use patterns by patients with COPD who are participating in a 12 month dyspnea self-management program. Participants ($n=12$) in this study have access to multiple web and mobile tools including, interactive learning modules on dyspnea management strategies, nurse-facilitated forums to reinforce self-management skills and peer support, and a daily dairy for collaborative exercise and symptom monitoring. We will analyze date and time stamped visit logs which track when and which aspect of the web site participants used in the first 3 month of the study and will correlate these use patterns with relevant individual characteristics. Since previous research has shown that greater use of cognitive-behavioral Internet-based programs are associated with better health outcomes, the findings from this study will help us understand how the

first cohort of participants have used the web tools in order to design reinforcement strategies to promote greater and consistent use.

Effect of Fever on 3-Month Outcomes in Pediatric Patients with Traumatic Brain Injury

Yeon Ok Song, Senior, Nursing and Sociology

Mentor: Hilaire Thompson, Biobehavioral Nursing and Health Systems

Traumatic brain injury (TBI) is disruption of the normal function of the brain cause by a blow or jolt to the head or a penetrating head injury. Among many complications, fever is known to be associated with worse neurologic outcomes following TBI in adults; however, little is known about its effects in pediatric populations. The specific aims of this study were to: 1) determine the number of episodes of fever in the first week following injury experienced by a critically ill pediatric population with TBI; 2) explore the association between fever with changes in cerebral vascular dynamics; and 3) to examine the association between fever and neurologic outcome at 3 months post-injury (as defined by Glasgow coma scale (GCS) and Glasgow outcome scale (GOS)). Secondary data analysis of available records was conducted on subjects enrolled in the Improving CPP Management Study from 2003 – 2007. Eligible patients were children < 18 years of age with a primary diagnosis of TBI admitted to the PICU who had complete 3 month outcome data ($n = 54$). The study was approved by the University's Institutional Review Board under the goals of the parent study for which informed consent was obtained. For each subject, temperature data was evaluated by interval (daily mean for a week post-admission), age, initial injury severity (GCS, injury severity score) and outcome at 3 months post injury (GCS, GOS). Fever was defined as temperature $> 38.3^\circ\text{C}$. Demographics and regression analyses were performed. Previous studies in pediatric patients have reported a lower GCS at ICU discharge in patients with febrile episodes than those without fever. Further research needs to be conducted to learn more about this population. Meanwhile, specific guideline to manage fever in TBI patients should be developed to result in better neurological outcomes in both adult and pediatric populations.

Vertical Distributional Behavior of *Mytilus* spp

Elishia Stefanowski, Senior, Environmental Science, UW Tacoma

Mentor: Bonnie J. Becker, Environmental Science, UW Tacoma

Examining bivalve larval retention and connectivity first requires knowledge of larval behavior and vertical distribution. Considering that mussel larvae are planktonic, knowing how they behave in connection to tides and currents may lead to greater predictability of adult distribution. Within the planktonic habitat, it is important to understand

larval connectivity in order to determine the likelihood of species conservation or protection, and the distribution of invasive species. Considering that evidence demonstrates bivalve larvae do not act as passive particles, where are the larvae found in the water column? This laboratory study analyzes the vertical distributional behavior of *Mytilus* larvae at varying life stages, temperature and light regimes. The literature has illustrated that early *Mytilus* larval stages swimming vertically with intermittent sinking until leaving the planktonic environment and settling to the bottom of the water column. This behavior combined with tides and currents likely contributes to the retention of bivalve communities. Understanding larval behavior contributes to the study of bivalve population connectivity.

Blight Horizon

Amir Stone, Senior, Computer Science and Digital Arts & Experimental Media

Mary Gates Scholar

Mentor: Shawn Brixey, Digital Arts & Experimental Media

Imagine a space filled with light and fog. Beams of light pass by in 3D space, scattered in a tapestry of color. As you move about the space the beams of light avoid you. You do not know why. You can see forms hanging in space, moving slowly with composed purpose and reacting to your movements. My project, Blight Horizon is on the cutting edge of both science and fine art. It utilizes computer vision and real time image manipulation with physics principles of light, and video composition. Infra red (IR) light is electromagnetic radiation that has wavelengths that lie outside the spectrum of visible light, thus making it invisible to the eye. This can be combined with an IR equipped camera to detect the silhouette of the viewer standing in front of the projector, and cause the light to avoid the user without interference from the visual projection. Video using vector graphics is projected through space. Since vectors are infinitely scalable, a shift in scale of universal magnitudes is possible from the size of galaxies to blades of grass. Using professional video editing software such as Final Cut Pro and Adobe After Effects, video content will reveal to participants a view of nature that they have not seen before, allowing them to experience the awe of a nebulae, the beauty of a flock of birds, and the memory of a cityscape through time and space. Blight Horizon is an art installation that relies upon scientific principles to create an entirely immersive environment.

Anger Expression, Violent Behavior, and Symptoms of Depression among Male College Students

Dale Terasaki, Senior, Bioengineering

Mentor: Bizu Gelaye, Epidemiology

The objective of this project was to assess the associations

of anger expression and violent behavior with symptoms of depression among college students. A cross-sectional study among 1,294 male college students in Awassa, Ethiopia was conducted in June, 2006. A self-administered questionnaire was used to collect information on socio-demographic and lifestyle characteristics, and violent behavior. The questionnaire incorporated the Spielberger Anger-Out Expression scale and depression and depressive symptoms were evaluated using a nine-item depression module of the Patient Health Questionnaire (PHQ-9). Multivariable logistic regression procedures were used to calculate adjusted odds ratios (OR) and 95% confidence intervals (95% CI) for depression, depressive symptoms and violent behavior in relation to outward anger expression. Symptoms of depression were evident in 23.6% of participants. Some 54.3% of students reported committing at least one act of violence in the current academic year; and 29.3% of students reported high (Spielberger Anger-Out score ≥ 15) levels of anger expression. In multivariate analysis, moderate (adjusted OR=1.97; 95% CI 1.33-2.93) and high (adjusted OR=3.23; 95% CI 2.14-4.88) outward anger were statistically significantly associated with increased risks of depressive symptoms. Violent behavior was noted to be associated with depressive symptoms (unadjusted OR=1.82; 95% CI 1.37-2.40). However, the association was greatly attenuated after adjustment for confounding (adjusted OR=1.12; 95% CI 0.82-1.45). Results from our cross sectional study of Ethiopian male students confirms a link between outward anger expression and symptoms of depression. Further research should be conducted to better characterize community and individual level determinants of anger, violent behavior and depression among youths.

T2K Sensors and Water Bag Testing

Rob Thompson, Sophomore, Physics

Mentor: Jeff Wilkes, Physics

Neutrinos have only recently been proven to have mass, and there are still many unanswered questions about their oscillation behavior. The T2K experiment is a US-Japan-Canada-Korea-EU collaboration, involving 200 physicists. It will generate an intense neutrino beam at the new 50GeV high-intensity proton accelerator in Tokai, on Japan's east coast, and send it through the earth to Kamioka in western Japan, where the 50ton water Cherenkov detector Super-Kamiokande (SuperK) is located, approximately 300km away. The accelerator will produce artificial neutrinos which will be detected and analyzed at the accelerator site before heading off to SuperK. Then any changes in the beam properties, particularly flavor (neutrino type) makeup, can be assessed by comparing the "near" and "far" detector results. My research involves testing the water bags that will be used as a neutrino target in the near detector at Tokai. It is important to have maximum water volume and minimum container mass, so testing the bag design is a critical task. The project also involves creating and testing the temperature, pressure, and level sensors

that will sit in the water, with a focus on reducing size and cost while maintaining reliability, as the water mass in the bags must be known to a high degree of accuracy at all times. When the project comes together in three years it will provide valuable data on neutrino oscillation, which can then be applied to neutrino-based astronomy.

King County Metro Bus Schedule Improvement

Daniel Toader, Senior, Informatics

Bettu Gemedra, Senior, Informatics

Mentor: David Hendry, Information School

Bus schedules are among the first artifacts that public transportation users must engage to use the system. We think improvement of the current King County Metro schedules at bus stops, which are deficient in providing some key information, will help experienced riders as well as assisting new riders to make the transition to using public transportation. To achieve this objective, we employed several methods from user centered design to develop a more informative schedule. A preliminary usability evaluation at the University of Washington's HUB bus station helped us narrow our focus toward a stem-and-leaf plot design and clarified the way we should present route information in the schedules. After iterating through the design process, we created two schedules: 1) a stem-and-leaf design which has the advantage of displaying readily visible frequency of bus arrivals and encourages the users' eye move from hour to hour by scanning only vertically; and 2) a tabular design which emulates Metro's current schedule minus the branding. To evaluate the effectiveness of the two schedules, we conducted a usability evaluation hypothesizing that people could use the stem-and-leaf design more quickly and with fewer errors. Thirty participants were intercepted at a bus stop in downtown Seattle over the course of two days which involved asking participants to complete a number of tasks using both schedules. Their performance in speed and accuracy was recorded and they were asked which design they preferred. The results will be analyzed and a final report will be delivered to Metro's Signage Division.

Acute Tissue Damage due to Grasping in Minimally Invasive Surgery

Emi Tokuda, Junior, Bioengineering

Roy Chan, Junior, Electrical Engineering and Mechanical Engineering

Mentor: Blake Hannaford, Electrical Engineering

Mentor: Smita De, Bioengineering

Minimally invasive surgical (MIS) techniques are becoming standard practice in many specialties with patient benefits including faster recovery time, less scarring, and shorter hospital stays compared to open surgery. Procedures, which can be traditional or robotic, involve small incisions through which an endoscopic camera and long surgical instruments are inserted to handle tissues.

Current MIS instruments lack accurate tactile feedback, potentially allowing for inadvertent damage during tissue manipulation. Our goal was to quantify damage on a cellular level resulting from grasping of tissues, and potentially identify 'safe' thresholds for applied stress duration and magnitude to minimize damage. A motorized endoscopic grasper was used to grasp porcine liver and small bowel in vivo for a range of stress parameters typical to MIS. After a short recovery, the grasped tissues were harvested, fixed, stained, and analyzed for cell death and immune responses. A hematoxylin and eosin stain was used to identify necrosis in the liver based on morphological changes. Antibody based stains were used to identify neutrophil infiltration, fibrin deposition, and apoptosis. Digital images of the stained sections were analyzed to find either the percent of area stained for cell death and fibrin deposition or the number of neutrophils. Results indicate a strong positive correlation between damage and applied stress magnitude in both the liver and the small bowel for all measures of damage. Inflammation and vascular damage, marked by the presence of fibrin, increased noticeably between 80-130 kPa in the liver, suggesting a potential threshold for manipulation. In the small bowel, apoptosis increased with higher stress magnitudes, with a potential threshold at 160-180 kPa. No significant differences in damage were found with respect to stress duration. This study provides insight into how tissues react to surgical grasping, which could help guide design of better surgical instruments to minimize inadvertent damage.

Creating Electrical Engineering Educational Tools

Jessica Tran, Senior, Electrical Engineering

Intel Research Experience for Undergraduate Program

Mentor: Eve Riskin, Electrical Engineering

I am developing and creating an online educational tool for the electrical engineering Discrete-Time Linear Systems class (EE 341). Currently, there exists an interactive webpage for the preceding electrical engineering class, EE 235, Continuous Time Linear Systems. Positive comments have been expressed in course evaluations displaying the usefulness of the EE 235 web site, which highlighted the need for an interactive website for the EE 341 class. The intent of this tool is to educate and engage engineering students at the University of Washington and nationally through the use of interactive examples. Research in effective teaching methods has shown that active learning is an excellent way to teach students new concepts (Borich). The types of examples used in the EE 341 educational tool have drag and drop questions, fill in the blank, as well as animated pictures and examples to present alternative explanations. These types of examples engage the user in active learning as well as provide a progressive approach to the different concepts presented in the course. In addition, the user will be able to check their understanding in a systematic step-by-step manner.

The tools used to develop this educational tool include: Adobe FLASH CS3 Professional, Adobe Dreamweaver, and LaTex2HTML software. This educational tool can be viewed at <http://www.ee.washington.edu/class/341/riskin/> and is currently being used in the Spring 2008 EE 341 course.

The relationship between *Alexandrium catenella* cyst abundance and surface sediment characteristics at Quartermaster Harbor and Dyes Inlet in Puget Sound, Washington, USA

Katherine Tran, Senior, Environmental Science, UW Tacoma

Mentor: K. Siân Davies-Vollum, Interdisciplinary Arts & Sciences, UW Tacoma

Alexandrium catenella is a marine dinoflagellate (algae) that is one of the main sources of toxins that lead to paralytic shellfish poisoning in Puget Sound. Dinoflagellates spend part of their life cycle as cysts (dormant phase of dinoflagellate) in sediments. Previous studies have indicated that Quartermaster Harbor has extremely high numbers of cysts, while the similarly sheltered harbor in Dyes Inlet has low numbers. In this research, seven surface sediment samples from Quartermaster Harbor and thirteen from Dyes Inlet were analyzed for grain size distribution and total organic carbon (TOC) content to determine whether these parameters may associate with cyst densities. Results revealed strong relationships between silt size and TOC content, but minimal correlations between cyst abundance, TOC content, and sediment grain size, which agreed with previous works. There may be other factors such as temperature, oxygen, light, and nutrients contributing to algae germination.

Design and Testing of a Thermal Gradient Device for Rapid PCR Melt Curve Measurement and Pathogen Identification

Kristen Trett, Senior, Bioengineering

Mentor: Paul Yager, Bioengineering

Mentor: Sujatha Ramachandran, Bioengineering

Every distinct DNA sequence has a characteristic melting temperature (T_m) at which 50% is denatured. One method to determine T_m is to amplify DNA using a pathogen-specific primer labeled with a fluorescein at one end and a quencher at the other. When heated sufficiently the DNA denatures, the single strands coil randomly, the fluorescein comes within range of the quencher, and the fluorescence is absorbed before it can be detected. The amount of denaturation at different temperatures can therefore be quantified by a fluorescence detection method. This analysis can be used to create a melt curve (derivative of fluorescence vs. temperature) for the sequence. The peak of the melt curve corresponds to T_m , the identifying mark of the sequence and thus the pathogen. In this way, DNA melting analysis has long been used as a means

of pathogen identification. The traditional method of DNA melting analysis, however, is very slow because it involves heating and cooling the PCR amplicon gradually to determine its melt curve. To expedite the process, a thermal gradient device that can be used to obtain a spatial, rather than temporal, resolution of DNA melting has been designed. The device consists of a brass plate with water at different temperatures running through either end. Heat flow through the conductive plate from the hot water at one end to the cooler water at the other produces a linear temperature gradient. When a microfluidic card containing the fluorescently-labeled amplicon is placed on the plate, a corresponding fluorescence gradient quickly develops as the DNA melts across the thermal gradient. As a result, the entire range of DNA melting can be captured under a stereomicroscope and analyzed with a single image. This technique allows for rapid measurement of PCR melt curves and thus almost immediate detection and identification of pathogens.

Augmentative Communication in Washington State Public Schools: A Study of Users and Intervention Practices

Kelly Trevithick, Senior, Speech & Hearing Sciences and Linguistics

Mentor: Patricia Dowden, Speech & Hearing Sciences

The purpose of this study was to analyze the characteristics of augmentative and alternative communication (AAC) users in Washington State (WA) public schools. AAC users are individuals who are unable to use speech as their primary means of communication, whether due to cerebral palsy, autism, significant language delays, or other etiologies. As a result of these communication limitations, AAC users require specialized services and substantial intervention time to increase communication abilities both in and out of the classroom. Previous research has examined this population in Washington State, as well as nationally and internationally. However, over the past twenty years, the field of AAC has changed dramatically as a result of changing disability classifications, the increase in the prevalence of certain etiologies, and significant advances in intervention procedures and technology. To re-examine this population in light of these changes, a multi-part survey was sent out to all speech-language pathologists (SLPs) in WA public schools in May 2001. The present investigation addressed only the results from the final section in which the SLPs described the AAC users on their caseloads. The data obtained from survey respondents was analyzed using Statistical Package for the Social Sciences (SPSS). Results were analyzed in terms of demographic characteristics, nature of services provided, existing communication abilities, and AAC strategies used. The findings from this investigation will provide SLPs with data on AAC users and intervention practices across the state. Researchers will be interested in the comparison of our investigation to past demographic

studies of AAC users, as well as any significant patterns in current intervention services. Our investigation will add to the existing knowledge about AAC users and service delivery in WA public schools, providing a platform for future research.

Pulse formation in actively mode-locked laser cavities

Jonathan Tu, Senior, Aeronautics & Astronautics and Mathematics

Mary Gates Scholar

Mentor: J. Nathan Kutz, Applied Mathematics

Active mode-locking is a proven method for generating pulsed streams of data with a fixed repetition rate. This can be achieved through the use of acousto-optic modulators, which control and enforce the inter-pulse spacing by creating an effective loss modulation in the laser cavity. The drawback to this approach is the limitation on the modulation frequency of the acousto-optic modulators themselves (e.g. tens of gigahertz). However, even the ability to generate precisely spaced pulses ranging from tens of picoseconds to hundreds of femtoseconds offers significant gains for applications ranging from telecommunications to medical surgery. In this project we consider the formation dynamics and temporal shortening of the pulses as a function of the cavity gain. Both pulse shortening and broadening can be achieved in the laser cavity by varying the laser cavity energy. In either case, soliton formation and harmonic mode-locking dominate the underlying pulse dynamics. A complete characterization of the stability and dynamics of the pulse formation is given and a mechanism is conjectured which is responsible for generating the underlying soliton pulses. Simulations confirm that for low cavity energy, the solitonic pulse which forms is actually broader in the time domain than the modulation window generated by the active mode-locking mechanism. As the gain is increased, the pulse compresses temporally and is eventually narrower than the modulation window. Finally, a further increase of the gain leads to harmonic mode-locking until all modulation windows of lowest attenuation have a time-narrowed temporal pulse, as predicted in theory by Kärtner et al.

Focused ultrasound: a sensitive and specific test for localizing peripheral neuropathic pain

Rowen Tych, Senior, Biology

Mentor: Pierre Mourad, Neurological Surgery

Attempts to find the anatomic source and location of pain caused by deep anatomical structures are often difficult and unrewarding. Current techniques lack specificity and precision, especially in these deep tissues, where those techniques can also cause further discomfort. Imaging with MRI or ultrasound is vague and inconclusive in most cases, and invasive alternatives introduce many new risks, including infection and complications. A new non invasive device is needed that is sensitive and specific enough to

probe deep structures. When a pain generating structure is pushed, a patient will feel pain, just as pushing on a bruise on the skin can elicit pain. Focused ultrasound (FU) seems to be a way to virtually extend a physicians palpations into deep tissue. In previous studies where FU was applied to normal and inflamed rat paws, rats would respond to a dose on their inflamed side but did not show response on their normal paw with that same dose of ultrasound. In this study, we demonstrate that transcutaneously applied focused ultrasound can distinguish a rat paw that has been damaged by purely neuropathic damage, which is a common cause of lower back pain. We performed partial sciatic nerve ligation (pSNL) on Sprague Dawley rats on one of the two hind paws. We tested with FU which can focally shear and heat tissue, and with the Hargreaves heat test, which determines thermal threshold responses. We found that there was a significant difference in sensitivity to FU between the ligated and control paws, consistent with the results of the Hargreaves test. These results demonstrate that FU can reliably distinguish neuropathic from control paws following sciatic nerve injury, further demonstrating that this technology has the potential to become an important diagnostic tool for evaluating deep pain.

Elbow Prosthesis Design for Manufacture in Sierra Leone

Jesse Unger, Senior, Mechanical Engineering

Mary Gates Scholar

Mentor: Randal P. Ching, Mechanical Engineering

As a result of over a decade of civil war in Sierra Leone, thousands of people remain disabled and, consequently, non-productive members of society. Unable to pay the immense expenses associated with contemporary western prostheses, people learn to exist without the use of their limbs. To resolve this situation, I researched, designed, and fabricated a low-cost, interchangeable, elbow-joint to facilitate the construction of upper arm prosthesis for the people of Sierra Leone. The ideal prosthesis was to be economical, durable, and visually appealing; while maintaining a high load limit. Various prosthetic elbows were considered, including body-powered, electric, and hybrid models. However, as a result of the technological limitations of the manufacturing environment, a simple body powered device was chosen. Furthermore, both contemporary and well-established elbow models were analyzed for their mobility and locking functions to determine which would be best suited for the project constraints. This resulted in the development of a modular redesign of the Fitch elbow, which was created in 1951 by the United States Navy. The simplistic pulley design of the prosthetic provided the ideal elbow model to be implemented in the manufacture of upper-arm prosthesis in Sierra Leone.

What are Native Tribes of the Northwest Doing to Revive their Languages?

Audra Vincent, Senior, American Indian Studies and Linguistics

Mary Gates Scholar

Mentor: Dian Million, American Indian Studies

This project consists of interviews of people involved in language revitalization from their own tribes. The interview is used to gain basic information about how the language is doing and what types of programs the tribe offers to produce new speakers and language learners. There is little if any information available on the state of Native languages in the northwest. What is written is not current and there is no guarantee of its accuracy. Most information available categorizes many of the Native languages of the northwest as extinct or nearly extinct with no further information. I don't believe in the possibilities of a language becoming extinct or dead. A language can be in a changing state. The languages in the northwest are not extinct. They have speakers who are working to teach the younger generations. The information I will present will be on the number of speakers and the types of programs these tribes are doing to revive their languages. These languages and the information that I will find with this research is important for the Native languages in this country and the indigenous languages across the world. Many indigenous languages across the world are categorized as extinct. Information on other people who are working on revitalizing their languages is important to show that it is possible for "dead" languages to come back to life.

The Habituation of *Mimosa pudica*

Michelle Waldron, Senior, Biology

Danielle Waldron, Senior, Botany

Mentor: Elizabeth Van Volkenburgh, Biology

Mimosa pudica, a plant that is sensitive to touch, is able to perceive stimuli and transmit a signal to the rest of the plant, which then activates motor cells that cause the leaf to move. In our experiment we are testing the habituation of *Mimosa pudica*. To do this we are exposing plants that we have grown in the greenhouse to varying durations of constant stimulus, and then record the length of time it takes for them to re-open their leaflets. Once it has re-opened its leaflets, we expose the same leaf again to the same amount of stimulus, and allow the leaf time to re-open again. We conduct this 3 times in total and compare the times it took the leaflets to re-open for each trial. We will test 5 minutes, 10 minutes, 20 minutes, and 40 minutes to see if by increasing the length of the constant stimulus the plants learn or become conditioned. By analyzing the time it takes for the plant to open again, we can measure if the plant has changed its behavior toward the stimulus. If the mimosa plants become less responsive to the touch stimulus, they have become habituated. In the case of

mimosa and touch, it would mean that when exposed to the stimulus repeatedly the amount of time for the leaflets to re-open would decrease. If there is a consistent pattern of changed behavior in the plants responses we can conclude the plants have been habituated and we can begin to investigate learning in plants.

Dissecting chromosomal interaction networks in human embryonic stem cells

Hongjiang Wan, Junior, Biology

Mentor: Zhijun Duan, Hematology

Mentor: C. Anthony Blau, Hematology

The architectural and spatial organization of genetic material in nucleus provides multi-level platforms for gene expression regulation in a eukaryotic cell and therefore plays important roles in development. Accumulating evidence has shown that epigenetic genome modifications are important for specifying the lineage and developmental stage of cells as well as pluripotency of embryonic stem cell (ESC). More recently, emerging evidence indicates that the spatial networks of chromosomes which feature both distant intra- and inter-chromosomal interactions might also serve as a layer of regulator of development. Human embryonic stem cell (hESC), which possesses both self-renewal and pluripotency capacities, provides a cellular model for studying human development and diseases in vitro. Although the mechanisms governing hESC self-renew and pluripotency remain largely elusive, Nanog, Sox2 and Oct4 have been identified as the core transcription factors that regulate a molecular circuitry of self-renew and pluripotency. Here we hypothesize that a unique cis-regulating network (i.e. chromosomal interaction network) exists in hESCs and the gene loci of Nanog, Sox2 and Oct4 are involved in this network. To test this argument, we adopted a recently established technique, Chromosome Conformation Capture (3C), and our preliminary data has shown that the promoters of Nanog, Sox2 and Oct4 genes are all involved in multiple long-distance intra and inter-chromosomal interactions in hESCs. Our goal is to dissect the whole cis-regulating network in hESCs.

Anthropology video project in Yishala, Sichuan, Southwest of China

Shuo Wang, Junior, Anthropology

Jianxiong Wang, Junior, Anthropology

Shishi Yao, Junior, Anthropology

Wenting He, Junior, Anthropology

Ben Gersten, Junior, Anthropology

Mentor: Stevan Harrell, Anthropology

We are currently working on a video project led by Professor Stevan Harrell, which focus on marriage, tourism, and living ideology of Yi people in Yishala - a small town located at the southern border of Sichuan province in Southwest of China. This project is based on anthropological field work done by Prof. Harrell and

his students, including several from Sichuan University-University of Washington exchange program. We are going to show and briefly analyze the social ideology change and the inter-generation belief contradictions on sexuality, love, family, and social responsibilities. People in this documentary play different social roles, and some of them are in a certain stage of their lives, such as farmers, workers, farmer-workers, housewives, government officials, newlyweds. Our display will consist of a 5-7 minute loop from the projected 35- to 40-minute film, plus a poster explaining the work.

Investigating Heavy Metal Contamination of the Puget Sound Environment with New Isotopic Tracers

Rachel Weber, Senior, Earth and Space Sciences

Mary Gates Scholar

Mentor: Bruce Nelson, Earth and Space Sciences

The Tacoma Smelter operated for approximately 100 years at the southern end of Puget Sound and is a known source of heavy metal contamination to the local environment. Previous studies confirm significant local contamination based on a dramatic increase of metal concentrations in sediments deposited in the Sound following commissioning of the smelter. These metals, such as lead, copper, and zinc, are toxic to the environment and pose a potential regional health hazard. The extent of regional contamination, mechanisms of dispersal, and chemical form of metal contamination in the environment are not well known. The goal of our study is to analyze lead, copper, and zinc isotope ratios in contaminated sediments in order to calibrate isotopic tracers of heavy metals emitted by the smelter. Isotope ratios are more robust than metal concentrations for tracing contaminants because, once in the environment, isotope ratios are not altered by chemical reaction and transport. Preliminary data from lead isotope analyses of a sediment core from Quartermaster Harbor identify a clear isotopic fingerprint diagnostic of smelter-derived lead, which we can use for tracing Tacoma Smelter lead throughout the Puget Sound. We will do a more thorough analysis of lead isotope ratios in the sediment core from Quartermaster Harbor, as well as, for the first time, test the use of copper and zinc isotope ratios as a fingerprint of smelter derivation for these metals. These isotopic tracers can then be used to determine the extent, pattern, and mechanism of heavy metal contamination in the Puget Sound region.

Identification of Agrobacterium vitis F2/5 Genes Required for the Elicitation of a Hypersensitive Response in Tobacco

Kimberly Wellner, Senior, Biology

Mentor: Derek Week, Biology

Agrobacterium vitis F2/5 is the causative agent of crown gall disease in grape vines and stone fruits such as cherries and peaches, affecting crops and produce. Agrobacterium

vitis F2/5 is a pathogenic bacteria, which induces a Hypersensitive Response (HR) when injected into tobacco plants. A Hypersensitive Response is an active response of the plant to a pathogen in an attempt to prevent the pathogen from spreading. HR is characterized by a local tissue collapse, followed by cell death around the infection site. *A. vitis* F2/5 has a tumor-inducing (Ti) plasmid, which transfers a segment of the T-DNA from the Ti plasmid into the plant's genes to cause the production of opines (an energy and carbon source) in crown gall tumors. Opines can be metabolized by the bacteria *A. vitis* F2/5, but not by the plant cells. Julianne Druinger made an *Agrobacterium vitis* F2/5 rifampicin (Rif) resistant kanamycin (Km) resistant mutant library by crossing *A. vitis* F2/5 Rif and *E. coli* BW20767/pRL27. The *E. coli* pRL27 has a kanamycin resistant disk. Druinger selected for *A. vitis* F2/5 Rif with pRL27, which is Km Resistant, and she selected against *E. coli* with Rif antibiotic. Research was conducted to get a consistent HR assay using the controls F2/5 and C58. The mutant library has been screened to check for contaminants. The *Agrobacterium vitis* F2/5 mutant library of 2500 mutants is currently being injected into tobacco plants to test for no hypersensitive response, as the wildtype *vitis* F2/5 causes the elicitation of HR in tobacco plants. Through the known *Agrobacterium vitis* F2/5 genome sequenced by Wood, et. al., the genome of a non-HR inducing mutant can be compared to the known wildtype genome, and it may help to enlighten the role of *A. vitis* F2/5 in pathogenesis. Research on the elicitation of pathogenesis by *Agrobacterium vitis* F2/5 contributes practical applications for antibacterial treatments and the prevention of crown gall disease, prevalent in agriculture today.

Performance of coupling beams in elevator core walls

John Werner, Senior, Civil & Environmental Engineering

Mary Gates Scholar

Mentor: John Stanton, Civil & Environmental Engineering

This project deals with reinforced concrete coupling beams in buildings. Coupling beams link the two thick C-shaped walls that make up the elevator core. The primary purpose of the core is to protect the elevators and stairways in the event of fire, but because these coupled shear walls are almost always the stiffest, strongest part of the structure, they are also used for resisting earthquake forces. However, present designs do not work. These beams must be heavily reinforced to resist the huge forces to which they are subjected, and some designs have coupling beams with so much reinforcement that they are virtually unbuildable. With no efficient way to construct them, they are both time and labor intensive to build. Other designs currently used are more constructible, but with the trade-off that they have insufficient strength and ductility. This shortcoming presents serious challenges to the structural engineering community because often the

walls offer the only substantial piece of structure that can be used for seismic resistance. This project is an attempt to develop coupling beam designs that are both strong and constructible. It will contain both a design and analysis component and a laboratory testing component, by which the new designs will be verified for use in practice.

Landslide-Generated Tsunamis in Puget Sound: A Possible Smoking Gun in Saratoga Passage

William Whiteaker, Senior, Oceanography

Mentor: Mark L. Holmes, Oceanography

Landslides, both subaerial and submarine, commonly occur in the Puget Lowland and in Puget Sound. Large coastal landslides can produce tsunamis, thus creating potential hazards in areas that are not in close geographical proximity to the actual landslide. The western coast of Camano Island in northern Puget Sound is characterized by ‘scalloped’ indentations, the largest of which (1500 m x 275 m) is north of Onamac Point; such features are often the result of slope failure. To determine if the Onamac Point morphology was the result of a landslide, a marine geophysical survey and bottom sampling operations were undertaken aboard R/V Clifford A. Barnes. Seismic reflection data imaged a large slide mass, consisting of a series of concentric arcuate blocks of deformed glacial sediments, on the bottom of Saratoga Passage in 85 m of water. The volume of material involved in the slide was estimated in two ways. An isopach (thickness) map was prepared using the seismic reflection data, yielding a volume estimate of 17.5 x 106 m³. Next, the island topography and nearshore bathymetry of the Onamac Point area were used to create a pre-slide or paleosurface. Differencing this surface and the present topography gave a volume of approximately 17.3 x 106 m³. The offshore slide mass is covered by 4-5 m of modern sediments. The average accumulation rate in Puget Sound is about 0.5 cm y⁻¹, suggesting that the Onamac Point landslide occurred about 1000 years ago. This corresponds to the date of a major earthquake in Puget Sound; this M7.5 quake may have triggered the slide. The characteristics of the Onamac Point landslide (volume, slopes, material type) are similar to those of massive tsunamigenic landslides that occurred Alaska in 1958 and in British Columbia in 1975, making the Onamac Point landslide an excellent candidate for tsunami modeling.

Maintaining Intelligibility of ASL Video in the Presence of Data Loss

*Sam Whittle, Senior, Computer Science and Mathematics
Mary Gates Scholar*

Mentor: Richard Ladner, Computer Science and Engineering

Mentor: Eve Riskin, Electrical Engineering

The goal of the MobileASL (American Sign Language) research project is to enable sign language communication

over the US cellular network. State of the art video compression is achieved by using reference frames to predict future frames, taking advantage of the image correlation of neighboring frames. Unfortunately the cellular network in America is low bandwidth and lossy. Loss of data can greatly impact the quality of compressed video because errors are propagated through predictions. I investigate techniques to minimize the effect of error loss on the intelligibility of transmitted ASL video. As both computation power and bandwidth are limited on cellular devices, I concentrate on determining good allocations of these resources. Specifically I focus on determining the best placement of image blocks coded independently to ensure the video is robust to error loss.

The Role of Certs Denied on the Supreme Court’s Agenda

Michelle Whyman, Senior, Political Science

Mary Gates Scholar

Mentor: Bryan Jones, Political Science

In contemporary American politics, the agenda of the Supreme Court is as critical to the policy process as the agendas of other institutional venues such as Congress and the Presidency. The Court’s agenda contains not only those issues it chooses to address, but also those it chooses to ignore. Most of the cases appealed to the Supreme Court are denied a writ of certiorari and therefore not heard or decided by the Court. By comparing the policy content of cert granted and cert denied cases over time, I hope to determine if there is disproportionate attention focused on specific policy areas. I anticipate that I will find if factors such as the ideological make up of the Court affects the types of issues that the court considers at any one time. In order to study the distribution of the Court’s attention across policy areas, I am overseeing the creation of a Supreme Court Certs Denied dataset which samples cases denied a writ of certiorari from 1947 to 2006 and codes them according to the policy content of the case. I will compare these data with those of the Policy Agenda’s Project Supreme Court Certs Granted dataset to determine areas of disproportionate attention. I hope that this research will contribute to scholars and students’ understanding of how the Court prioritizes issues and sets its agenda through both its action and inaction.

Terrace Formation in Jiuzhaigou National Park

Sarah Widder, Senior, Chemical Engineering

Mary Gates Scholar

Mentor: Thomas Hinckley, Ecosystem Sciences

Jiuzhaigou National Park in Sichuan, China contains many diverse ecosystems and geological phenomena. The geomorphic feature of particular interest here is the formation of irregular terraces on many loess hillslopes near villages throughout the region. The terraces range in size from 1 to 30 m tall, 2 to 100 m wide, and up to

500 m long at right angles to the fall line. The terraces approximately parallel contours on the hillslopes with vertical, unvegetated faces and grass and small bushes and shrubs covering the surfaces. While nearly all observed terraces occur at elevations above 2200 m, there seems to be no relationship between aspect or slope angle and terrace location. However, there is a strong correlation between terrace formation and current or past village sites. The soil at terrace sites is almost pure silt that sits above and below a distinct paleosol. The terraces observed in Jiuzhaigou National Park are unique in the mountainous environment in which they occur, their scale, and vegetation scheme. The terraces in Jiuzhaigou National Park exhibit a direct relationship with long-term human habitation, suggesting an anthropogenic influence on their formation. To explore the origin of these distinct geological features, an interdisciplinary research team of geologists, archeologists, anthropologists and ecologists conducted preliminary research to discern the nature of these terraces and circumstances surrounding their formation. My role in the research consisted of aiding in surveying and soil sampling. By exploring the anthropogenic role in terrace formation, this research sought to clarify the historical interaction of humans with the environment within the park. This knowledge will have important impacts on management and policy decisions within the park, whether the terraces constitute a natural feature that stands to be preserved or a new and possibly detrimental change in the park landscape that should be mitigated and restored.

The impact of micro-holes on Mylar sampling balloons for the collection of exhaled breath and analysis of nitric oxide

*Stephanie Wong, Senior, Environmental Health
Mary Gates Scholar*

Mentor: Lee Jane Sally Liu, Environmental and Occupational Health Sciences, School of Public Health & Community Medicine

The measurement of nitric oxide in the exhaled breath (eNO) is a non-invasive method to assess airway inflammation among individuals with asthma. One commonly used method is the off-line collection of breath samples in a non-reactive Mylar balloon. This involves collection of breath and ambient air samples in the field and analysis of nitric oxide in the laboratory with a Nitric Oxide Analyzer (NOA). Mylar balloons allow for low-cost, convenient, and efficient portable sampling of breath samples. However, there were unresolved issues associated with repeated use of the balloons. Invisible micro-holes on the surface of the balloons form due to wear and tear and could possibly result in contamination of the samples. In addition, the time lag between the off-line sample collection and on-line sample analysis might result in degradation of the breath samples and biases in nitric oxide measurements. We conducted a series of experiments to determine the impacts of micro-holes and time lags on the breath and ambient air samples.

Mylar balloons that contained micro-holes were compared to those free of any micro-holes and analyzed at varying time lags after sample collection. Both human breath samples and standard air samples were compared. Time charts were plotted and two-sample t-tests were performed to compare various conditions. We found that the presence of micro-holes on the Mylar balloon surface did not change NO concentrations. The NO concentration within a sample was relatively stable within 8 hours of the collection but increased afterwards. These results allow for scientific justifications for permissible data that were collected in Mylar balloons with micro-holes and analyzed within 8 hours of collection. As the off-line eNO collection method is increasingly used in both epidemiological studies and clinical settings for asthma assessment and evaluation, these results provide practical insights for future study design and applications.

The Significance of a Highly Conserved Region to the Function of the Spinocerebellar Ataxia Type 7 Gene Product

*Wing Wong, Senior, Biology and Communication
Mentor: Albert R. La Spada, Laboratory Medicine*

Spinocerebellar ataxia type 7 (SCA7) is caused by the expansion of a CAG repeat tract in the 5' coding region of the SCA7 gene. This results in an abnormally long series of glutamine residues due to the translation of this tract within the Ataxin-7 protein. SCA7, like Huntington's disease, is one of nine diseases linked to a polyglutamine expansion. SCA7 is an autosomal dominant disease characterized by degeneration of the cerebellum, brainstem and retina. Currently, little is known about the function of Ataxin-7. However, interspecies sequence alignment has shown that the protein contains a highly conserved region, which may be relevant to the basic function of the protein as well as SCA7 pathogenesis. Within this region are several domains that have been identified but not thoroughly characterized. The domains are the nuclear export signal (NES), zinc binding domain (ZBD) and arrestin-like domain (ARR). My project is to identify the relevance of these domains to Ataxin-7 function and SCA7 toxicity. I will create several versions of Ataxin-7 with mutations in the NES, ZBD, and ARR domains in order to alter their function. The mutated versions of Ataxin-7 will be transfected into HeLa cells to observe any obvious disturbances in protein localization or cell viability. Furthermore, the mutant proteins will be immunoprecipitated to identify any alterations in binding partners. Our goal through the successful completion of this work will be to better understand the function of Ataxin-7 in health and disease.

Mete Meme: Identifying Social Roles within Online Message Board Communities

Lane LaRue, Senior, Informatics

Jason Wyttenbach, Senior, Informatics

Mentor: Batya Friedman, Information School

Mentor: David Hendry, Information School

The emergence of online social groups provides a unique area of exploration in new marketing mediums such as blogs, message boards, social networking services and community management programs. Within these domains of communication, participants tend to assume one or more roles, such as “leader”, “helper”, or “spammer”. Our study aims to understand such roles and their relationship with users in a message board community. To achieve this, we first identified a set of roles and a definition for each role based on interviews with professional message board moderators, and a review of existing research. Next, we will map a unique set of statistical metrics to each role. Each metric is comprised of multiple queries of a message board’s database, and a corresponding threshold to determine a user’s role. For example, one indicator of the role “spammer” could be a threshold of five or more duplicate messages posted over a period of time. In this case, the query would be the total number of user’s duplicate message posts. Then, we will run all of our metrics against a popular gaming message board, yielding a list of users and posts used to determine an assigned role. Finally, we will validate the accuracy of the metrics by manually comparing a sample of our identified user’s message board posts with our predetermined role definitions. Future work could incorporate additional roles, datasets, more complex metrics and the use of textual analysis. We expect our findings will show how existing raw message board data can be harnessed in potentially powerful new ways. This is a vital first step in exploring, mapping, and profiling social functions of community information flows online.

Seasonal and Interannual Variability of Denmark Strait Eddies

Krysta Yousoufian, Sophomore, Computer Science

NASA Space Grant Scholar

Mentor: James Girton, Applied Physics Laboratory

The Denmark Strait Overflow (DSO) is a dense current flowing southwest through the Denmark Strait. Although the DSO is located deep in the ocean, it causes surface eddies, or circular currents, above its path. Theory and numerical experiments suggest that the particular characteristics of the eddies should depend on the characteristics of the DSO water. Therefore, tracking changes in the eddies could potentially be a way to track changes in the DSO, which is a crucial current to the global ocean network and is difficult to study directly. Our research aims to identify seasonal and interannual variability in the eddies by studying satellite data. Because the eddies mix colder and warmer surface water, they appear on satellite images of sea-surface

temperature, including those taken by the Advanced Very High Resolution Radiometer (AVHRR). We first download AVHRR images from NOAA’s Comprehensive Large Array-data Stewardship System. After modifying the image files with the NOAA CoastWatch satellite utilities, we display them using the MATLAB data processing language. For images not obscured by clouds or sea ice, we use MATLAB to mark the locations and sizes of eddies. We sometimes shift images’ recorded positions slightly as well, since the satellite often miscalculates latitude and longitude values. After reviewing images, we plot data such as the locations and sizes of eddies relative to space and time and the number of useful images per day and month. So far, we have analyzed the AVHRR images from 1990, 1996, and 1998 and graphed the resulting data. Marking all eddies on a single map has strongly shown the path where most eddies appear, but we have not yet identified many other significant patterns or trends. The knowledge of eddy variability we aim to gain will hopefully offer insight into variability in the DSO.

Ultrasound-induced palpation of brain for the non-invasive determination of intracranial pressure

Kang Yu, Senior, Electrical Engineering

Hardisty Scholar

Mentor: Pierre Mourad, Applied Physics Laboratory

Mentor: Michel Kliot, Neurological Surgery

Intracranial Pressure (ICP), the pressure exerted on the brain, is a critical determinant of brain function. ICP is frequently measured following trauma or indication of other serious neurological conditions such as tumors, bleeds, hydrocephalus, and a Glasgow Coma Score (GCS) < 9. Having elevated ICP can result in permanent neurological impairment in patients with prolonged increases leading to possible death. However, with continuous monitoring, physicians are able to design and tailor a more effective treatment plan and significantly improve a patient’s prognosis. Currently, ICP is measured invasively by placing a transducer through a hole in the cranium—a procedure which requires the skill of a neurosurgeon and the inherent risks of an operation. In an effort to circumvent many of the inherent risks and complications associated with the current methodology, we propose a non-invasive measuring methodology using a combination of high-intensity focused (HIFU) and diagnostic ultrasound (A-mode) to transcranially palpate and measure brain tissue displacement, respectively. This measurement method, known as acoustic radiation force imaging (ARFI), uses displacement measurements recorded at a known repetition frequency to calculate the rate of tissue relaxation following a palpating pulse. Since it has been shown that tissue stiffness is positively correlated with applied pressure, analysis of reflections from diagnostic interrogation can be used to quantify tissue stiffness as a function of relaxation rate. Through extensive in vitro testing, we have shown that our prototype

device is effective in precisely quantifying micron-order tissue displacements and distinguishing between in vitro pressure changes. Furthermore, preliminary animal studies have indicated that our device is capable of eliciting and measuring transcranial displacements with micron-order precision.

Study of Rigid Natural Fibers-Lessons for New Composites

*Jason Zhou, Senior, Materials Science and Engineering
Mentor: George Mayer, Materials Science and Engineering*

Spicule fibers of the siliceous sponge *Euplectella aspergillum* were studied under torsional loading to determine the mechanical response of this concentrically-ringed structure. Laser confocal scanning microscopy and scanning electron microscopy have clarified the damage mechanisms in these natural rigid composite systems. The results have confirmed the controlling roles of thin protein layers, and the complex architecture of such sponges in structural toughening. It is expected that this work will lead to new design composite configurations for normally brittle materials, such as undersea optical cables.

The effects of 5-HT1B Overexpression and Social Defeat on Subsequent Cocaine-Induced behavior

*Eric Zimmerman, Sophomore, Neurobiology
Mentor: John Neumaier, Psychiatry and Behavioral Sciences*

The social defeat paradigm is an ethologically robust stressor that triggers heightened responses to drugs of abuse in rodents. Serotonin (5-HT) has been shown to play a role in the etiology of psychiatric disorders and addiction. Our group has determined that the 5-HT1B receptor - which is synthesized in cell bodies projecting from the nucleus accumbens shell (NaccSh) to the ventral tegmental area - is a key modulator of these conditions. Specifically, 5-HT1B expression is increased after both chronic social stress and chronic cocaine administration. In addition, mild stress paired with 5-HT1B overexpression resulted in increased locomotor activity and sensitization in response to amphetamine treatment. We hypothesize that 5-HT1B overexpression combined with chronic social defeat will intensify the rewarding effects cocaine treatment. Animals will receive either 5-HT1B overexpression or control GFP injections in the NaccSh, driven by a viral vector. Subsequently, half of each treatment group will be socially defeated once per day for one week, while the other half remains in their home cages. The resulting effect on hedonic state will be measured by conditioned place preference (CPP) to cocaine. We expect that individuals overexpressing 5-HT1B who are socially defeated will show increased CPP, suggesting that the hedonic state of these animals was amplified by the experimental treatment. This experimental model reveals the physiological basis for

the varied predisposition to addiction among individuals exposed to environmental stress.

STUDENTS SUM UP THEIR RESEARCH EXPERIENCE IN A WORD

Evolution:

It seemed that my work/reward ratio during my research period followed an exponential curve. The harder I worked and the more I learned gave me an increasing number of opportunities, connections, and knowledge. I've evolved from a naïve undergraduate into a potential scholar and lifelong researcher.

Odyssey:

My research has been conducted as an epic journey through space and time. I have had the help of professors, friends, librarians, and clergy at SPU, Oxford University, and the UW. I have met intriguing characters, including a monk and a humble Polish nun – all this for the sake of nine Greek words.

Fulfilling:

Many people go into graduate school without extensive lab experience. I am already a fully integrated, essential part of my lab and I am gaining the experience I need now to best decide how to proceed with my career.

Enlightening:

As undergraduates we take classes that introduce us to others' ideas. It is only when one begins to think for oneself, pioneering uncharted intellectual territory, does one irreparably expand one's capacity to comprehend the surrounding world.

PRESENTATION SESSION 1

1:00 - 2:30PM

PLEASE NOTE:

Abstracts are listed alphabetically by the presenter's last name, unless otherwise noted.

SESSION 1A

MICRO TO MACRO: SENSING AND ACTUATION FROM DNA TO HUMANS

*Session Moderator: Gaetano Borriello, Computer Science & Engineering
Mary Gates Hall Room 228*

* Note: Titles in order of presentation.

Natural Energy Harvesting: Employing Thermoelectric Effect to Self-Power Biological Systems

*Saima Haq, Senior, Electrical Engineering
Mary Gates Scholar*

Mentor: Thomas Daniel, Biology

Mentor: Brian Otis, Electrical Engineering

Energy can be produced naturally by converting the heat energy of a biological system into electric energy. The proof of concept of thermal energy harvesting lies in the fact that a thermocouple—working on the phenomenon of thermoelectric effect—can be employed to extract heat energy from a large insect, the Hawk moth: *Manduca Sexta*. It is of much interest to see how much voltage and thus power can be produced by a single thermocouple device given the environment of a moth's free-flight. The highest voltage achieved is on the order of millivolts, and the highest power is about $40\mu\text{Watts}$. The fact that more power can be produced by a larger temperature difference emphasizes the importance of a good heat sink. These optimistic results show that small integrated circuits or programmable chips can be used without any batteries while a moth is in free-flight. Moreover, they can be used to send some stimulus to the moth or for data acquisition on a long-term and sustainable basis. It is recommended to employ different heat sink designs in the future research study to find the highest voltage that can possibly be created by a thermocouple placed on a moth. Moreover, actually putting the device with heat sink on the moth during free flight is recommended in the future study as much of the challenge lies in the interfacing of computer hardware and biological neural networks.

Engineering *Mycobacterium smegmatis* porin A (MspA) for DNA analysis

*Risa Wong, Senior, Physics
Mary Gates Scholar, Amgen Scholar*

Mentor: Jens Gundlach, Physics

Mentor: Tom Butler, Physics

My lab focuses on driving single-stranded DNA through nano-scale biological pores. When a voltage difference

is applied across a pore, an observable level of electrical current is seen due to the flow of ions through the pore. This applied voltage can also cause charged molecules such as DNA to pass through the pore, which physically blocks some of the ionic current. Because of the narrow constriction of the pore, single-stranded DNA must thread through the pore one base at a time. Theoretically, each of the four bases of DNA will block the ionic current at a different level. Thus, if nanopore analysis of DNA is perfected, it has the potential to be a direct DNA sequencing tool. MspA is a promising biological pore for DNA analysis, with a short and narrow constriction zone as well as high stability. However, DNA does not pass through wild-type MspA, most likely because negatively charged amino acids in the constriction zone repel the similarly charged DNA. We have obtained two types of engineered mutant MspA with excess negative charges removed. I have worked to characterize the two types of pores and to test them for DNA interaction. Promisingly, both mutants demonstrate clear current blockages when single-stranded DNA is present, though further tests are needed to show that these blockages represent full DNA translocation.

FPGA-Accelerated BLAST using Macah

*Ben Weintraub, Senior, Computer Science
Mentor: Scott Hauck, Electrical Engineering*

The problem of detecting similarities between different genetic sequences is fundamental to many research pursuits in biology and genetics. BLAST (Basic Local Alignment and Search Tool) is the most commonly used tool for identifying and assessing the significance of such similarities. With the quantity of available genetic sequence data rapidly increasing, improving the performance of the BLAST algorithm is a problem of great interest. BLAST compares a single query sequence against a database of known sequences, employing a heuristic algorithm that consists of three stages arranged in a pipeline, such that the output of one stage feeds into the input of the next stage. The initial stage searches for short fragments ('words') that are found in both the query sequence and a database sequence. The second stage extends these short word matches, attempting to produce high-scoring alignments centered on word matches without any gaps. The highest-scoring alignments are passed on to the third stage, which aligns the sequences while allowing for gaps. Several recent studies have successfully investigated the use of Field-Programmable Gate Arrays (FPGAs) to accelerate the execution of the BLAST algorithm, focusing on the first and second stages, which account for the vast majority of the algorithm's execution time. While these results are encouraging, translating algorithms like BLAST that contain somewhat complex and unpredictable control flow and data access patterns into FPGA versions turns out to be quite difficult using currently available tools. FPGAs are usually programmed using Hardware Description Languages (HDLs), which are significantly more difficult

to learn and use than standard programming languages. We present an accelerated version of the BLAST algorithm written in a new language, called Macah, which is designed to make the task of programming for FPGAs and FPGA-like architectures accessible to programmers comfortable with the widely known C language.

Utilizing Heterogeneous Self-Assembly To Create Optical Sensors

*Louis Draghi, Senior, Electrical Engineering
Mentor: Babak Parviz, Electrical Engineering
Mentor: Samuel Kim, Electrical Engineering
Mentor: Ehsan Saeedi, Electrical Engineering*

Self-assembly aids in the fabrication of heterogeneous semiconductor systems on unconventional substrates such as glass, plastic, and ceramics. The self-assembly process uses gravity, fluid flow, and capillary forces to integrate free-standing semiconductor elements onto a common substrate. The substrate is pre-patterned with a low melting point solder alloy that wets the metal contacts on the free-standing microcomponents during the self-assembly process. This provides electrical as well as mechanical connections between the substrate and the assembled microcomponents. Components such as gallium-arsenide light emitting diodes (LED) and silicon photosensors can be assembled together to form an optical sensor. The optical sensor can be used to detect certain wavelengths of light from objects which have been fluorescently dyed and then excited by the LED. Self-assembly provides a quick and low-cost method to manufacture these heterogeneous devices.

Error Recovery in Programmable Reaction Networks

*Sam Burden, Senior, Electrical Engineering
Washington Research Foundation Fellow
Mentor: Eric Klavins, Electrical Engineering*

Self-organization drives assembly in nature. Crystallization, protein synthesis, and cell specialization all occur in a distributed manner among large quantities of relatively simple components. Understanding how to engineer such processes should enable us to construct computational devices and novel materials at small scales. Current efforts to design self-assembled structures do not scale well. As assembly size increases, errors introduced by thermodynamic noise compromise the integrity of the structures. Therefore to develop scalable methods for engineering self-organizing systems, we must either design fault-tolerant assembly schemes or develop methods to perform error identification and recovery on self-assembled structures. Using an assembly model originally developed to study chemical systems, we investigate methods to perform error recovery in programmable reaction networks. By studying self-assembly at the macro-scale, we intend to uncover design principles that can be applied to self-organization at all scales.

Human Activity Recognition

*Laura Pina, Senior, Computer Engineering
Mentor: Jonathan Lester, Electrical Engineering
Mentor: Carl Hartung, Computer Science and Engineering
Mentor: Gaetano Borriello, Computer Science and Engineering*

Currently, many people live sedentary lifestyles and do not actively engage in physical activity. In the United States in particular, in addition to this lifestyle, excessive consumption of foods high in calories have led to an obesity epidemic. To finding a solution, this research project seeks to develop sensing technology for monitoring a person's physical activity for applications such as physical training, weight management and elderly care. The goal is to develop an unobtrusive personal activity recognition system that is practical and reliable, enough to be carried throughout the day (in a mobile phone or wristwatch form-factor). The system should be able to provide accurate journal data on a person's physical activity (e.g., walking, sitting, running, riding a bicycle, driving, etc.) at a fine-grain (i.e., every second), and at a coarse-grain (daily behavior). The principal element of the system is a multi-sensor board (MSB). The MSB has seven different sensors, including: a 3-axis digital accelerometer, a digital compass, light level sensors, and a digital barometer. The current activity recognition algorithm is heavily dependent on machine learning and bases its classifications on positive and negative examples for a specific activity. Our ultimate goal is to define a new human activity classification algorithm using a hierarchical taxonomy. We are still in the process of determining which features calculated from data retrieved from the sensors are most informational and/or accurate. Our hypothesis is that a hierarchical approach less dependent on machine learning will be adaptable to a variety of users, more informational of the activity, and capable of integrating new sets of physical activities. My work seeks to prove or disapprove this hypothesis.

C-arm

*Radivoje Jovanovic, Senior, Electrical Engineering
Mary Gates Scholar
Mentor: Blake Hannaford, Electrical Engineering
Mentor: Jacob Rosen, Electrical Engineering*

The first hour after severe physical trauma is known as the “golden hour.” A person who receives operating room care within the “golden hour” has a better chance of survival. TraumaPod is a vehicle designed to bring a mobile operating room to soldiers in need by using the principles of tele-surgery. From any point in the world, a surgeon would perform surgery on a soldier using the RAVEN surgical robot, installed within the TraumaPod. In order to be successful, the RAVEN needs to be positioned at the correct location, operating tools need to be changed, and the RAVEN should be moved in the cleaning chamber

after each procedure. The C-arm is a set of two robotic arms intended to control the position of the RAVEN. The C-arm consists of six joints that are controlled over six amplifiers (three Xenus, and three AMC amplifiers). The C-arm project demonstrates how to control the robotic arm using the Control Area Network (CAN). CAN is generally used as a set of network protocols in the automobile industry and is convenient to use because it utilizes only two wires for communication. Advantages of CAN include its error detection capabilities, its robustness, and its light weight. The C-arm incorporates all three levels of CAN communication: Network Management (NMT), Service Data Object (SDO), and Process Data Object (PDO). NMT is used to determine the number of joints that are currently on line. The SDO is used to set up the network and parameters of the system, while the PDO is used during C-arm operation for its fast and reliable data transfer system. Proving that the C-arm works over the CAN network, designers have shown that the TraumaPod can be built as a vehicle with a minimum number of wires, which not only improves the overall system cost, but the system mobility as well.

SESSION 1B

EVALUATING NON-INVASIVE IMAGING AND SURGICAL TECHNIQUES IN IN-VIVO MODELS

Session Moderator: James Bassuk, Program in Human Urothelial Biology

Mary Gates Hall Room 231

Lactobacillus crispatus as a Probiotic to Prevent Recurrent Urinary Tract Infections

*Melissa Au-Yeung, Senior, Neurobiology and English
Mary Gates Scholar*

Mentor: Ann E. Stapleton, Division of Allergy & Infectious Diseases

Recurrent urinary tract infections (RUTIs) in women are caused by *E. coli* in 85-90% of cases and are currently managed with prophylactic antimicrobials. However, a worldwide increase in antimicrobial-resistant bacteria has generated interest in alternative preventive approaches, such as probiotics, living organisms administered to confer a health benefit. We are conducting a clinical study to prevent RUTIs in women by randomizing women to receive either a placebo or a vaginal suppository containing a representative, protective commensal organism, *Lactobacillus crispatus* CTV-05. *Lactobacillus* species such as *L. crispatus*, *L. jensenii*, and *L. gasseri* constitute the normal commensal flora of the vagina. They protect the epithelium from colonization by pathogens such as *E. coli*, by producing

lactic acid and hydrogen peroxide to kill pathogens and by competitively excluding pathogens from adhering. We used Rep-PCR on vaginal specimens from subjects to distinguish DNA fingerprints of *L. crispatus* CTV-05 from *L. crispatus*, *L. jensenii*, and *L. gasseri* and found that *L. crispatus* was the most prevalent species. Colonization with the three *Lactobacillus* species was stable throughout the study. Some subjects became colonized with the probiotic strain *L. crispatus* CTV-05 after receiving the probiotic. We also used real-time PCR to quantify gene copies of *L. crispatus* in the subjects' vaginal specimens to monitor the quantitative effects of receiving probiotics or placebos. When the study is complete, we will correlate and compare quantities of commensal lactobacilli with the clinical endpoint of preventing UTIs in subjects who received probiotics or placebos. We anticipate this targeted assessment of efficacy will support the principle that vaginal probiotics are effective in preventing UTIs.

Surgical Approach to Weight Loss and the Improvement of Appetite and Insulin Sensitivity

Harpreet Dhaliwal, Sophomore, Biology (Cellular, Molecular and Development)

David Burzo, Senior, Physiology, German Language & Literature

Keliang Xiao, Sophomore, Pre-Medicine

Lisa Yang, Sophomore, Biology

Mentor: David Flum, Surgery

Gastrointestinal surgical procedures typically used for weight loss, such as Roux-en-Y Gastric Bypass (RYGB), have shown to dramatically change appetite regulation and improve insulin sensitivity before significant weight loss occurs. The cellular mechanisms and interactions that trigger these improvements are not well understood, however, and determining the mechanisms involved in gastrointestinal surgery will be important in determining appropriate interventions to ameliorate Type 2 diabetes. Previous research on gut hormones indicates three potential influences: GLP-1 is a hormone that promotes insulin sensitivity and is produced in the distal small intestine, PYY is a hormone that suppresses hunger and is released primarily from the distal small intestine, and ghrelin is a hormone that stimulates hunger and is primarily released in the stomach. The purpose of this study was to evaluate changes in weight, appetite, insulin sensitivity, and gut peptide hormones after gastrointestinal surgery. Four variations of gastrointestinal surgeries (RYGB with and without proximal gut feeding and gastrojejunostomy with and without pyloric exclusion) were used to elucidate the potential roles of the proximal and distal small intestine on these outcomes. Miniature swine were treated with special diets to promote weight gain and insulin resistance. The animals were weighed and had daily food intake quantified weekly. Animals underwent pre-operative and post-operative Intravenous Glucose Tolerance Tests to evaluate insulin sensitivity, as demonstrated by blood glucose clearance after

a bolus injection of glucose. We have hypothesized that the direct pathway of food to the distal small intestine promotes RNA expression of GLP-1, and therefore improves insulin sensitivity. To study this, stomach and small intestine tissue samples were taken before surgery and during necropsy for genetic expression and quantification of GLP-1, PYY, and ghrelin. With a growing understanding of the cellular and chemical mechanisms involved in metabolic surgery, we hope to find non-surgical approaches to improve Type 2 diabetes.

Does the Suppressive Function of Regulatory T cells Contribute to the Establishment of Persistent *Mycobacteria tuberculosis* Infection?

Alevtina Gall, Senior, Biology (Cellular, Molecular & Development) and International Studies

*EIP Presidential Scholar, Mary Gates Scholar,
Washington Research Foundation Fellow
Mentor: Kevin Urdahl, Department of Pediatrics*

Tuberculosis is a disease that annually kills two million people, predominantly those living in developing countries. Bacillus Calmette-Guerin (BCG), the currently used vaccine against Tuberculosis, is not effective in geographical areas with the highest disease burden. The ability of *Mycobacterium tuberculosis* to establish a persistent infection may depend on a mechanism used by the pathogen to circumvent the natural immune response of the host. Regulatory T cells (Tregs), a subset of Foxp3-expressing CD4+ T cells, provide a “self-check” mechanism to prevent autoimmunity and play an important role in moderating the anti-microbial response of the host. We hypothesize that pathogen-specific regulatory T cells are activated during *M. tuberculosis* infection and suppress the proinflammatory response of the host that may otherwise be sufficient to clear the infection. My project focuses on designing an in vitro model of Mtb-specific regulatory T cells to test our hypothesis. Using bone-marrow derived dendritic cells (BMDCs) and regulatory T cells isolated from TB infected and uninfected mice, we expect regulatory T cells from infected individuals to undergo significantly higher proliferation in response to activation with TB antigen than the uninfected regulatory T cells. This provides evidence that Tregs that respond in TB infection are antigen specific. Generating antigen-specific Tregs will allow us to produce cell lines that can be used in a number of novel experiments to further test our hypothesis. This approach has never been used in the study of Tuberculosis infection and remains promising in the potential design of a more efficacious vaccine to protect against Tuberculosis.

Calcium Coupling Process: A proposed mechanism mediating the regulation of insulin secretion by calcium influx

*Joanne Abby M. Marasigan, Junior, Chemistry
Mentor: Ian Sweet, Medicine*

Type II diabetes occurs as a result of decreased sensitivity to insulin’s action on glucose uptake and a reduction in insulin secretion by pancreatic islets. Islets sense glucose levels through a mechanism involving its metabolism, and consequent rises in calcium uptake lead to the secretion of insulin. However, the mechanism by which calcium mediates insulin release is unknown. In our lab we hypothesize that there is a calcium coupling process (CCP) comprised of a cascade of steps that regulate the amount of insulin released. The CCP is highly energetic, therefore we can analyze oxygen consumption rate (OCR) in combination with calcium and insulin levels to test this hypothesis. To do this we are developing techniques that monitor these three parameters simultaneously in rat pancreatic islets. Using a fluorescent imaging system, methods to measure intracellular calcium and insulin secretion are well established, but methods for measuring OCR by small islet amounts are not available. Our approach is based on using an oxygen sensitive dye that is painted on the inflow and outflow sides of the cell chamber, and detecting the difference between two signals. That difference will reflect the amount of oxygen used by the islets. This project aims to 1. Calibrate the intensity of the fluorescent images against oxygen tension in the media; 2. Miniaturize and optimize chamber size, flow rate and number of islets to achieve a detectable decrement in oxygen tension without causing damage to the islets; and 3. Validate the method by comparing OCR results obtained with larger scale systems. Completion of these aims will be followed by screening with pharmacological inhibitors of calcium-sensitive proteins in order to identify and study the critical proteins that comprise the CCP. We predict that these proteins would represent candidate targets for drugs aimed at increasing insulin secretion in patients with Type II diabetes.

Regulatory T Cell Kinetics in the Periphery

Katherine Nutsch, Senior, Biology (Cellular, Molecular and Developmental)

*Mary Gates Scholar
Mentor: Alexander Rudensky, Immunology*

During development in the thymus, thymocytes randomly generate T cell receptors (TCRs), creating a T cell repertoire with the potential to recognize antigens from any pathogen. However due to the random nature of the generation of TCRs, some of the T cells created will be reactive to self antigens, creating the potential for autoimmune disease. Most of these autoreactive T cells are deleted before leaving the thymus, but some escape. One of the mechanisms preventing these pathogenic cells from causing autoimmune disease is a subset of T cells called regulatory T cells (Tregs).

Once Tregs leave the thymus their survival and regulation of in the periphery is not well understood. The peripheral population is made up of a combination of recent thymic emigrants and Tregs that have expanded in the periphery. To analyze these populations I have taken various groups of mice and given them BrdU. BrdU incorporates itself into the DNA of dividing cells, which I can then measure using flow cytometry. The first group is normal B6 mice half of which were injected with BrdU at 10 through 1 day timepoints and the other half were injected at the same timepoints and then given water with BrdU in it for the remainder of the days. I conducted the same experiment, with thymectomized mice. Additionally, I compared 10, 6, 3 and 1 day timepoints of 6-month-old and 4-week-old mice. By comparing these groups I can see the proportion of Tregs that are actively cycling in each group to get an idea of cellular Treg kinetics in the periphery. I can also compare Treg kinetics to naïve T cell kinetics. Gaining a better understanding of the Treg population in the periphery will help in determining what factors control the Treg niche.

The Role of p38 Activation by HSV in the Release of Immunosuppressive Interleukin-10 by T Lymphocytes

Laura A. Walsh, Senior, Biochemistry and Chemistry

Mary Gates Scholar

Mentor: Keith R. Jerome, Fred Hutchinson Cancer Research Center

T lymphocytes (T cells) play a key role in host defense against bacterial and viral infection through the production of cytokines and selective induction of apoptosis in infected cells. T cells interact with infected cells through the T cell receptor (TCR). However, T cells infected with Herpes Simplex Virus (HSV) have reduced TCR signaling, leading to reduced synthesis of cytokines after antigen stimulation. Interestingly, IL-10 production in HSV infected T cells is maintained at non-infected levels. IL-10 is an immunosuppressive cytokine, and its preserved production may be a viral strategy to evade the immune response. IL-10 production in HSV infected T cells has been found to require TCR independent p38 kinase phosphorylation. The HSV proteins ICP27 and VP16 have been implicated in the phosphorylation of p38 in other cell types infected with HSV. Therefore, we have investigated the role of ICP27 and/or VP16 in p38 phosphorylation and IL-10 production in HSV infected T cells. Using ICP27 mutant viruses, we have found that ICP27 is required for the phosphorylation of p38 and its downstream substrates. However, the ICP27 mutant is otherwise fully competent to inhibit TCR signaling. We are now investigating the effect of ICP27 deletion on the production of IL-10 in addition to Th1 and Th2 cytokines. We plan on using ICP27 functional mutants to determine which activity of ICP27 is responsible for p38 phosphorylation and preserved IL-10 production. Future experiments will evaluate the role of VP16 in this process.

SESSION 1C

SOCIAL ACTIVISM AND COMMUNITY EMPOWERMENT

Session Moderator: Kari Lerum, Interdisciplinary Arts & Sciences

Mary Gates Hall Room 234

Football: A Grassroots Approach to Exploring Female Empowerment in Oman

Jennifer Hamann, Senior, Anthropology, Seattle University

Mentor: Ted Fortier, Anthropology, Seattle University

Mentor: Elizabeth Langston, School for International Training, Muscat, Oman

Unsatisfied with the statistical way that non-governmental agencies and non-profit human rights groups define and thus make judgments on the Western concept and term female empowerment, I wanted to take an unconventional, literally grassroots, approach to exploring this concept for women in the Middle East. In Muscat, Oman, women are becoming more visible in universities, the labor force and the government. However, society remains highly gendered, making efforts to delve into what were predominantly male arenas difficult. Perhaps the best way to explore gender roles and this notion of female empowerment is to dive into an area of society where women are both nonexistent and culturally discouraged, football. The literature has already identified football, and sports in general, as grassroots mirrors to cultural norms and ideologies, but little has been done in the fields of female empowerment from the perspective of sports in Islamic societies. The big question still remains: why don't women play football? Through a salvage ethnography of a young girls football team and their prominent parents in Omani society, two major themes have emerged: 1. Female empowerment is a Western construct where Omani women perceive empowerment with different, often contrasting ideals and 2. Empowerment is not only a basic set of human rights but most importantly, a woman's choice perceptions and feelings. Additionally, the study has revealed that football may not provide a short and sweet notion of female empowerment but it does unravel the cultural layers in Omani society that show how women feel empowered, what globalization is contributing to this change in perceived female empowerment and perhaps what changes we can predict for the future.

Poetry and Politics through the Works of Pablo Neruda

*Gina Mauro, Senior, Business Administration (Marketing & Management), UW Bothell
Mentor: Julie Shayne, Interdisciplinary Arts & Sciences, UW Bothell*

In this paper, I use the works of Chilean poet Pablo Neruda to discuss politics before and leading up to the bloody 1973 coup in his beloved homeland. Although a large body of his work was devoted to love, women, and wine, Neruda was a poet of humanism, nationalism, and politics. Neruda was born in rural Chile in 1904, a country rich in culture, history and leftist politics. As a young man, Neruda wanted to be a French teacher. Excited by the idea of traveling, he accepted a position as consul to Rangoon and from there served in that capacity to India, Ceylon, Java and Singapore. As an active Communist since 1945, Neruda's strong opposition to corrupt regimes in Chile resulted in his exile in the late 1940's. While in exile, Neruda continued to campaign for Chile and gained many supporters abroad. In the last years of his life, Neruda watched as Salvador Allende, a medical doctor, leftist politician, and close friend became the first elected socialist president in history. On September 11, 1973 General Augusto Pinochet orchestrated a coup against Allende which ended the president's life. Neruda, already ill, was deeply troubled by the events and died shortly afterward. Pablo Neruda was much more than a poet and a Nobel Prize winner; he was a political activist who shaped the history of Chile. In this paper, I describe Neruda's poetry, how it relates to politics, and how his work inspired the Chilean people. Additionally, I discuss how exile can shape individual people's politics and their devotion to them.

Contending with Censorship: The Underground Music Scene of Urban Iran

Heather Rastovac, Senior, Near Eastern Languages & Civilizations

Ronald E. McNair Scholar

Mentor: Firoozeh Papan-Matin, Near Eastern Languages & Civilizations

As modernity and traditionalism collide in contemporary Iran, an underground music scene is emerging in Iran's urban centers. Rap, Rock and Fusion musical styles are developing a position in Iranian musical culture as a means for many musicians to articulate cultural identity. One music video from Iran displays a young man with a shaved head and goatee singing lyrics of the fourteenth century Persian poet Hafez, accompanied by an electric guitar. Another video shows a Rap musician dressed in baggy pants and an oversized T-shirt reciting spoken word poetry and quoting the Quran as he poetically critiques the Iranian government. Though these artists' music reflects their deep respect for Iran's cultural heritage and rich literary traditions, these musicians struggle to distribute their music and music videos

in their home country. Because of the Iranian government's religious scrutiny and state implemented censorship, many of these musicians are prohibited from producing albums or playing concerts. However, they continue to engage in their art and find creative ways around this censorship through such means as distributing their music and videos over the Internet and playing 'secret' concerts. Through a survey of literature on music and politics in Iran, analyzing the perspectives of Iranian musicians and listeners (in and out of Iran) via online blogs, and interviews with local Iranian musicians who have recently emigrated from Iran, I will critically examine the ways in which censorship in Iran is implemented and how these underground musicians in Iran work around and/or against this censorship. This study also seeks to explore how censorship has contributed toward and/or drawn away from Iranian musicians' creative processes.

Youth, Conflict, & Creative Social Change

Angeline Candido, Junior, English and Communication

Mary Gates Scholar

Daphne Chu, Senior, Digital Arts/Experimental Media and Women Studies

Mary Gates Scholar

Donna Freedman, Junior, Comparative History of Ideas

Mary Gates Scholar

Shannon Goodwin, Senior, Community Environment & Planning and Geography

Mary Gates Scholar

Margaret Gordon, Senior, Vocal Performance and Anthropology

Mary Gates Scholar

Mentor: Kari Lerum, Interdisciplinary Arts & Sciences, UW Bothell

In collaboration with the Safe Schools Coalition, our research team set out to investigate bullying in schools, particularly in middle and high school. We viewed existing anti-bullying programs, read professional research reports, and interviewed local experts. In addition to these standard research methods, we also engaged in reflexive research by discussing, evaluating, and reflecting on our own experiences with bullying. To hear from others who have experienced, witnessed or even perpetrated social conflict, we created an online survey and planned, publicized and conducted a focus group for youth and young adults. The focus group was also reflexive in that we simultaneously moderated, observed, and participated in the conversation. We concluded that bullying is a reflection and extension of the violence embedded in power structures. As a way of intervening in these power structures, we constructed a "toolkit" for youth and their allies with a variety of creative, interactive interventions. We leave this project with a commitment to the importance of reflection and creativity, both as an innovative research method and as a process that enables progressive social change.

Praxis Makes Perfect: Re-envisioning the Role of Activist-Academics in Community Organizing
Hala Dillsi, Senior, Near Eastern Languages & Civilization and Political Science

Mary Gates Scholar

Sujot Kaur, Recent Graduate, Comparative History of Ideas and International Studies

Mary Gates Scholar

Sooja Kelsey, Recent Graduate, Social Sciences

Mary Gates Scholar

Lindsay Lamfers, Recent Graduate, Comparative History of Ideas

Mary Gates Scholar

Mentor: Georgia Roberts, English

Our collaboration with Powerful Voices (PV), an organization focused on developing leadership and critical thinking skills in adolescent women, was two-fold. Members of the PV staff asked us to document the curriculum for the summer DYVAS program and contribute additional lesson plans and writing prompts. This partnership afforded us the opportunity to explore questions of how university-based activists and artists can participate in community-based work without replicating or re-inscribing social hierarchies embedded in the academic institutions that we represent. We built relationships with our community partners that challenged traditional binaries of expert researcher and subject-informant through participation in DYVAS classroom activities and critical discussion in meetings with PV staff alongside more traditional research methods such as recording observations, conducting interviews, and scholarly reading. The end of our participation with the Summer Institute has brought to the fore the necessity of long-term, ongoing work both with our community partners specifically and social justice education generally. We look forward to continuing the conversations we have begun and building on the work set into motion.

SESSION 1D

IDENTITY, RELIGION, AND THE ARTS
Session Moderator: Stevan Harrell, Anthropology
Mary Gates Hall Room 238

* Note: Titles in order of presentation.

A Hand in History: Ministeriales and their Influence in Bavaria

Allison Hericks, Sophomore, Sociology, Seattle University
Mentor: Kan Liang, Interdisciplinary Arts & Sciences, Seattle University

Mentor: Theresa Earenfight, History, Seattle University

Between 1000 and 1500 in Bavaria, struggles between dynastic families split the duchy into fiefdoms, social class lines were blurring, and a caste-like system was being replaced with a different construct that allowed for social mobility. Out of this transformation emerged a group of serf-knights known as ministeriales. For the privilege of being counted among the elite, ministeriales were given special treatment by their overlords and in return they pledged eternal allegiance to their lords and ladies. They showed their devotion by managing their lord's assets or jousting for their ladies' honor. In one instance of extreme devotion, Ulrich von Liechtenstein, a prominent knight, cut off a finger to symbolize his fervor for his desired lady. By examining von Liechtenstein's 1255 autobiography Service of Ladies, which he wrote in response to the decline in chivalry and courtly values, I address the following questions: Why would someone disfigure themselves for a person who is almost a complete stranger? How could this possibly represent service? I argue that the action of cutting off his finger exemplifies the ministeriales' desire to offer complete service to their lords or ladies as a way to repay the debt ministeriales felt they owed their benefactors. The Latin word for hand manus, derives from munus the Latin word meaning service. So not only is von Liechtenstein literally offering part of his hand to his lady, he is offering his service to her as well. Though von Liechtenstein's actions are graphic and bizarre, they can be very telling of society's feelings. This semi-servile group and their subsequent actions show the shifting boundaries between classes and the different ideals that embodied the Middle Ages in terms of societal ascension.

What Causes Islamic Separatism in Britain?

Matthew Bennett, Senior, Sociology and Psychology

Mary Gates Scholar

Mentor: Steven Pfaff, Sociology, The Center for West European Studies

Desiring independence and autonomy, British Muslims socially isolate themselves whilst maintaining a strong group identity and political voice, causing tension and concern for the British government and wider population. Research does not account for high levels of separatism and religious discontent amongst British Muslims relative to their European counterparts. This is particularly paradoxical given the strategies implemented by the British Parliament to accommodate the Muslim population - strategies that do not exist in other European states. British Muslims, compared to their European contemporaries, are highly educated and citizenship status is easily attainable. Not only should this result in low political and religious tension and low separatism levels, but high integration rates also. Research suggests that Muslims are integrating at slower rates relative to other minority groups within Britain. Is Islam the fundamental obstacle to integration or does separatism operate via other mechanisms? The Fourth National Survey of Ethnic Minorities (FNSEM) provides

unique data at the individual level, allowing insight into this question. My analysis required the construction of subjective religiosity scales, objective measures of piety, and levels of ethnic identification. Using the FSNEM, I created the latent variable separatism to explain integration. Separatism has been operationalized in the minority demographic as, 1) preferred levels of white interracial marriage and 2) levels of preferred educational isolation. My results suggest that lower integration rates are not a product of being Muslim for some minorities with important interaction effects.

“I half believe, half don’t believe”: An Ethnographic Approach to the Nuosu Rituals of SW China

Deborah Sung, Senior, International Studies

Mentor: Stevan Harrell, Anthropology

Situated near the Tibetan plateau of southern Sichuan, Yangjuan is an agricultural and pastoral village of a Nuosu community. Officially categorized by the Chinese government as belonging to the broader Yi minzu (nationality), this ethnic minority population traditionally abides by a complex, animistic system that integrates ancestral worship with nature worship, spirit worship, and a belief in ghosts. However, there is an emerging trend amongst the people to only be “half-believing, half-not believing.” This phenomenon of irresolute belief can in part be analyzed historically by understanding Nuosu religion as an “evolving religion.” For the Nuosu, the ten year struggle during Cultural Revolution not only instigated a trauma of forced acculturation, but it physically and psychologically established traditional Nuosu beliefs as being superstitious. Intellectuals and village leaders were labeled enemies of the people, while spiritual texts were confiscated and burned. Since the early 1980s though, changes in minority policies have allowed the Nuosu to revitalize their culture and religious activities. Through religious-spiritual coping, rituals and ceremonies are utilized as coping mechanisms that prompted posttraumatic growth. However, the Nuosu currently find themselves in the wake of yet another change, this time China’s push to modernize. With increasingly more individuals leaving Yangjuan as either migrant workers or students, the Nuosu see their traditional ways being once again perceived as outmoded—this time by the younger generation. Therefore, rather than having their beliefs be absolute, the historical experience of the Nuosu have fashioned their beliefs to be “half and half.” An ethnographic analysis of Yangjuan’s traditional Nuosu rituals demonstrates these two parallel events by serving as a microcosmic replica of the Nuosu world. Not only is posttraumatic growth maintained today through ceremonies, operating as a sacred space and lens for meaning reconstruction, but rituals also exhibit how not believing has manifested itself with today’s modernization period.

Keeping the Tradition Alive: The Promise of Natural dyes and Japanese Silk Industries

Ai Okubo Roach, Senior, Fibers

Mary Gates Scholar

Mentor: Layne Goldsmith, The School of Art

As a fiber artist, I strive to communicate through my work the importance of succeeding traditions; the value in the tradition of cultures does not fade away no matter how much technology develops. For that purpose, I researched silk materials, which thrived during generations of silk industries in Japan and natural dyes that developed since ancient times in all over the world. The procedures and protocols for dyeing different types of fibers with different kinds of natural dyes vary. Compared to synthetic dye methods, natural dyes take time and patience to process. As a result, the complexity of natural dyes creates hues that evolve only from natural dyes. Establishing recipes for colors for my own custom palette has been more than a delight. As well as natural dyes, being a native of Japan, I value the craftsmanship in making of Japanese silk materials. My home province, Gunma, was once one of the largest silk producing areas in Japan. There artisans produce exceptional silk fabrics and yarns that could not been found in America. Unfortunately, the number of artisans has dropped in these industries; consequently the tradition of manufacturing silk products has been declining. My aim is to contribute to the effort to keep the traditional silk manufacturing alive in Japan. Establishing my position as a bridge in the textile field between America and Japan will serve a broader meaning in my role as an artist. I have been studying the properties of the Japanese silk fabrics and yarns by manipulating them with natural dyes in my work. I am intrigued by the possibilities of how the silk materials and natural dyes coming from a traditional discipline will work in a modern art practice.

What the beat can carry: the role of popular Cuban music in today’s increasing globalization

Deva Wells, Senior, Neurobiology

Mary Gates Scholar

Mentor: Clarke Speed, Anthropology, College Honors Program

Similar to American jazz and rock, the world has felt the infectious pulse of Cuban music. This research will: 1) highlight the ways in which popular Cuban music reflects Cuba’s current socioeconomic conditions, drawing especially from working-class Afro-Cuban ways of life and stretching the limits of permissible speech and self-expression; and 2) examine the music’s role in generating commercial interests and capturing the aspirations of Cuban youth, many of whom have become disenchanted with the ideals of the Cuban revolution and the government’s socialist rhetoric. In Cuba, although music has always centered on festivities and functioned as a kind of communion with the people, its latest evolution has promoted—and been driven by—a growing interest in consumerism, urban identity and

foreign musical forms. Since the Soviet Union's fall, the Cuban government has increasingly depended on tourism and capitalized on the appeal of popular Cuban music. Most nightclubs in Havana now utilize Cuba's double currency system: one form of currency circulates among tourists and privileged Cubans, while the other is worth significantly less and used by the vast majority of Cubans. Most Cubans live in serious economic hardship, although top-rate Cuban musicians can now travel around the world and return to Cuba with access to the "tourist" currency; however, they continue to look towards Cuban "black urban culture," including traditional, Afro-Cuban ritual music, for musical and lyrical inspiration. I will present results from my field research based in Cienfuegos and Havana, where I conducted interviews with musicians and figures in the music business and made audio recordings of local groups. My findings were integrated in a radio program that aired on a community radio station here in Seattle. I am currently preparing a second installment, to be aired in 4-6 weeks.

SESSION 1E

NANO- AND MICRO-STRUCTURED BIOENGINEERING DEVICES

*Session Moderator: Wendy Thomas, Bioengineering
Mary Gates Hall Room 241*

*Note: Titles in order of presentation.

Automation of microfluidic stacked flow gradient generator by multilayer soft lithography

*Hoyin Lai, Senior, Bioengineering
Mentor: Albert Folch, Bioengineering*

Automation and miniaturization of cell biology has been driven by the need for high experimental throughput. We designed a microfluidic stacked flow device that generates a gradient over a wide area. The device generates a stable and reproducible gradient for extended period of time. We propose to upscale the stacked flow generator to automate fluid delivery. We propose to integrate a linear peristaltic pump modified from the original design by Quake et. al (2000) into our device using multilayer soft lithography. In our design, the pump will actuate two fluid lines simultaneously to control fluid flow and to deliver sterile cell culture. We will demonstrate the applicability of the peristaltic pump in fluid delivery to generate a stable and reproducible gradient in the stacked flow generator. Furthermore, we will test the scalability of the modified device into multiple gradient arrays.

Development of a Multi-Channel Microfluidic Device with Novel Cross-Channel Seeding for Biofilm Growth and Study

*Christina Hao Wang, Senior, Bioengineering
Mentor: Wendy Thomas, Bioengineering*

Fluid dynamics plays an integral role in the initial microbial adhesion and retention to surfaces exposed to aqueous environments. For instance, bacterial binding in strains of *Escherichia coli* (*E. coli*) to monomannose-coated surfaces have been shown to depend on the shear forces resulting from fluid flow or viscosity. The ability of microorganisms to adhere to surfaces despite high shear forces has profound implications not only in clinical diseases but also in tissue engineering, environmental wastewater studies, and surgical instrumentation. Moreover, studies have shown that bacteria can colonize a surface and form complex structures known as biofilms. Biofilms are composed of a complex aggregation of sessile bacteria characterized by an irreversible attachment to the substratum, the production of adhesive extracellular matrix, and an altered growth rate and gene transcription. Many studies have characterized these structural and growth changes, but we seek to better understand the initial steps in biofilm formation when planktonic bacteria attach and come to colonize a biological surface despite the presence of shear forces due to the flow of fluid in the body. Examining the initial stages will provide better understanding of how biofilms spread from a small number of bacteria and provide insight into how tissues and instruments get infected. This project seeks to design a microfluidic device, which has flow channels with dimensions under 1 mm, to optimize the study of biofilm growth under various flow conditions. The proposed features include three main channels that run in parallel, which allow for performing experiments with different bacterial strains or different conditions for direct comparison and control. In addition, we include a novel cross-seeding feature which introduces a controlled area of bacteria from an inlet which intersects perpendicular to the main channels. The device integrates into a heating base and is compatible with inverted phase and confocal microscopy.

Home Monitoring of Drug Levels in Saliva using a Microfluidic System

*Benedict Hui, Senior, Bioengineering
Mary Gates Scholar
Mentor: Paul Yager, Bioengineering*

The symptoms of epilepsy and side effects of antiepileptic drugs (AEDs) are currently a serious problem in the United States, with an annual estimated cost of \$12.5 billion in 1995. Pharmacotherapy has been the most common method of treating epilepsy. Deciding which kind of medication, how much the patient should take, and how often the patient should take it is often a very complex process due to many factors. In order to optimize the benefits of AEDs and minimize the adverse effects of AEDs, the drug levels

in the patient must be monitored. Thus, therapeutic drug monitoring (TDM) has been used for a long time in order to optimize AED regimens. Currently, the method of TDM is via blood samples. This results in infrequent use for outpatients due to the need for phlebotomy, and the need for the patient to visit a doctor. The overall result of this is improper drug dosing, and thus an increase in morbidity and mortality. This problem can be solved by moving the TDM from the laboratory to the home. A practical home TDM system based on saliva would have the potential to improve the quality of healthcare for tens of millions of people in the US. The primary goal of this project will be the home monitoring of AEDs using saliva. The increased frequency of saliva-based monitoring of AED levels, coupled with monitoring of seizure frequency and drug side-effects, will have several significant benefits: rapid titration of drug levels to the optimal dosage and frequency for patients, effective long-term compliance monitoring, and the ability to test the efficacy of new and existing drugs for chronic treatment of outpatients. The results would be improved clinical outcomes, a reduction in overall healthcare costs, and an increase in quality of life for the patients.

Quantum Dot-based Medical Diagnostics

Mark Sena, Junior, Bioengineering

Amgen Scholar, Mary Gates Scholar,

Undergraduate Research Travel Awardee

Mentor: Xiaohu Gao, Bioengineering

It has been shown that Quantum dots (QDs) have great potential for use in medicine as nanoscale tools for biomolecular screening and disease diagnostics. These nanoparticles, ranging in size from 2-8 nm in diameter, display unique optical properties such as tunable fluorescence, high brightness and photostability. These characteristics make QDs well suited for use as fluorescent reporters in point-of-care diagnostics. Our lab can conjugate an array of molecular probes such as antibodies or DNA fragments to QDs and use them to detect specific biomarkers for disease. New tools for point-of-care diagnostics are needed for more effective detection and treatment of disease. We present a rapid and sensitive assay, with potential for simultaneous multianalyte detection on a microfluidic platform. Using antibody-linked QDs as fluorescent reporters (peak emission 655 nm), a sandwich immunoassay was carried out inside a poly-laminate plastic card. The card was constructed by cutting flow channels into a layer of Mylar plastic using a CO₂ laser system, and layering it, along with PMMA plastics, over a gold-coated glass slide. The slide was patterned with a self-assembled monolayer of biotin-alkyl-thiol and passivated with non-fouling polyethylene glycol-thiol. The final channel dimensions were 60 mm by 2.5 mm by 0.064 mm (total channel volume ~10 µL). Chip inlets were interfaced with a pump system in order to control fluid flow. Small volumes (100µL) of streptavidin, biotinylated capture antibody, mouse IgG as a target analyte, and QD-antibody conjugates were then sequentially flowed into the

channel. Multispectral imaging was used to analyze QD fluorescence of the sandwich immunoassay region. Using this assay, we have currently achieved detection as low as 70 pM of model analyte in PBS buffer.

Smart Adhesive FimH Regulated by Mechanical Force to Aid Endoscopic Capsule Mobility

Kimberly Tran, Senior, Bioengineering

Mary Gates Scholar

Mentor: Wendy Thomas, Bioengineering

Endoscopic microcapsules are small devices resembling the physical shape of a capsule, which allow medical professionals to view the small intestine. The capsule is swallowed by the patient, passes through the digestive tract and saves image data for the analysis and diagnoses of a range of diseases related to the small intestine. Despite the great advantages of microcapsules, success rates in detecting diseased areas are still limited to approximately fifty percent. The low success rate for disease detection arises from the microcapsule's passive nature (without the availability for position or orientation control), thus resulting in a chance for missed diagnoses. There is a need for availability of systems control with control parameters to allow clinicians to re-examine regions of interest with full orientation on command. Therefore this project aims to address the need for microcapsule locomotion through the use of mechanically activated biological adhesion naturally expressed on the small intestinal epithelium. These biological adhesions are FimH-mediated binding to their mannose binding sites and are intended to be coated around microcapsule limbs. FimH proteins are naturally expressed on most intestinal bacteria with a high-affinity binding state that is shear induced. The use of adhesive material FimH can be utilized to initiate catch bonds to bind robotic limbs to intestinal epithelium and guide the "walking" movements of endoscope instruments.

Development and Characterization of Novel Alginate Scaffolding Material with High-precision Pore-size and Thin Chitosan Coating For Human Finger Tissue-engineering

Arnold Kim, Senior, Bioengineering

Mary Gates Scholar

Mentor: Christopher Allan, Orthopedics and Sports Medicine

Mentor: Buddy Ratner, Bioengineering

In tissue engineering, a biodegradable scaffold serves as a temporary support until tissue regeneration is completed. Here we report the formulation of a novel scaffolding material made of chitosan and alginate with a highly precise pore-size for the use as the base material of an implantable human finger tissue-engineering construct. Chitosan is a non-toxic, biodegradable, natural polymer derived from chitin (a main component of crustacean exoskeleton). Chitosan is considered by many to be a good

bone and cartilage tissue-engineering material as it contains various chemical groups present in cartilage, even though it alone has poor mechanical strength. Alginate is a natural polysaccharide derived from brown sea algae. In addition to being non-toxic and biodegradable, its gel-forming ability in the presence of divalent cations (e.g. Ba²⁺, Ca²⁺) makes it a good matrix forming material. A hybrid of chitosan and alginate has been shown to possess desirable characteristics as a tissue-engineering material that are unattainable by chitosan and alginate alone. Porous chitosan-alginate has been previously prepared by lyophilization. While these materials have been shown to be a good scaffolding material for cartilage and bone tissue engineering, the conventional preparation techniques allow for minimal control over pore-sizes. We hypothesize that this lack of control over pore-sizes may result in the suboptimal angiogenesis, which is important in healing and regeneration. In the duration of the research project, we have developed a novel alginate tissue-engineering material, coated with chitosan that has highly controlled pore-size as the base material for a human digit tissue-engineering construct. A mouse implant study has been set up to compare angiogenic properties of the novel scaffolds with that of conventional, lyophilized scaffolds. Prior to the implant study, all materials have undergone cytotoxicity and endotoxin test which screen for any leachable toxins and residual remnant of bacterial cell walls, respectively. In parallel with the implant study, SEM and DVI images of the new scaffolds will be taken to visualize the three-dimensional structures of these new scaffolds, and ESCA will be performed to analyze the surface composition. Finally, some mechanical testing will be performed to evaluate their stiffness and yield strength.

SESSION 1F

COMMUNITY DEVELOPMENT, LAND RIGHTS AND IDENTITY

*Session Moderator: Dennis Ryan, Urban Design & Planning
Mary Gates Hall Room 242*

*Note: Titles in order of presentation.

Fomenting Community Consciousness in the Ixil: NGO Rural Development in the Highlands of Guatemala

*Alyson Dimmitt, Senior, International Studies and
Community, Environment & Planning
Mary Gates Scholar*

*Mentor: Wolfram Latsch, International Studies
Mentor: Deborah Porter, International Studies*

Secure land rights are widely recognized as the foundation

of rural poverty relief, yet effective implementation of land reform programs has eluded the post-conflict government of Guatemala. The successful community development work of Agros International, an NGO using land ownership to facilitate agriculturally-based development in the Guatemalan highlands, begs for an examination of the intriguing success of the private sector in this field. Based upon concurrent examinations into the history of the Ixil region and Agros methodology, the cultural significance of spirituality and land as historic forces of transformation and provision for the Ixil people become central to the development methodology of this NGO. Analysis of interviews of Agros village members reveals the centrality of land and spirituality to the identity of the project participants. When included in the methodology of village development, these elements foment a community consciousness that sustains the success of village projects. Thus, Agros' inclusion of land ownership and spiritual practice as culturally significant elements that cultivate community become the distinguishing factor in their success. This specific study highlights the potential for NGOs to facilitate rural development based on land ownership in unexpected post-conflict regions based upon a simultaneous fomentation of community.

Sacred Lands in a Profane World: Fencing in Spirituality at the Bighorn Medicine Wheel

*Robyn Rossmeisl, Senior, Post-Baccalaureate, Art
History, Western Washington University
Mentor: Julia Sapin, Art History, Western Washington
University*

The unification of religion and land is a foreign concept to those living in a Judeo-Christian cultural framework. As Gregory Campbell and Thomas Foor have pointed out in their work, Native American religions are often land-based and utilize the earth to gain access to spiritual and supernatural realms. In contrast, Euroamerican worldviews value land according to its productivity in minerals, crops, or money. The designation of Wyoming's Bighorn Medicine Wheel as a National Historic Landmark altered the physical nature of the site to accommodate tourism; specifically, the placement of fences in the vicinity has drastically disturbed the sanctity of this religious site. Matthew Liebmann's study of the Medicine Wheel and its location on Medicine Mountain within a cultural context illustrates how the Medicine Wheel derives much of its spiritual significance from the landscape. In this presentation, the examination of several photographs of the Medicine Wheel throughout time demonstrates how the fences used to protect the Medicine Wheel disturb the site's connection with its sacred landscape. The fence affects both physical and metaphysical aspects of Native American spirituality. The fence physically breaks the bond between the Medicine Wheel and the landscape, denies access to the site, and alters the act of worship. Metaphysically, the fence communicates beliefs of ownership and trespassing that were not intrinsic

to the area, and is used to appropriate the site for tourism. Across the United States various sacred sites are undergoing changes similar to the Bighorn Medicine Wheel. By understanding and acknowledging the intimate relationship that exists between the spiritual and the secular in Native American religions, those unfamiliar with Native American spirituality can better appreciate the vitality and importance of these sacred landscapes.

The Origins of Property Rights in the United States Old Northwest: A History of Land in the Ohio Valley from 1760-1790

*Sandley Chou, Senior; History and International Studies
Mentor: Richard Johnson, History
Mentor: Bob Stacey, History*

Land ownership and title in the Ohio Valley was vague under French colonial rule in the 16th-17th century and remained vague when the British seized control of the area in the mid 17th century. Disputed claims, squatters, and Indian controversies further hazed a clear concept of property rights in the Ohio Valley until after the Revolutionary War, when the newly formed young United States republic began aggressively legitimizing land holdings. My study attempts to explain how the United States succeeded in developing clear property rights in the Old Northwest where the French and British had previously failed. Through the analysis of documents left behind from different land companies placed in charge of distributing land, state and federal government letters dictating land cessions and military letters, I have built upon past historical work to write a brief history of land in the Ohio Valley with particular attention paid to the late 18th century. The United States was able to develop small landholders in the Old Northwest with clearly marked property boundaries that paved the way towards future statehood through recognition of squatter holdings, strong territorial governments, and private entrepreneurship to aid distribution of land in legitimate fashion.

Global Silicon Valleys

*Emily Cernak, Sophomore, Business Administration
(Finance) and International Studies
Mary Gates Scholar*

*Paul Fleurdelys, Junior, Economics
Samuel Garfield, Senior, International Studies
Jessica Salo, Junior, History
Mentor: Margaret O'Mara, History*

Shenzhen, China: once a rural agricultural area, now a bustling metropolis with nineteen Starbucks retailers. Similarly, globalization and the high-tech industry have converted sleepy Bangalore into the “Indian Silicon Valley.” While Silicon Valley has been a region synonymous with innovation and high tech entrepreneurship throughout our lifetime, the industrializing world is engaging in a catch-up process. Global Silicon Valleys seeks to understand this phenomenon, or how the hunger for

and implementation of high-tech parks and the resulting economic development transform communities. By studying 1) the initial drive to industrialize and the attempts of communities to capitalize on the marketing cachet of the silicon valley label (for example, Ireland as the “Silicon Isle”); 2) the roles of national industrial and community planning and higher education policies in encouraging the proliferation of the high-tech industry; and 3) the resulting transformation of communities in the areas of high-end retail and luxury housing developments, we focus on a complementary and comprehensive set of indicators of high-tech industrialization and globalization. We focus on three cities (Bangalore, Shenzhen, and the San Francisco Bay Area) as case studies of successful high-tech economies and gather information from archival materials, scholarly literature, and more contemporary sources, ranging from corporate annual reports to community wikis and interviews with property managers to white papers and policy reports to articles from marketing materials and the popular press. In studying the efforts of communities to attract and support the high-tech industry and the resulting integration of western business principles and cultural ideals into local cultures (and the broader patterns of globalization), we hope to better understand not only the successful policies a community can adopt to foster the growth of the high-tech industry but also appreciate the effects of this industrialization on existing living patterns, consuming patterns, and traditional cultures more generally.

Won't You Be My Neighbor? Tent City 4 and the Experience of Home(lessness)

Tara Olson, Senior, International Studies

Mary Gates Scholar

Jesse DeLira, Senior, Art

Mary Gates Scholar

Salena Farris, Senior, Interdisciplinary Arts & Sciences

Mary Gates Scholar

Jamie Stroble, Senior, International Studies and Environmental Studies

Mary Gates Scholar

Mentor: Ron Krabill, Interdisciplinary Arts & Sciences, UW Bothell

In the summer of 2007, a group of University of Washington undergraduate students undertook a community collaborative research project with Tent City 4, a mobile homeless encampment in the Seattle suburbs run through democratic self-governance. Students engaged in the research project asked the following question: in terms of community collaboration, what is the best way to create an authentic body of knowledge relevant to community, home and what it is to be a good neighbor in relation to the emergent community of Tent City 4? Using visual documentation methods, students worked with residents of TC4 in an effort to construct both an art installation and a documentary film that resisted typical depictions of people experiencing homelessness while exploring the multiple, sometimes contradictory meanings of these often-invoked concepts.

SESSION 1G

DYNAMIC EARTH: EARTHQUAKE DETECTION, ENVIRONMENTAL CONTAMINATION, THE PALEOCLIMATE RECORD, AND EDUCATION

Session Moderator: David Montgomery, Earth & Space Sciences

Mary Gates Hall Room 248

Designing and evaluating a website focused on Cascade igneous rock samples of the Pacific Northwest at the University of Washington Tacoma
Susan Black, Senior, Environmental Science, UW Tacoma
Mentor: Sian Davies-Vollum, Environmental Science, UW Tacoma

The purpose of this study is to develop a website based on igneous Cascade rock samples housed at UWT and determine the educational usefulness of the website. The process of developing the website included learning how to produce a webpage, writing the verbage for the website in terms that a non-specialist can understand, emphasize rock samples from the Pacific Northwest and choose samples from the North Cascades, Mt. St. Helens, and Newberry National Volcanic Monument, the website was designed around these samples and photographs. The research also includes testing how well the website is understood by an entry-level geology class and receiving feedback from the students in the geology class on how to improve the website design. Testing of the website is based on a set of questions provided to the students. The students used the website to answer these questions on geologic time, processes, local geology, etc. Most of the students who participated in the website testing got all 10 questions correct. Evaluation of the website by the students was performed using a survey that asked how helpful and educational the website was, how it could be improved, how it could be changed, and if they would recommend it to others. The results expected from the student feedback include positive points on how the questions and website helped them better understand the geology of the Cascades. The website was updated to include geographic information of the sites, which was a suggestion from the students who evaluated the website.

Timeline of deposition and concentrations of lead in lake sediments

Shawna Donley-McClure, Senior, Environmental Science, UW Tacoma
Mentor: Jim Gawel, Environmental Science, UW Tacoma

A long industrial History in the lowlands of Puget

Sound has left the land and water with mild to severe environmental contamination. The ASARCO smelter in Ruston, Washington, now a Superfund cleanup site near Tacoma, effectively contaminated much of the south-central Puget Sound over a long hundred year history. Previous studies have shown that metal levels are elevated not only in proximity to the ASARCO smelter, but also in areas away from the smelter in the direction of the dominant wind patterns for the region. Lake sediments in the region record a timeline of metal contamination transported through the atmosphere. This study examines the spatial and temporal pattern of lead deposition to lakes in the region, and the relative role of ASARCO in local sediment contamination. The lakes studied follow trajectories consistent with the dominant wind patterns that would have carried particles emitted from ASARCO. Sediment cores from sixteen lakes were collected, digested and analyzed for Pb concentrations and dated using ^{210}Pb techniques. The sediments from the lake cores show that levels of lead increase significantly around the era of the industrial boom in Puget Sound and continue to today. Moreover, the influence of the ASARCO smelter on regional sediment contamination may dwarf other sources of lead emissions, including historical use of leaded gasoline.

Detection of Tremor in the Cascadia Subduction Zone

Jenny Hanna, Senior, Physics
Mary Gates Scholar
Mentor: Ken Creager, Earth & Space Sciences

Tremor is one of the several non-traditional types of seismic sources currently detected by the Pacific Northwest Seismic Network (PNSN) in the Cascadia subduction zone. This deep, non-volcanic tremor is associated with Episodic Tremor and Slip (ETS), which loads the offshore megathrust fault each time there is an event. Local ETS events occur on a 14-month cycle, and it is possible that the next Cascadia megathrust earthquake would be far more likely to happen during one of these events. A megathrust earthquake can be a magnitude 9 on the Richter scale, and is extremely destructive. For this reason, timely and accurate detection is key. To this end, I am attempting to modify and improve a detection algorithm that automatically scans PNSN continuous seismic records. This will be a big improvement on the current unreliable and slow analyst-detection. The program should detect and report any time when there are waveforms characteristic of tremor concurrent on 3 or more stations. By examining records from the earliest detected tremor in January 2002 to present, we hope to create an algorithm that is accurate and usable in real time. By monitoring tremor in near-real time, we can be ready for the afore-mentioned megathrust earthquake, or any other notable seismic activity. Also part of this research will be improving the methods for accurately locating the source of the tremor, as well as scanning for both low-frequency (~ 1 Hz) events (LFE) and very low frequency (~ 0.05) events (VLF). Both LFE and VLF have been found in association

with ETS in the Nankai Trench in Japan, but none have been found in Cascadia so far. Implications of LFE and VFL are as of yet uncertain. Also detectable in this way are events such as volcanic tremor and glacial sliding. All of these programs will enable us to get a more complete picture of Cascadia seismic activity, hopefully allowing us to be more prepared for future events such as a megathrust earthquake.

Validation of Mt. Waddington Ice Core Paleoclimate Record: Stable Isotope and Melt Stratigraphy Correlation

*Peter Neff, Senior, Earth & Space Sciences
Mentor: Ed Waddington, Earth & Space Sciences*

The merit of polar ice core retrieval and analysis is well established as a method for generating high-resolution records of past climate. Ice coring sites at temperate latitudes remain largely unexplored, yet can yield similar paleoclimate records. While such records will be more limited in length than those from polar regions, they can augment the instrumental climate record, providing a means to examine climate variability on decadal to century timescales. The North Pacific region, which is data poor and rich in decadal-scale variability, is of particular interest. A new ice core site at Mt. Waddington, British Columbia, Canada, has the potential to deliver high-resolution data over the last 200-1000 years. Detailed study of a 65-meter core taken from the Mt. Waddington site reveals that, despite some summer melting at the surface, resolvable visual melt-stratigraphy and water stable isotope records are preserved. Low isotope ratios correspond with core sections containing few melt layers, while high isotope ratios match with melt-heavy sections. This relationship is consistent with the expected seasonal correlation between water stable isotope ratios and air temperature. The results indicate that there is preservation of annual stratigraphy, suggesting that Mt. Waddington is an excellent site for ice core studies and argues in favor of retrieving a complete ice core record to bedrock (~200 meters).

SESSION 1H

INNOVATIVE METHODS OF EVALUATING AND TREATING ILLNESSES

Session Moderator: Amy Cizik, Orthopaedics and Sports Medicine

Mary Gates Hall Room 251

Spatio-temporal modeling of hypoxia and glucose metabolism in human gliomas

Gargi Chakraborty, Senior, Neurobiology and Biochemistry

*Washington Research Foundation Fellow, Mary Gates Scholar
Mentor: Kristin Swanson, Pathology*

Mathematical modeling presents a new tool to understand time and space dependent functions in biology. Modeling the growth of gliomas, which are primary brain tumors, involves quantifying their diffuse and proliferative capacity. These properties can be assessed *in vivo* through non-invasive imaging techniques, which include Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET). The current mathematical model developed by Dr. Kristin Swanson is based upon the Fisher equation and utilizes MRI scans from two time points to determine velocity of tumor growth. The purpose of this study is to enhance the Swanson model by incorporating metabolism within and outside the clinically defined tumor region. Two characteristic metabolic activities exhibited by gliomas include up-regulation of glycolysis and hypoxia (state of low oxygenation). These functional activities can be quantified via PET imaging using [18F]-Fluorodeoxyglucose (FDG) to monitor glucose uptake and [18F]-Fluoromisonidazole (FMISO) to monitor hypoxia. Using combinatorial imaging for *in vivo* studies, we have spatially localized regions of excessive glycolysis and oxygen depletion. Currently, we are developing a model to characterize spatial and temporal changes in peak metabolic activity driving tumor growth. This model incorporates heterogeneity of grey and white matter within the brain and the microenvironment of the tumor. Our goal is to develop simulations that mimic future FDG and FMISO PET scans based on original PET imaging conducted at the time of diagnosis. This mathematical model will allow early assessment of tumor behavior and prediction of its spatio-temporal spread enabling patient-directed treatment of gliomas.

Three-Dimensional Modeling of the Osteocyte Network

Chao Huang, Senior, Bioengineering

Mentor: Ted S. Gross, Orthopedics and Sports Medicine

Osteoporosis is a leading cause of death among senior citizens; it is therefore essential to study the mechanisms of bone growth. Intercellular communication through the gap junctions that join osteocytes (cells responsible for bone formation) is believed to play an important role in how bone responds to external stimuli. While previous studies have demonstrated that increased stimulus through mechanical loading begets increased bone mass, it has been observed that such a relationship is nonlinear, as the bone's response rapidly saturates. Our lab is investigating alternative solutions for augmenting the bone's response, and one of our most surprising results is that an unloaded rest interval inserted between loading cycles substantially increases bone mass. Because of the bone's nonlinear response to external stimuli, we hypothesize that the osteocyte distribution is not uniform throughout the loaded and unloaded parts of the bone. To verify this hypothesis, I have developed a protocol that combines hematoxylin and eosin staining with light microscopy to image viable osteocytes within a given cross-section of murine cortical bone. Using the acquired images of successive z-axis bone cross-sections, I have designed a MATLAB program that quantifies the spatial (x, y, z) coordinates of the osteocytes to produce an accurate 3-D representation of the osteocyte network morphology. The program employs a graphical user interface, allowing users to easily piece together separate images into one whole bone cross-section. After the z-axis bone cross-sections are reconstructed, the program stores each successive cross-section's cell locations and displays the osteocytes in a 3-D scatterplot that shows where osteocytes are located in relation to one another. Attaining a graphical sense of how the osteocyte network changes in response to outside forces will aid our lab in understanding the same cellular mechanics that occur during bone formation.

Glioblastoma Concurrent Chemoradiation: Synergy of Chemotherapy and Radiotherapy

Jennifer Kristjansson, Senior, Neurobiology and Biology (Molecular Cellular & Development)

Mentor: John Silber, Neurological Surgery

Combination radio- and chemotherapy shows great promise in Glioblastoma treatment; however, this new therapy standard is not a cure, and its effectiveness varies widely from patient to patient. Radiation therapy leads to DNA breaks by producing reactive oxygen species, which attack the DNA backbone. The current chemotherapy drug of choice, temozolomide, acts by methylating DNA at the O6 position on guanine, a modification easily repaired by O6-methylguanine-DNA methyltransferase (MGMT) and mismatch repair machinery. Research has shown that the effectiveness of combined therapy is largely dependent on

an intact mismatch repair mechanism, as well as on MGMT activity. We hypothesize that the presence of the altered base O6-methylguanine (produced by temozolomide) and the activity of functional DNA mismatch repair is required to achieve the synergistic effect and that temozolomide treatment must precede radiation treatment. Tumor cell killing power is measured by comparing levels of phosphorylated core histone protein H2AX, which is phosphorylated to gamma-H2AX in response to DNA double-strand breaks. Double-strand breaks are correlated with cell death. We expect to find increased gamma-H2AX in tumor cell lines lacking MGMT activity that still have mismatch repair, but not in those with intact MGMT or lacking mismatch repair. We also predict that gamma-H2AX levels will be higher in cells treated with temozolomide before receiving clinical levels of radiation (2 Gy gammarays). We hope to vary the dosage and timing between chemotherapy administration and radiation treatment to determine the combination required to achieve maximum therapeutic effect.

Needle "microscope" for optical biopsy of the pancreas

Jason Padvorac, Senior, Bioengineering

Mary Gates Scholar

Mentor: Xingde Li, Bioengineering

A needle imaging probe is being developed to allow minimally invasive, highly accurate diagnosis of pancreatic cancer. Optical Coherence Tomography (a type of laser imaging) will be used to take microscopic images from the tip of an optical fiber inside a hypodermic needle. Using this probe will give doctors enough information to make a diagnosis without introducing the risks of a major biopsy. This is important because pancreatic cancer is almost always diagnosed after it has advanced to an incurable stage. Better diagnostic technology will lead to earlier diagnoses, allowing doctors to better treat their patients.

Effective Cancer Treatment Comparison: Calibration Phantom Analysis Project

Yogesh Salelore, Junior, Computer Science and Bioengineering

Mary Gates Scholar

Mentor: Paul Kinahan, Radiology

We are continuing research to implement a display and analysis tool to be used with a calibration phantom for medical imaging scanners. Medical imaging using dual-mode positron emission tomography and x-ray computed tomography (PET/CT) scanning is an effective method of diagnosing cancer, but inherent variations between scans can lead to data that does not always indicate whether the cancer therapy is having the desired effect. We propose to use a calibration phantom, a solid plastic/epoxy container with spheres of radioactive germanium, as a reference control in cross-calibrating different scanners. Our hypothesis is we

can utilize the contrast of CT images to determine consistent and accurate estimation of key parameters in PET images. First, a parser was created to read in the DICOM file format used for medical image data transfer. The second phase is to find the regions of interest (ROIs) encompassing the spheres within each 3-dimensional image. Our plan is to use the Otsu threshold to take advantage of the high contrast in the CT images to localize each sphere. These can then be used as masks on the PET image to find each spherical ROI. The average and maximum radioactivity levels of each sphere can be collected and compared to levels detected in images from other scanners. This data will serve as the basis for the cross-calibration. Manual analyses conducted by our lab indicate that the variability is indirectly proportional to the size of the phantom's spheres, and we expect our automated analysis tool to corroborate these results. We believe the automated analysis will be robust and efficient, enabling analysis of large data sets while removing any manual error in the analysis. Our results can then be used to allow for a more reliable comparison of PET/CT images, and a more accurate diagnosis of cancer treatment effectiveness.

Diagnosis and Management of Pregnancy-related Sarcomas

Mailinh Vu, Post-Baccalaureate, Biochemistry

Mentor: Ernest Conrad III, Orthopaedics & Sports Medicine

Mentor: Amy Cizik, Orthopaedics & Sports Medicine

Sarcomas are musculoskeletal tumors that arise from mesenchymal cells and affect less than 1% of the adult population diagnosed with cancer. The incidence of gestation-related sarcomas is even less frequent, appearing in approximately 0.07 to 0.1% of all pregnancies. The paucity of these bone and soft-tissue tumors has resulted in limited medical experience in managing them, thus making it difficult to standardize diagnostic and therapeutic approaches. General methods of treatment have included surgery, chemotherapy, and radiation therapy. These modalities in combination have demonstrated increased efficacy. However, in pregnancy cases, the concern for fetal well-being must also be considered when planning a treatment strategy best-suited for the patient. It has been generally accepted that surgical intervention can be utilized in most pregnancy cases without harm to either the mother or fetus. On the other hand, the safety of administering chemotherapy during pregnancy has been greatly debated. From our sarcoma database, we retrospectively identified a small subset of women (N=11) who presented with tumors either during the time of pregnancy or within a month post-partum. For these patients, gestational intervention ranged from no treatment to combined surgery and chemotherapy. All identified patients underwent successful delivery of healthy infants. The purpose of this study is to describe our institution's methods of handling pregnancy-related sarcoma cases and to compare the outcomes to similar literature. It has been demonstrated that a multi-disciplinary approach

to the management of sarcomas during pregnancy offers the most promise for accurate diagnosis and effective treatment. With the diverse tumor classifications and tumor sites, the medical team should tailor its treatments specifically to each patient. In most situations, pregnancy-related sarcomas can be successfully managed with early surgical intervention. If chemotherapy is administered, it is usually only in the third trimester, as this is the lowest risk period for the fetus.

SESSION 11

MEDIA, POWER, AND THE POLITICAL SYSTEM: COMPARING ACROSS NATIONS

Session Moderator: Matt Barreto, Political Science

Mary Gates Hall Room 254

Community Organizing, State Power and Democracy in Latin America

Alexandria DeLong, Senior, International Studies and Spanish, Seattle University

Mentor: Robert Andolina, International Studies, Seattle University

While most observers of Latin American democracy focus on its institutional stability or instability, this paper highlights how crisis of representation in Latin American countries provide incentives and opportunities for experimentation with new forms of community organizing and grassroots democracy. Drawing upon personal fieldwork in Venezuela with Global Youth Connect, independent media material and numerous secondary sources, this essay compares and contrasts such political processes in Venezuela and Argentina over the past ten years. Focusing on these two countries to reveal distinct outcomes, it examines these unique Latin American examples where social movements are strong forces of political change. Whereas the Chavez administration in Venezuela has supported a cooperative interaction between the state and civil society by promoting the formation of community councils, Kirchner's government in Argentina co-opted popular organizations to the advantage of state control at the cost of civil society's autonomy. The Venezuelan case shows how the executive branch and civil society associations may reinforce each other's power, while Argentina reveals that such interaction can weaken both entities. As political confidence crumbled in Venezuela, Chavez swept in to write popular power into the new constitution. The president's support base is now heeding the call to organize itself and communicate its needs to the executive. In Argentina, political and economic elites were discredited as the economy plunged and the middle class questioned the efficacy of prevailing political parties.

With widespread unemployment and a lack of electoral solutions, citizens looked to each other for support by creating neighborhood assemblies from 2001 to 2003. Since then, however, community organizations in Argentina began to divide ideologically and succumb to external political manipulation. These two cases reflect distinct responses to political crisis of representative democracy as well as the advantages and disadvantages of state and political party influence in popular organizing.

Electronic media as a new democratic forum and moderator of state-society relations in Egypt

*Christine Dulaney, Senior, International Studies
Mentor: Shaun Lopez, History*

Oppressive regimes exist in every part of the world, sometimes even under the guise of democracy. As part of the State of Emergency Laws that have been in effect in Egypt since the assassination of President Sadat in 1981 political expression has been limited. Furthermore, elections practices have been questionable and the belief is commonly held that elections are manipulated. However, in the past, civil society groups have had the power to influence the state. The government can avoid unrest and derive some legitimacy by allowing these groups to have influence. It raises the question as to whether these groups have influence only because the government allows them to or whether they constitute a democratic forum for influencing the state. After spending four months in Egypt conducting interviews and research on state control and the ability of society to influence the state, I found that electronic forums have created a new channel through which society's voice can be heard. Issues such as censorship of the press and police brutality, to which society has no recourse, can be exposed through these electronic channels and addressed by international organization with the power to influence the Egyptian state externally. The data will be collected from these electronic forums such as blog sites, civil society groups in Egypt, international organizations, media sources and interviews. Through this collection and analysis I hope to measure the success of these electronic forums and the scope of their influence on the state.

Shifts in Language Addressing Domestic Terror Pre and Post 9/11 in Media Discourse

*Sophia Le, Senior, Communication and Political Science
Mary Gates Scholar*

*Mentor: Taso Lagos, Communication
Mentor: Peter May, Political Science*

Conveying fear and threat has been nothing that's new to the scholarship behind studying the media. Symbols that evoke these emotions are easily conveyed in the media due to its power to emphasize specific situations in allowing for viewers to understand its intensity. In discussing fear in circumstances relevant to the present day, the concept of terror has become very relevant to the nation due to

the events of September 11, 2001. This study examines language shifts in how domestic terrorism is portrayed in newspaper editorials from the New York Times and the Washington Post over a span of twenty years, 1988 - 2007. This research involves doing a content analysis of all articles under the search string of "terror" and analyzing the language that is used in covering stories surrounding various attacks on the nation through tone, scope, and types of terrorists identified. While the events will be all different, the nature of the language used to emphasize the events still invoke a fear element. Due to the implications of media's tendency to magnify threats, this study is relevant to the readers of the print media because of the possibility of being persuaded to believe that a threat is more pronounced than truly is.

Press Openness in China: A Comparative Analysis of Newspaper Coverage of Labor Dispute

*Vi L. Nhan, Senior, International Studies, Political Science
Mentor: Susan H. Whiting, Political Science*

The People's Republic of China, governed by the Chinese Communist Party, has arguably one of the most restrictive media systems in the world. The government censors all venues of media to maintain its monopoly on power and information while pushing ambitious economic modernization projects. However, there have been signs of liberalization and marketization of the media in response to these reforms. Given the conservative nature and the control of the CCP, why does the Chinese press seem to be more daring and critical in its reporting in the recent years? The current debate in the field is between commercialization as a decrease of party control and commercialization as a different form of party control. Besides touching on the legal, political, and economic structures in which Chinese media exist, my hypothesis attempts to bridge the two sides of the debate. The research focuses the portrayal of labor disputes in the press as a manageable window into the larger world of censorship. This involves a comparative analysis of labor disputes coverage in 2000 between the two different sources of information available to the readers, an official and a semi-commercial newspaper, in the Shandong Province. The research method utilizes content analysis and discourse analysis to identify specific characteristics of messages that would denote the degree of editorial/journalistic freedom. My hypothesis is that due to commercialization, the Chinese press has been more daring and critical toward the government but within certain boundaries. Semi-commercial papers are more commercial; therefore, I expect them to be more critical toward the government and government institutions. Conversely, official papers are less commercial and more in line with the Party; therefore, I expect them to be less critical. By looking at the discrepancy, or the lack thereof, between types of papers, one can achieve a more nuanced understanding of the changing role of the press in China.

Building a Movement for Transnational Justice: The Activism of the KDP in Seattle

Michael Schulze-Oechtering, Senior, American Ethnic Studies and History

Ronald E. McNair Scholar

Mentor: Rick Bonus, American Ethnic Studies

My research focuses on the Union of Democratic Filipinos (KDP), a Marxist and anti-imperialist organization that emerged in the Filipino American community in 1973 and lasted till 1986. I examine the activism of the KDP through their work in a trade union for Alaskan cannery workers, International Longshoremen and Warehousemen Union (ILWU) Local 37. Within the local 37 KDP members built a movement that addressed exploitation of Asian and Native Alaskan workers. At the same time KDP members also worked to build a movement within the local 37 that took a political stance that condemned the dictatorship of Ferdinand Marcos in the Philippines. I examine the local and international activism of the KDP to further understand how to build a movement for transnational justice. I approach my research question through a historical analysis of corruption in the canneries. Then I detail a reform movement that combated corruption as well as the work of the local 37 to make connections with trade unions in the Philippines that opposed the Marcos Dictatorship and US imperialism. I put the repression of KDP activists by both the US and Philippine government in context with other vocal US activists that connected the oppression people of color and working class people in the US to the international oppression of the third world. I argue that the activism of the KDP provides a political framework that we can apply to oppression today; if oppression exists on a global scale then a collective response should exist on a global scale.

SESSION 1J

MOLECULAR INSIGHTS INTO EVOLUTIONARY PROCESSES

*Session Moderator: Billie Swalla, Biology
Mary Gates Hall Room 271*

The role of a mitochondrially targeted homologue of RecA in *Arabidopsis thaliana*

Andy Nam, Junior, Biology

Mentor: Arnold J. Bendich, Biology

All organisms are prone to DNA damage. The RecA protein of *Escherichia coli* is essential for DNA maintenance, repair and homologous recombination. Structural and functional homologues of *E. coli* RecA are present in all organisms.

The nuclear genome of the model plant, *Arabidopsis thaliana*, encodes RecA homologues that are targeted to mitochondria. In mitochondria, reactive oxygen species that are generated as a byproduct of ATP production may damage mitochondrial DNA (mtDNA), which is potentially repaired using RecA. We are investigating the role of one of the mitochondrially targeted RecA homologues, AT3G10140, in the maintenance of mtDNA. In wild type plants, mtDNA is present in complex branched forms and small linear forms as determined by pulsed-field gel electrophoresis (PFGE). We are isolating homozygous T-DNA insertion mutations in the mitochondrially targeted RecA. PCR-based genotyping identified three homozygous mutant lines. The structural forms of mtDNA from these mutants will be compared to their wild-type siblings using PFGE. If mitochondrially targeted RecA is integral to the maintenance and repair of mtDNA, we expect to see a marked difference in mtDNA structural forms between mutant and wild-type plants.

Phylogeny and Evolution of the Verbenaceae: Evidence from Chloroplast and Nuclear DNA Sequences

Hannah Marx, Senior, Plant Biology

Howard Hughes Medical Institute Biology Fellow, Mary Gates Scholar

Mentor: Richard Olmstead, Plant Molecular Systematics & Evolution

Historically, the family Verbenaceae has been a large and poorly defined group due to the wide range of morphological characters and geographical distribution. Previous studies have removed many genera of the traditionally recognized Verbenaceae to the family Lamiaceae, and redefined Verbenaceae to be a smaller monophyletic group comprised of 4-7 tribes with 34 genera and 1200 species. Verbenaceae include small forest trees, shrubs, herbs, and lianas. The family is predominantly found in the New World, with a few groups in Africa and Madagascar, and occurs in habitats ranging from wet tropical forests to temperate deserts and high Andean ecosystems. Economically, they have been used for wood, as ornamentals, and for herbal and medicinal purposes (e.g., secondary compounds present in species such as *Aloysia citriodora*, Lemon Verbena, have been used for scents and digestive aids). We aim to produce a detailed molecular phylogeny using data from the chloroplast and nuclear genomes that may be used to answer systematic and evolutionary questions concerning the family, such as the monophyly of tribes circumscribed by conventional taxonomists based upon morphological characters. Using field-collected leaf tissue from the United States, Cuba, Puerto Rico, Nicaragua, and Argentina, as well as herbarium specimens, we have included 83 taxa representing 32 genera for *ndhF* and *trnL-F*. Here we present a phylogeny of Verbenaceae, displaying a polyphyletic relationship of traditionally circumscribed tribes.

On the origin of species: The genetic basis of reproductive isolation in monkeyflowers

Brian Christensen, Senior, Biology

Mary Gates Scholar

Mentor: Toby Bradshaw, Biology

Reproductive isolation is the most important process in the divergence of two species from a single common ancestor because it creates a barrier to gene flow between populations. By studying the genetic mechanisms that lead to reproductive isolation (and therefore to speciation) in sympatric species, we can discover more of the process of evolution on a genetic level. Two sympatric species of monkeyflowers that recently diverged in their evolutionary histories due to reproductive isolation are *Mimulus cardinalis* and *Mimulus lewisii*, species that have marked distinctions in their flower morphologies. *M. cardinalis* has a narrow red and yellow flower pollinated by hummingbirds and *M. lewisii* has a wide pink flower pollinated by bumblebees. Prior research has shown that floral traits, including flower color, cause nearly all of the difference in pollinator preference, and therefore the reproductive isolation, between these two species. Although just four genes are believed to control most of the divergence in flower color between *M. cardinalis* and *M. lewisii*, none of these “speciation genes” have been cloned and characterized at the molecular level. However, I have recently discovered and genetically mapped the YELLOW LOWER (YLO) gene that regulates the deposition of yellow carotenoid pigment in the lower epidermis of the *Mimulus* flower. Using newly-developed SNP genetic markers, physical maps of overlapping BAC clones, and the whole genome DNA sequence for the closely-related *Mimulus guttatus*, I will positionally clone the YLO gene. I will then characterize the YLO alleles from *M. cardinalis* and *M. lewisii* and assess its contribution to reproductive isolation by measuring the effect of each type of YLO allele on pollinator preference in nature. By studying monkeyflower floral adaptations, we can ascertain genetic mechanisms causing reproductive isolation and speciation on a much broader scale.

Rapid Evolution of Reproductive Proteins

Eric Nguyen, Junior, Biology, Computer Science and Philosophy

Amgen Scholar

Mentor: Willie Swanson, Genome Sciences

Proteins involved in reproduction have numerous effects on reproductive responses, including female behavior modification, pathogen defense, and sperm storage. Due to competition between these proteins and others encountered during mating, they are likely to be subjected to coevolutionary forces, resulting in rapid adaptive evolution; this pattern of evolution has been shown to be the case across wide taxonomic ranges. In a screen for this pattern in rodents, a number of mouse prostate proteins were selected based on their ratio of non-synonymous (changing protein

sequence) versus synonymous (silent) mutations between mouse and rat. An analysis of these proteins revealed a group of seminal vesicle secretion (Svs) genes potentially under selection. One of these genes, Svs7, is evolving very rapidly, with many amino acid sites under selection. This adaptive evolution is occurring in rodents and humans, and the same region of the protein is under selection in both groups. These regions are located on the surface of the proteins, which is to be expected given that surface residues are more likely to interact with other proteins. More research into rapidly evolving reproductive proteins should yield novel information about the mechanisms of speciation, as well as clarify which reproductive genes are most functionally important. Additionally, since disease genes are often associated with positive selection, such study should provide insights into the mechanisms of disease evolution.

Characterization of a toll-interacting protein (TOLLIP) gene in the Black Abalone (*Haliotis cracherodii*)

Cullen Taplin, Senior, Aquatic & Fishery Sciences
Mentor: Steven Roberts, College of Ocean & Fishery Sciences

The Black abalone (*Haliotis cracherodii*) is a commercially valuable single shelled gastropod inhabiting the intertidal zone along the west coast of North America. In recent decades, populations along the California coast began to experience significant declines. While physical factors such as over-fishing and increased water temperature likely played a role in this decline, a bacterial infection known as withering syndrome was found to be the major contributor to black abalone mortalities. Some abalone infected with the pathogen, a Rickettsiales-like prokaryote, have mortality rates significantly lower than cohorts in other locations. This suggests that the immune system in some abalone could have evolved to become more resistant to withering syndrome. The goal of this research is to better understand the abalone immune response at a molecular level. In order to identify immune-related genes in the black abalone, expressed sequence tags from other species of *Haliotis* were functionally annotated and used to design primers for PCR amplification. PCR products were then sequenced and identified using sequence comparison techniques (i.e. BLAST). One novel gene identified was a toll-interacting protein (TOLLIP) transcript (GenBank Accession EU408785). This protein is involved in the toll-like receptor signaling pathway, a conserved pathway producing proinflammatory cytokines. The deduced amino acid sequence of this partial gene sequence has 64% similarity with TOLLIP in mice. Quantitative RT-PCR was carried out digestive tissue of infected and control abalone and revealed differential expression of abalone TOLLIP across groups. These combined data suggest the toll-like receptor signaling pathway plays an import role in the abalone immune response and could be related to disease resistance in this species.

Genomic Imprinting in the Canine: An Evolutionary Approach

Jillian Buchan, Senior, Biology (Molecular, Cellular & Developmental)

Mentor: Kay Nolan, Biology & Environmental Science, University College Dublin

Genomic imprinting is a form of gene regulation where epigenetic modifications result in differential expression of an allele based on the parent-of-origin. The imprinted gene M6P/IGF2R has been studied almost exclusively in the mouse, revealing gene expression from only the maternally-derived allele. Studies show an antisense IGF2R RNA (Air) transcript is produced from intron 2 of the paternally-derived allele that prevents transcription of M6P/IGF2R. The Air transcript is vital for monallelic expression of M6P/IGF2R in the mouse; however it was not associated with the imprinted M6P/IGF2R in marsupials, such as the opossum. Therefore, studies of M6P/IGF2R imprinting in Carnivora, an order located between mice and marsupials on the phylogenetic tree, could provide further insight into the conserved elements of the regulatory mechanism of M6P/IGF2R imprinting. Previous research in the lab identified that M6P/IGF2R is imprinted in the canine, *Canis familiaris*, a member of Carnivora. In the canine, no Air transcript was expressed from intron 2, indicating a mechanism unlike the mouse and more similar to the opossum. However, low levels of mRNA expression were found in two intergenic regions between M6P/IGF2R and the nearest upstream gene, MAS1. To see if this expression could represent canine Air, canine genomic DNA samples were sequenced for polymorphisms in the two intergenic regions. Using heterozygous individuals, cDNA was sequenced from the regions to determine if the mRNA expression represented monoallelic expression or biallelic expression. Unexpectedly, some individuals showed monoallelic expression, while others had biallelic expression. In the case of one individual with monoallelic expression, the intergenic transcript appeared to represent the maternally-inherited allele. More research is needed to determine the nature of the transcription observed in the canine M6P/IGF2R-MAS1 intergenic region and its relationship (if any) to the monoallelic expression of the imprinted canine M6P/IGF2R.

SESSION 1K

DIACHRONIC EXPRESSIONS OF RELIGIOUS AND LITERARY CONCEPTS

*Session Moderator: James Clauss, Classics
Mary Gates Hall Room 284*

The History and Transmission of the Trisagion in Eastern and Western Liturgy

Susan Bilynskyj, Senior, Classics, Seattle Pacific University

*Mentor: Owen Ewald, Classics, Seattle Pacific University
Mentor: Santha Bhattacharji, English, Seattle Pacific University*

The Trisagion is one of the most ancient hymns of the Christian liturgy, and the history of its development, transmission, and theological interpretation is complex. The earliest evidence for the use of the Trisagion dates from the fifth century AD. In one legend, the Trisagion was a penitential hymn recited for the preservation of Constantinople during an earthquake; the hymn was later adopted into the Byzantine liturgy at Constantinople and other Eastern forms of the liturgy. In the East, the Trisagion proved to have an inflammatory early career due to disagreement as to whether it was Christological or Trinitarian in nature, and whether certain additions were orthodox or heretical. The accepted form of the Trisagion in the Byzantine liturgy includes the addition of a Trinitarian doxology for regular use on Sundays. In the West, however, the Trisagion has a more irregular history. Byzantine influence on Southeast Gaul led to its use in the Gallican liturgy, but it is unclear to what form of the Trisagion these missals refer, and whether the form was Christological or Trinitarian in purpose. In the West, the Trisagion became connected with the Good Friday service of the Veneration of the Cross, a service also borrowed from Eastern rites. This use of the hymn as penitential and directed toward the crucified Christ has become the prevailing interpretation of the Trisagion in the modern Western liturgy, even in recent developments as in the Chaplet of Divine Mercy. The Trisagion remains Trinitarian in the Byzantine liturgy, but in a later development independent of the Western rites, the Trisagion appears at a service commemorating the burial of Christ, reflecting its penitential origins centuries ago in the East.

Putting Your Faith Where Your Mouth Is: Intrinsic Religious Motivation and Moral Behavior

Tom Carpenter, Senior, Psychology, Seattle Pacific University

Trustees' Scholar, Philip W. Eaton Scholarship

Mentor: Margaret Marshall, Psychology, Family & Community, Seattle Pacific University

The current study examines the relationship between intrinsic religious motivation and moral choice behavior in the presence and absence of cognitive priming. Past research on moral motivation has found little behavioral evidence for intrinsic moral motivation (motivation to practice one's moral commitments for their own sake). However, this research has shown that people who endorse moral attitudes on surveys do possess a desire to appear moral to themselves and others. Because one can feel and appear moral without consistently acting on one's principles, this leads to moral hypocrisy: a disconnect between one's principles and behaviors accompanied by strong verbal commitment to those principles. Such instrumental moral motivation maximizes personal benefit while minimizing cost. Gordon Allport's theory of religious motivation (1967), posited that those with intrinsic religious motivation have a genuine internal commitment to live out their religious beliefs, including affiliated moral commitments. In the present study, we examined a behavioral indicator of intrinsic religious motivation, utilizing the moral motivation paradigm with a Christian population. Our goal was to determine if self-reported intrinsic religious motivation is truly intrinsic or predominantly instrumental. We also tested whether cognitive priming—exposing some participants to stimuli that reminded them of their religious commitments—had any significant impact on behavior in this paradigm. This has not been the case in prior research on moral motivation, although past research on intrinsic religiosity suggests that priming may be important for it to be fully effective. In a sample of 102 participants, preliminary findings suggest the presence of genuinely intrinsic religious moral motivation: in a religious prime condition, individuals scoring higher in intrinsic religiosity were more likely to act on their moral commitments even at cost to themselves, in private. This suggests that intrinsic religious motivation functions differently than moral motivation as previously explored in past research.

Wit, Charm, and Control in Plautine Comedy

Cortney Norris, Senior, Latin and Greek

Mary Gates Scholar, Harvey Densmore Scholar,

Jim Greenfield Scholar

Mentor: Catherine Connors, Classics

In this paper I explore the ways that the 2nd century BC comic playwright Plautus uses the word *lep(idus)* throughout his corpus of 21 extant plays. *Lep(idus)* has been widely studied for its programmatic and historically important usage in late republican Latin authors, and in particular

Cicero and Catullus. While scholars have generally dismissed its use in Plautus, the characteristics encompassed by *lep(idus)* -- wit, charm, trickery, and cleverness -- are essential to a successful comic plot. I believe that it is for this reason that Plautus chooses to use the term in marked and significant ways. I have found that this word, takes on a performative meaning in three ways: (1) when characters take on different roles, thus staging a smaller play-within-the-play, (2) when characters try to portray themselves as having a higher social status, and (3) as an illocutionary speech act, which functions as a covert bid to take control of the comic plot. Through exploring the different ways that Plautus employs *lep(idus)* performatively, I am able to show how Plautus self-consciously comments on the dramatic form, thus creating a meta-theatrical layer of text, and, by evaluating how the word *lep(idus)* was used in early Latin, I provide new perspective on the evolution of this important word.

Exploring Hybridity: Method and Imagination in the Study of Japanese Religion

Aleah Robbins, Senior, Comparative History of Ideas

Mentor: Wendy Wiseman, Comparative History of Ideas

The phenomenon of religious syncretism can be basically characterized as a blending of multiple religious systems and the unification of practice or denomination. As a concept, however, religious syncretism is also a means to explore the implications of joint practice and belief on the concept of identity, a part of multi-cultural personhood, a means of cultural synthesis, and a challenge to the rigidity of faith and identity. Through an exploration of Japanese religion, especially the blending of Shinto and Buddhist practice since the arrival of Buddhism in the 7th century CE, this project will approach the topic of syncretism with special attention to problems of modern religious study. As an act of comparison, description, and imagination this project will be framed as to an inquiry into methods of study, calling into question the relationship between the studier and the studied, and paying close attention to the interplay between humanism and post-modernism, problematizing either a completely universal or completely relative approach to the study of culture. As a study of Japanese religion, this project will center on three contextual moments in Japanese history to help explain the complex relationship of Shinto and Buddhism, including the point of contact in the 7th century, the disestablishment of Buddhism and rise of State Shinto in the Meiji Period during the 19th century, and the post-war religious landscape of Japan.

SESSION 1L

ECOLOGY

Session Moderator: Frieda Taub, Aquatic & Fishery Sciences

Mary Gates Hall Room 287

*Note: Titles in order of presentation.

Differences in the thermal biology of woodlice (Isopoda, Oniscidea) residing in different climatic regimes

*Jason Borchert, Senior, Biology and Aquatics & Fisheries
Mary Gates Scholar*

Mentor: Joshua Tewksbury, Biology

Mentor: Kimberly Sheldon, Biology

I examined Dan Janzen's hypothesis that tropical mountains are physiologically "higher" using woodlice (Isopoda, Oniscidea) collected from different seasonal regimes. This hypothesis postulates that since temperate, high latitude organisms experience wide seasonal variation in temperature, they should have a broader range of temperatures for which they are adapted and can optimally perform at when compared with tropical, low latitude organisms which experience less seasonal variation regardless of the altitude at which they occur. To test this, I collected woodlice from four locations exhibiting varying degrees of seasonality. My sites included Eastern and Western Washington, California, and Ecuador. For each woodlouse population, I determined the following for physiological tolerance: optimal temperature, maximum and minimum temperatures of tolerance, and preferred temperature. To decide optimal temperature I developed performance curves for woodlice from each region by using the ambient air temperature and speed of woodlice moving down a temperature-controlled tube. Temperature preferences were found by allowing the woodlice to freely move along a temperature gradient and observing the temperature of the area in which they settle. I made the a priori prediction that woodlice collected from highly seasonal areas, such as Eastern Washington, would have a much broader range of thermal tolerances, and optimal and preferred temperatures than those collected from areas with more seasonal homogeneity, like Ecuador. If this holds true it could help explain the high biodiversity found in the tropics since mountains would pose a greater physiological barrier to dispersal in the tropics due to the large temperature gradient found when moving along an altitudinal gradient. This could also indicate that climate change will cause greater extinction rates in the tropics than in temperate regions due to tropical organism's decreased ability to handle changes in temperatures.

The effect of EFAs in cold water adaptation of Daphnia

*Bo Li, Junior, Civil & Environmental Engineering
Mentor: Michael T. Brett, Civil & Environmental Engineering*

In animals, Essential Fatty Acids (EFAs) are important "drivers" of ecosystem health/stability and are therefore highly conserved in aquatic food chains which make them a critical link between lower and higher trophic levels. EFAs have very important impacts on cell membrane structural and functional integrity by conferring fluidity, flexibility and selective permeability, and play a critical role in cold adaptation for both plants and animals. The significant impacts of EFAs on the nutritional ecology of herbivorous zooplankton and juvenile fish make it a powerful means to analyze what will impact Daphnia's EFAs composition. To date, limited research has suggested the temperature and diet influence the Fatty Acids (FAs) composition in Daphnia. In our study, we investigate the effect of EFAs in cold water adaptation of Daphnia by using two species of algae (*Scenedesmus* and *Cryptomonas*) as the diets for culturing two types of Daphnia starting as neonates until they reach an egg-bearing stage at 10 °C and 20 °C. One Daphnia clone was isolated from Lake Washington, where some researchers suggest is unable to survive in the winter. Another Daphnia was taken from nearby Green Lake where Daphnia are not found during the summer due to cyanobacteria blooms. Fatty Acid Methyl Ester (FAME) analysis is used to identify the possible different allocation of EFAs in Daphnia at different temperatures. Preliminary results suggest that Daphnia grow faster in 20 °C and there is a possible linkage between Fatty Acids and swimming behavior. We will use a video system which takes 30 images per second and uses a "nearest neighbor" algorithm to track the movements of individuals to understand if Daphnia acquire more efficient swimming behavior due to different FAs accumulation.

Mosses and lichens on tree trunks: more useful to hikers without compasses or without umbrellas?

Arwen Norman, Senior, Biology (Ecology and Evolution)

Mary Gates Scholar

Mentor: Janneke Hille Ris Lambers, Biology

Mentor: Jennifer Ruesink, Biology

Ecologists have proposed many mechanisms that may be responsible for the maintenance of diversity in natural systems. I investigated niche partitioning as the main mechanism working in a community of corticolous macrolichens and bryophytes at the base of sycamore trunks. Previous studies have found that the distributions of different species of lichens and bryophytes throughout the canopy and trunk of trees are based on moisture and light availability. My study asked whether the same resources control distributions at a smaller scale, based on two initial observations. Epiphytes appear to be concentrated on the "uphill" sides of leaning tree trunks, which might be

expected to receive more rain and light. Tufts of bright green, hydrated moss can be found within centimeters of dry moss after a rain, suggesting that variation in moisture availability may occur on a small scale. I sampled the epiphyte communities in areas at the base of 40 sycamore trees and measured moisture and light at multiple points within the same areas in order to determine whether these variables are related to the diversity or abundance of epiphyte species. I also investigated whether the predictor variables of tree lean angle and side of the tree (north, south, etc.) were related to species distributions. Both epiphyte diversity and abundance varied with environmental variables. Total species richness and total abundance were related to tree lean, with “uphill” sides showing higher abundance and richness. The abundance of some epiphytes varied with tree side and tree lean, but the relationship was weak. These results suggest that the partitioning of resources may play a role in the coexistence of species in this community, but that other variables, such as differences in competitive and dispersal ability, also play a role.

The effects of vacuuming tobacco (*Nicotiana*) on the greenhouse whitefly (*Trialeurodes vaporariorum*) population and parasitism rates by *Encarsia formosa*

Tracy Seimears, Senior, Biology and Business

Mary Gates Scholar

Mentor: Jennifer Ruesink, Biology

The whitefly (*Trialeurodes vaporariorum*) is a common greenhouse pest. It oviposits its eggs upon the leaves of suitable plants and feeds by tapping into the phloem of the leaves. It causes damage to plants directly through feeding with toxic saliva, through the growth of larva upon the leaves, and from its waste products that promote molds. Capable of causing damage to a number of plant species, whiteflies are being targeted for control with several different methods. Biological control has been applied with a parasitic wasp (*Encarsia formosa*) that oviposits in whitefly larvae. Mechanical control has been applied by vacuuming whiteflies off an attractive “trap” plant, tobacco (*Nicotiana Tobaccum*). This experiment tested the direct and indirect effects of vacuuming on whitelfy reproductive success by monitoring larval densities and parasitism rates. I vacuumed tobacco plants in the following treatments: high (six days a week), medium (twice a week), and low (zero times). The experimental treatments were replicated 3 times in each of the 4 blocks throughout the botany greenhouse. Vacuuming reduced adult whitefly numbers, consistent with direct mechanical control. However the long-term effect depends on reducing oviposition (measured as larval densities on leaves) while maintaining biological control by beneficial insects (measured by parasitism rates).

In-situ culturing of larval sand dollars, *Dendraster excentricus*, in Friday Harbor, Washington

Hannah Julich, Senior, Environmental Science, UW Tacoma

Mentor: Bonnie J. Becker, Environmental Science, UW Tacoma

Scientists have utilized various systems to attempt to raise larvae in the ocean to answer questions about their ecology, biology, and behavior in nature. The artificial nature of in-situ culturing often leads to high mortality and highly unrealistic results. In order to attempt a more realistic approach, large mesh enclosures (150L) were used to raise larval sand dollars (*Dendraster excentricus*) off of Friday Harbor Laboratories, San Juan Island, Washington. Mesocosms were designed to maximize water flow and facilitate cleaning, while providing a stable and relatively inexpensive study vessel for larvae. Thirteen-day old *D. excentricus* larvae were introduced into the mesocosms for one week. Daily water samples were taken to assess the number of surviving larvae and the physical and chemical water parameters. At the end of the study period, the mesocosms were retrieved and the contents were concentrated and filtered to determine the number of surviving larvae. A comparison of most physical parameters inside and outside of mesocosms revealed small differences that were not significant at the p=0.1 level. However, temperature and light results revealed several unexpected anomalies, indicating that mesocosms act as insulators, preventing to some degree the normal diurnal light and temperature fluctuations experienced by larvae in a marine environment. Follow up experiments are being conducted to examine the insulation effect and results are pending. These results are important because larval growth and chemical makeup have been shown to be affected by temperature, thus affecting potential ecological and elemental fingerprinting applications of this in situ larval culturing technique.

Interactions between invasive dwarf eelgrass (*Zostera japonica*) and Manila clams (*Ruditapes philippinarum*)

Chaochung Tsai, Senior, Biology and Environmental Studies

Howard Hughes Research Internship, Mary Gates Scholar

Mentor: Jennifer Ruesink, Biology

Mentor: Alan Trimble, Biology

Dwarf eelgrass (duckgrass; *Zostera japonica*) and Manila clams (*Ruditapes philippinarum*) are two introduced species that co-occur on intertidal flats of the northeast Pacific. While the clams are economically valuable, *Z. japonica* is often considered a weed that interferes with aquaculture. However, interactions between the two species have not been scientifically tested. Through factorial manipulation of clam and eelgrass density, we examined intra- and interspecific effects on performance, as well as modification of the physical environment. Three clam densities (0, 250,

500 adult clams per 2x2 m plots) were nested within three eelgrass treatments (mechanical removal of eelgrass via harrowing, removal of eelgrass by hand in 10x10 m plots, no removal of eelgrass). The experiment was carried out at a tidal elevation of ~+1m Mean Low Low Water from June to September, 2007, overlapping the summer season of peak productivity. The clams recruit naturally and were marked upon collection. Based on dissolution blocks, the presence of eelgrass reduced water flow by as much as 48% and was also observed to retain water, which may explain why eelgrass actually grew faster in the presence of conspecifics through facilitation. Harrowed areas contained high densities of small clams, suggesting that eelgrass impedes clam recruitment. Condition index (measure of clam growth) was significantly affected by combined effects of eelgrass removal and clam densities. In contrast, clams appeared to have weak effects on measured responses even at aquaculture densities: across clam densities treatments, there was no difference in ammonium within the sediment, eelgrass growth, or clam growth. Overall, both cumulative effects of eelgrass presence and clam densities, as well as eelgrass alone can exhibit significant effects on clam growth, but clam densities do not negatively affect eelgrass. These results illustrate that large-scale removal of an invasive eelgrass can help reduce its re-colonization rates and alleviate the impact of this invasive species on the aquaculture sector.

Artificial Selection on Temperature Preference of Fruit Flies

*Maria Yousoufian, Senior, Biology
Mentor: Raymond Huey, Biology*

As the earth's climate changes, organisms must be able to perform at different temperatures in order to survive. Many organisms have an optimal temperature, where running speed or other performance indicators are greatest. It is to these organisms' advantage to regulate their body temperature, through physiological or behavioral methods, to approach this optimum. Our study focuses on ectotherm (cold-blooded) animals, which can regulate temperature behaviorally by moving to a thermally preferred location. It is hypothesized that the preferred temperature of these animals should coincide with their thermally optimal temperature to maximize performance and reproductive fitness. Thermal preference is heritable and can be shifted through natural or artificial selection. We used artificial selection on fruit flies (*Drosophila melanogaster*) to explore the performance effects of manipulating thermal preference. We hypothesized that flies selected to prefer temperatures other than their thermal optimum would suffer reduced performance, because they would spend more time in suboptimal conditions. We used several lines of flies descended from wild populations, all reared in the lab at 25° C. We selected certain lines for higher or lower temperature preference and certain lines as controls (no selection on preference). We placed flies on a temperature

gradient ranging from cold to hot, and collected a subset of flies for the next generation based on their thermal location on the gradient (cold, hot, or random). After 20-23 generations of selection, we tested fly walking speed across five temperatures to see if selecting for temperature preference had also affected performance. Our hypothesis was not supported: the temperature preference of the high- and low-selected lines did shift as a result of artificial selection, but performance did not change significantly. This implies that temperature preference and temperature-dependent performance are genetically independent. These results may have implications for how organisms will adapt to changing climate. In future work, we will extend our investigation to reproductive fitness.

SESSION 1M

BIOPHYSICAL CHEMISTRY: MODELS AND APPLICATIONS

*Session Moderator: Emily Turner, Chemistry
Mary Gates Hall Room 288*

*Note: Titles in order of presentation.

Modeling the Optical Properties of Plasmon Resonant Metal Nanoparticles

*Jessica M. Smith, Senior, Chemistry
Mary Gates Scholar, Washington Research Foundation Fellow, NASA Space Grant Scholar
Mentor: David S. Ginger, Chemistry*

Nanostructured metals can exhibit strong optical scattering and large local electric field enhancements. It has been shown that these nanoparticles can enhance or quench emission of nearby fluorescent molecules (fluorophores). The effect occurs because of the interaction between the fluorophore and the localized surface plasmon resonance (LSPR) of the metal nanoparticle. The conduction electrons on the surface of the metal particle oscillate coherently, scattering light at different wavelengths depending on the size and shape of the nanoparticle. In order to investigate the optical properties of gold and silver nanoparticles, Maxwell's equations are solved discretely across space and time using Finite-Difference Time-Domain (FDTD) software. Previous results from these calculations have supported an experimental study about the linewidth of triangular silver nanoprisms. The nanoprisms scatter light of different colors within the visible region. The linewidth is characteristic of the shape of the scattering peak and has been shown by experiment and calculation to be dependant on the volume of the nanoparticle and the wavelength at which it scatters. Current work includes determining the local field enhancements by examining the interaction between a fluorescent molecule and a plasmon resonant

nanoparticle. From this study, we hope to better understand metal-enhanced fluorescence for potential applications in biosensors, light-emitting diodes (LEDs), and solar cells.

Synthesis and Evaluation of Secreted Phospholipase A2 Inhibitors

Nathan Cermak, Junior, Neurobiology

Mary Gates Scholar

Mentor: Michael Gelb, Chemistry

Phospholipase enzymes are a family of enzymes which hydrolyze phospholipids to free fatty acids. My research is on a subset of phospholipase enzymes, known as the secreted phospholipase A2 (sPLA2) enzymes. There is substantial evidence that sPLA2 enzymes are involved in inflammatory processes, especially in asthma and arthritis, which makes them a novel target for drug development. However, the biological function of the nine different sPLA2s expressed in humans is not known. I focus on both the organic synthesis of new inhibitors, and evaluation of these new inhibitors by in vitro enzyme activity assays, as well as cell culture assays with a variety of cell lines. Within this project, our goals are to develop a set of cell-permeable, selective sPLA2 inhibitors which allow us to knock out the function of a specific enzyme and determine its biological importance.

Small-molecule inhibitors of secretory phospholipase A2

Philip P. Rodenbough, Senior, Chemistry and Biochemistry

Mary Gates Scholar

Mentor: Michael H. Gelb, Chemistry

Phospholipase A2 is an enzyme that triggers the release of arachidonic acid by hydrolyzing cell membrane phospholipids. This is of significant biomedical importance because arachidonic acid is a precursor to inflammatory mediators such as leukotrienes and prostaglandins. Currently there are several families of phospholipase A2, whose roles are understood to varying degrees, but of particular interest to the Gelb lab is secreted phospholipase A2 (sPLA2). There are 10 known mammalian sPLA2 enzymes, but their biological role is not completely understood. Having potent sPLA2 inhibition that is selective for individual sPLA2 enzymes would greatly help us understand how the enzymes function. This research project is two-fold. The first part involves the synthesis of potential inhibitors from smaller, commercially available chemicals. There are a host of possible inhibitors that have received cursory attention from various sources. The second part of this research project will involve testing the final synthesized molecules for selectivity, potency, and permeability, using various in vitro and cell-based assays. If successfully inhibition is observed, these types of compounds would be extremely useful to labs worldwide that study the effects of sPLA2 in various biological systems.

Automated Portable Magnetic-Bead SPR Sensors

Joshua Probert, Senior, Bioengineering

Mary Gates Scholar

Mentor: Clement Furlong, Medical Genetics

In light of the increasing threat posed by bioterrorism, bird flu, food contamination and the spread of disease, a portable near real-time sensor system is needed for rapid identification and tracking of pathogens and toxins. While many bio-detection techniques exist, surface plasmon resonance (SPR) is one of the fastest and most versatile. The Furlong Biosensors laboratory has developed a portable SPR sensor (SPIRIT) capable of detecting up to 24 separate analytes simultaneously. This device is rugged, compact and designed for field use. Antibody-coated magnetic beads can rapidly purify and concentrate samples. The bead/analyte complex can be captured by a magnetic column allowing for a rapid clean up of the sample and removal of matrix components that might interfere with signal detection. Eluting the beads into a smaller volume significantly increases the sample concentration. When bound to the detection antibodies (or receptors) on the sensor surfaces, the beads greatly amplify the SPR signal. Modifications of the system's fluidics, electronics and software components will enhance the usefulness of the system and increase the user friendliness of this technology. These are the goals of my project.

SESSION 1N

DESTRUCTION AND RECONSTRUCTION IN LITERATURE, ARTS AND THEATRE

Session Moderator: Julie Villegas, University Honors

Program

Mary Gates Hall Room 295

Instructions for Destruction: Yoko Ono's Performance Art

Whitney Frank, Senior, Art History and Women Studies

Mentor: Patricia Failing, Art History

What is currently known as “destruction art” originated in the artistic and cultural work of avant-garde art groups during the 1960s. In the aftermath of World War Two, the threat of annihilation through nuclear conflict and the Vietnam War drastically changed the cultural landscapes and everyday life in the United States, Asia, and Europe. In this context, “destruction art” has been situated as the “discourse of the survivor,” or the method in which the visual arts cope with societies structured by violence and the underlying threat of death. Many artists involved in destruction art at this time were concerned with destroying not just physical objects, but also with performing

destruction with various media. By integrating the body into conceptual works rather than literal narratives of violence, artists contested and redefined mainstream definitions of art, social relations and hierarchies, and consciousness. Yoko Ono, who was born in Tokyo in 1933 and began her work as an artist in the late 1950s, addresses destruction through conceptual performances, instructions, and by presenting and modifying objects. Ono's work is not only vital to understanding the development of the international avant garde, but it is relevant to contemporary art and society. In recognition of her accomplishments and their impact, she received a Distinguished Body of Work award from the College Art Association this year. Her cultivation of fully conceptual artworks predates not only the development of conceptual art in form and as discourse, but she often engages in proto-feminist commentary as well. Her attention to the internalization of violence and oppression reflects contemporaneous feminist theory that situates the female body as text and battleground. By repositioning violence in performance work, Ono's art promotes creative thinking, ultimately drawing out the reality of destruction that remains hidden within the physical and social body.

Resistiendo el Secuestro: Performing resistance to kidnappings, through normativity, in contemporary Colombia

Ismenia Gaviria, Senior, Drama

Mentor: Sarah Bryant-Bertail, Drama

The Colombian citizen-subject living in their crisis-stricken country performs resistance by not resigning and by continuing to live normal lives. It is through their performative normativity that Colombians perform resistance to one of the most plaguing acts to date: secuestros, or kidnappings. Colombians do not embrace nor deny the existence of kidnappings, but instead by performing normativity, they resist allowing themselves to live as fearful, submissive, and defenseless citizens in their own country. I am interested in exploring the ways in which the Colombian citizen-subject performs "normativity" as resistance to the violent phenomena of secuestros in present-day Colombia. I will use Colombian theatre, literature, and media in order to understand how the Colombian citizen-subject performs normativity under such crisis. Specifically I will analyze the play *Lucky Strike* (*Golpe de suerte*), created and produced collectively by Santiago García and his Teatro La Candelaria. Through the analysis of these selected texts, I will demonstrate that secuestros are actively contested by the performance of "normativity," by resistant Colombian citizen-subjects residing in present-day Colombia. In addition, the use of additional mediums will be useful in analyzing the effect of kidnappings on individuals living in Colombia as well as conceptualizing the Colombian daily life.

Interpretation of video as a 3-dimensional interactive volume

James George, Senior, Computer Science

Mentor: Shawn Brixey, Digital Arts & Experimental Media

My research involves a software system for interpreting video not as a linear sequence of frames, but as a volume of pixels in a 3-dimensional space. This interpretation allows for extracting images from video that bend spatiotemporal relationships. Video interpreted as a volume means mapping each pixel to a 3-dimensional vector, where X and Y are derived from the pixels location in the frame and Z is the position in time. Viewed from this context, traditional video is displayed by moving a plane along the Z-axis in the volume and generating frames where the pixels intersect the plane in space. If the plane is replaced by an arbitrary 3-dimensional surface, the system can generate frames that are derived from many moments in time. Sequences generated in this fashion encourage exploration and reflection on our perception of linear time and motion. The research work is an interactive software system that allows the viewer to manipulate and watch such a 3-dimensional surface as it moves through either live or prerecorded video displaying the output in real time.

"The Red Question": Analyzing the Role of Marx, Marxism and Communism in Wright's and Ellison's Black Literary Aesthetic

Adam Hamilton, Senior, English

Mary Gates Scholar

Mentor: Laura Chrisman, English

During the 1930s and the 1940s, Karl Marx's dialectical and historical materialisms and the civil rights activism of the Communist Party had a profound influence on Black literature and literary theory. In fact, by the end of the 1930s, Marxist discourse crystallized in the literature of Richard Wright and Ralph Ellison to the creation of a Black Marxist literary aesthetic, which hinged on utilizing a Marxist approach to chronicle the Black American experience. However, by the second year of World War II, the aesthetic was being heavily critiqued by its own vanguards, and Wright and Ellison turned to other theoretical approaches to articulate Black American life. I argue that this integral shift in these two black authors was caused by both theoretical and pragmatic elements. First, by analyzing the literature of Karl Marx for its Eurocentric, racialized biases, I will show that his methodology fails to accurately articulate the black American experience because it is theoretically unable to handle racial conflict. Further, the Communist Party, because it employed an international agenda, supported the struggle for black rights acquisition only insofar as it weakened United States imperialism through fomenting the interracial labor movement. However, once WWII threatened that agenda, auxiliary objectives such as the Black Question became inconsequential for the Party,

belying their instrumentalism. By placing the essays, short stories, and major works of Wright and Ellison within these theoretical, historical, and biographical contexts, I will show through a literary methodology that Wright and Ellison participated in their own dialectic: first creating and applying a black Marxist literary criticism, next critiquing that model, and finally turning to other, more inclusive literary alternatives to chronicle the black experience and participate in a broader than “black”, international literary discourse.

Flash Mob!: *Communitas* for the Twenty-First Century

*Rebecca Snow Landa, Senior, Interdisciplinary Studies
Meena Vasheed Scholarship, Sunshine Lady Foundation Scholarship
Mentor: David Goldstein, Interdisciplinary Arts & Sciences, UW Bothell*

In 2003, Harper’s Magazine Editor Bill Wasik invented a new form of amassing bodies together in a chosen place called the “flash mob.” His intention was to prove that the 18-40-year-old urban educated demographic--what he calls “hipsters”--will show up anywhere, anytime, for any purpose, if they think it is the “next big trend.” In other words, instead of the edgy iconoclasts they claim to be, “hipsters” are followers. The Flash mob concept took off and flash mobs are now held in towns and cities all over the world for social, artistic and political purposes. I investigate their popularity and that although all people, even urban hipsters, have a “following instinct,” this is not necessarily a bad thing. Flash mob fun is free public art, group therapy, and anarchistic reclamation of public space.

system in which certain muscles are continuously active. Spasticity can be managed with physical therapy, and oral pharmacologic medicines. For extreme cases, patients are often treated with alcohol injection or Botulinum toxin. For very severe cases of spasticity, patients often undergo peripheral surgery for cutting nerves or tendon. All these treatments have significant limitations including high cost, adverse side-effects and only short-term benefit. Clinicians need more effective, lower cost, lower risk treatments for the treatment of spasticity. My role in the project is to design a high intensity focused ultrasound (HIFU) transducer with imaging ultrasound that can provide a non-invasive and non-pharmacological method for treating spasticity. When HIFU is used with diagnostic ultrasound, the specific anatomic structure of interest and the treatment site can be monitored in real time which gives a huge advantage over other imaging modalities. It is suggested that different doses of HIFU on nerves could produce a range of biological effects. For example, doses above 23,000 J/cm² completely suppressed the action potential in the nerve whereas doses below 4,600 J/cm² had no effects on conduction. On the other hand, when the dose was set to above 4,200 J/cm² and below 23,000 J/cm², partial block on the conduction through nerve occurred. Different suppression of action potential in the nerve indicates the possible use of HIFU on nerve conduction blockage for application to treat spasticity. With accurate localizing and targeting of nerves, HIFU holds promise as a low-cost, low risk treatment for spasticity.

Modification and optimization of a 3-D in vitro perfusion system for long term nanoparticle penetration and transport studies

*Goh Zhi Cong, Junior, Bioengineering
Mary Gates Scholar
Mentor: Suzie Pun, Bioengineering*

The process of discovering new drugs is often hindered by the inavailability of in vitro assays that adequately predict in vivo efficacy. This is especially so in the field of gene therapy. Often, in gene/drug delivery studies, results obtained in 2-D cultures are not reproducible in vivo. In this work, I made improvements on an existing perfusable 3-D chamber designed by Drs. Chee Ping Ng and Suzie Pun for studying nanoparticle penetration and transport in cell-gel soft tissue cultures. The existing chamber was not able to provide a constant flow rate over time and also does not provide an easy way to accurately measure flow rates through the matrix. The device consisted of a chamber made by molding polydimethylsiloxane (PDMS) on a polymethylmethacrylate (PMMA) template that was created using micromachined lithography. The device was then bonded to a microscope slide via hydrophilic interactions. A cell-gel matrix was loaded in the center of the chamber between PDMS posts that holds the matrix in place. The device was modified to allow for facile measurement of media flow rates. The improved chamber offers the following features over the existing chamber: (i) constant

SESSION 10

MEDICAL THERAPEUTICS AND DEVICES

*Session Moderator: Suzie Pun, Bioengineering
Mary Gates Hall Room 389*

Image-guided Focused Ultrasound Devices for the Non-Invasive Treatment of Spasticity on Rat Sciatic Nerve

Andy Chang, Senior, Bioengineering and Electrical Engineering

Mary Gates Scholar

Mentor: Shahram Vaezy, Bioengineering

Spasticity is a neurological disorder of the body's motor

controllable perfusion flow rate (ii) accuracy of quantifying flow. To test the chamber, cell culture media was delivered to cell-embedded Matrigel under 3D flow conditions under pressure driven flow. Maximum sustainable flow rates for the Matrigel containing HeLa cells were measured. The maximum flow rate sustainable in the chamber was much lower than that of human physiological flow rates. Increases in flow rate result in dislodging of Matrigel from the anchoring posts. I am currently exploring methods to chemically modify the surface of the device to directly bond the surface to the Matrigel, thus potentially increasing the maximum sustainable flow rate. The modified chamber could be used for delivery studies and may have other applications in the field of biology, tissue engineering and drug delivery.

Real Time Monitoring of HIFU Power through the Source

*Aaron Hossack, Senior, Physics, Astronomy
Mary Gates Scholar
Mentor: Lawrence A. Crum, Bioengineering*

This experiment explores a new way of monitoring the power reflected off the focus of a High Intensity Focused Ultrasound (HIFU) transducer. Current methods of detecting boiling, cavitation, and blood flow in-vivo are lacking, but this system utilizes a directional coupler and phase-locked receiver to pull out the reflected signal for analysis. This has the significant advantage of being far easier to implement in clinical HIFU because no other monitoring devices are necessary. Preliminary tests have shown that the system is capable of detecting boiling and tissue distention, and shows promise for detecting cavitation and blood-flow. When hard plastic targets are moved through the focus in a water tank the receiver clearly shows the phase vector rotating in relation to the target movement. This is because the reflected signal is Doppler shifted and the receiver produces in phase and quadrature signals. When plotted against each other on an oscilloscope a rotating phase vector is displayed. The next step is to digitize these signals and give an operator real time feedback about how fast and far the tissue moves. In a joint experiment with Michael Canney, the phase vector produced obvious spikes at the moment boiling occurred, which was confirmed by a high-speed camera. Boiling produces bubbles which have a dramatically different impedance than water, so the amount of signal reflected back to the transducer increases drastically. A test that involved sending fluid through the focus (to mimic blood flow) produced a Doppler shifted envelope frequency in the audible range. More work on signal processing is necessary to extract information about cavitation, a broadband signal not obvious on the oscilloscope plots.

Inducing and Maintaining Hyperthermia in Tissue

*Nayan Patel, Senior, Bioengineering
Mentor: Shahram Vaezy, Bioengineering*

It has been shown that hyperthermia in tissue promotes both angiogenesis and neurogenesis. My work is focused on optimizing the parameters, i.e. frequency, duration and intensity, of ultrasound applied to tissue to induce and maintain hyperthermia. These experiments are being conducted in vitro. I am varying the ultrasound parameters on a FDA approved ultrasound physical therapy device and measuring the temperature change over time across the tissue using thermocouples and an in-house written LabVIEW VI. There is currently no accepted clinical use of ultrasound for neurogenesis. This research will be a step towards increasing healing in patients who suffer injuries that disrupt blood vessels and nerves. The next step in this research is to conduct similar experiments in vivo.

Surface-modified *Listeria monocytogenes* as a carrier for the intracytosolic delivery of therapeutics

*Teresa Peterson, Senior, Bioengineering
Mary Gates Scholar, Levinson Emerging Scholar
Mentor: Suzie Pun, Bioengineering
Mentor: Jamie Bergen, Bioengineering*

The introduction of macromolecular therapeutic agents into diseased cells in the body has the potential to revolutionize the treatment of life-altering diseases like cancer. One of the major needs in delivery to tumors is the development of carriers that can efficiently transport therapeutic agents into tumor tissue. *Listeria monocytogenes* (LM), a facultative intracellular pathogen, is a promising potential carrier because it is highly efficient at entering the cytosol after invading host cells. It is also capable of moving through and between cells, giving it the potential to make its way past the most accessible layer of the tumor, reaching deeper, central cancer cells for delivery. To deliver therapeutic macromolecules to tumor cells, we propose to attach them to the surface of LM via a streptavidin-biotin linkage. We have developed a surface conjugation strategy that allows modular attachment of therapeutic cargo to LM. LM were surface-modified by reaction with an amine-reactive biotin, enabling the attachment of biotinylated cargo through a streptavidin linker. Surface biotinylation of LM was confirmed through a plate-binding assay. Biotinylated LM bound to a plate displaying surface-adsorbed streptavidin, while unmodified LM failed to bind. The attachment of a biotinylated, fluorescently-labeled model protein cargo to the surface of biotinylated LM was examined, and the invasion of host cells by this LM-protein conjugate was investigated using fluorescence microscopy. We have further evaluated the delivery of saporin, a ribosome-inactivating protein which causes cell death when present in the cytosol, to the cell cytosol. This method will ultimately be translated to a less pathogenic strain of LM. LM-drug conjugates could be applied toward nucleic acid and protein delivery in the future.

Non-Invasive Determination of Intracranial Pressure by Means of Vibroacoustography

Pavan Vaswani, Junior; Computer Science, Biochemistry and Neurobiology

Barry M. Goldwater Scholar, NASA Space Grant Scholar, Mary Gates Scholar; Washington Research Foundation Fellow

Mentor: Pierre D. Mourad, Neurological Surgery, Applied Physics Lab

Intracranial pressure (ICP) is a critical parameter of brain function and, when elevated, is associated with a number of serious neurological conditions, including intracranial masses such as tumors and bleeds, hydrocephalus, stroke, infections, high altitude sickness, and brain edema from traumatic head injury. Monitoring ICP in these traumatic situations has been shown to improve clinical outcome. Currently, ICP is measured invasively by drilling a hole through the skull to place a transducer near the brain, a procedure requiring surgery and the skills of a neurosurgeon. We propose a simple, non-invasive method of monitoring ICP using vibroacoustography, which would allow for faster, easier, and safer measurement of this critical parameter. Prior work suggests a positive correlation between tissue stiffness and ambient pressure in an enclosed chamber. We intend to exploit this variable tissue elasticity by observation of brain tissue's acoustic response to low frequency vibration. Two beams of confocal high intensity ultrasound are used to remotely and non-invasively palpate and vibrate tissue while its acoustic response is analyzed to determine frequency content. A test system has been constructed and preliminary studies show promise. Current experiments focus on calibration and refinement of the system to reduce noise and early tissue phantom and ex vivo tests.

The Molecular Swiss Army Knife: Designing multifunctional non-viral vehicles for gene delivery to neurons

Kathy Y. Wei, Junior; Bioengineering and Computer Science

Amgen Scholar, Mary Gates Scholar, NASA Space Grant Scholar

Mentors: Suzie Pun, Bioengineering

Mentors: Jamie M. Bergen, Bioengineering

Gene therapy promises to treat neurological disorders, such as Alzheimer's disease, Huntington's disease, and Parkinson's disease, that currently have limited or no available treatment. Non-viral gene delivery vehicles offer several advantages over viral-based vectors because they are potentially safer and more customizable. The particular non-viral vehicles used in this experiment are polyplexes, which are polymer/DNA complexes. The major challenge faced by these materials is the inefficiency of polyplexes at overcoming barriers to gene delivery, especially in non-dividing cell types such as neurons. Intracellular barriers to nuclear delivery of foreign DNA include targeting (getting

to the cell), uptake (getting into the cell), endosomal escape (getting out of the endosome), retrograde transport (getting to the nucleus), and nuclear localization (getting into the nucleus). This project focuses on attaching peptide ligands that target individual barriers to the surface of polyplexes to increase DNA delivery efficiency. Specifically, a peptide ligand based on the human papillomavirus minor capsid protein L2 (L2 peptide), which is hypothesized to have endosomal escape as well as retrograde transport capabilities, was conjugated to polyethylenimine (L2-PEI), a cationic polymer that is widely used to deliver DNA. The DNA incorporation efficiency, polyplex size, and polyplex charge were measured for various formulations of L2-PEI with DNA. The L2 peptide increased gene delivery in a model cell line by up to a factor of 26-fold. Success in increasing gene delivery with safe, customizable polyplexes will bring us closer to treating not only neurological diseases, but also diseases like cancer.

STUDENTS SUM UP THEIR RESEARCH EXPERIENCE IN A WORD

Surprises:

*Funny how real life research comes out different
than how textbooks explain it.*

Zoom:

*That's the sound of the future, whizzing toward me as I learned
everything I needed to know to finish this project!*

Frabjous:

This is Lewis Carroll's famous portmanteau from his poem, the Jabberwocky. A portmanteau is a word formed by combining sounds and meaning from other words; frabjous is a combination of fair, fabulous and joyous. Research is complex, just like a portmanteau. One needs to apply a diverse set of skills to understand interdisciplinary research for it to be something that is comprehensively sensible and lovely.

HAREWARTH:

Hard, REWArding but worth it!

POSTER SESSION 2

2:30 - 3:30 PM

POSTERS WILL BE ON DISPLAY UNTIL 5PM

PLEASE NOTE:

Abstracts are listed alphabetically by the presenter's last name.

Developing *Lepidium* as a Model for Dioecy in the Brassicaceae

Parisa Aalami, Junior, Biology

Brittany Ng, Junior, Biology

Mentor: Verónica Di Stilio, Biology

Arabidopsis is a genetic model organism within the Brassicaceae family comprised of predominantly hermaphroditic members. In contrast to hermaphroditic plants, dioecious plants are characterized by separate male and female reproductive organs located on different individuals. Lepidium is the closest dioecious relative of Arabidopsis, which provides an interesting perspective on sex development within this phylogenetic context. Our project aims to explore sexual differentiation and determination within the dioecious *L. sisymbrioides* in relation to its two closest hermaphroditic and putative evolutionary ancestors, *L. naufragorum* and *L. tenuicaule*. These three New Zealand endemics are rare and have not been studied in great depth thus far. As a result of its strategic phylogeny and dioecious character, we are developing Lepidium as a plant system to characterize floral development, look at cytogenetic relationships, and determine the presence of heteromorphic cytotypes within and between species. Genome size estimation by flow cytometry has indicated that Lepidium is a feasible system to analyze at the molecular and genetic level, while preliminary observations of chromosomes have revealed the presence of possible sex-specific cytotypes. Future work will elucidate the evolution of dioecy in Lepidium flowers and help draw relationships between morphology and cytology.

Competition between different *Desulfovibrio* species in mutualism with *Methanococcus*

Charles T Atkinson, Sophomore, Environmental & Conservation Biology and Public Health

Mentor: Kristina L Hillesland, Civil & Environmental Engineering

Mutualisms between sulfate reducing bacteria and methanogenic archaea are found in lake sediments, animal digestive tracts, wastewater treatment plants, and may affect many microbial communities in global ecosystems. We investigated a mutualism in which the bacteria Desulfovibrio grows by oxidizing lactate or pyruvate and transferring electrons to the archaea Methanococcus in the form of hydrogen. The archaea gains energy by using the hydrogen to produce methane. What trait determines the propensity of certain species of Desulfovibrio to persist in populations over time? We hypothesized species of Desulfovibrio that induce rapid mutualistic growth with Methanococcus are more competitively fit than species that induce slower growth. If so, the genes and alleles that govern the phenotype for faster growth rate will be favored by natural selection in competitive environments lacking sulfate. To test this hypothesis, we grew Methanococcus

maripaludis together with three species of Desulfovibrio: *D. oxamicus*, *D. vulgaris*, and *D. desulfuricans*. These experiments showed that mutualisms with *D. vulgaris* grew slightly faster than mutualisms with *D. desulfuricans*, and these mutualisms both grew much faster than the mutualism with *D. oxamicus*. To test competitive differences, we inoculated three replicates of all possible pairs of the Desulfovibrio species above into both lactate and pyruvate media with *Methanococcus maripaludis*. We plated several times over 33 generations of competition to measure the rate of increase of each Desulfovibrio species. We found that *D. vulgaris* outcompetes *D. oxamicus* substantially in lactate ($12.5 \pm 1.7\%$) but less so in pyruvate ($6.7 \pm 2.7\%$); *D. desulfuricans* substantially outcompetes *D. oxamicus* in both; and *D. vulgaris* slightly outcompetes *D. desulfuricans* in lactate. The results are consistent with the hypothesis that growth rate is a determinant of the propensity of certain species to persist. However, it is interesting that the magnitude of dominance of *D. vulgaris* over *D. oxamicus* varied on lactate versus pyruvate. Further investigation will focus on determining potential interactions between species of Desulfovibrio that may also affect competitive fitness.

Differential Photometry of Symbiotic Stars

Jennifer Baerny, Recent Graduate, Astronomy and Physics

NASA Space Grant Scholar

Mentor: Julie Lutz, Astronomy

I observed Symbiotic stars, a binary star system showing variability in brightness, to watch for general variations and/or short period flickering, which occurs due to an accretion disk seen around one of the stars in the pair. I frequently traveled to Manastash Ridge Observatory (MRO) outside of Ellensburg for nine weeks during the summer of 2007, to image the stars. The targets were imaged in the Stromgren y (yellow) filter anywhere from a few times a night to a few times an hour for any given observing run. Targets were chosen based on the low number of references found in the SIMBAD database (a main astronomical database). Once data for the targets was obtained, we used the IRAF system to reduce the raw data down to a useful science image, by subtracting out the noise coming from the charged-coupled device (CCD) used to obtain the image, from the filters, and mirrors of the telescope. The science images of the targets were further analyzed in IRAF by using the fieldphot package to determine the magnitude, the apparent brightness, of the star. The magnitude was then plotted as a function of time to find the light curve for each target. From the generated light curves, we were able to see variability in several of the targets.

Agenda Setting Practices of the Supreme Court

Kayla M. Baker; Senior, Political Science

Mentor: Bryan Jones, Political Science

The Supreme Court continues to play a decisive role in American politics. Despite its importance, we still lack an understanding of how the court's agenda fits in with the larger policy process. This project attempts to fill this gap by examining Supreme Court attention towards business and social issues. While political scientists have researched this topic, there is no definitive way to know the agenda setting practices of the Supreme Court. I will attempt this large feat in part by outlining patterns of certiorari selection based on the subject matter of the case. To do this, I will use data on Supreme Court cases granted certiorari from the Policy Agendas Project, an NSF-funded research project. I distinguish between those cases that relate to business and social issues. I use certiorari granted data provided by the Policy Agendas Project and code it by whether it is a socially or business related. I expect to find that when social concern for a certain issue is high, the court is likely to grant more of that type. If this correlation is accurate then it can be deduced that the court's discretion is ultimately limited by the American public. This is an important finding, because through my research I have found that congress is not overly active in holding hearings when social concern is high on some issues. For example, the issue of abortion was a huge concern in the 1970's especially with Roe v. Wade. However, we do not see a huge rise in congressional hearings to consider this matter. This means, through my findings I can deduct that the court is more attuned to social issues than is congress.

The Role of the Law in Othering Young Male Moroccan Immigrants and Preventing Their Integration into Host Societies: A Comparative Analysis of The Netherlands and Spain

Mina Barahimi, Senior, Law, Societies & Justice and African Studies

Mary Gates Scholar

Mentor: Michael McCann, Political Science and Law, Societies & Justice

Recently in history both The Netherlands and Spain have experienced large-scale immigration by individuals looking to escape the economic and social malaise of their home countries. My research has focused on the struggle of young, male Moroccan immigrants to navigate the legal labyrinth erected by the Dutch and Spanish governments. The comparative study seeks to show how, in both countries, immigration law and policy serve to "other" this demographic, that is, to distance them from any notion of sameness or belonging and to thereby relegate them to the status of non-citizens. Thus, rather than facilitating their integration, the law paradoxically reproduces the inequalities that prevent immigrants from being recognized as citizens of their host society by denying them access

to permanent residence, employment, and participation in decision-making processes. The legalization process is purposely rife with obstacles which ensure that the quality of immigrant otherness remains ingrained in the public perception and contributes to their marginality. The law in essence constructs and reconstructs their difference as black Muslim Others. As a result, social and political integration remains elusive for the majority of them. I am using the following questions to guide my research: First, does the law construct and protect identity? How does it do (or not do) this? Does it construct and protect the identity of non-citizens? Should the law seek to protect the identity of all citizens? How are immigrants expected to negotiate a space within their host society if the law does not protect their identity? I am using newspaper accounts to research documented incidents of clashes between Moroccan immigrants and citizens of Dutch and Spanish society. I am also using a number of other print and online sources by Dutch, Spanish and Moroccan authors and human rights organizations that detail the ways in which the law has criminalized and racialized Moroccan immigrants and prevented their integration. Ultimately, I will explore the implications for Dutch and Spanish society of trapping these immigrants in a vicious cycle of social and political exclusion for generations.

Characterization of splice junction in the mRNA of latency-associated nuclear antigen (LANA) in RFHVMn and development of an assay to detect the presence of RFHVMn in infected cells

Mitra Barahimi, Junior, Neurobiology

Mentor: Tim Rose, Pathobiology

Retroperitoneal fibromatosis herpesvirus Macaca nemestrina (RFHVMn) is the macaque homologue of the human rhadinovirus, Kaposi's sarcoma-associated herpesvirus (KSHV). KSHV causes Kaposi's sarcoma (KS), a cancer commonly occurring in AIDS patients, while RFHV causes retroperitoneal fibromatosis (RF), a neoplasm associated with simian AIDS (SAIDS). SAIDS associated RF has many similarities to AIDS associated KS. Latency-associated nuclear antigen (LANA), encoded by ORF73 of KSHV, is a protein most prominently expressed in cells latently infected with KSHV. KSHV LANA is encoded by a polycistronic transcript associated with two other gene products with intervening sequences. We designed experiments to determine whether the RFHVMn LANA mRNA contains splice sites similar to those found in KSHV. The development of an assay across a splice junction would allow us to demonstrate the presence of viral DNA and LANA transcription which would indicate viral infection of the cells. We transfected DNA containing the RFHVMn LANA gene into COS-7 cells, isolated RNA, and used reverse transcriptase to synthesize cDNA. We performed polymerase chain reaction (PCR) on the cDNA using primers for RFHVMn based on predicted splice sites from KSHV LANA. When the PCR products were

analyzed on an agarose gel, we observed a band of the approximate size for a spliced product. When the band was sequenced, we were able to identify a splice that removed a 405 base pair intron. Several primers sets were designed across the splice site and tested to find an efficient assay specific for the spliced transcript. We have developed an assay to demonstrate the presence of virus in infected cells by utilizing splice sites of LANA in RFHVMn. This assay will allow us to study the life cycle of RFHVMn, especially viral latency.

A Case Study of Opportunities and Resources

Available to Latina/o Graduate Students

Cristal Barragán, Senior, American Ethnic Studies

Zesbaugh Scholar, McNair Scholar

Mentor: Juan Guerra, The Graduate School

It is well known that people of color have been historically excluded from institutions of higher education. But as shocking as the numbers are for Latina/o undergraduate enrollment at colleges and universities, the numbers are even smaller when we look at Latina/o students who pursue graduate studies. The University of Washington at Seattle, Bothell, and Tacoma is no exception, with the autumn 2007 enrollment showing that of the 10,573 students in graduate programs at the three UW campuses, 3% of them were Latina/os. The case study examines the opportunities and resources available to Latina/o students who decide to pursue a graduate education. First, the study explores the experiences of Latina/o graduate students in various academic programs at the UW and the challenges they face both during their search for graduate programs and once they are enrolled at the UW. Secondly, the study discusses the views of Graduate Program Advisors who work directly with these students; advisors explain their role in aiding students and provide their perspective on the difficulties facing students of color. Lastly, the study examines the services that support staff in the Graduate Opportunities and Minority Achievement Program (GO-MAP) provides in its efforts to recruit and retain students of color at the UW. These interviews will yield significant information on the subject of Latina/o participation in graduate studies. The findings will serve as a valuable resource for undergraduate minority students in general who are preparing to apply to graduate programs.

Effects of Acute Corticosterone on Learning and

Memory in Captive White-Crowned Sparrows

(*Zonotrichia leucophrys*)

Carolyn Bauer, Junior, Biology

Mary Gates Scholar

Mentor: John Wingfield, Biology

Mentor: Jason Davis, Biology

Corticosterone (CORT) has been associated with a variety of effects in the white-crowned sparrow (WCS), including suppression of reproductive behavior, and increase of

alteration of metabolic function. The effects of acute CORT on cognition have also been examined in a variety of species, but have not been examined in the WCS. Previous experiments in our laboratory have indicated that chronically administered CORT can improve learning acquisition in the WCS. The focus of the current study was to explore the effects of acute CORT on learning and recall in captive housed WCS. We tested WCS learning and recall using a bird adapted Y-maze protocol. WCS were split into groups, which were given CORT during either i) learning trials, or ii) recall trials, or iii) were not given CORT. CORT was administered non-invasively by feeding birds mealworms injected with CORT dissolved in peanut oil. Contrary to expectations based on our previous chronic CORT studies, acute CORT impaired task performance. Specifically, WCS that were administered CORT during either the learning or recall trials had longer escape times compared to control birds. Here we will discuss implications of these findings, as well as present directions for future research.

Computerized face-specifics training effects on event related potentials in adults with autism

Joshua Bavaro, Sophomore, Biochemistry

Mentor: Sara Jane Webb, Psychiatry & Behavioral Sciences

Individuals with autism spectrum disorder (ADS) have impairments in face recognition and differences in face-sensitive event related potentials (ERP) to faces compared to matched controls. Faja et al. (2008) showed individuals with ASD, who completed a computerized face-specific training, improved in certain behavioral face processing tasks. This study examines the effects of the computerized face-specific training in adults with ASD on neural responses (ERPs) to faces. Seventeen subjects with ASD with face processing deficits (determined by standardized tests) were selected from a larger study. The subjects were divided into two groups, eight subjects received face training while nine received training on houses (control group). Before training, responses to faces and houses were recorded using ERPs. The participants then received five to eight hours of computerized training. After successful completion of the training, the same ERP paradigm was employed. Computerized face-specific training should elicit more normative ERP face responses to faces. An alternative prediction is that behavioral improvements in face processing are not related to ERP changes in amplitude and latency. However, if the results suggest a more normative ERP pattern in the face training group, computerized face-specific training could possibly be a mechanism for treatment for those with ASD.

The Role of Nitric Oxide in Microvascular Circulation

Kirsten Becker, Junior, Chemistry and Biochemistry

Mentor: Steven Deem, Anesthesiology

Mentor: Jennifer Moulding, Anesthesiology

Nitric oxide (NO) is a key signaling molecule involved in the regulation of a variety of biological and physiological processes. Within the pulmonary vasculature,

NO plays a role in shear stress vasodilation and hypoxic vasoconstriction. These effects are further modulated by red blood cells (RBCs). To investigate the possible roles of RBCs and NO in microvascular control, an isolated rat lung was visualized using intravital microscopy. Applying gentle suction to the lung through a hole in the microscope stage creates a window to the exterior surface of the lung, which is imaged with a microscope linked to a video camera with zoom. In each experiment, one arteriole and one venule are chosen for measurements. NO synthesis will be inhibited by administering the drug, N (G)-nitro-L-arginine methyl ester (L-Name) in two of three groups of experiments as follows: (1) control, (2) red blood cells (RBCs) are treated by incubation with L-Name (100 μ M), and (3) the vasculature is treated with L-Name (100 μ M). By comparing the diameters of the arterioles and venules under normoxic (FiO_2 21%) and hypoxic (FiO_2 5%) conditions, conclusions can be made regarding the relative role of NO produced in either the RBC and/or the endothelium. These experiments will assist in clarifying the roles of NO, the endothelium, and RBCs in pulmonary microvasculature regulation. Ultimately, this will have implications for the matching of ventilation and blood flow to optimize gas exchange in the lung.

How Do Song Sparrows Learn Their Songs?

Hamilton Boyce, Senior, Biology

Mary Gates Scholar

Mentor: Michael Beecher, Psychology

Adult male song sparrows (*Melospiza melodia*) use vocal communication as a means of defending their territories and attracting mates. Songbirds (including song sparrows) are one of the few taxa whose vocalizations are not genetically inherited but learned through social interactions. The songs are learned from adult tutors sometime during the early stages of life. Prior to this study, very little was known about this period due to the difficulties of observing juveniles in the wild. To avoid this problem—in order to better understand vocal learning—we followed young song sparrows, using radio telemetry, throughout their first year of life and recorded their interactions and behaviors. Much of the research done on songbirds is done with captive animals but our telemetry project is based on the observation of wild birds. Its focus is not on what song sparrows are capable of doing under controlled laboratory conditions, but what they actually do in the field, with natural social and environmental interactions. The main question we want to answer is how, when, and from whom

do young song sparrows learn their songs. Understanding song learning in song sparrows is important because it has parallels to language learning in humans and serves as a more general model of learning—not just song learning—for many other species. The results indicate that individual birds have unique patterns of movement and that each individual's movement pattern will influence which songs he learns.

Examination of United States Cities as Forces in Environmental Policy

Phaedra W. Boyle, Senior, Psychology

Mentor: Lowell Hargens, Sociology

Studies of human impact on the environment have shown that, since the 1950's, increase in atmospheric carbon dioxide concentration, nitrogen fixation in the soil and rates of species extinction far exceed natural parameters. In the United States, local governments, at the city and state level, have been documented to be the most powerful force determining environmental policy and the centers of the greatest impact. The theory suggests that it is the business elite, in cooperation with the political elite, which determines the outcome of local environmental policy and its enforcement. However, some have pointed out the importance of stakeholders, citizens and consumers, as being influential in local environmental policy creation. Factors that may influence environmental policy include type of prevalent business, socioeconomic status, homogeneity of culture and geographical location of the city in which the policy is adopted. The methods and networks by which environmental issues are dealt with are a growing focal point in the sociological, environmental, business and political literature. This paper will examine the relationship of the aforementioned factors with the likelihood of a city to agree with the United States Mayor Climate Protection Agreement, a city-level version of the Kyoto Protocol.

Engineering Robust Designs for Synthetic Biology

Alex Bratt, Senior, Bioengineering

Mentor: Herbert Sauro, Bioengineering

It has been shown that prokaryotic transcriptional gene regulatory networks (GRNs) can be engineered *in vivo* to perform pre-programmed functions (e.g. act as sensors, produce oscillating concentrations of specific proteins). However, engineered GRNs tend to be delicate—they cease to function if perturbed. Unfortunately, perturbations such as gene sequence mutations and environmental changes are frequent and often unpredictable in rapidly dividing cellular systems like *E. coli* (a popular engineering target). It is the goal of this project to find robust network schemes that can be used to generate computer models of GRNs that function properly under wide ranges of conditions. Each GRN model will comprise a series of differential equations representing the rates of degradation and synthesis of

transcription factors in the network. One transcription factor in each network will be arbitrarily designated as the network output and model simulations will be carried out deterministically. A genetic algorithm will be developed to search for robust models. In the genetic algorithm—a search technique that operates on the principles of natural selection—a large initial population of randomly generated GRNs will be created. A first round of selection will eliminate networks that do not produce the desired output. Once a sufficiently fit population emerges, a second round of selection will be applied to eliminate delicate networks. It is expected that negative feedback will be a dominant characteristic among the robust network schemes that are generated; it is well known that biochemical networks rely heavily on negative feedback to confer resistance to perturbation. In any case, the network schemes that emerge may help guide future efforts to design transcriptional gene regulatory networks *in vivo*.

Studies of FMRP isoforms lacking nuclear export signals in transgenic mice

*Luis Briseno, Sophomore, Bioengineering
Mentor: David Morris, Biochemistry
Mentor: David Brackett, Chemistry*

The focus of my research will be to study two unique Fmr1 mRNA isoforms to better understand their biological function in an *in vivo* system. The proteins coded by these mRNA isoforms lack nuclear export capacity. Using homologous recombination techniques I will characterize and assemble expression vectors containing the cDNA of these two isoforms for expression in C57/B6 mice. The resultant mice will lack all forms of FMRP except those introduced by cloning. The mice will then be studied to determine the biochemical function and the gross neuro-anatomical and behavior and contribution of these forms of FMRP. Previous studies have shown that in neurons, Fragile X Mental Retardation Protein (FMRP) is involved in transporting certain mRNAs from the soma to dendrites. FMRP has also been shown to play a role in pruning dendritic spines. In the absence of FMRP, both in Fragile X patients and Fmr1 knockout mice, dendritic spine shapes appear immature and lack dendritic pruning associated with mature neurons. The Fragile X syndrome phenotype is further complicated by the fact that the FMR1 gene is alternatively spliced into multiple mRNA encoding protein isoforms of FMRP whose functional role in neural development remains to be determined. As a result of alternative splicing of the Fmr1 gene, a functional domain that allows FMRP to exit the nucleus is excluded in half of the known Fmr1 mRNA transcripts.

Accessmonkey: Enabling blind people to improve their own web accessibility

*Jeremy Brudvik, Senior, Computer Science
Mary Gates Scholar
Mentor: Richard Ladner, Computer Science & Engineering*

The internet has the potential to be a great tool of independence for blind people, but inaccessible web sites can be very limiting. Accessmonkey is a system under development that enables blind end-users to improve the accessibility of web sites and share these improvements with other users and developers. User modifications will be created through a user interface (UI), without programming, and then are transformed into JavaScript page scripts. Screen readers, software that blind people use to interface with computers, are dependent upon proper HTML usage to indicate semantic page elements, such as headings, lists, and paragraphs. Unfortunately, many web sites rely upon visual styling to suggest these elements, which leaves them invisible to screen readers and the people using them. The Accessmonkey UI will allow blind users to provide semantic annotations to web page elements which will then be applied as transformations to the web pages themselves through the generated scripts. Accessmonkey will also use machine learning techniques, together with user annotations to programmatically compare structural and visual characteristics of other page elements to infer other semantic content.

Comparison of Peppermint Flavoring Found in Candy Canes and Peppermint Oil from *Mentha piperita*

*Melissa E. Bruns, Senior, Chemistry, Evergreen State College
Raúl E. Murcia, Senior, Chemistry, Evergreen State College
Mentor: Peter J. Pessiki, Chemistry, Evergreen State College*

Over the past seven years we have been successful in our goal to establish a Chemical Garden on our campus. The continuing goal is to supply our research and teaching labs with a sustainable source of plant materials suited for laboratory science and chemical analysis. The garden is located on the Organic Farm, which is part of The Evergreen State College campus. Our focus has been with plants that produce volatile oils. These plants lend themselves well to extraction by steam or ethereal solvents. The extracted constituents are readily analyzed via Gas Chromatography-Mass Spectrometry, our primary analytical tool. The plants we have focused on are garlic, hops and mints. This research reports on our progress toward understanding the chemical make-up of the mint oil as a function of the time of the year the plant was harvested. Our initial results show in all cases that menthone and menthol are the dominant components of the peppermint oil. The presence of other constituents, including limonene, eucalyptol and menthyl acetate has been confirmed. We have quantified subtle changes in the ratio of these constituents and are attempting to understand how this is related to plant maturity. In addition, we have analyzed the peppermint flavoring found in four different candy canes manufactured in China and for the holidays of 2007.

LcERV, the First Characterized Retrovirus in Lemurs

*Jacqualyn Burnson, Senior, Molecular Biology,
Evergreen State College
Mentor: Clarissa Dirks, Biology, Evergreen State College*

To date there have been no retroviruses characterized in lemurs, an independent primate lineage endemic to the island of Madagascar. Endogenous retroviruses (ERVs) are the result of ancestral germline infections by active retroviruses, which are thereafter transmitted vertically through Mendelian inheritance. Using bioinformatics, we have identified and characterized a novel intact class II ERV in *Lemur catta*. *L. catta* ERV (LcERV) was identified by blasting the translated nucleotide database at the National Center for Biotechnology Information (NCBI), with the Pol protein from Mason Pfizer monkey virus (MPMV). Subsequently, the viral open reading frames (ORFs) and flanking viral long terminal repeats (LTRs) were identified and then further analyzed for sequence homology to other known retroviruses. Phylogenetic analysis of LcERV revealed that this virus clusters closely with endogenous and exogenous retroviruses found in Old World Monkeys, particularly with those found in Asia. Current research is focused on determining the viral copy number present in *L. catta* and other lemur species that represent all Malagasy Strepsirrhine clades. The cell-surface receptor used by LcERV will be identified by using Murine Leukemia Virus core particles pseudotyped with LcERV Env in infection assays against a nonpermissive cell type over-expressing the desired receptor. This research is the first step in a larger project that aims to characterize the types of retroviruses in Malagasy primates and examine their coevolution during the past 60 million years. This work is also linked to studies with broader ecological implications; we wish to understand factors impacting viral zoonoses and use ERVs as viral fossils to elucidate the origins of Malagasy primates.

Evolution of Function in the Nuclear Receptor HR78

Among Arthropods

*Clarissa Cabbage, Senior, Biology
Mary Gates Scholar
Mentor: Lynn Riddiford, Biology*

Pancrustacea is a monophyletic group consisting of the insects and crustaceans. Recent evidence suggests that the insects likely arose from the crustaceans. Metamorphosis is a widely used strategy among these arthropods and appears to have evolved twice within the group. It is present in both basal crustaceans and derived insects but absent in derived crustaceans and basal insects. HR78 is an ecdysone-responsive nuclear receptor and transcription factor that is necessary for the onset of metamorphosis in *Drosophila melanogaster*. The RNA is maternally deposited in the egg but present for only about two hours after laying, yet its absence has no effect on embryonic development. HR78 expression is highest within this insect during puparium

formation. I have isolated HR78 in the crustacean *Apohyale pugettensis*. In contrast to *Drosophila*, HR78 expression is high in the embryo yet can not possibly regulate metamorphosis as *Apohyale pugettensis* is a direct developer. At first this expression pattern seems conflicting. The insect larval stages are a continuation of the embryo; while the adult body form develops within the pupa. In both examples, HR78 expression is highest in the stage directly preceding the appearance of the adult body form. I hypothesize that HR78 was originally involved in directing the development of the adult body form. As metamorphosis re-evolved in the insects, HR78 was co-opted to play a role in the formation of the adult body form within the pupa.

Compliance to ‘Minimum Information about a Microarray Experiment (MIAME)’ Standards in Microarray Research

*Alisa Carlson, Freshman, Pre-Engineering
Mentor: Rebecca Rule, Civil & Environmental Engineering
Mentor: Peter A Noble, Civil & Environmental Engineering*

High-throughput oligonucleotide microarrays are now widely used in the fields of engineering, environmental and biomedical sciences to study gene expression and for the identification of microorganisms. In order to improve the presenting and exchanging of data, and to aid in the difficulty of interrupting and verifying published results, an international group of scientists proposed a minimum standard of information for all array studies. Since its conception in 2000, the Minimum Information About a Microarray Experiment (MIAME) standard has been endorsed by most highly regarded journals (e.g., *Science*, *Nature*). There is a paucity of information on whether or not recently published microarray studies are in compliance with this standard. Our study evaluated the top 100 most highly cited articles published sometime during 2004 or after, which used microarray technology. We compared the reporting methods from these articles to the standard requirements from the MIAME protocol. An example of some of the reporting criteria examined include: the availability of (i) raw data, such as raw microarray images for microarray hybridizations, (ii) final processed data, (iii) microarray target and probe information, (iv) microarray manufacturer information, and (v) processing protocols used to attain experimental results. From this assessment, the scientific and health communities will be aided in their understanding of the level of compliance and repeatability for research findings on which they depend.

Design of a poly(2-hydroxyethyl methacrylate-co-methacrylic acid) scaffold for cardiac tissue engineering

Christine Anne Cezar, Senior, Bioengineering

Mary Gates Scholar

Mentor: Buddy D. Ratner, Bioengineering and Chemical Engineering

According to the American Heart Association, cardiovascular disease claims the lives of more Americans each year than cancer, chronic lower respiratory diseases, and diabetes mellitus combined. In addition, 7.9 million Americans have suffered from myocardial infarctions, resulting in damaged heart tissue that suffers from reduced function and forms a barrier to healthy cell migration. Unfortunately, significant regeneration of this damaged tissue is not seen in human hearts and current treatments are highly invasive and only offer temporary relief to the patient. The goal of this project is to develop an alternative treatment using tissue engineering constructs. Cardiac tissue engineering requires a scaffold material that provides structural support and is conducive to cell growth. A degradable, hydrogel scaffold of hydroxyethyl methacrylate (HEMA) copolymerized with methacrylic acid (MAA) that is capable of controlled biomolecule release was chosen for its biocompatibility and mechanical properties. Controlled release systems are advantageous as they offer extended treatment and eliminate the problem of patient compliance. To promote cell adhesion, the surface of the hydrogel was activated with N-(3-dimethylaminopropyl)-N'-ethylcarbodiimide hydrochloride (EDC) and N-hydroxysuccinimide (NHS). The activated hydrogels were then reacted with collagen and seeded with C2C12 mouse myoblasts. Mechanical testing and ESCA analysis confirms the successful activation of the gel and immobilization of collagen. Cell studies confirm the bioactivity of the immobilized collagen as a significant number of cells attached and survived on the activated p(HEMA-co-MAA) hydrogels. Degradation studies and cytotoxicity studies characterize the scaffold system's release profile and ability to promote cell survival in the presence of degradation products.

Construction of RC Snubber for Use in ZaP Flow Z-pinch Experiment

Dean Chahim, Freshman, Pre-Engineering

NASA Space Grant Scholar, Mary Gates Scholar

Mentor: Uri Shumlak, Aeronautics & Astronautics

Mentor: Brian A. Nelson, Electrical Engineering

In the ZaP Flow Z-pinch Experiment, plasma in a Z-pinch configuration is stabilized using sheared flows. Due to the inductance of the experiment geometry and the capacitance of the two electrodes, a rapid fluctuation of voltage occurred during the initial switching on of the experiment. In addition to causing noisy data, this effect posed a safety hazard since the voltage on the experiment overshot the

target by a factor of nearly two, to a maximum of 20kV. To counteract this, the snubber was constructed from parallel capacitors in series with parallel resistors which critically damp the voltage spikes and fluctuations. The snubber acts by attenuating signals over a cutoff frequency of 5 MHz, which is determined by the capacitance and resistance of the snubber's circuit elements. With these signals damped, noise is reduced, data quality increased, and safety maximized.

Bolometry for the Investigation of Helicity Injection on the HIT-SI and NSTX Experiments

Mark Chilenski, Sophomore, Aeronautics & Astronautics

Mary Gates Scholar

Mentor: Thomas R. Jarboe, Aeronautics & Astronautics

Bolometry is being used as an integral diagnostic in the study of the formation and sustainment of fusion plasmas by helicity injection. The Helicity-Injected Torus (HIT-SI) is a plasma confinement device exploring the generation and sustainment of plasmas by a novel AC process known as Steady Inductive Helicity Injection (SIHI). The National Spherical Torus Experiment (NSTX) is a plasma confinement device using, among other things, electrostatic Coaxial Helicity Injection (CHI) for startup. In both CHI and SIHI, the level of total radiated power in the injector region is of particular interest, and plays a significant role in understanding the dynamics of CHI startup. A bolometer is a device that measures total radiated power. In the bolometers in use on and under construction for NSTX and HIT-SI, an AXUV silicon photodiode with a very flat spectral response (International Radiation Detectors, Inc.) is used to measure the total intensity of the plasma's emission. The design of a bolometer originally built for HIT-II, and currently operated on HIT-SI, has been updated and optimized, and two units have been completed for NSTX. Design work is underway on two new units for HIT-SI, as well as a specially modified multi-chord unit for NSTX. In addition to this design work, the calibration of the units for HIT-SI entails a numeric integration over the plasma volume, to be implemented in Matlab. This research will enable a better understanding of the power balance in plasmas formed with both SIHI and CHI.

Effects of adenosine vasodilation agents on ischemic stroke

Joshua Yaozhang Chua, Senior, Accounting and Physiology

Mentor: Al Ngai, Neurosurgery

The research goal is to find out if pharmacological agents could enhance collateral flow in rats during a surgically produced ischemic stroke (middle cerebral artery occlusion), and improve outcome after the removal of occlusion. Adenosine acts as a neuroprotectant and vasodilator. During ischemia, adenosine levels rise in the ischemic region and cause the pial arterioles to dilate

allowing increased collateral blood flow. In order to elevate adenosine levels further, 5'-deoxy-5'-iodotubercidin (5'-IT), an inhibitor of Adenosine Kinase, the primary adenosine metabolic enzyme, is identified as a possible vasodilation agent. In addition, 2-p-(2-carboxyethyl)-phenethylamino-5'-N-ethylcarboxy-amidoadenosine (CGS-21680) is a topically applied A2A adenosine receptor agonist which potently dilates arterioles during ischemic conditions. The experiments involve the installation of a cranial window, where a portion of the skull will be replaced by glass. This allows pial arteriole diameter to be measured by a dimensional analyzer and arteriole blood velocity by laser doppler flowmeter. After cranial window installation, the animals are stabilized for approximately 20 minutes. This is followed by 2 hours of middle cerebral artery occlusion (MCAO) by surgically inserting a silicon-coated suture to simulate a clot in the MCA. 30 minutes after MCAO onset, CSF (Control), CGS-21680 (topical) or 5'-IT (intravenous), will be applied. After the 2 hour occlusion period, the suture is removed to allow reperfusion. The animal's neurological deficit and ischemic damage are evaluated after 24 hours of reperfusion. Due to the short treatment window of rtPA treatment for stroke, these agents can be refined in the future to lengthen the treatment window, allowing more patients to receive treatment and recover well.

Expression of -Defensins in Monocytes

Matthew D. Clark, Senior, Biology and English

Mentor: Beverly Dale-Crunk, Oral Biology

Mentor: Sun Chung, Oral Biology

Mentor: Orapin Horst, Oral Biology

Mentor: Beth Hacker, Oral Biology

Human -Defensins (hBDs) are anti-microbial peptides which are found in epithelium and the oral mucosa. HBDs are involved in the body's innate immune response to oral pathogens such as bacteria and viruses. Mono Mac6 (MM6) is a human monocytic cell line that is also involved in innate immunity. The expression of hBDs in MM6 cells is not known at this time. The goal of the present study was to identify mRNA expression of hBD 1, 2, and 3 in MM6 cells exposed to inflammatory agents. Cells were stimulated with interleukin-1 (IL-1), tumor necrosis factor- (TNF-), Pam3CSK4 (a synthetic lipopeptide), Escherichia coli lipopolysaccharide (LPS), phorbol myristate acetate (PMA, an epithelial stimulant), and interferon- (IFN-), along with unstimulated controls. Three independent stimulation experiments were performed. The expression levels of hBD 1-3 were measured using real-time quantitative PCR (Q-PCR). IL-1 and TNF- both showed a 1.5 fold increase in hBD1 expression. LPS stimulation resulted in decreased hBD1 expression as compared to controls, while Pam3CSK4 induced a 3 fold increase in hBD1. However, neither hBD2 nor 3 was expressed in MM6 cells. This result is different from what is seen in gingival epithelial cells where hBD2 and 3 expressions are stimulated by regulatory substances. Further experiments

are needed to add to our knowledge of hBD 1-3 expression in monocytes.

From Concept to Creation: Making Fea's Gown

Meredith Cook, Senior, Art, Media & Culture, UW Tacoma

Mentor: Tyler Budge, Interdisciplinary Arts & Sciences, UW Tacoma

The Gown of Fea the Soul Weaver is an art project designed to combine storytelling with costume making. The project's scope includes developing the concept of a character and storyline, designing the garment, researching materials and construction methods, and constructing the gown. Nestled within the holes of Irish myth, Fea's story is a combination of carefully chosen elements from the historical legends of the Tuatha De Danann. Even the mythological figure Fea, who's name is based on the Gaelic word for "weave", is chosen to support the initial character concept. Where Fea's traditional history lacks content, a new story is created: During the Tuatha De Danann's battle against the Fomorians, Fea saves the spirits of the dying by weaving their souls into her garments. Designing Fea's gown then becomes an illustration of a moment in her newly created history. To further support the character concept, materials and construction methods are selected to emphasize Fea's action of weaving souls. Materials like hand-dyed wool are sculpted into faces and felted into a base garment. The felting process, like Fea's weaving, knits the individual wool fibers into the weave of the base fabric. Costume construction and materials also include making weft-fringe of human hair, fabric appliquéd of Celtic patterns, and hand-sewn beading. The final results of the project should be an art piece that explores elements of shape, materials, and construction that best represent the concepts behind a character's story.

Feeding Study to Examine the Effect of Glycemic Load and Obesity on Cancer Biomarkers

Samantha Croffut, Junior, Biology (Physiology)

Mentor: Johanna W. Lampe, Public Health and Community Medicine Epidemiology

The Fred Hutchinson Cancer Research Center is working on a \$54 million initiative studying the link between obesity and cancer. The goal is to avoid and prevent deaths resulting from cancer that are related to obesity. To accomplish this, participants will undergo a twelve-week study comprised of four-week periods where the participant will have their own usual diet, a diet with high glycemic load foods, or a diet with low glycemic load foods. One of the two controlled diets will be randomly assigned for the first four-week period, then a washout period will take place where participants eat their own food, then the other control diet will be assigned. This study length was used because it was short enough to ensure maximum participant completion, but also long enough to note how changes in

diet affect changes in biomarkers. After 41 weeks have been spent on conducting the studies, an additional 12 weeks will be used for data analysis. The biomarkers that will be tested have all been recognized as relating to cancer and include insulin, glucose, leptin, adiponectin, and interleukin-6. After analyzing the changes in these biomarkers after each four-week period, researchers hope to find how the specific diets directly affect these biomarker changes and how being obese changes how these diets affect the biomarkers. This study is incredibly relevant considering that two-thirds of the US is currently either overweight or obese. Overall, the goal is to find ways to prevent this large proportion of the US population from being diagnosed with these obesity-related cancers. To do this, they will find the specific underlying physiological mechanisms involved in relating diet to obesity and both of these factors to cancer.

Shoreline Erosion Rates of Southern Island County

*Suzanne Cruchon, Junior, Earth & Space Sciences
Mentor: Terry Swanson, Earth & Space Sciences*

Quantitative assessment of shoreline erosion rates of the Puget Sound area, including Island County have not been studied in-depth. Population pressure has caused more people to build in geologically hazardous area, including unstable bluffs. I will be assessing the shoreline erosion rates of southern Island County over the past 60 years, particularly in the area around Double Bluff and Possession Point. I hypothesize that the erosion rate of the past 60 years will be strongly controlled by the aspect of the bluff relative to prevailing storm track and the length of the fetch. I propose to utilize the 1944 declassified military air photos of this subject area by overlaying these images with recent aerial photos using geo-referencing. By superposition of shoreline position in the 1944 versus recent aerial photos I will quantify the rate of erosion over a sixty-year time interval. My research project will complement the research projects being completed within the Cronus Earth project, where cosmogenic isotope dating and geomorphology are being used to calculate long-term erosion rates over the last 6000 years of the Holocene.

Characterization of a New Voltage-Sensitive Dye for Monitoring Dipole Potential of Membranes

*Jaideep Das Gupta, Junior, Chemical Engineering
Mary Gates Scholar
Mentor: Hong Shen, Chemical Engineering*

Voltage-sensitive dyes are used when manual measurement of the dipole potential would be too risky and difficult. Optical imaging techniques have the advantage due to non-invasively monitoring dipole potential with high spatial and temporal resolution. However, current optical probes are not sufficient to monitor neural activity because of low voltage sensitivity for fast time response. A new type of voltage-sensitive dye is proposed based

on the electric-field dependence of electron-transfer potential has potential for the neural imaging field. These probes contain an electron donor-acceptor pair in which intramolecular transfer competes with fluorescence emission. New organic semiconductors, n-type conjugated oligomers, include donor-acceptor junctions that exhibit efficient optical properties in organic electronics. One of these co-oligomers, B3TPQ, is a preliminary choice for monitoring dipole potential. In this study, B3TPQ has been incorporated into an artificial cell membrane environment made from liposomes. B3TPQ responses to dipole potential changes have been characterized for its potential as a future voltage-sensitive dye that can be applicable for imaging.

Development of an embedded computer system for recording the vocalizations of marine mammals

Matthew D'Asaro, Sophomore, Mechanical & Electrical Engineering

*Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Kate Stafford, Applied Physics Laboratory*

To better study the vocalizations of marine mammals and other ambient noise, I helped develop a versatile underwater passive acoustic recorder. The instrument is designed to be attached to an oceanographic mooring for extended periods of time to record sound for later retrieval and analysis. It is also designed to have a flexible software-configurable sampling scheme capable of multiple sampling rates and duty cycles so that it may be used for many different projects with little or no modification. The core of the instrument is a small computer, the Blackfin BF537 embedded processor, running the open source operating system uClinux. To minimize cost and maximize versatility it uses battery packs of standard alkaline batteries, a commercially manufactured pressure case, and records data from any one of several common commercial hydrophones onto any standard USB storage device. To allow for events captured on different devices to be correlated in time, it has the option of using a high-stability temperature-compensated crystal clock as a time base. Both the software and hardware have been carefully designed to minimize power usage so that the instrument can be deployed continually for up to 12 months. The completed instrument should allow for higher quality and lower cost recordings of marine mammal vocalizations, which will facilitate a better understanding of their acoustic behavior and how this behavior may be applied to species conservation.

Relationship between aging and proteotoxicity in *Caenorhabditis elegans*

Christina Davis, Senior, Biology (Physiology)
Mentor: Matt Kaeberlein, Pathology
Mentor: Katherine Steinkraus, Pathology

Dietary restriction (DR) increases life span and delays the onset of a variety of age-associated diseases, including cancer, diabetes, and cardiovascular disease in mammals. In the nematode *Caenorhabditis elegans*, DR can be accomplished by removing the bacterial food source during adulthood, referred to as bacterial deprivation (BD). In prior studies, we have determined that BD suppresses disease phenotypes in nematode models of Alzheimer's disease (AD) and Huntington's disease (HD). Both of these diseases are caused, in part, by the accumulation of toxic proteins (proteotoxicity) and can be modeled in *C. elegans* by transgenically expressing the toxic peptide. In this study, we have explored more generally the relationship between pathways that modulate longevity and resistance to proteotoxic diseases. Using RNA interference, we have screened more than 200 genes previously shown to modulate life span in *C. elegans* and examined disease progression in our nematode HD and AD models. To date, more than three-dozen RNAi clones (each corresponding to a single gene) have been found to slow disease progression in one or both models. Ongoing studies are identifying and verifying additional RNAi clones that confer disease resistance. Future efforts will be aimed toward characterizing the molecular mechanisms by which these genes modulate proteotoxicity and determining which of the identified genes are likely to be useful therapeutic targets for treating human diseases of proteotoxicity.

Social Competence, Gender, and Depression

Katey Davis, Senior, Psychology and English
Mentor: Dawn De Gere, Psychology
Mentor: Yuichi Shoda, Psychology

While some research studies have shown that women are harsher judges of their own social competence than men are, other studies have failed to detect any gender differences in perceived social competence. A more consistent finding is that social competence is linked to depression. That is, self-report measures indicate that depressed individuals rate themselves as having low levels of social competence, even when outside observers rate them as socially competent. In the current study, we explored whether depression and other individual differences could moderate the relationship between gender and social competence. Consistent with previous research, we found that high levels of depression are associated with low levels of perceived social competence. While gender and social competence were not found to be directly related, our findings suggest that depression may influence the relationship between social competence and

gender. Indeed, we found that women with higher levels of depression reported lower levels of social competence than any other group, including depressed men and non-depressed women and men. The findings may help to explain the conflicting results of previous studies on gender and social competence and also help to identify individual difference factors that may play a role in people's perceptions of their own social competence.

Nucleotide polymorphisms in IFNg from Chinook salmon, *Oncorhynchus tshawytscha*

Sarah Ellen Demlow, Senior, Molecular, Cellular & Developmental Biology
Mentor: Stevie Wallis, Northwest Fisheries Science Center
Mentor: Linda D. Rhodes, Northwest Fisheries Science Center

Bacterial kidney disease (BKD), caused by the agent Gram-positive bacterium *Renibacterium salmoninarum*, is one of the most common infectious diseases associated with captively reared Pacific salmon. Little is known, however, about the molecular immune response these fish use to combat BKD. To help determine the host response, Chinook salmon were challenged by an attenuated strain (MT239) of *R. salmoninarum*. To identify genes associated with an effective host response, a suppression subtractive hybridization (SSH) was then conducted to compare anterior kidney mRNA from Chinook salmon challenged by an attenuated strain (MT239) or a virulent strain (33209) of *R. salmoninarum* to identify genes associated with an effective host response. Expressed sequence tags (ESTs) matching two interferon inducible genes (IFN-inducible GBP and VLIGI) were observed from the SSH to be up regulated expressed at higher levels in the response to the attenuated strain after 24 hours and 72 hours after challenge. In order to determine whether type II interferon (IFNg) was also expressed at higher levels, we decided to clone and was selected to be sequence IFNg cDNA to design a primer-probe set for in order to set up a quantitative PCR (qPCR) that would determine its transcript levels. Therefore, using primers derived from the rainbow trout IFNg sequence, IFN-g sequences were amplified by PCR from the cDNA of individual fish infected with MT239 was amplified through PCR, cloned into Escherichia coli, and sequenced for further analysis. The sequence results were unexpectedly, as multiplex nucleotide polymorphisms and insertions/deletions have been identified not only between among different fish, but also from among multiple sequences clones from individual fish. These polymorphisms variations in IFN-g also are not seen to just affect the predicted nucleotide sequence, but also the amino acid sequence. Because polymorphisms in such an important mediator of immune response could affect susceptibility to infection, we are interested in determining the number of loci for IFN-g, including defective genes and

pseudogenes. Alterations at the polypeptide level could make certain individuals more genetically susceptible to infection similarly to how mutations in MHC I and II proteins as well as transferrin can weaken host responses. Multiple polymorphisms within an individual fish are also a potential indication that IFN-g is a tetraploid gene in salmonids.

The Interaction of Two Growth Hormones in *Arabidopsis* Seedlings

*Rachel Denney, Junior, Environmental Health
Christine Lawrence, Senior, Biology (Molecular, Cellular & Developmental)
Mentor: Jennifer Nemhauser, Biology*

Auxin and brassinosteroids are two crucial hormones that control plant development. When present, auxin and BR cause an increase in growth and an increase in expression of specific genes. These hormones have been shown to have a synergistic relationship, which implies an interconnected BR and auxin pathway. We are performing a genetic screen to find plants with different responses to the combination of BR and auxin hormones. In our screen, we use two assays to visualize hormone response: reporter gene expression and hypocotyl growth promotion. The reporter we are using is called SAUR15::GUS. The SAUR15 gene is activated by BR and auxin, and the levels of the GUS enzyme can be measured by staining the plants with a colored substrate. By measuring the length of the hypocotyls, we have a quantitative measure of seedling growth. We began by mutagenizing and collecting seeds from 5,000 individuals. So far, we have examined approximately 30,000 M2 seeds (representing seeds from 3,000 M1 plants) and are currently performing secondary screens to find the best mutants for further study. After such mutant plants are identified, we will begin the process of positional cloning to determine the specific mutation that causes the change in hormone responses. Once we find a mutation that causes our phenotype, we will have identified a gene involved in connecting the two hormone pathways.

Sol-Gel Derived Hydroxyapatite Coatings of Controlled Thickness

*Angela Desisca, Senior, Materials Science & Engineering
Mentor: Nik Hrabe, Materials Science & Engineering
Mentor: Rajendra Bordia, Materials Science & Engineering*

The focus of this research is to develop a processing route for the application of hydroxyapatite (HA) coatings on porous titanium. These materials are being developed for a range of orthopedic implants. As titanium is not a bioactive material, the growing bone does not bond to the substrate. HA coating will serve to activate titanium and promote the desirable binding of bone. HA is a calcium-phosphate based ceramic and is the primary inorganic constituent of the bone. The HA is being synthesized using a simple

sol-gel technique that is effective in coating irregular and porous substrates. In addition, sol-gel requires a lower heat treatment temperature which prevents degradation of the titanium due to oxidation or phase transition. The main focus of this research is to investigate the effect of withdrawal speed on coating thickness. HA coatings will be applied via dip-coating, using different withdrawal speeds and the resultant coating thickness will be measured using profilometry; higher speed result in thicker HA coating. The results will be analyzed using available models for Newtonian fluids. An additional goal of this study is to determine the critical coating thickness (and the corresponding withdrawal speed), past which cracking occurs due to stresses from shrinkage during sintering.

Genetic Interactions in the Dystroglycan-Dystrophin Complex

*Benjamin Drum, Sophomore, Biochemistry
Mary Gates Scholar
Mentor: Hannele Ruohola-Baker, Biochemistry*

Muscular dystrophies are a set of diseases in which the muscles slowly degrade, leading to premature patient death. In all muscular dystrophies, the Dystroglycan-Dystrophin (DG-Dys) complex, which is a transmembrane channel that binds laminin to actin, malfunctions and leads to muscular inhibition in skeletal, smooth, and cardiac muscle tissue. The DG-Dys complex interacts with many genes, and it is one of the goals of the lab to find these genes and determine if mutations in these genes could rescue the muscular dystrophy phenotype. *Drosophila melanogaster* is a model organism for muscular dystrophy because DG-Dys mutants display muscular dystrophy phenotypes. In addition, all of major components of the DG-Dys complex are present in *Drosophila*. Furthermore, the relative simplicity of the fully mapped genome and short reproductive cycle of *Drosophila* make it an excellent model organism. In addition to muscular defects, a mutation in the DG-Dys complex causes a cross-vein wing phenotype. This phenotype is easily scored and provides a simple way to identify genetic mutations that may interact with the DG-Dys complex. I have used this feature to look for numerous genetic interactors. In *Drosophila*, muscular dystrophy also leads to neuronal disorganization in the brain, specifically in the axons running from the ocular region to the central brain. Mutations that may interact with the DG-Dys complex are analyzed using a variety of methods, including analyzing brain structure and axon termination abnormalities. I have dissected the juvenile brains of the genes *inscuteable*, *semaphorin 1-a*, and *polyEGF RNAi* mutants crossed to the GAL4 driver *tubulin* and immunofluorescently stained the axons in the brains. From these dissections, I looked for mutant axon terminations and found that *semaphorin 1-a* and *inscuteable* show potential brain defects. These genes are still being researched, and I plan to cross these genes to Dystroglycan to see if these genes interact in the brain and to different GAL4 drivers in order to test for possible phenotypes.

News without borders: The international distribution of online news and influencing factors

*Elizabeth Evans, Senior, Communication
Mentor: Philip N. Howard, Communication*

What is the international distribution of online news? This study aims to compile a global dataset on the distribution of online news today, as well as determine influential factors of the flourishing online news circuit. Many scholars argue that the internet may provide a forum for ideas that are overlooked or restricted in the mainstream media by evading some of the censorship controls that affect print media news, and, in recent years, the internet has established a thriving news media population. The internet is an excellent conduit for online newspapers because they can be operated from outside their target country through the medium of the internet. The purpose of this study is to find from where the majority of online newspapers and their servers originate. Most of the prevailing theories on online media hold economics responsible for the “digital divide”. I argue that lack of economic funding is no longer a problem, and the servers for online news media may originate in areas of the world with the economic and technical means to operate web sites. This study will examine possible relationships through regression analysis between the proportion of online news sources operated within the country and possible variables conducive to a thriving online medium. These factors will include the level of freedom that country maintains, the level freedom imparted to the media, the percentage of internet users in the country, and the country’s gross domestic product. The results from this study will provide a global view of the news media online today, as well as isolate possible variables that foster successful online media. This knowledge will aid further development in the online medium, which is becoming a critical means to thriving in an increasingly globalized world.

Elementary English language learner's educators: struggles and strategies

*Martha G. Flores Pérez, Senior, English and Spanish
Zesbaugh Scholar
Mentor: Jennifer Joyce, Education*

My project is evaluating a segment of an English Language Learner's (ELL) intervention. Over the course of four years, small groups of elementary school teachers met for development programs facilitated by staff from Schoolwide Preparation for English Language Learners (SPELL) Academy. The goal of the ELL intervention was to first come up with a question to focus on the improvement of their teaching methods directed at meeting individual needs of their ELL students. By providing a space and time for the teachers to talk about their obstacles, many shared their experiences and provided strategies that they implemented for a month, after which they returned to discuss the results on a follow-up meeting. My research is based on analyzing

thematically the transcripts of the meetings and pre and post records. The focus is the teacher's struggles in working with ELL students and the strategies each school came up with and what their results were. Since there were various schools participating, there was an exchange of information regarding distinct programs. I found that there were two main focuses of concern for ELL teachers. The first one, having two parts: structure and communication, which implied outside district policies, resources and distribution of information and communication within the school staff. The second focus was vocabulary. The main concern was the difference in receptive and productive knowledge. As part of this vocabulary comprehension was emphasized, as well as a method for assessment. My analysis supports the finding that this type of program is important because it connects ELL teachers with a supportive network of peers that opens channels for discussing and expressing the barriers in their profession.

Utilization of WiMAX Development Boards for Future Research

*Joseph Garrison, Senior, Electrical Engineering
Mentor: Sumit Roy, Electrical Engineering*

One of the primary problems doing communications research is when hardware implementation is needed for further testing. Computer simulations can suffice, but at the expense of only being able to approximate real-world environments. Hardware implementation, however, is not an easy task. At best, this requires modification of the firmware, which may require reverse engineering it if the source code is not available. At worst, it requires hardware that is not available, making acquisition a very lengthy and expensive proposition, if it is indeed possible. Our lab is currently investigating the use of a WiMAX (Worldwide Interoperability for Microwave Access) development board for real-world testing involving the IEEE 802.16 protocol. By default, these boards are limited in their feature set; they can do send, receive, encode, and decode WiMAX frames, but do not have a complete Medium Access Controller (MAC) implemented, which would be necessary to have these units communicate over radio frequencies without interfering with each other. Our goal is to develop an on-board test bench and a full-fledged MAC to make these boards suitable as a testbed. From there, it would be possible to test techniques such as collaborative MIMO (multiple-input, multiple-output) and other medium access schemes on real hardware, adding accuracy and credibility to computer simulations by making sure these schemes work on real hardware in a real environment using real radio signals.

Internet Use in the International Women's Health Movement

*Olivia Garrow, Senior, Communication
Mentor: Kirsten Foot, Communication*

As use of the Internet has spread to become widely appropriated by political activism campaigns, the actors within these campaigns have found ways to change the processes of political activism to support their work as members of international social movements. In a seminal report, Mark Surman and Katherine Reilly classed their analysis of Internet appropriation in four categories: online collaboration, online publishing, mobilization, and observation. My study will support the use of these four categories by asking how actors within the international women's health movement use each to reinvent themselves on the Internet, and to create networks, publish information, mobilize activists, and observe trends in the movement, completely outside of government support. I will be using the application ScrapBook for Firefox to capture websites of the three organizations. I will then analyze the content of the pages for factors that indicate the presence of online collaboration, online publishing, mobilization, or observation. Scrapbook will allow me to highlight portions of text and make notes directly on the page impressions. This will allow me to organize my data according to the presence of patterns of similarities and differences between the organizations. I will then have a well-balanced way of discussing my analysis and displaying my conclusions about the diverse characteristics present on each webpage. The United Nations Population Fund, The International Center for Research on Women, and One By One are diverse organizations within one movement which were chosen due to my personal familiarity with each, allowing me to gain the most in-depth information as I analyze their websites. This research seeks to contribute to the growing body of literature discussing social movements' use of Internet technology to advance activism, as this is becoming an integral part of the dialogue about movements and political activism in the communications community.

Molecular Phylogeny of Boraginaceae

*Julia Gertsen, Senior, Plant Biology
Howard Hughes Medical Institute Biology Fellow*

Mentor: Richard Olmstead, Plant Molecular Systematics & Evolution

The family Boraginaceae, the Borage family, consists of about 134 genera and 2650 species. Plants of this family include herbs, shrubs, trees, and occasionally lianas and are widely distributed both in temperate and tropical regions. Many plants are ornamentals, like species of the genus *Myosotis* the "forget-me-nots", and several others have been used as medicinal herbs such as *Symphytum officinale* (comfrey) and *Borago officinalis* (borage). A second, smaller family, Hydrophyllaceae, the Waterleaf

family, consisting of about 20 genera and 300 species, is restricted to western North America and has been suggested to be closely related to Boraginaceae. Building on an existing set of sequences for the chloroplast gene *ndhF*, we add a second DNA region, *trnLF*, to test the hypothesis that Hydrophyllaceae is actually part of the larger Boraginaceae. Also, we test the monophyly of subfamilial groups within Boraginaceae and Hydrophyllaceae to create a classification that allows us to make inferences about evolutionary history within the group. Here, we present a phylogenetic tree that more accurately reflects the patterns of evolution between taxa of Boraginaceae.

Evangelicals in the Media

*Matt Gilchrist, Senior, Political Science
Mentor: Bryan Jones, Political Science*

In the last two U.S. Presidential elections, Evangelical Christians played a large role in electing, and re-electing George W. Bush to office. In 2000, Bush received 68% of the Evangelical vote, and in 2004, he received 78%. Much has been made of this constituency since its rise to political prominence in the 1970s with the help of Jerry Falwell, James Dobson, Pat Robertson, and others. Less is known about how Evangelicals are portrayed in the media. Over time, are they presented as a mainstream American constituency, or a fringe group of the Republican Party? The New York Times is the closest the U.S. has to a national paper; its articles are printed in smaller newspapers around the country, and the paper is generally considered to be the newspaper of record for the U.S. By examining New York Times articles about the Evangelical political movement, we can gain a more complete understanding of this constituency, its relation to the media, and how culture war issues (abortion, homosexuality, school prayer, etc) have developed and changed over time.

Probing Halo Substructure with RR Lyrae using Manastash Ridge Observatory

*Skyler Grammer, Senior, Astronomy
Dylan Morgan, Senior, Astronomy
Atria Welch, Senior, Astronomy
Mentor: Chris Laws, Astronomy*

We investigated probable substructure in the Milky Way galactic halo using radially pulsing variable stars known as RR Lyrae. The substructure of the Milky Way galactic halo is not fully known and mapping substructure of the galactic halo can be achieved using RR Lyrae as tracers. RR Lyrae are specifically important for this purpose as they all have approximately the same light output (luminosity), therefore if we know how luminous they appear to be then we know their distance. Sesar et al. (2007) selected 634 RR Lyrae candidates from multi-date Sloan Digital Sky Survey (SDSS)-I observations of a region of the sky called stripe 82. SDSS-I is an all sky survey that has detected nearly 200 million objects in one quarter of the sky over

the course of five years. From these 634 probable RR Lyrae, several clumps in the galactic halo were discovered. Follow up photometry (measuring the amount of light entering the telescope from the source) was obtained at Manastash Ridge Observatory (MRO) in order to confirm the existence of these RR Lyrae over-densities. Due to time and telescope limitations we observed two of the discovered clumps. Using the photometric data, we created light curves with an average of 15-20 data points for each observed RR Lyrae candidate; the light curves display the periodic variability of the star. RR Lyrae have a very specific range of periods (0.2 – 1 days) which are identified using the light curves. Of our sample, 23 stars (70%) have light curves consistent with RR Lyrae, thus confirming these new substructures.

Chemical Characterization of Particulate Matter using GC-MS and Scanning Electron Microscopy

Kristina Gill, Sophomore, Nanotechnology, North Seattle Community College

Anna Grimes, Post-Baccalaureate, Naturopathic Medicine, North Seattle Community College

Rebekah Hermosillo, Junior, Radiology, North Seattle Community College

Josh McLaughlin, Sophomore, Chemistry, North Seattle Community College

Mentor: Kalyn Owens, Chemistry, North Seattle Community College

Mentor: Ann Murkowski, Biology, North Seattle Community College

Atmospheric particles from automotive emissions have been shown to be key players in a significant number of bronchial related human illnesses. It is believed that these nanometer-sized particles disrupt mitochondrial function by cell membrane penetration and electron transport chain interference. There is preliminary evidence that the presence of transition metals and/or polycyclic aromatic hydrocarbons (PAHs) on these particles are responsible for the documented disruption in cellular function, but the details of the underlying toxicological mechanism remains largely unknown. In this study, we take the first step towards gaining a better understanding of the health effects of combustion particulate matter by characterizing and quantifying the PAHs present on atmospheric particles collected in proximity to a major interstate freeway. The particles are collected using a size fractionated particle collector, then extracted via solid phase extraction process, and analyzed using GC-MS. Furthermore, the particles are visualized and the base elements are identified using SEM (Scanning Electron Microscopy). The presence of PAHs on the particulate matter has been documented and SEM imaging will show the elemental makeup of the particulate matter. Future studies of mitochondrial toxicity will elucidate the connection between PAHs and health related effects due to particulate matter.

***Alexandrium catenella* in Quartermaster Harbor, Puget Sound: Past and Present**

Audrey Hackett, Senior, Environmental Science, UW Tacoma

Mentor: Cheryl Greengrove, Interdisciplinary Arts & Sciences, UW Tacoma

Harmful algal blooms caused by the dinoflagellate *Alexandrium catenella* have increased throughout the world in the last 30 years. Saxitoxin, the neurotoxin produced by *A. catenella*, can be concentrated in the tissues of shellfish which filter-feed the plankton, causing Paralytic Shellfish Poisoning (PSP). Although the toxin is not usually harmful to shellfish, people that ingest the shellfish can suffer from loss of coordination, numbness, and even death. The international and U.S. harvesting limit for this toxin in shellfish is 80 µg toxin/100 g of tissue. Quartermaster Harbor (QMH) in Puget Sound has a high abundance of *A. catenella* cysts in the sediment and harvesting is frequently closed due to exceedance of the PSP limit for saxitoxin. To further investigate plankton patterns and environmental conditions conducive to the increased production of *A. catenella*, we sampled water properties and phytoplankton at seven stations within QMH. A historical timeline for saxitoxin concentration in shellfish was also created using Washington State Department of Health's (WDOH) data from 1980-2005 in QMH. Quantitative phytoplankton counts from water samples identified the presence of *A. Catenella* in the months of July and August, 2007. This is consistent with the WDOH historical timeline which frequently showed increased saxitoxin levels between June and October annually. Additional research is needed to determine the cell concentrations of *A. catenella* necessary to produce enough saxitoxin to exceed the shellfish harvesting limit.

Immunologic Tolerance to Myelin Basic Protein Prevents CNS Autoimmunity and Improves Neurological Outcome Following Stroke

Jessica Hadwin, Sophomore, Neurobiology and English Howard Hughes Scholar

Mentor: Kyra J. Becker, Neurology

Animals subjected to an inflammatory insult during middle cerebral artery occlusion (MCAO) tend to develop an autoimmune response to the brain antigen myelin basic protein (MBP) which is associated with a worse neurological outcome. The induction of immunologic tolerance to MBP prior to MCAO via mucosal treatment is linked to improved outcome. Our study aimed to determine the long term neurological outcomes associated mucosal tolerance and stroke. Male Lewis rats were tolerized to either MBP or ovalbumin (OVA) by intranasal administration over a period of 10 days prior to MCAO. During reperfusion the animals received lipopolysaccharide (LPS; 1 mg/kg intraperitoneal) to simulate infection, resulting in sensitization to MBP. Behavioral tests were

performed at set time intervals before and up to one month after MCAO to assess neurological status. These tests included rotarod to measure physical deficits, sticky tape test to measure contralateral limb awareness, and footfall to measure alertness and physical ability. One month after occlusion, splenocytes of the MBP tolerized animals generally exhibited a regulatory response (Treg) and were less likely to show an autoimmune response to MBP than those that were tolerized to OVA. The animals that exhibited the Treg response performed better on behavioral tests. Conversely, animals that developed an inflammatory response (TH1+) to MBP generally performed worse on behavioral tests than animals that lacked this response. These data imply that deleterious autoimmune responses (TH1+) to brain antigens can be improved by inducing tolerance to these antigens (Treg response) prior to stroke.

Predator Identification and Response in American Crows

Scotty Hardwick, Senior, Biology

Mentor: John Marzluff, College of Forest Resources

American Crows have complex vocalizations that display a great deal of meaning. This study is designed to see if crows specifically label different predators with their scolds. In a study on chickadees, ornithologists found a correlation between numbers of syllables in their calls and the degree of threat of the predator being scolded. These results suggest that crows might have a similar system of labeling predators, due to their social tendencies and advanced intelligence. This study is designed to see how specifically crows label different predator types (i.e. hawk, owl, or raccoon) with their vocalizations. It is also to see if information such as predator location is distinguished in their calls. Furthermore, the study is designed to see if crows' behavior varies in response to different types of predators. To test these ideas I presented one of three different types of predators; a red tailed hawk, a barn owl, or a raccoon. Once set out I waited until the crows recognized the animal as a predator and scolded it. With this setup I recorded their vocalization and behavior. I have done this over six test sites. I have also introduced the variable of placement in the tree as opposed to on the ground. The data suggests a behavioral difference between the different predator types. The owl especially gets a much lessened response as opposed to the other two predator types. The red tailed hawk seems to get the most extreme response often resulting in the largest number of swooping attacks. Overall this study is testing to see how American Crows respond to different types of predators at the behavioral and vocal levels.

Crabs with rhythm: characterizing a clock gene in *C. productus*

Emily Haug, Senior, Biology and Spanish

Mary Gates Scholar

Mentor: Horacio de la Iglesia, Biology

All living organisms must adapt to their immediate environment in order to survive. Since most of the environments on our planet are subject to cyclic changes, it is often advantageous for their inhabitants to have a way to predict these changes. One extremely prolific adaptation is an endogenous biological clock that oscillates in synchrony with the earth's rotation - the factor that ultimately determines light/dark cycles, fluctuations in temperature and the resultant changes in the physical environment. These clocks are generally composed of a group of genes whose expression is regulated by light cues and often demonstrate a circa-24-hour (circadian) period of expression. One type of ecosystem that experiences rhythmic environmental fluctuations that are distinct from light cues is the intertidal zone. Organisms that reside in this area must deal with periods of submersion in water and exposure to air on a cyclic basis, and some intertidal crustaceans have been shown to exhibit patterns of circatidal behavior (with a period of approximately 12.4 hours) even when they have been removed from tide-related entraining agents. This project attempts to characterize a part of the molecular mechanism involved with the endogenous clock of *Cancer productus*, an intertidal crab species that can be found in the Puget Sound. This is accomplished by cloning a putative clock gene homolog called *cycle* and using *in situ* hybridization to determine whether it is being expressed in the brain of *C. productus*. Using a cDNA template generated from RNA extracted from *C. productus* brain tissue, we have generated and sequenced a functional region of the gene which will now be used to generate an RNA antisense probe to detect expression of *cycle*, and compare it with the results of an immunolabeling assay using an antibody generated against the *Drosophila* protein CYCLE.

Examination of soil charcoal to determine historic extent of Puget Sound prairies

Joshua Hegarty, Senior, Environmental Science & Resource Management

Mentor: Darlene Zabowski, Forest Resources

It is widely known that the prairies in the Puget Sound region were maintained by tribes using anthropogenic fires to suppress the growth of trees and promote a prairie ecosystem. Over the last two centuries, the south Puget prairies have come to occupy less than 10% of their former extent. This is due in part to forest encroachment resulting from fire suppression instituted since colonization by Europeans. This has led to a loss of biodiversity, and cultural resources of First Nations, as well as habitat for rare and endangered flora and fauna such as the

endangered Golden Paintbrush (*C. levigata*) and native grasses. Before land managers can take the necessary steps to restore these endangered prairies they must first determine the former extent of the prairies. The focus of this study is to determine the historic extent of native prairies by examining soil from remaining Puget Sound prairies and adjacent forests, including Glacial Heritage Park and Mima Mounds Park in the south Puget area, and American Camp on San Juan Island and Ebey's Landing on Whidbey Island. Soil samples have been collected along transects extending into the current prairie and into the encroaching forest. Samples are being examined for total black carbon (charcoal), relative size class of charcoal, cellular structure, and isotopic signature. From these parameters it can be determined if the charcoal was created by the burning of prairie vegetation or by the burning of forest vegetation. With this soil charcoal record, the past transition from prairie to forest can be identified at these four sites and indicate to land managers appropriate areas for restoration efforts.

Infants' Vowel Discrimination in Background Noise
Jessica Hesson, Senior, Speech and Hearing Sciences
Mentor: Lynne Werner, Speech and Hearing Sciences

Research has shown that infants can discriminate between vowels in a quiet background, but how well infants perform on the same type of tasks in competing background sounds is not known. In this study, vowels were presented to infants with one of two competing sounds. One was a noise with the same frequencies as speech that stayed at the same amplitude over time. The other was the same noise, but its amplitude varied over time in the same way that the amplitude of speech would vary if one person were talking in the background. This "modulated" noise is more like the background sounds that people hear in real world situations. It is known that adults can understand speech better in a modulated background than in a steady background, because they are able to listen during times when the amplitude of the modulated background is low. The subjects were normal hearing 7-month-old infants and adults. The infants were tested in a sound booth while seated on the parent's lap. Sounds were played through a soft foam eartip that was placed in the right ear. Subjects learned to respond when they heard a repeated vowel change from "ah" to "ee" or from "ee" to "ah". Correct responses were reinforced by the activation of a mechanical toy or a video. The sounds were presented at an intensity that was expected to allow the subjects to discriminate the vowels 70% of the time in steady noise. The expected result is that infants, like adults, will be able to better discriminate between vowels with the modulated noise than with a steady noise.

Osmotic stimulation of the SFO causes cFos expression in PVN in conscious rats.
Carolyn M. Higuchi, Senior, Psychology
Mentor: Douglas A. Fitts, Psychology

Previous studies have concluded that the subfornical organ (SFO) and the paraventricular nucleus of the hypothalamus (PVN) do contain osmoreceptive neurons that produce an effect when hyperosmotic solutes are introduced intravenously or intragastrically. These effects include stimulation of the supraoptic nuclei (SON) and PVN which also contain osmoreceptors leading to vasopressin secretion and ultimately drinking. Further, experiments have shown that lesions of the SFO result in reduced drinking induced by hyperosmotic solutes. We tested the obvious prediction that hypertonic NaCl microinfusions directly into the SFO will decrease drinking latency and increase cFos-like immunoreactivity in the SON and PVN. Five male Long-Evans rats with SFO-targeted cannulas were screened for drinking in response to angiotensin (ANG II). Two days later, all rats received a sustained intracerebral infusion of 1 M artificial CSF with the extra osmoles as NaCl. The rates of infusion was 0.8 ml/h for 90 min and drinking latencies were recorded. The brains were prepared for analysis of cFos expression by immunohistochemistry. Two of the five rats had cannulas situated in the SFO and these animals drank 7 and 12 ml in 30 min during the ANG II test and also had the shortest drinking latencies during the infusion. The other three rats had cannulas situated 1 mm rostral to the SFO in the septum and did not drink during the ANG II test and had long drinking latencies. Only hyperosmotic infusions into the SFO elevated cFos expression in the SON and PVN while the septal infusions did not. Thus, the results physically demonstrate that the SFO as an osmoreceptive area mediating thirst and cFos expression in the hypothalamus.

Finding Eclipsing M-Dwarf Binary Systems at SDSS Equatorial Stripe 82
Monica Huang, Sophomore, Astronomy
Mentor: Suzanne Hawley, Astronomy
Mentor: Eric Hilton, Astronomy

Eclipsing binary systems are comprised of two stars orbiting each other in such a way that when an eclipse occurs, one star intersects the line of sight to the second star, partially reducing the total amount of light collected from the system. An M-dwarf is a particular class of star characterized by its red color, surface temperatures of under 3,500 K, and masses less than 40% of the Sun's mass. M-dwarfs make up about 70% of all the stars in the galaxy. We aim to find such eclipsing binary systems of M-dwarfs in the Sloan Digital Sky Survey at Equatorial Stripe 82, which is a unique data set comprised of repeat observations of thousands of stars. Such eclipsing binary systems are identified through a single set of observations with significantly smaller flux than the median observation

of a particular star. This reduction in flux must be present in all five observations taken with different filters in a short time period. We present candidate eclipsing binary systems selected from hundreds of thousands of observations. Eclipsing binaries are used to determine crucial properties of stars, such as mass and radius, for theories of star formation, while M-dwarfs are promising to the field of astrobiology for their given likelihood of hosting terrestrial planets. By identifying as many eclipsing M-dwarf binary systems as possible, we provide a basis for further research on the study of M-dwarfs, as well as the search for habitable exoplanets.

Older Adults in the HIV/AIDS Epidemic: A Pilot Survey of Area Agencies on Aging in Washington State
*Amanda Hudson, Senior, Social Work, UW Tacoma
Mentor: Charles A. Emlet, Social Work, UW Tacoma*

The number of adults 50 and over living with HIV/AIDS in the U.S. increased by nearly 80% in only four years, from 65,450 in 2001 to 116,085 in 2005. Older adults affected by HIV/AIDS include: long term survivors who are aging with HIV; newly infected with HIV in mid/late life; and those who engage in risky sexual behaviors thus placing themselves at risk for HIV/AIDS. The purpose of this research is to capture the activities, plans, actions, and attitudes of the Area Agencies on Aging (AAA) in Washington State related to HIV/AIDS and aging. The research questions include: 1) Are area agencies on aging knowledgeable about HIV risk and infection among older adults? and 2) What activities are currently being undertaken to provide HIV/AIDS prevention, education, information and referral or care to HIV infected older adults within these agencies? The methods include an online survey using Catalyst that is available to each AAA in the state of Washington. Once all information is gathered the data will be entered into SPSS for data analysis. The survey will obtain data on the following: 1) the number of clients with HIV/AIDS 50+ served by these agencies; 2) the need for services for those effected by HIV/AIDS 50+; and 3) services currently provided to older adults effected by HIV/AIDS through area agencies on aging. The data, once collected and analyzed, will help indicate whether or not there is a need for improved training and materials to be made available to each AAA in Washington. Training and materials on HIV/AIDS will address the growing needs of older adults infected with and affected by HIV/AIDS in Washington.

Breast Cancer Immunogene Therapy Using Adenovirus Vectors
*Jeffrey Jacobs, Senior, Biochemistry
Mentor: Andre Lieber, Medical Genetics
Mentor: Sebastian Tuve, Medical Genetics*

Breast cancers are naturally immunogenic tumors. They express a panel of tumor-specific antigens (TAAs) such as

Her2/neu(neu). TAA specific cellular immune responses are naturally triggered in patients with breast cancer. However, peripheral immune tolerance mechanisms (in particular regulatory T cells) dampen anti-tumor immune responses. The aim of this study is to counteract immune tolerance mechanisms and induce therapeutic tumor-destructive immune responses in a mouse model of breast cancer using adenovirus-vector mediated transfer of immunogenes into the tumor. As a model we use mouse mammary carcinoma (MMC) tumor cells that express the Her2/neu tumor antigen and were established from a spontaneous tumor harvested from neu-transgenic mice. Neu-transgenic mice have active induced immune tolerance towards the neu antigen, which is dependent on the function of regulatory T cells and allows for the outgrowth of neu-positive MMC cells, despite the presence of neu specific CD8 T effector cells in these mice. We will generate adenovirus vectors expressing recombinant anti-CTLA-4 antibody and IL-15. Anti-CTLA-4 antibody counteracts the function of regulatory T cells. IL15 stimulates the activation and proliferation of NK and CD8+ cells via binding to the IL-15 receptor. We will establish subcutaneous MMC tumors via injection of 5x10e5 MMC cells in neu-transgenic mice. Once tumors reach a size of 4mm diameter we injected one dose of 2x10e9 pfu (in 50ul PBS) Ad5.IL15 and Ad5. aCTLA-4 or a control virus expressing no therapeutic transgene. A second control group will receive injection of PBS only. Survival time will be determined. In a second set of experiments we will sacrifice animal at different time points after virus injection (day 3, 8, 14) for extraction and quantification of tumor-infiltrating lymphocytes (including Her2/neu specific CD8 T cells) via flow cytometry and testing for viral gene expression.

Effects of intervention on familiar face recognition in toddlers with autism spectrum disorders
*Dana Kamara, Senior, Psychology
Mentor: Sara Jane Webb, Psychiatry & Behavioral Sciences*

Individuals with autism spectrum disorder (ASD) experience impairments in the area of face processing, including the recognition of faces. This study analyzes the effects of behavioral intervention and face recognition training on familiar face recognition in toddlers with ASD. The intervention is an intensive, 2 year behavioral therapy targeted at decreasing autism symptoms. The therapy was combined with face training sessions, in which the toddlers work through two face training booklets with their therapist. These booklets contain photos of their mother, father, therapy assistants, and distractors. At the end of intervention, familiar face recognition abilities for toddlers in the intervention group were compared to a control group. Face recognition was evaluated by having the child point out their parent from a variety of distractors across two different contexts: one with whole faces and one with

faces with the outer area cropped. Percent correct for the whole faces, cropped faces, and overall was analyzed. Data has been collected for 23 subjects (N = 10 intervention, N = 7 control), aged 48 months to 54 months. All of the intervention subjects and 78% of the controls were able to complete the task. Preliminary data suggest that there was no difference in percent correct for both groups. We are continuing to collect data and further analysis will be conducted to determine if additional factors such as IQ and diagnostic severity are related to performance on this task.

Fiber Composite Adhesion: A comparison of bonding theory with experimental adhesive bond quality in various aerospace carbon fiber and fiberglass composites

Conor D. Keenan, Senior, Materials Science & Engineering

Mentor: Brian Flinn, Materials Science & Engineering

The use of fiber composite materials in aircraft design is rapidly growing and has led to increased discussion on the successful joining of composite parts in the assembly of aircraft. In order to fully take advantage of the material properties of fiber composite materials, adhesive bonding is greatly preferred over the mechanical bolting of the composite parts. Adhesive bonding of composite parts, however, can be a rather sensitive technique. There is a variety of different aerospace grade fiber composite fabrics, adhesive bond surface preparation materials, and adhesives on the market today. Generating high-quality, repeatable bonding results is not easily accomplished with different combinations of these materials. There are a great deal of interrelated variables including surface roughness, wettability, voids, pores, impurities, chemical interactions and many more that can affect the quality and success of the adhesive bond. Understanding how these factors affect the bond quality and learning how to control the variables in a production environment is crucial to the successful development of dependable techniques for the adhesive bonding of composite parts. Bonding surfaces of fiber composite materials that are prepared with various peel plies, laminates, and removed peel plies will be characterized and the fracture behavior of the bonded materials will be analyzed in an attempt to predict the best bonding conditions for certain material combinations. Using three mechanical test methods, Double Cantilever Beam, Climbing Drum Peel, and Instrumented Rapid Adhesion Test, along with various surface characterization fractography techniques, the bond quality of various layups were analyzed to determine acceptable composite bonding techniques. The main task that is addressed is the determination of quality of bond with a variety of composite substrates and some select film adhesives for the newest line of peel plies currently being developed by a major peel ply producer.

BRCA1-mediated Ubiquitination

Jonathan Keller, Senior, Biochemistry

*Mary Gates Scholar, Levinson Emerging Scholar
Mentor: Rachel Klevit, Biochemistry*

The breast cancer susceptibility gene, BRCA1, encodes a crucial tumor suppressor protein involved in multiple DNA damage repair pathways. One of its most important functions is ubiquitin ligase activity, in which BRCA1 facilitates the transfer of the small protein ubiquitin to other protein substrates. The ubiquitin acts as a molecular tag, important for marking substrates in many cellular processes such as proteolysis, cell signaling, and DNA repair. The process of ubiquitination requires adaptor proteins in addition to BRCA1, though the ways in which the proteins interact, and why mechanistically the adaptors are necessary for ubiquitin transfer, is still unknown. The Klevit lab employs high resolution structural biology techniques, such as Nuclear Magnetic Resonance (NMR), that offer powerful insight into the three dimensional characteristics of BRCA1 complexes. I focused specifically on the interaction of BRCA1 with the ubiquitin-conjugating enzyme Ubc13, which has been shown to build unique polyubiquitin chains important in DNA damage repair pathways. NMR spectroscopy can be used to analyze BRCA1/Ubc13 protein complexes and reveal information about the structural properties of interacting components. When interacting proteins are added together, the change in the chemical environment surrounding a protein will cause its representative signals in the NMR spectrum to shift position or change in intensity. I used this technique to investigate the interacting surfaces of BRCA1/Ubc13 complexes, the mechanisms of assembly, and how the ubiquitin molecules are transferred. The loss of ubiquitin ligase activity when BRCA1 contains cancer-associated mutations suggests an important role for this function in tumor suppression capacity. Investigation of BRCA1 complexes will expectantly lead to more precise treatment possibilities for breast cancer, the second most common cause of cancer related death in women.

CO₂ flux in the Thornton Creek Watershed: Effects of Weather, Season, and Location in the Watershed

*Monica Kerr-Riess, Post-Baccalaureate, Oceanography,
North Seattle Community College*

*Kathleen Lunghofer, Sophomore, Science, North Seattle
Community College*

*Hailie Colson, Sophomore, Biology, North Seattle
Community College*

*Sophea Ny, Sophomore, Science, North Seattle
Community College*

*Mentor: Ann Murkowski, Biology, North Seattle
Community College*

*Mentor: Kalyn Owens, Chemistry, North Seattle
Community College*

Recent studies suggest wetlands are a large source of CO₂,

indicating their importance in the global carbon cycle. Tropical wetlands have been studied extensively, but little is known about CO₂ flux in temperate wetlands, especially during the winter months. A temperate wetland and creek in Seattle, WA, were chosen as a location to study CO₂ flux during the winter and spring. The objective was to investigate seasonal and weather related changes in CO₂ flux and other water quality measures, and determine the changes along the length of the watershed, including the headwaters of the South Fork of Thornton Creek, Meadowbrook Pond, and the outlet at Matthew's Beach. On a weekly basis CO₂ flux, measured with an Infrared Gas Analyzer, dissolved oxygen, pH, and temperature were collected. Daily weather data was collected including temperature, barometric pressure, and rainfall. The abundance and types of plants and animals were noted in order to observe the seasonal changes and any influence of these organisms on the CO₂ levels. It is expected that the waters will become more of a CO₂ sink as the season changes due to the increased photosynthetic activity prominent in the spring. Interestingly, the headwaters are evading CO₂ while the downstream waters are absorbing CO₂. The preliminary data indicates that CO₂ evasion at the headwaters is occurring at a rate of 4 ppm/min and CO₂ absorption is occurring at the outlet at a rate of 4 ppm/min. The results of this study could be extrapolated and used to aid in construction of a CO₂ flux model for the Pacific Northwest. Further study into the summer and fall and studies on other types of streams would also be beneficial.

Gene therapy, tumor-targeting and real-time imaging with semiconductor quantum dots

Daniel Kim, Junior, Neurobiology

Washington Research Foundation Fellow

Mentor: Xiaohu Gao, Bioengineering

Quantum dots (QDs) are semiconductor nanocrystals with a range of size between 2-10 nanometers. Depending on the size, the quantum dot can absorb and fluoresce different wavelengths of light, allowing for control and flexibility. Quantum dots play an integral role in current research in immunohistochemistry as they offer superior photostability and brightness than that of traditional organic dyes. These specific strengths and their ability to be conjugated to larger substrates as carrier molecules have led us to use quantum dots in the creation of a real-time video of the process of gene transfection. We will accomplish this by conjugating multiple quantum dots to a plasmid encoding for Green Fluorescent Protein and then injecting these complexes into cell lines. A real-time video of the process of transfection will allow us to see the specific pathways and mechanisms that are used intracellularly to result in genome modification. This knowledge is necessary for the application of gene transfection in specific cancer therapy through usage of quantum dots, the second aspect of our project.

Arsenic Induced Apoptosis Pathway in P53 Wild Type and Knockout Cells

Jihye Kim, Senior, Biology (Cellular, Molecular, and Developmental Biology)

Deborah Chang, Senior, Biology (General Biology)

Mentor: Elaine M. Faustman, Environmental & Occupational Health Sciences

Mentor: Xiaozhong Yu, Environmental & Occupational Health Sciences

Mentor: Sung Woo Hong, Environmental & Occupational Health Sciences

Mentor: Zachariah Guerrette, Environmental & Occupational Health Sciences

Arsenic is an environmental toxicant that is known to be associated with a dose and time dependent activation of p53 and its downstream products. P53 is a gene found in normal cells that plays an important role in regulating the cell cycle by preventing inappropriate cell division. It is also responsible for the induction of genes that trigger apoptosis, thus maintaining the genomic integrity following cellular stress such as DNA damage. In order to examine any differential responses in apoptotic pathways that may occur depending on the absence or presence of p53, two mouse fibroblast cell lines, one with and one without a functional p53 gene, were cultured and each treated with a range of arsenic concentrations. Whole cell lysates were harvested and the protein content was quantified for use in Western blots. Proteins of interest include general markers of apoptosis and cell cycle regulation (cleaved caspase-3 and p21) as well as pro-apoptotic proteins normally regulated by p53 (Noxa and Puma). Since these proteins each occupy different positions within the apoptotic pathways, changes in the amount of proteins expressed by the different cell lines will allow us to understand which protein or proteins play a role in arsenic-mediated cell death. A differential response in protein expression levels depending on the presence or absence of p53 is important in determining the effect on pathways or intermediates prior to apoptosis.

Regulation of Kiss1 gene expression by sex steroids in the medial amygdala of mice

Joshua Kim, Senior, Neurobiology

Mentor: S. Kauffman, Obstetrics and Gynecology

Mentor: Donald K. Clifton, Obstetrics and Gynecology

Mentor: Robert Steiner, Physiology & Biophysics

The Kiss1 gene encodes a family of neuropeptides called kisspeptins, which bind the G-protein-coupled receptor, GPR54. Kisspeptins and GPR54 have been implicated in the neuroendocrine activation of the reproductive system at puberty and in adulthood. Kiss1 mRNA in the arcuate (ARC) and anteroventral periventricular (AVPV) nuclei of the hypothalamus is regulated by androgens and estrogens. In the AVPV, Kiss1 expression is induced by sex steroids, whereas in the ARC, Kiss1 is inhibited by

these same hormones. The differential regulation of Kiss1 by sex steroids in the ARC and AVPV may provide the mechanism for the negative and positive feedback control of gonadotropin secretion, respectively. Kiss1 neurons are also present in several other brain regions, including the medial amygdala (MeA), but these Kiss1 populations have received little formal attention. Of note, the MeA is rich in steroid receptors (both androgen and estrogen) and has been implicated in the regulation of reproductive and social behaviors. We postulated that Kiss1 neurons in the MeA—like those in the ARC and APVP—would be targets for regulation by sex steroids. To test this hypothesis, we performed *in situ* hybridization for Kiss1 mRNA on brain tissue of adult male and female mice that were gonadectomized and given a Silastic implant either containing testosterone (T) or left empty (sham). We found that T-treated males and females possessed greater numbers of Kiss1 neurons in the MeA than did gonadectomized males and females. Our findings indicate that Kiss1 neurons in the MeA are regulated by gonadal steroids, in a fashion similar to Kiss1 neurons in the AVPV—but opposite of those in the ARC. However, in contrast to Kiss1 neurons in the AVPV, Kiss1 neurons in the MeA do not appear to be sexually dimorphic—at least when circulating levels of T are equivalent between the sexes. These observations suggest that Kiss1 neurons in the MeA may play a role in complex sex steroid-dependent behaviors, such as mating, arousal, and sexual partner preference.

HIV-2 Antiretroviral Drug Resistance Genotyping in a Senegalese Cohort

Moon Kim, Junior, Molecular, Cellular, & Developmental Biology

Paul Lu, Junior, Neurobiology

Mentor: Geoffrey S. Gottlieb, Medicine/Infectious Diseases

HIV-2 is endemic in West Africa, but unlike HIV-1 has had limited spread worldwide. Compared to HIV-1 infection, HIV-2 is characterized by a much longer asymptomatic stage, lower plasma viral loads, slower decline in CD4 count, decreased mortality rate due to AIDS, lower rates of genital tract shedding, mother to child transmission, and sexual transmission. Nonetheless, a significant proportion of HIV-2 infected individuals eventually progress to AIDS. Antiretroviral therapy (ART) is becoming increasingly available in West Africa where HIV-2 infects up to 1-2 million people. However, HIV-2 is intrinsically resistant to the non-nucleoside reverse transcriptase inhibitors (NNRTI) and T-20 (enfurviride) and reports suggest that HIV-2 may be partially resistant to some protease inhibitors (PI) and have a low genetic barrier to nucleoside reverse transcriptase inhibitors (NRTI) resistance. In order to assess the emergence of reverse transcriptase (RT) and protease (PR) resistance mutations that occur during ART in a cohort of HIV-2 infected individuals in resource limited Senegal, West Africa, we sequenced pol genes from

plasma and PBMC samples from a cohort of ARV-treated persons participating in the l'Initiative Sénégalaise d'accès aux Antirétroviraux (ISAARV) program. Specifically, the PR and RT genes of the virus are analyzed for mutations that may be associated with resistance. Viral RNA is extracted from plasma and reverse transcribed to make cDNA, or PBMC DNA is extracted directly. Nested PCR of pol, DNA cloning, and sequencing are performed to analyze for mutations that are known or thought to confer ARV resistance in HIV-2. Limited data to date in this cohort suggest a high degree of ARV resistance, and therefore illustrates a need for further research towards understanding HIV-2 resistance and creating more targeted drugs specifically for HIV-2.

210-Pb Study of Fjord Sedimentation Rates in the South Shetland Islands and Antarctic Peninsula

Brittany Kimball, Senior, Oceanography and Earth & Space Sciences

Mentor: Bernard Hallet, Earth and Space Sciences

Mentor: Chuck Nittrouer, Oceanography

As part of a study concerning the factors controlling rates of glacial erosion and sedimentation across climatic regimes, sixteen kasten cores were collected from ten fjords in the South Shetland Islands and Antarctic Peninsula in April and May, 2007 from the R/VIB (Research Vessel Ice Breaker) Nathaniel B. Palmer. They were sampled for 210Pb measurements of accumulation rates. The cores were collected from basins within a few kilometers (km) of the calving front at the respective glacier, where sediment accumulation was observed in 3.5 kilohertz (kHz) sub-bottom profiles. Core lengths ranged from 34-289 centimeters (cm). For most of the cores (10 of 16), sandy mud has accumulated steadily at rates ranging from 1 to 10 millimeters per year (mm/y) over the past century, as tightly defined by clear linear trends of 10 to 15 log 210Pb values versus depth, with r^2 ranging from 0.75-0.98. Several cores show evidence of variable sedimentation with pulses of sand emplacement. Three cores contained a surficial layer >50 cm thick of uniform 210Pb activity, indicating recent, rapid deposition of a large turbidity current or mass flow. The consistency of many of the 210Pb profiles implies that, over the past century, the glacial-marine processes that supplied, transported and deposited sediment in these sub-polar and polar fjords have not varied markedly. This contrasts with other glacial-marine systems in warmer regions such SE Alaska, where sedimentation in the fjords from calving temperate glaciers tends to vary significantly, and where the accumulation tends to slow as the calving front recedes rapidly from the core location. The rates of sedimentation reported here for the last 10 to 100 years off the Antarctic Peninsula will be compared to those on a millennial time scale derived from isotopic carbon (14C) data, and will be interpreted in the context of corresponding bathymetric and glaciological data as they become available.

An Investigation into Arsenic Distribution within the Water Column and Sediments of Shallow Lakes as Impacted by the ASARCO near Tacoma, Washington
*Kara King, Senior, Environmental Science, UW Tacoma
Mentor: Jim Gawel, Environmental Science, UW Tacoma*

An analysis of the distribution of arsenic in sediments and in the water column of five urban lakes in the South Puget Sound Region was performed to investigate the mobility of historical arsenic contamination. Research focused on shallow lakes, ranging from 0.7 to 4.0 meters in depth, in the American Smelting and Refining Company (ASARCO) atmospheric fallout zone primarily north and east of the Ruston-based Superfund site. Water column, surface sediment grab samples, and sediment core samples were collected in order formulate a model of arsenic fate and transport in these lakes. Water column samples were collected twice in each of the five lakes: once in early summer, and a second time in late summer after lake turnover. Samples were digested and analyzed for arsenic in the lab using graphite furnace atomic absorption spectrometry. Results show that arsenic levels in surface sediments are spatially distributed consistent with the ASARCO smelter as the primary source. Also, water column measurements show a distinct increase in human health hazard potential in these shallow lakes caused by transport of higher arsenic concentrations to surface waters.

Characteristics of Jaw and Tongue Movements during Mastication in Pigs

*Ronald Matthew Ko, Senior, Biochemistry
Mentor: Zi-Jun Liu, Orthodontics*

The jaw and tongue play a vital role in speech, mastication, deglutition, and breathing. Jaw and tongue disorders have shown to be associated with clinical syndromes such as dystonia, malocclusion, speech impediments, cerebral palsy, Huntington's disease, and most orofacial myofunctional disorders. The purpose of this study was to investigate the characteristics of masticatory movements of the jaw and tongue in seven 12-week-old Yucatan miniature pigs using a high-speed digital video camera (250 frame/s). The pig was chosen because its oral apparatus is anatomically and functionally similar to that of a human being, making it a suitable model for jaw and tongue movement studies. Movements were videotaped during natural feeding sessions, digitized, and calibrated. Jaw movement displayed stereotypical and rhythmic chewing cycles, which were composed of three distinct phases, i.e., opening, closing and occlusal (power stroke) phases. The velocity of the jaw movement peaked at early opening phase and slowed down to reach zero velocity at maximum opening. Shortly after maximum opening, velocity peaked at the early closing phase and slowed down to reached zero velocity at complete closure. The velocity was close to zero and showed slight enhancement

from the beginning to the end during the occlusal phase. The elongation of anterior tongue started at early jaw opening, reached the maximum almost simultaneously, and shortened at late closing phase. During the opening phase, tongue forward movement was accompanied with a descending component; however, during the closing phase an ascending component occurred while the forward movement extended. These results suggested that the sequence of jaw movement during chewing may be in the order of fast opening, slow opening, slow closing, fast closing, static and dynamic power stroke (occlusal phase). The tongue moving direction and sequence are not always consistent or synchronized with those of the jaw during mastication. Supported by NIH grant R01DE15659.

Mitigating Proteotoxicity in *C. elegans* Models of Disease

Erika Korinke, Senior, Biology (Molecular, Cellular & Developmental)

*Mary Gates Scholar
Mentor: Matt Kaeberlein, Pathology*

There are a number of neurodegenerative diseases (i.e. Alzheimer's, Huntington's and Parkinson's diseases) that result from proteotoxicity in which misfolded or aggregating proteins cause damage to integral parts of the body via an unknown mechanism. In an effort to easily and ethically characterize these ailments as well as examine treatments to lower proteotoxicity in affected subjects, we used engineered strains of the nematode *Caenorhabditis elegans*. We used two strains identified by a normal phenotype of paralysis around day seven of adulthood: mQ35, which is a Huntington's disease model, and A⁺, which is an Alzheimer's disease model. We treated these strains with compounds that interfere with protein folding in the endoplasmic reticulum (ER), theoretically inducing a pathway to mediate proteotoxicity by increasing the abundance of repair machinery or degrading protein. We saw that -mercaptoethanol (ME) is not effective as it damages the worm's cuticle, negating any positive effects. However, other reducing agents such as dithiothreitol (DTT) lower paralysis along with tunicamycin, which blocks glycosylation of new proteins. Many compounds are still waiting to be assayed, including lithium chloride, a drug used to treat bipolar disorder, and the anticonvulsant ethosuccimide. In addition to scoring paralysis to determine drug efficacy, we were able to visualize protein aggregates in the mQ35 strain. These worms have a green fluorescent protein (GFP) conjugated to the detrimental peptide that can be seen by fluorescent microscopy. It may be possible to determine the mechanism responsible for the mediation of proteotoxicity using the above method in conjunction with a series of experiments affecting levels of chaperone proteins and other repair machinery. For example, the strain Hsp-4::GFP allows us to view upregulation of the chaperone hsp-4 by fluorescent microscopy and Western blot upon application of the chemicals used in paralysis assays and knockdown of genes in that pathway.

UW Dream Project Mentoring Model: An Assessment of the Effectiveness of the Program in Six Seattle-area High Schools

*Anna Kramer, Senior, General Biology and Public Health
Howard Hughes Scholar, Zesbaugh Scholar*

Mentors: Wanda Brown, Education

Mentor: Ed Taylor, Education and Undergraduate Academic Affairs

The Dream Project is a student-initiated high school outreach program that partners UW students with first-generation and low-income students in Seattle area high schools to assist in the college admissions process. This program attempts to supplement the work that larger, campus-wide programs, such as the Office of Minority Affairs, does to recruit and retain students from disadvantaged backgrounds. In Spring 2008, the Dream Project is beginning to work with its third cohort of high school students. Since two full cohorts have cycled almost completely through the program, it is an ideal time to reflect on and assess the program. A survey was given to teachers and counselors at each of the six high schools with the goal of determining the success of the Dream Project mentoring model from their unique perspective. Focus was placed on the community fostered by the Dream Project and the attitude of the high school students toward post-secondary education.

Characterization and identification of fungi associated with a *Hedera helix* leaf spot disease

Elizabeth Kramer, Senior, Biology

Mary Gates Scholar

Mentor: Dean Glawe, Forestry

The eradication of the destructive invasive species *Hedera helix* (English Ivy) is the focus of many habitat restoration projects in the Pacific Northwest. I am investigating two species of pathogenic Deuteromycete fungi, *Phoma hedericola* and *Colletotrichum trichellum*, that are associated with a naturally-occurring leaf spot disease affecting *H. helix* in the Seattle area. This study includes characterization of host symptomatology, identification of associated fungi and completion of Koch's Postulates. Fungi are identified on the basis of morphological features and by analysis of ribosomal DNA (rDNA) focusing on highly variable regions 18S and ITS. Results of this study will clarify taxonomic and phylogenetic relationships of these fungi and result in new information on the region's fungi that will be included in the Pacific Northwest Fungi Database. This study may also contribute to effective control of *H. helix*. Phomaspecies have been previously shown to have potential for use as bioherbicides in control of *Circium arvense* (Creeping Thistle). This study also investigates possible herbicidal activity in *P. hedericola*. Results of this study suggest that *P. hedericola* is a good candidate for further investigation into potential herbicidal use against *H. helix*.

Marine Bacterial Community Diversity in a Hypoxic Fjord

*Andrea Kunkle, Junior, Biology (Physiology)
Mentor: Gabrielle Rocap, Oceanography*

Hood Canal has been in a continual state of hypoxia, or near hypoxia for several years, and there is much scientific and academic interest as to the causes, effects, and possible remedies. Since Hood Canal is poorly flushed, the same water remains in place for months at a time and oxygen used up. This state is worse at the southern end, to the point of massive fish kills, but the extent and severity of the hypoxia varies by time of year, physical location, and depth. I am interested in the effects of hypoxia on bacterial communities living throughout Hood Canal. To examine how these communities change with time, geography, and depth, I am using a set of samples collected over the year from June 2006 to June 2007 from five stations and at multiple depths at each station. These include whole water samples which are filtered, mildly preserved and frozen. I have employed a technique called Automatic rRNA Intergenic Spacer Analysis (ARISA) which relies on variability of the Internally Transcribed Spacer (ITS) region, a section of DNA situated between genes that code the 16S and 23S ribosomal RNAs. The length and sequence of this segment generally varies in length and sequence from species to species. I have extracted DNA from each whole community sample and amplified the ITS regions to generate products of varying length, which represent different species in the community. I will next use computer programs designed to analyze community ecological statistics in order to understand the trends in the data I have generated and ultimately, I will be able to see spatial and temporal trends in community diversity and abundance.

Differences in Interpersonally Attributed Rejections between Asian Americans and White Americans

Rika Kurose Reid, Senior, Psychology and Communication

Alfred Lam, Sophomore, Psychology and Anthropology

Yuri Yano, Senior, Psychology and Music

Ann Nguyen, Graduate, Psychology

Mentor: Janxin Leu, Psychology

Mentor: Jennifer Wang, Psychology

Although overt racism in the United States is not prevalent as it was in the past, psychologists have suggested that racism still exists through a more subtle and indirect form known as microaggressions. Microaggressions consist of verbal, behavioral, and situational offenses that may be intentionally or unintentionally directed toward minorities that compromise their self-worth and identity. Asian Americans are often overlooked within the discourse of racial discrimination in the U.S. because of the misconception that racism is diametrically "black and white". However, past studies have shown that Asian

Americans do encounter microaggressions in their daily lives. They are likely to experience stress as a result of microaggressions, and chronic stress has been shown to result in negative health outcomes (Folkman & Lazarus). The current study examines whether there are differences between Asian Americans and White Americans in whether they interpret ambiguous interpersonal rejections as racially-based microaggressions. We hypothesized that Asian American (AA) college students are more likely to perceive these rejections as due to their race than do their White American (WA) counterparts. Participants (AA: N = 184; WA: N = 162) were asked to read 12 hypothetical situations which involved rejection by other people and to explain the situation using open-ended measures. We coded responses that used race as an explanation of the situation. As predicted, we found that AA more frequently reported race as an explanation for their rejection than WA. Although AA are considered to be model minorities who experience less racial discrimination than other racial/ethnic minorities, race is still an essential part of the Asian American experience.

Evolving Optimal Foraging in Bacteriophage T2

Kelsea Laegreid, Recent Graduate, Biology

Mentor: Ben Kerr, Biology

This experiment was motivated to understand how certain strategies are favored by evolution. For instance, many phenomena occurring in the world from growth rates of guppies to plant usage of carbon between their roots and shoots to the foraging time of hummingbirds in flower patches can be seen as fitness improving strategies. The relative advantage of a strategy (e.g. the amount of time a hummingbird spends at a patch obtaining a variable amount of nectar) is evaluated using optimality theory. The strategy set will often be constrained, such as a bird cannot obtain a large amount of nectar in a short amount of time, leading to tradeoffs. We sought to test the optimality theory with a series of experiments with virus (Bacteriophage T2), in which we explore the evolution of strategies of the virus, seen as the duration of host usage, within a varying amount of host density.

Perennial Solutions: Information Processing and Agenda Setting in the Creation of the Department of Homeland Security

Jami Jo Larson, Senior, Political Science

Mentor: Bryan Jones, Political Science

The Homeland Security Act of 2002 created the new Department of Homeland Security (DHS) to deal with issues of domestic preparedness and disaster relief following the terrorist attacks on September 11, 2001. Recent literature on the topic of homeland security is either descriptive or examines only one aspect of homeland security, for example, FEMA and disaster relief, or information sharing between federal bureaucracies. This work highlights the

shortcomings of DHS but neglects to address a more fundamental question; why did Congress choose to enact the DHS as the best solution to the problem of domestic preparedness? This project addresses this gap in the literature by examining how agenda setting and information processing in Congress led to the enactment of the DHS as the best solution for domestic preparedness problems facing the nation. I will first track domestic preparedness problems in a longitudinal scope, looking specifically at the problems and solutions that reached the formal agenda over time in the area of domestic preparedness. Then I will look at domestic preparedness problems highlighted in national media outlets. I expect to find that congress chose to enact the DHS rather than a solution from a limited pool of alternatives, and that media coverage affected the framing of the problems discussed in Congress.

The Development of Automated Processes for Generation of Optimized Circuit Components

Nicholas LaVassar, Senior, Electrical Engineering

Mentor: Vikram Jandhyala, Electrical Engineering

Mentor: Arun Sathanur, Electrical Engineering

Passive circuit components built on silicon wafers have become a very important part of today's high speed chips. As the size of such devices decreases and as they are used in increasingly complex circuitry, electromagnetic (EM) effects have an increasingly significant impact on circuit performance. The mathematical models of EM interaction are well established, however, sometimes they are difficult to solve. Taking advantage of the increasing availability of computing power, this project aims to develop a computer-automated process for generating copper-based electrical passive components. The performance characteristics of these components depend on geometry parameters and hence to optimize for the performance, they need to be adjusted. With this goal in mind, completely parametric models of these components have been created. The tool will use the concept of libraries and both gradient-based and heuristic optimizing techniques to minimize the cost of this computationally expensive undertaking. Through this approach, an initial best-fit design is selected from the library which is pre-built and then repeatedly redesigned and solved using a fast boundary element based full-wave electromagnetic solver until the component performs as desired. The intermediate solving results at every stage can be appended to the library to increase its capacity to speed the design process. Such a tool has very desirable qualities which would assist in developing highly customized and precise circuit components.

Sexual Differentiation of Kiss1 Gene Expression in the Brain and its Role in Generating the Surge of Luteinizing Hormone

Janessa K. Lawhorn, Senior, Biology

Mary Gates Scholar

Mentor: Robert Steiner, Obstetrics & Gynecology

The capacity of the brain to generate a surge in the secretion of luteinizing hormone (LH) is sexually differentiated—normally only females can generate LH surges, while males lack this ability. The expression of a gene called Kiss1 is also sexually differentiated in a region of the brain called the anteroventral periventricular nucleus (AVPV), with females having higher levels of Kiss1 mRNA in the AVPV than males. We postulated that sexual differentiation of the LH surge is attributable to differences in the expression of Kiss1 in the AVPV. We argued that if this were true, males that are genetically altered to have greater expression of Kiss1 in their AVPV should have the capacity to generate a LH surge, just like normal females. We produced such males by knocking out a gene that is critical for sexual differentiation of the brain, G-coupled protein receptor 54 (GPR54). The brains of these GPR54 knockout (KO) males look much like females and have much greater levels of Kiss1 mRNA in the AVPV than normal males. To test this hypothesis, we compared the ability of normal females, normal males, and GPR54 KO males to elicit an LH surge in response to estradiol. We challenged animals with estradiol and collected sera in the morning and again 30 min after lights out (when LH surge normally occurs) and analyzed LH levels. Preliminary data indicate that most (~60%) of the females and none of the normal males produced LH surges, as expected. However, some (~20%) of GPR54 KO males also produced an LH surge, suggesting that the Kiss1 cells in the AVPV of male GPR54 KO mice can indeed support an LH surge. We conclude that sexual differentiation of the LH surge mechanism may be attributable to differences in the expression of Kiss1 mRNA in the AVPV.

Role of environmental osmolarity on aging in *Caenorhabditis elegans*

Anna Le, Junior, Biochemistry and Public Health

Mentor: Matt Kaeberlein, Pathology

Aging can be defined as a progressive decline in the ability of an organism to maintain homeostasis. Studies from many different laboratories have shown that aging can be modulated by both genetic and environmental factors. One environmental factor that has been found to increase life span in a variety of organisms, including mammals, is dietary restriction (DR), which is defined as a reduction in nutrient availability without malnutrition. We are studying the interaction between diet, environment, and aging in the nematode *Caenorhabditis elegans*, a multicellular eukaryotic invertebrate model organism. *C. elegans* are maintained in the laboratory on a bacterial diet

consisting of *E. coli* bacteria on a nutrient agar surface, referred to as Nematode Growth Medium (NGM). NGM consists of peptone (digested proteins), agar, cholesterol, salts, and trace minerals. We have observed that by increasing the amount of peptone in the NGM, *C. elegans* life span can be significantly increased. We hypothesized that this life span extension may be due to activation of an osmotic stress response. To test this hypothesis, we are adding different osmolytes to the NGM and measuring the effect on longevity. Thus far, addition of the acyclic polyol sorbitol led to a significant increase in life span, while addition of glucose shortened life span. Additional osmolytes will be tested to determine whether the divergent effects of sorbitol and glucose are specific to each sugar and to understand the relationship between osmolarity of the NGM and aging of the nematodes.

The role of Nrf2 in domoic acid induced effects on early neurodevelopment.

Quy Ha Le, Senior, Biochemistry, Chemistry (A.C.S.), Mathematics

Mary Gates Scholar

Yeasule Hwang, Senior, Biochemistry

Mentor: Elaine Faustman, Environmental & Occupational Health Sciences

Mentor: Xiaozhong Yu, Environmental & Occupational Health Sciences

Mentor: Sungwoo Hong, Environmental & Occupational Health Sciences

Domoic Acid (DA) is a neurotoxin found in shellfish and produced by *Chondria armata*, a red alga, and *Pseudonitzschia*, a diatom. DA causes short-term memory loss, brain damage and death in humans. In adult rodents, neuronal deaths have been observed to occur in the hippocampus and amygdala. However, there is little information on how DA affects the developing brain. We hypothesized that DA alters neuronal differentiation and proliferation during CNS development. Previous studies have suggested that DA acts through ionotropic glutamate receptors by hyperactivating them, which lead to oxidative stress. Nrf2 knock out mice were used as a potential sensitive model to DA induced oxidative stress due to reduced antioxidant response. Nrf2 is a key transcriptional factor for antioxidant response element (ARE)-regulated genes. We characterized DA-induced toxicity in early brain development using two cell-culture systems, neuronal precursor cells (NPCs) isolated on gestation day (GD) 11 and mixed cortical neuron culture isolated on GD16. We measured DA-induced cytotoxicity by LDH and neutral red assays and morphological examination. Moreover, we used immunocytochemistry and western blotting to assess the expression of synaptic and structural proteins (alpha-synuclein and beta-tubulin), early neuronal developmental markers (Kainate, AMPA and NMDA subtypes) and PCNA. In the NPCs system, we did not observe DA-induced cytotoxicity (<100uM) after nine days in culture

suggesting that development of glutamate receptors are insufficient. In neurons isolated from wildtype and Nrf2 knock out mice on gestational day 16, dose dependent cytotoxicity was observed in day 5 after treatment with increasing DA exposure (0-20uM). However, there was no significant difference observed between the cell types. Our study suggested glutamate receptors play a critical role in DA-induced toxicity of neurodevelopment and the role of Nrf2 needs further examination.

Establishing the Gateway System in *Agrobacterium tumefaciens*

Alan Lee, Senior, Biology

Mentor: Derek Wood, Biology

Agrobacterium tumefaciens C58 is a Gram-negative bacteria that is found in soil worldwide and is responsible for crown gall tumors. This bacteria causes disease in plants by transferring its own DNA into plant cells. Once in the plant cell, the transferred bacterial DNA will randomly insert itself into the plant's genome, resulting in a change in certain plant hormone production which then leads to the growth of tumors or galls. Sequenced by Wood et. al. 2001, the genes of *Agrobacterium tumefaciens* has become of great interest as gene modification and replacement may provide *A. tumefaciens* versatility and efficiency as a biotechnology tool. With the use of the Gateway system developed by House et. al., we are creating a construct that will increase the recombination efficiency of *A. tumefaciens*. The construct will provide us with a functional genomic toolbox that will allow us to delete and tag genes as well as other applications in the research community. Through this tool, we hope to provide a complete Gateway set for this model organism that can be used by the larger research community to facilitate functional analysis of targeted gene products.

Wuxia Film: a qualitative perspective of Chinese legal consciousness

Jing-Lan Lee, Senior, International Studies

Mentor: John Christopher Hamm, Asian Languages & Literature

Mentor: Deborah Porter, Jackson School of International Studies

With the increase of economic liberalization in the last three decades, intellectuals, optimistic China observers and members of the Chinese government view the law as a great potential social stabilizer and perhaps, more importantly, a precursor to political reform. Indeed, several recent studies have pointed to a seeming increase in Chinese litigiousness—indicated particularly by the passage of hundreds of new laws, the rise in the number of legal professionals and a statistical increase in the use of courts—to argue that China is undergoing a change in legal consciousness, or that China sees the law as a means for social change. The question is, then, whether

this rise in Chinese litigiousness is truly indicative of a transformation of Chinese legal consciousness, and whether the Chinese have faith in the law as a vehicle for eventual social and political reform. Wuxia film, as a source that has been neglected in discussions about legal consciousness despite being a genre of films identified by scholars as expressing implicit commentary on this very issue, offers a qualitative dimension to the overall formation of Chinese legal consciousness. By conducting a close reading of contemporary wuxia film produced after 2001 (after China joined the World Trade Organization) and assessing changes in the character development and visual composition of the movies from that which characterized the genre in the 1980s, I determine that the films indicate Chinese skepticism of the transformative power of the new legal reforms that is deeply rooted in the country's historical experience of being objectified and colonized by the West.

Black Hole Time Evolution in Colliding Galaxies

Joel Leigh, Sophomore, Astronomy and Physics

Lauren Pope, Sophomore, Astronomy and Physics

Mentor: Thomas Quinn, Astronomy

The standard paradigm of galactic evolution involves the creation of large grand design spiral galaxies from the merging of smaller dwarf galaxies. In turn these large spirals can also merge with one another creating even more complex and dynamic events. Convincing evidence suggests all galaxies have central supermassive black holes. These black holes are radically altered by the spectacular collisions of their huge host galaxies. Analysis of simulations of these mergers helps astronomers to understand the evolution of galactic interactions. Properly processed “observations” of a galactic merger simulation are comparable to telescopic observations of active galactic nuclei (AGN) and their host galaxies. Using a smooth particle hydrodynamic model of two merging galaxies we observed the brightness of the galactic disk, central bulge, and spectral energy distribution at several different times and from several different points of view in order to determine how the system evolved over an approximately two gigayear time span. We used a detailed analysis of the shape of the galaxies and their stellar distributions before, during and after the merger in order to distinguish a merged galaxy from one that has had no extragalactic interactions. We also viewed the galaxies in several different color filters to simulate realistic observational data for comparison with actual observations of AGN. This comparison aids observational astronomers in determining where a given galaxy is in the merger process and how the merger will proceed.

Accessmonkey: Improving Internet Accessibility for Blind Users

Jessica Leung, Junior, Computer Science & Psychology

NASA Space Grant Scholar

Mentor: Richard Ladner, Computer Science & Engineering

Blind users use screen readers to navigate and access content on the web. The reader reads text effectively but cannot communicate information contained in graphics or represented by the visual layout of a page. Greasemonkey for Firefox and Turnabout for Internet Explorer are plugins that run scripts that can improve the accessibility of web pages as users visit them. Unfortunately, scripts written will only improve pages for the user who runs them. Web developers and other users are unaware when scripts are available and are unable to incorporate the beneficial changes these scripts create. To overcome this, we are developing Accessmonkey which will be a new plugin similar to Greasemonkey that will share user's scripts with both web developers and other users. The system will include a centralized repository to store and organize scripts and enable these scripts to be applied automatically to applicable web sites. This repository will also store changes made to web pages and give an opportunity for developers of the pages to review and save improvements made by these scripts. To seed this repository, we have written several scripts that target improvements to specific pages. From these scripts we identified specific modifications that occurred frequently. We then created general scripts from these patterns that can be applied to web pages more universally. To quickly evaluate the accessibility of web pages, we created and used web evaluation tools that quantitatively gauge accessibility of web pages. In the future, we will continue to set up the user interface and the repository for Accessmonkey. Once this project is completed, not only will the user's scripts be automatically shared but the improvements to the pages can be saved allowing the user to improve the accessibility of the web as a whole.

The Role of Traditional Authority in the Modernization Campaigns of Afghanistan

Sally Li, Senior, Sociology

Mentor: Steven J. Pfaff, Sociology

The history of Afghanistan has been built on the foundation of tribes and religion. It is commonsensical to conclude that these organizations and their leaders will have the clout and voice in directing the future of the nation. The modernization campaigns prove this point. Since the modernization efforts began at the crest of the 20th century, success largely predicated on the support from tribal and religious authority figures across the country. Traditional authority lent a sense of legitimacy to the efforts and a sense of familiarity to the unfamiliar. I propose that the modernization campaigns became more successful as

traditional authority became more involved in the Shah's efforts. A historical survey of the unsuccessful attempts by Amanullah Khan (1919-1929) and Mohammad Daoud Khan (1973-1978), and a successful effort by Mohammad Zahir Shah (1933-1973) will illustrate the influence of traditional authority in determining the end result of these campaigns. The results of this study will provide implications to the current modernization movement in Afghanistan.

Virtual Equipment for Rapid Prototyping and Testing of ICs using FPGAs

Wei-Ting Liao, Junior, Electrical Engineering and Computer Engineering

Mentor: Brian Otis, Electrical Engineering

After integrated chips (ICs) are fabricated, their functionalities need to be tested using various complex equipment (i.e. logic analyzer, oscilloscope, waveform generators, etc.) Chip characterization can be very time consuming because of the limited specialized functionality of the test equipment. In addition, testing equipment is very expensive. In this project, we utilize a low cost FPGA (Field Programmable Gate Array) board to facilitate IC testing and investigate a more flexible testing environment. The goal of the project is to reduce the test setup to only an FPGA board and a host computer. The first step is implementing a methodology for the host computer to send testing signals defined in a user-friendly text file to the prototype IC through a FPGA. Next, the receiving signals from the prototype IC will transmit to the host computers through the FPGA. After designing the virtual testing system, we download the system to a FPGA board through USB cables, and connect IC pins to a FPGA board to conduct testing routines. We have verified the functionality of a virtual pattern generator by sending testing signals from the FPGA to the prototype IC. During the remainder of this project, we will develop a more complete testing system as described above. The virtual equipment will then be used to test the prototype IC developed by a graduate researcher in the lab. Furthermore, we expect the virtual testing system to be easily modified and adaptable to the specific testing requirements of a variety of prototype ICs.

Quantitative Analysis for *In Vivo* Mouse Brain MRI

Cheng-I Lin, Senior, Materials Science & Engineering and Economics

Hao Yin, Junior, Biochemistry

Mentor: Donghoon Lee, Radiology

Magnetic resonance imaging (MRI) has been utilized as a non-invasive imaging technique to monitor cancerous regions before and after injection of nanoparticle contrasting agents. The scanned images are then processed and analyzed by the software ImageJ to verify signal enhancements under T1/T2 relaxation variances. Signal enhancements have been captured by the comparison

between anatomical images before the injection and the colorized T2 mapping images post injection. In this project, we focused on correlating the signal enhancement in the region of interest (ROI) before and after the injections. Our goal is to develop a method of image analysis, which generates an automated processing of image segmentation of ROI, color coding based on signal variance, template matching of ROI, and superposition of color coded masks over the anatomical images. We expect to see a high correlation of greater T2 signal change in tumor regions due to a higher particle intake. This program will help us locate signal changes in different regions within the ROI with a better visualization, while eliminating excess noises outside of the brain. Another focus of our project involves the quantitative analysis of 3-dimensional T2* weighted images, using manually altered java plug-ins for ImageJ in comparison to the traditional 2-dimensional image analysis of T2* maps. Three dimensional images cover a broader ROI, and could prove to be helpful in data comparison in relaxation time between the ROI and its surrounding area. The expected outcome with this plug-in is to identify locations within the ROI with higher particle intake in a 3-dimensional orientation. With these methods, we will be able to facilitate the process of data analysis that would provide better visualization and result interpretation.

Using Small Molecules to Inhibit Bcl-xL

*Aliscia Lindeke, Senior, Molecular, Cellular, & Developmental Biology
Mentor: David Hockenberry, Medicine and Gastroenterology*

Apoptosis is a mechanism of cell suicide initiated under conditions of cellular stress or damage to prevent uncontrolled cell growth. Bcl-xL, an anti-apoptotic protein in the Bcl-2 family of cell death regulators, is over-expressed in cancers resistant to standard chemotherapies. As many current cancer treatments rely on triggering apoptosis in cancer cells, targeting and blocking Bcl-xL action with small molecules may increase the effectiveness of these drugs. Favorable candidates among Bcl-xL inhibitors should be most effective with high levels of Bcl-xL expression, thereby targeting cancer cells selectively. This type of activity is referred to as a gain-of-function mechanism. Testing a variety of cancer cell lines with potential Bcl-xL antagonists in vitro and later as athymic mice xenografts serves to confirm and explore biological activity in a range of tissue types. Ideal cell lines should exhibit high levels of endogenous Bcl-xL expression (demonstrated by western blot analysis) and suitability for a microtiter plate assay (resazurin). Pancreatic cancer cell lines Panc1, PaTu1, and MiaPaca perform acceptably in resazurin assays only at high cell densities. In preliminary studies, Panc1 and PaTu1 express high levels of Bcl-xL, and are sensitive to candidate Bcl-xL inhibitors. Additional testing is planned to confirm these results and confirm Bcl-xL as the relevant target in these cell lines.

Optical Microbend Sensor for Clinical Force Measurement

*David Linders, Junior, Bioengineering
Levinson Emerging Scholar
Mentor: Wei-Chih Wang, Mechanical Engineering*

For many clinicians, their effectiveness is dependent on the forces they apply to their patients. However, current care strategies lack quantitative feedback. Therefore, my objective is to develop a force-sensing glove to provide real-time quantitative feedback to assist in clinical diagnosis and treatment. To minimally affect a clinician's function, obtain maximal signal to noise in a medical environment, and maintain patient safety, a fiber optic sensor is being developed for this application. This sensor will be embedded in a latex glove similar to those already used in clinical medicine. Its design is based on the bendloss properties of optical fiber whereby the attenuation of light through a fiber is related to the bending of that fiber. The sensor consists of a plastic applicator and a soft rubber layer which sandwich the fiber. The thin top part deforms under an applied load to bend the fiber under a series of teeth. The amount of light attenuation depends on the degree of bending that the fiber experiences under the teeth. In this way, the force applied can be related to the light lost in the fiber. The sensor was printed on a rapid prototype machine then cast into polymer before being embedded into the latex glove along with the fiber. The sensors were attached to the glove after the hand mold was dipped into natural latex, and a second coat sealed the sensor and fiber. The sensor achieves an appropriate clinical thickness (1.1mm) while providing force feedback with a range of 60N, threshold of 4N, and resolution of 0.4N. This will enable us to meet the force demands of a diverse clinical population and deliver a novel technology to improve the effectiveness of clinical diagnosis and care.

The effect of herbicides on the retention and loss of chloroplast DNA in maize

*Ke Liu, Junior, Biology
Mentor: Delene J. Oldenburg, Biology
Mentor: Arnold J Bendich, Biology*

The chloroplast is the cellular location for converting solar energy to chemical energy during photosynthesis. Like the nucleus, the chloroplast has DNA that encodes proteins for chloroplast biogenesis and function. The content of chloroplast DNA (cpDNA) changes during leaf development in Zea mays (maize, corn): it is high in meristematic tissue and declines greatly in the mature chloroplast, where many chloroplasts contain no detectable DNA. The retention or loss of cpDNA may be affected by genetic factors and growth conditions, such as temperature, light, and the application of herbicides. The degradation of cpDNA may be part of a developmental program regulated by the nuclear genome or the result of photooxidative damage

resulting from a byproduct of photosynthesis. In this study, I used herbicides to inhibit chloroplast biogenesis in both light and dark growth conditions. The content of cpDNA per chloroplast was measured as the fluorescent signal from the DNA-specific dye DAPI. I chose to investigate how several factors contribute to DNA content change in the chloroplast, such as DNA replication and repair, carotenoid production, anti-photooxidative processes and chloroplast-nucleus cross-talk. Typically, chloroplasts lose DNA in the light and retain it in the dark in control plants. Interestingly, my results thus far show that cpDNA was retained in plants grown in the light with Amitrole. I found that the mean DNA copy number per plastid was higher in plants treated with Amitrole than those in control plants. How herbicides “help” chloroplasts retain DNA is still not clear. One of my goals is to investigate the mechanism of herbicide-induced cpDNA retention.

**An important tool for community based restoration:
Ideas for expansion of the Seattle Urban Nature
Interactive Habitat Map**

*Arin Lexine Long, Senior, Environmental Science &
Resource Management and Community, Environment &
Planning*

Mentor: Dennis Ryan, Urban Planning

It often seems in our modern, highly urbanized world, people are less connected to the natural world around them. Many Seattleites cannot name five native trees around them, or differentiate between native and non-native species. This project explores the power of community stewardship in their local forest, community mapping, and the value of knowledge about the surrounding natural world. The project consists of both background research about these topics, as well as working with an organization that is committed to implementing these values. Seattle Urban Nature (SUN) is an organization that is “dedicated to enriching the quality of life in the Puget Sound region by engaging communities to improve urban forests.” They work to provide the scientific data and information about urban forests for local citizens, community groups and government organizations to use in restoration and stewardship. SUN has mapped and inventoried all of the vegetation and wildlife habitats on Seattle’s public land. Out of this information they have created an online habitat map that shows the composition of native and non-native vegetation and the sites where ecological restoration is currently occurring. The map has the potential to be a very useful tool to the forest stewardship community in Seattle, to inform local citizens about the environment around them, and to inspire them to take care of it. The work with SUN will include case studies of similar projects with the intent of learning from the successes and failures of other projects, and recommendations for expansions and improvement of the features on the map. In addition, a write up on the historical vegetation of Seattle will be produced for the website, so users will be able to

understand the change in the landscape over time, and be motivated to take part in the stewardship and restoration of the surrounding ecosystems.

**Gestational Cocaine Exposure Produces Age-
Dependent Alterations in Locomotor Activity**

Lauren Ludwick, Sophomore, Neurology

Christine A. Scarlis, Senior, International Studies

Undergraduate Research Travel Awardee

Mentor: Nigel S. Bamford, Neurology and Pediatrics

Prenatal exposure to cocaine produces impairments of cognition and motor function. We hypothesize that such neurodevelopmental abnormalities are produced through enduring striatal neuroadaptations manifest by alterations in behavior. We performed behavioral experiments in litters, aged 30 (COC30) and 60 (COC60) days derived from timed-pregnant cocaine treated (20 mg/kg i.p. twice daily from E8- E18) and pair-fed saline-treated Swiss Webster mice to determine if prenatal cocaine exposure induces long-lasting changes in locomotor function and sensitized responses to a drug challenge. Tail suspension tests demonstrated that COC30 mice remained immobile longer than controls, whereas COC60 mice were more active than controls. Tail flick test also demonstrated a reduced response to stimulation in COC30 mice and a heightened response on day 60. Rotarod testing showed increased ambulatory effort in both COC30 and COC60 mice but less locomotor learning when compared with controls. Finally, locomotor tests demonstrated that cocaine exposure decreased responsiveness to psychostimulant challenges at both 30 and 60 days. These data suggest that cocaine exposure in utero produces alterations in ambulatory function characterized by a reduction in motor activity at 30 days, followed by an increase in activity at 60 days. While cocaine exposed mice demonstrated cross-sensitization to psychostimulants, evoked ambulatory activity was reduced. These experiments provide insight into behavioral abnormalities often seen in drug exposed children.

**Contextual variations of mindfulness: A behavioral
model and preliminary results**

Jeremy Luk, Senior, Psychology

Mary Gates Scholar, Undergraduate Research

Travel Awardee

Mentor: Robert Kohlenberg, Psychology

Just as mindfulness can be practiced anywhere, questionnaires such as the Kentucky Inventory of Mindfulness Skills (KIMS) tend to evaluate mindfulness across a variety of contexts. Such questionnaires thus produce a ‘global index’ of mindfulness, rather than an assessment based on contextual variations in behavior. A behavioral perspective suggests that different learning histories in, for instance, interpersonal and work contexts may produce corresponding variations in context-

specific mindfulness. We present a behavioral model of mindfulness which focuses on distinguishing mindfulness in intimate-interpersonal and work-related contexts. We then present preliminary results of a study in which we evaluated contextual variations in mindfulness by administering alternate versions of the KIMS, which specified either no-context, interpersonal context, or work context, to a sample of undergraduate research participants. Observed contextual variations in mindfulness related to gender and race/ethnicity are discussed. Findings about the potential relationships between mindfulness, social support, attachment style, self-construal, and mood are also explored. Despite the limitation of the self-report method, this study is one of the first systematic empirical evaluations of contextual variations in mindfulness. Finally, we evaluate clinical implications of contextual variations of mindfulness from a behavioral analytic perspective.

Monte Carlo Projective Clustering Algorithms

*Henry Lyons, Senior, Computing & Software Systems,
UW Bothell
Mentor: Clark Olson, Computing & Software Systems,
UW Bothell*

Projective clustering is a statistical data analysis technique that is used to partition data sets into subsets of related members in lower-dimensional space. Projective clustering has practical applications in many areas, including computer vision, data mining, and marketing research. Projective clustering algorithms tend to be computationally intensive, because the possible number of projective clusters in a data set increases exponentially as data set size and dimensionality increases. One popular projective clustering algorithm uses a Monte Carlo approach to reduce computational complexity. In this approach, a cluster center and a small number of other points (the “discriminating set”) is randomly selected from the data set, and the cluster subspace is computed from these points. Then the entire data set is scanned to find cluster members (i.e., members that are sufficiently close to the cluster center in each of the cluster subspace dimensions). One major disadvantage of this algorithm is that the maximum cluster width constraint is relaxed in order to increase the probability of finding higher-dimensional clusters. Consequently, the detected clusters may be significantly wider than the maximum cluster width. This research team is investigating enhancements to this algorithm that would solve this problem, and also significantly improve running time.

Analysis of Suppressive Regulatory Elements of the mouse Muscle *Creatine Kinase* gene in skeletal muscle

*Alexandra MacKenzie, Senior, Biochemistry
Amgen Scholar, Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Stephen Hauschka, Biochemistry
Mentor: Phillip Tai, Biochemistry*

The means by which muscle genes are regulated is not fully understood. This study focuses on transcriptional regulation of the gene Muscle Creatine Kinase (MCK). MCK encodes a biologically critical enzyme that reversibly catalyzes transfer of the high-energy phosphate bond of phosphocreatine to ADP yielding ATP in muscle. Historically, MCK has been a paradigm for muscle gene regulation because it is exclusively expressed at high-levels in all striated muscle. MCK has three known regulatory regions: 1) the proximal promoter, 2) the upstream enhancer, and 3) the poorly characterized Modulatory Region 1 (MR-1). Recent studies have shown that MR-1 contains a 95-bp sub-region that acts as a potent enhancer for muscle specific gene transcription. We have now identified another highly conserved 161-bp sub-region of MR-1 called MR-1A. When MR-1A is deleted from an expression construct containing MR-1, the remaining sequence exhibits a two-fold enhancement in transcriptional activity when assayed in cultured mouse skeletal muscle cells. Sequence alignments of several vertebrate species revealed five regions of highly conserved sequence within MR-1A that do not match any known transcription factor binding motifs. Individual deletion of these regions also demonstrated an approximate two-fold increase in transcriptional activity. These data suggest that MR-1A, and its components, function to repress gene transcription. Finally, we predicted that MR-1A may also suppress the powerful upstream enhancer, due to the common elements found between the upstream enhancer and the 95-bp enhancer. However, ligation of MR-1A to the upstream enhancer does not result in a significant repression of transcription. This study suggests that the suppressive nature of the MR-1A region is specific for repressing the 95-bp enhancer of MR-1. Further work is necessary to fully determine the role of MR-1A during MCK gene transcription and to identify the DNA elements within MR-1A and the transcription factors that bind these elements.

Adaptive Evolution of an Avian Reproductive Protein: the ZP1

*Sathi Maiti, Senior, Molecular, Cellular, & Developmental Biology and Sociology
Mentor: Jennifer Calkins, Genome Sciences
Mentor: Willie Swanson, Genome Sciences*

Reproductive proteins appear to be adaptively evolving in a number of species. This is hypothesized to be a result of sexual selection, in particular sexual conflict over polyspermy (the penetration of one egg by several sperm). In most taxa the penetration of an oocyte by more than one sperm results in egg death, however avian egg coat proteins tolerate physiological polyspermy, and therefore evidence of adaptive evolution in avian egg surface proteins (such as zona pellucida 3 (ZP3) indicates that sexual conflict over polyspermy is not sufficient to explain the pattern of adaptive evolution in reproductive proteins. However, very

little research has been conducted testing the evolution of reproductive protein evolution in birds. My research focuses specifically on the avian zona pellucida 1 (ZP1) protein, an egg coat protein involved with sperm entry and activation, and for which little is known. To examine the pattern of divergence in this protein I compared the rate of synonymous and nonsynonymous substitutions among four species' sequences published on Genbank. The results suggest there is a pattern of evolution similar to that of the ZP3 protein. In order to increase statistical power of these results I am currently sequencing additional species using primers designed from sequences on Genbank. My work will shed light on these patterns and generate much needed information on avian and vertebrate reproduction.

Relating classroom acoustics to students' listening experiences

*Hiroka Mamiya, Senior, Speech & Hearing Sciences
Mentor: G. Christopher Stecker, Speech & Hearing Sciences*

College students' listening experiences in two different lecture halls on the UW campus (Smith 205 and Eagleson 001) were assessed by survey and compared with room acoustics measured in the rooms. Data, such as reverberation times, early to late arriving sound energy ratio, direct to reflected sound ratio, times of the strongest reflection, and speaker-listener distances were examined for correlation with students' survey responses regarding their listening environments. Fifty-four students, who attended a class taught by the same instructor in both rooms on alternating days, participated in this study. At the end of the quarter, they rated their listening experiences and selected descriptive terms that best matched their acoustic perceptions. On average, the smaller room received better overall listening and speech recognition ratings. Subsequent to the survey, binaural room impulse responses were recorded in each room by playing synthesized sound through a loudspeaker. A binaural recording mannequin was placed in various seats to measure the room response at representative locations. The sound was recorded in each ear separately. Interestingly, the maximum reverberation time in the back seat of EGL 001 was very close to the minimum reverberation time recorded in the front seat of Smith 205. For some seats, reverberation times in Smith 205 approached 1.0 second, sometimes given as an upper limit of the ideal reverberation time for classrooms. Also, a larger proportion of seats in Smith 205 experienced acoustic reflections (echoes) that were stronger than the direct sound, consistent with students' descriptions of that room's acoustics as "echoey" or "muffled."

Atoms to Ecosystems: An Interdisciplinary and Community-based Program for Science Majors

*Matthew Manges, Post Baccalaureate, Physical Therapy,
North Seattle Community College
Mentor: Kalyn Owens, Chemistry, North Seattle*

Community College

*Mentor: Ann Murkowski, Biology, North Seattle
Community College*

Mounting evidence suggests that the traditional focus on content knowledge acquisition in isolated discipline-specific classrooms is not preparing students to be "flexible" thinkers in an increasingly interdisciplinary scientific community and in a rapidly changing global marketplace. In response to this notion, we have designed a post-secondary program for science majors (Atoms to Ecosystems) that makes learning interdisciplinary and makes learning about community by providing opportunities for students to engage in daily shared learning experiences that drive classroom activities. This particular study is focused on gaining a better understanding of how students in our Atoms to Ecosystems program think and problem solve at the interface between chemistry and biology with a specific emphasis on understanding how shared experiences drive progress in the affective dimensions of learning (such as engagement, motivation and confidence). To document learning in process we utilized the "capture method", which involves videotaping a group of learners as they work to create meaning of a complex interdisciplinary idea. In this study, we document a group of students struggling together to represent and understand the structure and function of the membrane bound protein Aquaporin, which required an understanding of both chemistry, biology, and how to problem solve at the interface of these two disciplines. We then see how the story affects them, their classmates, the facilitator, other faculty, and ultimately leads to a better understanding of the power of a community of learners.

The Impact of Legislation and Educational Programs on Teen Sexuality and Health Outcomes

*Jaimée Marsh, Senior, Social Welfare, Public Health and Geography Minor
Mentor: Ratnesh Nagda, Social Work*

Teen birth rates in the United States have increased for the first time in 15 years. Despite this national increase, birth rates in Washington State continue to decrease. The Healthy Youth Act, passed in 2007, mandated that all sexual education programs taught to school-aged youth must include medically accurate information about pregnancy and disease prevention in addition to promoting abstinence. This legislation supported the comprehensive sexual education programs offered through Seattle Public Schools and other health organizations such as Planned Parenthood of Western Washington. The intent of this project is to evaluate the effectiveness of legislative measures and reproductive/sexual health education programs in Washington State in preventing teen pregnancy and sexually transmitted infections. In addition, using a Grounded Theory approach, the goal of this project is to identify strategies to enhance teens' implementation of contraceptive methods and health information allowing

them to prevent unintended pregnancies and sexually transmitted infections. This evaluation will incorporate a combination of surveys and personal narratives addressing people's experiences with sex education programs and the impact of these programs on their behavior and health. These surveys and interviews will include the perspectives of health educators and students who have participated in projects such as Planned Parenthood's Teen Council, and Family Life and Sexual Health (FLASH) curriculum in Seattle Public Schools. These programs will also be critiqued using criteria for sex education curriculums that work as established by Dr. Doug Kirby, a nationally known research scientist in the field of adolescent sexuality.

Washington State Senate Bill 5297, The Healthy Youth Act: Comprehensive sexual health education in public schools

*Monique Mascio-Saltarelli, Senior, Sociology
Zesbaugh Scholar*

Mentor: Tom Stritikus, College of Education

Sex Education in public schools is a widely debated and highly controversial issue. The No Child Left Behind Act of 2001 requires that in order to be eligible to receive federal funds, schools must teach abstinence only sex education which does not provide students with information on safe sex practices or contraception. The intent of this research project is to examine the Washington State Legislatures' identification that abstinence only sex education is not enough to teach young people and how they created legislation requiring every public school that offers sexual health education to ensure it is medically and scientifically accurate, age appropriate and appropriate for students regardless of gender, race, disability status or sexual orientation. In addition, it will examine how select schools/districts are being impacted and what curriculum adjustments are being implemented. Abstinence only education identifies heterosexual marriage as the only legitimate family structure without addressing nontraditional family beliefs using culturally sensitive curriculum. However, the Washington State Legislature has identified that there is a need for a more comprehensive sex education program to counteract the increasing rate of teen pregnancy and Sexually Transmitted Infections. The 2007 Legislature enacted Senate Bill 5297 The Healthy Youth Act which requires that comprehensive and medically accurate information be taught. My methods of research will begin with careful observation and review of testimony from the public and Legislatures during the Committee Hearings and Senate Floor Debate. I plan to interview the prime sponsor of the bill. Furthermore, I will seek to contact the Office of Superintendent of Public Instruction and selected school to look how curriculum has been adjusted. I anticipate a great deal of information and progress as schools work with state mandated requirements and use suggestions by The Department of Health and OSPI to develop comprehensive and effective material.

Transcutaneous Acoustic Palpation (TAP) for localizing painful tissue: many TAPs are better than one

*Abigail McClintic, Freshman, Pre-major
NASA Space Grant Scholar
Mentor: Pierre D. Mourad, Neurosurgery*

In order to diagnose and treat painful sensations, we must know the location of the sensitive tissue. We must differentiate between normal tissue and painful tissue; however, current techniques lack specificity and precision. Our research focuses on the use of intense focused ultrasound (iFU) to localize pain. iFU can cause sensation in superficial and deep structures within the body. The ability for iFU to cause sensation in normal and damaged tissue has been used to show that inflamed/neuropathic tissues have lower sensation thresholds than normal tissue. In previous studies, where iFU was applied to normal and inflamed rat paws, rats exhibited a withdrawal response to a given dose on their inflamed side but showed no response to that same dose on their normal paw. Through the implementation of a phenomenon known as wind-up, we want to lower the acoustic dose required to elicit a withdrawal response from damage tissue in order to increase the safety of the device. Wind-up is a type of pain amplification in which a stimulus applied repeatedly (1 – 20 times per second) causes more pain than a single application of that same stimulus. This suggested to us that iFU protocols incorporating repeated applications would create a sensation in damaged tissue at a lower net acoustic dose than a single, long application of iFU. Specifically, we applied iFU with two different acoustic protocols of the same average acoustic dose to two different cohorts of rats with artificially inflamed paws. One acoustic protocol consisted of a single burst of iFU while the other we divided into three short bursts such that each produced the same heat within tissue. Our preliminary data is consistent with our hypothesis, namely that the average acoustic dose necessary to evoke a withdrawal response by a single iFU application was larger than that necessary to evoke a withdrawal response by multiple iFU applications with the same average acoustic dose.

How Do Demographic Faultlines Influence Team Performance? The Mediating Processes of Relational Learning Behaviors and Psychological Safety

*Andrew McCornack, Sophomore, Psychology
Mentor: Brad Owens, Management and Organization*

The aim of this study is to answer the call of van Knippenberg and Shippers (2007) to understand more fully the mechanisms through which team diversity impacts team performance. This study introduces a new construct, Core Relational Learning Behaviors (CRLB) which unifies the existing constructs of transparency, feedback seeking, and inclusiveness into one, core, interconnected construct. Empirical results confirmed

the unidimensionality of CRLB. 151 participants in 34 teams of management students showed that strong demographic faultlines—groups with two sub-groups that differ in at least two physical characteristics—negatively predicted team psychological safety ($b = -.40$, $p < .05$, $\Delta R^2 = .18$). Strong demographic faultlines also had a negative relationship with CRLB ($b = -.37$, $p < .05$, $\Delta R^2 = .13$) and team performance ($b = -.47$, $p < .01$, $\Delta R^2 = .19$). Finally, CRLB partially mediated and psychological safety fully mediated the relationship between demographic faultlines and team performance. Implications and future research are discussed.

Isotopic, Chemical and Petrographic Changes Associated with Hydrothermal Alteration of Ocean Island Basalts

*Rex McLachlin, Senior, Earth & Space Sciences
Mentor: Bruce Nelson, Earth & Space Sciences*

Numerous studies on the isotopic and chemical changes caused by the reaction of new basaltic crust formed at mid-ocean ridges with seawater have provided a good understanding of deep seafloor hydrothermal systems. However, comparatively little research has been done on alteration of basalts in seamounts and ocean islands during their submarine growth phase. In this study, we characterize the changes in major and trace elements, Sr, Nd and Pb isotopes and petrology associated with increasing intensity of hydrothermal alteration of a suite of samples from the island of La Palma, Canary Islands. La Palma is the westernmost and youngest island in the Canarian Archipelago. The island is situated on Jurassic oceanic crust and consists of several overlapping basaltic volcanoes of Pliocene to Recent age. In the Barranco de las Angustias on the western side of the island, a combination of uplift and deep erosion has exposed a section through the early seamount phase of the island. All layers of the old seamount, from seafloor sediment to plutons in the magmatic core, are exposed. From seafloor to core, the rocks become increasingly metamorphosed from zeolite through greenschist facies. Measurement of the isotopic, chemical and mineralogical changes relative to location will allow comparison of these samples with the existing literature for mid-ocean ridge basalts. This will allow us to identify differences and similarities in how hydrothermal systems operate along mid-ocean ridges versus at seamounts.

Effects of Encouragement and Discouragement on Test Performance

*Kidst Messelu, Psychology and Law, Societies, and Justice, North Seattle Community College
Glenn Larson, Junior, Psychology, North Seattle Community College
Mentor: Melissa Grinley, Psychology, North Seattle Community College*

Research suggests test performance increases when

students are warned of the difficulty of an exam well in advance (Sax & Reade, 1964, as cited by Weber, C. & Bizer, G., 2006). This is because students who expected a difficult exam studied more. Little research has studied the effects of warnings directly before an exam (Weber, C. & Bizer, G., 2006). We tested these effects, using college-level participants. Each participant received the same test, with three written instruction conditions: difficult, easy, and a control. We hypothesized that participants who were instructed their test was difficult, would have mean scores lower than the other conditions. Likewise, the control group would perform worse than the participants who were instructed their test was easy.

Molecular dynamics analysis of PrPC and PrPSc structure including cross-species variations

Julia L Moore, Junior, Applied & Computational Mathematics and Microbiology

Amgen Scholar, Goldwater Scholar, Mary Gates Scholar

Mentor: Valerie Daggett, Bioengineering

Mentor: Alexander Scouras, Biochemistry

The prion protein (PrP) is an ubiquitous protein that is linked to transmissible spongiform encephalopathies (TSEs) such as mad cow disease, Fatal Familiar Insomnia (FFI) and Creuzfeldt-Jakobs Disease (CJD). Research indicates that infection is caused by multimers of misfolded cellular PrP, thought to arise in vivo in cellular compartments with low pH. Additionally, numerous strains have been found both within and across species, leading to what is known as the species barrier. To gain an understanding of the mechanisms of disease progression and toxicity, it is necessary to study the structure of both cellular PrP (PrPC) and converted PrP (PrPSc) in multiple species. We have used molecular dynamics (MD) simulations to study early intermediate of converted PrP structures in both human and Syrian hamster, focusing specifically on contacts of acidic amino acids with basic and polar residues. To induce conversion, a low pH environment is simulated, and comparisons are made between converted structures and control structures simulated at neutral pH. In addition, we have examined contact differences between human and Syrian hamster PrP to gain insight into interspecies infectivity.

No Child Left Behind What? Searching for the Impetus of American Education Reform

Rob Muilenburg, Senior, Political Economy and Economics

Mary Gates Scholar

Mentor: Bryan Jones, Political Science

My research project sets out to discover what motivates the federal government to enact policies that overhaul the American education system. There are plenty of potential reasons to reform education, from low graduation rates to high unemployment. My project's goal is to understand

which ones gain traction in Washington and for what reason. Education reform offers a somewhat unique platform from which to observe the American political dynamic. It is broad enough to garner interest from agents beyond the political subsystems many American issues are decided in; its status is generally easy to gauge with hard statistics; and when the quality of American education appears to be trending unfavorably, some manner of reform is almost always a politically safe solution. For those reasons, one might assume education reform would be considered and enacted based exclusively on education-oriented statistics, and done so in a swift timeframe. Because this is not strictly accurate, my project offers some insight as to why that is not the case. My work analyzes data that measures the level of activity on Capitol Hill regarding education reform and compares it with contemporary data that could logically explain why Congress would put education reform on its agenda such as trends in college enrollment or unemployment. Additionally, I review source material like legislation and transcripts of hearings to assess official justifications for Congressional interest and validate or disprove their assertions as relevant.

Blogging Outside Iran: A Tool for Internal Democratic Change?

Arman Nafisi-Movaghari, Senior, Communication and Political Science

Mentor: Kirsten Foot, Communication

This research examines whether expatriate Iranians communicate using blogs with Iranians inside Iran to promote democratic reforms. The 1979 Islamic Revolution set historical precedent for using audio cassettes as a tool to instigate regime change. Iranians left Iran during and after the Islamic Revolution to pursue liberty, education, and economic opportunities in democratic countries. Twenty-eight years later, these expatriate Iranians, such as the founder of an Iranian blog, Hossein Derakhshan, see one example of modern communication technology, weblogs, as possessing the potential for additional historical precedent. They view weblogs, or “blogs,” as an opportunity not only to communicate with Iranians inside Iran, but also to advocate democratic values and reforms, if not regime change. To examine whether expatriate Iranians are communicating via blogs with Iranians inside Iran for the purpose of promoting democratic change, a content analysis of English language blogs by expatriate Iranians, interviews with Iranian blog experts, and an online survey of expatriate Iranian bloggers were conducted. Results from this research indicate that while most expatriate Iranian bloggers do not create blogs for the purpose of promoting democratic change in Iran, many do support and promote democratic values on their blogs. Although democratic values are supported and promoted, expatriate Iranian bloggers, as a whole, are not using their blogs to mobilize Iranians for political change inside Iran. Thus, expatriates and Western observers, particularly in the

United States, who point to blog communiqués as evidence of momentum towards greater democracy inside Iran, need other indicators to support this conclusion or hope.

Identification of an FGFR3 Variant in Hodgkin's Lymphoma Cell Line, L-428

Shinae Namkoong, Senior, Biology (Physiology)

Mentor: Matthew Mealiff, Medicine

Mentor: Marshall Horwitz, Medicine

Hodgkin's Lymphoma (HL) is a B lymphocyte cancer that is newly diagnosed in approximately 8,000 people per year in the US. Population-based and twin studies show that HL risk is a heritable phenotype. Though the genetic basis of HL risk is essentially unknown, Fibroblast Growth Factor Receptor 3 (FGFR3) is an intriguing candidate because: 1) it is located in a region of suggestive linkage on chromosome 4p from a familial HL genome-wide linkage scan and 2) it is a known oncogene in Multiple Myeloma (MM), a related B lymphocyte cancer. Therefore, we tested whether FGFR3 mutations might contribute to development of HL. We sequenced all FGFR3 coding exons in genomic DNA from affected probands from 47 families with two or more individuals affected with HL and also from six HL Cell Lines: HDLM-2, HD-MY-Z, KM-H2, L-428, L-540, and L-1236. A non-synonymous FGFR3 variant, P449S, was found in HL Cell Line, L-428 and was absent from control individuals. No FGFR3 variants were found in any of the 47 probands with HL. The altered FGFR3 amino acid in L-428 is found in the juxtamembrane (JM) domain, which is distinct from the domains involved in pathogenesis of MM and TD (Thanatophoric Dysplasia). Previous studies have shown that the FGFR3 JM domain is important for the binding of PYK2 and EPHA4 proteins. We speculate that the P449S substitution may alter binding of FGFR3 with one or both of these proteins. Future studies should investigate: 1) the functional implications of the P449S substitution; 2) whether somatic FGFR3 mutations are present in the malignant Reed-Sternberg cell in HL and 3) whether any non-coding genetic variation in the vicinity of FGFR3 may be involved in inherited HL risk.

Characterization of a Novel Endogenous Retroviral Envelope Related to HERV-W

Simon Newkirk, Senior, Biology, The Evergreen State College

Mentor: Clarissa Dirks, Biology, The Evergreen State College

Approximately 8% of the human genome consists of retroviral elements named human endogenous retroviruses (HERVs). Like endogenous retroviruses (ERVs) in other organisms, HERVs are the result of ancestral germ-line infections by active retroviruses, which are thereafter transmitted in a Mendelian manner. The envelope protein of human endogenous retrovirus family W (HERV-W) is involved in the formation of the placenta syncytiotrophoblast layer.

This highly fusogenic glycoprotein induces the syncytia formation through its interaction with the type D retrovirus receptor. Related endogenous retroviral envelopes found in other mammals are thought to serve the same function. My research is focused on characterizing a closely related ERV envelope protein found in the Brazilian common Marmoset, *Callithrix jacchus*. This previously undescribed envelope gene was identified through bioinformatics. The gene was then cloned into a mammalian expression construct for testing host range and receptor use. Given that the envelope protein sequence is highly homologous to the HERV-W envelope, we hypothesize that the new envelope protein uses the same receptor as HERV-W. If our predictions are true, then future studies will be directed at determining whether the envelope/receptor interaction leads to syncytia formation.

Enrichment and characterization of phototrophic bacteria that can use thiosulfate as an inorganic source of electrons to support nitrogen-fixation, carbon-dioxide fixation and bio-hydrogen production

*Catherine Nguyen, Senior, Microbiology
Mentor: Caroline Harwood, Microbiology*

Thiosulfate is an inorganic compound that is found in nature as an intermediate of the sulfur cycle. *Rhodopseudomonas palustris* is a metabolically versatile bacterium that generates energy for growth from light by photophosphorylation. It can also convert nitrogen gas to ammonia, a useable nitrogen source, using thiosulfate as an electron donor. This process, called nitrogen fixation, is accompanied by the production of hydrogen, a biofuel. Thiosulfate also serves as an electron donor for carbon dioxide fixation to support autotrophic growth. Is *R. palustris* unique in its ability to carry out this metabolism? To answer this question, I set up enrichments to look for other photolithoautotrophic nitrogen-fixing bacteria from the environment. I designed media that were free of fixed nitrogen, included carbon dioxide and contained thiosulfate as the sole source of electrons and incubated them at various wavelengths of light ranging from 470-1020 nm to select for phototrophic bacteria from water and soil collected around Seattle. Several enrichment cultures were obtained, and I am in the process of characterizing the strains that I isolated from the enrichments according to their growth on thiosulfate, morphology, absorbance spectra, 16S rRNA phylogeny, and hydrogen production. I am interested in whether this mode of metabolism is widespread among bacteria and how the environmental isolates compare with *R. palustris* regarding hydrogen production using this mode of metabolism. Ultimately I hope to obtain more information on organisms that can grow in this way and on their potential contributions to photobiological production of hydrogen.

Measuring Metal Stress in Trees in Norway Using Phytochelatins

*Quyen Ngoc Nguyen, Senior, Environmental Sciences, UW Tacoma
Mentor: James E. Gawel, Environmental Chemistry and Engineering, UW Tacoma*

Metal deposition to soils in Southern Norway has been discovered by previous studies to be higher than in Northern Norway due to coal-fired power plants, smelters, and other emissions sources in mainland Europe and Great Britain. However, metal concentrations in soils, or even plant tissues, do not necessarily indicate metal stress to plants growing in the area. A better method for determining metal stress in the environment is to measure phytochelatins—intracellular metal-binding peptides in plants or some fungi that act as an indicator of metal stress. Phytochelatins are synthesized from glutathione, an antioxidant protecting cells from toxins and performing other functions in cells, in response to metal stress. This study examines the concentration of phytochelatins in Norway spruce needles collected along a transect from Southern to Northern Norway and compares these concentrations with metal levels in soils and foliage. Phytochelatins are quantified using high performance liquid chromatography (HPLC) with fluorometric detection. Comparing patterns of metal deposition and phytochelatin production may help elucidate particular metals as culprit stressors in Norwegian forests.

Raf Kinase Inhibitors: Potential Drug Agents for Treatment of Cancer and Parasitic Diseases

*Thuan V Nguyen, Senior, Biochemistry and Chemistry
Mentor: Dustin Maly, Biological Chemistry*

Raf kinase, a downstream effector of Ras signaling pathways, is a key mediator of signal transduction pathways from cell receptors to the nucleus. The activation of Ras signaling pathways by Raf kinase is highly regulated in a normal cell. Mutational activation of Ras signaling pathways can lead to uncontrolled cellular proliferation and tumorigenesis. Small molecule inhibitors of Raf kinase, such as BAY 43-9006, are potential drug candidates for the treatment of cancer. Studies have also shown that such inhibitors selectively inhibit kinases in diseases caused by parasites such as malaria. These kinase inhibitors are thought to be promising agents that can be used as drugs to treat various parasitic diseases. Our goal is to synthesize BAY 43-9006 and a number of other analogs. We hope to find an analog that binds parasitic kinases more tightly than BAY 43-9006. Starting with a picolinic acid scaffold, we derivatize it in a four step synthesis to gain access to BAY 43-9006 and various analogs. Flash column chromatography and reverse phase high-performance liquid chromatography (HPLC) allow us to separate the product mixture of the reactions in order to obtain a purified compound. We can properly characterize the pure compound of each reaction through ¹H NMR spectroscopy and mass spectroscopy.

Teachers' Assessment of the Pipeline Project

Wayne Sang Nguyen, Senior, Psychology

Felise Hwang, Junior, American Ethnic Studies

Mentor: Christine Stickler, Pipeline Project

The Pipeline Project serves to connect University of Washington undergraduates with educational and service opportunities in local K-12 schools. It is through these opportunities that the Pipeline Project strives to achieve four primary objectives: 1) to enable undergraduates to discover personal and academic direction, 2) to provide under-serviced K-12 students with individualized tutoring and college role models, 3) to support the work of the public school teachers and 4) to bring academic departments at the University of Washington into direct contact with the greater educational community. With particular attention to the third objective of supporting the work of the public school teachers, three central questions drive our research: 1) does the Pipeline Project program definition of an effective tutor mirror a teacher's definition? 2) from a teacher's perspective, are Pipeline Project volunteers really supporting the work of the teacher? and 3) what are some ways that we could improve our training and support of tutors to match the teacher's needs? The purpose of this study is to address the three central questions. In the first time in eleven years, a local school district survey has been implemented to obtain qualitative and quantitative data. This web based and self-reported, 5 to 10 minute survey aims at understanding teacher expectations and how the Project has quantitatively met those expectations. Next, we conducted a personal follow-up interview to further explore the qualitative responses given during the survey. These qualitative data will help find ways on how Pipeline trains and supports its future tutors. We hope to gain insight into teacher recommendations for program improvement and success.

Effect of Smyd3 in the Wnt Signalling pathway

Colyn Nouv, Junior, Chemistry

Mentor: Jason Berndt, Pharmacology

Histone modifications are known to regulate gene transcription. Smyd 3, a histone methyl transferase, has been shown to inhibit wnt-dependent transcription in cultured cells. Since Wnt signaling is known to regulate vertebrate development, we hypothesized that genetic manipulation of smyd 3 expression in embryonic zebra fish would result in wnt-like phenotypes. Specifically, we injected exogenous smyd3 mRNA or smyd3 anti-sense oligonucleotides into developing zebra fish and then assayed for expression levels of wnt-target genes. We found that smyd3 gain of function reverses the increase in wnt target genes due to the overexpression of wnt 8. Furthermore, smyd3 loss of function made the phenotype due to wnt 8 overexpression worse. These findings suggest that smyd 3 plays a prominent role in the wnt signaling pathway during embryonic development.

Early time course of visual evoked potentials in individuals with autism spectrum disorder

Justin Numata, Senior, Neurobiology

Mentor: Sara Jane Webb, Psychiatry & Behavioral Sciences

In autism spectrum disorder (ASD), higher level visual processing abnormalities have long been found; it is unclear what role lower-level "bottom up" visual processing plays in these deficits. In 8 adults with autism, Hadjikhani et al. (2004) found (via functional Magnetic Resonance Imaging) that early stage visual processing areas were normally organized. Using visual evoked potentials (VEPs), a specific form of event related potentials (ERPs), early abnormalities in the visual processing stream have been found in a number of other neurological disorders (e.g., depression, schizophrenia, ADHD). As well, preliminary evidence from our lab suggests alterations in P1 amplitude and latency in children with ASD when viewing faces. The goal of this study was to examine the early time course of VEPs in individuals with autism to basic checkerboard stimuli. In our study, 27 adults with high functioning ASD and 21 age and IQ matched controls were presented with a unilateral flashing checkerboard stimulus while high density VEPs were recorded. The N75, P100, N145 components were analyzed. Preliminary analyses suggest a high degree of similarity between control and ASD groups in early visual processing; both morphology and topography of the waveforms were similar. Lack of differences between groups would suggest that abnormalities in higher order visual processing in individuals with autism are not the result of earlier irregularities as assessed by ERPs.

Design and Construction of a Vacuum Bypass System for Use in the ZaP Flow Z-pinch Experiment

Rachel Oberto, Sophomore, Aerospace Engineering and Physics

Mary Gates Scholar

Mentor: Uri Shumlak, Aeronautics & Astronautics

Stabilizing plasma is the primary focus of the ZaP Flow Z-pinch experiment. For this experiment, the plasma is created in a high vacuum chamber, and the turbo pump used to create and maintain the necessary vacuum level is extremely fragile. The pump can only handle pressures up to about 10 millitorr (there are 760 torr in 1 atmosphere) and below without breaking. The pump has been sufficient in handling a single puff of gas used to create a small amount of plasma. However, one of our current questions is how the amount of gas used affects the plasma created. Designing a bypass system that feeds the gas to the pump in smaller amounts will enable us to study the effect that increasing the amount of gas has on the plasma. The bypass will essentially be a piping system with a conductance matching the pumping speed of the vacuum pump. A throttling valve will be used to control the flow of gas and

ensure that the pump does not become overpressured. The new bypass system will enable us to study the behavior of plasma in greater detail by varying the amount of gas used in its creation.

The Role of Norms: Tracing Environmental Norms in Scandinavia's Education System

Christina Oh, Senior, International Studies

ScanDesign Fellowship

Mentor: Christine Ingebritsen, Scandinavian Studies

As societies confront the negative consequences of industrialization, it has become increasingly important to address environmental problems and manage scarce resources in an efficient and sustainable manner. Scandinavian countries have exercised leadership in environmental policymaking and exemplify how modern developed countries can practice sustainable development by generating and spreading environmental norms in the international political economy. My research will use the Scandinavian education system as its main variable in order to examine how environmental norms are transmitted and then become socialized and internalized in society. This analysis will examine the high level and quality of education in Scandinavia and trace their initiatives in order to integrate environmental knowledge with teaching. The education system's interdisciplinary approach has successfully integrated social networks with environmental education, thus strengthening the environmental norm.

An international comparison of water quality standards

Kiel Rasp, Freshman, Biochemistry

Bedii Altug, Sophomore, Pre-Major (Arts & Sciences)

Eric Guttorp, Pre Architecture & Urban Planning

Ryan Youngman, Sophomore, Physics

Mentor: Peter Guttorp, Statistics

Recently, water has been a growing concern for many people all over the world. What's in our water? Is it safe to drink the water? Is there lead in the water? Some blame this concern on the marketing attempts of international companies introducing bottled water to the public, claiming it to be cleaner than tap water. In reaction to the heightened concerns of the public, many governments consider it their duty to make sure that the public gets quality drinking water. Using the web and libraries as sources, we have researched the laws under which water quality is regulated, and the legal actions taken to maintain a high standard of water quality. In addition to studying the regulations of America, we have attempted to obtain data on water quality on a worldwide scale. By comparing the data found on Washington State and United States, Scotland, Sweden, and Turkey, we hope to find a link between government intervention and water quality levels in order to inform the public of how effective governments can be on this issue. We chose to only use Washington State because

each state has its own laws on top of the federal laws that are in place. We chose Scotland and Sweden as two of our countries to study because they are part of the EU and must abide by their laws and adhere to their standards. Turkey is trying to join the EU and is developing an infrastructure for environmental data collection and standards. Our poster will explore the differences between the countries with respect to who governs and enforces each country's drinking water regulations.

Investigating Anomalous Water Flow on the Microscopic Level

Colin O'Rourke, Senior, Earth & Space Sciences and Physics

Mentor: Gerald Pollack, BioEngineering

Water has shown a remarkable phenomenon when exposed to hydrophilic surfaces – a naturally occurring zone near the surface which excludes any particles in the solution. Upon investigating this exclusion zone, we soon found that one could induce a flow between two reservoirs of initially identical water solutions that were separated by a hydrophilic membrane. Furthermore, by altering the pH of the water on one side of the surface we can dramatically increase, decrease, or even reverse the direction of the flow. My current research is probing the cause of this flow, and the chemical properties associated with it. By approaching the problem from a variety of angles I have been slowly refining my understanding of the chemical and electrostatic forces at work. I believe that within the next few months I should have sufficient data to determine with good confidence the origin of this phenomenon.

Association of the ALDH1A1*2 polymorphism with alcohol expectancies and drinking behavior in Asians

Jacqueline Otto, Senior, Psychology

Mentor: Christian Hendershot, Psychology

Mentor: William H. George, Psychology

Variations in the genes that code for alcohol metabolizing enzymes show different prevalence rates across ethnic groups and are associated with drinking behavior. The *2 allele of the ALDH2 gene, which encodes the enzyme aldehyde dehydrogenase, has been consistently associated with physiological responses to alcohol and drinking behavior in northeast Asian populations. Recently, polymorphisms in the promoter region of a gene coding for cytosolic aldehyde dehydrogenase (ALDH1A1) were identified and linked to alcohol expectancies and drinking behavior in some ethnic groups. However, research is limited to three studies, initial findings have been conflicting, and no study has focused exclusively on Asians. This study examined relationships of the ALDH1A1*2 polymorphism with physiological and behavioral alcohol expectancies and alcohol consumption in a sample of east Asians while accounting for ALDH2 genotype. The sample consisted of Korean (n = 49), Chinese (n = 83), and Japanese (n =

15) undergraduates. Participants provided a blood sample for genotyping and completed web-based questionnaires assessing alcohol use and expectancies. Prevalence of the ALDH1A1*2 allele was 5%, similar to existing studies, and 50% of participants possessed an ALDH2*2 allele. ALDH1A1 genotype was examined as a predictor of alcohol expectancies and drinking behavior while stratifying by ALDH2 status. Among participants with an ALDH2*2 allele, participants with the ALDH1A1*1/*2 genotype reported more positive evaluations of negative and physiological drinking outcomes compared to participants with the ALDH1A1*1/*1 genotype. These differences were not observed in individuals without the ALDH2*2 allele. No significant relationships were found between ALDH1A1 genotype and alcohol consumption. Results from this study provide additional early evidence that the ALDH1A1 gene may relate to expectations of the effects of alcohol. Results further suggest these genotypes may interact to predict drinking phenotypes in East Asians, a possible subject to be tested in future studies.

Experiencing DBT Enhanced BASICS

*Mandy Owens, Senior, Psychology and Biology
Mentor: Ursula Whiteside, Psychology*

There are four main reasons college students drink: the primary two purposes being for social benefits and celebration reasons, the third being to cope with overwhelming or uncomfortable emotions, and the fourth being conformity. Motivational Interviewing approaches have been found to help lower drinking rates and the risky behaviors associated with college drinking through the program BASICS (Brief Alcohol Screening and Intervention for College Students). Dialectical Behavior Therapy (DBT) provides skills to people experiencing overpowering emotions, like those associated with depression and anxiety. The present study examines the drinking behaviors of college students who meet depression and/or anxiety criteria. By adding DBT skills to the already effective BASICS interventions, these students may be more likely to engage in these skills for handling emotions that lead to drinking, which we hypothesize will result in a reduction of drinking and risky drinking behaviors. The underlying therapeutic style of Beyond BASICS is Motivational Interviewing, and one of the main aspects of this style is to elicit “change talk”. If a student talks about changing in some manner during the intervention, it is far more likely that they will follow-through with change. To begin to examine motivation for change, we examined twenty-nine students’ responses to questionnaires following BASICS and DBT enhanced BASICS sessions. These students reported experiencing BASICS just as positively as DBT enhanced BASICS, and reported similar levels of motivation to change. These findings provide initial support for further development and implementation of DBT enhanced BASICS.

New Production in the Equatorial Pacific Ocean

Sharmila Pal, Senior, Chemistry and Oceanography

*Mary Gates Scholar, NASA Space Grant Scholar
Mentor: James W Murray, Oceanography and Chemistry*

Biological Production in the ocean can be broken into Regenerated Production and New Production (NP). The equatorial Pacific contains the world’s largest high nitrate-low-chlorophyll (HNLC) ocean region and produces between 20-50% of global NP (Chavez and Barber 1987). Previous estimations of NP have shown that there is a lot of variability in this region. NP is a crucial subject of study because it is closely related to the export of organic carbon to the deep ocean, which in turn is associated with the global carbon cycle and climate change. In order to investigate the mechanisms behind New Production we conducted a research cruise from Honolulu, Hawaii to Rabaul, Papua New Guinea (August 15, 2006 to October 2006) to answer the following questions: (a) What are the distributions of nutrients in the Equatorial Pacific? ; (b) How much NP is being carried out ? (c) What is the distribution of iron in the Equatorial Pacific ? and (d) What controls the magnitude and variability of NP ? Stations were located along a zonal transect from 140°W to 145°E. A complete set of biological reservoir and rates measurements were conducted. We found: (a) The highest surface temperature was centered at 180° and surface water west of 180° had low salinity; (b) the hydrographic data in the subsurface showed a maximum salinity at a density of 25.5 with the highest values seen south of the equator. Moreover, during the cruise, an El-Nino had started. However, this El Nino started late, ended early and was below average strength. Future research is going to attempt to compare our nutrient zonal section along the equator with historical satellite data for other El Nino and non-El Nino conditions

Over-expression of Epilysin (MMP-28) in the Respiratory Epithelium using Gene Transfer with Adeno-Associated Virus

*Janet Pan, Senior, Biochemistry
Mentor: Anne Manicone, Pulmonary Medicine*

Matrix Metalloproteinases (MMPs) are proteases capable of degrading extracellular substrates and are expressed by cells associated with repair, inflammatory and disease processes. Recent research has shown that MMPs play an important role in inflammation and innate immune responses by activation of antimicrobial peptides, regulation of cytokine and chemokine activity, and directing epithelial cell repair. Epilysin (MMP-28), a member of the MMP family, is constitutively expressed in many epithelial cells; yet unlike most MMPs, epilysin is down regulated during inflammatory responses. Our lab focuses on the expression and function of epilysin in the lung, where it is most highly expressed. In previous studies, we discovered that epilysin inhibits macrophage recruitment to the lung during pneumonia. Mechanisms by which epilysin mediates anti-

inflammatory process is still unknown, and we are trying to uncover epilysin's function through the over-expression of epilysin *in vivo*. We hypothesize that over-expression of epilysin in the lung during pneumonia will result in reduced leukocyte recruitment. To test this hypothesis, we plan to over-express wildtype (WT) or catalytically-inactive epilysin (E/A) using gene transfer with adeno-associated virus. The mutant construct was generated by a single amino acid substitution (GLU to ALA) at position 251 inactivating its catalytic-site. Both constructs were tagged with a V5 epitope at the carboxyl terminus to identify protein expression. After verifying *in vivo* protein expression, we plan to induce pneumonia in mice over-expressing wildtype, mutant epilysin or empty vector. Mice will be sacrificed at various hours post-infection and evaluated for chemokine/cytokine levels, cell differential, and other analysis. We anticipate that mice over-expressing WT-epilysin will have reduced leukocyte recruitment and airway inflammation, affecting severity of pneumonia. Examination of phenotype difference between the models will help us gain insight on the functions of epilysin and how epithelial cells prevent inflammation.

Investigation of Glioma Growth Dynamics through Analysis of Magnetic Resonance Imaging

Shokouh Pardakhtim, Junior, Mathematics

Chunyan Zhou, Senior, Biochemistry

Julia Hamilton, Junior, Music

Mentor: Kristin Swanson, Pathology

Mentor: Russell Rockne, Pathology

Gliomas are brain tumors that grow aggressively and are deadly even with treatments such as surgery, chemotherapy, and radiation. Dr. Kristin Swanson's lab focuses on modeling glioma growth and diffusion using imaging techniques such as MRI. We measure the imaging modalities of T1-gadolinium, T2 and Fluid-Attenuated Inversion Recovery (FLAIR) using MATLAB. T1-gad provides a direct visualization of the neoplastic tissue. T2 and FLAIR enhance the water swelling around the tumor. The model parameters are calculated from the velocity of growth as obtained by measurers from at least two pretreatment scans in this study and the extent of spread as measured on MRI (T2 versus T1Gd). All of these measures come from MRI images which are measured in MATLAB. By measuring the tumor, the volume can be computed and then the parameters (the net proliferation (λ) and net invasion (D)) for Dr. Swanson's model can be calculated. Once the parameters are known, virtual tumors can be compared with real tumors as measured on MRI to assess response to therapy. Virtual tumors can shed light on recurrence patterns and predict survival. This study helps to obtain volume data, from which model parameters are calculated, from which virtual tumors are simulated, from which conclusions regarding therapy and growth patterns can be concluded.

Negative feedback regulation of luteinizing hormone via bovine serum albumin conjugated estrogen

Maile E. Parker, Senior, Neurobiology

Mary Gates Scholar

Mentor: Robert Steiner, Obstetrics & Gynecology

Gonadal sex steroids are critical for the appropriate feedback regulation of gonadotropin releasing hormone (GnRH) and subsequent gonadotropin secretion. Luteinizing hormone (LH), a gonadotropin, is both positively and negatively regulated by estrogen (E) depending upon the current steroid milieu. To exert this control, E is thought to bind its receptors, ER α and/or ER β in the hypothalamus and activate transcription factors that mediate long-term genomic effects. However, a recent appreciation that ERs can also mediate rapid signaling events has begun to change our understanding of this regulation. In the present study, we sought to determine whether the action of E on LH secretion can be mediated via a rapid membrane bound receptor pathway in addition to classical ER signaling. To test whether the effects of E may be mediated through a membrane bound ER, we treated mice with E conjugated to bovine serum albumin (BSA), which is membrane impermeable, and another group with unconjugated E, which is membrane permeable. We report that in ovariectomized mice, which have tonically high LH due to the reduction in endogenous E produced by the ovaries, BSA conjugated E lowers serum LH as effectively as unconjugated estrogen. Therefore, at least some of the actions of E upon LH secretion appear to be mediated through a membrane bound ER.

Predictive Risk Modeling and Applications

Alex Paulsen, Senior, Economics

Mary Gates Scholar

Mentor: Eric Zivot, Economics

The Value-at-Risk framework is the most widely used metric to measure financial risk and exposures. This framework generates a single dollar amount of financial exposure for risk managers, but when capital markets are distressed and accurate risk models are needed most, the precision of the Value-at-Risk risk framework can deteriorate substantially. In order to develop a new risk framework which is robust to distressed capital markets, I focused on finding a financial variable which indicates the level of uncertainty associated with a given market. The implied volatility series for the S&P 500 index (VIX) tracks the variability implied by derivatives contracts on the S&P 500 index (SPX). My research has indicated a strong relationship between the VIX and the SPX which is especially strong when the returns on the SPX are negative. This relationship forms the basis for a new risk management framework which is not subject to the shortcomings of the Value-at-Risk framework. Additionally, due to the persistent nature of implied volatility, accurate short term volatility forecasts can be generated. Given this information, I have been able

to develop a forward-looking risk management model which attempts to predict losses on the S&P 500. Once properly calibrated, this predictive risk management model will be tested against the current Value-at-Risk framework to determine the viability of such a model. Ultimately, the goal of this research project is to present an alternative to current risk management models as well as discuss strengths and weaknesses in the application of such a model.

Spatial monitoring of dissolved Oxygen in Thornton Creek: a study of the factors influencing the water quality

Brett Periard, Sophomore, Biochemistry, North Seattle Community College

Joe Reichert, Sophomore, Rehabilitation Medicine, North Seattle Community College

Iulia Vartolomei, Sophomore, Biochemistry, North Seattle Community College

Jordan deVos, Sophomore, Rehabilitation Medicine, North Seattle Community College

Aisha Khan, Sophomore, Pre-Major, North Seattle Community College

Vanessa Penski, Recent Graduate, Economics, North Seattle Community College

Mentor: Kayln Owens, Chemistry, North Seattle Community College

Mentor: Ann Murkowski, Biology, North Seattle Community College

Gaining a better understanding of the effects due to non-point pollutants in urban watersheds is crucial to ultimately making progress in improving water quality and restoring livable habitats for native aquatic life. Currently, Thornton Creek has several water quality problems including excessive levels of fecal coliform bacteria, depressed dissolved oxygen (DO), elevated temperature, pesticides, and increased nutrient concentrations. Although all of these problems need attention, we are particularly interested in gaining a better understanding of spatial variance in DO levels along the entire length of the creek. Field studies have shown that low oxygen levels can be lethal to many fish, yet a coordinated effort to monitor and understand variance in DO levels along the creek has not been done. In this study, we measured DO concentrations both at the surface and on the stream bed at multiple Thornton Creek sites. We also quantified CO₂ out-gassing using an infrared gas analyzer (IRGA) and nutrient concentrations as a means to explore the causative factors in the spatial variance of DO. Recent monitoring indicates that oxygen concentrations are indeed depressed at the gravel floor of the creek, and show a preliminary increasing trend as the creek progresses towards the mouth of Lake Washington. In line with this trend, both CO₂ out-gassing and nutrient levels indicate a steady decline as the water progresses downstream. This work supports the suggestion that a large coordinated effort is needed to continuously monitor

urban water quality parameters, and that more exploration of the specific impacts of non-point pollutants is needed and will be explored in our future work.

Blist Mobile: The world's easiest database - on the go!

Adam Pflug, Senior, Informatics

Mentor: Batya Friedman, Information School

Mentor: David Hendry, Information School

In some ways simple spreadsheets are the most widely used databases in the world. While they lack most of the features associated with true database management system, their flexibility and ease of use combine to lower the barriers to entry for potential users. This raises the question of whether the ease of use of simple spreadsheets could be combined with the power of more traditional databases. Blist is a new web-based database that aims to do just that, while simultaneously leveraging the collaborative power of computing on the internet. The goal of this research is to develop Blist Mobile, which will take the project step further by bringing these features into the mobile realm. To achieve this goal, contextual interviews were used to identify usage scenarios and requirements for a mobile database application. This information was used to determine what database interactions make sense in a mobile environment (e.g. access, search and some data entry but not schema design, permissions management, etc.) Three potential users were then asked to enter the data for these scenarios in the desktop Blist application, followed by discussion of the issues that could surround the use of the resulting schemas on mobile devices. A round of testing with paper prototypes was conducted to evaluate the initial design and to explore some of the practical restrictions of the medium. This design will be further refined based on the results of the user testing before a second round of prototyping and testing is completed. This second round of prototyping will use a higher fidelity model that is based on web technologies running within the mobile version of Safari. After the second round of prototyping the design will then be finalized and development of a working version of the mobile application based on Apple's forthcoming iPhone SDK will begin.

Investigating the Ubiquitin Lysine Linkage Specificity of the Breast Cancer Protein, BRCA1

TramAnh Phan, Senior, Biochemistry and Biology

Howard Hughes Scholar, Mary Gates Scholar,

Undergraduate Research Travel Awardee

Mentor: Kate Stoll, Biochemistry

Mentor: Rachel Klevit, Biochemistry

In humans, the Breast Cancer Associated Protein 1 (BRCA1) and its binding partner BARD1 have been identified as a tumor suppressor for breast and ovarian cancer. This heterodimer functions as a ligase enzyme in ubiquitination, which is the ligation of ubiquitin (Ub) protein to a substrate protein or to another Ub. A missense

mutation in BRCA1 causes the loss of ligase activity of the heterodimer and is associated with increased risk of breast and ovarian cancer. In the ubiquitination facilitated by BRCA1-BARD1, the Ub conjugating enzyme participating in the pathway determines whether BRCA1-BARD1 enables monoubiquitination or polyubiquitination and which lysine residues on which the Ub chains are preferentially formed. Interestingly, different Ub linkages target a substrate for different cellular fates. Therefore, elucidating the specific chain linkage requirement in ubiquitination facilitated by BRCA1 with different conjugating enzymes provides a better understanding of the mechanism with which BRCA1/BARD1 forms poly-Ubiquitin chains. Subsequently, the results will give a better understanding about the biochemical suppression of breast and ovarian cancer tumorigenesis. In my project, a ubiquitin-fused BRCA1 (BRCA1-Ub74) is used as a simplified model system mimicking a substrate bound BRCA1. The linkages preferentially formed by BRCA1/BARD1 will be identified by mutating each lysine to arginine of the fused Ub one at a time. The ubiquitin ligase activity assay of mutated BRCA1-Ub74 under the presence of different conjugating enzyme is monitored by Western Blot to visualize the products. My results show that the ubiquitination facilitated by BRCA1-BARD1 in conjunction with one of the conjugating enzymes requires a particular lysine residue of the fused ubiquitin.

BARD1: A Structural Perspective in Cancer Development

*Chris Pierini, Junior, Biochemistry
Mentor: Rachel E. Klevit, Biochemistry*

The Breast Cancer Associated Ring Domain (BARD1) constitutively interacts with Breast Cancer Associated protein (BRCA1) in the nucleus to form a stable heterodimer that facilitates the transfer of the small and highly conserved protein ubiquitin to other protein substrates. Little is known about the role BARD1 plays in the cell theater independent of BRCA1. The BARD1 open reading frame is capable of creating several unique alternatives of its full length form called splice variants. One form, -BARD1, contains a unique combination of three domains: The Really Interesting New Gene (RING) domain, an Ankyrin Repeat Domain (ARD), and tandem BRCA1 Carboxy-Terminus domains (BRCT). In contrast to full length BARD1, -BARD1 lacks the BRCA1 interacting domain. -BARD1 has been shown to localize in the cytoplasm and co-purify with CstF-50 which is critical for RNA processing and DNA repair. Furthermore, -BARD1 shows possible tumor suppressor activity. Ovarian cancer cell lines expressing only -BARD1, instead of BARD1, become resistant to apoptosis. My project approaches -BARD1 from a structural perspective. Nuclear Magnetic Resonance (NMR) and X-ray crystallography will be employed to three dimensionally characterize -BARD1 domains. Working toward solving the structure of -BARD1

will provide a plethora of insight of BARD1 independent of BRCA1. Possible mechanisms of BARD1-mediated protein interactions that facilitate the proliferation of cancer cells could be elucidated. Structural and functional aspects for the other splice variants could be extrapolated. Yet the most important component is how the arrangement of -BARD1 domains determines its function in cancer progression.

Localized Reconnection and Plasma Structures at the Magnetopause

*Jennifer A. Porter, Junior, Physics
Mary Gates Scholar
Mentor: Robert Winglee, Earth & Space Sciences*

The magnetopause current sheet is known to have a thickness comparable to an ion gyro-radius. The resultant particle processes, while neglected in magnetohydrodynamics (MHD) models, are the focal point to multi-spacecraft missions such as the Themis and Cluster. Multi-fluid/multi-scale modeling is used to examine the structure of the magnetopause, down to a resolution of 200-300 km. Attention is focused on the southward interplanetary magnetic field (IMF) and places where a non-zero component IMF B_y exists. It is shown that with the inclusion of ion gyro-radius, the reconnection on the magnetopause is very patchy, with a significant (10-20 nT) core magnetic field being generated by the Hall term in the generalized Ohm's law, orthogonal to the incident IMF (even when the IMF B_y component is non-zero). We have demonstrated that the strongest acceleration of particles occurs in the vicinity of the subsolar region, although the reconnection is localized to structures less than 0.5 Re in width and a few Re in breadth, which vary in time and space. A comparison of the signatures of this reconnection is made between equator and polar orbiting spacecraft.

Towards a Proteome Analysis of the General and Virulence-Specific Response of the Plant-Pathogen *Agrobacterium tumefaciens* to Acidic Growth Conditions

*Marianne Powell, Sophomore, Biochemistry and Biology
NASA Space Consortium Scholar
Mentor: Gundula Bosch, Chemical Engineering*

The ubiquitous soil microorganism *Agrobacterium tumefaciens* causes tumors ("crown galls") in a wide variety of plants by transferring a fragment of its tumor-inducing plasmid DNA (Ti-DNA) into the host, and is therefore of agricultural as well as of genetchnological interest. The infection process can be triggered by several inducers, such as phenolic compounds, sugars and acidic pH. Our focus is to get insight into the effects of an acidic environment on the metabolism of *Agrobacterium tumefaciens* in general and on virulence factor expression in particular. First, we are analyzing the proteomic expression profile of a basic physiological state, i.e. cells

grown at pH 7.0. Subsequently, we will compare these data with an acidic, virulence-inducing growth condition (pH 5.5). Since Agrobacterium's genome is considerably large compared to other prokaryotes (genome size 5.67 Mbp, 2 chromosomes and 2 plasmids), its proteome is expected to be very complex, which poses a challenge for modern protein and peptide separation science. To address this problem, we chose a shotgun proteomics approach, which consists of cell lysis and homogenization, protein digestion and 3-dimensional chromatographic peptide separation followed by tandem mass spectrometry. After searching the resulting data against a combined Agrobacterium-human protein database with the help of a search algorithm, the data will be quality-filtered and relatively quantified. By differentiation of the datasets under virulence-inducing and non-inducing conditions we hope to detect key proteins involved in virulence response and compare our results to an existing transcriptome profile. Through this systems biology analysis, we hope to identify candidates for post-translational protein modifications and contribute to a more comprehensive model of Agrobacterium's metabolism.

Implementing Ink Replacement in the Classroom Presenter's Playback Tool

Devy Pranowo, Senior, Computer Science

Mentor: Richard Anderson, Computer Science & Engineering

Classroom Presenter is a Tablet-PC-based interaction system that is used as a classroom presentation tool. It allows the integration of digital ink and electronic slides. This powerful capability is intended to replace conventional whiteboard presentations by instructors and note-taking methods by students. One of the main features of Classroom Presenter is the ability to capture ink written on a slide, store it as an archive and replay the presentation later. The playback system synchronizes the audio and video with the display of the ink images. Users can view the ink being drawn on the slide in time with the instructor's audio explanations. This would enable the flexibility for a student who is unable to attend class to view the presentation with the ink marks at a later time. The playback tool has also been used for distance learning in several institutions in China. My research focuses on exploring and implementing methods to replace ink on the slides and synchronize it to the playback system. A basic usage scenario taken into consideration is that of an instructor cleaning up the ink marks on the slides outside of class. The playback tool increases efficiency by allowing the instructor to remove ink gestures and scratches or replace messy handwriting on the slides at a later time, without messing up the playback system. When revising handwriting, the tool has the ability to recognize when the same word is re-written over an older ink mark of itself. It will replace the drawing of the older word with that of the re-written word at the appropriate time during the replay of the presentation. The features investigated in

this research help to provide new tools to assist instructors in improving classroom presentations.

Robotic Mobility & Rehabilitation: The Semi Autonomously Controlled LIFESUIT Exoskeleton Provides Mobility and Passive Exercise

Monty Reed, Junior, Biosynthetics General Studies

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: Steven Stiens, Rehabilitation Medicine

Mentor: Karen Petersen, Biology

Mentor: John Kramlich, Mechanical Engineering

Robotics has become more popular for use in rehabilitation for passive exercise. Considering the problems of lower limb loss and paralysis, we have fabricated a brace support structure animated by pneumatically driven actuators to mimic gait. We present the current prototype LIFESUIT Exoskeleton Fifteen (LS-XV) from a series of demonstration projects. The LS-XV is designed to walk autonomously while being guided by ÒdirectionÓ from the operator. This allows them to have the mobility of upright walking and the benefit of passive exercise from their legs being moved by the LS-XV. The combination of an autonomous walking robot, the orthosis support bracing that holds the user in the LIFESUIT, and the users control of the LS-XV system results in 'Semi Autonomous' control. The user gives a ÒdirectionÓ via a joystick and the ÒBrain PakÓ onboard control system determines: IF the 'direction' Is safe THEN 'Execute Command' such as ÒWalk ForwardÓ. IF it is Not safe: THEN it will 'Deny Command'. If a patient was to try to walk into a wall the ÒBrain PakÓ will choose to ignore the direction or correct it and 'Execute Command' such as ÒTurn LeftÓ. With the safety of Semi Autonomous Control the LIFESUIT Exoskeleton becomes a viable option for providing passive exercise to patients and astronauts. Implementation of ÒMechanical BalanceÓ allows the robotic suit to balance without electronics or software. Biosynthetic Inner Ear for balance and Biosynthetic muscle fibers as actuators will be explored for future versions of the LIFESUIT Exoskeleton.

Comparison of the developmental time courses of critical genes in the cochlea of two different mouse strains.

Byung Rhee, Senior, Microbiology

Mentor: Olivia Bermingham-McDonogh, Biological Structure

In the past decade, the use of mutant mice in scientific research on hearing has greatly expanded. Often the mutant animals have a variety of distinct strain backgrounds. In our previous studies, we became aware of discrepancies in the cochlear development relative to the developmental stages of mouse embryos across different strains. This strain difference leads to complications when comparing results of particular cochlear gene expression experiments

with those already published. The developmental stage of an embryo is defined according to a set of gross morphological criteria. We observed that, given a well-defined stage of development of embryos, cochleas of different strain backgrounds followed different temporal patterns of gene expression. Previous data showed 1-2 days of developmental delay in the cochlea of CBA mice relative to Swiss Webster mice at the same age. My current work is to compare the gene expression of two different strains: CBA and Swiss Webster at different developmental ages. I examined the developmental time course of cochleas by following the expression of a set of markers, Myosin7A and Prox1 using immunohistochemistry. Myosin7A is a marker of cochlear cells, while Prox1 is an early marker for a set of support cells in the cochlea. Many research groups now employ mutant animals that are on different strain backgrounds, so it is critical to clearly define the time course of gene expression in a particular background. Successful completion of this work will present a valuable asset to the auditory research community.

Evaluation of South Puget Sound Ecological Health through Microbiota Species Analysis

*Paul Richardson, Senior, Earth & Space Sciences
Mary Gates Scholar*

Mentor: Elizabeth Nesbitt, Earth & Space Sciences

The Puget Sound Ambient Monitoring Program (Department of Ecology) has collected sediment samples from 3 primary and 25 rotating stations from South Puget Sound, over the last 10 years. Changes in species density and diversity along with morphological deformation are key to assessing the health of the Puget Sound's faunal community that live at the sediment-water interface. Samples from Thea Foss Waterway, East Anderson Island, and Inner Bud Inlet served as the primary stations of interest in the South Sound for analysis of microbiota (foraminifera, ostracods, and diatoms). Abundance of benthic foraminifera varied drastically on both a temporal and geographical basis. Foraminiferal abundance and species diversity correlated with the degree of other infaunal community taxon-richness. East Anderson Island and Thea Foss Waterway both had high species richness and numerical abundance of macro- and microfauna. Both were able to account for statistically relevant numbers of foraminifera for particular years. Regardless of the significant decrease in heavy metal concentrations in the early 1990s, Inner Bud Inlet had poor infaunal species abundance, and was not able to produce statistically relevant numbers of foraminifera. Over the last 15 years, all of these stations have undergone significant changes in pollutant levels, presence of heavy metals, and taxa abundance and diversity. There were a total of 8 foraminiferal species of both calcitic and agglutinated morphologies present in the South Sound with 5 commonly reoccurring species. These foraminiferal biodiversity results are similar to other estuarial ecosystems such as San Francisco Bay. The

high ratio of agglutinated to calcitic species along with the overall low abundance of foraminifera in the South Sound is indicative of poor ecological health at the sediment-water interface. The specific cause of the flux in species abundance will hopefully be solved through continued analysis of the station data.

They Shall Walk

*Andrew Robinson, Senior, Mechanical Engineering
Mentor: John Kramlich, Mechanical Engineering
Mentor: Monty Reed, Project Executive, They Shall Walk*

The They Shall Walk Project is a non-profit organization founded by Monty Reed. The goal of the project is to develop a powered exoskeleton that will allow the disabled to walk. The benefits of a powered exoskeletal suit over a wheelchair are numerous. With the suit the user could navigate stairs, rough terrain and steep inclines and even jump if they needed to, all while carrying heavy loads. In addition the suit moves the user's legs with it, providing the user with constant physical therapy. This physical therapy would help the user become less dependant on the suit over time. There are currently 14 working prototypes called LIFESUITS, these models work well within their scope but are cumbersome and difficult to use. With further research it is expected that newer models will become smaller, lighter and more user friendly. Ideally the suit would ultimately fit under a person's normal clothing. The current models use a manually triggered pneumatic cylinder system, which is to be replaced by a computer controlled pneumatic system in the next prototype which is already being developed. This will greatly improve the user interface, to the point that anyone can use the suit. Also study is being done using computer models to produce more advanced exoskeletal structures. With this research the new generations of the suit will use better materials, be stronger, more reliable, have a longer range, and be smaller and lighter.

Creation of a *ura3 auxotroph* and determination of ploidy and mating types in *Kluyveromyces waltii*

Lisa Rolczynski, Senior, Biochemistry

Mary Gates Scholar

Mentor: Bonny Brewer, Genome Sciences

Mentor: M. K. Raghuraman, Genome Sciences

Mentor: Kim Lindstrom, Genome Sciences

Kluyveromyces waltii is a particularly interesting, yet uncommonly studied, strain of yeast. It shares a common ancestor with *Saccharomyces cerevisiae*, a widely used and well-established model organism. At some point along its lineage from the ancestral species, *S. cerevisiae* underwent a duplication of its entire genome. Though most of the duplicated genes were reduced to one copy, much of the order of the remaining genes still resembles *K. waltii*, allowing us to identify evolutionarily related regions between the species. Our lab is interested in how origins of replication—sites on chromosomes where replication

begins—have evolved since the divergence of the two species. Currently little is known about *K. waltii*: there are no genetic markers, and even its ploidy and mating system are uncertain. I have two projects aimed at turning *K. waltii* into a model organism. The first project is to create a *ura3* auxotrophic mutant (unable to synthesize uracil, requiring a supplement). This task involves cloning the URA3 region into *E. coli*, creating a deletion within the gene, and then reincorporating the mutated gene back into the *K. waltii* genome through recombination. Once we have a *ura3* mutant, we can use the wild type URA3 gene for transformation experiments to further manipulate *K. waltii*'s genome. The second project is to determine the ploidy and mating system in *K. waltii* (more specifically, whether we have a haploid a or a strain, a mixed haploid population, or a diploid), and if possible, to isolate and maintain a specific population. Once we have an a haploid strain we will be able to manipulate the growth of *K. waltii* (by treating cells with the appropriate mating pheromone) to study chromosome replication during the S phase of the cell cycle and be able to compare *K. waltii*'s origins of replication to those of *S. cerevisiae*.

Identification of Essential Genes in *Azotobacter vinelandii* DJ

James Rosser, Senior, Biology, Seattle Pacific University
Mentor: Derek Wood, Microbiology, Seattle Pacific University
Mentor: Kathryn Houmiel, Biology, Seattle Pacific University

Azotobacter vinelandii is a Gram-negative soil-borne bacterium that fixes nitrogen aerobically. This bacterium also has a number of industrial applications including the production of pharmaceutical grade alginate and bioplastics. We recently completed sequencing the 5.36-Mb genome of *A. vinelandii* DJ. The availability of these sequence data allowed us to implement a novel high-throughput screen to investigate the function of proteins in this genome. Specifically, we have set a goal to identify essential genes under nitrogen-limiting conditions. Several previous studies have reported that *A. vinelandii* maintains between 40 and 80 identical copies of its genome per cell depending on growth conditions. Genetic studies in this organism have shown that mutations in essential genes are maintained in a heterogenomic state while mutations in non-essential genes will become homogenomic after chromosomal segregation. These observations form the basis for our screen. To address our goal, an 8000 member Tn5 mutant library has been constructed in *A. vinelandii* DJ. Using a two-step high throughput screen, we identified 1082 mutants in essential genes under nitrogen limiting conditions. Fifty of these mutants have been confirmed and the locations of the Tn5 inserts have been identified. The success of this assay indicates that essential genes can be identified under a variety of conditions that affect this model organism's biology.

Evolution and Population Genetics of microRNA in Humans

Kimberly Sacha, Senior, Mathematics
Mentor: Joshua Akey, Genome Sciences

MicroRNAs (miRNAs) are a recently discovered class of non-protein coding RNA genes that serve as regulators of gene expression. Currently, over 400 miRNAs have been identified in the human genome. Previous research has focused on miRNA identification and functional characterization. Considerably less work has been done on understanding basic issues related to the population genetics and molecular evolution of miRNAs, which was the focus of our research. I have written a computer program which found single nucleotide polymorphisms (SNPs), a type of genetic variation, in microRNA precursor and mature regions. I also wrote a program that parses the SNP database results to identify frequency data for the SNPs in microRNA. We are using the results of these two programs to find interesting and important microRNA for further study. Next we will sequence between five and eight interesting genes in geographically diverse populations to determine allele frequency distribution. Alleles are the points of variation in the RNA sequence and their frequency distribution tells us how often the variation occurs in the population. Then we will run an RNA folding program to determine the optimal folding structures for miRNA and estimate their Gibbs Free Energy (G) levels. The smaller this value is, the more stable the molecule will be. In calculating G we can determine if the aberrant alleles are likely to be deleterious to the organism. Sequencing and RNA folding analysis will allow us to infer more about the evolution of miRNA and their role in disease. So far, we see that levels of genetic variation in miRNA regions are significantly less compared to non-functional regions and we interpret a reduction in genetic variation as evidence for functional constraint. Thus, we hypothesize that polymorphisms in miRNA regions tend to be deleterious and rapidly removed from the population by purifying selection.

Cp18-FGAL4: DNA construct for tissue-specific gene expression during oogenesis in *Drosophila melanogaster*

Atriya Salamat, Biology (Physiology)
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Celeste Berg, Genome Sciences

Tube formation is a critical part of development and leads to the formation of many of our organs. Imperfections in this process cause defects in about 3% of live births each year. To develop diagnostic tools and potential treatments, we first need to understand the process. We use dorsal appendage (DA) tube formation in *Drosophila melanogaster* as a model system to study tube formation. DAs are extensions of the *Drosophila* eggshell that assist the embryo in getting access to oxygen. Egg development

in D.melanogaster has 14 stages and DA tubes start to form after stage 10. To study the role of different genes in DA tube formation, I developed a new tool, Cp18-FGAL4, which will let us express any gene only in the female fly ovary (where eggs are produced) and only in stages 13-14. This tool allows over-expression or mis-expression of genes, to test gain of function, and expression of RNA-interference constructs that reduce gene function. Since genes are used repeatedly in development, Cp18-FGAL4 will let us investigate potential effects specifically on DA formation.

LERIXHelper: Who Couldn't Use a Little Help at the Synchrotron X-ray Lightsource?

Carin Schlimmer, Junior, Physics

Mentor: Gerald Seidler, Physics

The Lower Energy Resolution Inelastic X-ray Scattering Spectrometer (LERIX), stationed at the Advanced Photon Source in Argonne, Illinois, provides researchers with a new method for studying the electronic and molecular structure of materials. By measuring inelastic x-ray scattering (IXS) simultaneously at nineteen different scattering angles, LERIX offers clearer pictures of the available final states for excited electrons and of the related electron-determined properties like thermal conduction and chemical reactivity. Given this ability to measure fundamental properties of materials, LERIX's fields of application cover most sciences, and its studies range from atmospheric airglow to boron carbide, the second-hardest material on earth, to Li-ion battery cells. To make LERIX more accessible to those in other disciplines and speed up the initial data processing, I created LERIXHelper. Our group's current data analysis software is written in Mathematica, a language little-used outside of physics. To reach other researchers, I wrote the application in the more commonly-used Matlab and its freeware cousin Scilab. LERIXHelper begins analysis by calibrating for energy loss, then normalizes, bins, and averages the data, using Poisson statistics and saving any data needed for future analysis into data files. At user request, LERIXHelper averages data across specified scattering angles. LERIXHelper offers several options for user-specification of data analysis procedures, making it easy to customize the application for a particular project. The Matlab version includes a comprehensive GUI. My group has already used LERIXHelper with much success during data collection runs and has installed a copy for use at LERIX's x-ray beamline in Argonne. Further expansions of the application include correction for systematic errors and background subtraction, making LERIXHelper even more valuable to LERIX users.

Water Properties in Quartermaster Harbor, Puget Sound: Past and Present

Kelly Scholting, Senior, Environmental Science, UW Tacoma

Mentor: Cheryl Greengrove, Interdisciplinary Arts & Sciences, UW Tacoma

Puget Sound has a long history of paralytic shellfish poisoning (PSP). Over the last four decades there has been an increase in toxic outbreaks in Puget Sound. The primary organism that causes PSP in Puget Sound is a dinoflagellate called *Alexandrium catenella*. *A. catenella* produces saxitoxin, which is the toxin that is absorbed by shellfish and causes PSP if shellfish are eaten by humans or animals. Part of *A. catenella*'s life cycle is spent as a cyst in the sediment and the other part is spent in the water column. Due to the increase in PSP outbreaks in Puget Sound a survey of Puget Sound sediments was done in 2005 to determine the distribution of *A. catenella* cysts in Puget Sound. The results showed that the concentrations of *A. catenella* cysts are two orders of magnitude higher in Quartermaster Harbor (QMH) than any other location in Puget Sound. To learn more about the environmental conditions in QMH where *A. catenella* appears to thrive, a water property and plankton study was undertaken from October 2006 to December 2007. Water samples were collected from seven stations on a longitudinal transect through QMH monthly. Data collected at each station included continuous CTD profiles and discrete water samples for dissolved oxygen, chlorophyll and nutrients. Discrete water samples were collected near the surface, near the bottom and at the pycnocline (during summer months) using a niskin bottle. Results showed that August of 2007 has the most optimal growing conditions for *A. catenella*. In addition, all water property results for each month from October 2006-December 2007 are presented here.

GEMA: Graphical Event Mapping Application

Benjamin Schwartz-Gilbert, Senior, Informatics

Ryan Musgrave, Senior, Informatics

Devyn Jones, Senior, Informatics

Mentor: Batya Friedman, Information School

Mentor: David Hendry, Information School

The existence of a social event is, most times, spread through word of mouth from person to person. However, this method of information transmission can often be far from perfect. In order to address this problem we aimed to construct a web-based application that followed Edward Tufte's Design Principles to present event browsing and mapping capabilities, focused on a user's desired geographical location. Our Graphical Event Mapping Application (GEMA) began with a requirements gathering survey conducted over a college student population at the University of Washington, yielding 96 usable results (average age of respondents 21.8). This survey sought to determine the informational criteria that college students consider before deciding to attend a music concert. We chose to focus on concerts of touring artists as our initial scope because data for these events is plentiful and would provide a good starting point consistent with the interests of our target population. The results showed us that the main artist, the price of tickets, and the genre of

music were the most important aspects when deciding to attend a selected concert. These and other findings were used to steer the initial layout, design, and presentation of both the information and features for browsing and dynamically searching for events. We iterated through several paper prototypes. Currently, we are developing a working prototype. Finally, we plan to perform a usability evaluation of our prototype and draw conclusions about the effectiveness of the design.

Increasing Program Awareness Among College Students: How to Get Noticed

*Josef Serpe, Senior, Marketing
Mentor: Reza Moinpour, Marketing*

Organizations and institutions continually seek the most effective means of communicating and recruiting college students into their programs. This study examines the most commonly utilized means of outreach to students and the effectiveness of those methods. The focus is on the Carlson Center at the University of Washington and the issues surrounding their communications with the student population and the student's awareness of the mission of the organization and the services available to them via the volunteer programs. A survey was conducted with a representative sampling of University of Washington students and the results were analyzed for several factors surrounding interest levels, gender, reasons for selecting programs, and methods by which students receive information on campus. This study attempts to answer the questions: How can organizations most effectively reach college students? And once they are reached, how can they most effectively communicate their message? It was shown that students are most receptive to the message when it appeals to their area of interest, stresses how it can improve them both personally and professionally, and allows for time flexibility. In addition, it was discovered that there is a link between the specific communication methods employed and awareness of individual programs.

Self-Assembled Flexible Micro-Displays on Plastic Substrates using Inorganic LEDs

*Sunny Sharma, Senior, Electrical Engineering
Mentor: Ehsan Saeedi, Electrical Engineering
Mentor: Babak Parviz, Electrical Engineering*

Via the process of self-assembly, we are developing a protocol for constructing a truly flexible micro-display on plastic. The motivation behind flexible displays is the increase in its demand for various applications in athletic equipment, clothing, commercial 3D displays, and flexible electronic papers. Current flexible display technology involves the use of organic LEDs (Light Emitting Diodes) on plastic, which have significantly lower reliability, performance, and lifespan when compared to inorganic LEDs. The fabrication process of inorganic LEDs generates complications because of its thermal and

chemical incompatibility with common flexible substrates such as plastics. To overcome this issue, free-standing inorganic LEDs are fabricated and then integrated onto display substrates, which include electrical connections and are 100 micro-meters thick. This is accomplished via self-assembly process. The process of self-assembly involves a plastic template onto which LEDs self-assemble. Binding wells are fabricated directly on the template onto which LEDs attach during the process. The wells are submerged into a bath of molten solder that assists in the formation of stable electrical and mechanical connections between LEDs and the substrate upon contact. Once the plastic template is placed in a fluid at an angle of 30°, LEDs are released so they can self-assemble onto the plastic substrate with the help of external agitation. Flexible displays are considered to be one of the most groundbreaking technologies introduced in the past decade. The displays revealed by major companies in the past are fairly rigid, susceptible to failure, and are very expensive to manufacture. However, self-assembly process can be used to produce large, inexpensive flexible displays. Our protocol outlines the fabrication of functional free-standing LEDs, plastic substrates with electrical interconnects, and the self-assembly process required to attach the LEDs onto the plastic substrate. The cost-effective nature of the self-assembled flexible display can possibly lead to future commercialization.

LERIX-2: A Larger Slice of Pi

*Alicia Skilton, Junior, Mechanical Engineering
Mary Gates Scholar, Morrison Scholar, NASA Space Grant Scholar
Mentor: Gerald Seidler, Physics*

The Lower Energy Resolution Inelastic X-ray scattering (LERIX) spectrometer was designed and built at the UW, and is now the world's premier instrument for studies of the inelastic scattering of x-rays from the core shell electrons of light elements or the less tightly bound electrons for heavy elements. It is now located at the Advanced Photon Source x-ray synchrotron at Argonne National Labs. LERIX measurements are providing previously inaccessible information about the local electronic properties of solids, glass, and crystals. Early studies with LERIX span basic physics, environmental sciences, geophysics, pharmaceutical development, battery and solar cell technology, and fuel-compounds for nuclear reactors. The 19 high-efficiency analyzer crystals on the LERIX spectrometer collect about 40 times more scattered radiation than the best prior user-available instrument; however there are still many important problems where even LERIX does not provide sufficient counting rates for a reasonable study. To collect more of the scattered x-ray radiation I have been designing LERIX-2. Instead of the 19 spherical analyzer crystals on LERIX, LERIX-2 will have over 300 analyzer crystals allowing it to detect more

than 10 times the scattered radiation of the current LERIX x-ray spectrometer. In order for LERIX-2 to be built and transported, LERIX-2 has to be made up of pieces which are small enough to machine, but it also needs to be possible to assemble the spectrometer in a reasonable amount of time. To deal with these challenges I have used CAD software to design a support structure which includes 30 interlocking pieces which bolt together, each of which must use 5-axis machining in its manufacture. En route to this design, I have also solved several other short-comings of the original LERIX design, which would further improve the ease of use and reliability of LERIX-2 with respect to its predecessor. Preliminary machining and assembly of a prototype, 6-foot diameter hemispherical support structure for LERIX-2 has begun.

Effect of Biosolids Application and Septage Applied to Biosolids on Douglas-Fir Tree Stands Twenty Five Years After Application

*Jeff Smith, Junior, Environmental Science, UW Tacoma
Mentor: Erica Cline, Interdisciplinary Arts and Sciences, UW Tacoma*

Biosolids were applied to Douglas-fir *Pseudotsuga menziesii* tree stands in the Charles L. Pack experimental Forest located near Eatonville, WA. It was determined whether stands historically treated with biosolids and application of septage to biosolids twenty-five years after initial biosolids application, would show significant increases in DBH, height, and live crown ratio over a control. In addition annual growth increment was observed in 5 year intervals during the period before septage application. Moreover, septage application to biosolids in 2006 was observed for annual growth increment when compared to a control. Pelletized biosolids were applied in 1982 (103,782 Mg ha⁻¹). Effects of biosolids on DBH and height was determined to not be significantly different. Live crown ratio (ratio of total tree height to total foliar growth) was significantly greater in control plots, but to little extent. Tree ring analysis indicated reduction of annual growth increment with application of septage (133,380 gallons ha⁻¹) to biosolids in 2006, but the difference was not significantly different. On the other hand, mean annual growth increment seemed to be greater in biosolids plots than in controls in each five-year period before septage treatment, but these differences were determined not to be significant. Application of biosolids did not significantly increase growth response measures. The absence of a significant growth response with application of biosolids and application of septage to biosolids is of particular interest. It warrants further study.

Calculation and Analysis of the Rate of Diffusion of Gliomas

*Rita Sodt, Senior, Computer Science
Mary Gates Scholar
Mentor: Kristin Swanson, Pathology*

Gliomas are highly diffuse and invasive brain tumors that are notorious for their recurrence following all forms of therapy. These tumors often recur because even the most advanced medical imaging is unable to detect the entire portion of cancerous cells. Our research aims to mathematically model and predict the growth and invasion of gliomas in a three dimensional virtual brain using data collected from MRI's. There are multiple ways that a tumor's velocity of growth can be calculated. One is to calculate the volumetric velocity of the tumor by measuring its volume at two different dates, and the other is to calculate the velocity by finding the distance between the visible tumor surface from an image at time one to a corresponding image at time two. My research aims to develop, compare and contrast these methods of calculating the velocity of tumor growth. These techniques will allow us to separate tumor velocity into its velocity moving through white brain matter versus gray brain matter. Adding this complexity to our data will enhance our understanding of tumor growth and make the testing of our mathematical model more accurate.

Exploring the host-pathogen relationship of the black abalone (*Haliotis cracherodii*) and the Rickettsiales-like prokaryote responsible for Withering Syndrome

*Stephannie Spurr, Senior, Aquatic & Fishery Sciences
Cullen Taplin, Senior, Aquatic & Fishery Sciences
Mentor: Steven Roberts, Aquatic & Fishery Sciences*

In the mid-1980's, mass mortality in populations of black abalone (*Haliotis cracherodii*) were first observed along the California coast. The mortalities were attributed to withering syndrome, a disease caused by an intracellular Rickettsiales-like prokaryote (RLP), *Candidatus Xenohaliotis californiensis*. The RLP is associated with an inhibition of digestive enzymes that leads to starvation and atrophy of the muscular foot. The abalone RLP shares some aspects of each tribe in order Rickettsias, but when compared phylogenetically, RLP falls out into its own distinct group. There is limited information on the physiology of this pathogen and nothing is known about the interaction it has with the abalone at the molecular level. The objective of this research is to examine the relationship of RLP pathogenicity with abalone immune response by characterizing gene expression patterns in two strains of abalone exposed to RLP. One strain has demonstrated putative resistance to RLP, while another is historically naive to Withering Syndrome. To identify candidate genes involved in RLP pathogenicity, multiple sequence alignments were generated with similar taxa and degenerative primers were designed to amplify transcripts from RLP. In order to identify immune-related genes in the black abalone, expressed sequence tags from other species of *Haliotis* were functionally annotated and used to design primers for PCR amplification. PCR products were sequenced and identified using sequence comparison techniques (i.e. BLAST). Some of the genes identified in

black abalone include catalase, rab7, and a toll-interacting protein. RLP genes, such as a putative outer membrane protein (OMP) were also characterized. Quantitative RT-PCR was carried out on select genes to determine if expression levels were correlated with pathogen load and RLP gene expression patterns. Different gene expression patterns were observed across samples analyzed. These data provide insight into the complex host-pathogen relationship of abalone and the causative agent of withering syndrome.

Isolation and Characterization of Xylose-utilizing Yeasts and Filamentous Fungi for Bioethanol Production

*Juliana Suarez, Senior, Microbiology
Mentor: Dean Glawe, Forestry*

Efficient, renewable and clean alternative sources of energy are urgently needed. The search for new sources of energy has gained momentum in recent years as a response to the petroleum crisis and the need to protect the environment. The purpose of my research project is to find organisms capable of fermenting xylose for bioethanol production. Xylose is a five carbon sugar that is very abundant in forest and agricultural products (lignocellulosic feedstock). Although xylose-containing materials are renewable and cheap to obtain, not all organisms can use or ferment xylose. To be industrially viable, fermenting organisms must produce significant ethanol yields but also must tolerate the various metabolic byproducts (including ethanol) produced in fermentation. For my project I isolated naturally-occurring yeasts and fungi from different sources and assessed their ability to utilize and ferment xylose for bioethanol production. I isolated microorganisms using different media and growing conditions and recovered several different organisms. Two strains of yeast and two strains of filamentous fungi were chosen for further study because they ferment ethanol, resist toxic effects of metabolic byproducts and are easy to culture. After confirming their ability to utilize xylose, I measured ethanol production using a PerkinElmer TurboMatrix HS Trap with the Clarus 500 GC/FID. Based on these results the best ethanol producers were characterized using both morphological features and rDNA sequence data.

Examination of sand units in Sinclair and Dyes Inlets may provide clues to past tsunami events

*David Sullivan, Senior, Earth & Space Sciences
Mentor: Jody Bourgeois, Earth & Space Sciences*

The focus of this project is to differentiate the sources of two sand units in Sinclair and Dyes Inlets; are they tsunami or river deposits, and when were they deposited? Both inlets are branches of Puget Sound lying 22 and 20 km west of Seattle respectively. At the head of both inlets are intertidal mudflats fringed by varyingly urbanized tidal marshes and alder swamps. Tools used during the

course of this project include mapping the thickness, elevation and extent of deposits; describing sedimentary structure; analyzing grain size; and radiocarbon dating. The sand unit in Sinclair Inlet has been studied in more detail, and is likely from a Puget Sound tsunami, but other mechanisms, such as debris flows, are possible. Cores and pits in the wetlands at Sinclair Inlet reveal an abrupt upward change from tidal flats to forest probably resulting from uplift. The unit consists of silty fine sand, has a sharp contact with shelly mudflat deposits below, and a sharp to gradational contact with overlying peat. A possibly related sand unit is found away from the inlet, up the valley in the banks of Gorst Creek, and in pits at a nearby park. While numerical tsunami models suggest that a tsunami could have made landfall in both inlets, the sand units studied at Dyes Inlet have so far only shown evidence of stream migration. Investigation of this area is ongoing. Regardless of what else the Dyes Inlet deposits may reveal, study of these units may be useful, by comparison and contrast, in the identification of the sand unit in Sinclair Inlet. The importance of this project lies in the close proximity of tsunami deposits and populated areas.

Adolescent Health and Educational Attainment

*Mindy Szeto, Senior, Sociology and Biochemistry
Mary Gates Scholar
Mentor: Charles Hirschman, Sociology*

Higher education is the primary gateway to economic success and mobility in modern industrial societies such as the United States. The transition from high school to college is especially important, as most students set definitive goals regarding post-secondary schooling by their senior year of high school. However, not all seniors who plan to attend college immediately after graduation are successful in doing so. We investigate the influence of adolescent health on educational attainment, calling attention to the impact of health on students' academic performance and social connections in school. Specifically, we consider self-assessed health, risk behaviors, and access to healthcare as possible explanations for variation in the realization of college plans. In accordance with a life-course approach, we also examine the relative contributions of social status categories – gender, race, ethnicity, and socioeconomic status - as predictors of health. Survey data from a longitudinal study of high school seniors in Washington State are analyzed, with emphasis on responses to follow-up surveys that report post-graduation school enrollment. By exploring the associations between adolescent health and the attainment of higher education, we hope to achieve a greater understanding of the implications of exposed health inequalities at this critical stage in the life-course.

High-frequency Focal EEG changes preceding Epileptiform Discharges in Focal and Generalized Epilepsies

*Amir Talebiliasi, Junior, Neurobiology and Mathematics
Mentor: Shahin Hakimian, Neurology, Regional Epilepsy Center*

Generalized onset seizures, such as absence seizures, are thought to involve aberrant circuits involving the cerebral cortex and thalamus. These connections may be similar to sleep related circuits, and in particular, circuits involved in generation of specific EEG features of sleep: sleep spindles and K-complexes. We investigated this relationship by comparing the high-resolution distribution of EEG activity from generalized seizures. High-resolution scalp EEG data were recorded using a 256 Channel EGI equipment at 500 or 1000 Hz after appropriate filtering. EEGs from 30 subjects with focal onset epilepsy, and 15 with generalized epilepsies were available for analysis. Spikes/sharp waves were identified after screening each study based on a 10-20 average referential montage. Quantitative EEG analysis was made with MATLAB software package and EEGLab toolbox (UCSD). Spikes belonging to one class/patient were aligned to the first fast rising portion of a spike and wave complex. Average scalp potentials across spikes, peri-event spectral power maps of EEG across spikes, and scalp location specific time frequency decomposition of spikes were computed for a period of 5 seconds before and after each spike. We could reliably measure event related spectral changes across specific EEG channels as proposed.

Understanding Personal Electronics Recycling Among Students at the University of Washington

*Kitty Tang, Senior, Informatics and Computer Science
Anh Tran, Senior, Informatics and Sociology
Garry Wong, Senior, Informatics
Mentor: Batya Friedman, Information School
Mentor: David Hendry, Information School*

Where do personal electronics go when they are no longer used? In this information age, personal electronics, such as computers, cell phones, mp3 players, laptops, game consoles, and many other electronic devices are constantly becoming obsolete and left behind as e-waste. A serious problem is when e-waste is improperly handled and disposed haphazardly into the environment. E-waste contains lead, cadmium, mercury, and other toxic substances that cause various environmental and health concerns. Every decade, the University of Washington Properties and Transport Services conducts a study about campus generated waste. Unfortunately, e-waste was not a primary focus of their last study in 2004. To gain insight on how serious the problem of e-waste is for college-aged students, this study investigates what students do with outdated, broken, or unused personal electronics. Data was collected from 300 graduate and undergraduate students at the University of

Washington through electronic and paper surveys. Results will be analyzed to determine how students dispose of their personal electronics and their reasons for doing so. The outcome of this study will influence the initiation of an e-waste recycling program for future students at the University of Washington.

Cognitive Impairments in Patients Diagnosed with Fibromyalgia Syndrome, Systemic Lupus Erythematosus, and Rheumatoid Arthritis

*Anique Thieme, Junior, Psychology
Mentor: Dennis C. Turk, Anesthesiology
Mentor: Gromnica-Ihle E, Anesthesiology
Mentor: Herta Flor, Cognitive and Clinical Neuroscience, University of Heidelberg, Central Institute of Mental Health, Germany
Mentor: Kati Thieme, Cognitive and Clinical Neuroscience, University of Heidelberg, Central Institute of Mental Health, Germany*

The present study evaluated fibromyalgia syndrome (FMS), systemic lupus erythematosus (SLE), and rheumatoid arthritis (RA) patients for the presence of cognitive impairments as well as the contributions of demographic, physical, pain and stress, affective, and cognitive variables to the occurrence of cognitive impairments. thirty-seven FMS, 27 systemic lupus erythematosus (SLE), 26 rheumatoid arthritis (RA) patients, and 20 healthy controls (HCs) underwent a standardized neuropsychological dynamic test battery to determine the presence of deficits in concentration, memory, psychomotor speed, cognitive interference, learning and recall. Pain intensity, fatigue and sleep disorder were assessed. Further, endocrine variables (ACTH, and Cortisol) were collected. Patients and HCs with mood disorders were excluded. FMS and SLE patients showed significantly more cognitive impairments than RA patients and HCs. FMS patients demonstrated significantly more concentration and SLE patients more memory deficits. Impairments in psychomotor speed and complex attention were not different between FMS and SLE patients, however, both groups showed significantly worse cognitive abilities than RA patients on all measures except for psychomotor speed. Short-term concentration ability in FMS was negatively correlated with reported sleep disorders ($r = -0.54$) and ACTH ($r = -0.55$). Memory ability in SLE patients was negatively associated with reported fatigue ($r = -0.81$). The results support the presence of significant cognitive deficits in FMS and SLE patients compared to RA patients and healthy controls. While the correlation of cognitive impairments and fatigue in SLE suggests immunological influences, the correlation of cognitive impairment and ACTH influencing sleep quality in non-depressed FMS patients implicates the involvement of endocrine influences on the central nervous system in neuropsychological functioning.

Characterization of ubiquitin-ribosomal protein fusions in *Saccharomyces cerevisiae*

James Thornton, Junior, Biology (Molecular, Cellular, and Developmental) and Sociology

Mary Gates Scholar

Mentor: Stanley Fields, Genome Sciences

Post-translational protein modification is an essential process to life. A common and well-characterized form of modification is ubiquitination, in which the 76 amino acid protein ubiquitin is attached to a target protein. Protein ubiquitination is a multi-step process in which ubiquitin is covalently linked to the epsilon amino group of a target lysine by a three-enzyme cascade. Ubiquitin is encoded by four genes in the budding yeast *Saccharomyces cerevisiae*, three of which express protein fusions between ubiquitin and ribosomal proteins. The fusions are subsequently cleaved post-translationally. This ubiquitin-ribosomal protein arrangement is highly conserved from yeast to humans, and is important in ribosomal biogenesis, as removing the ubiquitin portion of the gene leads to reduced growth rates. Despite the importance of this arrangement, the roles of these fusion proteins remain unknown. We hope to understand what features of this system are most important for function in the cell, why this arrangement is so highly conserved, and which enzymes are responsible for cleaving the peptide bond between ubiquitin and the particular ribosomal proteins. To address these questions, I generated variants of one of these fusion proteins, Rps31, and tested their ability to rescue the chromosomal deletion of the wild-type fusion. Using this method, I determined several features of the protein fusions that are essential. When this fusion is rendered uncleavable, the cells show a dramatic slow growth phenotype, indicating that the removal of ubiquitin from the fusion is important for normal function. However, when in addition to this mutation, a mutation was made that eliminates a conserved amino acid important for ubiquitin binding, I observed wild-type growth. This result suggests that an unknown ubiquitin binding protein is interacting with the ubiquitin-ribosomal protein fusion to facilitate some step in ribosome biogenesis. Understanding detailed steps in the processing of these fusion proteins will reveal insight into an important basic cellular process.

Nine Reasons Why: Giving Homeowners Nine Good Reasons to Demand Greener Building Materials and Home Furnishings from Manufacturers

Rose Thornton, Senior, Community, Environment, and Planning, Program on the Environment

Mary Gates Scholar

Mentor: Martin Westerman, Business

Mentor: Michael Reese, Program on the Environment

Many homeowners are not well-informed of the dangers and consequences of using particular traditional building materials and furnishings in their homes. For

my culminating Program on the Environmental project, I explored the effects of interior design and remodeling choices on occupant health, environmental sustainability and economic viability. I gathered information from a variety of government agencies, non-profits, third-party certifiers, and private companies, focusing my inquiries on insulation, flooring, wall color, cabinetry, and countertops. For each of these building materials and furnishings, I investigated the impacts of their production, transportation, installation, use, and disposal, and then compared companies that claim to be offering greener alternatives. In collaboration with Alicia Silva, owner and founder of Synergy Design Studio, a Seattle-area green interior design firm, I wrote of a series of informational pamphlets titled “Nine Reasons Why” that cite specific, measurable, close-to-home reasons why consumers must demand “greener” products. In these pamphlets, I argue that consumers must factor in the negative externalities when they exert their buying power and consider that investing in greener products now is in fact much less costly than traditional products to individuals and societies in the long run.

Effects of Tone Level and Signal-to-Noise Ratio on Neural Encoding

Wendy Tolin, Senior, Speech and Hearing Sciences and French

Mentor: Kelly Tremblay, Speech and Hearing Sciences

Mentor: Curtis Billings, Speech and Hearing Sciences

Little is known about the effect of hearing aid amplification on the central auditory system (CAS). One way of measuring the effects of auditory stimulation on the brain is to use electroencephalography (EEG). We have used time-locked averaged EEG activity (also called evoked potentials) to examine the effects of hearing aid amplification but found no differences between unaided and aided brain responses. Because animal studies demonstrate that evoked brain activity is affected by signal-to-noise ratio (SNR), we questioned if the absence of amplification effects reported earlier was in part due to SNR changes introduced by the hearing aid. In other words, when the signal was amplified by the hearing aid, ambient noise was amplified as well. We therefore hypothesize that signal-to-noise ratio, rather than absolute signal level contributes to evoked brain activity. To test this hypothesis, we recorded cortical auditory evoked potentials in 15 normal-hearing subjects using a signal-in-noise paradigm. Two tone levels, (60 and 75dB) and six different signal-to-noise ratios, (quiet, 20, 10, 0, -5, -10dB) were used. By varying the tone and noise levels, we could determine contributions of tone level and SNR to the evoked response. We measured the latency and amplitude of cortical auditory evoked potentials P1, N1, P2, and N2. Our data shows that auditory evoked brain activity is most sensitive to changes in SNR, rather than absolute stimulus tone levels. These findings support our hypothesis; therefore, background noise must be considered when recording cortical auditory evoked responses in hearing aid users.

Habitat Fragmentation Affects Herbivory of a Model Plant Species *Solanum americanum*: Preliminary Results

Nash Turley, Senior, Biology (Conservation and Environment)

Mary Gates Scholar

Mentor: Joshua Tewksbury, Biology

Habitat fragmentation is a primary threat to biodiversity. It negatively affects plants and animals by decreasing effective habitat area, reducing dispersal and gene flow, and increasing edge-to-area ratios of remaining habitat. These consequences of fragmentation can significantly alter plant-animal interactions, including insect herbivory. To test this, 640 seedlings of an early succession annual (*Solanum americanum*) were planted in plots located in experimentally fragmented landscapes that control for patch area, connectivity, and edge-to-area ratios. Plots were spaced at varying distances from edge to elucidate edge effects. Levels of insect herbivory on leaves were monitored throughout the growing season. Preliminary results suggest that patterns of insect damage correlate positively with distance from edges in habitat patches with increased edge-to-area ratios, but not those with greater core habitat or increased connectivity. These results suggest that large-scale landscape patterns can affect important plant-animal interactions in potentially unexpected ways and that limiting habitat fragments with increased edge could be an important conservation strategy for plants in fragmented environments.

Craniofacial Attractiveness Study

Danielle Ung, Junior, Psychology

Mentor: Brent Collett, Psychiatry & Behavioral Sciences

Mentor: Matthew Speltz, Psychiatry & Behavioral Sciences

Craniosynostosis is a birth defect involving premature fusion of one/more cranial sutures. As the infant's brain continues to grow, the condition results in an increasingly asymmetric head shape characterized by restricted growth in regions of the fused suture(s) and compensatory growth in unfused regions. Elective surgery releases the fused sutures, helping normalize head shape and appearance. Although findings are mixed, studies have shown that children with craniosynostosis have elevated rates of learning and behavioral problems and low self-esteem. The purpose of this study is to investigate facial attractiveness ratings for infants with and without craniosynostosis. Additionally, we will examine pre- and post-surgery ratings to determine the extent to which children's appearance 'normalizes' after surgical intervention. Participants in the study (n= 236 cases, 236 controls) were recruited as part of a multi-site, longitudinal case-control study of infants with and without isolated (i.e., non-syndromic) craniosynostosis. In conjunction with this study, photographs were taken of participants in early infancy (for cases, prior to surgery)

and at age 18-months. We plan to have eight childcare professionals from a local daycare, blind to children's case/control status, rate children's attractiveness on a scale of 1 to 7, 1 being highly unattractive and 7 being highly attractive. Descriptive statistics (e.g. chi-squared, frequency measurements, and average scores of facial attractiveness before and after surgery) will be used to explore potential group differences, as well as change post-surgery. We hypothesize that (1) children with craniosynostosis will receive lower attractiveness ratings than controls, and (2) children with craniosynostosis will show significantly improved facial attractiveness after surgery, in relation to comparisons of controls over the same time period. If this hypothesis is supported, we will be able to give parents reliable information about anticipated cosmetic outcomes that will help them to make an educated decision about surgery.

"Oh, no, I failed math, I have to be an English major now": some features of discursive Identity Formation in Undergraduate Engineering Students

Chloe Valencia, Senior, English

McNair Scholar, Zesbaugh Scholar, Mary Gates Scholar

Mentor: Andrew Jocums, Educational Psychology

This project focuses upon identity construction and development among undergraduate engineering students. I use responses to questions from ethnographic interviews over four years from the Academic Pathways Study, a longitudinal multi-methods study. I have isolated student's responses to two questions asked throughout four years, which are relevant to how engineering students develop an engineering identity. These questions are: 1) Would you say that in general other engineering students more different from you or more similar? 2) Would you say that there are things that distinguish engineering students from students in other majors? By asking students to describe their perceptions of their fellow engineering students and non-engineering students, we are offered a glimpse of how students construct a relational identity. The process of constructing an identity, and investigating the objects that do so, is a problem of importance because of the unique nature of the engineering educational experience (e.g. weed-out classes, it's own college at a university vs. college of arts and sciences, its high level of specialization and strong career/goal orientation). I will analyze identity development in engineering undergrads through answering the following question: how do engineering students form an identity where they position themselves towards both other engineering students as well as non-engineering students? These research questions clarify some features that define their emerging engineering identities. Some of the most important aspects of identity development are human agents: the student's own perception of themselves, their engineering peers, their professors and practicing/career engineers as role models. In my analysis I will

categorize students' identity development in terms of the different aspects of an engineering identity. I argue that in the process of classifying themselves as similar to other engineers, they simultaneously express autonomy in relation to the standard perception of an engineer.

Can you have it all?: How Socioeconomic status affects group cohesion

Jamie Vann, Senior, Psychology

Maria Acosta, Junior, Neurobiology

Mentor: Dellanira Valencia-Garcia, Psychology

Mentor: Jane Simoni, Psychology

Higher socioeconomic status (SES) has been popularly associated with positive outcomes (i.e. higher self-esteem, higher income, and higher position in society). In the present study, we examine the relationship between SES and ethnic group cohesion among women of Mexican heritage and the psychological and personal processes keeping members of a social entity together and united to varying degrees. Six groups of 3-6 (n=29) Latinas were interviewed in focus groups as part of a larger study, and each group was divided by language preference (Spanish or English) and their reported income level (i.e. higher or lower income status). Preliminary findings, using a thematic analysis framework of the focus group data showed stronger disconnection among their ethnic group on group cohesion for women of higher income levels than for women of lower income levels or monolingual Spanish speaking women. Using income level as a proxy for SES, the data suggests that women of a higher SES (higher income status) feel more isolated from their ethnic group as compared to women of a lower SES (low income status) who feel a stronger sense of cohesion with the Latino community in the greater Seattle area. These patterns may indicate an important relationship between SES and perceived group cohesion through group solidarity, group identity and an individual's sense of belonging to the Latino community in the Seattle area.

Production of Plant Callus for Genetic Modification

Gabriel Verdugo, Senior, Plant Biology and German

Mary Gates Scholar

Mentor: Sharon Doty, Forest Resources

Giant Reed (*Arundo donax*) and Willow trees (*Salix* spp.) are excellent candidates for genetically enhanced paper production and/or phytoremediation (the use of plants to remove contaminants from the environment) since they are fast-growers that thrive in a variety of habitats. We plan to increase Giant Reed's usefulness as an alternative paper source by downregulating lignin with an antisense 4CL gene, and increasing the plant's cold tolerance so that it can be cultivated in colder areas. We intend to make transgenic Willow trees that are viable for phytoremediation by inserting the same CYP2E1 gene that was inserted into Poplar trees by the Doty lab, resulting in a dramatically

increased degradation of common environmental pollutants when compared to wild-type Poplars.

Willow trees, however, have never been successfully transformed because they respond defensively to Agrobacteria, the most common vector for plant transformation, and Giant Reed has been proving difficult as well. This project's ultimate goal is to transform the plants by means of a modern method: particle bombardment. In order to accomplish this, we must first induce them to form undifferentiated, embryogenic callus tissue. This tissue can then be bombarded with gold particles coated with the desired gene, and then transferred to media containing plant growth regulators (PGR's) that will induce the growth of a whole plant. This phase of the project involves determining the correct concentration of PGR's to induce callus growth in these species. We have succeeded at stimulating possible embryogenic callus growth in two species of willow, but we now need to induce the callus tissue to expand large enough to be viable for particle bombardment. Although we have not yet induced giant reed to reliably produce embryogenic callus tissue, we have found a combination of PGR's that it reacts well to.

Calibrating Spectroscopic Instruments for ZaP Flow Z-Pinch Plasma Investigation

Genia Vogman, Sophomore, Aeronautics and Astronautics

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: Uri Shumlak, Aeronautics and Astronautics

The ZaP Flow Z-Pinch experiment is an innovative plasma confinement concept that uses a $J \times B$ force to compress and a sheared flow to stabilize an otherwise unstable column of plasma. The applications for such a steady-state plasma configuration include fusion power production, high-energy space propulsion, and semiconductor photolithography. To study the characteristics and longevity of the plasma column, the experiment utilizes an array of diagnostics including spectroscopy, which is the analysis of discrete light spectra emitted by the ions in a plasma. This method of data collection is particularly useful because it allows for analysis of overall plasma behavior through passive means. Fiber optic telescopes are set up on the experiment in order to capture twenty chords of light data corresponding to twenty different locations along the diameter of the pinch. Investigating light intensity and wavelength in specific locations and times of the pinch lifetime yields qualitative and quantitative information regarding its impurities, temperature, and bulk velocity profile. To ensure accuracy in these spectroscopic measurements, it is necessary to calibrate and normalize each chord's intensity of response to the same light signal. The survey involves measuring the peak intensity of each fiber optic chord at each of ten distinct wavelengths and using a photodiode detector to generate a calibration factor. As a result, the light signals received by the fiber optic cables can be normalized, and instrumental error can be diminished

significantly. Furthermore, the survey accounts for the effect of polarized light on the calibration factor so that spectroscopic measurements of the internal magnetic field of the plasma can be made with accuracy. The results of this calibration are then used to make adjustments to the spectroscopy diagnostic so as to ensure precision in spectral surveys and calculations involving light radiation from Z-pinch plasmas.

p120 catenin's role in regulating cell migration and adhesion is required for gastrulation in zebrafish

Ryan Walsh, Senior, Biology: Cell, Molecular & Developmental

*Cynthia Hsu, Junior, Biology
Mentor: Merrill Hille, Biology*

The process of gastrulation is a key step in vertebrate embryogenesis, during which the framework of the vertebrate's body plan is laid down. Normal gastrulation involves mesendoderm internalization and convergence & extension. In mesodermal cells during gastrulation, cadherins are highly expressed and localized at the plasma membrane; here their extracellular domains bind tightly to those of adjacent cells, causing the cells of the mesoderm to tightly adhere to each other. To complete gastrulation, the cells of the mesoderm must be able to switch between tight binding and migration. p120 catenin has previously been shown to play an important role in mediating cell-cell adhesion through its interaction with a class of transmembrane proteins known as cadherins. p120 catenin binds the cytoplasmic tail of cadherins, and by doing so keep the cadherins localized at the plasma membrane. When free in the cytosol, p120 catenin also indirectly acts on certain Rho-family GTPases to rearrange the actin cytoskeleton and promote migration. Given that p120 catenin is highly expressed in developing vertebrate embryos and p120 catenin's role in regulating cell-cell adhesion and migration, it is likely that p120 catenin plays a crucial role in the cell migrations that occur during gastrulation. Indeed, p120 catenin has previously been reported to play a vital role in *Xenopus* gastrulation, where knockdown of p120 catenin resulted in severe convergent-extension defects. Here we have demonstrated, for the first time in zebrafish, that morpholino oligonucleotide (MO) based depletion of p120 catenin causes defects in development consistent with a loss of cellular ability to migrate and adhere. We have also shown that these MO-induced defects can be rescued by coinjecting mRNA from the *Xenopus* homolog of p120 catenin. These data provide strong evidence that p120 catenin's role in mediating both adhesion and cell migration is necessary for the successful completion of gastrulation.

Removal Arsenic in the Lake Washington water and DI water

Zhining Wang, Junior, Civil and Environmental Engineering

Mentor: Mark M. Benjamin, Civil and Environmental Engineering

Arsenic is a naturally occurring element ubiquitously present in the earth's crust. Arsenic is introduced into the water environment by weathering, erosion of minerals, or the use of herbicides or pesticides containing arsenic. Especially, its release to water has been significant in areas of mining activities. Arsenite and arsenate are the predominant forms of arsenic in natural waters. The maximum allowable arsenic concentration in drinking water was lowered from 50 µg/L to 10 µg/L in the United States in 2001. The project is to remove arsenic from deionized water and from Lake Washington water using membranes and heated aluminum oxide particles, a new material invented in the UW laboratories. The natural organic material in the Lake Washington water will have an influence on the removal of arsenic. Our goal is to see how the natural organic material affects the arsenic removal efficiency.

Investigating the contractility properties and spatial expression of MYH3 in human, mouse, and rabbit tissues

Alice Ward, Senior, Bioengineering

Mary Gates Scholar

Mentors: Michael Regnier, Bioengineering

Mentor: Michael Bamshad, Pediatrics

Mentor: Anita Beck, Pediatrics

The distal arthrogryposis (DA) syndromes are a related group of conditions characterized by the Bamshad lab that exhibit contracted hands and clubfeet at birth. The syndromes are caused by mutations in the genes coding for several proteins of fast-twitch skeletal muscle. Myosin is part of the protein structure that makes up a muscle cell; it works together with actin to cause muscle contraction, thus generating force and causing movement. One of these DA syndromes, DA2A or Freeman-Sheldon syndrome (FSS), is caused by mutations in the embryonic myosin heavy chain (MYH3). In FSS patients who carry one mutant MYH3 gene, 50% of the myosin heavy chain proteins are hypothesized to exhibit abnormal contractile properties. In this project, we are surveying the spatial expression of MYH3 RNA in two animal models, rabbit and mouse, and conducting a preliminary exploration of the contractility similarities and differences between the models and FSS patient biopsies. RNA is what our body uses to communicate the protein's "recipe" from the genetic code to a protein. This data will be critical for understanding the perturbations that may occur in an animal model of FSS. To identify the contractility traits of our muscle samples, we dissect muscle tissue down to single muscle

cells, and then use force transducers to test the contractility of the muscle fiber under various calcium concentrations. Thus, we test the force generated by a muscle cell and the sensitivity of that force to changes in calcium, which is the activating ion for muscle contraction. Small changes in any of these parameters can have devastating consequences on the muscle physiology. Through this, we will better understand how mutations in the MYH3 gene lead to the phenotype of contracted hands and feet.

Media's Influence on Perpetuating Gender Norms

Tracey Ward, Junior, Psychology, North Seattle Community College

Darren Branning, Junior, Psychology, North Seattle Community College

Mentor: Melissa Grinley, Psychology, North Seattle Community College

Rigid gender role (RGR) portrayals in the media influence our expectations of accepted gender roles. Media acts, in this way, as a set of gender schemas rather than its true role as an unrealistic medium. With the average American watching six to seven hours of television each day, mediums such as television and movies have become an increasingly accessible approach to form views about gender role expectations. Society has become more liberal about gender expectations, however a large proportion of television and movies portray gender roles as rigid. A study was conducted at North Seattle Community College to examine if immediate exposure to RGR in television and movies would influence an individual's opinion of gender roles. Haphazardly selected college students viewed a series of four gender rigid media video clips followed by a Likert scale survey examining personal expectations of gender roles. A control group was not exposed to a media selection, but presented with the same survey. We hope to find results to support our hypothesis, that the experimental group will illustrate higher scores on gender rigid concepts. Media's portrayal of unrealistic gender roles may perpetuate views of inequality. The implications of this study could provide evidence to support such a relationship.

Evaluating the long-term trends of blue and fin whale presence using acoustic data in the Northern Pacific Ocean

Jessica Warner, Junior, Biology

NASA Space Grant Scholar

Mentor: Kate Stafford, Applied Physics

Pairing acoustic data from blue and fin whale calls with data on three different oceanographic variables in the North Pacific may assist in predicting future blue and fin whale presence. Blue and fin whale numbers were depleted during the last century by whaling, and they have been protected since 1966 as endangered species. The relationship between prey availability, geographic location

and seasonal population trends in these highly migratory species of baleen whales is not well understood because of the difficulty in studying marine animals at great depth with long migration ranges. The influence of ocean color, sea surface temperature and sea surface height on whale occurrence is the focus of this project. Data collection of these oceanographic variables from 1997 to 2006 has been evaluated against acoustic data that indicates the presence or absence of blue and fin whales. The data collection was organized into three areas in the North Pacific designated eastern, central and western. These areas were determined based on the position of hydrophones that provided the acoustic data. Blue and fin whales produce loud, low-frequency sounds that can be distinguished on a species level and used as an alternative measure of population data not involving actual species numbers, which are rare and inaccurate. Seasonal and annual trends from 1997 to 2006 in the 16-30 Hz frequency range may correspond with trends in ocean color, sea surface height and temperature, which can, in turn, give significant insight into these species' occurrence in the North Pacific. Learning more about possible factors behind blue and fin whale distribution will help predict the fate of this species in an uncertain future.

Using satellite and ship cruise data to understand aerosol-cloud interactions over the southeastern Pacific Ocean

David E Weir, Senior, Atmospheric Sciences

Mary Gates Scholar

Mentor: Robert Wood, Atmospheric Sciences

The purpose of this study is to examine relationships between satellite-derived and in-situ measured cloud and aerosol parameters over the Southeastern Pacific Ocean, a region of persistent low-level clouds. The parameters being compared are the cloud droplet number concentration derived from MODIS satellite data (Moderate Resolution Imaging Spectroradiometer), and aerosol concentration measured in-situ on research cruises under the clouds. The nature of the relationship between these two parameters is important for quantifying the indirect effects of aerosols upon clouds. The aim of this study is to examine the relationship and how it is impacted by cloud structural changes. Confirmation of this correlation would justify the wider use of MODIS data to infer aerosol concentrations, and on much larger scales than the limited in-situ studies. This could foster better understanding of key cloud processes which influence climate, and the parameterization thereof in numerical climate models.

Zeitgeist: RSS Feeds and Online ‘Buzz’

Charles Williams, Senior, Informatics and Comparative History of Ideas

Mentor: Batya Friedman, Information School

Mentor: David Hendry, Information School

Though major search engines have done a fairly complete job of indexing the world wide web, most store only the current state of websites. There is not yet a reliable way to visualize and interpret the stream of data recently added to the web at large. A fundamental problem with tracking changes to websites is the vast array of unique website designs. This research explores the use of Really Simple Syndication (RSS) feeds to solve this problem. RSS feeds were developed to alert web users of new content. Normally, RSS feeds are used to monitor updates to a handful of favorite websites all in one place with a program called a Feed Reader. Instead of manually checking each website, the program checks the RSS feed for each website and displays a list of newly added content for all the user’s selected sites. For my project, I have designed and built a system with the potential to monitor every RSS feed available online. It is currently monitoring 8.8 million RSS Feeds, and has collected 8 weeks worth of data. The data is stored, aggregated, analyzed, and served back to end users through visualizations in a web interface. Users can explore and compare the daily frequency of any number of terms. I will be conducting a usability study and performing a design iteration of this interface in the future. In a preliminary analysis of the data, a strong correlation was found between the amount of online ‘buzz’ for a given presidential primary candidate and his or her success or defeat in that day’s primary election. Being able to understand trends in new information added to the world wide web will be useful and interesting to private industry, government agencies, and individuals.

Computerized Tracking of Infected Macrophages During Tuberculosis Pathogenesis and Granuloma Formation

Kathryn Winglee, Junior, Microbiology and Computer Science

*NASA Space Grant Scholar, Mary Gates Scholar
Mentor: Lalita Ramakrishnan, Microbiology*

Tuberculosis (TB) is a bacterial disease that accounts for more than two million worldwide deaths every year. One important characteristic of this disease is the formation of granulomas, aggregations of infected macrophages and other immune system cells, in the infected host. Understanding how granuloma formation in TB infections occurs is important to understanding this disease. One model makes use of zebrafish embryos infected by *Mycobacterium marinum*, a close relative of *Mycobacterium tuberculosis*, the causative agent of human TB. These embryos are transparent, allowing real-time observation of the course of infection. Essential to

this model is the need to analyze 3D and 4D microscopical images to observe the migration of bacteria and infected cells through the fish. One major challenge to studying granuloma formation is that current software is designed to track small, featureless objects, such as actin. In contrast, *M. marinum* in granulomas forms large clumps with shapes that change over time, while retaining some constant features. Available software cannot recognize these features, and in consequence tracking must either use a high density of timepoints (increasing potential damage to the organism), or be done by hand. In my current work, I am refining a program which works with MATLAB and Imaris to track clusters of bacteria automatically as they form granulomas. This program could eventually reduce the volume of data needed and the time necessary to analyze this data. Ultimately this automated approach will streamline the process of characterizing granuloma formation and of analyzing the effect of host and pathogen mutations on this process.

Tbr2 expression in the adult olfactory system

Roderick Yang, Junior, History

Mentor: Robert Hevner, Neurological Surgery

The olfactory bulb is one of two sites where neurogenesis – the growth of new neurons – is known to occur in the adult mammalian brain. The existence of adult neurogenesis, suggested as early as the 19th century, has only recently been demonstrated in mammals. There is a relationship between adult neurogenesis and many neurodegenerative conditions such as Alzheimer’s disease and Parkinson’s disease; in patients with such diseases, pathologies can arise in some specific regions of the brain involved in normal adult neurogenesis. Our research is concerned with Tbr2, a protein that acts as a transcription factor in the brain and plays a role in controlling the expression of many other genes. Existing research on Tbr2 in the embryonic cerebral cortex shows that it is a key regulator of brain development. Tbr2 was also found to play a similar role in the adult hippocampus, the only other area of the brain where adult neurogenesis clearly occurs. Our research is focused on identifying what role Tbr2 plays in adult neurogenesis in the olfactory system. In order to further characterize the role of Tbr2 in adult neurogenesis, we will analyze the expression of Tbr2 in stem and progenitor cells in the adult olfactory system, and determine the types of olfactory neurons that arise from the Tbr2 lineage in the adult brain. Preliminary data suggest that the Tbr2-positive cells in the adult olfactory bulb express vGluT, a marker for neurons that use glutamate as a neurotransmitter. Understanding the potential of these and other endogenous stem cells is the first step in exploring new treatments for many diseases.

Vowel Discrimination in Infants with Cochlear Implants

*Louise Yeager, Senior, Speech & Hearing Sciences
Mentor: Lynne Werner, Speech & Hearing Sciences*

Children as young as one-month-old have the ability to discriminate between speech sounds. This ability enables them to perceptually organize speech into categories, facilitating language acquisition. For infants with congenitally severe to profound hearing loss this discrimination and categorization of speech sounds is difficult, if not impossible, to accomplish. Many of these children have had a device surgically implanted that sends signals directly to the auditory nerve enabling the detection and discrimination of sounds. This device is called a cochlear implant (CI). There is a lack of studies showing that infants with CI's can discriminate between speech sounds. This study investigates the ability of infants with CI's to discriminate two synthesized vowel sounds; "ah" and "ee". Infants with CI's and infants with normal hearing participated; their ages range from 15 to 36 months. The vowels were 320 ms in duration at an intensity of 65 dB SPL. The vowels were presented through a speaker in a sound booth. One vowel was presented repeatedly at 400 ms intervals. Infants learned to respond when they heard the repeated vowel change from "ah" to "ee" or from "ee" to "ah". Correct responses were reinforced by the activation of a mechanical toy or a dvd. Infants were tested for 40 trials or until they had achieved a criterion of 80% correct. It is predicted that infants with CI's will be able to reach criterion, although it may take them a little longer than it takes normal hearing infants to reach criterion.

Modification and Implementation of a Multiple Autonomous Vehicle Hardware Testbed

*Kevin Yee, Senior, Aeronautics & Astronautics
Mentor: Mehran Mesbahi, Aeronautics & Astronautics*

With the recent growth in popularity of autonomous vehicle technology, the development of multiple-agent autonomous systems, otherwise known as distributed systems, has seen significant growth. One specific family of distributed systems are those consisting of multiple autonomous spacecraft, which have possible future applications in extrasolar observation and satellite repair and maintenance. One of the key technical challenges that has arisen when dealing with these systems is the development of effective coordination and control algorithms that govern their behavior. To help develop and test control algorithms that define the movement and coordination of the system, a hardware testbed was developed by the UW Distributed Space Systems Laboratory. The testbed simulates a distributed system of vehicles with multiple wheeled robots that travel across the floor. In order to make the robots behave more akin to a system of spacecraft, they will be modified to move in a way that mimics the motion of a spacecraft in a microgravity environment. Better suited

algorithms can then be written that can more accurately control the behavior of the system as if it were a distributed system of spacecraft. To accomplish this modification for robots that move in a two dimensional environment, the robots need to be made to translate across the surface of movement (the floor) with minimal friction, much like the way a spacecraft translates through space: both the translating robot and the spacecraft have full control of their movements throughout all of their degrees of freedom. This means that the robot will need to be able to fully control its movement through the degrees of freedom that exist in a 2D plane. By making the testbed more closely simulate a real spacecraft system, the algorithms that are written for the testbed software will be more readily adaptable to real world applications.

Securing a Web Application: eMath4KSEA

Leon Yip, Senior, Computing & Software Systems, UW Tacoma

Yoon Kim, Sophomore, Computing & Software Systems, UW Tacoma

Mentor: Sam Chung, Computing & Software Systems, UW Tacoma

Unlike the traditional desktop application, a Web application is an application that is accessed over the Internet, or also known as the Web. Web applications are often built around numerous systems such as a Web server, an application server, a database server, and other backend systems. Securing a Web application is a difficult task since there are numerous points of attacks and other vulnerabilities for all systems involved. Common major vulnerabilities of a Web application can include ineffective data validation techniques on data sent by end-users of a Web application or the mishandling of e-commerce payments. To present our approach to securing Web applications we will use an existing unsecured Web application known as eMath4KSEA which also provides a feature that handles online financial transactions. By using Microsoft's STRIDE threat model to assess the security risks in eMath4KSEA, it allows us to pinpoint what appropriate security fixes are to be applied to the features provided by eMath4KSEA. As a result of the security risk assessment and applying the appropriate security fixes, we were able to mitigate threats on all common security risks such as minimizing the potential loss of data of its end-users, minimize the chance of unauthorized access, and minimize the chance of denial of service attacks. Web application developers can follow our approach to develop secured Web applications or maintain existing Web applications such that it is secured and safe for usage from their end-users.

**What causes intraspecies color variation in azaleas?:
Hybridization between species or simple genetic variation**

*Wentao Yu, Junior, Molecular Biology
Mentor: Benjamin Hall, Biology*

Deciduous azaleas (Section Pentanthera) are the category of Rhododendrons with the most species native to North America, 16 of them. One of these, *R. occidentale* occurs in Oregon and California, while the others are largely to be found only East of the Mississippi River. A general feature of many Pentanthera azalea species is extreme variation from place to place in the flower color. For many years, this variation was explained as being due to hybridization between different azalea species, but recent DNA studies have called into question this explanation. I am studying DNA variation in the species *R. colemanii*, a newly named species that occurs in the states of Alabama and Georgia. Previous studies by others have documented extensive flower color variation ranging from white to yellow to pink within *R. colemanii*. I made use of flower bud samples from 12 locations to extract *R. colemanii* DNA from each of them, then to characterize several genes by DNA sequencing. The nuclear genes I have studied include intron4 of RPB2-I, AT-MC (a region between two genes) and Rpl37. Within intron 4 of RPB2-I, the samples vary greatly, specifically by the presence or absence of two deletions, each of approximately 20bp. By studying the same DNA regions of RPB2-I and of the other genes in azalea species that overlap the range of *R. colemanii*, I will determine whether or not hybridization is responsible for any intraspecies DNA variation observed in *R. colemanii*. Basically, the technologies I am using include DNA extraction, PCR, and automated fluorescent DNA sequencing. The DNA sequences will be aligned and analyzed in Computer program Se-Al 2.0.

Mixed Television

*Roya Zahed, Senior, Communication
Mentor: Ralina Joseph, Communication*

Forming one's identity is no easy adventure and for multiethnic-and-multiracial people in America, there are few to no markers to follow on the road of identity formation. The ever-changing perspectives about "mixedness" throughout history have created a wide range of stereotypes. The current trends put much focus on the idea of racial ambiguity. The purpose of this study is to better understand this idea within multiethnic-and-multiracial dialogue and to examine the portrayal of mixed actors on popular television programming to discover if and how reflections of racial ambiguity, discussed so heavily in academia, are being displayed. Mass media, especially television, plays a key role in perpetuating stereotypes that have the power to frame ideas about identity formation, thus it is an important tool to be studied. This research is fueled by the quest to discover our society's current state

of mixed discourse.

Plexers and n-to-1 Graphs

*Tracy-Ying Zhang, Senior, Physics, Mathematics
Mary Gates Scholar, Undergraduate Research Travel Awardee
Mentor: James Morrow, Mathematics*

A rank one matrix has the property that any 2-by-2 sub-determinant is zero. It is then possible to determine all entries of the matrix by knowing just some of them. This project classifies the sets of entries that determine the rest. Define a plexer P to be a rank one, symmetric matrix together with a partition of its off-diagonal entries into two sets. The two sets are called U and K . Assume that all entries in K are known, and the rest of the matrix unknown. P has the property that (a) None of U can be recovered from given information; (b) If any of K becomes known, then the entire matrix, including diagonals, can be determined. We call P an m -plexer if $|U|$ is m . For any n -by- n ($n > 2$) rank one symmetric matrix, there always exist a smallest and a largest plexer whose size depends on n . All plexers on this matrix assume one of two types of block partitions. In one type, none of the diagonal entries can be determined. In the second type, some diagonals can be recovered directly from K . The number of allowed block structures in each type also depends on n . In the inverse problem on electrical networks, plexers are crucial in constructing graphs with n -to-1 recovery property.

Characterization of Metallothionein Expression in Cd-exposed and non-exposed C57 and SWV Embryos undergoing Neurulation

*Chunyan Zhou, Senior, Biochemistry, Chemistry
Mentor: Elaine M. Faustman, Environmental and Occupational Health Sciences
Mentor: Xiaozhong Yu, Environmental and Occupational Health Sciences
Mentor: Joshua F. Robinson, Environmental and Occupational Health Sciences*

The heavy metal, cadmium (Cd), is a ubiquitous environmental pollutant that causes great concern to human health due to associations with several diseases, including lung and prostate cancers. Although Cd has not yet been classified as a teratogen in humans, animal models have shown that Cd is a developmental teratogen, causing fetal death, growth retardation, malformations, and interference of neural tube closure, resulting in neural tube defects (NTDs). Previous studies have shown that common inbred mouse strains, C57 and SWV, differ in their susceptibility to Cd when exposed during neurulation, inducing a higher incidence of NTDs in the C57 compared to the SWV. Cd's ability to interfere with the neurulation process may come from its effects on several biological processes due to the production of oxidative stress and disruption of zinc homeostasis. Exposure to Cd may

result in the induction of expression of Metallothioneins (MT). MTs are cysteine-rich, intracellular proteins that bind to endogenous metal ions (Zn, Cu) with high affinity. MTs may reduce stress caused by Cd-induced toxicity by decreasing bioavailability of Cd and/or produced electrophilic byproducts capable of interacting with cellular targets. Thus, the constitutive level as well as the inducibility of MTs may be an important determinant of the developing embryo's sensitivity to Cd. In the present study, using RTPCR, we will assess MT RNA expression of MT1 and MT2 in control and Cd-treated C57 and SWV embryos during the period of neurulation (GD8-10). RNA will be isolated from litters of C57 and SWV embryos (GD8, 8.5, 9.0, and 10) and purified using the RNAeasy kit (Qiagen). We will conduct RTPCR using probes (Taqman) for MT1 and MT2. We will discuss Cd-inducibility of MT and control levels of MTs in SWV and C57 embryos and how MT levels may implicate increased protection against Cd-toxicity.

STUDENTS SUM UP THEIR RESEARCH EXPERIENCE IN A WORD

Eye-opening:

Research isn't the "cool" fun, glamorous world most people believe it to be. It's painstaking, often repetitive, and often boring. It's real work. I thought I understood that before starting research, but now I know better. I wouldn't trade this experience for anything, though. Knowing there is a huge gap between having an idea and presenting it, knowing the nature of that gap is research, and understanding what research is all about is the real "cool".

Re-learning:

Of course I knew how to learn; I was in college, wasn't I? But my previous approach was too much like Paulo Freire's "banking method" of education: deposit knowledge to be withdrawn at a later date. Heck, Wikipedia can do that. What I learned this summer is how not just to learn, but to make meaning.

Reaffirming:

Before I started research I believed that I would graduate and move on to other, unrelated career paths. This was my conclusion simply because my grades were not as competitive as I'd hoped and my passion for biology had fizzled. As soon as I began to work and think and sweat biology in the lab, I was once again enamored with it. I've been so fortunate to have had this experience that will be with me all of my life. I plan now to continue on in biological research for as long as I am able.

PRESENTATION **S**ESSON **2**

3:30 - 5PM

PLEASE NOTE:

Abstracts are listed alphabetically by the presenter's last name, unless otherwise noted.

SESSION 2A

THE LIVES TO COME: BODIES, BELIEFS, AND SOCIAL JUSTICE

*Session Moderator: Phillip Thurtle, Comparative History of Ideas Program
Mary Gates Hall Room 228*

*Note: Titles in order of presentation.

Resilient Biosustainability in Western Civilization

*Chaim Eliyah, Senior, Comparative History of Ideas
Mentor: Cynthia Anderson, Comparative History of Ideas*

My project deals with the need for a mindset of sustainability, namely the sustainability of biodiversity, in Western civilization. Humanity has achieved great heights of technological advancement, and yet the industrial civilization that has brought us that advancement threatens the existence of life as we know it, i.e., of biodiversity and its future. There are also hundreds of millions of people all over the world who do not have access to food, and there are an increasing number of people without shelter. People have traditionally relied on biodiversity for their subsistence during the last ten to fourteen millennia. Today, biodiversity is decreasing at an alarming rate. My project will attempt to answer the question of why our way of thinking and our way of life have become so unsustainable, and how we could go about constructing a paradigm that would include the need for the future prosperity of our world's ecosystems, which is directly related to our own survival. In order to answer these questions I will work with communities who have been living in a sustainable manner for tens of thousands of years, namely the Andean indigenous tribes, and particularly the Shuar. I will also engage those who are working locally to increase the sustainability and biodiversity of our surroundings. My goal is to be able to create within the psyche of the West a pragmatic and a spiritual sense of our need for biodiversity and the interconnectedness of the human species with all life.

International Perspectives on Disability Rights and Identity Politics

*Travis Grandy, Senior, English and Law, Societies & Justice
Mentor: Sharan Brown, Educational Leadership & Policy Studies*

A cornerstone of Disability Studies is the Social Model of Disability, and recent successes in the adoption of disability rights laws are very much rooted in this model to use the law as a means of removing social barriers that

create disability. Though the law has enabled people with disabilities to realize rights and accommodations in society, it also represents a discourse where identities are formed as well as proscribed. Even within the circles of disability rights advocates, the use of language and whether certain types of language are appropriate regarding disability and the individual is a highly contested and politicized space of discourse. My focus is to treat various sources of law (such as the ADA in the United States, and the UN Convention on the Rights of Persons with Disabilities) as signifiers of social identity through using a discursive psychological model of disability. It is through the discourse of law that underlying norms and assumptions of disability are revealed and provide insight into the corresponding social identities of a given "condition." This essay examines how such identities are produced through the law on several levels: within national legal systems, multinational entities, and international law pertaining to disability. Specifically, this essay will study how identities emerge within the category of "mental disability" and perhaps how distinctions between identities are lost through generalized implementations of policy. In such cases, the individual has agency in deciding whether or not to adopt that identity in exchange for rights and inclusion. The eventual goal of this paper is to analyze the implications of the presence of these identities in legislation intended to liberate individuals. However, this paper also asks whether that liberation comes with a cost, and if measures meant to increase access have the potential to also be restrictive.

Stem Cell Research: Ethics versus the Progression of Science

*Christina Kipelidis, Sophomore, Premajor, UW Tacoma
Mentor: Amos Nascimento, Interdisciplinary Arts & Sciences, UW Tacoma*

Stem cell research is currently a prominent and controversial form of research that raises important moral and ethical questions, especially regarding the use of embryonic stem cells. While some believe that this research holds tremendous potential for helping treat patients with many different ailments including lupus, cancer, and limb loss, others believe that it is immoral to use stem cell extracted from embryos due to the fact that the embryo needs to be destroyed to do so. This debate presents new challenges to medical ethics. To address this issue, I review the ancient Greek tradition that gave us medical ethics (the Hippocratic Oath) and the idea of searching for truth (aletheia) as to show that sometimes there is not one simple answer to life's complicated dilemmas. I also consider the current U.S. federal funding policy regarding stem cell and its strict regulations on what can be funded in regards to research. Looking at medical research and policy issues from an ethical standpoint, it is important to remember that there is never a simple answer. Therefore, I believe that an expansion of the current U.S. federal funding policy in regards to stem cell research is

crucial in the development of new treatments for the sick and dying, and thus, I propose that federal funding be used for research on donated embryos from abortions cases as well as extra embryos from in vitro fertilization clinics. If respect is giving to all sides of this debate and a consensus is reached, stem cell research can help us move forward into a healthier world.

Scofield's notes and Moody's press: The Rise of Dispensationalist Thought in Late Nineteenth Century America

Michael Thomas, Senior; History, Seattle Pacific University

Mentor: Michael Hamilton, History, Seattle Pacific University

In the late nineteenth and early twentieth centuries, Darbyite Premillennial Dispensationalism gained a powerful influence in American Protestantism, forming the basis of what would become modern Evangelicalism. Among those most affected were a number of relatively prominent, well-educated ministers who began their careers as mainline postmillennialists and “converted” to Premillennial Dispensationalism mid-ministry. Among these were social activist Arthur Tippan Pierson and prophecy interpreter Arno Gaebelein. By examining the reasons behind their conversions we can better understand the contemporary relationship between Evangelicalism and mainline denominationalism. Intellectually, Dispensationalism provided an “empirical” method of demonstrating the existence and relevance of the supernatural in terms compatible with post-Enlightenment rationalism. Dispensationalism demanded a literal interpretation of the Bible, and explained how its internal consistency was “empirical proof” of Biblical authority. Further, its incorporation of prophecy provided another means to “prove” the truth of the Bible’s predictions against current events. Finally, Dispensationalism’s individualist emphasis allowed for the final empirical “proof” of the supernatural in personal experience, especially in financial provision. The intellectual attraction of Dispensationalism was inseparable from its organizational attraction. During the late nineteenth century, denominations were increasingly becoming more hierarchically structured and organized. The anti-denominational stance of Dispensationalism resonated with what Nathan Hatch calls the “recurring populist impulse in American Christianity,” as denominations were increasingly seen as the bastions of the elite, and the largely Dispensationalist parachurch organizations placed greater emphasis on the contributions of the common people. However, in spite of these conflicts, premillennial Dispensationalists and postmillennialists had much more in common than either typically admitted. Both belief systems were “couched in terms of eighteenth-century rationality.” Both foresaw a coming kingdom that would include the entire globe, and actively worked to promulgate that vision. Both viewed themselves as the

guardians of true knowledge (particularly, the contributions of the Scientific Revolution).

Lottery Regressivity in New Hampshire: A Study of Powerball

J. Christopher Park, Junior, Economics, Temple University

Temple University Scholarship, Diamond Research Scholars Grant

Mentor: William Stull, Economics, Temple University

“Lottery Regressivity in New Hampshire: A Study of Powerball” observes the incidence of regressivity in Powerball lottery ticket sales and examines how regressivity changes as jackpots fluctuate. Since their systematic re-institution in the U.S. beginning in the 1960’s, lotteries have been under fire for their apparent exploitation of the less privileged in society. It has long been noted in academic literature that, in terms of percentage of total income, those in the lower economic classes contribute a greater proportion to state lotteries than those who are in the upper classes. Thus, there exists a “regressive, implicit tax” in the lottery; it is a regressive tax because, on the average, lotteries are funded disproportionately by the underprivileged and poor (as opposed to a progressive tax, where an increase in income leads to a higher tax rate), and implicit because the expected value of nearly all lottery products is less than their cost. The purpose of this project is to extend upon an econometric study on the nature of lottery regressivity done by Emily Oster for the state of Connecticut. This is achieved by running logarithmic regressions similar to those done in Oster’s study on lottery data from the state of New Hampshire. Both this study and Oster’s study find that Powerball drawings become less regressive as jackpots increase. The current study suggests, via an out-of-sample calculation, that Powerball lotto in New Hampshire become progressive at a jackpot of approximately \$324 million for the time period studied, compared with Oster’s finding of \$806 million for the state of Connecticut during this period. While the body of data assembled for this paper partially supports Oster’s assertion that higher jackpots lead to lower regressivity, it contains a number of details that help to explain why differences in state demographics and Powerball participation can have a marked effect on regressivity from state to state.

SESSION 2B

SENSING THE OUTSIDE WORLD AND DOING SOMETHING ABOUT IT

Session Moderator: Horacio de la Iglesia, Biology
Mary Gates Hall 231

Presenting: Detecting the Presence of Circadian Rhythms in *Daphnia pulex*

Matt Badger, Senior, Biology
Mentor: Benjamin B. Kerr, Biology
Mentor: Brooks E. Miner, Biology

We sought to establish the presence or absence of an endogenous circadian rhythm in the widespread freshwater zooplankton *Daphnia pulex*, or water flea. It is well documented that many zooplankton species, including *Daphnia pulex*, possess behavioral mechanisms for avoidance of environmental threats. Diel vertical migration is one such mechanism, in which zooplankton typically swim to greater depths during the day to avoid such dangers, and shallower surface waters during the night to feed. However, no studies have been conducted to determine the presence of an innate daily rhythmic cycle of zooplankton activity, independent of environmental cues and regardless of migratory behavior. We hypothesize that behavior of *Daphnia* is regulated by a circadian rhythm with intervals ranging from high activity to low activity in a typical 24-hour day. To test this hypothesis we measured the activity of *Daphnia* individuals of lineages from both alpine and lowland lakes in Washington State. We placed animals in a light/dark cycle for seven days, followed by 24-hour darkness for an additional seven days. Our hypothesis predicted that individuals would maintain a rhythmic cycle of activity and inactivity that is independent of light cues.

Circadian Regulation of *crh* Expression in Desynchronized Rats

Yoshito Kosai, Senior, Computer Engineering
Mary Gates Scholar
Mentor: Horacio de la Iglesia, Biology
Mentor: Cheryl Wotus, Biology

Circadian rhythms are daily physiological and behavioral rhythms that are governed by biological clocks. In mammals, output from a master circadian clock located in the hypothalamic suprachiasmatic nucleus (SCN) drives these rhythms. One output of the SCN that is not fully understood is that controlling the release of glucocorticoids through the hypothalamic-pituitary-adrenal axis. Studies have suggested that this output may be regulated by two pathways, one light-dependent and one light-independent.

We hypothesize that the light independent pathway is regulated by the release of corticotrophin-releasing hormone (CRH) from the hypothalamus, whereas the light-dependent pathway relies on a multi-synaptic neural pathway emerging from the SCN and projecting to the adrenal cortex directly. We are using a neurologically intact rodent model, the forced desynchronized rat, to test our hypothesis. Rats housed in 11 hours of light and 11 hours of dark show two bouts of activity, one free-running with a period longer than 24 h and the other with a period of 22 h and synchronized to the light-dark (LD) cycle. These two rhythms are associated with the activities of the dorsomedial and ventrolateral SCN, respectively. Based on our hypothesis, we predict that the expression of the *crh* gene will be correlated to the free-running rhythm, but not the LD-associated rhythm in these animals. We have found that 24-h synchronized control animals show the same pattern of *crh* expression as previously reported. We are now analyzing *crh* expression in desynchronized animals to test the above prediction. Our studies will establish for the first time the role of specific SCN subregions and output pathways in the circadian control of glucocorticoid release.

Food sensing determines longevity in *Caenorhabditis elegans*

Brynn Lydum, Junior, Biochemistry and Neurobiology
Mary Gates Scholar
Mentor: Matt Kaeberlein, Pathology
Mentor: Erica Smith, Pathology

Dietary restriction (DR), defined as a reduced nutrient availability without malnutrition, has recently gained much notoriety for its potential beneficial health effects in humans. DR has been found to increase life span and delay the onset of age-associated diseases in a variety of animal models, from yeast to mice, and the central focus of current research is to determine the mechanism by which this occurs. Many hypotheses have centered on calorie intake or metabolic by-products such as free radicals as the lifespan-limiting factors of an unrestricted diet. However, recent studies by our lab in the model organism *Caenorhabditis elegans* suggest that a portion of the longevity benefits from DR are mediated by a mechanism distinct from food consumption. In light of the fact that a variety of chemosensory mutant strains exhibit increased longevity, we hypothesize that food sensing plays a role in regulating aging. Consistent with this hypothesis, we have observed that approximately 50% of the life span extension associated with DR can be accounted for by the absence of a soluble component of the bacterial diet that regulates longevity. The goals of our continuing experiments are to identify the dietary compounds that limit longevity and the sensory pathways through which these dietary signals modulate aging.

Intermediate Processing Role of Melatonin between Sleep and Immune Function

Joseph Noh, Senior, Psychology

Mary Gates Scholar

Mentor: Bonnie McGregor, Health Services

Mentor: Rachel Ceballos, Health Services

As tumor vaccines continue to emerge as viable tools for cancer treatment and prevention, researchers have begun to identify factors that are capable of promoting an efficient vaccine immune response. This is because a sufficient antibody response is required to achieve optimal vaccine efficacy. One factor known to be associated with immune function is quality of sleep. However, despite this association, little is known about the exact mechanism by which sleep enhances or reduces immune function. In the present study, we hypothesized that the immuno-modulatory properties associated with sleep are mediated by the synthesis of melatonin, a factor known to have immuno-stimulatory properties in mammals. To evaluate this hypothesis, women with a positive family history of breast cancer were recruited from the greater Seattle area. Three variables were measured - sleep quality, salivary melatonin, and immune function. The quality of sleep was measured by the Pittsburgh Sleep Quality Index, a self-report questionnaire that assesses sleep quality and quantity. Salivary melatonin was measured by commercially available ELISA kit. Immune function was measured by primary and secondary responses to Hepatitis A vaccination. The participants received Hepatitis A vaccination four weeks prior to the measurement of immune function, and the IgM and IgG antibodies against the vaccination were measured. Results will be analyzed using the path analysis model during April 2008. The expected findings are that the synthesis of melatonin plays an intermediate processing role and mediates the immuno-stimulatory properties of sleep quality. Successful completion of this study may be considered valuable as a demonstration of a biological mechanism by which sleep may influence immune function.

Chloride-opathies in Spinal Reflex Circuits: A Possible Etiology for the Unusual Dystonias of Complex Regional Pain Syndrome

Adam Przebinda, Senior, Physics and Biochemistry

Mary Gates Scholar

Mentor: Mark S. Cooper, Biology

Pathological changes in chloride homeostasis (i.e. chloride-opathies) are linked to the genesis of certain forms of epilepsy and chronic pain states. This presentation examines theoretically how neuroinflammatory-induced chloride-opathies in spinal motor circuits could evoke the tonic dystonic (locked and clenched) postures commonly observed in Complex Regional Pain Syndrome (CRPS), a neuropathic pain condition. Downregulation of KCC2 (Potassium-Chloride Cotransporter 2) in response to

microglial-secreted BDNF (Brain Derived Neurotrophic Factor) results in an increase of intracellular chloride in CNS (Central Nervous System) neurons. When the transmembrane Nernst potential for chloride becomes more positive than the resting potential for the neuron, the electrochemical driving potential for chloride current becomes inverted. As a result, chloride-dependent inhibitory synapses undergo a conversion to become excitatory synapses. This switch (i.e. conversion) in synaptic behavior is known to occur in pain receptor (nociceptive) neurons in lamina one of the spinal cord, contributing to the allodynia (painful response to non-painful stimuli) of CRPS. A similar BDNF-induced conversion of chloride-dependent synapses in deeper laminae of the dorsal horn, as well as within the intermediate zone of the spinal cord, would alter the sign and amplitude of chloride-dependent inhibitory post-synaptic potentials within spinal motor interneurons. The resulting loss of chloride-dependent inhibitory tone in spinal motor interneuron circuits would be expected to induce phase shifts and aberrant gain. Loss of reciprocal inhibition between antagonist muscle groups would ensue, thereby increasing the rigidity of affected joints. Sustained aberrant proprioceptive (motion) signals from affected muscles/joints could subsequently cause of a loss of surround inhibition in supraspinal motor control centers. Aberrant supraspinal drive to disinhibited spinal reflexes could further provoke the evocation of tonic dystonic postures.

Resetting the liver biological clock by restricting food access in zebrafish

Erica Victoria Tartaglione, Junior, Biology (Physiology)

Mary Gates Scholar

Mentor: Horacio de la Iglesia, Biology

In vertebrates many processes are regulated by the circadian system. Circadian rhythms are oscillations of physiology and behavior driven by a biological clock with a period of around 24 hr. The circadian system of animals is organized hierarchically with one or more master pacemakers and "slave" oscillators in the rest of the brain and periphery. Both master and peripheral oscillators are constituted by single-cell oscillators that exhibit transcription-translation feedback loops of so-called clock genes. In rodents, the light-dark (LD) cycle entrains the master circadian clock located within the hypothalamic suprachiasmatic nucleus (SCN), which in turn synchronizes peripheral oscillators. When animals are exposed to daily restricted food access (RFA), however, this hierarchy is altered and the rhythms of clock gene expression in organs like the liver, kidneys, and heart are entrained by the food availability, leaving unaffected the phase of clock gene expression in the SCN. The molecular pathways by which RFA entrains peripheral oscillators are unknown. We conducted similar RFA experiments in zebrafish to determine whether this stimulus is equally effective in synchronizing peripheral oscillators as it is in rodents. By using zebrafish, we can

capitalize on genome-wide approaches and induced mutagenesis to identify molecular pathways specifically involved in the synchronization of peripheral clocks by food. Here we present evidence that as compared to fish fed randomly throughout the day or in the mid light phase, animals fed during the night show a phase shift in the liver oscillation of the clock gene Period1 (Per1). Whereas Per1 expression in the brain oscillates with the same phase in all treatment groups, expression in the liver was delayed in the dark treated group as compared to randomly fed or light-phase treated animals. Thus, clock gene expression in the liver suggests food availability entrains the liver in a brain-independent manner.

SESSION 2C

ANTHROPOGENIC FORCES IN NATURE:

MITIGATING THE MESS

*Session Moderator: John Banks, Biology,
Interdisciplinary Arts & Sciences, UW Tacoma
Mary Gates Hall Room 234*

A new kind of forest: improving carbon forestry in New Zealand with ecological theory and native species use

Nathaniel Hough-Snee, Recent Graduate, Program on the Environment

Mary Gates Scholar

*Mentor: Michael Reese, Program on the Environment
Mentor: Kern Ewing, Forestry*

New Zealand signed the Kyoto protocol in 1998 (ratified 2002) as an annex I nation committed to reducing their 2012 net greenhouse gas emissions to 5% below their 1990 emission levels. To meet this goal, New Zealand (NZ) is working not only to reduce industrial emissions, but also to provide carbon sinks through activities such as forestry. Inherently, NZ is developing carbon forestry programs and protocols to establish forests for maximum carbon sequestration to mitigate global climate change and become Kyoto compliant. At present, a majority of plantation forests in NZ are non-native timber species such as *Pinus radiata*, *Pseudotsuga menziesii* and *Eucalyptus* species. These slow growing species often require large amounts of maintenance and petroleum-based fertilizers to compete with weeds, retaining little native biodiversity in their canopy understory. In contrast, NZ is now discussing initiatives that encourage the retention and development of native forests that require less input capital, retain greater native biodiversity and serve as improved forest sinks by utilizing vegetational succession. Manuka (*Leptospermum scoparium*) is a pioneer shrub native to New Zealand and

Australia that may best facilitate the establishment of large forests on cut timberlands and marginal farmland. Manuka is fast growing, accumulating biomass very quickly while out-competing common pastoral invasive species. Manuka is also inedible to most livestock while remaining favorable to birds that disperse native seed into the understory. The literature surrounding the ecology of New Zealand native pioneer forests and the eco-physiology of manuka are reviewed, with a brief assessment of the socio-economic factors that affect NZ carbon forestry. In conclusion, a case is made for the establishment of more NZ native species-based carbon forest sinks that match plant species performance and site availability rather than non-native forests that require additional capital and provide less ecological value.

Carbon Emissions and Biomass Accumulation from Slash-and-Burn Agricultural Fires: A Case Study from the Chiquitano Forest in Bolivia

*Kelsay Knutson, Senior, Program on the Environment
Mentor: Ernesto Alvarado, College of Forest Resources*

Many indigenous people have used swidden, or slash-and-burn agriculture, for thousands of years. However, modern issues such as climate change, air pollution, environmental degradation, and over population may make it a practice that is no longer ecologically and socially sustainable. Consequently, it may be necessary for those that have relied on it to use alternative methods to help preserve the landscape for future generations. Therefore, it is not surprising that slash-and-burn fires in developing countries have been one of European and American Environmentalists highest priorities abroad. This attention has led to efforts to educate Native peoples about alternative uses of fire and other agricultural practices, such as prescribed fire. One of the main problems with slash-and-burn agriculture is the amount of carbon it emits. Thus, for my project, I analyzed carbon emissions from slash-and-burn fires over a ten-year period, from 1998 to 2007. In addition, I also investigated many other issues surrounding slash-and-burn fires. Among these issues were the effectiveness of education, and the viability of prescribed fire and alternative fire-use models in other Amazonian countries. I also examined what forest tracts were better able to withstand the effects of slash-and-burn.

Biologic Degradation of Triclosan by a Bacterial Isolate

*Sarah Lynn Koser, Junior, Chemical Engineering
Mentor: John Ferguson, Civil & Environmental Engineering
Mentor: Heidi Gough, Civil & Environmental Engineering*

Triclosan is an antibiotic used in many common household products such as toothpaste, beauty products, clothing and toys. Recent evidence suggests that trace-level concentrations

of triclosan can cause impacts to the environment, such as disrupting algal growth and community biodiversity. Environmental impacts are most often associated with streams receiving wastewater effluent. For this study, starting with a microbial enrichment previously established in the laboratory from activated sludge, I have successfully grown single colonies on fully-defined solid media with micromolar concentrations of triclosan as the sole carbon source. By monitoring concentration loss in defined liquid media using high performance liquid chromatography (HPLC), I have confirmed that this isolate degrades triclosan. 16S DNA sequencing identified the isolate, now designated SK-1, as a close relative of *Ralstonia basilensis*. Interestingly, though *Ralstonia* has not been reported to degrade triclosan, *R. basilensis* was previously isolated using chlorinated phenolic compounds, which share some structural similarities with triclosan. Using the sequence that I obtained for SK-1, primers targeting relatives of *R. basilensis* have been developed. Currently I am testing the substrate range of SK-1, which I recently confirmed grows in a complex media known as Luria-Bertani (LB). Other compounds that I will test include chlorinated phenolic compounds, and other trace-level contaminants found in wastewater. Additionally, a BIOLOG EcoPlate will be employed to test for active respiration using 31 different common carbon sources. Simultaneously, quantitative-PCR (qPCR) protocols will be developed using the new *R. basilensis* primers, which I will implement to quantify *R. basilensis* concentration in wastewater treatment processes, and to develop growth curves under extreme oligotrophic media conditions in bench-scale experiments. These studies will provide valuable information for the growth range of *Ralstonia* species SK-1, and help to establish its ability to degrade trace-level contaminants in wastewater treatment.

Cultivating Community in Small-Scale Organic Olive Oil Production in Sicily, Italy

Maria Elena Rodriguez, Senior, Environmental Studies and Program on the Environment

Student Success Fund Recipient

Mentor: Michael Kucher, Interdisciplinary Arts & Sciences, UW Tacoma

Since the 1970s, numerous Italian family farmers have sought to improve their quality of life while reducing their impact on the environment. One option has been to revert back to historical agricultural practices that reduce or eliminate the use of petro-chemical-based fertilizers and pesticides. Small-scale food producers have strengthened connections with the communities in which they live, through farmer's markets, community supported agriculture programs, food exchanges, and the sale of food products directly from their farms. In response to these recent transitions back to organic and local farming, relationships between humans, their local communities and the land have been redefined. The objective of this ongoing research is

to evaluate how these relationships have changed in recent years and to distinguish ways in which viable markets for locally grown food function in Sicily, Italy. Data was collected from October to November 2007 on small-scale organic olive oil producers throughout Sicily. Open-ended personal interviews were conducted with farmers and community members and observations were made at organic farms, agrotourisms, and farmer's markets. Small-scale organic farmers raised issues about competition over farmland with large-scale "factory farms", inability to compete in the international export industry, and difficulty in selling products to supermarkets. However, it was found that Sicilian olive oil producers who actively employed innovative methods for enhancing community ties, such as neighborhood food exchanges, were more successful in creating viable local markets for their products. Farmers also reported receiving additional benefits such as an increased sense of community and improved quality of life. This evaluation of human relationships and community development is fundamental in expanding possibilities for sustainable development of food systems and providing support to small-scale organic farmers around the world.

Identifying new bacteria that can degrade 17 - ethinylestradiol

Nan Pei, Junior, Civil & Environmental Engineering

Mentor: Heidi Gough, Civil & Environmental Engineering

Mentor: John Ferguson, Civil & Environmental Engineering

The synthetic estrogen 17 -ethinylestradiol (EE2) is an active ingredient in oral contraceptives and hormonal supplements. At low concentrations, EE2 can influence the hormonal system of aquatic animals, and has been associated with feminization in fish. Wastewater treatment effluent has been identified as a major source of EE2 to aquatic systems. To date, only a small number of EE2 degrading microbes have been isolated, and typically these have been at concentrations significantly higher than that found in typical municipal wastewater treatment facilities. Established on the laboratory study, earlier EE2-degrading bacteria were found to be some nitrifying bacteria, which obtain energy from ammonia and carbon from carbon dioxide. In this project, media has been developed to select for bacteria that use EE2 as sole carbon source and energy by replacing ammonia by nitrate. Parallel enrichments will be inoculated with activated sludge with different solids retention times (SRT) to increase the probability of discovering diverse EE2-degrading bacteria. High performance liquid chromatography (HPLC) will be used to monitor EE2 concentration, and enrichments will be transferred when EE2 has been degraded. Polymerase chain reaction (PCR), cloning, sequencing then blasting the results are used to identify the bacterial strain. Terminal restriction fragment length polymorphism (TRFLP) will be used to monitor community simplification. This research

will identify new species that easily degrade EE2 at low concentration.

Environmental Spices in Puget Sound

Britta Voss, Junior, Oceanography

Mary Gates Scholar

Mentor: Richard Keil, Oceanography

Environment splices are organic compounds found in many of the foods we eat that enter the environment through wastewater. Some of these splices occur naturally (such as vanilla and cinnamon) while others are synthetic and originate solely from manufactured foods. Little is known about the impact of these compounds in the natural environment. In areas of Puget Sound where circulation is sluggish, these splices could be building up; or perhaps marine bacteria can use these compounds as a source of energy. It is known, however, that the current levels of environmental splices in Puget Sound can be detected by fish. Our lab analyzes water samples from the West Point Wastewater Treatment Facility as well as from sites around Puget Sound and the more pristine Clayoquot Sound on Vancouver Island. Using a solid phase extraction onto hydrophobic-lipophobic balance cartridges and gas chromatography, I measure concentrations of a suite of natural and synthetic flavoring agents, including cinnamon, thyme, and various vanillin compounds. Already, spikes in certain splices are evident in Seattle's wastewater following the holidays of Thanksgiving, Christmas, and Valentine's Day, when presumably Seattlites are consuming greater quantities of foods containing these flavorings. Continued sampling will elucidate the consistency and nuances of any such patterns. In the near future, we plan to expand our analysis to include other organic compounds found in personal care products (such as perfumes and cleaners). The ultimate goal of these measurements is to demonstrate a connection between residents of the Puget Sound region and our marine environment. Environmental splices provide such a link that the general public can understand in the context of their own lives and personal actions.

SESSION 2D

PSYCHOLOGICAL PERSPECTIVES ON SELF, IDENTITY, AND CULTURE

Session Moderator: Cheryl Kaiser, Psychology

Mary Gates Hall Room 238

*Note: Titles in order of presentation.

The Relationship between Language Preference and Anxiety among Mexican Women in Seattle

Maria Acosta, Junior, Neurobiology

Mentor: Dellanira Valencia-Garcia, Psychology

Mentor: Jane Simoni, Psychology

Despite the historical presence of Latinos in the U.S., there's a lack of health data on Latinos at the national level. In recognizing the importance of mental health for all, it's essential to ensure that the proper information regarding mental health penetrates all cultural barriers. It has become imperative to collect data about language preference and proficiency among the Latino population given that 26 million Latinos in the United States are primarily Spanish speakers. Understanding such questions may indeed allow us to improve on the current approaches to studying Latinas mental health and ultimately expand research in a continually marginalized population. The present is a cross-sectional study targeting Mexican women in the Seattle area. A paper/pencil survey will be administered to participants in the language of their choice, either Spanish or English. Eligibility for participation includes self-identification of Mexican origin, over the age of 18, and living in the greater Seattle metropolitan area. By examining the relationship between language preference and anxiety, we hope to better understand the role language may play in mental health among Mexican women.

Gender difference in depression among Chinese Americans: The role of smoking status

Jeremy Luk, Senior, Psychology

Mary Gates Scholar, Undergraduate Research

Travel Awardee

Mentor: Robert Kohlenberg, Psychology

Mentor: Janice Tsoh, Psychiatry, University of California San Francisco

Mixed findings on gender difference in depression have been reported in population studies across various ethnic groups, but few have considered the account of smoking status. This study investigated the association between smoking status and depression among 1393 Chinese American males and females using baseline data from a nationwide smoking cessation study. Participant characteristics were

43.8% female, mean age=40.4 (range:18-87), 65.1% employed, 74.4% married or living with partner, and 44.2% lived in the U.S. for at least 10 years. The sample included 53.4% current smokers (defined by having ever smoked 100 or more cigarettes and smoked in the past 7 days), 7.3% former smokers, and 39.3% never smokers. A 2(gender) x 3(smoking status) ANCOVA on depression as measured by a 10-item CES-D (Center of Epidemiological Studies—Depression Scale) using employment status, acculturation and perceived social support as covariates showed significant gender x smoking interaction ($F=6.011$, $p=0.003$) and smoking status main effects ($F=14.428$, $p<0.001$). Current smokers scored higher on the CES-D than both former and never smokers (current: 11.477, former: 8.892, never: 9.486, $p<0.001$). Females reported a higher mean CES-D score than males among current smokers (13.091 vs. 11.271, $p=0.002$). No gender difference in depression was observed among former and never smokers. Results suggested that current smoking is associated with elevated depressive symptoms in both Chinese American males and females. Demographics and perceived social support did not account for the observed associations. The findings underscore the importance of addressing depression among Chinese American smokers, especially among females.

Bicultural Identity and Seeing Bias

Elaine Leigh, Senior, Psychology

Mary Gates Scholar, Undergraduate Research

Travel Awardee

Mentor: Cheryl R. Kaiser, Psychology

Research on stigma and discrimination has established that members of devalued social groups can protect their self-esteem by attributing causes of negative experiences to external factors (e.g. prejudice) rather than to internal, global, stable factors (e.g. a personal deficiency). However, the idea of enhancing self-esteem is especially characteristic of Western cultural models of the self that place importance on individuality and independence. In contrast, Eastern cultural models assert that people seek to self-improve (rather than self-enhance) in the face of negative experiences. To understand how cultural identities can affect perceptions of prejudice, 250 Asian American females (who possess both Western and Eastern self-construals) will be completing a cultural priming task activating an American, Asian, or university student identity. Participants will then read a scenario about receiving a bad grade on a test from a male evaluator that contains either blatant, ambiguous, or no sexism cues. Participants will be asked to provide estimates of the likelihood that their grade was due to sexism. They will also indicate how much time they would spend trying to raise their grade for a subsequent test graded by the same evaluator. Participants with an activated Asian identity are expected to make fewer attributions to prejudice and report more self-improvement (i.e. spending more time

on the next test) than those activated with an American or university identity.

Social Desirability: Impact on Participant Response

Mary Alice Davis, Sophomore, Psychology, North Seattle Community College

Mentor: Melissa Grinley, Math, Science & Social Sciences, North Seattle Community College

Social Desirability (SD) is the tendency for people to behave in the most favorable or socially acceptable way. People are more likely to exhibit socially desirable responses in interview versus questionnaire settings. The current study hypothesized that participant response to a verbal survey would be affected by the appearance of the interviewers. The three interviewers had distinct appearance styles: biker, conservative, and hippie. This was a 3x2 between subjects design: each interviewer presented two surveys, either written or verbal. 60 participants answered questionnaires, administered on paper or verbally. We expect participants' verbal questionnaire responses to exhibit higher rates of SD compared to written responses (control group). We also expect differences in participant responses based on which interviewer they encounter. Additional authors of study include: Andrea Sugar and Brent Venters.

The Agony and Ecstasy of Awareness

William Nathaniel Green, Senior, Comparative History of Ideas

Mary Gates Scholar

Mentor: Kathleen Noble, Women Studies

In this project I investigate the intellectual effects of studying consciousness and spirituality in an academic setting. Helping to teach the course HA&S 262b: The Farther Reaches of (Human) Nature, an inter-disciplinary examination of consciousness, I explore how students' beliefs about consciousness and reality change over the quarter and how this impacts their educational experience. Despite a growing interest among college students to explore these issues in their education, few are provided with an opportunity to do so. Recent studies examining the relationship between people's beliefs about consciousness and spirituality and their psychological and intellectual development suggest that these beliefs affect how people learn and that spiritual experiences can be catalysts for psychological development. Drawing upon this research, my project uses qualitative and quantitative methods to collect and analyze empirical data and to discern whether and how participants' beliefs about consciousness and reality changed over the ten-week period. Participants completed a pre and post-test measurement of beliefs about consciousness and reality, kept a journal about experiences related to studying consciousness, and engaged at the end of the quarter in a two hour group discussion about the impact the course had on them. The questionnaire was analyzed statistically and both the journals and group

discussion were content analyzed for themes. Results are forthcoming, however preliminary observations and my own experiences as a student in the Farther Reaches course indicate that studying consciousness is a powerful method to incite curiosity and critical thinking – both highly lauded values within the higher education community.

A Phenomenological Investigation of Job Satisfaction

Shannon Claire Wiedey, Senior, Psychology, Seattle University

Mentor: Steen Halling, Psychology, Seattle University

Research has made it plain that from a managerial perspective job satisfaction is integral to retaining employees, increasing productivity and performance, and ultimately keeping costs low. But since many of us are employees of some sort, surely we should wonder what this experience means from an employee's point of view. That is, what is the nature of the phenomenon in the context of an employees' personal and professional life? This study adds a new dimension to existing research by exploring the qualitative or lived experience of job satisfaction. Data is collected through detailed descriptions, transcripts of follow-up interviews with participants, and previously published accounts. Analysis involves a systematic and careful reading of descriptions in order to arrive at the core components or particular meaning as articulated by participants (using Jonathan Smith's Interpretive Phenomenological Analysis). Such a portrait of essential qualities and meanings (e.g., feeling challenged, that one has a purpose, and having good relations with co-workers) have implications for employees and employers alike. If individuals could gain clarity in their understanding of what satisfaction means to them, they could find more suitable jobs or change their present situations in order to be more satisfied. Also, an understanding of work satisfaction can translate into a better grasp on life satisfaction in general. This understanding and clarity has major implications for employees (since they could become more proactive in shaping their lives) and also for management and organizations (since more satisfied workers stay longer, work harder, have higher morale, and are more productive). As part of the follow-up interviews with participants, the experience of participating in the research project is addressed. This experience is examined in terms of what impact it might have on understanding themselves, the nature of their satisfaction, and their work situation.

SESSION 2E

MOLECULAR DETERMINANTS OF TRANSMISSION, RESISTANCE AND VIRULENCE IN SEVERAL SIGNIFICANT HUMAN PATHOGENS

Session Moderator: Paul Amieux, Pharmacology

Mary Gates Hall Room 241

*Note: Titles in order of presentation.

Breastmilk HIV-1 Transmission among Kenyan Women Receiving Antenatal Zidovudine

Daniel Kim, Junior, Neurobiology

Washington Research Foundation Fellow, Mary Gates Scholar

Mentor: Carey Farquhar, Epidemiology

We evaluated breastmilk HIV-1 transmission in a prospective cohort accrued prior to HAART to determine timing of infant infection and assess risk factors. HIV-1-infected pregnant women were followed in Nairobi with their infants to 12 months postpartum. Women received zidovudine from 34 weeks gestation through delivery and clinical data were collected monthly. Infant HIV-1 infection status was evaluated at birth, 1 month, and then every 3 months using HIV-1 DNA and RNA PCR assays. Cox proportional hazards regression was used to determine rates of breastmilk transmission and risk factors were analyzed with independent t-tests and multivariate regression models. Among 276 mother-infant pairs, 13 infants were HIV-1-uninfected at month 1 and subsequently acquired HIV-1 through breastfeeding. Cumulative probability of being infected was 2.6% at month 3, 3.4% at month 6, 4.6% at month 9 and 5.0% at month 12. Median duration of breastfeeding was 7.9 months. Women with late postnatal transmission had lower CD4 counts antenatally compared to non-transmitters (mean 310 versus 501 cells/ μ l; p=0.006) and maternal viral load was significantly higher at month 1 among transmitting mothers in both plasma (5.25 versus 4.50 log₁₀ copies/ml; p=0.006) and breast milk (3.37 versus 2.53 log₁₀ copies/ml; p=0.009). Only 3 (25%) of 12 women with late postnatal transmission with CD4 results had antenatal CD4<250 and CD4 count was not an independent predictor of transmission risk after adjusting for viral load (p=0.2). Among those with higher CD4 counts, 6 (50%) women had CD4 >250 and <350 and 3 (25%) had CD4 count >350. Advanced maternal disease stage (low CD4 count, higher plasma and breast milk HIV-1) was strongly associated with increased breastmilk HIV-1 transmission risk. The majority of women transmitting after month 1 postpartum had CD4 >250 antenatally and no identifiable risk factors other than high maternal viral load.

Lower Genetic Barrier to Escape from Drug Selection in HIV-2

*Crystal Pyrak, Senior, Microbiology and Art History
Mary Gates Scholar*

*Mentor: Robert A. Smith, Pathology
Mentor: Bradley D. Preston, Pathology*

Two distinct types of human immunodeficiency virus (HIV) are known to cause AIDS in humans: HIV-1 and HIV-2. Both viruses are susceptible to nucleoside analog inhibitors of reverse transcriptase (RT). Although HIV-1 drug resistance has been studied extensively, little is known regarding the development of drug resistance in HIV-2. To examine the genetic basis of nucleoside analog resistance in HIV-2, we introduced specific mutations in RT that are commonly observed in drug-treated HIV-2 patients. We then measured the susceptibility of the resulting mutant viruses to nucleoside analog inhibitors in cell culture. A single Q151M amino acid substitution in HIV-2 conferred substantially greater resistance (40-fold) to the nucleoside analog AZT than the same mutation in HIV-1, which only provided slight resistance to AZT (4-fold). The combination of Q151M with mutations M184V and K65R was sufficient for resistance to all seven of the nucleoside analogs currently used in antiretroviral therapy. In contrast, two of the pivotal substitutions that confer AZT resistance in HIV-1 (M41L + T215Y) had little to no detectable effect on AZT sensitivity in HIV-2. These results demonstrate that relative to HIV-1, fewer mutations in HIV-2 RT are required for escape from drug selection. The lower genetic barrier to nucleoside analog resistance in HIV-2 creates the potential for rapid therapeutic failure and could severely limit the number of effective drugs for treating HIV-2 infected individuals.

Effects of a light activated cancer drug (Hexyl-ALA) on drug resistant human uterine cancer cells

*Mark Shi, Junior, Neurobiology and Biochemistry
Amgen Scholar, Mary Gates Scholar*

Mentor: Rodney J.Y. Ho, Pharmaceutics

Drug resistance is a major challenge for cancer therapy. Drugs that can be activated by a specific light source are being considered to overcome drug resistance. Unfortunately, these compounds, given as a part of photodynamic therapy (PDT), may also be recognized by the multi-drug resistant (MDR1) efflux transporter, which lowers their intracellular concentration. To determine the interactions between a representative compound, 5-aminolevulinic acid hexylester (Hexyl-ALA), and the drug resistant transporter, we systematically examined the effects of light activated Hexyl-ALA on two human uterine sarcoma cells. One expressed MDR1 and the other did not (control). Reduced levels of the Hexyl-ALA metabolite, protoporphyrin IX (PpIX), were observed in MDR1 expressing cells. MDR1 expressing cells also displayed reduced sensitivity to light activated Hexyl-ALA. These

findings indicate that Hexyl-ALA may be a target of the MDR1 transporter. Alternatively, we also observed that Hexyl-ALA negatively affected MDR1 in drug resistant human uterine sarcoma cells. Treatment with light activated Hexyl-ALA reduced the multi-drug transporter's transcript and protein levels. Other housekeeping proteins in the same cells (e.g. GAPDH) were unaffected. Together, these findings suggest that although Hexyl-ALA may be recognized by MDR1, treatment with light activated Hexyl-ALA could be used to selectively reduce MDR1 protein levels and may help overcome cancer cell resistance to widely used cancer drugs, such as doxorubicin and paclitaxel.

High-Throughput Mass Spectrometry Analysis of Influenza Virus-Host Protein Interactions

Kevin Wilmot, Senior, Microbiology

Mentor: Michael G. Katze, Microbiology

In 1918, nearly 60 million people worldwide lost their lives to a highly pathogenic strain of influenza virus. To this day, tens of thousands of people, primarily the young and the elderly, still lose their lives to influenza virus infection. The human body has the capacity to mitigate the effectiveness of viral infection through primary immune defenses that stimulate the antiviral state of a host cell. However, successful viruses have developed ways to subvert the host's ability to mount a proper immune response to infection. Previous data suggests that the virally encoded NS1 (non-structural 1) protein functions to antagonize the host response during influenza virus infection. Further studies have shown that in the absence of NS1, virulence of influenza virus is severely attenuated. We hypothesize that NS1 attenuates the antiviral response through its interaction with host proteins that play crucial roles in activating the immune response. The present study examines four different NS1 genes: one from the 1918 influenza virus infection and three from highly pathogenic lethal H5N1 infections isolated from patients in Hong Kong, Thailand, and Vietnam. We compared these to an NS1 gene from a less pathogenic strain of influenza virus. NS1 protein bound to any host proteins with which it is interacting were purified, and mass spectrometry analysis was performed to determine the identity of the NS1 binding partners. Results from this experiment will provide further insight into novel immune pathways while also giving us a clearer understanding of how influenza virus attenuates the host's immune response to viral infection. This understanding will enable the development of better vaccines and treatments for influenza virus infection.

Investigating the Role of GTP Cyclohydrolase-I in Sulfadoxine-Pyrimethamine Resistance in Malaria Parasites

*Lianna Wood, Senior, Biochemistry and History
Amgen Scholar, Herschel and Caryl Roman
Undergraduate Science Scholarship
Mentor: Carol Sibley, Genome Sciences*

Every year, approximately 500 million people become severely ill with malaria. Malaria is caused by eukaryotic parasites of the genus Plasmodium, transmitted by the bite of the Anopheles mosquito. The most lethal species of malaria in Africa, *P. falciparum*, is now almost entirely resistant to sulfadoxine-pyrimethamine (SP), one of the inexpensive drugs most commonly used in malaria treatment. Clinical resistance to SP has been associated with a series of four point mutations in the dihydrofolate reductase (DHFR) gene that encodes one of the enzymes in the folate pathway directly targeted by the drug. Surprisingly, highly resistant SP mutants have only developed a handful of times, but subsequently they have spread widely to other parts of the world. This limited set of origins of SP resistance implies additional factors may be necessary to develop SP resistance beyond the handful of point mutations in the DHFR gene identified so far. Recently, Kidgell, et al discovered a high variability in copy number in *P. falciparum* GTP cyclohydrolase-I (GTP-CH), the gene that encodes the first enzyme in the folate pathway. An increase in GTP-CH copy number may increase the concentration of folate pathway intermediates that compete with the drug for binding to the enzymes targeted by SP, reducing the effect of the drug on the parasite and increasing resistance. We are currently investigating the relationship between GTP-CH copy number and drug resistance in *P. falciparum*, utilizing a set of patient blood samples collected in Kilifi, Kenya between 1987 and 2006. The collection of these samples began before SP was used in the area and ended at a time when SP resistance had increased to a very high level. By measuring the copy number over time, using quantitative PCR, we can assess the correlation between the GTP-CH copy number and SP drug resistance.

Toxicity of malaria proteins to *Escherichia coli*

*Michelle Kriner, Sophomore, Biochemistry
NASA Space Grant Scholar, Mary Gates Scholar
Mentor: Pradipsinh Rathod, Chemistry*

Malaria, a disease caused by parasites of the genus Plasmodium, is responsible for approximately three million deaths annually. Widespread resistance to antimalarial drugs has made the development of new drugs essential. In order to study a potential drug target, large amounts of the protein must be generated. While this is traditionally done in bacteria such as *Escherichia coli*, malaria proteins are often difficult to express in such systems. It is hypothesized that this occurs because malarial proteins are toxic to *E.*

coli. *Plasmodium falciparum* dihydrofolate reductase (DHFR) is being used as a model for understanding the molecular basis of this toxicity. In the first experiments to quantify toxicity, *E. coli* were transformed with a range of plasmids that express DHFR at different efficiencies due to the presence/absence of transcriptional and translational regulators. As expected, the greatest decrease in bacterial viability was observed when the DHFR protein was produced most efficiently. It was further hypothesized that the molecular mechanisms of malaria protein toxicity involve nucleic acid binding domains that are not found in common model organisms but are active in normal, autologous gene regulation in malaria parasites. In order to test this hypothesis, the plasmids from bacteria that survived malaria DHFR expression were retransformed into fresh *E. coli*. It was expected that regions of the DHFR gene that are responsible for toxicity would be mutated and thus be identifiable from sequencing data. Results from this second set of experiments are pending.

SESSION 2F

LOOKING AT PROBLEMATIC AREAS IN THE FORMULATION OF AMERICAN FOREIGN POLICY

*Session Moderator: Daniel Chiro, Sociology and the Jackson School of International Studies
Mary Gates Hall Room 242*

Security Through Diversified Diplomacy: U.S. Policy for South Asia

Christina Billingsley, Senior, International Studies and History

Jonathan Brown, Senior, International Studies and Economics

Tyler Burns, Senior, International Studies

Regina Durr, Senior, International Studies and Political Science

Angela Gaffney, Senior, International Studies

Elizabeth Jeffers, Senior, International Studies

Robert McVay, Senior, International Studies

Leila Mende, Senior, International Studies

Veryl Pow, Junior, International Studies

Matt Scroggs, Senior, International Studies

Charity Thielen, Senior, International Studies

Andrea Waade, Junior, International Studies

Stepanie von Wogau, Senior, International Studies

Rachel Wood, Senior, International Studies

Mentor: Anand Yang, Jackson School of International Studies

U.S. relations with South Asia have never been more

important. The economic and political changes that have been ushered in by the 21st century have reinforced the need for the U.S. to create stronger bilateral ties with nations throughout the world, but especially in the growing South Asia Region. Whether through increased economic ties with India, cooperation in transparency and human rights in Bangladesh, or nuclear safeguards in Pakistan, it is the duty of the United States as a world power to enhance its partnerships in the region. The time has come for a U.S. foreign policy based not solely on our regional interests, but on our values, among which are freedom of religion, access to healthcare and education, and freedom from tyranny. This Task Force accepts the responsibility in creating this foreign policy in South Asia. Divided into three sections: National Security, Human Security, and Economic Relations, the Task Force has crafted a broad and interwoven foreign policy. National Security needs come first, as the first goal of any U.S. policy abroad is to ensure the safety of Americans. No amount of economic prosperity or public education will matter in the short term if the people are not safe. The other sections focus on long term solutions to complex problems. The environment, human rights, public health, and student exchanges have never been perceived as the most important topics of diplomacy, but this Task Force argues that these human and economic security issues are strongly correlated with security issues. To solve one is to solve the other, and to ignore one is to exacerbate the other. Through a comprehensive approach, we believe that both the United States and South Asia can become safer and more prosperous through the implementation of these recommendations.

Modeling a Cooperative's Success: Narrative and Charisma in Chávez's Bolivarian Revolution

Laura A. Brady, Senior, International Studies

Mary Gates Scholar

Mentor: Anand Yang, Jackson School of International Studies

Mentor: Deborah Porter, Jackson School of International Studies

Rigorous state-promotion of cooperatives as part of the Bolivarian Revolution has triggered an increase in the number of cooperatives in Venezuela from 762 in 1998, before President Hugo Chávez came to power, to 108,000 in 2006, placing Venezuela above all other countries in its number of cooperatives. In July 2007, however, Chávez declared the program a failure, condemning it for its failure to transform capitalistic relations. Given Chávez's break from a past of exclusionary national rhetoric and his popular support, the failure of the program is counterintuitive. Equally so is the absence of literature that addresses the success or failure of cooperative movements existing external to communist and dictatorship state regimes. My research of Cecosesola (Central Cooperative of Lara state), a pre-Chávez cooperative that has been

applauded internationally as one of the most successful examples of cooperative development, addresses this gap. I argue that a cooperative's success is tied to its effectiveness in generating a new group narrative, and that for this narrative to arise, a cooperative must be the product of individual initiative for the purpose of serving a communal need. Unlike Cecosesola, which has developed independently of state support and with its own narrative of Venezuelan and global belonging, Chávez's program provided cooperatives with an already-formulated state narrative of cooperative identity reliant on his charisma. Due to their inherent politicization and position as a key element in Chávez's revolutionary state-centric model, the state-promoted cooperatives could not, as a whole, stimulate the citizen mobilization for which they were initially designed. My research ultimately suggests new reasons for why cooperatives succeed or fail, what role cooperatives play in citizen mobilization and forms of protest and, most significantly, why Chávez's government is characterized by the contradiction of strong popular support but weak social change in response to community-building programs.

Child Soldiers in Chad: A Policy Window for Change

Mary Jonasen, Senior, Interdisciplinary Studies, UW Bothell

Mentor: Ron Krabill, Interdisciplinary Arts & Sciences, UW Bothell

The post-Cold War period has experienced a rise in the use of child soldiers fighting in conflicts worldwide to numbers exceeding a quarter of a million. This research focuses on child soldiers in Chad, and how the worsening regional instability in Central and Western Africa forces more children into Internally Displaced refugee camps, creating a vicious cycle of violence in which children are vulnerable to being used as soldiers. Although most of the countries perpetuating this practice have signed and ratified the International Convention on the Rights of the Child, children continue to be caught up in soldiering while protection of their human rights remains largely unenforceable. The current debate involving the age of accountability and appropriate punitive measures draws attention away from potential solutions. The policy proposals made in this paper support incentives to create compliance within the Chadian government, but the most significant proposal favors a long-term solution of a regional grass roots peace building and human rights education.

Justice Denied: Impunity During and After the Salvadoran Civil War

*Liam McGivern, Junior, Interdisciplinary Arts & Sciences (Global Studies), UW Bothell
Mentor: Julie Shayne, Interdisciplinary Arts & Sciences, UW Bothell*

Justice Denied: Impunity During and After the Salvadoran Civil War is an examination of three infamous atrocities of the Salvadoran civil war and attempts to bring those responsible to justice. The Salvadoran civil war lasted twelve years, from 1980-1992, and resulted in the deaths of approximately 75,000 civilians. The first case is the March 1980 assassination of Archbishop Romero, a highly revered and outspoken critic of the Salvadoran government. The second case is the December 1980 rape and murder by a government death squad of four American churchwomen. The final case discussed is the November 1989 murder by Salvadoran military personnel of six Jesuit priests/professors and their two domestic servants on the University of Central America campus where they taught. The Salvadoran justice system, the international justice system vis-vis a United Nations Truth Commission, and the United States civil courts attempted to hold those responsible for the human rights atrocities accountable for their crimes. The Salvadoran justice system, however, tried only to accountable hold those individuals who actually committed murders, not the military officials who ordered the killings. I argue that ultimately justice was never served due to four factors: corruption within the government of El Salvador, a lack of power given to the United Nations Truth Commission, United States Cold War politics, and the inability of the United States civil courts to create meaningful accountability for former members of the Salvadoran military responsible for human rights violations. In addition to secondary research, this paper is based on first-hand accounts from the memoirs of Robert White, who was United States Ambassador to El Salvador during the time the atrocities were committed, and James Burgenthal, who was a member of the United Nations Truth Commission for El Salvador.

US National Space Policy, Missile Defense, and Sino-Russian Relations

*Victoria Stephanova, Senior, International Studies
Mentor: Darryl Johnson, Jackson School of International Studies*

In the late 1990s, former Secretary of Defense Donald Rumsfeld chaired two major advisory panels on national security. The first commission stated that “rogue states” such as North Korea could be just five years away from possessing the capabilities to attack the United States with ballistic missiles. The second commission warned of a growing need to protect US space systems against possible attacks from countries and groups hostile to the United States. These findings had considerable influence

on the George W. Bush administration’s national security strategy. In 2002, the US announced its intention to develop and deploy missile defenses aimed at defending the United States and its friends and allies against limited ballistic missile strikes. Four years later, the White House released its version of the US National Space Policy. This document asserts the United States’ freedom of action in space and suggests that the US may pursue space-based weapons that could destroy satellites or terrestrial targets. Furthermore, it states that the United States would oppose any new international agreements that would restrict or prohibit US space activities. These developments have strained the United States’ bilateral relations with Russia and China. Moscow and Beijing have argued that US policies could lead to a militarization of outer space, an arena that has been only used for “peaceful purposes” thus far. With this in mind, my research will examine whether the Bush administration’s pursuit of missile defenses and its unwillingness to forgo the development and deployment space weapons could inadvertently prompt increased Sino-Russian cooperation against the United States.

SESSION 2G

THE PERFORMANCE OF SOCIAL RESPONSIBILITY

*Session Moderator: Judy Howard, Sociology and Women Studies
Mary Gates Hall Room 248*

Cross Cultural Comparisons of Corporate Environmental and Social Responsibility Performance in the U.S. and Canada

*Sean Cappello, Senior, Biology (Ecology & Evolution)
Mentor: Dorothy Paun, Business & the Environment*

Introduction. Sustainability refers to meeting the current needs of people, businesses, governments, and organizations without compromising Earth’s capacity to provide for future generations. This requires balancing environmental stewardship, social responsibility, and financial prosperity, an integration referred to as a “triple bottom line” approach to sustainability. Research Goals. The number of corporations reporting sustainability performance has increased dramatically (KPMG 2006), but this trend might stall if the costs of sustainable business practices outweigh the benefits. Our Study 1 investigated sustainability performance reporting (SPR), information disseminated annually by corporations on their environmental and social responsibility practices and associated performance. Study 2 will explore whether sustainable business practices impact financial returns and if positively or negatively.

Furthermore, cross cultural comparisons of U.S. and Canadian firms are an important component for insights into drivers and incentives in North America. Study 1 Methods. We conducted an analysis of sustainability performance reports using the Pacific Sustainability Index (Morhardt, 2006), an assessment method based on Global Reporting Initiative (GRI, 2006) guidelines and protocols for sustainability reporting. Additionally, cross cultural comparisons were explored between U.S. and Canadian firms using a sample of publicly-traded firms. Study 1 Findings. Major findings: 1) on average, all North American firms scored higher environmental performance than social responsibility performance; 2) U.S. firms scored higher environmental performance relative to Canadian firms; and 3) Canadian firms scored higher social responsibility performance relative to U.S. firms. Study 2 Research in Progress. Demands for better corporate stewardship have created a shift in business management. Study 1 findings provide justification for a deeper exploration of the impact of SPR on corporate financial performance. If a positive correlation is discovered, then it will provide a powerful incentive (i.e. benefit) for corporations. Sustainability value creation will promote innovative financial intangibles that positively affect corporations and the quality of life for North American citizens.

Power Trip: Contemplating Power in Travel

*Melissa Chin, Senior, English and Comparative History of Ideas
Mentor: Christina Wygant, Comparative History of Ideas*

In this age of increasing globalization, travel is ubiquitous and for some, a frequent affair – whether in the form of leisure vacations, luxurious business trips, or labor migration. Travel, therefore, requires a constant rethinking and redefinition. My research explores the intersections and divergences of colonialism, migration, and tourism, as well as the difficulties in naming them each as “travel”. It spans the time from the age of imperialism to contemporary times, seeking to demonstrate that though each of these forms of movement may seem different, they are inextricably connected by the same hierarchies of power. Though travel theory is rich, little to nothing has been written on the intersections of these three important forms of movement, making this work significant and especially pertinent to our global condition. This project analyzes the histories of both European and U.S. colonialism and the types of movement those histories produced, setting a framework that continues to present itself in these contemporary forms of people movement. I explore different forms of movement asking first if they can be called travel, and further, how they are interconnected with each other. If colonialism, migration, and tourism are each forms of travel, how are they interrelated, and what are the implications of these intersections? Looking at the tensions between the voluntary forms of movement and others that are forced – whether by political or economical

powers – I explore how one influences the other and how even contemporary forms of movement are rooted in the power structures laid out in the colonial era.

Socially Responsible Apparel Purchasing at the University of Washington

Catherine Vincler, Senior, International Studies and Spanish

Katherine Furia, Senior, International Studies

Maryleah Hahesy, Senior, International Studies

Calla Hummel, Senior, International Studies

Mary Gates Scholar

Anthony Maack, Senior, International Studies

Kara Mann, Senior, International Studies

Alyson McLean, Senior, International Studies

Carrie Moore, Recent Graduate, International Studies

Maria Nicholson, Senior, International Studies

Andrew Rakestraw, Senior, International Studies

Mentor: Angelina Godoy, Jackson School of International Studies and Law, Societies, & Justice

In the winter of 2008, a senior research class of sixteen students from the Jackson School of International Studies set out to explore how the University of Washington could take a more proactive approach in its apparel purchasing practices. Our ultimate goal was to create a set of recommendations, outlining steps the UW could take to ensure that UW apparel is produced in a socially responsible manner. The Task Force was structured around an intensive week-long fact-finding mission to Guatemala, where we gained greater perspective on how the purchasing tendencies of UW licensees affects workers inside countries that produce UW logo apparel; culminating in a fuller understanding of the entire supply chain and how it functions. Prior to our trip to Guatemala, we conducted preliminary research on current UW licensees, initiated interviews with representatives from major brands, and studied Guatemala's labor history. Once in Guatemala, we conducted interviews with labor organizers, factory unions, a Ministry of Labor official, factory owners and managers, current workers who make UW logo apparel and workers who were fired from factories that used to make UW logo apparel. Additionally, we participated in tours of one unionized factory and two non-unionized factories. In our report, we outline and analyze the root causes that contribute to labor rights violations within the apparel industry supply chain, using the Guatemalan apparel industry as a case study. These findings contributed to short, medium, and long-term policy recommendations for UW's President Mark Emmert, to ensure that the conditions in factories that produce UW apparel can be better monitored and improved.

Creating ‘Friends of Jayyous’: Supporting Social Agency in Sites of Conflict

*Mark Balmforth, Senior, Comparative History of Ideas
Mary Gates Scholar
Mentor: Theron Stevenson, Comparative History of Ideas*

In June 2007 I traveled to Israel and the Palestinian Occupied Territories to research Israel’s security fence, called the ‘Apartheid Wall’ by Palestinians. There, I met a farmer in a Palestinian village called Jayyous who explained the village’s precarious future due to its proximity to the fence ‘Wall.’ As I saw firsthand, the barrier’s path has restricted the village’s access to two thirds of its land—crippling the ability of many families to support themselves. This village, home to 3000 inhabitants, exemplifies the tragic nexus between conflict, non-combatants and the destruction of social environments. I developed the Friends of Jayyous project to focus on the non-profit import of Jayyous’s olive oil, the village’s traditional and struggling industry and encourage a transnational community of support for the village. This case study of student engagement and global citizenship intertwines theory and practice; employing topics and themes such as the use of sustainable development models and the economic and social impacts of conflict, provoking cross-cultural awareness and the expression of humanity across divides. Forming Friends of Jayyous has shaped my understanding of project development as well as the myriad potential difficulties that working in politically contentious regions might incur. From the beginning of the project, questions and challenges arose from unexpected angles, yet the value of better understanding and learning from those setbacks has added tremendously to my undergraduate experience—helping me put real meaning behind the term ‘global citizen.’

SESSION 2H

RELATIONSHIPS BETWEEN BIOLOGICAL AND ENVIRONMENTAL SYSTEMS

*Session Moderator: Ginger Armbrust, Oceanography
Mary Gates Hall Room 251*

Development of a proxy for salinity from lipid biomarkers in halotolerant microorganisms

*Jeff S. Bowman, Biological Oceanography and Biology
Levinson Emerging Scholar, Mary Gates Scholar
Mentor: Julian P. Sachs, Oceanography*

Throughout the world inter-annual variations in precipitation constitute a major feature of the climate. The salinity of lakes and lagoons is fundamentally related to the

relative rates of precipitation and evaporation. A proxy for salinity based on the ratio of deuterium to hydrogen (D/H) in lipid biomarkers from phytoplankton has recently been applied to reconstruct hydrologic changes in the geologic past from sediment cores taken in the ocean and in lakes. We propose a new proxy for salinity based on changes in the lipid composition of halotolerant and halophilic microorganisms. Preliminary analyses of the polar fraction of lipids from the halotolerant gammaproteobacteria *Salinivibrio* grown at NaCl concentrations of 100 and 150 ppt suggest a markedly different lipid composition. A selection of two lipid biomarkers, one that changes with salinity and one that does not, will allow for a ratio that describes salinity independent of the abundance of the organism. We will report on the analysis by column and gas chromatography and mass spectrometry of the lipid composition of halotolerant strains of *Halomonas* and *Salinivibrio* grown at NaCl concentrations of 30, 60, 90, 120, and 150ppt.

The influence of population density on the capture of algal drift in *Strongylocentrotus franciscanus*

*Van Helker, Senior, Biology
Mary Gates Scholar
Mentor: Kevin Britton-Simmons, Biology*

In the San Juan Archipelago highly productive algal communities coupled with long-shore tidal currents allow the red sea urchin, *Strongylocentrotus franciscanus*, to rely on capturing drift algae instead of active grazing. Previous studies assert that aggregations of *S. franciscanus* protect juveniles, increase reproductive success, and reduce water velocities. We hypothesized that high density urchin populations would produce a non-additive, negative effect on water velocity, resulting in increased per capita drift capture and more selective feeding. We used a BACI (Before After Control Impact) experimental design to test the effects of population density on per capita drift capture and built a passive drift catcher to quantify drift abundance in the field. We found that density had no effect on per capita drift capture or feeding selectivity, however, additional analyses indicated that wind generated waves can be important for generating algal drift, but that this effect occurs over relatively small spatial scales.

The Connection Between Methylotrophy and Iron Homeostasis in *Methylobacterium extorquens* AM1

*Lauren Palmer, Senior, Biology
Levinson Emerging Scholar, Mary Gates Scholar
Mentor: Mary Lidstrom, Chemical Engineering*

Methylotrophic bacteria are important in the global carbon cycle and offer potential for bioindustrial production of value-added products from methanol. Though methylotrophy in *Methylobacterium extorquens* has been studied for decades, connections between methylotrophy and other metabolic pathways remain unknown. Microarrays comparing

chemostat cells grown with methanol to those grown with succinate showed an increase in gene expression of iron uptake genes during methanol growth, suggesting an increased iron requirement during methylotrophic growth. Here, we demonstrate this increased iron requirement by growth analysis using dipyridyl as an iron chelator. Cells grown with methanol were more sensitive to iron chelation than those grown with succinate. Cells grown with both carbon sources showed an intermediate sensitivity to iron chelation. Parallel studies with a strain containing a null mutation in *qscR*, the serine cycle regulator, suggest *QscR* may regulate both methylotrophic carbon assimilation and iron homeostasis. The *qscR* mutant strain is deficient in methanol growth, while microarrays in the *qscR* mutant strain show that *QscR* may activate iron uptake genes. Gel retardation assays demonstrate a direct binding to the promoter regions of iron uptake genes. In addition, *QscR* is a known auto-repressor, and in *in vitro* studies, iron increases the ability of *QscR* to bind to its own operator, suggesting a mechanism for self-regulation and coordination of methylotrophic metabolism and iron levels. Future work will characterize the involvement of *QscR* in iron homeostasis *in vivo*, including promoter fusion experiments testing expression of iron uptake genes in the wild-type strain and the *qscR* mutant strain. This regulation scheme may allow fine-tuning of iron levels during methylotrophic growth and may offer a novel mechanism to regulate iron levels in the cell.

Freshwater Flux and Mixing of a Highly Glaciated fjord: Glacier Bay, Alaska

Chase Stoudt, Senior, Oceanography

Mildred Carpenter Scholarship for Unique Undergraduate Research

Mentor: Eric D'Asaro, Applied Physics Lab

Glacier Bay Alaska is a highly glaciated fjord in southeastern Alaska that exhibits a very unique pattern of circulation due to its large amount of freshwater input from both tidewater glaciers and rivers. This freshwater input determines stratification within the water column, which also affects deepwater intrusion from the ocean. The magnitude of freshwater leaving the bay has not been accurately determined in the past, due to the environmental difficulties in measuring this number. To measure this number, surface drifters will be deployed along with a CTD cast at each deployment site. The purpose of the CTD (Conductivity, Temperature, and Depth) will be to calculate the density of the surrounding water. Using a mass balance equation, the flux of freshwater can be determined by combining the velocity of the drifters with the density of the surrounding water. By measuring the salinity at the endpoints of the drift tracks we can calculate the mixing coefficient. With both the freshwater flux and mixing coefficients major oceanographic implications involving circulation can be hypothesized.

Seasonal diversity of marine cyanobacteria *Synechococcus* in a low dissolved oxygen estuary, Hood Canal

*Amanda Thompson, Senior, Aquatic & Fishery Sciences
Mentor: Gabrielle Rocap, Oceanography*

The cyanobacteria *Synechococcus* are found in most surface waters of the world's oceans and account for a large percentage of primary production. Hood Canal, Washington, where *Synechococcus* are present, is an increasingly hypoxic body of water whose conditions are responsible for many fish kills over the last decade. Changes in primary production are one of many possible explanations for these conditions. *Synechococcus* is known to have at least 14 closely related clades distinguishable by physiological characteristics; many of these clades often coexist in a single environment. The goal of this project is to assess the diversity of *Synechococcus* in Hood Canal by analyzing the variety of individual clades using Terminal Restriction Fragment Length Polymorphism (T-RFLP). T-RFLP is a microbial analysis method involving PCR amplification and fluorescently labeled primers to display diversity by marking lengths of a specific DNA fragment, in this case, of *Synechococcus*. Environmental DNA samples taken from Hood Canal throughout the year will be assessed using the T-RFLP method to determine the overall diversity, and possibly seasonal diversity, of *Synechococcus* clades in waters of dangerously low dissolved oxygen levels. These results may eventually be used to correlate cyanobacterial diversity with environmental conditions in Hood Canal. Using our data with those collected by other research groups studying Hood Canal, such as temperature, chlorophyll levels, nutrient availability and concentration, and dissolved oxygen levels, we can establish a link between the diversity of *Synechococcus*, and specific environmental factors in Hood Canal and possibly find a correlation between *Synechococcus* diversity, specific environmental factors and the increasing hypoxia in Hood Canal.

SESSION 2I

MICROSCOPIC STRUCTURES: CELLS, CHROMOSOMES AND GENES

Session Moderator: Hannele Ruohola-Baker,
Biochemistry and Genome Sciences
Mary Gates Hall Room 254

Screening for Germline Stem Cell Mutants *Drosophila Melanogaster*

Vafa Amirkia, Junior, Physiology and Chinese
Mentor: Hannele Ruohola-Baker, Biochemistry

One of the key characteristics of stem cells is their capacity to divide for long periods of time in an environment where most of the cells are quiescent. Therefore, a critical question in stem cell biology is how stem cells escape cell division stop signals. Here, we report the necessity of the microRNA (miRNA) pathway for proper control of germline stem cell (GSC) division in *Drosophila melanogaster*. Using the FRT/flp mechanism to induce homozygous mutant adult flies allows for analysis of mature GSCs. Analysis of GSCs mutant clones, the homozygous mutant flies, revealed a marked reduction in the rate of germline cyst production. These mutated GSCs exhibit normal identity but are defective in cell cycle control. On the basis of cell cycle markers and genetic interactions, we conclude that mutant GSCs are delayed in the G1 to S transition, which is dependent on various inhibitors, and/or enzymes. Hence, each random mutation can potentially stop the cell cycle at any point in the cell cycle.

Design and Construction of Regulatory Gene Cassettes for Muscle-Specific Gene Expression and the Treatment of Muscular Dystrophies

Melvin T. Donaldson, Junior, Bioengineering and Biochemistry

Amgen Scholar; Mary Gates Scholar; NASA Space Grant Scholar
Mentor: Stephen Hauschka, Biochemistry
Mentor: Robert Welikson, Biochemistry

Transcriptional regulatory regions of the human muscle-specific gene Muscle Creatine Kinase (MCK) hold great potential for use in muscle disease gene therapy. Comparative sequence analyses of the MCK gene have previously identified highly conserved regions across several mammalian species, including human and mouse. Studies using these regions or regulatory cassette derivatives of the mouse gene drive high reporter gene expression specifically in muscle cells. Our current studies focus on deriving regulatory cassettes from the human MCK gene because its regulatory regions should

be more active than mouse MCK in human patient cells. Our experimental strategy will involve incorporating regulatory regions from human and mouse MCK genes into: 1) mouse and human embryonic skeletal myoblasts and 2) rat neonatal and human ES-derived cardiomyocytes via lentiviral transduction. Generation of the recombinant lentivirus for transduction involved cloning the upstream promoter of the human MCK gene (-937 to +50) into a lentiviral transducing vector with a nuclear localized LacZ (nLacZ) reporter gene containing a carboxyl terminal myc-tag for immunohistochemical staining. Muscle cell-specific expression will be determined by imaging nLacZ expression by X-gal staining and immunostaining with antibodies specific for b galactosidase, the myc epitope and muscle cell proteins. I will assay for relative transcriptional activity and muscle specificity in the different striated muscle cells by quantitative real-time PCR with primers designed for b galactosidase and for muscle-specific and viral mRNAs. In order to assess the function of the most critical control elements in the human MCK promoter I will mutate specific transcription factor binding sites in the human gene (e.g. E-boxes) that have been previously shown to be critical for muscle-specific expression in the mouse MCK promoter. If the human and mouse promoters behave similarly we expect to see changes in transcriptional activity with these mutated constructs.

Myogenic Differentiation of Somite cells in Response to FGFs and TGFs

Diana Eng, Senior, Bioengineering
Mary Gates Scholar
Mentor: Stephen Hauschka, Biochemistry

Somites are transient developmental structures that give rise to the dermis, vertebrae, and skeletal muscle. Cells within the somite receive signals from surrounding tissue that induce myogenesis and the expression of skeletal muscle specific proteins such as the myosin heavy chains (MyHCs). The signaling factors, bFGF, FGF8, and TGF- β 3 are of particular interest as potential inducers of myogenesis because they have been detected in chick embryo tissues adjacent to the somites during development. Previous studies in our lab have shown that bFGF and TGF- β 1 act synergistically to induce myogenesis in uncommitted somite explants. The aim of this study is to test the myogenic and proliferation inducing capability FGF and TGF family members both alone and combinatorially, and to determine when their presence is required. Myogenesis was quantified by immunostaining explants with a MyHC antibody and determining the percent MyHC+ cells per explant, and S-phase cycling was studied by BrdU incorporation into DNA. Treatments containing single factor conditions, or FGF8, induced little to no myogenesis in somite explants, while combinations of bFGF with a TGF- β family member showed synergy. Conditions containing bFGF had greater numbers of cells per explant, but percent cells undergoing S-phase at 24 and 48 hours

was not statistically significant, suggesting that increased proliferation is not the primary reason for the increase in myosin positive explants. Furthermore, it was found that the presence of bFGF and TGF- β 3 were necessary for the first 24 and 6 hours of culture respectively. These results suggest that TGF β 3, which is present at the right time and place to induce myogenesis of the somite cells, may be an important component of an FGF signaling pathway that induces muscle differentiation in the developing chick.

In vitro characterization of Kif18A; toward understanding its role in chromosome positioning during mitosis

Ryan Lemke, Senior, Biochemistry

Mary Gates Scholar

Mentor: Chip Asbury, Physiology and Biophysics

Mitosis (cell division) is the process by which one cell becomes two and is essential for the survival of all living things. During mitosis it is crucial for sister chromosomes to be separated, insuring that each daughter cell receives a complete DNA compliment. The mitotic spindle, a bipolar array of microtubules (MTs), attaches to each chromosome to organize and separate them. For proper partitioning of the parent cell genome to occur the chromosomes must first achieve congression at the spindle equator. The cell must exert exquisite control over the growth and shortening of MT's to position chromosomes. Errors in this process lead to unequal division of the genome and aneuploidy, the causes of genetic diseases such as Down's syndrome and some cancers. Despite the importance of this process, decades of research have not revealed the mechanism by which cells achieve this congression. Ongoing work by the Wordeman and Asbury labs implicates Kif18A, a human kinesin, as responsible for controlling the movement of chromosomes during congression. Cells lacking Kif18A fail to align their chromosomes and complete mitosis. Live cell imaging experiments indicate that Kif18A provides the spatial cue to help chromosomes find the spindle equator. We hypothesize that the function of Kif18A depends on a concentration gradient it forms on MTs, thus we are characterizing this protein *in vitro* to better understand its role influencing chromosome position during mitosis. I have experimentally verified that some attributes of Kif18A support our hypothesis, and our research continues with more exciting experiments. I am lucky to use the advanced tools in the Asbury Lab such as optical trapping (or laser tweezers) and TIRF microscopy to characterize this fascinating motor protein.

Cloning of Fluorescent Proteins for Expression in the Retina

Josephine L. Quitugua, Senior, Psychology

Mary Gates Scholar, EIP Presidential Scholar, EOP Scholar

Mentor: Susan Brockerhoff, Biochemistry

Mentor: Owen Lawrence, Biochemistry

Cone photoreceptors respond within milliseconds to small changes in illumination and require high metabolic rates. Existing research on photoreceptor function provides limited information about the molecular mechanisms of energy metabolism in cone cells. Unfortunately, the high metabolic rates make cone cells extremely vulnerable to mutations that disrupt the energy producing or consuming pathways and may stimulate the production of lethal reactive oxygen species (ROS) that could potentially cause cone photoreceptor cell death. Mutations in phototransduction pathway proteins can lead to changes in energy consumption and often cause retinal disease and even blindness. As such, we are using zebrafish which carry mutations in cone phosphodiesterase 6 (pde6c $-/-$) to study the mechanism of cone cell death. By expressing fluorescent proteins (i.e. mYFP, Kaeda, and td Tomato) in mutant cones, we can visualize the morphology of dying cones. Gateway Cloning Technology allows rapid gene cloning using recombination to move DNA fragments between plasmids. We are cloning the fluorescent proteins into entry plasmids for later insertion into the Bleeding Heart destination plasmid, which is injected into mutant zebrafish embryos. With our investigation of how cone photoreceptor cells die, we will gain a deeper insight into a possible prevention of cone photoreceptor degeneration and retinal disease.

SIR2 and a Link to Respiration in Yeast Aging

Bie Nga (Angela) Tchao, Senior, Biochemistry and Psychology

Mentor: Brian Kennedy, Department of Biochemistry

SIR2 (silent information regulator) is a part of the Sirtuin gene family conserved in evolutionarily distinct organisms. Sirtuins are NAD $^{+}$ -dependent histone deacetylases that have been implicated in regulating the lifespan of a variety of organisms including yeast, worms, and mice. In yeast, SIR2 is critical for silencing at the ribosomal DNA (rDNA) locus, a region of highly repetitive genes that code for rRNA. If unregulated, these repeats will continuously recombine to form extrachromosomal rDNA circles (ERCs), which become toxic to the cell. Deletion of SIR2 causes a loss of transcriptional silencing at the rDNA locus, increases ERC formation, and shortens lifespan. Consistently, an extra copy of SIR2 (2X-SIR2) limits ERC formation and extends yeast lifespan. Therefore, one model by which 2X-SIR2 is thought to increase lifespan is by limiting ERC formation. However, SIR2 has also been shown to regulate lifespan in worms and flies yet yeast is the only organism in which ERCs have been observed; this would suggest the possibility of an alternative mechanism for lifespan regulation. Here, I provide evidence for an alternative pathway for SIR2-mediated longevity regulation. Epistasis analysis has identified HAP4 to be essential for lifespan extension of 2X-SIR2. HAP4 is responsible for the regulation of respiration genes suggesting that the long lifespan of 2X-SIR2 is dependent

on respiration. In addition, fluorescence microscopy has uncovered differences in staining of mitochondrial DNA between 2X-SIR2 and wildtype yeast strains. Together, these data warrant further investigation of the role of respiration in SIR2-mediated lifespan regulation.

SESSION 2J

NOVEL APPROACHES TO BIOLOGICAL PROBLEMS

*Session Moderator: Colin Whitmore, Chemistry
Mary Gates Hall Room 271*

Protein fingerprinting of chemotherapy-treated and biopsied breast cancer cells

*Joan Bleecker, Senior, Chemistry
Levinson Emerging Scholar, Washington Research Foundation Fellow, Mary Gates Scholar
Mentor: Norman Dovichi, Chemistry
Mentor: Haley Pugsley, Chemistry*

Breast cancer is leading cause of cancer mortality for women in the United States. Prognostic indicators like progesterone receptor and Her2/neu proteins guide treatment and predict outcomes. Their expression levels directly affect patient survivability. Even with these indicators, there is a need for more detailed information to guide therapy. By generating protein fingerprints, which show the expression levels of multiple proteins at a time, our lab hopes to provide a valuable prognostic tool for cancer patients. MCF-7 is an established breast cancer cell line. By dosing MCF-7 with the chemotherapeutic agent mitomycin C (MMC), we hope to isolate survivor populations for protein studies. Cell viability will be determined by hemocytometry with Trypan blue staining and flow cytometry. Proteins in the survivor cell lines will be analyzed using 2D SDS PAGE/LC-MS and an ultrasensitive protein fingerprinting technology based on capillary electrophoresis and laser induced fluorescence. However, while the use of the established MCF-7 breast cancer cell line has the advantage of providing readily available breast cancer tissues, MCF-7 cells do not demonstrate the heterogeneity present in an actual breast cancer tumor. Our lab has obtained invasive ductal carcinoma breast cancer tumor tissues grades I, II, and III, in addition to normal tissue. These tissues will be dissociated and single cells run on capillary electrophoresis to look for differences in expression levels among the different grades and patient-to-patient variability. Our hypothesis is that the cell-to-cell variation in protein expression within a tumor carries prognostic and predictive information. All these techniques are used to better understand the complex network of proteins the breast cancer uses to grow and survive.

Cell cycle dependence of a conventional live/dead assay in *D. radiodurans*

*Vanessa R. Palmer, Senior, Chemistry
Mary Gates Scholar, Zesbaugh Scholar
Mentor: Norman Dovichi, Chemistry*

The combination of fluorogenic dyes Hoechst 33342 (H342) and propidium iodide (PI) has commonly been used as a microbiological live/dead assay for some time. H342 is a DNA-intercalating cell-permeable dye, while PI is able to enter only across permeabilized membranes. PI staining has therefore been supposed to directly correlate with nonviability; however, recent publications have documented the cell-cycle dependence of differential PI uptake in select species of bacteria, calling into question the efficacy of the H342/PI method recently implemented in our group's work with *Deinococcus radiodurans* (DEIRA). This organism's robust repair mechanisms are of considerable interest because it is the most radioresistant form of life yet discovered. The repair protein RecA is produced by the organism to initiate the SOS pathway in response to DNA damage and is the primary focus of our current DEIRA studies. Our group employs a novel strain of DEIRA which synthesizes its RecA molecules with an enhanced green fluorescent protein (eGFP) fusion tag, enabling quantitation of RecA levels using conventional fluorometric analyses. H342 and PI have been selected for work with this strain due to their eGFP-compatible spectral characteristics. The determination of possible cell-cycle dependence of the H342/PI method in this organism is a key step in the development of a multiparametric assay capable of simultaneously analyzing RecA levels and cell condition in DEIRA.

Development of a biofilm based system to simulate antibiotic treatment of cystic fibrosis lung infection

*Prina Strasbourger, Senior, Bioengineering
Mary Gates Scholar
Mentor: Paolo Vicini, Bioengineering
Mentor: Samuel Moskowitz, Pediatrics
Mentor: James Bryers, Bioengineering*

Cystic Fibrosis (CF) is a fatal genetic disease that affects about 60,000 individuals worldwide. The mutated CF gene is manifested as impaired epithelial salt transport, which causes dehydration and accumulation of mucus plaques in the lungs. This mucus causes breathing difficulties and promotes chronic bacterial infections that lead to premature death. The bacterium *Pseudomonas aeruginosa* (PA) is the most common pathogen in these chronic lung infections. PA is thought to grow in mucus plaques as a biofilm. PA's growth within a biofilm makes it less susceptible to antibiotics, which allows a PA infection to persist even at unusually high systemic dosages. Today, due to the lack of appropriate animal models, antibiotic regimens used in CF patients are based on bacterial antibiotic susceptibility

testing that is of uncertain relevance and efficacy. The goal of this project is to develop an in vitro system that models in vivo biofilm infections and their corresponding antibiotic treatments. This requires that the system accurately mimic the biofilm growth, the time course of appearance and disappearance of antibiotics at the target site (pharmacokinetics or PK), and the effects of antibiotic exposure time course on the bacteria found in the lungs of CF patients (pharmacodynamics or PD). Such a system would be used to test new antibiotics and antibiotic regimens for CF, and to tailor dosing for individual patients with less guesswork. So far, the team has engineered a system designed to yield a clinically relevant PK curve to work with a well-established biofilm growth compartment. This system has been evaluated with both lab and clinical PA strains. Looking forward, image analysis techniques will be used for in vitro PD measurements.

Extracorporeal Shock Wave Therapy and Bacterial Biofilms

Morgan Wise, Senior, Physiology

Mary Gates Scholar

Kevin Seals, Senior, Bioengineering

Mentor: Michael Chang, Rehabilitation Medicine & Mechanical Engineering

Mentor: James Bryers, Bioengineering

Extracorporeal Shock Wave Therapy (ESWT) is the application of acoustic waves percutaneously to biological tissues in the treatment of disease. SWs are high-pressure acoustic waves that deposit energy at acoustic impedance gradients. When this energy is released in biological tissues, the shock waves create shear and cavitation bubbles, which may produce free radicals and yield extremely high, localized temperatures. While ESWT was initially used exclusively to disintegrate kidney stones in lithotripsy, many new applications of the technology are being explored. We have recently completed what is, to our knowledge, the first comprehensive review paper describing the SW-bacteria interaction. Removal of localized bacterial infections represents a novel application of ESWT that is just beginning to be explored. As papers suggest, ESWT holds great promise for the treatment of infection. Our lab is working to clearly define what parameters are crucial to the antibacterial properties of ESWT, and to clarify the mechanistic basis of this phenomenon. Our project focuses on “biofilms”, which are aggregated layers of bacteria that naturally form in infections and their collective nature confers resistance to mechanical forces as well as antibiotics. We are quantifying the effect of SW treatment at various operating parameters on both suspended and biofilm-bound bacteria. We contend that ESWT may provide a potent means of non-invasively killing biofilm bacteria, as seen in biomedical device/implant infections, osteomyelitis and endocarditis.

Vaccination of Antigen Presenting Cells to Confer Resistance to Bacterial Biofilm Formation

Tyler C Mandt, Senior, Bioengineering

Mary Gates Scholar

Mentor: James D. Bryers, Bioengineering

Implanted biomedical devices improve the lives of millions of people and comprise a nine billion dollar industry in the United States. Despite being made of “biocompatible” materials (biomaterials), biomedical devices commonly fail due to bacterial infection. Bacteria infect biomaterials by first binding to a biomaterial surface and then proliferating to form a biofilm. Biofilms are 1000 times more resistant to antibiotics than free-floating bacteria. The goal of my research is to focus on eliminating the infection of biomaterials by *Staphylococcus epidermidis*. We propose to block the adhesion mechanism of *S. epidermidis* to inhibit formation of a biofilm on a biomaterial. The current approach to combat biofilm formation is to modify biomaterials with controlled-release systems that release anti-adhesion molecules such as antibodies that bind to bacterial binding proteins and compromise bacterial adhesion. Unfortunately, the finite quantity of anti-adhesive molecules deplete and degrade as they are released. Our aim is to use the immune system to compromise the binding mechanism of *S. epidermidis*. In contrast to controlled release systems, the potency of the immune system’s response to bacterial proteins will not decrease with time. When the *S. epidermidis* adhesion protein is put into the cytosol of an immune cell called an antigen-presenting cell (APC) in vivo a chain of events are incited that lead to the formation of antibodies that target and bind the adhesion protein on *S. epidermidis*. I am using a polymer delivery vehicle to encapsulate and deliver the bacterial binding protein to an APC. I will test for successful incorporation of the protein and presentation of protein fragments (antigens) through a variety of assays including fluorescence microscopy and enzyme linked immunosorbent assay. I am also designing a mathematical model of the delivery protocol that will be used as a benchmark to enhance its efficacy and efficiency.

Cholesterol Solubility in Giant Unilamellar Vesicles (GUV's) Containing the Ternary Lipid Mixture

DPPC: DOPC: Cholesterol

Mark Stevens, Senior, Biochemistry

Mary Gates Scholar

Mentor: Sarah L. Keller, Chemistry

In the laboratory, giant unilamellar vesicles (GUV's) offer a similar system to a basic cell membrane for studying miscibility of cholesterol and phospholipids in a lipid bilayer. The “raft hypothesis” of Simons and Van Meer postulates that separation of lipids into liquid ordered and liquid disordered regions helps to facilitate many important cell processes. Our laboratory produces vesicles through various methods, but this study will focus on

electroformation. We believe that the electroformation process creates vesicles with the same lipid composition originally put into the cell, up to an ultimate cholesterol solubility limit. It is important for us to test our assumption and also to determine the solubility limit in order to understand and properly interpret the results of other GUV studies from our laboratory. Studies of lipid compositions of vesicles containing DPPC:DOPC:Chol will be conducted by NMR, to develop a method to determine the post-electroformation solubility limits of other sterols that lack simple quantification techniques.

system, as well as common imperfections that may arise. Additionally, possible corrections to these imperfections are suggested. A first approximation to the parabolic mirror system is using a spherical mirror is similarly analyzed, and a working system is constructed.

The Search for the Permanent Electric Dipole Moment in Mercury

*David Meyer, Senior, Physics and Electrical Engineering
Mary Gates Scholar*

*Mentor: Norval Fortson, Physics
Mentor: Blayne Heckel, Physics*

The standard model (SM) of particle physics predicts electric dipole moments (EDMs) of fundamental particles that are immeasurably small using today's technology. However, there exist several theories beyond the SM, such as supersymmetry, that predict EDMs tantalizingly close to today's technological limits. Therefore, current searches for nuclear EDMs probe physics beyond the SM. In an electric field an EDM will produce a change in nuclear spin direction which we can measure by a corresponding change in the polarization of a probe laser beam. Our experiment places a stack of four quartz vapor cells filled with Hg in a magnetic field. We apply electric fields to the two middle cells such that the field of one is parallel to the magnetic field while the field of the other is anti-parallel to it. The outer cells are free of electric fields. They cancel noise due to magnetic field gradients as well as limit systematic effects due to charging and leakage currents. Current efforts to reduce the noise level have appeared successful; these include balanced polarimetry, new operating conditions and a new laser wavelength-lock system.

Superradiance and Subradiance in Barium Ions

*Aaron Avril, Senior, Physics
Mentor: Boris Blinov, Physics*

When an isolated atom is bombarded by particular frequencies of laser light, one of its electrons becomes energized. Once the laser is turned off, the electron falls back to its original energy level. The energy that the atom loses in this transition is emitted as a photon of a specific wavelength (color). This transition takes a random, but on average predictable amount of time called the natural lifetime. By contrast, when two atoms are very close to each other, relative to the wavelength of the emitted light, they alter each other's emission rate (calculated as the inverse of lifetime). In theory, the emission rate rises and falls about the natural value as the two are brought together. This phenomenon is described as "superradiance" when the emission rate is greater than that of isolated atoms, and "subradiance" when the atoms conspire to suppress their emission rate. In both cases, the effect becomes increasingly apparent as the atoms are brought together. To test this theory, we plan to isolate two Barium ions

SESSION 2K

OPTICS, ATOMS, AND NUCLEI

*Session Moderator: Gerald Seidler, Physics
Mary Gates Hall Room 284*

*Note: Titles in order of presentation.

Laser Stabilization Using Software Feedback

*Peter Greene, Senior, Physics and Mathematics
Mentor: Boris Blinov, Physics*

Many atomic physics experiments require lasers with steady frequencies. The most common method of frequency stabilization uses the spectra of various molecular compounds. This method has the drawback of being limited to the frequencies of the molecular transitions of the compound being used. We, however, are developing a method of laser stabilization that uses a precision wavelength meter and a software based feedback loop to stabilize the laser frequency. Although this method lacks the accuracy of spectrum based methods, it allows the stabilization to occur at any frequency and thus is adaptable to any laser, unlike spectrum based stabilization.

Concave Mirrors: Light Collection for Single Ions

*Nathan Pegram, Senior, Physics and Philosophy
Mentor: Boris Blinov, Physics*

Collection of light from single atoms is becoming increasingly important for experiments in atomic physics. Because light emitted by single atoms is very faint (roughly one trillion times weaker than common light bulbs), it is important to collect it as efficiently as possible. We explore the properties of a parabolic mirror as a means for increasing collection of light from a single ion. Collected light is to be directed to either an optical fiber or a photomultiplier tube. A computer simulated optical system is used to evaluate the performance of the parabolic mirror in both of these applications. We examine both the ideal performance of the

in an ion trap, and cool them almost to absolute zero. In this position, they will be stimulated by a laser, and then the emission rate of photons for the pair of atoms will be recorded. In previous experiments, the distance between atoms was large enough that this effect was minimal. Their results are consistent with the theory, but are not precise enough to confirm or disprove it. In our experiment we plan to bring the atoms closer to each other, to within one wavelength of the emitted light, so that we can observe a more extreme deviation from the single-atom emission rate. In this regime, the error in our recording equipment will be much less significant, allowing us to determine whether or not this theory is accurate.

Measurement of the $^{22}\text{Na}(\text{p}, \gamma)$ reaction rate

*Kseniya Deryckx, Senior, Physics and Chemistry
Mary Gates Scholar
Mentor: Alejandro Garcia, Physics*

Present models based on what is understood about the $^{22}\text{Na}(\text{p}, \gamma)$ reaction predict much more ^{22}Na in novae than has been observed with -ray telescopes. A solution to this puzzle would be the existence of a so far unobserved resonance in the $^{22}\text{Na}(\text{p}, \gamma)$ reaction, where resonance gives rise to a large enhancement of the cross section within a narrow energy window. There are hints from studies of the structure of ^{23}Mg that such resonance might exist, but no direct evidence. A crucial requirement for performing the measurement of such resonance is to have thin and pure ^{22}Na targets. Preliminary calculations indicate that a target with the appropriate number of atoms of ^{22}Na within a thin Cu layer could be obtained by implanting ^{22}Na at energies around 10 keV. The experimental data obtained so far suggests that target implanted at 10 keV provides a much higher signal-to-noise ratio than the target implanted at higher energies, which will facilitate the detection of the resonance. In addition to obtaining a thin target, the stability of the target must be assured with respect to the heating and sputtering that occurs due to the heavy proton bombardment when the $^{22}\text{Na}(\text{p}, \gamma)$ reaction is measured. Target implantations and characterization studies using naturally abundant ^{23}Na are very useful in understanding how the target will behave during proton bombardment with consideration to the safety procedures since ^{22}Na is radioactive with a half-life of approximately 2.5 years. The systematic research of all the issues associated with the ^{22}Na targets is conducted by doing implantations and bombardment measurements at CENPA (Center of Experimental Nuclear Physics and Astrophysics) using ^{23}Na . The optimized ^{22}Na targets will be produced at TRIUMF, the nuclear physics research facility in Vancouver, Canada, to perform the final measurement of the $^{22}\text{Na}(\text{p}, \gamma)$ reaction at CENPA.

SESSION 2L

ADVANCES IN MATERIALS AND STRUCTURES

Session Moderator: Paolo Feraboli, Aeronautics & Astronautics

Mary Gates Hall Room 287

*Note: Titles in order of presentation.

Characterizing Damage Resistance of Composite Materials to Lightning Strikes

*David Medendorp, Senior, Aeronautics & Astronautics
Andrew Southworth, Senior, Aeronautics & Astronautics
Mentor: Paolo Feraboli, Aeronautics & Astronautics*

With the increasing use of composite materials in the aerospace and automotive industries, lightning strikes on primary structures are becoming of greater concern for airworthiness and safety. When lightning strikes a typical aluminum aircraft, the current travels through the conducting, outer skin of the aircraft and escapes to ground. Carbon composites, on the other hand, despite the good conductivity of the carbon fibers, have low conductive properties because of the non-conductive polymeric matrix. The research is aimed at investigating the damage resistance and, in general, the behavior of carbon composites under lightning strike loads. For this purpose, lightning is simulated by an electric discharge of a 40 kV capacitor between two electrodes which gives rise to as much as 100 kA of current. The composite material specimens are placed between the two electrodes and the lightning arc from the capacitor passes through the test specimens. The damage on the panel will be examined by microscopically scanning the strike and exit locations as well as through-thickness samples for the fiber and matrix behavior. Furthermore, damage size will be characterized through the use of a C-scan process which will ultrasonically scope the composite material to show internal damages not otherwise visible.

Characterization of High Performance Composites for Automotive Applications

*Bonnie Wade, Senior, Aeronautics & Astronautics
Mentor: Paolo Feraboli, Aeronautics & Astronautics*

New affordable material forms and processing methods are being explored to increase usage of composites in the automotive industry. These include Vacuum Assisted Resin Transfer Molding (VARTM) of woven carbon fiber preforms as well as Resin Transfer Molding (RTM) of discontinuous glass fiber mats. These materials will be employed in stiffness-critical and crash applications, and therefore must exhibit a wide range of deformation behavior. The characterization discussed in this presentation

will include non-destructive inspections, micrographic analysis, coupon level material property assessment, as well as structural element testing. The ultimate goal of the study is to identify the most suitable materials for the realization of an affordable, high performance next-generation supercar chassis.

Na doped V₂O₅ Thin Films Prepared on Kapton Tape for Flexible Thermoelectric Energy Conversion Devices

*Nelson Robles, Senior, Materials Science & Engineering
Intel REU, Boeing Research Scholarship
Mentor: Fumio S. Ohuchi, Materials Science & Engineering*

Thermoelectric materials produce electricity when exposed to a difference in temperature. This research aims to develop a process to fabricate Sodium (Na) doped Vanadium Pentoxide (V₂O₅) thermoelectric thin films deposited on a polymer substrate called Kapton tape. Na doped V₂O₅ is synthesized via a polymer-based solution process, thus the solution is deposited onto a substrate by using spin coating, dipping, or by spreading with a disposable pipette. Wetting, however, is prominent when deposited on polymeric substrates due to their low surface energy properties. Oxygen plasma treatment was employed to alter the tape's surface energy. The contact angle between the solution and the substrate approached zero degrees after obtaining high surface energy conditions. The deposited films are then subjected to furnace annealing to facilitate crystallization of the Na doped V₂O₅; however, maximum temperature is determined by the degradation of Kapton tape, which is lower than the nominal crystallization temperature of the thin films. It is therefore, key to find proper catalytic conditions that allow crystallization at lower temperatures. Electrical conductivity and Seebeck measurements are conducted to assess thermoelectric properties of the thin film system. Successful fabrication of flexible thermoelectric thin film systems will provide an alternative method to power electronic devices.

Linear Stability of a Crystal-Melt Interface During the Freezing of Silver Drops in a Free-Fall Environment

*Michael Spector, Senior, Materials Science & Engineering and Mathematics
Mentor: Lucien Brush, Materials Science & Engineering*

Understanding how solid phases freeze is important in being able to control the properties of the solidified material. For example, in many instances, solids growing from melts undergo dendritic growth that can significantly affect the solid properties. Modeling the process will advance our understanding of how the solidification conditions affect dendrite growth. In previous work 99.9% pure silver droplets 4mm - 9mm in diameter were dropped in free-fall for 105 meters in a controlled atmosphere. Primary dendrite

spacing was observed within the drops and spherically symmetric growth was modeled. However, a spherically symmetric model cannot explain the appearance of dendritic structures. Here, as a first step, a new analyses using linear perturbation theory is carried out to test the stability of the inwardly freezing spherical drop, in order to identify conditions in which dendrites can be expected. By comparing results of the stability analysis with the primary dendritic-arm spacing observed experimentally, it is hoped that the physical mechanisms giving rise to the instability of the spherical shell and the physical effects controlling solidification microstructure can be identified.

Quasi Yagi-Uda endfire phased array antennas with novel dielectric phase shifters at 5.8GHz

*Matthew A. Stoneback, Senior, Electrical Engineering
Mentor: Yasuo Kuga, Electrical Engineering
Mentor: Junho Cha, Electrical Engineering*

A new phased array antenna using unique printed quasi Yagi-Uda endfire antenna elements paired with a novel dielectric phase shifter is developed, simulated, and tested at 5.8GHz. A Phased array antenna is a two dimensional array of phase shifters paired with antenna elements which, together, provide an electrically steerable beam. The superposition of phase shifted waves in space allows the antenna to change its directivity without mechanical movement of the array. Typically the phase shift is achieved using active MMICs (Monolithic Microwave Integrated Circuits) made with Gallium Arsenide or Indium Phosphide, necessitating high material and manufacturing costs. For most phased arrays there is a phase shifter for each antenna element, so a reduction in cost of phase shifter components will result in a significant reduction in cost of the entire array. The basis for our experimental phase shifting technology is a device which uses moveable dielectric slabs on coplanar waveguide to introduce various phase shifted signals to an array. The dielectric slabs can be mechanically positioned to create a disturbance in the electromagnetic field near the RF signal and introduce the desired phase shift. Dielectric phase shifters can be implemented cheaply and elegantly using widely available ceramic composites, making them much more attractive than traditional MMIC phase shifters. The quasi Yagi-Uda antenna is an endfire antenna which means the Yagi propagates electromagnetic energy in a direction parallel to the printed circuit board. Also, it has the advantage of being more directional than the patch antenna, thus increasing the efficiency of the array and improving the quality of the transmitted signal. The quasi-Yagi design has a wide range of applications especially where low-profile conformal array technologies are needed. Steerable wing-mounted antennas for UAVs (unmanned aircraft vehicles), directional WiFi communications networks, and automobile collision avoidance radars are a few relevant examples.

SESSION 2M

COMPUTATIONAL MATHEMATICS

*Session Moderator: Werner Stuetzle, Statistics and Computer Science & Engineering
Mary Gates Hall Room 288*

*Note: Titles in order of presentation.

Developing Automatic Methods for Measuring Metallicities from Stellar Spectra

*Rosalie McGurk, Senior, Astronomy and Physics
Boeing/OMA Research Scholarship, Mary Gates Scholar, NASA Scholar
Mentor: Zeljko Ivezic, Astronomy*

Stars emit light over a broad range of wavelengths. Using a spectrograph, a device similar to a prism, astronomers measure the amount of light received per wavelength. The plot of the intensity of light received over a range of wavelengths is called the spectrum of the star. The spectra of stars provide information about their temperatures, pressures, colors, masses, and metallicities (the ratio of the amounts of metals to the amounts of hydrogen and helium in stars). We are analyzing hundreds of thousands of spectra of hydrogen-burning main-sequence stars from the Sloan Digital Sky Survey using a technique called Principal Component Analysis (PCA). The PCA program mathematically analyzes each spectrum, compares it to a set of characteristic spectral shapes, and breaks the spectrum up into coefficients representing how well each shape describes or fits the spectrum. Using the characteristic spectral shapes and the coefficients, we can describe most spectra in our data set. My research explores possible relationships between the PCA coefficients and known stellar metallicities, pressures, and other astrophysical stellar parameters, such as temperature, mass, and color. Using these relationships, we hope to demonstrate that PCA is a more accurate and automated method of measuring stellar parameters, especially metallicity.

A geometric generalization of Gauss' arithmetic-geometric mean

*Nate Bottman, Junior, Mathematics
Mary Gates Scholar
Mentor: James Morrow, Mathematics*

Near the end of the 18th century, the analysts Gauss and Legendre invented a function, $M(a, b)$, called the arithmetic-geometric mean. The arithmetic-geometric mean (AGM) first caught Gauss' eye when he noticed that the arc-length of the lemniscate is algebraically dependent with $M(1, \sqrt{2})$; indeed, this led Gauss to remark that this work

would "surely open up a whole new field of analysis." Nowadays, the AGM plays a crucial role in algorithms for efficiently computing elementary functions – for instance, an AGM-like iteration allowed the calculation of 206,158,430,000 digits of π in 1999. I propose an n-dimensional geometric generalization of Gauss' AGM. I will present preliminary results on the n-dimensional AGM, such as a proof of the well-definedness of the generalized AGM, a proof of stabilization of the power series for the iterates of the AGM, a proof of quadratic convergence, and an interesting remark by Landau on the $n = 3$ case of this generalization.

Distributed Computation with Sage

*Yi Qiang, Senior, Mathematics
Mary Gates Scholar
Mentor: William Stein, Mathematics*

Distributed computing is a way of solving problems by splitting complex problems into smaller, more manageable chunks and distributing them to other computers for processing with the result being parallelism. This process of parallelization can greatly reduce the amount of time it takes to solve nontrivial and computationally expensive problems. However mathematicians have largely been unable to harness this computing resource since many tools that are dedicated to this task have not been developed with mathematicians in mind. Our research aimed to fill this gap in the mathematical community. We have developed a set of tools that allows mathematicians to perform massively parallel computations. In addition we have also developed algorithms, examples and documentation that demonstrates how to use this tool within Sage. One such algorithm is distributed integer factorization, which we have shown to benefit greatly from parallelization. We will present both the technical design of Distributed Sage as well as some interesting new results that were produced using Distributed Sage.

Central Stars of Planetary Nebula: A Search for Variability

*Jean McKeever, Junior, Astronomy and Physics
Mentor: Julie Lutz, Astronomy*

Planetary nebulae are stars that have ceased nuclear reactions in their cores and are shedding off their outer layers of material. Some of the central stars left behind by this shedding of material may exhibit interesting behavior. There are lots of known planetary nebulae, but there is not much known as to whether these central stars are variable or not. The source of our data was the MACHO (Massive Compact Halo Objects) database, a project that observed the galactic bulge in red and blue filters for eight years. From there we searched for periods using a Fourier method. When we were done running all the stars through the model fitting programs, we found that about ten percent of the stars showed some sort of variability. The

types of variability we identified were periodic variability and dropout variability. Dropout stars dimmed by several magnitudes and some showed an underlying period as well. We looked for periods from a tenth of a day up to three thousand days. We ended up finding only stars with periods of less than a day. Although the model fitting did pick up on the general brightening of one of the stars over time. The stars we classified as periodic had amplitudes that were larger than the surrounding noise and a good fit to the model.

SESSION 2N

INNOVATION AND CHANGE IN EDUCATIONAL PROGRAMS

*Session Moderator: Bradley Portin, Educational Leadership & Policy Studies
Mary Gates Hall Room 295*

Online Therapy: Exploratory Survey of College Campus Counseling Services

*Kathryn Cook, Senior, Social Welfare, UW Tacoma
Mentor: Jerry Finn, Social Work, UW Tacoma*

The emergence of online therapy has occurred amongst debate over ethical and legal, technological, theoretical approach and training concerns. Through exploratory study, we will ascertain the prevalence of online counseling offered through college counseling centers. Factors influencing decisions in the provision of online counseling services to students will also be explored through this study including issues of confidentiality, identity, technology, training, licensure, liability, and the use of face-to-face versus textual communication as a mode of therapy. The student population is shifting to a generation that embraces technology through text messaging, chat rooms, and instant messaging. The development of services meeting the communication needs of a technologically proficient generation may be applicable to the setting of therapeutic mental health services offered by college counseling centers.

Institutionalizing Antiracism in the Comparative History of Ideas (CHID) Program

*Farah Nousheen, Senior, Comparative History of Ideas
Mary Gates Scholar
Mentor: Nikhil Singh, History
Mentor: Craig Jeffrey, Geography
Mentor: Georgia Roberts, English
Mentor: John Toews, Comparative History of Ideas*

With roots in the late 1970s and Euro-American liberalism,

the Comparative History of Ideas (CHID) program offers self-motivated students an interdisciplinary student-centered education within the large public research institution University of Washington. However, CHID historically has had a predominantly white student body. In the last five years the program has become attractive to students of color largely due to its numerous study aboard programs along with the diversity efforts taking place in the university and the program itself. The CHID program is in a challenging transition period, at times even in upheaval from demands made by students of color for change. As a CHID major of color, I see this as an opportunity to take an active role in this transition process. I use the current scholarship of antiracist pedagogy as a way to provide theory and praxis necessary to accommodate a diverse student body. Antiracism as an ideology acknowledges that racism is embedded in the structures of society and individual behaviors. In the context of pedagogy, antiracism provides strategies for challenging behaviors and structures in the classroom that perpetuate racism. This research project involves the various members of the CHID community through interviews, web discussion board, community dialog events, student surveys, and focus groups to obtain testimonies and input in this critical process. This research project documents the possibilities, challenges, and successes of the attempts made at implementation of antiracism ideology into the CHID program. The project proposes structural modifications that can institutionalize antiracist practices, such as ongoing instructor antiracist training, departmental level support for students of color and white students working to become allies, and curricular modifications in core CHID courses. The ultimate aim of this project is to contribute towards producing a climate in the CHID program that fosters inclusivity, equity, and intellectual diversity.

Ask event fundraising strategies at Seattle Girls' School: a case study

*Vanessa Palmer, Senior, Chemistry
Mary Gates Scholar, Zesbaugh Scholar
Monica DeWald, Senior, Education, History, and Music
Zesbaugh Scholar
Mentor: Doris McEwen Harris, College of Education*

Seattle Girls' School (SGS) is an independent school located in Seattle's Central District. The mission of SGS is to empower middle school girls to think critically and seek creative solutions to real world problems in a challenging academic environment that highlights science, math, and technology, embraces diversity and promotes collaboration, integrated learning and respect for all. To ensure a diverse student body, SGS employs an aggressive need-based financial aid program, providing funds for over 30% of its students. Since its inception in 2002, SGS has disbursed over \$2.5 million to this end, relying on in-kind donations for support. The largest annual financial aid fundraising event is the Grace Hopper Awards Luncheon,

a ceremony honoring Pacific Northwest women in math, science, and computing fields for outstanding achievement and leadership. The objective of this study is to evaluate the efficacy of the fundraising campaign leading up to and during the luncheon. What are the most useful strategies for solicitation of area businesses? How does SGS' relationships with individuals within potential funding organizations affect donation outcome? We hope that our assessment of SGS' fundraising methods for the Grace Hopper Luncheon will benefit future giving campaigns both at SGS and at other independent schools.

Changes in foreign students' opinions as a result of study abroad in the United States

*Stacey Taplin, Senior, Communication and Sociology
Mentor: Gerry Philipsen, Communication*

This study will reflect how foreign students' opinions change after the experience of studying abroad in the United States. It aims at finding certain factors within the experience that influence a student's opinion concerning the country, people and values of their host family and native environment. Past literature has highlighted many experiences of American students studying abroad. I feel that it is necessary to research the foreign students in the U.S. and ultimately find results that can better our cross-cultural communication between Americans and other nations in order to improve international relationships. The participants consist of international students at the University of Washington (a high proportion recruited through the FIUTS program). I have conducted an online survey for three consecutive weeks and also executed four one-on-one interviews in order to obtain more descriptive data to supplement my survey's findings. Questions in both the survey and interview pertain to cultural challenges, interpersonal relationships, American/native cultures and opinions of the United States both before and after these international students began their study at the University of Washington. From extensively studying past data of American's experiences abroad, I have learned essential elements to include into my research questions. I predict that my findings will reflect similar trends to previous data, but also highlight unknown factors found exclusively in the experiences of international students in the United States. My hypothesis is that international students will, as a result of their foreign study in the U.S., have a greater understanding of the world, a more positive view of the United States and American, and a greater appreciation of their native country. My hope is that this research will illustrate not only that, but also how these study abroad experiences may substantially change a person's perspective.

Investigating Barriers to Technology Usage at Franklin High School

*Chloe Valencia, Senior, English
Mary Gates Scholar, McNair Scholar, Zesbaugh Scholar
Mentor: John Hardy, Digital Learning Commons*

Franklin High School, one of the largest in the Seattle Public School District, is undergoing a school wide academic transformation. One of the 2007-08 school year transformation initiatives is to "increase the technology skills of staff and students to support teaching and learning, productivity and communication." Franklin's school administration is taking steps toward this goal by providing new classroom tools (e.g. LCD projectors, document cameras); implementing The Source, a system that provides access to vital information by students and parents; and by obtaining membership to the Digital Learning Commons, a nonprofit provider of high-quality online educational materials, courses, and technology tools for students, teachers, and parents. Given their position of authority in the classroom, teachers are potentially the primary change agents for these initiatives as they adapt their practice to these enhancements. The purpose of this research is to explore the reasons why, despite the technology initiatives and new resources, many teachers choose not to use their technology options. I have determined that using a standard survey would not reveal the range of problems teachers actually face; therefore I conducted one-on-one interviews with teachers to account for a variety of subject areas and teaching styles, as well as to gauge their openness to a change in methodology. Initial results indicate a variety of possible explanations, ranging from a lack of training to a lack of pressing need. In spite of these issues there are multiple ways for educators to use online resources effectively. My continuing research will focus on identifying those barriers to effective practice that are the most amenable to interventions using the resources offered by the Digital Learning Commons through the provision of consistent, cohesive collection of tools and services.

SESSION 20

NEURONAL SYSTEMS IN DEVELOPMENT AND DISEASE

Session Moderator: Martha Bosma, Biology

Mary Gates Hall Room 389

Characterizing drivers of synchronous, spontaneous transients in embryonic chick hindbrain

Nauzley Abedini, Senior, Neurobiology

Mary Gates Scholar

Mentor: Martha Bosma, Biology

In many regions of the developing nervous system, synchronous, spontaneous activity plays a role in synaptogenesis, cell positioning, ion channel development, and neuronal migration. The hindbrain is the posterior aspect of the three primary divisions of the developing vertebrate brain. It develops into the cerebellum, pons, and medulla and coordinates complex muscular movements, equilibrium, and autonomic functions. Our lab has recently shown that hindbrain spontaneous activity is conserved between chick and mouse; we are now ascertaining whether the mechanisms of activity initiation are conserved as well. Up to embryonic day 4 (E4) in chick, the hindbrain is divided into segments called rhombomeres (r), which are important in determining the fate of neurons in the hindbrain, though they are not present in the adult. Intracellular calcium imaging has demonstrated that spontaneous, synchronous calcium transients occur in chick hindbrain from E6 to E9. Mouse hindbrain has a midline driver at the former r2, while chick appears to have two midline drivers: one at the former r2 and the other at the former r4. The lateral tissue does not appear to have an identifiable driver as it may be coupled via gap junctions. Our goal is to characterize the two midline drivers in chick, as well as the mechanism for propagation in the lateral tissue. We now demonstrate, using simultaneous rapid calcium imaging and whole-cell patch clamp recording, that the occurrence of calcium transients is coupled with electrical depolarization. Additional experiments at the midline will enable us to determine whether the two drivers are related or interdependent. Neurobiotin-injected cells are utilized to determine the underlying connectivity of midline versus lateral cells, which will further elucidate the mechanism(s) of event initiation.

An Extrinsic Cue Regulates Neuronal Temporal Identity in *Drosophila*

Bettye Appiah Apenteng, Senior, Neurobiology and General Studies (Public Health)

Howard Hughes Medical Institute Biology

Fellow

Mentor: Elizabeth Marin, Biology

Mentor: James W. Truman, Biology

The mushroom body (MB) is an insect brain structure formed by the division of four neuroblasts. Each of these neuroblasts divides to generate 3 neuronal subtypes sequentially. Experiments that uncouple mushroom body neuroblast divisions from organismal growth have shown that the switch between neuronal subtypes is regulated by an extrinsic cue. The aim of this project is to identify the extrinsic cue responsible, using a candidate approach. We show that expressing a dominant negative version of one ecdysone receptor isoform disrupts the fate of later born subtypes. Furthermore, loss and gain of function experiments demonstrate that the ecdysone-responsive transcription factor broad influences the number and subtype of neurons produced. Taken together, these results suggest that the steroid hormone ecdysone regulates the switch between mushroom body neuron subtypes during development.

Drp-1-Mediated Suppression of Mitochondrial Fusion Prevents Apoptosis in Cortical Neurons

Jenny Dworzak, Senior, Biology

Mentor: Richard S. Morrison, Neurological Surgery

Mitochondrial dynamics, or the ability of mitochondria to regulate their morphology by fusion and fission, is vital to neuronal viability, as evidenced by neurodegenerative disorders, such as Charcot-Marie Tooth Disease and Dominant Optical Atrophy. In healthy neurons, mitochondria exhibit a characteristically short, tubular morphology, which likely facilitates transport of mitochondria to regions of increased ATP-requirement, such as synapses. Changes in this short tubular mitochondrial structure in neurons may be associated with neuronal death. We are therefore currently investigating the relationship between mitochondrial dynamics and cell death in postnatal cortical neurons. Using mouse primary neuron cultures in conjunction with immunohistochemistry and western blotting techniques, we have shown that mitochondrial fusion is an early response to genotoxic stress in cortical neurons and that preventing mitochondrial fusion or enhancing mitochondrial fission reduces levels of genotoxic death in these neurons. We have also shown that mitochondrial fusion, induced by expression of dominant negative Dynamin-Related-Protein-1, a GTPase responsible for mitochondrial fission, is sufficient to induce significant levels of neuronal death. Furthermore, we have demonstrated that mitochondrial fusion is a p53-dependent response to genotoxic stress. Moreover, mitochondrial fusion occurs in association with a genotoxically-induced decrease in cellular levels of Drp-1. Based on recent literature detailing the role of Drp-1 in synapse formation, we suggest that mitochondrial fusion may also result from a decrease in Drp-1 GTPase activity, mediated by PUMA-Bcl-xL interaction. We have yet to determine the effects of Drp-1 manipulation in vivo. Furthermore, the dependence of cortical neuronal viability on Drp-1 activity

suggests that it may be a target for prevention of apoptosis in cortical neurons, and therefore a potential target for protection of neurons stressed by injury or disease.

Lentiviral Rescue of Kappa-Opioid Receptor Signaling in the Dorsal Raphe Nucleus

*William Giardino, Senior, Psychology
Mentor: Charles Chavkin, Pharmacology*

The dorsal raphe nucleus (DR) has been established as a critical mediator of depressive-like behavior in rodent models. Likewise, activation of the κ -opioid receptor (KOR) has been implicated in encoding the dysphoric state induced by stress. However, a role for the DR in regulating κ -opioid-dependent dysphoria is currently unknown. Here we show that lentiviral reintroduction of KOR into the DR of KOR(-/-) knock-out mice is a viable method for studying the behavioral and cellular response to selective κ -opioid receptor activation. We also present evidence supporting the role of the DR as an essential contributor to KOR-mediated aversive behavior. A bicistronic, KOR-expressing lentivirus tagged with green fluorescent protein (GFP) was microinjected into the DR of KOR(-/-) mice and visualized with antibodies selective against either phosphorylated κ -opioid receptors (KORp) or phosphorylated p38 mitogen-activated protein kinase (P-p38). Confocal microscopy revealed colocalization of KORp with P-p38 in DR neurons of animals that received the KOR-expressing virus, but not in animals receiving an empty viral vector. To examine behaviors induced by KOR reactivation in KOR(-/-) mice, the κ -opioid receptor agonist U50,488 (U50) was used to assess DR-dependent changes in tail-flick latency, locomotion, and conditioned place aversion. Tail-flick analgesia was amplified and locomotor activity was attenuated upon administration of 5 and 15 mg/kg of U50, respectively, mimicking the effect of U50 administration in a wild-type animal. In addition, mice conditioned with 5 mg/kg of U50 showed an increased place aversion that failed to reach statistical significance. Trends and correlations within the data implicate the DR as a key neural substrate in the KOR system and further validate lentiviral reintroduction of KOR as a valuable technique for studying molecular and behavioral effects in mice.

Effect of mitochondrially targeted catalase in a model of acute oxidative stress

*Christine Masuda, Senior, Neurobiology
Levinson Emerging Scholar, Mary Gates Scholar
Mentor: Peter Rabinovitch, Pathology
Mentor: Jonathan Wanagat, Pathology*

Neurodegenerative diseases of aging (e.g., Alzheimer's dementia, Parkinson's & Huntington's disease) have devastating effects on the people afflicted, their caregivers and society as a whole. There is considerable evidence that oxidative stress, resulting from exogenous and endogenous

free radicals, has a causal role in aging and age-related disease, in particular, neurodegenerative diseases. The mitochondria have been demonstrated to be the primary source of endogenous free radicals and attempts have been made to decrease mitochondrial free radical production to delay aging and age-related diseases without much success. The current study uses a transgenic mouse that expresses human catalase (an antioxidant enzyme) that is targeted to the mitochondria. This transgenic mouse demonstrates a 20% increase in life span and decreases in age-related pathology in the heart and possibly skeletal muscle. This study examines whether the increase in human catalase has a neuroprotective effect in the 3-nitropropionic acid model of acute oxidative stress which is often used to model Huntington's disease.

Characterizing the proliferative events and pathways responsible for hair cell regeneration in a zebrafish model

*Parhum Namdaran, Senior, Neurobiology and Biology (Molecular, Cellular and Developmental)
Mary Gates Scholar, Howard Hughes Scholar
Mentor: David W. Raible, Biological Structures*

In vertebrates, specialized sensory mechanoreceptor hair cells located in the inner ear allow the organism to sense a variety of stimuli, namely sound, balance, and orientation in space. However, hair cells are highly susceptible to damage from noise, normal aging, and exposure to ototoxic drugs, including aminoglycoside antibiotics. While the degeneration of hair cells in humans and other mammals is irreversible, regeneration of hair cells occurs in many non-mammalian vertebrates to replace those lost or damaged. Zebrafish (*Danio rerio*) have hair cells located both internally in the ear and externally within the lateral line system, in clusters called neuromasts along the length of their bodies. Each neuromast contains a central group of hair cells surrounded by support cells (SCs). After exposure to the aminoglycoside antibiotic neomycin hair cells are rapidly killed but then regenerate within 72 hours. New hair cells are generated from a transient increase in SC proliferation after neomycin exposure, dividing to renew both hair cells and replenish SCs. Of these proliferating SCs, we believe that there may be two distinct subpopulations within the neuromast identifiable based on their differing positions and morphologies. These two SC subpopulations differ in their pattern of proliferation during regeneration, leading us to hypothesize differing functions for these two subpopulations. To assess proliferation, two halogenated thymidine analogs, iododeoxyuridine (IdU) and chlorodeoxyuridine (CldU), that can incorporate into DNA during replication, will be used to distinguish whether the initial cells that enter the cell cycle are located differentially within the neuromast than those that divide at later times. Cells that incorporated both thymidine analogs will also identify whether support cells undergo multiple rounds of cell division, and might identify hair cell precursors with stem cell characteristics.

Mechanisms of spontaneous synchronous activity generation in medial cells in embryonic mouse hindbrain

*Julia Olson, Senior, Neurobiology
Mary Gates Scholar
Mentor: Martha Bosma, Biology*

The hindbrain, which develops into the brainstem structures of the pons, medulla, and cerebellum, has a remarkable pattern of development. This includes a period of widespread spontaneous electrical activity, synchronized across the entire hindbrain, which is integral to how it develops. Identification of a region of high activity in the rostral hindbrain midline, known as the initiation zone (IZ), suggests the activity may be triggered by a type of pacemaker cell, instead of a neuronal network as shown elsewhere in the brain. Using electrophysiology, I am comparing properties of the cells in the midline IZ versus lateral cells which might cause IZ neurons to act as pacemakers. In the medial IZ neurons, we find much larger inward (excitatory) currents that could contribute to spontaneous activity. In addition, we have found two mechanisms in lateral neurons that reduce spontaneous activity. First, in lateral tissue we have observed an inwardly rectifying potassium current that reduces excitability, preventing spontaneous activity. Addition of barium, an inward rectifier blocker, increases the size of depolarizations only in lateral tissue, suggesting that these potassium currents are only expressed in lateral tissue, and not in the medial pacemaker cells. Second, testing gap junction current coupling between lateral cells shows significant permeability between cells. Adding mefloquine, a gap junction blocker, abolishes that permeability, removing individual neurons from the coupled lateral network. Thus, with these three combined results, we propose that the medial and lateral cells differ in physiological properties: specifically, lateral cells express two inhibitory currents that reduce spontaneous activity, while medial IZ neurons have large excitatory currents. Showing that expression of these ion currents is different between medial and lateral cells supports our theory that the hindbrain spontaneous synchronous activity is initiated by pacemaker cells, and provides us with a mechanism for activity generation in IZ neurons.

SESSION 2P

PERFORMING RESEARCH: EXPLORING ISSUES OF ECONOMICS, AESTHETICS AND SITE IN CONTEMPORARY DANCE AND THEATRE

*Session Moderator: Betsy Cooper, Dance
Meany Hall Studio, Room 267
(See directions on next page.)*

*Note: Titles in order of presentation.

Consumed: An interdisciplinary solo performance researching the influence of market forces on contemporary dance

*Tonya Lockyer, Senior, Dance
Undergraduate Research Travel Award
Mentor: Mark Haim, Dance
Mentor: Jennifer Salk, Dance*

Consumed: an interdisciplinary one-hour solo performance, premiered at Seattle's national venue for contemporary performance On The Boards, as part of their Northwest Artists Series (March 2008). The Directorial Assistant was Guggenheim Fellow Dayna Hanson. Consumed questions the role of market forces on the creation, production and consumption of contemporary dance. What does it mean to create contemporary art in a capitalist society, with little or no capital? Does a dance have to inspire mass-market appeal to have value? How do we determine Dance's intrinsic value? What is necessary, what is desired and what is extraneous? Consumed addresses these questions through its content, structure and means of production. Part social commentary, part personal documentary, the work integrates autobiographical content drawn from the artist's twenty-year performance career with content appropriated from pop culture, dance history and current events. The work oscillates between the boundaries of experimental dance, theater and performance art moving easily between mismatched stories, pop songs, movement and video. Defined by a limitation of capital—all sets, costumes, props, video and sound production were borrowed, found or bartered. The result is an innovative performance arising from aesthetic, theoretical, social, philosophical, and physical experiments. The process involved extensive artist residencies; workshops on language and action; data collection; performances in diverse venues; and peer/mentor dialogue. This research was conducted through On The Board's Commissioning and Residency Programs, ACT's Choreographer-in Residence Program, The School of The American Dance Festival, Brigham Young University's Visiting Artist Program, and through independent studies with The University of Washington Dance Department.

First Arabesque: A Comparison of Perspectives

*Thomas Van Doren, Sophomore, Dance and Chemical Engineering
Mentor: Hannah C. Wiley, Dance*

The arabesque pose in ballet is reminiscent of the semi-lunar curves found in Moorish architecture. The pose most often is different for a dancer trained through aesthetics and a dancer trained through anatomical directions. The same basic shape is created, but the effect it has on the dancer and audience varies. By researching literature and interviewing expert instructors and former professional dancers, the aesthetic and anatomical perspectives are explored. Renowned literary works in dance by Gail Grant, Kenneth Laws, Adalbert Kapandji, Celia Sparger, and others were explored to gain depth and understanding. The ideal first arabesque pose is a compromise of finding the aesthetic working within the anatomical facility of each individual. It is maximum extension of the hip and spine to create the curve reminiscent of Moorish architecture. A deeper look into the differences between each perspective is recommended for future research.

Dance/Music: Steel Grace/Afriqué

*Kathryn Hightower, Senior, Dance Major
Mentor: Betsy Cooper, Dance Program*

Music and dance are said to be inseparable. However, trends in modern/postmodern dance in the past forty years (and even earlier) have often involved the rejection of music in the creation and performance of dance. As a dancer, I have discovered that many modern dance choreographers create their movement phrases in silence, and subsequently add music. Modern dance is rarely choreographed to music; in fact, this method is sometimes referred to as "Mickey-Mousing." My research project, the creation of a new piece of dance and music, is in many ways a reaction to this rejection of music. My project was inspired by my dual lives as a dancer and a musician, and officially began in October 2007, when I found six dancers to work with. However, the music had already begun naturally developing as far back as August 2007. During a multi-faceted six-month process, I challenged the dancers to become in touch with their own individual movement styles, to embody emotions and works of art, and to react to music on a deep level. At the same time, I worked in intense collaboration with world-renowned musician Jah Breeze to create the music. Together, we composed, recorded, and arranged an original piece of music incorporating rhythms from Africa and the Caribbean, as well as melodies inspired by the African Blues. After the music was ready, I worked with the dancers to create layered, polyrhythmic choreography that matched the style and feel of the music. The culmination of my research was a dance piece, entitled "Steel Grace," set to the song "Afriqué," and was performed at the University of Washington Dance Majors Concert in March 2008.

From Seawall to Viaduct: the Seattle Waterfront

Controversy
*Spencer Thomas, Senior, Program on the Environment and Drama
Mary Gates Scholar
Mentor: Michael Reese, Program on the Environment
Mentor: Odai Johnson, Drama*

This is a pivotal time for the Seattle waterfront. Since the late 20th century the waterfront has undergone a slow shift from an industrial hub to a tourist attraction. The 2001 Nisqually earthquake cracked the waterfront's seawall and the Alaskan Way viaduct, leading many safety experts to predict that the seawall and viaduct would collapse during the next earthquake. In 2007, the citizens of Seattle voted to reject both an elevated and underground replacement to the current Alaskan Way viaduct. Ensuing from a lack of clear direction is a controversy over what the waterfront's identity should be. At stake is the paradigm of Seattle's urban and transportation planning. Through interviews and historical research, this one-man play explores the numerous opinions, organizations, and personalities that are influencing the future of the waterfront.

Airport Dance

*Alice Gosti, Senior, Dance and English
Mary Gates Scholar
Mentor: Mark Haim, Dance*

This project is about creating a performance piece that in ten days will travel from airport to airport all around the world. It will interact with a characteristic shared by all airports—the power to alter one's perception of space and time. I am interested in juxtaposing the airport—a place where space and time are warped or even suspended with dance, an art form completely dependent on how we perceive the body moving in space and time. My intent is to situate a dance performance in the airport. The audience/travelers will decide if they want to take the time to engage with the performance and watch it in that single moment, or to leave and continue in their traveling. The act of engaging with the performance invites to a more consciously constructed sense of time and space. The viewers will watch the performance, appreciating it in a different way because of the airport (non-place) venue. No audience member will be formally invited to enter the airport to see the dance performance. The airport dance audience will be completely determined by chance. I will develop a solo piece, exploring the idea of the airport as a non-place in relation to dance as an ephemeral art. Although the solo choreography will be created in a traditional studio space, it will have to be continually adapted to fit each new airport site. Upon completion of this choreographic phase of the project, I will travel from airport to airport, circling the world, performing this piece. All the performances will be digitally recorded. The recordings and all the information about the performance will be posted on a web-site. If viewers connect to the page, they will be

able to see the videos of the performance. I would like the audience for my dance to feel stimulated and interested in understanding what the performance they are viewing is trying to address. My intention is to provoke thought in the audience. I would love to have viewers start thinking of where they are in the present tense, rather than where they will go next.

STUDENTS SUM UP THEIR RESEARCH EXPERIENCE IN A WORD

Eye-opening:

Research isn't the “cool” fun, glamorous world most people believe it to be. It's painstaking, often repetitive, and often boring. It's real work. I thought I understood that before starting research, but now I know better. I wouldn't trade this experience for anything, though. Knowing there is a huge gap between having an idea and presenting it, knowing the nature of that gap is research, and understanding what research is all about is the real “cool”.

Re-learning:

Of course I knew how to learn; I was in college, wasn't I? But my previous approach was too much like Paulo Freire's “banking method” of education: deposit knowledge to be withdrawn at a later date. Heck, Wikipedia can do that. What I learned this summer is how not just to learn, but to make meaning.

Reaffirming:

Before I started research I believed that I would graduate and move on to other, unrelated career paths. This was my conclusion simply because my grades were not as competitive as I'd hoped and my passion for biology had fizzled. As soon as I began to work and think and sweat biology in the lab, I was once again enamored with it. I've been so fortunate to have had this experience that will be with me all of my life. I plan now to continue on in biological research for as long as I am able.

Proceedings - Index of Presenters, Mentors, & Moderators

A

Aalami, Parisa 99
Abedini, Nauzley 184
Acosta, Maria 149, 164
Agol, Eric 17, 30
Ahn, Sang-gyuen 43
Akey, Joshua 141
Allan, Christopher 77
Allen, Peter 22
Althouse, Benjamin 11
Altug, Bedii 134
Alvarado, Ernesto 162
Alvino, Gina 28
Amieux, Paul 166
Amirkia, Vafa 174
Ammirati, Joseph 32
Anderson, Nicholas 11
Anderson, Richard 139
Andolina, Robert 83
Apenteng, Bettye Appiah 184
Apgar, Brent 11
Arif, Jennifer A. 11
Arraki, Kenza 52
Asbury, Chip 175
Atkinson, Charles T 99
Au, Johnny 12
Au-Yeung, Melissa 70
Avril, Aaron 178
Ayeshalmoutey, Fuad 48

B

Baars, Madeline 12
Bachleda, Amelia 12
Badger, Matt 160
Baerny, Jennifer 99
Baker, Kayla M. 100
Ballard, Jayme 13
Balmforth, Mark 172
Bamford, Nigel S. 126
Bamshad, Michael 150
Barahimi, Mina 100
Barahimi, Mitra 100
Barragán, Cristal 101
Baskaran, Rajashree 30
Bassuk, James 27, 42, 70
Bauer, Carolyn 101
Bavaro, Joshua 101
Baxter, Steve 13
Beck, Anita 150
Beck, Arianna 20

Becker, Andrew 52
Becker, Bonnie 24
Becker, Bonnie J. 40, 55, 90
Becker, Kirsten 102
Becker, Kyra J. 112
Becker, Matthew 13
Beecher, Michael 102
Bell, Kevin 14
Beltejar, Amihan 54
Bender, Emily 29
Bendich, Arnold 37
Bendich, Arnold J 125
Bendich, Arnold J. 85
Benjamin, Mark M. 150
Bennett, Matthew 74
Berg, Celeste 141
Berge, Jamie M. 96
Bergen, Jamie 95
Bergstrom, Carl 11
Birmingham-McDonogh, Olivia 139
Berndt, Jason 133
Bhattacharji, Santha 87
Bichindaritz, Isabelle 28
Biederman, William 14
Billings, Curtis 147
Billingsley, Christina 168
Bilynskyj, Susan 87
Black, Susan 80
Blair, Tiffany 14
Blau, C. Anthony 60
Bleecker, Joan 176
Blinov, Boris 178
Bloch, Eli 14
Bochanski, John 30
Bohringer, Karl 23
Bohringer, Karl F. 30
Bonus, Rick 85
Borchert, Jason 89
Bordia, Rajendra 11, 109
Borriello, Gaetano 69
Bosch, Gundula 138
Bosma, Martha 184, 186
Bottman, Nate 15, 181
Bourgeois, Jody 145
Bouta, Andrew 15
Bowman, Jeff S. 172
Boyce, Hamilton 102
Boyle, Phaedra W. 102
Brackett, David 103
Bradshaw, Toby 86
Brady, Laura A. 169
Branning, Darren 151

- Bratt, Alex 102
 Brett, Michael T. 89
 Brewer, Bonita 28
 Brewer, Bonny 52, 140
 Briseno, Luis 103
 Britton-Simmons, Kevin 172
 Brixey, Shawn 56, 93
 Brockenhoff, Susan 175
 Bromen, Nicholas 15
 Brown, Jonathan 168
 Brown, Sarah 16
 Brown, Sharan 158
 Brown, Wanda 120
 Brudvik, Jeremy 103
 Bruns, Melissa E. 103
 Brush, Lucien 180
 Bryant-Bertail, Sarah 93
 Bryers, James 176, 177
 Bryers, James D. 177
 Buchan, Jillian 16, 87
 Buckley, Kate 16
 Buckner, Frederick S. 11
 Budge, Tyler 106
 Burden, Sam 69
 Burgess, Maria 17
 Burke, Heidi 17
 Burns, Tyler 168
 Burnson, Jacqualyn 104
 Burzo, David 70
 Bushong, James 17
 Bussman, Nancy 18
 Butler, Tom 68
- C**
- Cabbage, Clarissa 104
 Calkins, Jennifer 127
 Cappello, Sean 170
 Cardillo, Gina 47
 Carey, Beth 27
 Carlson, Alisa 104
 Carpenter, Tom 88
 Ceballos, Rachel 161
 Cedarbaum, Emily 18
 Cermak, Nathan 25, 92
 Cernak, Emily 79
 Cezar, Christine Anne 105
 Cha, Junho 180
 Chahim, Dean 105
 Chakraborty, Gargi 81
 Chan, Roy 57
 Chance, Phillip 16
 Chang, Andy 94
 Chang, Deborah 117
 Chang, Howard 19
 Chang, Michael 177
 Chávez, Natividad 19
- Chavkin, Charles 185
 Chi, Daniel 45
 Chilenski, Mark 105
 Chin, Melissa 171
 Chin, Michael T. 14
 Ching, Randal P. 59
 Chirot, Daniel 168
 Chiu, Daniel 22, 27
 Chou, Sandley 79
 Chou, Yeu-Ru 46
 Chrisman, Laura 93
 Christensen, Brian 86
 Christensen, Charlotte 34
 Christensen, Quentin 54
 Chu, Daphne 73
 Chua, Joshua Yaozhang 105
 Chung, Sam 153
 Chung, Sun 106
 Cizik, Amy 81, 83
 Claire, Mark 30
 Clauss, James 87
 Clifton, Donald K. 117
 Cline, Erica 144
 Cline, Erica T. 50
 Cluff, Clayton 18
 Collett, Brent 148
 Collett, Kimberly 19
 Colson, Hailie 116
 Cong, Goh Zhi 94
 Conhaim, Jay 20
 Connors, Catherine 88
 Conrad, Ernest 83
 Cook, Kathryn 182
 Cook, Meredith 106
 Cooper, Betsy 186, 187
 Cooper, Mark S. 161
 Coorg, Shilpa 20
 Creager, Ken 80
 Crockett, Carolyn 53
 Croffut, Samantha 106
 Cruchon, Suzanne 107
 Cuhaciyan, Amie 20
 Curless, Brian 38
 Cushing, Jennifer 20
- D**
- D'Asaro, Eric 33, 173
 D'Asaro, Matthew 107
 Daggett, Valerie 130
 Dale-Crunk, Beverly 106
 Daniel, Thomas 68
 Davies-Vollum, K. Siân 58
 Davies-Vollum, Sian 80
 Davis, Christina 108
 Davis, Jason 101
 Davis, Katey 108

Davis, Mary Alice 165
Davis, Trisha 42
De, Smita 57
Deconinck, Bernard 15, 21
Deem, Steven 102
Delacruz, Danae 21
DeLira, Jesse 79
DeLong, Alexandria 83
Demlow, Sarah Ellen 108
Denney, Rachel 109
Dermatology 27
Deryckx, Kseniya 179
Desisca, Angela 109
deVos, Jordan 137
DeWald, Monica 182
Dhaliwal, Harpreet 70
Dillon, Julian 21
Dillsi, Hala 22, 74
Dimmitt, Alyson 78
Dirks, Clarissa 15, 104, 131
Doepker, Byron 22
Donaldson, Melvin T. 174
Donley-McClure, Shawna 80
Doren, Thomas Van 187
Doty, Sharon 149
Dovichi, Norman 176
Dowden, Patricia 58
Dowell, Alexander 22
Draghi, Louis 69
Drum, Benjamin 109
Duan, Zhijun 60
Dulaney, Christine 84
Dumo, Shiboney M. 23
Duncan, Glen 41
Duncombe, Todd 23
Dunmore, Jessica 55
Durr, Regina 168
Dworzak, Jenny 184

E

E, Gromnica-Ihle 146
Earenfight, Theresa 74
Eary, Janet F. 49
Ebeling, Kristin 31
Edward, Gottheil 48
Eliyah, Chaim 158
Emlet, Charles A. 115
Eng, Diana 174
Evans, Anthony 23
Evans, Dustin 46
Evans, Elizabeth 110
Ewald, Owen 87
Ewing, Kern 162

F

Failing, Patricia 92
Farquhar, Carey 166
Farris, Salena 79
Faustman, Elaine 32, 122
Faustman, Elaine M. 21, 117, 154
Feathers, James 20
Feng, Wenyi 52
Feraboli, Paolo 179
Ferguson, John 162, 163
Fields, Stanley 147
Finn, Jerry 182
Fitterer, Carolynn 23
Fitts, Douglas A. 114
Fitzhugh, John B. 48
Fleurdelys, Paul 79
Flinn, Brian 116
Flor, Herta 146
Flum, David 70
Folch, Albert 76
Foot, Kirsten 111, 131
Fortier, Ted 72
Fortson, Norval 178
France, Lindsay 24
Frank, Whitney 92
Fraser, Don 24
Freedman, Donna 73
Friedman, Batya 29, 53, 54, 64, 137, 142, 146, 152
Froehner, Stanley 20
Fulkerson, Katie 24
Furia, Katherine 171
Furlong, Clement 92

G

Gaffney, Angela 168
Gall, Alevtina 25, 71
Gao, Xiaohu 77
Garcia, Alejandro 179
Garfield, Samuel 79
Garrison, Joseph 110
Garrow, Olivia 111
Gaviria, Ismenia 93
Gawel, James E. 132
Gawel, Jim 80, 119
Gelaye, Bizu 56
Gelb, Michael 92
Gelb, Michael H. 92
Gemedo, Bettu 57
George, James 93
George, William H. 134
Gere, Dawn De 108
Gersten, Ben 60
Gertsen, Julia 111
Giachelli, Cecilia 30
Giardino, William 185
Gilchrist, Matt 111

- Gill, Kristina 112
 Ginger, David 11
 Ginger, David S. 91
 Girton, James 64
 Glawe, Dean 120, 145
 Godoy, Angelina 171
 Goldin, Marianne 25
 Goldsmith, Layne 75
 Goldstein, David 94
 Goodwin, Shannon 73
 Gordon, Margaret 73
 Gosti, Alice 187
 Gottlieb, Geoffrey S. 118
 Gough, Heidi 162, 163
 Governato, Fabio 34
 Grammer, Skyler 111
 Grandy, Travis 158
 Green, William Nathaniel 165
 Greene, Peter 178
 Greengrove, Cheryl 112, 142
 Gregoire, Ashley 25
 Grimes, Anna 112
 Grinley, Melissa 130, 151, 165
 Groom, Martha 24
 Gross, Ted S. 82
 Grue, Christian E. 46
 Gu, Stanley 26
 Guerra, Juan 101
 Guerrette, Zachariah 32, 117
 Gundlach, Jens 68
 Gupta, Jaideep Das 107
 Guttorp, Eric 134
 Guttorp, Peter 134
- H**
- Hacker, Beth 106
 Hackett, Audrey 112
 Hadwin, Jessica 112
 Hahesy, Maryleah 171
 Haigwood, Nancy L. 49
 Haim, Mark 186, 187
 Hakimian, Shahin 146
 Hall, Benjamin 39, 154
 Hallet, Bernard 118
 Halling, Steen 166
 Hamann, Jennifer 72
 Hamilton, Adam 93
 Hamilton, Julia 136
 Hamilton, Michael 159
 Hamm, John Christopher 123
 Hanna, Jenny 80
 Hannaford, Blake 57, 69
 Hannibal, Mark 16
 Hansen, Hale A. 26
 Hanson, Lauren 35
 Haq, Saima 68
- Hardwick, Scotty 113
 Hardy, John 183
 Hargens, Lowell 102
 Harrell, Stevan 34, 60, 74, 75
 Harrell, Steve 74
 Harris, Doris McEwen 182
 Hartung, Carl 69
 Harwood, Caroline 51, 132
 Hauck, Scott 68
 Haug, Emily 113
 Hauschka, Stephen 127, 174
 Havlina, Hillary 26
 Hawley, Suzanne 114
 He, Wenting 60
 Heckel, Blayne 178
 Hedeen, Hannah 27
 Hegarty, Joshua 113
 Helker, Van 172
 Hendershot, Christian 134
 Hendry, David 29, 53, 54, 57, 64, 137, 142, 146, 152
 Hericks, Allison 74
 Hermosillo, Rebekah 112
 Harness, Joel 27
 Herst-Gianol, Micah 46
 Hesson, Jessica 114
 Hevner, Robert 12, 152
 Hicks, Bryson 27
 Higgins, Erin 27
 Hightower, Kathryn 187
 Higuchi, Carolyn M. 114
 Higuchi, Emily 28
 Hill, Seth 28
 Hille, Merrill 150
 Hillesland, Kristina L. 99
 Hilton, Eric 114
 Hinckley, Thomas 62
 Hiremath, Pranoti 28
 Hirschman, Charles 145
 Ho, Rodney J.Y. 167
 Hockenberry, David 125
 Hodge, Dustin L. 29
 Holland, Martin 25
 Holmes, Mark L. 62
 Hong, Sung Woo 32, 117
 Hong, Sungwoo 122
 Horner, Philip 26
 Horst, Orapin 106
 Horwitz, Marshall 131
 Hossack, Aaron 95
 Hossain, Semonti K. 29
 Hou, Joshua 29
 Hou, Pei-Yu 30
 Hough-Snee, Nathaniel 162
 Houmiel, Kathryn 141
 Howard, Judy 170
 Howard, Philip N. 110
 Hrabe, Nik 109

Hsu, Cynthia 150
Huang, Chao 82
Huang, Ivan 30
Huang, Jean 51
Huang, Monica 114
Hudson, Amanda 115
Huey, Raymond 91
Huh, Alexander 30
Hui, Benedict 76
Hummel, Calla 171
Hwang, Felise 133
Hwang, Yeasule 122

I

Iglesia, Horacio de la 113, 160, 161
Ingalls, Carly 30
Ingebritsen, Christine 134
Ivezic, Zeljko 181

J

Jacobs, Jeffrey 115
Jandhyala, Vikram 121
Jarboe, Thomas R. 105
Javier, Johanna Christa 31
Jeffers, Elizabeth 168
Jeffrey, Craig 20, 182
Jerome, Keith R. 72
Jocuns, Andrew 148
Johnson, Darryl 170
Johnson, Odai 187
Johnson, Richard 79
Jonasen, Mary 169
Jones, Bryan 13, 15, 22, 36, 62, 100, 111, 121, 130
Jones, Devyn 142
Joseph, Ralina 154
Jovanovic, Radivoje 69
Joyce, Jennifer 110
Julich, Hannah 90

K

Kaeberlein, Matt 30, 52, 108, 119, 122
Kahsai, Benyam 48
Kaiser, Cheryl 164
Kaiser, Cheryl R. 37, 51, 165
Kamara, Dana 115
Kato, Nicholas 31
Katze, Michael G. 167
Kauffman, S. 117
Kaur, Sujot 74
Kazak, Yana 18
Keenan, Conor D. 116
Keil, Richard 164
Keller, Jonathan 116
Keller, Sarah L. 177
Kelley, Deborah 38
Kelsey, Sooja 74

Kennedy, Brian 175
Kenny, Tara 32
Kerr, Benjamin B. 160
Kerr-Riess, Monica 116
Khan, Aisha 137

Kim, Arnold 77
Kim, Daniel 117, 166
Kim, Hee Yeon 32
Kim, Jeong 45
Kim, Jihye 117
Kim, Jin 54
Kim, Joshua 117
Kim, Moon 118
Kim, Samuel 69
Kim, Tony 32
Kim, Yoon 153
Kimball, Brittany 118
Kinahan, Paul 82
King, Kara 119

Kipelidis, Christina 158
Klavins, Eric 69
Klevit, Rachel 116, 137
Kliot, Michel 64
Knutson, Kelsay 162
Ko, Ronald Matthew 119
Kochhar, Kanta 19
Koelle, David 38
Kohlenberg, Robert 126, 164
Kolobova, Irina 33
Koniges, Ursula 33
Korinke, Erika 119
Korsmo, Elizabeth 33
Korte, Steven 16
Kosai, Yoshito 160
Koser, Sarah Lynn 162
Krabill, Ron 79, 169
Kramer, Anna 120
Kramer, Elizabeth 120
Kramer, Patricia 23
Kramlich, John 139, 140
Kriner, Michelle 168
Kristjansson, Jennifer 82
Kropat, Whitney 34
Kucher, Michael 163
Kuester, Jordan 34
Kuga, Yasuo 180
Kuhl, Patricia 47
Kumandan, Bharath 34
Kunkle, Andrea 120
Kutz, J. Nathan 27, 59
Kyes, Randall 47

L

Ladner, Richard 62, 103, 124
Laegreid, Kelsea 121
Lagos, Taso 84

- Lagunoff, Michael 18
 Lai, Hoyin 76
 Laing, Robyn 35
 Lam, Alfred 120
 Lambers, Janneke Hille Ris 20, 89
 Lamfers, Lindsay 74
 Lampe, Johanna W. 106
 Lampe, Paul 29
 Landa, Rebecca Snow 94
 Landsverk, Megan 54
 Lane, Trevor 35
 Langston, Elizabeth 72
 Larimer, Mary E. 48
 Larson, Glenn 130
 Larson, Jami Jo 121
 LaRue, Lane 64
 Latimer, Andrew 35
 Latsch, Wolfram 78
 LaVassar, Nicholas 121
 Lawhorn, Janessa K. 122
 Lawrence, Christine 109
 Lawrence, Owen 175
 Laws, Chris 111
 Le, Anna 122
 Le, Quy Ha 122
 Le, Sophia 36, 84
 Leano, Jonathan 36
 Lee, Alan 123
 Lee, Christopher 36
 Lee, Donghoon 124
 Lee, Jing-Lan 123
 Leeper, Thomas 36
 Leigh, Elaine 37, 165
 Leigh, Joel 123
 Lemke, Ryan 175
 Lenihan, Jesse 46
 Leong, Chee Sheng 37
 Lerum, Kari 72, 73
 Lesli, Cliff 11
 Lester, Jonathan 69
 Leu, Janxin 38, 120
 Leung, Jessica 124
 Levi, Margaret 31
 Lewis, Melissa A. 41
 Lewis, Rebecca 37
 Li, Bo 89
 Li, Penny 38
 Li, Sally 124
 Li, Xingde 82
 Liang, Kan 74
 Liao, Wei-Ting 124
 Lidstrom, Mary 172
 Lieber, Andre 115
 Lilley, Matthew 38
 Lin, Cheng-I 124
 Lin, Lih Y. 26
 Lin, Sharon 38
 Lindeke, Aliscia 125
 Linders, David 125
 Lindstrom, Kim 140
 Liu, Jennifer 38
 Liu, Ke 125
 Liu, Lee Jane Sally 63
 Liu, Ruolan 39
 Liu, Tingyu 39
 Liu, Zi-Jun 119
 Lockyer, Tonya 186
 Long, Arin Lexine 126
 Lopez, Shaun 84
 Lopez-guisa, Jesus 31
 Lostutter, Ty W. 48
 Lotz, Marielena 26
 Lu, Paul 118
 Luche, Ralf 44
 Ludwick, Lauren 126
 Luk, Jeremy 126, 164
 Lundt, Jonathan 39
 Lunghofer, Kathleen 116
 Lutz, Julie 99, 181
 Ly, Brian 48
 Lydum, Brynn 160
 Lyons, Henry 127

M

- Maack, Anthony 171
 MacKenzie, Alexandra 127
 Maiti, Sathi 127
 Maly, Dustin 45, 132
 Mamiya, Hiroka 128
 Mandt, Tyler C 177
 Manges, Matthew 128
 Manicone, Anne 135
 Mann, Kara 171
 Mansfield, Margot 40
 Marasigan, Joanne Abby M. 71
 Marin, Elizabeth 184
 Marsh, Jaimée 128
 Marshall, Margaret 88
 Marx, Hannah 85
 Marzluff, John 113
 Mascio-Saltarelli, Monique 129
 Masi, Davide De 21
 Massey, Susan 40
 Masuda, Christine 185
 Matula, Tom 39
 Mauro, Gina 73
 May, Peter 36, 84
 Mayer, George 65
 McCallum, Stewart 14
 McCann, Michael 100
 McClintic, Abigail 129
 McCormick, Lindsay 40
 McCornack, Andrew 129

- McDavid, Brandon 31
 McGivern, Liam 170
 McGregor, Bonnie 161
 McGurk, Rosalie 181
 McKay, Susan 41
 McKeever, Jean 181
 McLachlin, Rex 130
 McLaughlin, Josh 112
 McLean, Alyson 171
 McVay, Robert 168
 Mealiff, Matthew 131
 Medendorp, David 179
 Mende, Leila 168
 Meredith, Christina 41
 Merz, Alexey 19
 Mesbahi, Mehran 153
 Messelu, Kidst 130
 Meyer, David 178
 Migotsky, Sean 41
 Miller, Ryan J. 47
 Million, Dian 60
 Mina, Adam 42
 Miner, Brooks E. 160
 Moinpour, Reza 143
 Montgomery, David 40, 44, 80
 Moody, William 35
 Moore, Carrie 171
 Moore, Julia L 130
 Morgan, Dylan 111
 Morris, David 103
 Morris, Joshua 42
 Morrison, Richard S. 184
 Morrissey, Colm 22
 Morrow, James 154, 181
 Moskowitz, Samuel 176
 Moulding, Jennifer 102
 Mount, Christopher 42
 Mourad, Pierre 59, 64
 Muilenburg, Rob 130
 Murcia, Raúl E. 103
 Murkowski, Ann 18, 23, 46, 48, 112, 116, 128, 137
 Murray, James W 135
 Musgrave, Ryan 142
- N**
- Nafisi-Movaghah, Arman 131
 Nagda, Ratnesh 128
 Nam, Andy 85
 Namdaran, Parhum 185
 Namkoong, Shinae 131
 Nascimento, Amos 158
 Neff, Peter 81
 Neighbors, Clayton 48
 Nelson, Brian A. 105
 Nelson, Bruce 61, 130
 Nemhauser, Jennifer 109
- Nesbitt, Elizabeth 21, 140
 Neumaier, John 65
 Newkirk, Simon 131
 Ng, Brittany 99
 Ngai, Al 105
 Nghiem, Paul 27
 Nguyen, Ann 120
 Nguyen, Catherine 132
 Nguyen, Eric 86
 Nguyen, Huong 55
 Nguyen, Thuan V 132
 Nguyen, Wayne Sang 133
 Nhan, Vi L. 84
 Nicholson, Maria 171
 Niou, Yuh-Chi 34
 Nittrouer, Chuck 118
 Noble, Kathleen 165
 Noble, Peter A 104
 Noh, Joseph 161
 Nolan, Kay 87
 Noone, Kevin 11
 Nordby, Kip 43
 Norman, Arwen 89
 Norris, Cortney 88
 Nousheen, Farah 20, 182
 Nouv, Colyn 133
 Numata, Justin 133
 Nutsch, Katherine 71
 Ny, Sophea 116
- O**
- O'Mara, Margaret 79
 O'Rourke, Colin 134
 Oberto, Rachel 133
 Oh, Christina 134
 Ohuchi, Fumio 14
 Ohuchi, Fumio S. 180
 Olavarria, Jaime 35
 Oldenburg, Delene 37
 Oldenburg, Delene J. 125
 Olmstead, Richard 85, 111
 Olmstead, Richard G. 47
 Olsen, Brady 44
 Olson, Clark 127
 Olson, Julia 186
 Olson, Tara 79
 Onslow, Mitchell 44
 Oren, Ersin Emre 28
 Otis, Brian 14, 68, 124
 Otto, Jacqueline 134
 Overney, René 33
 Owens, Brad 129
 Owens, Kalyn 18, 23, 46, 48, 112, 116, 128
 Owens, Kayln 137
 Owens, Mandy 135

P

Padagas, Dyan 44
Padvorac, Jason 82
Page, Elisabeth 45
Pal, Sharmila 135
Palmer, Lauren 172
Palmer, Vanessa 182
Palmer, Vanessa R. 176
Pan, Janet 135
Pang, 'Iris' Kok Shuen 45
Papan-Matin, Firoozeh 73
Pardakhtim, Shokouh 136
Park, J. Christopher 159
Parker, Maile E. 136
Parviz, Babak 69, 143
Patel, Nayan 95
Paulsen, Alex 136
Paun, Dorothy 170
Pavlovic, Anya 20
Peach, Joseph 26
Pegram, Nathan 178
Pei, Nan 163
Peng, Shujun 45
Penski, Vanessa 137
Peraino, David 46
Perez, Alex 46
Perez, Billie 46
Pérez, Martha G. Flores 110
Periard, Brett 137
Perisho, Nicolle 47
Perry, Jennifer 47
Pessiki, Peter J. 103
Petersen, Karen 50, 139
Peterson, Teresa 95
Pfaff, Steven 74
Pfaff, Steven J. 124
Pflug, Adam 137
Phan, Hanhla 47
Phan, TramAnh 137
Philipsen, Gerry 183
Phillips, Paul 16
Pierini, Chris 138
Pina, Laura 69
Plante, Danielle 48
Pollack, Gerald 42, 134
Poon, Jason Tsun-Yin 48
Pope, Lauren 123
Porch, Joshua 48
Porter, Deborah 78, 123, 169
Porter, Jennifer A. 138
Portin, Bradley 182
Pow, Veryl 168
Powell, Marianne 138
Pranowo, Devy 139
Preston, Bradley D. 167
Probert, Joshua 92

Provine, Nicholas 49
Przebinda, Adam 161
Pugsley, Haley 176
Pun, Suzie 94, 95, 96
Punt, Stephanie 49
Purdy, Julia 18
Pyrak, Crystal 167

Q

Qiang, Yi 181
Quinn, Thomas 123
Quitugua, Josephine L. 175

R

Raastad, Christopher 49
Rabinovitch, Peter 185
Radmer, Zachary 50
Raghuraman, M. K. 52, 140
Raible, David W. 185
Rajani, Samir 30
Rakestraw, Andrew 171
Ramachandran, Sujatha 58
Ramakrishnan, Lalita 152
Rasp, Kiel 134
Rastovac, Heather 73
Rathod, Pradipsinh 168
Ratner, Buddy 77
Ratner, Buddy D. 105
Reed, Monty 50, 139, 140
Reese, Michael 147, 162, 187
Regnier, Michael 16, 150
Regnier, Mike 34
Rehm, Eric 33
Reichert, Joe 137
Reid, Rika Kurose 120
Rhieu, Byung 139
Rhodes, Linda D. 108
Richardson, Paul 140
Riddiford, Lynn 104
Ridgway, Matthew R. 50
Rieck, Heather 37, 51
Riskin, Eve 57, 62
Roach, Ai Okubo 75
Robbins, Aleah 88
Robbins, Hannah 51
Roberts, Georgia 74, 182
Roberts, Steven 24, 86
Robinson, Andrew 140
Robinson, Joshua F. 21, 154
Robles, Nelson 180
Rocap, Gabrielle 120, 173
Rockne, Russell 136
Rodenhough, Philip P. 92
Rodger, Sarah 51
Rodriguez, Maria Elena 163
Rodriguez, Michael 31

- Rogers, Haldre 32
 Rolczynski, Lisa 140
 Rose, Amy 52
 Rose, Jennifer 52
 Rose, Tim 100
 Rosen, Jacob 69
 Rosser, James 141
 Rossmeisl, Robyn 78
 Roy, Sumit 110
 Rudensky, Alexander 45, 71
 Ruesink, Jennifer 89, 90
 Rule, Rebecca 104
 Ruohola-Baker, Hannele 109, 174
 Ryan, Dennis 78, 126
- S**
- Sacha, Kimberly 141
 Sachs, Julian P. 172
 Saeedi, Ehsan 69, 143
 Sager, Jennifer 52
 Salamat, Atriya 141
 Saletore, Yogesh 82
 Salk, Jennifer 186
 Salo, Jessica 79
 Sanders, Jamie 53
 Sanderson, Beth 50
 Sandona, Brent 21
 Sapin, Julia 78
 Sarikaya, Mehmet 28
 Sathanur, Arun 121
 Sauro, Herbert 102
 Scarlis, Christine A. 126
 Schleh, Stephen 53
 Schlimmer, Carin 142
 Scholting, Kelly 142
 Schubiger, Gerold 13
 Schulfer, Anjelique 53
 Schulze-Oechtering, Michael 85
 Schwartz-Gilbert, Benjamin 142
 Scott, Francis 48
 Scouras, Alexander 130
 Scroggs, Matt 168
 Seals, Kevin 177
 Seanez, Sara 54
 Seidler, Gerald 142, 143, 178
 Seimears, Tracy 90
 Sena, Mark 77
 Serpe, Josef 143
 Sharma, Sunny 143
 Shayne, Julie 73, 170
 Sheehan, Florence 36, 39
 Sheldon, Kimberly 89
 Shen, Hong 107
 Shi, Mark 167
 Shoda, Yuichi 108
 Shumlak, Uri 105, 133, 149
- Sibley, Carol 168
 Silber, John 44, 82
 Simoni, Jane 19, 149, 164
 Singh, Amanjot 52
 Singh, Amarpal 48
 Singh, Nikhil 182
 Sisley, Hope 54
 Skilton, Alicia 143
 Skinner, Sonny 54
 Smith, Cosmo 55
 Smith, Erica 52, 160
 Smith, Jeff 144
 Smith, Jessica M. 91
 Smith, Kathryn 52
 Smith, Robert A. 167
 Sodt, Rita 144
 Solomon, Mat 18
 Som, Sanjoy 44
 Sommerville, Jessica 33
 Son, Ju Yong 54
 Song, Steven 55
 Song, Yeun Ok 55
 Southworth, Andrew 179
 Spada, Albert La 17
 Spector, Michael 180
 Speed, Clarke 75
 Speltz, Matthew 148
 Spencer, Kristie 37
 Spurr, Stephannie 144
 Stacey, Bob 79
 Stafford, Kate 107, 151
 Stanton, John 61
 Stapleton, Ann E. 70
 Stecker, G. Christopher 23, 128
 Stefanowski, Elishia 55
 Stein, William 181
 Steiner, Robert 117, 122, 136
 Steinkraus, Katherine 108
 Stephanova, Victoria 170
 Stevens, Mark 177
 Stevenson, Theron 172
 Stickler, Christine 133
 Stiens, Steven 50, 139
 Stilio, Verónica Di 53, 99
 Stoll, Kate 137
 Stone, Amir 56
 Stone, John 49, 54
 Stoneback, Matthew A. 180
 Stoudt, Chase 173
 Stovel, Katherine 25
 Strasbourg, Prina 176
 Strikitus, Tom 129
 Stroble, Jamie 79
 Stuetzle, Werner 181
 Stull, William 159
 Suarez, Juliana 145
 Sullivan, David 145

Sung, Deborah 75
Sustar, Anne 13
Swalla, Billie 85
Swanson, Kristin 40, 81, 136, 144
Swanson, Terry 54, 107
Swanson, Willie 86, 127
Syvertsen, James 46
Szeto, Mindy 145

T

Tai, Phillip 127
Talebiliasi, Amir 146
Talebiliasi, Faezeh 26
Tang, Kitty 146
Taplin, Cullen 86
Taplin, Stacey 183
Tartaglione, Erica Victoria 161
Taub, Frieda 89
Taylor, Ed 120
Tchao, Bie Nga (Angela) 175
Terasaki, Dale 56
Tewksbury, Joshua 32, 89, 148
Thielen, Charity 168
Thieme, Anique 146
Thieme, Kati 146
Thomas, Michael 159
Thomas, Spencer 187
Thomas, Wendy 76, 77
Thompson, Amanda 173
Thompson, Hilaire 55
Thompson, Rob 56
Thornton, James 147
Thornton, Rose 147
Thurtle, Phillip 158
Toader, Daniel 57
Toews, John 182
Tokuda, Emi 57
Tolin, Wendy 147
Tolnay, Stewart 12, 45
Tran, Anh 146
Tran, Jessica 57
Tran, Katherine 58
Tran, Kimberly 77
Tremblay, Kelly 147
Trett, Kristen 58
Trevithick, Kelly 58
Trimble, Alan 90
Truman, James W. 184
Tsai, Chaochung 90
Tsoh, Janice 164
Tsunemi, Taiji 12
Tu, Jonathan 59
Turk, Dennis C. 146
Turley, Nash 148
Turner, Emily 91
Tuve, Sebastian 115

Tych, Rowen 59

U

Ung, Danielle 148
Unger, Jesse 59
Urdahl, Kevin 71

V

Vaezy, Shahram 94, 95
Valencia, Chloe 148, 183
Valencia-Garcia, Dellanira 19, 149, 164
Vann, Jamie 149
Varani, Gabriele 36
Vartolomei, Iulia 137
Vaswani, Pavan 96
Veeraraghavan, Anenny 21
Verdugo, Gabriel 149
Vicini, Paolo 176
Villegas, Julie 92
Vincent, Audra 60
Vincler, Catherine 171
Vogman, Genia 149
Volkenburgh, Elizabeth Van 60
Voss, Britta 164
Vu, Mailinh 83

W

Waade, Andrea 168
Waddington, Ed 81
Wade, Bonnie 179
Waiss, Mary 39
Waldron, Danielle 60
Waldron, Michelle 60
Wallis, Stevie 108
Walsh, Laura A. 72
Walsh, Ryan 150
Wan, Hongjiang 60
Wanagat, Jonathan 185
Wang, Christina Hao 76
Wang, Jennifer 38, 120
Wang, Jianxiong 60
Wang, Shuo 60
Wang, Wei-Chih 46, 125
Wang, Zhining 150
Ward, Alice 150
Ward, Tracey 151
Warner, Jessica 151
Webb, Sara Jane 101, 115, 133
Weber, Joel 35
Weber, Rachel 61
Week, Derek 61
Wei, Kathy Y. 96
Weintraub, Ben 68
Weir, David E 151
Welch, Atria 111
Welikson, Robert 174

Wellner, Kimberly 61
Wells, Deva 75
Werner, John 61
Werner, Lynne 153
Westerman, Martin 147
Whiteaker, William 62
Whiteside, Ursula 41, 135
Whiting, Susan H. 84
Whitmore, Colin 176
Whittle, Sam 62
Whyman, Michelle 62
Widder, Sarah 62
Wiedey, Shannon Claire 166
Wiley, Hannah C. 187
Wilkerson, John 55
Wilkes, Jeff 56
Williams, Charles 152
Williamson, Rebecca A. 26
Wilmot, Kevin 167
Wilson, Chris 25
Wingfield, John 101
Winglee, Kathryn 152
Winglee, Robert 138
Wise, Morgan 177
Wiseman, Wendy 88
Wong, Garry 146
Wong, Risa 68
Wong, Stephanie 63
Wong, Wing 63
Wood, Derek 25, 123, 141
Wood, Lianna 168
Wood, Rachel 168
Wood, Robert 151
Wotus, Cheryl 160
Wright, Richard 17
Wygant, Christina 171
Wytenbach, Jason 64

X

Xiao, Keliang 70

Y

Yager, Paul 58, 76
Yam, Kai Chi 38
Yang, Anand 168, 169
Yang, Lisa 70
Yang, Roderick 152
Yano, Yuri 120
Yao, Shishi 60
Yeager, Louise 153
Yee, Kevin 153
Yin, Hao 124
Yip, Leon 153
Yoon, Hanna 46
Youngman, Ryan 134
Yousoufian, Krysta 64

Yousoufian, Maria 91
Yu, Heidi 48
Yu, Kang 64
Yu, Wentao 154
Yu, Xiaozhong 21, 32, 117, 122, 154

Z

Zabowski, Darlene 113
Zahed, Roya 154
Zhang, Tracy-Ying 154
Zhao, Xue-Qiao 35
Zhou, Chunyan 136, 154
Zhou, Jason 65
Zimmerman, Eric 65
Zivot, Eric 136
Zucker, Lila 31
ZumBrunnen, Craig 51

ACKNOWLEDGEMENTS

The Undergraduate Research Program wishes to recognize all of the faculty members, postdoctoral associates, staff, and graduate students who have provided guidance and mentoring to the undergraduate researchers featured in this symposium.

None of this would have been possible without you.



A special note of thanks to the faculty who released their classrooms in Mary Gates Hall and the Center for Career Services for opening up their space for this event.



We wish to thank all of the volunteers who helped to organize and run this event:

Session Moderators: Paul Amieux, Ginger Armbrust,

John Banks, Matt Barreto, James Bassuk, Gaetano Borriello, Marti Bosma, Daniel Chirot,
Amy Cizik, James Clauss, Betsy Cooper, Paolo Feraboli, Stevan Harrell,

Judy Howard, Horacio de la Iglesia, Cheryl Kaiser, Kari Lerum, David Montgomery, Brad Portin,
Suzie Pun, Hannele Ruohola-Baker, Dennis Ryan, Gerald Seidler, Werner Stuetzle, Billie Swalla,
Frieda Taub, Wendy Thomas, Phillip Thurtle, Emily Turner, Julie Villegas, Colin Whitmore.

Planning Assistance: Gargi Chakraborty, Jeff Eaton, Tina Gall, Lauren Hansen, Jonathan Keller,
Daniel Kim, Ryan Maas, Christine Masuda, Chloe Valencia.

Event Preparation and Support Staff: Center for Experiential Learning Staff, Sarah Borsic,

Patience Browne, Julia Bruk, Robin Chang, Koeun Choi, Stanley Choi, My Christensen, The
Community of Mary Gates Scholars, Jodene Davis, Rod Davis, Denise Della, Neil Dobson, Wendy
Durant, Allison Galbraith, Sarah Garner, Jesmie Ginez, Toni Hsu, Manbir Kaur, Brook Kelly,
Kristen Lindley, Katherine Mabantia, Keiko Minami-Page, Vanessa Montoya, Torrey Morgan, Tracy
Maschman Morrissey, Adan Noriega, Jason Patterson, Adelaide Rhodes, Solomon Robbins, Atriya
Salamati, Beth Scholler, Clay Schwenn, Mariam Shehata, Emily Solberg, Kerianne Steucke, Cari
Swanger, Cam Tran, Jaleesa Trapp, Matt Wojciakowski, Patsy Wosepka, Joshua Gibbs, Roberta
Hopkins, Jon Linse, Virginia Lupori, Catherine O'Donnell, Mona Pitre-Collins, Eric Poon, Judy
Robertson, Bob Roseth, Kathryn Schrenk, Jo-Ann Sire, Christine Stickler, Irene Svete, Susan Terry,
Jeff Todd, UW Postdoctoral Association, Jennifer Walters, Debbie Wiegand, Matt Winslow, Rachel
Woods, Pat Wrobel

Special Guests: President Mark Emmert, Provost Phyllis Wise, Vice Provost Mary Lidstrom, Dean
and Vice Provost Ed Taylor.

Hearty thanks to *Phi Eta Sigma* and all the other wonderful volunteers
who helped make this event a success.



We express appreciation for sponsorship of this event to the Office of Research, the Mary Gates Endowment for Students, Undergraduate Academic Affairs, and the UW Alumni Association.

