Fostering a Community of Student Scholars

University of Washington
Twelfth Annual Undergraduate Research Symposium

Celebrating Undergraduate Scholarship and Creativity

15 May 2009

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.

Dedication

In memory of Celia Kelly, a talented undergraduate researcher, colleague, and friend

The Twelfth 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 Staff Assistant
Joy Kim, Undergraduate Student Assistant

The Undergraduate Research Program is a unit of the
University of Washington's Undergraduate Academic Affairs

Proceedings

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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 at: http://www.washington.edu/research/urp. Other URP opportunities include the Amgen Scholars Summer Program, the Summer Institute in the Arts & Humanities, as well as courses and workshops. URP staff offer individual advising to undergraduates; email urp@u.washington.edu for an appointment.

Travel Awards for Undergraduates to Present Research

Students who have had a paper or poster accepted to a national conference may apply for funding for travel expenses and registration fees. Applications are accepted on a continuing basis. For more information visit:
http://www.washington.edu/research/urp/students/urcta.html.
Sponsored by the UW Office of Research, the Undergraduate Research Program and the Mary Gates Endowment for Students.

Mary Gates Research Scholarships

These competitive research scholarships are available to enhance the educational experiences of students in all disciplines who are engaged in research closely guided by UW faculty. The next application deadline is in autumn 2009. For more information visit:
http://www.washington.edu/uaa/mge/
Funded by the Mary Gates Endowment for Students.

Washington Research Foundation Fellowships & Levinson Emerging Scholars Awards

(Application deadline: Monday, June 1, 2009)

These scholarships support advanced undergraduate researchers (with at least 3 quarters of prior research experience) who work on creative and sophisticated science, engineering, and biotechnology-related research.
For more information and application visit:
http://www.washington.edu/research/urp/students/funding.html
Funded by the Washington Research Foundation and Art & Rita Levinson.

Library Research Award for Undergraduates

The University Libraries' Library Research Award for Undergraduates competition recognizes UW students who produce significant inquiry requiring use of information resources, the library, and its collections. Application deadline: May 18, 2009. For more information visit:
http://www.lib.washington.edu/researchaward/
Funded through the Kenneth S. Allen Library Endowment and the Friends of the Libraries.

Through my research, I was able to travel and work with children. I loved going to a new place and learning so much valuable information from the people I worked with. I am also proud that I can give something back to that community. Without my project, I would not have been able to accomplish so much.

-Jessica Chandras, Senior, Anthropology

The most rewarding part of my research experience has been to be able to apply text-book concepts in genetics and molecular biology that I would have only had the chance to read about in classrooms. Today I'm actually performing these assays myself!

-Harpreet Dhaliwal, Senior, Biology (Molecular, Cellular & Developmental)

The Undergraduate Research Program
and UW Alumni Association
Congratulate the 2009
Undergraduate Research Mentor Awardees

For excellence in guiding undergraduates to become scholars.

Martha M. Bosma
Associate Professor of Biology

James E. Gawel
Associate Professor of Interdisciplinary Arts & Sciences, UW Tacoma

Matt R. Kaeberlein
Assistant Professor of Pathology

Sheri J.Y. Mizumori
Professor and Chair of Psychology

Jentery F. Sayers
Graduate Student in English

UW Alumni Association

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

Undergraduates Honor Their Mentors
A selection of nominations from undergraduate researchers

Professor Bosma has been extremely supportive, kind, and generous with her knowledge. She keeps the laboratory atmosphere laid back, but always pushes us to apply our knowledge to our projects. She is very understanding of the concerns of undergraduates but still maintains high expectations for us. Professor Bosma should receive this award because of the atmosphere of learning, understanding and knowledge she fosters in her laboratory.

As a mentor Jentery Sayers constantly pushes his students to exceed expectations while never demanding perfection. His project-based approach to classroom learning drives students to be competent in both theory and practice. These are difficult fronts to cover, but through computer integration of the classroom Jentery succeeds in creative approaches to authoring, responding, teaching, and feedback to students. The projects that I have developed under him have been an invaluable stepping stone in my academic progress. His emphasis on revision, collaboration, and student feedback should be the standard at this University: it is something I have come to expect from my professors and higher education.

Professor Schlamminger should be praised for his investment in his students. He seeks to grow my skills as an experimenter. He makes my goals his goals for our work together. When I began talking with him about working with the group, I mentioned my desire to apply for the Mary Gates Research Scholarship. Prof. Schlamminger decided that, since I wanted to apply for the award, I should have a self-contained project to call my own. He was eager to help with my application and rejoiced with me when I received the award. He values my contribution to the research. I was both impressed and delighted by his decision to skip a large regional conference in order to come and hear me give my little 10-minute talk at the Symposium.

Undergraduates Honor Their Mentors
A selection of nominations from undergraduate researchers

Nadine was a constant source of support and energy to our entire task force team throughout our research. She was a driving force behind getting us to Ottawa to conduct interviews that really made our research top notch. Our team's time in Canada was a truly memorable experience in large part because of Nadine's enthusiasm for helping us excel at our research.

Sapna is TRULY the most amazing mentor and guide. I feel comfortable with her because she is excited to help however she can and has given me advice in many areas beyond our project! She makes it seem like she doesn't have an entire lab with 12+ members, multiple Graduate students and another Honors student. Now multiply that individual care by 15 because she makes everyone else in her lab feel the same importance. She allows the perfect mix of challenge and support to help us develop. She is clearly happy to help, but she always ensures that it's myself that's in the driver's seat. She is a role model, too. I see her at all the educational opportunities I attend, whether it is lectures on or off campus and never is she without such perfect questions. I have worked under many PIs before and Sapna is above and beyond them all in her kindness, intelligence, and in her desire to help students grow!

Rachel Chapman has gone above and beyond her role as my mentor! Over two years, Rachel has fostered my growth as a young researcher and scholar. She has supported me through my honors research project and graduate school preparation. Her rigorous expectations have challenged me to work harder and become a better researcher. Her passion and commitment have been the sources of my inspiration. Rachel believes in my success therefore pushes me to higher limits. I would not be presenting at the 2009 Undergraduate Research Symposium without her guidance and support.

Dr. Daniel has been incredibly supportive throughout my research career in his lab. He upholds a friendly environment and encourages students to voice any questions or concerns they may have regarding their research or project. He devotes equal time to every personnel member in the lab, whether they are post-bac, grad students, or undergrad. Dr. Daniel has allowed me to chase my goals without restrictions and wants to see his students succeed. It is for these reasons that I think Dr. Thomas Daniel should be awarded the outstanding mentor award.

The Undergraduate Research Program
and UW Alumni Association
Honor the 2009
Undergraduate Research Mentor Award Nominees

Daniel Schindler ~ Arzoo Osanloo ~ Gabrielle Rocap ~ Joyce Dinglasan-Panlilio ~ Karl F. Bohringer ~ Steven Roberts ~ Joshua Bandfield ~ Megan Dethier ~ Ludmila Moskal ~ Steve Hauschka ~ Bo Zhang ~ Gregory Wilson ~ John Hansen ~ Catherine Carr ~ Shahram Vaezy ~ Sian Davies-Vollum ~ Jim Gawel ~ Paul Nghiem ~ Benjamin Kerr ~ Sharon Doty ~ Maya Gupta ~ Jiangyu Li ~ Matt Kaeberlein~ Nadine C. Fabbi ~ Benjamin Hall ~ Michael Stiber ~ Kristin Swanson ~ Toshiyuki Ogihara ~ Thomas Quinn ~ Ralina Joseph ~ Sheri Mizumori ~ Michael Murias ~ Michael Reese ~ Janelle Taylor ~ Susan Joslyn ~ Tom Daniel ~ Frances Contreras ~ David McDonald ~ Chris Laws ~ Martha Bosma ~ Rachel Chapman ~ Stacy Betz ~ Melissa Grinley ~ Alex Horner-Devine ~ Nikolai Tolich ~ Nancy Rivenburgh ~ Christian Sidor ~ Billie Swalla ~ Alexander Mamishev ~ Alicia Wassink ~ Munira Khalil ~ Cheryl Greengrove ~ Suzanne Hawley ~ Ufuk Ince ~ Baya Friedman ~ Charles Hirschman ~ Steven Pfaff ~ Raphael Bernier ~ Xiaohu Gao ~ Roberto G. Gonzales ~ Jashvant Unadkat ~ Kimberlee Gillis-Bridges ~ Scott Hauck ~ Leo Pallanck ~ Jason DeLeon ~ Barbara Wakimoto ~ Uri Shumlak ~ Stephan Schlamminger ~ Vincent Gallucci ~ Jennifer Nemhauser ~ John Ravits ~ Buddy Ratner ~ Paul Quay ~ Jentery Sayers ~ Steven Goodreau ~ Derek Wood ~ Jennifer Salk ~ Sapna Cheryan ~ Robert Smith ~ Rebecca Price ~ Lalita Ramakrishnan ~ Celeste Berg ~ R.J. Wilkes ~ James Bassuk ~ Lorenz Hauser ~ Brian Flinn ~ Horacio de la Iglesia ~ Joanne Wang ~ Eric Klavins ~ Dorothy Paun ~ Frederick Buckner ~ Marisa Sylvester ~ Teresa Mares ~ Justin Siegel ~ Daryl Haggard ~ Virginia Manner ~ Rob Burke ~ Meghan Halabisky ~ Ursula Valdez ~ Kaishi Wang ~ Christian Hendershot ~ Richard Frock ~ Emily Howe ~ Candace Brown ~ William Grady ~ Mike Karl ~ Michael Town ~ Snow Peterson ~ Catherine Blish ~ Arminda Suli ~ Elsa Raibon ~ Lynne Jones ~ Heather Dungan Lemko ~ Jeremy Riedel ~ Tim McGinnis ~ Mark Matsushita ~

Unique Opportunities: Students Talk About Research

What did research allow you to do that you wouldn't have done otherwise?

I get to study exactly what I am most interested in because I am working on a project that was entirely my own idea. In my opinion this is by far the most rewarding and worthwhile way to learn.

It has helped me become better at planning and recording what I do. It has forced me to gain practice with public speaking, something that I normally avoid. I have been able to work with experts in the field – my mentors – and use advanced equipment – evaporating metal is pretty neat!

I was given the opportunity to really own my work, be a part of a research team, and be an author on a paper to be published in a scientific journal. Without this undergraduate experience I may not have discovered my interest in research until much later or at all.

My project, in particular, has taught me to constantly reevaluate the things I hold to be true, and that this world is not static, giving us endless opportunities to learn about the new.

My research experience showed me that the more you learn, the more you learn that you don't know! It takes a lot of time and commitment to do great and helpful research and because of my research I got to learn an amazing amount of material.

I learned how a dance can be used as a tool for social change and to think about movement in ways that are different from my previous experiences.

I was able to make connections with faculty that I would not have been able to make.

Research has definitely been one of the greatest experiences of my undergraduate education – it has taught me that I am indeed capable of anything that I set my mind to!

Poster Presentation 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.

Footnotes: Crowdsourcing Hikers to Preserve and Maintain our Trails

Dong-Jin Ahn, Senior, Informatics
Kevin Merritt, Senior, Informatics
Benjamin Fields, Senior, Informatics
Mentor: Batya Friedman, Information School
Mentor: David Hendry, Information School

Over the last two years over 40 million young adults went on hikes all over the United States, while volunteer organizations contributed 80,000 hours maintaining these trails annually. Despite these numbers, trail maintenance still lags behind trail use. All of these young hikers represent an unrealized opportunity to improve the system of trail preservation. The way current systems solicit and aggregate trail information (e.g. sending an e-mail to a trail organization about a problem) inadequately facilitate this important job. To design a more flexible trail reporting process, this research and design project investigates the use of crowd-sourcing, a technique through which the public helps capture and systematize large amounts of data. An assessment of user needs was obtained by conducting six informal interviews with leaders of hiking and trail maintenance groups and by evaluating key current reporting systems. A combination of GPS coordinates, pictures, and the hiker's intuition were found to generate the most helpful reports. Based on this data, our system was developed to record everything from wildlife to trail conditions. Footnotes consisting of a mobile application running on GPS enabled iPhone, allows hikers to tag "notes" with geographic location data. Different trail problems and issues are categorized, so it helps the users can easily report it when they encounter trail issues. We developed an interactive prototype and website to display a comprehensive view of trail conditions for hikers and land managers. Later, we invited 5 participants to test the mobile interactive prototype. Based on their feedback, we made several design changes which made the application easier to use along the trail. With the ability to aggregate trail information for land managers, Footnotes is intended to expedite trail maintenance. By harnessing the hiking community through mobile reporting, a more accurate log of trail conditions can be established.

Effects of Muscimol Reversible Inactivation of the Prelimbic Area on Spatial Working Memory

Lisa Akiyama, Senior, Psychology, Biology (Molecular, Cellular Developmental)
Mentor: Sheri Mizumori, Psychology

Spatial working memory (SPWM) is a specific type of working memory that temporarily stores and manipulates incoming spatial information. The function of SPWM is essential in human life, and SPWM deficits have devastating effects on humans. Prefrontal cortical malfunction has been pointed out as the plausible cause of SPWM deficits in several psychiatric disorders, such as Parkinson's Disease and Schizophrenia. SPWM is strongly functioned by the prefrontal cortex (PFC) and the hippocampus (Hip). Recently it has been specifically emphasized that the prelimbic area (PL) of PFC plays an active role in SPWM. Moreover, it has been suggested that spatial learning heavily depends on the Hip-PL circuit. Despite these findings, further investigation is still necessary to clarify the mechanism of Hip-PL circuit's involvement in purely SPWM activities. In this study, the role of PL in SPWM will be studied by measuring the SPWM ability of mice with inactivated PL. Precisely localized bilateral PL inactivation was achieved by reversible inactivation, involving bilateral local microinfusions of muscimol, a GABAA agonist, in PL. After the infusion of muscimol, followed by food deprivation of the mice, SPWM was assessed using a plus-maze task.

Investigating the Influence of Dust Aerosol on the Atmospheric Sulfur Budget in the Marine Boundary Layer Using Oxygen Isotope Measurements of Sulfate Aerosol and a One-Dimensional Box Model

Helen Amos, Senior, Atmospheric Sciences
Mary Gates Scholar
Mentor: Becky Alexander Suess, Atmospheric Sciences

Sulfate is an important chemical species in the atmosphere and may be formed by various oxidation pathways. A one-dimensional box model was constructed to investigate the relative importance of six different sulfate formation pathways using oxygen isotope tracers. Boundary conditions (e.g. temperature, pressure, oxidant concentrations) for the box model are specified by GEOS-Chem, a 3-D global chemical transport model. Our particular study is concerned with gas-phase oxidation by OH; in-cloud oxidation by O_3, H_2O_2, and O_2 (metal-catalyzed); and oxidation by O_3 on dust and sea-salt aerosols. Each oxidant is assumed to have a unique anomalous enrichment of δ17O relative to δ18O, which is quantified according to the expression Δ17O = δ17O – 0.5* δ18O. The Δ17O signature of each pathway is reflected in the sulfate that is subsequently formed (e.g. sulfate formed by O_3 oxidation has Δ17O ˜9 whereas sulfate formed by OH oxidation has Δ17O = 0). To determine what the Δ17O of an atmospheric sulfate aerosol might look like, the model adds together the mass-weighted Δ17O contributions from each of the six sulfate formation pathways. Model estimates of the Δ17O of a sulfate aerosol may then be directly compared to Δ17O measurements made in the laboratory on a stable isotope mass spectrometer. We will present a box model-based interpretation of measurements of Δ17O(SO42-) from aerosols collected off the west coast of the Sahara desert in order to quantify the impact of dust aerosol emissions on the sulfur budget in the marine boundary layer.

Contingency Management for Stimulant Use for the Severely Mentally Ill

Kevin Aranas, Senior, Environmental Health
Mentor: Michael McDonell, Psychiatry Behavioral Sciences

Contingency management is an intervention where opportunities for rewards are earned by people for not using drugs. The goal of this study is to determine the effectiveness of contingency management in the reduction of stimulant drug use among the severely mentally ill population. The study involves 12 weeks of treatment where people come in three times a week and earn opportunities for rewards for not using stimulant drugs. Participants must be suffering from drug addiction and mental illness. The screening for stimulant drug use is accomplished through urine analysis. Participants who are abstinent from drugs earn a chance to draw for prizes. Rewards are based on taking draws, which utilizes a variable-ratio schedule of reinforcement. The variable-ratio schedule involves the absence of pattern in obtaining reward. In this study, that absence in pattern is accomplished through draws. Variable-ratio reinforcement is utilized to help maintain a behavior (drug abstinence) and reduce cost (not give out a reward at every time). After 12 weeks, participants are followed for 3 months without being in treatment to measure the length of time the effects of the treatment last. Then, contingency management is compared to a control condition. A novel component of the study is that it is being implemented in a community mental health center. This is being done in order to increase the generalizability of study findings and to quickly disseminate the treatment if it is found to be effective.

Pancreatoscopy Using Steerable Guidewire With Eyes

Alexander Babchanik, Senior, Mechanical Engineering
Mentor: Eric Seibel, Mechanical Engineering
Mentor: Cameron Lee, Mechanical Engineering

Pancreatitis is the most common complication after endoscopic retrograde cholangiopancreotography (ERCP) which can be lethal. As a result, the popularity of ERCP has declined over the past decade. Development of pancreatitis can be partially attributed to the damage caused by contact between the pancreatic duct tissue and the tools inserted over a standard guidewire without endoscopic visualization. One way to prevent pancreatitis is to use a recently developed steerable guidewire with eyes for ERCP, an ultrathin scanning fiber endoscope (SFE), rather than standard guidewire. The SFE has a relatively high resolution by acquiring 500-line images at 30 Hz frame-rate while being only 1.2 mm in diameter with a 9 mm rigid tip length. SFE also has a wide field of view with electronic zooming capability. Although the 0.9 mm standard guidewire is smaller in diameter, the high resolution steerable guidewire with eyes allows direct interductal visualization, which can significantly aid in early detection and treatment of pancreatic ductal adenocarcinoma. To demonstrate safety of the new device, a comparison study is being conducted using a synthetic pancreas with embedded force sensors. Synthetic pancreas with a duct was constructed using soft silicone rubber material, which has similar mechanical properties to the actual pancreatic tissue. The duct was made according to the dimensions and shape of an average human pancreatic duct, which is about 15 cm long and 2-4 mm in diameter. Two different types of small force sensors considered for the model were piezoelectric and piezoresistive force sensors. Due to inherent poor characteristics of piezoelectric material for low quazi-static measurements, piezoresistive sensors were chosen for measuring forces on the pancreas during insertion. A comparison will be made between the forces involved in the standard ERCP procedure versus using our new steerable guidewire with eyes using the synthetic pancreas.

The Social and Political Transformation of the Latino Populations in the White Center and South Park Neighborhoods, 1970-Present

Charysa Beeman-Varela, Senior, American Ethnic Studies
Katherine Viola, Junior, American Ethnic Studies
Kelsey Bramer, Sophomore, Pre-Arts
Wendy Grande, Junior, Communication
Mentor: Erasmo Gamboa, American Ethnic Studies

Seattle's White Center and South Park neighborhoods have historically been home to industrial workers, farmers, low-income families, and European and Asian immigrants. Since the 1970s, however, these neighborhoods have witnessed a large influx of Latino migration and immigration. By the time that the Latino population began to grow, for various reasons, these areas of the city had high levels of poverty and crime. Our project studied how Latinos, one of the area's largest populations, has transformed and improved the social and structural ecology of White Center and South Park. Latinos have become major participants in the community and implemented programs such as community health centers, opened up businesses, and organized to enhance the quality of public education. In order to map the transformation taking place in South Park and White Center, our research examined census maps, school enrollment trends, and business directories. As a way of documenting how Latinos are impacting these communities, oral histories were collected from people connected to the areas as well as old and recent photographs of long standing buildings in the community. Finally, the research calibrated the Latino population in South Park and White Center with the larger context of Latino immigration to the U.S. and Seattle. In effect, the project car-

ried out both quantitative and qualitative research in order to study how Latinos have converted the two neighborhoods for the better. Our project demonstrates how global immigration and migration processes can result in significant local change. We hope that through our study, others can understand how immigrants and migrants can improve marginalized neighborhoods. Just as important, in the process of revitalizing their communities, our project discloses how Latinos have become catalysts to their own empowerment.

Effect of Temperature on Respiratory Exchange Ratios Kinetics in Trained Male Athletes

Benjamin Lovelace, Senior, Exercise Science, Seattle Pacific University
Mentor: JoAnn Atwell-Scrivner, Exercise Science, Seattle Pacific University

Much of the research to date observing the relationship between substrate utilization and exercise has been conducted under thermal neutral conditions. Physiologically, it is clear, that temperature, specifically extreme heat, directly impacts the hormonal and cardiovascular systems. These acute hormonal and cardiovascular adaptations, in turn, manipulate the metabolic and bioenergetic networks that govern substrate utilization. Additionally, an athlete's muscle and hepatic glycogen, as an energy resource for working muscle, is limited in capacity. Once an athlete transitions from a combination of lipid and carbohydrate substrate, to a primarily carbohydrate substrate, time quickly becomes the enemy as an athlete will run out of carbohydrate resources in about 90 minutes. Full depletion of muscle and hepatic glycogen can lead to a severe energy imbalance followed by a heat related illness. The combination of these two reactions can end an athlete's day or even their life if the necessary precautions are not followed. This current research study will be presented orally and will include observations of 2-4 collegiate male soccer players [18-24 yr] cycling at 70% VO2 maximum under a thermal neutral (20C) condition, and elevated temperature (40C). Respiratory exchange ratio kinetics will be measured during cycling at 70% VO2max to pinpoint the speed at which an athlete transitions from a combination of carbohydrate and lipid substrate, to a primarily carbohydrate based substrate. Emphasis in this investigation will focus on the speed at which these metabolic adjustments take place. This research project hopes to add to a growing interest in the field of bioenergetic advancements that specializes in the body's ability to adapt to heat regulation. The ultimate goal is to contribute to updated safety standards for athletes participating in a wide variety of sports in varying temperatures around the world.

The Role of Hypoxia in Germline Stem Cell Division and Maintenance in *Drosophila Melanogaster*

Jacqueline Benthuysen, Senior, Biochemistry
Mary Gates Scholar
Mentor: Hannele Ruohola-Baker, Biochemistry
Mentor: Ellen Ward, Biochemistry

Cancer stem cells (CSCs) are thought to contribute to progressive tumor growth in hypoxic, or low oxygen, environments. In Dr. Ruohola-Baker's lab at the Institute for Stem Cell and Regenerative Medicine, postdoctoral fellow Julie Mathieu has shown in unpublished data that hypoxia could be a key factor in the ability of human embryonic stem cells (HESCs) to remain undifferentiated. This, however, has not been tested in adult stem cells. Because adult stem cells are difficult to study in mammals, my work in the Ruohola-Baker lab involves the study of the germline stem cells (GSCs) in the ovary of the *Drosophila melanogaster*, a model system that can be easily manipulated genetically. Similar to the importance of hypoxia to the division and maintenance of HESCs and CSCs, we have hypothesized that the GSCs may need hypoxia to properly divide and remain in the niche, the environment with which GSCs survive. To study this, we knocked out the subunits of the Hypoxia-Inducible Factor (HIF-1) homolog, tango and sima, which are required for survival of a cell in hypoxic conditions. We made homozygous mutant cells for the genes tango and sima and we overexpressed HIF Prolyl Hydroxylase (HPH), which degrades HIF-1 alpha (sima) in a normal oxygen environment. By observing how many GSCs remain in the niche compared to controls using fluorescence microscopy, we can determine if GSCs require HIF-1 to survive and divide properly as stem cells, suggesting they are maintained in hypoxia. The initial results suggest that HIF-1 is important to the niche cells, which send signals to the GSCs to remain in the niche and divide appropriately. Determining the role of HIF-1 in GSC division and maintenance will allow us another way of studying the importance of hypoxia to the progression of tumors and the differentiation of HESCs.

Large-scale Energy Efficiency in Utility Distribution Planning: Methods and Techniques for Successful Infrastructure Deferral

Alexander Berres, Senior, Electrical Engineering
Mentor: Alexander Mamishev, Electrical Engineering

As population grows across the country, the demand for electricity increases. In order to accommodate these new loads, utilities are forced to build more infrastructures. Planning, building and operating new substations are very expensive for utilities. Rather than support new loads through construction of new equipment, many utilities are looking to alternate strategies of demand reduction. One method of demand reduction practiced by many utilities around the world is end-use energy effi-

ciency. Energy efficiency projects at electric utilities are focused on arbitrary locations around a utility's service territory. This helps to relieve demand on generation, but does not help to relieve strain on regional distribution substations that are getting close to their capacity. If energy efficiency projects could be focused in regions served by substations nearing their capacity, it may be possible to slow load growth and defer future substation upgrades, saving utilities money on investment capital. There are several barriers blocking successful integration of distribution planning and energy efficiency. Distribution planners need to accurately forecast load and determine customer type breakdown in a specific area to determine whether the area is suitable for large-scale energy efficiency projects. They also need to be able to quickly compare the economic advantages of energy efficiency approaches versus traditional infrastructure improvements. This research focuses on development of accurate long-term load forecasting methods for regional areas. A software tool program for forecasting load will be developed based on data provided by local utilities. It will employ time series regression and artificial neural networks to accurately forecast regional substation loads. This will serve as one piece of the solution required for distribution planners to make decisions in regards to alternative solutions.

Sage: A Free, Open-Source Mathematics Software Program

Elliott Brossard, Sophomore, Computer Science
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: William Stein, Mathematics

Current fully-functional computer algebra systems are generally expensive and closed-source. Sage is a free and open-source alternative to such systems, and encapsulates a variety of free mathematics libraries in an object-oriented, user-extensible Python environment. Led by Associate Professor of Mathematics William Stein at the University of Washington, Sage's development team is a world-spanning combination of student employees, professors, and other contributors. Primary methods of use comprise browser-based interaction with a Sage web server, textual command line input/output, and embedded Sage code in LaTeX documents. Applications of Sage include calculus, algebra, geometry, number theory, graph theory, combinatorics, data analysis, research, and many other aspects of math and the sciences. Sage also acts as a front-end to installed commercial computer algebra systems such as Mathematica, Magma, and Maple, allowing the user to capitalize upon the unique functionality or performance of one system in tandem with Sage or others. I wrote a comprehensive web-based tutorial on both beginning calculus and Sage. The goal of the tutorial is to promote the use of Sage among high school and undergraduate students, a demographic that Sage has heretofore not actively cultivated. Through in-depth lessons, examples, and practice problems, the tutorial warmly familiarizes the reader with Python—the language behind Sage—and the concepts of calculus. In developing the tutorial and the website that houses it, feedback from professors and graduate students involved with Sage was critical in shaping a high-quality product, as was my own knowledge of HTML, Javascript, and calculus. The tutorial is now used internationally in educational settings as a teaching resource and aide.

Keeping Lines Clear: IV Flushing Techniques in Practice

Liana Brown, Senior, Nursing
Mentor: Karen Thomas, Family Child Nursing

Intravenous (IV) therapy is a common intervention in hospitals. IV access allows for the administration of life-saving fluids and drugs. Once established, a peripheral intravenous line can typically be used for three days. Keeping an IV line patent for this duration can be a challenge. When an IV is no longer being used for a continuous infusion, it is often left in the patient for intermittent use, this is called a saline lock. Nursing interventions aimed at maintaining the patency of saline locks include not only routine flushing but flushing techniques known as the push-pause method and clamping the line with positive pulse pressure. These techniques help to remove debris and keep the line patent for longer periods of time. There has been ample research in determining the most effective solution to use for routine flushing and the volume needed to flush. However, there is little research on flushing techniques. The lack of research to support these methods has led to inconsistent hospital protocols for flushing techniques. The purpose of this project is to evaluate the evidence for flushing techniques in peripheral IV lines and perform an audit of local hospital policies. A critical review of literature was performed using PubMed, CINAHL, and T.R.I.P databases yielding six pertinent articles. Protocols for flushing techniques were then audited from five local hospitals. The results of this critical review indicate that the evidence for flushing techniques is based on expert opinion and clinical experience. Three out of five hospitals had instruction for their nursing staff on flushing techniques to maintain patency. This critical review of literature and audit of procedures in hospital policies suggest that more research in this area needs to be done to establish an evidence-based practice for flushing techniques in saline-locked peripheral IV lines.

Surface Plasmon Resonance Imaging as a Tool for Probing Pathogenic Protein-Carbohydrate Interactions

Jesse Burk-Rafel, Senior, Bioengineering
Mary Gates Scholar
Mentor: Daniel Ratner, Bioengineering
Mentor: Shivang Dave, Bioengineering

Enteric pathogens – including protists, bacteria, and viruses – cause millions of infections globally each year. Diagnostics for characterizing host-pathogen interactions and therapeutics to disrupt these interactions are desperately needed to reduce the global burden of disease. Many of these interactions are mediated by protein-carbohydrate binding events at the intestinal wall. Additionally, flow conditions of pathogens past carbohydrate surface receptors have been shown to greatly influence binding dynamics. Thus, to develop effective therapeutics *in vitro* modeling must mimic physiological flow conditions yet be sensitive, specific, and high-throughput. A surface plasmon resonance (SPR) imaging platform, in conjunction with microfluidic technologies, is explored as a means for accurately assessing protein-carbohydrate interactions between whole-cells under physiological flow conditions and immobilized ligands. Specifically, type I fimbriated *Escherichia coli* expressing the adhesin protein FimH are examined. FimH is known to mediate *E. coli* binding through interactions with immobilized mannose structures in a shear/flow-dependent fashion. The ability of our platform to detect specific binding interactions whose kinetics depend on flow conditions is assessed by testing variants of the *E. coli* with mutated or absent FimH proteins.Specific *E. coli* binding via FimH – mannose (protein – carbohydrate) interactions can be reliably detected on our platform. Continued work and potential modification of our platform is needed to show that binding behavior can be modulated by shear conditions. Successful development of our SPR imaging platform to detect binding interactions under conditions mimicking the physiological environment of the human body will be an invaluable step towards subsequent development of optimized therapeutics.

Speech Codes in Secular and Faith-Based Hospital Mission Statements

Cherie Cabrera, Junior, Social Sciences, Evening Degree Program
Mentor: Gerry Philipsen, Communication

The Speech Codes Theory is an important heuristic for understanding the structure of communication in particular communities (Philipsen 1997). This theory helps the researcher recognize the social construction of communicative conduct within certain speech communities. Speech Codes Theory was applied to the mission statements of two healthcare systems based in Tacoma, Washington, St Josephs Medical Center and Tacoma General Hospital. Each of these public mission statements reflect the symbols, premises, and rules of the larger system of organized medicine in the US; nevertheless, each hospital is founded upon opposing social patterns leading to a secular or a religious value base, this is demonstrated within the speech of the mission statements. These unique codes are tools used to influence staff and therefore affect patients. St. Joseph Medical Center is a faith-based organization; this is stated explicitly in its mission statement. This hospital's deliberate ideology is reflected in a vocabulary of morality that is central to the statement. Tacoma General Hospital's mission statement is, in contrast with that of St. Joseph's, a very secular statement. It appears that both statements are addressed to the same community causing many shared values, though stated through different codes of communication. Speech Code Theory helps reveal the codes and meanings of each statement, affirming several unique speech communities and their dimensions within the larger community of Tacoma, Washington. Using these statements I was able to examine how the hospital defines: itself, the community it is based in, its relationship with that community, and modern healthcare system standards.

Molecular Dynamics Simulations of p53 Cancer Mutants for Drug Design

Sara Calhoun, Senior, Bioengineering
Mary Gates Scholar
Mentor: Valerie Daggett, Bioengineering
Mentor: Peter Anderson, Biomedical Health Informatics

The tumor suppressor p53 is a transcription factor involved in many important signaling pathways, such as apoptosis and cell-cycle arrest. Over half of human cancers lose p53 function by a single nucleotide mutation in its gene. Although structures of some p53 mutants have not been determined experimentally due to low structural stability, the structural effects of a single amino-acid change can be predicted using molecular dynamics (MD) simulations. We have performed MD simulations of wild-type p53 and 19 common cancer mutants. Different single amino-acid changes in the core domain of the protein result in a variety of structural changes. Simulations have shown that a few mutations disturb the overall structure of the protein while other mutations have a local effect on the DNA-binding site. Previous experimental studies suggest that p53 mutants that affect the overall stability are potential targets for drug rescue by a small molecule drug. We will use our understanding of the structural conformations of p53 mutants as a basis to design an effective anticancer drug that can bind mutants and restore function.

Addressing the Mumps, Measles, Rubella Vaccine (= MMR-Vaccine) and Autism Debate: A Theory of Planned Behavior

Nicole Calian, Graduate, Germanics
Margie Nicklos, Junior, Psychology
Mentor: Melissa Grinley, Psychology, North Seattle Community College

The Theory of planned Behavior (TpB) by Icek Aizen (1988) is based on the constructs of attitude, subjective norm and perceived behavioral control. This study applies Aizen's theory to immunization behaviors of parents in response to the ongoing debate on the causal relationship between the MMR vaccine (Mumps, Measles, Rubella) and autism. Specifically, we investigate parent's attitudes towards the MMR vaccine as well as their perceived control over their decision to immunize their children. Subjective norms were measured using Seattle School District data. An anonymous questionnaire was distributed to parents at two elementary schools in the Seattle metropolitan area, at the Little Gym, at North Seattle Community College, and online through an email list that serves parents (Kinderstube.org). We expect to find an inverse relationship between believing in a link and inoculating children against the vaccine. This information could provide important information about predicting and understating health behavior for medical professionals and public health officials.

Study of the Evolutionary Relationships among *Rhododendron Catawbiense* Populations Using Molecular Markers

Chuan Cao, Junior, Exchange - Arts Sciences
Mentor: Benjamin Hall, Biology

The species *Rhododendron catawbiense*, native to the eastern United States, is named after the Catawba tribe of Native Americans in the southeastern states. It is a dense, rounded shrub, 1-3 meters high. The leaves are evergreen and flowers are usually lilac-purple, occasionally pinkish or white with faint spots. Given the wide and patchy distribution of *R. catawbiense* from south Virginia to northern Alabama, DNA variation is expected via mutations unique to individual populations and fixation of these DNA changes through genetic drift. These differences can be scored using PCR- amplification of DNA regions followed by sequencing or by electrophoretic analysis of fragment size. Six genes have been studied with samples acquired from the Rhododendron Species Botanical Garden and so far five DNA markers had been identified for ascertaining different genotypes. Further research on this project will require collecting (in early spring) samples from populations across the range of *R. catawbiense* and classifying them using the genotypic markers I have developed. The goals of this project include finding out whether the Northern or the Southern population of *R. catawbiense* is ancestral and determining the region of origin of a unique marker found in a sample of the low elevation (*var. insularis*) population. Also, as was shown by the previous study of *Rhododendron macrophyllum* done by Wenyu Zhou, dispersal of ancestors of *R.macrophyllum* (one of the closest relatives of *R.catawbiense*) ocurred from Asia across the Bering land bridge in Eocene times, with southward migration during the Oligocene. *R.caucasicum, R.aureum* and *R.brachycalyx*, the three other close relatives of *R.catawbiense*, are native to Asia. Thus it will be interesting to use DNA sequence relationships between these five species to test the hypotheses that ancestors of *R. catawbiense* and *R. macrophyllum*, or a common ancestor of both, migrated from Asia to North America.

Characterization of Unique Ionic Liquid Gas Chromatography Columns

Tyler Carter, Senior, Chemistry
Brian Fitz, Senior, Chemistry (ACS Certified)
Mentor: Robert Synovec, Chemistry

Gas chromatography is a method of chemical separation used to quantitatively determine the presence and/or concentration of analytes (compounds of interest) within a complicated chemical mixture. Chromatographic experiments are important in a wide range of applications including environmental studies, determination of the purity of pharmaceuticals, and even criminal investigations. A gas chromatograph instrument relies on a chromatography column to achieve separation of the individual analytes. The chromatography column consists of a thin silica capillary tube coated with a complex chemical matrix know as the stationary phase. The ionic liquid columns which were studied utilize a stationary phase with one or more cationic functional groups bound to a ridged organic backbone. The ionic nature of these columns causes them to retain polar analytes. Most commercially available stationary phases are nonpolar and have a high affinity for compounds such as n-alkanes. Having stationary phases available which separate more polar compounds creates an opportunity to separate analytes chromatagrpahically which may coelute on a traditional column. Other polar stationary phases are available but most tend to thermally decompose above 250C. The unique structure of these ionic liquid columns allows them to remain stable to ˜350 C, allowing for the separation of a much wider range of analytes. The unique cationic funtional group utilized in each of the ionic liquid columns also provides for the unique retention of specific classes of analytes, and creates the opportunity to study new and exciting properties of the natural world.

Indigenous Language and the Construction of Identity in Oaxaca, Mexico

Jessica Chandras, Senior, Anthropology
Mentor: Jason De Leon, Anthropology

Language is key in the construction of identity. This is especially true among bilingual children who must negotiate the use of two languages according to particular contexts and situations. Building upon Breakwell's (1992) social psychology studies of the self and Fuller's (2007) observations of bilingual children, this study explores the role of indigenous language use in the construction of identity among indigenous youth at the Casa Hogar Benito Juarez orphanage in Oaxaca, Mexico. The state of Oaxaca has the highest number of indigenous language speakers in Mexico. My research explored the relationship and implications of indigenous language use in the construction of children's identities. I focused specifically on how levels of fluency in an indigenous langugage influenced how children perceived themselves. I proposed that high levels of fluency would reflect high levels of shame, or vice versa. Data were collected using a combination of interviews and participant observation of the interactions of children both with peers and adults. I found that levels of fluency displayed in the children's respective indigenous languages had no strong correlation with emotions of pride or shame, which suggests that other factors such as age, gender, and ethnicity may be stronger influences on identity formation.

Searching for Star Clusters

Rebecca Chang, Sophomore, Pre-Engineering
Laroy Chase, Freshman, Pre-Engineering
Mentor: Stephanie Gogarten, Astronomy
Mentor: Julianne Dalcanton, Astronomy

Clusters are the birthplaces of stars, but many of them do not last very long - the intense radiation from the newly-formed stars dissolves the gas in the cluster, and the stars gradually drift apart. Other clusters can survive for billions of years. The Advanced Camera for Surveys (ACS) Nearby Galaxy Survey Treasury (ANGST) has Hubble Space Telescope images of many nearby galaxies of different types, with such high resolution that we can identify individual stars as far as 12 million light-years away. Finding all the star clusters in these galaxies can tell us about the rate at which clusters form in galaxies of different types, and the rate at which these clusters are destroyed. We will examine color images of the ANGST galaxies to find star clusters, and record their positions, sizes, and brightnesses. The resulting catalog of star clusters can be used to investigate the relationships between star clusters and galactic environment, and correlate our observations with images at other wavelengths, such as ultraviolet and infrared.

Mitochondrial DNA Sequencing and Mutation Rate in the Naked Mole Rat: Studies of a Model of Exceptional Longevity

Tony Chen, Senior, Neurobiology
Mary Gates Scholar
Mentor: Peter Rabinovitch, Pathology
Mentor: Jonathan Wanagat, Medicine

As the longest-lived rodent, the naked mole rat (NMR), *Heterocephalus glaber*, has an average lifespan of approximately 28.3 years. With species of similar size and same phylogenetic order (such as the rat and mouse) having a lifetime of 3-4 years, the NMR exhibits ten-fold longer lifespan compared to its closely-related cousins. The current theories of aging propose that increased oxidative stress and increased mutations in the mitochondrial DNA (mtDNA) contribute to aging and age-related diseases. The NMR, on the contrary, has actually much higher oxidative stress despite its extended longevity. Consequently, there is significant interest in the NMR for studies on aging and age-related diseases, specifically its mtDNA which has not been sequenced. So far, isolation and amplification of the mtDNA using polymerase chain reaction have been achieved. Genome sequencing using the traditional method of dye-terminator sequencing is currently underway. Once completed, comparison of the NMR mtDNA to that of other closely-related species will help answer whether or not changes in the genome can explain the increase in oxidative stress, and test the current oxidative-stress theory of aging. Next, a Random Mutation Capture assay can be carried out to determine the mtDNA mutation rate in young and old NMRs. The assessment of mtDNA mutation rate will allow for comparisons across species and correlations to lifespan. Therefore my current research focuses on three main steps: (1) sequence the NMR mtDNA, (2) compare the NMR mtDNA sequence to that of other species, (3) adapt an assay to detect mtDNA mutation load in NMR mtDNA. Despite the inevitable impact of aging on all of us, its biological processes still remain a mystery. For this reason, the ultimate objective is to understand the mechanism underlying the aging process so we can elucidate innovative and therapeutic applications to improve healthspan.

Probcast Usability Study

Gin Chieng, Senior, Psychology, English
Sam Ford, Senior, Psychology
Mentor: Susan Joslyn, Psychology

This poster reports a usability study of a probabilistic weather forecast website. The objective of this research was to examine how well people can extract and understand information from the website. The Probcast website (www.probcast.com) is the only fully probabilistic weather website. It provides uncertainty information that gives upper and lower bound of a forecast. An ex-

ample would be a forecast of a daytime high temperature of 86 degree, with an upper bound of 90 degrees and a lower bound of 82 degrees. The upper and lower bound are defined in an explaining that 1 time in 10 chance the temperature will be above (upper bound) or below (lower bound) these values. A talk aloud procedure and screen monitoring were used to assess participant's understanding of uncertainty information. A total of 17 undergraduate students participated in this study. There were two parts of this procedure, an exploration phase in which participants planned an outdoor trip using the Probcast website, and a specific information search phase in which they were asked to identify specific pieces of information on the Probcast website. Participants were able to find the basic information they needed to create outdoor plans, but had trouble finding specific information and understanding the uncertainty information displayed. Participants were also unsure of how the deterministic (daytime high) forecast related to the upper and lower bounds. Participant's ability to navigate and use the website was good and there were relatively few errors caused by the usability of the website itself; however, most error came from misunderstanding the information of the probabilistic forecasts (upper and lower bounds). Displaying uncertainty in weather forecasts is challenging, but presenting uncertainty information would be helpful for everyday decision making as well as for severe weather warning.

Conceptualizing Gender Status and Criminal Sanctions in a Sharia Framework

Cynthia Chiu, Senior, Law, Societies, Justice
Mentor: Arzoo Osanloo, Anthropology

In Islam, Sharia (Islamic religious law) dictates the ways in which Muslims should lead their life, spanning from acceptable meals to sexuality and morality. Sharia differs from Western concepts of law because it is shaped as a social discourse rather than a state establishment. States with Sharia influenced laws demonstrate confounding concepts of personal injury law and criminal law. From this conflation, tensions in punishment and justice emerge. Criminal sanctions in countries with Sharia based legal systems show discrepancies in application to men and women. For instance, under Sharia, when an individual is murdered the perpetrator's family is required to pay a "blood price" or give "blood money", referred to as diya, in restitution to the victim's family. While the Qur'an does not directly speak to diya, legal interpretation has over time expressed the value of a woman's diya as half that of a man's. This gender disparity demonstrates a conflict with Western human rights values. Understanding legal justifications for this disparity is important to the status of women in the countries with Sharia influenced systems. This project will first explore the historical and cultural bases through which a woman's diya came to be interpreted as half that of a man's. Then, in the second half, it will explore contemporary jurisprudential debates among Islamic legal scholars who argue for reforming this disparity.

Halting the Havoc of HIV in the "Land of Smiles": HIV/AIDS Prevention Campaigns in Thailand

Kira Conrad, Senior, Nursing, Individualized Studies, Spanish
Christy Park, Senior, Nursing, Communication
Mentor: Gail Johnson, Psychosocial Community Health

Despite successful prevention campaigns in the 1990's, HIV/AIDS rates have been on the rise in Thailand. Current data reports an estimated 610,000 Thai people living with HIV and approximately 31,000 deaths from AIDS in 2007. This study addresses the following research questions: What populations in Thailand are at greatest risk for HIV transmission? What are the factors influencing the changing rates and demographics? How are these groups and changes being addressed? A review of the literature was conducted using PubMed, CINAHL, and ProQuest. Twenty-one articles were identified. Epidemiological and statistical data was found through websites including World Health Organization, Joint United Nations Programme on HIV/AIDS, and Morbidity and Mortality Weekly Review. In Chiang Mai, Thailand we interviewed 21 outreach workers at the New Life Family Friends Center (NLFFC). We also interviewed the founder and three student leaders involved in a school based sex education program for Thai youth at 10 schools in the Northern provinces of Thailand. The literature review identified two high-risk subpopulations, youth and MSM (men who have sex with men). HIV volunteers identified the following factors for the rise in HIV transmission: government funding cuts, lack of public visibility of the risks, and the success of treatments. Both the literature review and interview data confirmed the need for comprehensive sex education programs to prevent HIV transmission among Thai youth. A harm-reductionist approach was taken by both of the community organizations visited. Based on the literature, analysis of the interviews and observations of the community organizations, the most effective intervention strategies were: education, peer support, and capacity building. These strategies were applicable to both high-risk populations identified. Future research should include comprehensive program evaluations of preventative efforts to determine effectiveness of programs.

Parental Receptivity to HPV Vaccination and Availability in the Seattle Area

Megan Costa, Senior, Individualized Studies, Anthropology
Mary Gates Scholar
Mentor: Steven Goodreau, Anthropology

Human Papilloma Virus (HPV) is a sexually transmitted disease that can lead to genital warts, lesions, cervical cancer, and several other forms of reproductive cancers. A recently released vaccine protects against the 4 major types of HPV and can lead to 70% fewer cervical cancer cases. There are currently about 20 million cases of HPV in the United States. In most cases, the body can clear the infection without individuals ever knowing they contracted the virus. Other cases may result in more outward signs of infection, such as genital warts. A three-dose vaccine was released in 2006 that protects against four major types of HPV linked to reproductive cancers. This vaccine is suggested for females aged 8-12. Vaccination before sexual debut allows for maximum efficacy, though it has sparked debate among parents and policymakers. Some parents are concerned receiving the vaccine may encourage children to behave more promiscuously than they would otherwise, and many believe they have taught their children values that keep them from needing the vaccine. However, the high prevalence of this particular STD and the potential consequences of an infection may put even those with only one partner at risk. The HPV vaccine is currently included in the Vaccine for Children (VFC) program in Washington State, which allows free vaccine for all children below age 19. VFC offers free vaccination when a child visits a healthcare provider, which uninsured individuals may lack. Given the vaccine is free and parents must provide permission, this study measures parental receptivity to both the vaccine and voluntary vaccination in schools through a cross-sectional survey. Identifying parental motivation for vaccination and their preferred location of administration allows for the creation of programs acceptable to parents, which may increase vaccination rates and lower cervical cancer and HPV rates in King County.

The Mass Media and U.S. Crime Policy: How Media's Frame on Crime Coverage Led to the Rise in Punitive Crime Policy

Christopher Cunningham, Senior, Political Science
Elizabeth St Clair, Senior, Political Science, French
Heeyoung Park, Senior, Political Science
Mentor: John Wilkerson, Political Science
Mentor: Asaph Glosser, Political Science

In the United States, research indicates that the public receives most of its news about society and politics through private media sources. For these media, the need to generate a profit does not necessarily encourage objective reporting of events. One reported effect of the profit motive is a tendency towards over-reporting of highly sensational news. Our study looks at media coverage of crime from 1973-2002. While controlling for other possible influences on incarceration rates such as economic stability, actual crime rates for both non-violent and violent crimes, abortion rates, and public opinion, we more thoroughly examine the frame through which media portrays crime news. We expect to find that the media presents crime stories with a marked emphasis on the victim. In addition, we expect to find that policy makers, as media consumers are also affected by media coverage of crime, evidenced by the type of policies they form and enact.

Zine Library Comprehensive Research Survey & Discussion

Owen Curtsinger, Senior, English (Creative Writing)
Mary Gates Scholar
Mentor: Lisa Fusco, Information School

Zines are often defined as any independently published booklet that artfully blends text and imagery and is produced and distributed by hand. Perhaps the most defining characteristic of zines is that they are not produced out of the need to reap commercial profit. Zine collections and libraries in the United States have, since the late eighties, have become a large agency for the research and expression of alternative media. Because of this volunteer-based structure, as well as their relative infancy in the world of library and information sciences, many fundamental logistics of maintaining a zine library have not been thoroughly and formally researched. This study seeks to understand the different ways that zine libraries function and how they are structured and organized. My project proposes to conduct a survey of every known zine library currently existing throughout the United States, gathering information on the logistics of each library such as collection development statements, membership, patronage statistics, preservation, and outreach programs. Data is collected from such surveys that are given to people managing zine libraries. Findings serve as an analysis of zine libraries as well as a reference for a growing community of zine librarians.

Examining Ethnicity, Acculturation and Loss of Face as Correlates of Drinking Behavior in Asian Americans

Kattie Dang, Recent Graduate, Psychology
Mentor: William George, Psychology
Mentor: Christian Hendershot, Psychology

Asian ethnic subgroup and acculturation are important factors in understanding drinking behaviors of people originating from Asia. Korean ethnicity and acculturations have each been implicated as risk factors for drinking among Asian Americans. An additional cultural factor that has not been examined in relation to drinking behavior is loss of face (LOF). Loss of face is defined by a culturally based construct that involves a concern about losing one's socially sanctioned claims and fulfilling one's social roles as a member and representative of a group. This study examines the effect of ethnic subgroup and acculturation on drinking behaviors as

well as examines the possible predictive value of LOF. A total of 182 University of Washington students participated in a study of drinking behavior. The sample consisted of 67 Korean participants (28 males, 39 female) and 115 Chinese participants (58 males, 57 females). Participants' age ranged from 18 to 27 years old with a mean of 20.2. Students completed web-based measures of drinking behaviors, cultural factors, and demographics. Result showed that Korean participants scored significantly higher on drinking measures than Chinese participants. Differences between levels of acculturation, however, did not significantly influence drinking behaviors. Tests that examined interactions between acculturation and ethnic subgroups also showed no significant differences in levels of acculturation between different ethnic subgroups. LOF also did not significantly influence drinking behaviors. These results support previous findings in that Korean ethnicity could be a risk factor for drinking. However, association of acculturation with drinking behaviors reported in other studies was not seen here. Additional research is needed to clarify the conditions under which cultural factors influence drinking behavior.

Bioaccumulation of Persistent Organic Pollutants in Fish from the Thea Foss Waterway, Tacoma, WA

Hoang Dao, Senior, Environmental Science, UW Tacoma
Mentor: Joel Baker, Center for Urban Waters, UW Tacoma

The Thea Foss waterway is an industrialized waterway of Commencement Bay, Tacoma, Washington, which was the focus of a significant remediation and restoration project to remove contaminated sediment. The Thea Foss still receives significant quantities of stormwater runoff, however, and its sediments contain elevated levels of polychlorinated biphenyls (PCBs) and the flame retardants polybrominated diphenyl ethers (PBDE). Fish are exposed to and accumulate these chemicals via the food web. Ingestion of PCBs and PBDEs at sufficiently high rates may affect both humans and aquatic organisms. Recreational fishing in the Thea Foss waterway is common, and these fish may be an important part of the diets of some local residents. To evaluate this risk, the purpose of this study is to determine concentrations of PCBs and PBDEs in skinless fish muscle tissue from English Sole at the Thea Foss waterway and from a control site in the Nisqually River. English Sole were collected in 2005 and 2007 by the Washington Department of Fish and Wildlife. In the laboratory at the University of Washington, Tacoma, 5 grams of fish muscles tissue without skin are extracted with solvent using accelerated solvent extraction (ASE). The extract is evaporated about 5 ml in a TurboVap concentrator at 30 degree Celsius and 15 psi of nitrogen pressure. Next, the solvent is cleaned up using alumina and evaporated again to 1 ml. Finally, this concentrated extract is analyzed to find the concentrations of PCBs or PBDEs by Gas Chromatography/Mass Spectrometry. The result of this experiment will be compared to the previous studies and the Environmental Protection Agency standard level of PCBs and PBDEs.

Repetitive Elements in Chromosome 19 MicroRNA Cluster may Facilitate Transcription of Human Embryonic Stem Cell Specific miRNAs

Geoffrey Darby, Senior, Biology (Physiology)
Mary Gates Scholar
Mentor: Bradford Stadler, Biochemistry
Mentor: Hannele Ruohola-Baker, Biochemistry

MicroRNAs, miRNAs, are small, endogenous, genes that have the ability to regulate the expression of genes bearing complementary sequences. MiRNAs have been shown to play numerous roles in regulating developmental, metabolic, and maintenance pathways in both somatic cells and stem cells. Although most miRNAs are expressed by RNA polymerase II, recent data suggests that a cluster of human embryonic stem cell-enriched miRNAs on chromosome 19 may be expressed by RNA polymerase III. It is hypothesized that Alu family repetitive elements interspersed throughout this region of the chromosome are responsible for expression of the neighboring miRNAs. Our project aims to demonstrate that these Alu sequences are indeed facilitating expression of the miRNAs in this chromosomal cluster. The project is specifically examining the mechanism for Alu-induced expression of the miRNAs, as well as the factors regulating this process in human embryonic stem cells.

The Effects of Local Warming of Surgical Incisions

Allyne Delossantos, Senior, Biology (General)
Mentor: JoAnne Whitney, Biobehavioral Nursing Health Systems
Mentor: Margo Perrin, Biobehavioral Nursing Health Systems

My research project focuses on a sub-analysis of the Warming Study, a clinical trial funded by the National Institutes of Health that is evaluating the effects of warming pad application to surgical incisions in relation to wound healing and infection. My sub-analysis will focus on the pain scores, wound evaluations, and tissue oxygen levels of the patients enrolled in the Warming Study. In a previous study conducted by Ozan Akca et al, the data shows that poorly managed pain (higher pain score) correlates with reduced tissue oxygen levels, which is related to an increased incidence of surgical wound infection. The purpose of my project is to see whether the same relationship is found with our data. First, I will analyze the pain scores of all patients at three time points: PACU, post-op day 1, and post-op day 2. Next, I will compare the pain levels between patients based

on the type of surgery they had undergone (weight-loss, colon or gynecological). Then, I will look at the subset of patients who were randomly assigned to have their tissue oxygen levels measured and look at that data to see whether oxygen levels correlate with pain. Lastly, I will look at the patients with wound infections and compare their pain and oxygen levels to the patients with no wound infections. If a similar correlation exists, then my results would reinforce what Acka et al. had found, and it would imply that pain management is critical to reducing surgical wound infection.

Advances Towards Nanobioprotonics
Yingxin Deng, Freshman, Exchange - Arts Sciences
Mentor: Marco Rolandi, Materials Science Engineering
Mentor: Jessica Torrey, Materials Science Engineering
Mentor: Stephanie Vasko, Chemistry

Many nanoscale architectures are readily available in nature, and several exhibit potential technological applications. In this project, the suitability of collagen fibers for devices based on bioprotonics, the conduction of protons through biological materials, is being investigated. Collagen is a fibrous natural material occurring in tissue, cartilage, and bone. It is theorized that protons can translate along the nanoscopic channels of hydrogen-bonded water present in hydrated bio-fibers; this phenomenon may result in semiconducting behavior. In order for this technology to be applicable to advances in computation technology, the long range protonic movement along these fibers must be investigated. Bulk rat tail collagen is dissolved, fibrillated, and aligned on a silicon dioxide wafer. Palladium contacts are deposited on top, creating biowires out of the deposited collagen. The conductivity of the fibers is measured to ascertain the functionality and reproducibility of these devices at different temperatures and humidity. Potential applications of these hydrated fibers include biological transistors, protonic wires for bio-based sensors, and as replacements for the membranes in hydrogen fuel cells.

Persistence of *E. coli* 157: H7 in Forest Soils at Pack Forest after Septage Application
Kimberly Dennett, Junior, Environmental Science, UW Tacoma, Tacoma Dual Enrollment
Mentor: Erica Cline, Interdisciplinary Arts Sciences, UW Tacoma
Mentor: Gregory Ettl, Forest Resources
Mentor: Matthew Ridgway

Septage has recently been proposed as a suitable fertilizer for forests. Before application, septage is limed to raise the pH to12 and eliminate microbes and pathogenic bacteria such as *E. coli* O157:H7, but the effectiveness of this treatment under field conditions has yet to be thoroughly evaluated. The persistence of pathogenic *E. coli* O157:H7 in forest soils after septage application could pose a serious human health risk, particularly in the initial period after application or when septage is applied near streams. To investigate the possibility that pathogenic *E. coli* could survive this treatment and persist in forest soil after septage application we sampled managed stands at Pack Forest that received experimental septage applications between 2006 and 2007. We sampled a total of 80 soil samples from six managed stands that received septage and adjacent untreated control stands at three different dates from February 2008 to January 2009. Bacterial genomic DNA was extracted from soil and polymerase chain reaction (PCR) was performed using *rbfE*-specific primers, a gene found only in the pathogenic strain of *E. coli*. Positive PCR test results were obtained from 7 of 8 septage-treated soils in February 2008, but there were no positive results from July 2008 samples. In preliminary testing of the January 2009 samples, four positive results were obtained out of the 20 soils tested in five different stands. The ability to detect DNA specific to pathogenic *E. coli* in soils more than two years after application is cause for concern, although presence appears to be inconsistent and viability has yet to be determined.

The Potential Costs and Benefits of Two Seed Predating Biocontrol Agents on *Cytisus Scoparius*
Jonathan Deschamps, Senior, Biology (Ecology, Evolution Conservation)
Mentor: Janneke Hille Ris Lambers, Biology

The use of natural enemies as biological control agents of invasive species is a controversial subject among conservation biologists. Proponents argue that biological control agents can control invasive species at lower densities without the aid of harmful pesticides or strenuous physical labor while opponents argue that biological control agents are just too dangerous because they posses the potential to harm non-targeted species. In the Pacific Northwest two species of seed predating beetles—*Bruchidius villosus* and *Exapion fuscirostre*—have been introduced from Western Europe as biological control agents of the invasive legume *Cytisus scoparius* (Scotch broom) which is of special ecological and economic concern because it 1) prevents forests from regenerating by outcompeting tree seedlings for resources and 2) because it increases the nitrogen levels in soils and thereby alters native plant communities that are adapted to low nutrient soils. In order to investigate both potential benefits (i.e. negative impacts on an important invader) and costs (i.e. negative impacts on native plants) of introducing *B. villosus* and *E. fuscirostre* as biocontrol agents, seed pods were collected from *C. scoparius* and native legumes (*Lupinus* spp and *Vicia* spp) in both a major urban park and a South Puget Sound prairie. Seed predation by the two biocontrol agents on the seeds in these

pods was quantified. For *C. scoparius*, seed predation estimates were incorporated into existing population matrix models that can project population growth rates. Results were used to determine i) whether biocontrol agents have negative impacts on native legumes ; and ii) how the introduction of these seed predating beetles affects the population growth rates of *C. scoparius*.

Life Cycle and Evaluation Criteria in Engineering Students' Design Processes

Joseph Douglas, Senior, Civil Engineering
Yang Du, Senior, Biochemistry, Chemistry
Johanna Hayenga, Senior, Bioengineering
Laura Julich, Junior, Chemical Engineering
Charlene Reyes, Recent Graduate, Electrical Engineering
Mentor: Ken Yasuhara, Center for Engineering Learning Teaching

The NSF-funded Center for Advancement in Engineering Education includes the Academic Pathways Study (APS). This longitudinal study surveyed, interviewed, and administered design tasks to engineering undergraduates at four institutions as they progressed through their education. The students were given a design task regarding a dangerous intersection for pedestrians in their second year (153 students) and in their fourth year (66 students). They were asked to provide solutions to the problem and an evaluation of their "best" solution. This work extends our group's prior research on design by focusing on how students evaluate potential solutions. Although the engineering education literature discusses courses and methods for teaching design extensively, there is little research on undergraduates' breadth in design with respect to life cycle and evaluation criteria. Our first inquiry assesses student consideration of a design at each stage of its "life cycle" by coding responses for discussion of status quo, design and construction, solution in place, and solution maintenance and disposal. Our second inquiry focuses on criteria used to evaluate solutions, e.g., safety, cost, and implementation. Our research questions examine differences in life cycle consideration or evaluation criteria in students of different class standing or gender, and the degree to which each gender's responses change between their second and fourth years. Preliminary results suggest that only 25% of second-year students and 35% of fourth-year students consider either the design and construction or solution maintenance and disposal stages of the life cycle. While second-year women were more likely than men to consider design and construction in their evaluation, the gender difference narrows in the fourth year. Our motivation for this study is to observe the progression of students' engineering education concerning breadth of scope. With this, we hope to help shape engineering education to better develop these abilities.

Critical Enzymes in DNA Damage Response - RNF8 and its New Partners

Katja Dove, Senior, Biochemistry
Mary Gates Scholar
Mentor: Rachel Klevit, Biochemistry
Mentor: Catherine Eakin, Biochemistry

Ubiquitin is a small signaling protein that is involved in nearly all aspects of cell biology including but not limited to protein degradation, apoptosis, endocytosis, and DNA damage repair. Ubiquitin attachment to a target protein involves an enzymatic cascade of three enzymes: Ubiquitin activating proteins (E1), Ubiquitin conjugating proteins (E2) and Ubiquitin ligases (E3). The ultimate fate of an ubiquitinated substrate depends on the topology of the poly-ubiquitin chain formed. Substrates with a Lys48 linked poly-ubiquitin chain are sent to the proteasome for degradation, while substrates with a Lys63 linked ubiquitin chain are recognized and involved in DNA damage repair. One of the E3s central in forming Lys63 linked ubiquitin chains on substrates during DNA damage repair is RNF8. It has been shown that RNF8 interacts with the E2 Ubc13 to form Lys63 following DNA damage. Here, we show that RNF8 also interacts with other human E2s including Ube2w. In addition, using BRCA1 as the E3 ligase the Klevit lab has posed a new theory for how Lys63 polyubiquitin chains are formed. In order for BRCA1 to form Lys63 polyubiquitin chains with the Ubc13 the substrate must first be "primed" by transfer of a single ubiquitin by the Ube2w. To investigate whether this mechanism can be generalized for other E3s we performed similar activity assays with RNF8. Our results show similarities between BRCA1 and RNF8 activity. This strengthens our understanding of general ubiquitination mechanisms and enhances our knowledge about DNA damage repair.

Design of a Self Sufficient Scalable Water Purification and Desalination System

Kenneth Doyle, Senior, Materials Science Engineering
Huy Ta, Senior, Materials Science Engineering
Mentor: Brent Goodwine, Technical Communication
Mentor: Raj Bordia, Materials Science Engineering

There is an estimated 1.1 million people in the world who don't have access to clean water. Lack of clean water is the cause of many diseases in these areas. Many have looked to the ocean as a source of water to solve this problem. In order to turn seawater into water that can be used for human consumption or irrigation, it must be desalinated. The majority of the desalination plants in the world are large in scale and typically use large amounts of energy. Aside from this, they can only function in very specialized and expensive infrastructures. The objective of our research is to design a sustainable water desalination device that is scalable. Our solution is a desalination device that is scalable, requires no external power source

and very little maintenance. This is made possible by utilizing both the ultraviolet (UV) and infrared (IR) radiation given off by the sun. From the sun's IR radiation, we will be able to generate power using a sterling engine coupled with a parabolic dish concentrator. The electricity generated from the sterling engine will be used to desalinate saline water solutions. This device will drastically improve both the livelihoods of the people it serves and the environment.

Mysterious Disturbance of a Stellar "Frisbee"
Zachary Draper, Freshman, Pre-Engineering
Mentor: John Wisniewski, Astronomy

A "Be" star is a main sequence B class star which has H-alpha in emission rather then absorption. These stars have gaseous circumstellar disks, which can dissipate and regenerate over time. 60-Cygni is a "Be" star which we observed from 1992 to 2006, including a time period where it lost its disk. Since the mechanism which controls the disk formation around "Be" stars is not well understood, studying these stars during disk degeneration and regeneration can help us understand the disk's properties in order to model the phenomenon. Our analysis of the data has shown that 60-Cyg's disk loss occurred over 750 days. We determined 60-Cyg's binary companion is not responsible for the degeneration or regeneration of its disk because its orbital period of 150 days doesn't match the disk loss time period of 750 days. We also analyzed 60-Cyg's spectrum in polarized light to help determine the spatial distribution and density of the disk. A source of uncertainty to these observations is the effects of the interstellar medium or ISM. We use three methods to overcome this problem; the "field star" technique, H-alpha line depolarization, and an assessment of the wavelength dependence of the polarization when the disk is absent. These observations will be modeled to determine the "Be" disk mechanism.

Integrating EWOD with Surface Ratchets For Active Droplet Transport and Sorting
Todd Duncombe, Senior, Electrical Engineering
Mary Gates Scholar
Mentor: Karl F Bohringer, Electrical Engineering

Surface Ratchets are a recently developed microfluidic device which achieves droplet transportation on an asymmetrically designed super hydrophobic surface when vibrated. This technology has the advantage of simplistic, reliable droplet transport with minimal actuation energy, but lacks droplet specific control. Electricwetting on dielectric is a more traditional method of droplet transport which functions by applying an asymmetric electric field on a droplet to alter the solid liquid surface tension and pull a droplet towards the higher electric field. Combining surface ratchets and electrowetting on dielectric (EWOD) produces novel microfluidic systems that achieve passive droplet transport by vibration along microscopically-rough surfaces and active droplet sorting by electric signals. The super-hydrophobic surface ratchet and EWOD plate sandwich a droplet; when vibrated the device adopts passive droplet transportation via the surface ratchet. The EWOD technology is utilized at particular junctions to produce several droplet specific control functions, including the combination of a new ratchet design with an EWOD plate to develop a switch (serving the same purpose as a switch in train tracks) that sorts 10 μl droplets at a junction. We have implemented a device that takes advantage of surface ratchet's passive transport characteristics, and EWOD's droplet specific control. Using the integrated system, we have demonstrated three critical functions that could greatly expand the applications of surface ratchets. Now a device that functions primarily through surface ratchet's passive droplet transportation, moving several droplets over long periods of time, can be controlled at specific junctions, stopping droplet flow with a valve, moving droplets backwards with a flow reversal device, and sorting droplets at a switch.

The Influence of Salmon-Derived Nutrients on Juvenile Steelhead in the Elwha River, Washington
Logan Dunphy, Recent Graduate, Aquatic Fishery Sciences
Mary Gates Scholar
Mentor: Daniel Schindler, Aquatic Fishery Science
Mentor: Sarah Morley, Northwest Fisheries Science Center, NOAA

Freshwater ecosystems adjacent to the North Pacific Ocean receive significant inputs of nutrients and energy from spawning populations of anadromous salmon. Research over the last two decades has documented that stream fishes benefit from this seasonally available, high quality subsidy. Declines in salmon runs have prompted concern that freshwater ecosystems may be receiving considerably less salmon-derived nutrients. On the Elwha River, WA, dams have significantly reduced salmon runs and excluded them from most of the upper watershed. We added salmon carcasses to the Elwha River to test if this would increase salmon-derived nitrogen in juvenile steelhead and increase their body condition and energy density. Salmon derived nitrogen did increase marginally three months after the addition of carcasses. However, energy content and condition factor did not increase following the carcass addition. These results suggest that juvenile steelhead may not have been limited by food but by other factors such as available habitat. Competition may have increased due to aggregation of steelhead around carcasses thereby limiting the effect of the increased food resources at the individual level. Further research should examine how carcass additions may influence overwinter survival, movement and foraging pat-

terns.

New Face, Post Race?: The Politics of Mixed Race Identity and the Emergence of Post-Race Discourse
Camille Elmore, Senior, Comparative History of Ideas, Communication
McNair Scholar
Mentor: Ralina Joseph, Communication
Mentor: Audra Gray, Education
Mentor: Manoucheka Celeste, Communication

Racial identification in the United States has been conceptualized as a simple process, structured around categorization in relationship to phenotypical features rather than self-identification. Because of this limited and static thinking, the concept of mixed race identity seems to be radically displaced, pushed to the margins of racial discourse and left to only enter the spaces of black/or/white. This research project aims to understand on a historical level why those who are multiracial, are unable to appropriate their racial identity as black and white but are rather categorically fixed as one or the other. To help illuminate this process through a significant case study, this project examines the way in which the U.S mainstream media has constructed the racial identification of Barack Obama, a mixed race man, as a singular black subject - thus revoking his access to accurate self-representation and appropriation of his multiple identities. Therefore, this research projects seeks to question and understand the ways in which multiracial people are unable to appropriate their multiple identities simultaneously and furthermore, how the media works to situate multiple identities into one monolithic category, limiting the rights of self-representation. In addition to the former, the latter part of this project examines the "post-race/race-less" discourse that has circulated in relationship to Barack Obama and his ability to "transcend institutionalized racism and/or racial discrimination" as a minoritzed body, a type of racial discourse, this research argues, that has been prompted by the mainstream media. The methodology used in this research project utilizes a fusion of comparative content analysis and critical discourse analysis of major newspapers (*i.e.*, The New York Times, Washington Post, Seattle Times) that are used as secondary sources to analyze the media's portrayal of Barack Obama's racial identification. Currently, this research project is in its final phase of data collection.

Piezo Electric Harvesting
Eshetu Eneyew, Senior, Mechanical Engineering
Mentor: Jiangyu Li, Mechanical Engineering

In this project we are trying to analyze an electric harvesting mechanism using mechanical stress applied to a piezo electric material. Using wind as source energy and converting this wind energy into mechanical vibration to apply the required stress to the piezo electric material. Our first phase analyzes and measures the charge produced. The second phase quantifies the amount of electric charge that could be produced in a given amount of mechanical stress. After quantifying these parameters the next step will be to develop a suitable mechanism for the electric harvesting process. After completion of the development of this mechanism it will be tested in different areas. The harvested electric charge could be used in different areas to provide an electric power for various electrical appliances.

The Undocumented in Society: Comprehensive Theoretical Frameworks on Illegal Immigration
Julian Estrada, Senior, Sociology
Zesbaugh Scholar
Mentor: Roberto G Gonzales, Social Work

Much of the recent scholarship on undocumented immigrants has moved towards new theoretical approaches on this topic, specifically the reception of undocumented inside the borders. Meanwhile, established sociological theories have been discarded while this topic has been treated as a social phenomenon. In particular, undocumented immigrants themselves as a sampling frame have posed a problem for social scientists due to their illegal status. Moreover, a pervasive politicized atmosphere has drawn them further into the shadows. However, drawing on established sociological theories and comparing the experience of undocumented immigrants with experiences of other subordinate groups allows for a theoretical reference and macro-analysis of undocumented immigrants. This paper revisits major sociological theories in the context of undocumented immigrants as a minority while simultaneously comparing the experiences of other subordinate groups as a cross-reference point in absence of currently unavailable research methods. I use current literature on undocumented students and draw on ethnographic accounts of undocumented students in higher education at California universities. The end result of drawing on established theories, experiences of other subordinate groups, current immigration literature and ethnographic accounts of undocumented students is merging point of old lines of thought with fertile ground for future research.

Childhood Maltreatment and Tonic Immobility in Female College Students
Perry Firth, Junior, Pre-Sciences
Mentor: Debra Kaysen, Psychiatry Behavioral Sciences

Women who experience Tonic Immobility (TI) or a freeze response during sexual assault experience more severe distress, higher self blame, a reduced response to psychopharmacological treatments, and engage in fewer help seeking behaviors post assault than women who do not experience TI (Heidt et al., 2005). Recent literature

has found that over 52% of women who have experienced child sexual abuse (CSA) report TI in subsequent assaults (Heidt et al., 2005). It has been suggested that CSA induces TI because CSA may diminish the victim's perceived ability to escape thus inhibiting the likelihood of resisting a future assailant (Heidt, et al., 2005). However little research has examined whether other forms of childhood maltreatment also affect the TI response in adult sexual assault. The present study examined child physical abuse (CPA) and CSA as predictors of TI following a more recent sexual assault in a sample of college women (n = 227) who had experienced adult sexual victimization. Measures included the Tonic Immobility Scale (TIS; Forsyth et al., 2000), Sexual Experiences Survey (SES; Koss & Gidycz, 1985), and the Traumatic Life Events Questionnaire (TLEQ; Kubany et al., 2000). Sixty three percent of the sample had not experienced child maltreatment, 18% had experienced CSA, 10% had experienced CPA, and 9% had experienced both. TI was predicted by CSA but not CPA, with women with past histories of childhood sexual abuse reporting higher TI following sexual revictimization. These findings suggest that it is not solely the effects of developmental stage of first trauma exposure, nor is it necessarily prior exposure to inescapable trauma that may elevate risk of TI during adult sexual victimization, but rather that CSA may have unique effects that are associated with elevated TI.

Investigations into the Placement of the Genus Diplophos (Teleostei: Stomiiformes) using Neuroanatomical Characters

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Mary Gates Scholar
Mentor: Christopher Kenaley, Aquatic Fishery Science
Mentor: Ted Pietsch, Aquatic Fishery Science

The order Stomiiformes is the most diverse group of deep-sea fishes containing over 390 species. Many species of this group engage in ecological diel vertical migration, inhabiting the epipelagic realm at night and returning to the depths during the day to escape predation. Although this group has been established as sister to all other neoteleosts, many taxonomic relationships within the order are still not completely resolved and a number of problematic taxa, such as Diplophos, remain unplaced. The most recent work on the phylogenetic relationships of Diplophos places the genus as basal to all stomiiforms based on only six plesiomorphic characters. Our previous work on lateral line neuroanatomy in stomiiforms suggests a more derived placement of Diplophos due to several characters shared with more derived photichthyan taxa. In this study we expand on this by examining cranial nerve innervation, cephalic photophore innervation, and, and possibly the histological composition of photophores. These characters will bring new insight into the relationships of Diplophos within the Stomiiformes.

Optical Sensing with a Glass Fiber from the Deep Ocean

Elliott Fray, Junior, Materials Science Engineering
Mentor: George Mayer, Materials Science Engineering

The purpose of this study is to investigate the optical characteristics and biological significance of the basal spicules (fibers) found in the 'glass sea sponges' of the phylum Porifera and class Hexactinellida. The Hexactinellidae are known as 'glass sea sponges' because their skeletons consist of fibers (spicules) of amorphous hydrated silica (glass containing water). In one example, the sponge Euplectella aspergillum has spicules which appear to have wave guiding properties similar to single mode optical fibers. These spicules are important because their optical and mechanical properties may prove attractive for medical fiber optics. In addition to the use of basal spicules as anchorage for the sponge, it has been proposed that they may capture light in the vicinity of the sponge. Because the glass sponges have no known nervous system, and because many of the sponges live at depths below 500m where there is no ambient sunlight, it is theorized that the sponges may use their spicules to sense and respond to the bioluminescent light in their surrounding environment. The intention of this study is to measure the amount of transmission for a range of light wavelengths in Hyalonema Populiferum (a larger hexactinellid sponge) spicules. The data collected in this test will be used to clarify the optical function of spicules in these sponges, and will be used to compare the optical properties of these spicules to modern fiber optics. To date, samples of the spicules have been prepared for optical analysis, and an adapter is being built to fit these fibers onto a Newport RS-4000 Optical Table; where the fibers can be tested with a single wavelength laser. In the future, it is our intention to modify a Lambda 9 spectrophotometer to test the spicules over a larger range of wavelengths.

Child EEG and Maternal Depression

Nissa Freed, Senior, Neurobiology
Mentor: Sara Jane Webb, Psychiatry Behavioral Sciences
Mentor: Emily Jones, Psychiatry Behavioral Sciences

Depression is a heterogeneous disorder characterized by a wide range of symptoms which vary among individuals; however, a growing body of research has identified an electroencephalogram (EEG) profile that may help to identify patients at risk of depression. These studies have found that depression is associated with an increase in right frontal activation which is fairly stable within individuals and across age groups. In particular, studies of maternal depression have shown a correlation

between right lateralized EEG in mothers and right lateralized EEG in their newborns, suggesting that lateralization is at least in part a result of genetic or biophysical factors rather than experience or learning. Children with Autism Spectrum Disorders (ASD) may also show right-lateralized neural activity (Dawson, 1986). Since there are higher rates of mood disorders in families with a child with ASD, it is possible that this lateralization is related to maternal mood disorders rather than directly to ASD. To investigate this possibility, my current work investigates the correlation between maternal mood scores and EEG data collected from their children in the Toddler Assessment Project (TAP) study. This study included 38 children aged 18-30 months with ASD, typical development or general developmental delay. EEG recordings were made while children viewed repeated 500 ms images of either their mother or a stranger. Mothers completed psychological surveys describing quality of life adjustment and mood including the Brief Symptom Inventory (BSI), Life Experiences Survey (LES), and Dyadic Adjustment Scale (DAS), and also provided a detailed medical and psychological history. Data analysis is ongoing. We predict a correlation between child EEG and maternal mood scores in our study population, potentially suggesting that maternal mood is a factor that needs to be taken into account when analyzing child EEG.

Moisture Budget on Arctic Sea Ice
Hugo Froyland, Senior, Atmospheric Sciences
Mentor: Stephen Warren, Atmospheric Sciences
Mentor: Michael Town, Laboratoire de Glaciologie Geophysique de l'Environnement, CNRS/UJF

Perennial Arctic sea ice is experiencing decreasing trends in both area and extent, including a record summer ice coverage minimum in 2007. Sea ice is an important climate regulator, allowing for a high reflectivity of incoming radiation which maintains the cool temperatures of the Arctic ocean, as well as providing a source of saline water which affects overturning of the ocean as well as ocean circulation. Moisture is transferred to the sea ice surface during the winter through precipitation and direct deposition, and to the atmosphere during the summer though evaporation and melting. Due to lack of adequate direct observations, and the instability of models to simulate the near-surface atmospheric fluxes in stable conditions, moisture transfer rates over sea ice are uncertain. During the 1957-1958 International Geophysical Year pan evaporation and surface meteorology measurements were made at a floating Arctic station. We will compare the 1957-1958 evaporation data set to what is predicted from Monin-Obukhov similarity theory using the surface meteorology data set, and further draw comparisons between our data set and more recent observations of latent heat flux over Arctic sea ice. Our analysis will hopefully improve our understanding of the Arctic sea ice mass budget, and will provide a foundation to evaluate surface layer parameterizations in climate model simulations, which could lead to a more accurate representation and prediction of the Arctic sea ice.

Topographic Mapping with LiDAR - A Summary of an Undergraduate Geospatial Technician Internship
Aaron Frye, Senior, Geography
Mentor: L. Monika Moskal, Forest Resources

A research internship is a critical and career defining step in developing a professional portfolio as a geospatial specialist. One may have all the tools to their disposal, but may lack the methods and means to use those tools. The following project describes one such experience with Seattle's Division of Aero-Metric Inc., which has grown to be one of the largest photogrammetric and geospatial firms in the State of Washington. The internship focused on LiDAR data processing and topographic model generation. LiDAR is an emerging geospatial technology, which uses airborne laser scanners to create highly accurate digital terrain models (DTM's). This new technology offers higher accuracy, extent, and efficiency over traditional methods of acquiring DTM's. Since LiDAR is an emerging technology, it does not have a strong presence in physical geography based courses offered, and as a result, much research needed to be done by the intern to acquire the proper methods to manipulate the data. When the technician receives the raw LiDAR data, it is run through a series of post-processing algorithms that will classify the data coordinates into ground, vegetation, gross errors, etc. It is then run through an extensive review, ensuring that no points were classified erroneously in the previous step, and if so, correcting the software's errors. Finally, the data is prepped for the client, which could mean displaying the data as a topographic contour map, a gridded digital elevation model, an intensity return image, or as a plain XYZ text tile. In conclusion, the internship offered the opportunity to prepare for a solid foundation in a geospatial career, beyond the fundamental of GIS, remote sensing, cartography and surveying offered in a typical university setting.

"Business Sense": An Ethnographic Exploration of the Wine and Sex Trades in Northern Sierra Leone
Melissa Garrison, Senior, Anthropology, English
Mentor: Clarke Speed, University Honors Program

In Kagbere–a rural village in the Northern Protectorate of Sierra Leone, West Africa–*poyo*, or palm wine, functions as both an economic provision and a cloak to an immense network of covert sociocultural exchange. Using *poyo* as an ethnographic foil, I set out to probe this diagrammatic regime of socio-sexual relationships in Kagbere: which types of relationships form between wine tappers and wine vendors, between wine vendors

and wine consumers, and the consumers themselves, and how these relationships translate into social and sexual power within both Kagbere village and Sierra Leone at large. Through a series of in-depth, qualitative interviews with participants on all levels of the wine trade, I have been able to explore in greater depth the commodities truly at stake in this economy: labor, women's bodies, and sexual exchange. Yet, despite their subjugated economic position within Kagberian society, many of these women are revered for their "business sense"–their ability to sell wine through sex and sex through wine, thereby maintaining control of *both* trades–and take a degree of pride in their work, rather than assuming the demeanor of the marginalized and the oppressed. These women profit in two currencies, both fiscal and sexual. They support their families, male members included, with dignity and ingenuity. The network of relationships they create–economic, sexual, and familial–form the social foundation of Kagbere village: a foundation within which women are both celebrated and oppressed, slaves to those who use them and ruler of those who depend upon them. Their stories provide us with a vital and vibrant portrait of the Kagberian woman, and a fresh new perspective on feminist theory.

The Role of Spatial vs. Temporal Selective Pressures in Determining Evolutionary Adaptation Trends in *E. coli*

Carrie Glenney, Fifth Year, Biology (Ecology Evolution)
Marc Wiseman, Fifth Year, Biology (Ecology, Evolution Conservation), Environmental Science Resource Management
Mentor: Benjamin Kerr, Biology

The influence of spatial vs. temporal selective pressures is of interest to many evolutionary biologists. A study by Kashtan, Noor and Alon (2007) using computer simulations found that temporal variation, a form of serial disturbance, sped up evolutionary adaptation and eased transitions along the evolutionary pathway in comparison to an undisturbed, fixed environment evolution. These results can also be explored within a biological system using E.coli as model organisms. Organisms within environments that undergo regular disturbance should select for greater plasicity, allowing them to adapt to new environments more quickly. We will be evolving E.coli within two different environments, one simulating serial disturbance through a temporally alternating carbon source and one within a constant, mixed carbon source environment. According to our predictions, and the results of Kashtan, Noor and Alon (2007), when the strains are competed within a unique carbon source, the strain exposed to temporally alternating resources should outcompete the constant, mixed strain.

Peace Activism and Media: A Clash of Values

Alyssa Goldberg, Senior, International Studies, Communication
Jacquelyn Allen, Junior, International Studies
Tiffany Martin, Senior, International Studies, Communication
Laurel Severt, Senior, Economics, International Studies
Mentor: Nancy Rivenburgh, Communication

American media has been analyzed time and again about the depiction and coverage of war and violence, but the media's portrayal of peace is a topic that has rarely received attention. The public's understanding of war and peace on a local and international level is shaped in large part through the press. Peace groups in Washington State range from those such as "Bike-4-Peace," who bike cross-country, to the "Raging Grannies," whose grandmotherly members sing together. In analyzing newspaper coverage of 103 peace groups within Washington State and surveying peace organizations, our group of 4 undergraduate students sought to investigate how local press cover peace activism and the implications of the organizations' coverage. Prior research suggests that the values of mainstream media, including conflict and simplicity, clash with many of the values in peace activism. Although activists rely largely on the media to spread their message, the media often marginalize peace movements rather than promote them. Moderate peace activists do not fit the mold of what attracts readers and is profitable to print. Reporters often depict activists through their associations with a 'hippie' culture or focus on the legality of their actions rather than their message. This coverage undermines the organizations' goals and puts pressure on activist groups to conform to stereotypes in order to attract coverage. This distorted image is how peace activists have come to be viewed by society at large. Without peace organizations holding a legitimate voice in mainstream media, the public and government may overlook the prospect of non-violent resolutions to international conflict.

Screening Dried Blood Spots to Detect Severe Combined Immunodeficiency in Infants

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Mentor: Troy Torgerson, Pediatrics
Mentor: Stephanie Anover-Sombke, Immunology, Seattle Childrens Hospital

Severe Combined Immunodeficiency Disease (SCID) is a universally fatal immunodeficiency disorder that occurs because of a genetic mutation that causes a lack of T cell production and therefore susceptibility to infections. If the diagnosis is made early, patients can undergo bone marrow transplantation to cure the disease. If the diagnosis is made after patients get severe infections (often by 2-3 months of age), then the possibility of surviving the disease decreases substantially. The so-

lution would be to perform newborn screening for the disorder, hopefully by capitalizing on technologies that are already available in newborn screening labs or by developing a new cost-effective technology that could be readily implemented. One technology, already used extensively utilized for newborn screening is tandem mass spectrometry (MS/MS). Our design of an MS/MS test for SCID has begun with isolation of purified CD3ϵ, a cell surface marker for T cells and identification of key "fingerprint" peptides of this protein. The next step is to design conditions for mass spectrometry. Testing will begin with purified protein but will then be applied to testing of dried blood spots, such as those obtained from all newborn infants, to identify if there is any CD3ϵ in the blood spot. The assay will be validated using patient and normal dried blood spots.

ChapterOne: Information Management for Sorority Recruitment

Kaitlyn Grady, Senior, Informatics
Mentor: Batya Friedman, Information School

Every year nearly 700 potential new members (PNMs) participate in sorority recruitment at the University of Washington. By the end of the recruitment week, each sorority chapter will have narrowed this list to a freshman class of roughly 30. While each chapter employs different processes to accomplish this, it is common for a sorority member to talk to 50 PNMs during one round (of four) in the recruitment week. At the chapter where the system will be piloted, decisions were based on index cards that sorority members filled with their opinions on each PNM. A small reviewing committee typed information from the cards into a spreadsheet. This process left the committee little time to decide whether or not to keep each PNM through the next round. To facilitate better record-keeping and decision-making, this research and design project yielded a web-based system to input and manage information during the hectic recruitment week, in keeping with traditional recruitment processes. The first iteration of the system focused on displaying a PNM's picture and interests from her recruitment application. For the benefit of the reviewing committee, PNM application information is displayed with member contributions to form a single, comprehensive page of information for decision-making. The early system was released to the sorority chapter for user testing. The subsequent feedback influenced the final design's feature set and organization. The system is still being improved, but the current version is functional and will be used for recruitment in the fall.

Analysis of Observed X-ray Sources in our Neighbor M-31

Jerica Green, Junior, Astronomy, Physics
Mentor: Benjamin Williams, Astronomy

I observed and classified optical spectra of x-ray sources in the direction of our neighboring galaxy M31. The types of objects I was classifying, objects that emit light in the X-ray part of the spectrum, typically could be, (1) background active galactic nuclei- where a super massive black hole in a distant galaxy accretes hot gas, (2) X-ray binary systems- where a neutron star, white dwarf or black hole pairs with another star and the distance between them is so small that matter from the star gets accreted by its companion, and (3) supernova remnants- the remains of an already exploded star. I observed spectra using the Double Imaging Spectrograph on the 3.5 meter telescope at Apache Point Observatory, and I calibrated and extracted the objects' spectra from the sky background with standard image reduction and analysis techniques. With these final spectra, and a collection of previously-calibrated spectra, I classified the objects based on their emission and absorption lines. I then compared the lines to known standard emission lines to determine the 'red-shift' or distance to each object. With this information I was able to conclude if the object was in the galaxy M31 or if it was somewhere else along our line of sight.

Mesoporous Silica Encapsulation of Nanoparticles for Biomedical Applications

Stanley Gu, Senior, Bioengineering
Amgen Scholar, Mary Gates Scholar
Mentor: Xiaohu Gao, Bioengineering

With the advent of new biological nanotechnologies, new promise has arisen to vastly augment current biomedical applications, such as drug delivery and cellular imaging. For instance, the quantum dots, nanoscale semiconductor particles with unique optical properties, have garnered much interest in recent years as a basis for creating new biomedical therapies. However, obstacles in applying these new technologies have also arisen, such as biocompatibility and drug release. Many nanoparticles, including quantum dots, are toxic to cells without further surface modification. Furthermore, methods of controlling drug release are important to maximize the beneficial effects of drug therapies while minimizing its side effects. Mesoporous silica encapsulation is one technique that can enhance the ability of nanoparticles to function in a biological environment, control drug/therapeutic release, and serve as a platform for further functionalization. In this project, mesoporous silica encapsulation is applied in several nanoparticle-based delivery systems. This proof-of-principle work explores the potentials and limitations of using mesoporous silica by applying the technology in several forms. One example of this is to use silica encapsulation to functionalize quantum dots, providing a platform for therapeutic drug loading and controlled release while simultaneously reducing toxicity.

Afro-Mexicanos Communities in Mexico: Challenging and Reconstructing Mexican Nationalism and Identity

Maria Guillen, Senior, Anthropology
Mentor: Jason De Leon, Anthropology

Mexico has a complex history of socially constructed racial and ethnic identities. Unfortunately, historic accounts of Afro-Mexicanos (Mexicans of African descent) have often been ignored in Mexican ethnic studies. By analyzing the history of Mexican Nationalism and the Vasconcelos philosophy of racial homogenization through Critical Race Theory, I reconstruct the history of Afro-Mexicanos in Mexico. I am most interested in how modern Afro-Mexicanos in the Costa Chica Region of Oaxaca and Guerrero challenge and reconstruct Mestizaje and Mexican nationalism. The research presented here is a combination of a literature review and preliminary ethnographic data collected during previous visits to the Coast Chica Region. This information forms the outline for an ethnographic field project focused on Afro-Mexicanos living in Guerrero that will be carried out in the summer of 2009. Preliminary results of this study suggest that although the majority of Mexico is predominately mestizo (mix of Native and Spanish ancestry); the number of African-descent people is currently unknown. This is no doubt influenced by the fact that the Mexican census form and government do not officially recognize Afro-Mexicanos as a racial or ethnic group. It is assumed either that Afro-Mexicanos are integrated into modern Mexican society or that their numbers are small enough to not warrant official recognition. I argue that Mexico is far from homogeneous and that the current use of the Vasconcelos ideology of Mestizaje disenfranchises modern Afro-Mexicanos.

Endophtye-Assisted Phytoremediation using Sweet Potatoes in East Africa

Gabriela Guncay, Senior, Biology (Environmental Conservation)
Mentor: Sharon Doty, Forest Resources

At various sites near Lake Victoria in Africa, high amounts of metal contaminants have accumulated in the soil and groundwater. We are testing commercially produced *Ipomoea batatas* (sweet potato plants) for potential phytoremediation, a process where plant roots absorb and degrade chemical compounds in soil and groundwater available to roots. Our research on bacterial endophytes (microbes living inside the plant) of sweet potato plants have shown increased plant growth and possible nitrogen fixation, but other conferred benefits like nutrient and chemical absorption has not been determined. We hypothesized that the native endophytes would not affect TCE absorption or TCE degradation since the plants lacked selective interactions with TCE. When we compared normal endophyte-containing plants and sterile endophyte-free plants, there were no significant differences in TCE absorption among plant types. Further analysis has revealed that plants with the original endophytes contained higher concentrations of TCEOH, a metabolite of TCE. Sterile plants contained significantly less TCEOH. This finding suggests that pre-existing endophytic bacteria mediated metabolism of TCE within plant tissue or helped with overall stress tolerance and health of the plant, allowing increased metabolism of TCE, and that ultimately, chemical phytoremediation was driven by plant-mediated absorption and endophyte-mediated metabolism. Future research will focus on comparing commercially available Ipomoea batatas with native varieties sent from sites in East Africa.

The Effects of Past Experience on Baseline Responding in Rats

Haley Carroll, Senior, Psychology, Seattle Pacific University
Paul Knight, Senior, Psychology, Seattle Pacific University
Jenette Donovan, Senior, Psychology, Art History, Seattle Pacific University
Mentor: Baine Craft, Psychology, Seattle Pacific University

Disequilibrium hypothesis effectively describes how researchers and clinicians can identify and create response-reinforcer contingencies. This hypothesis proposes that every response has some probability of occurrence or homeostasis. Moreover, responding is due to the combination of an individual's evolutionary history and past experiences. However, scant discussions exist regarding the factors that contribute to homeostatic/baseline responding. The current experiment was designed to determine the effects of past experience on baseline responding. It was predicted that past experience with food deprivation would influence baseline responding in rats on a fixed interval (FI) 15s schedule rather than actual deprivation level. Subjects (Sprauge-dawley rats, n=10) were divided into two groups. Each group was exposed to three deprivation conditions such that subjects in Group 1 experienced 90%, 100%, and 90% and Group 2 experienced 90%, 80%, and 90% deprivation relative to ad lib body weight established prior to the experiment. Subjects' body weights were manipulated by reducing or supplementing daily food allotments. During each deprivation condition, subjects were exposed to five sessions (one session per day, 20 trials per session) of a FI 15s schedule using a standard operant response chamber. During each FI 15s trial, one operant response was required for one pellet of food. The number of operant responses was analyzed using a Mixed ANOVA and post hoc analyses. The results revealed that exposure to a particular order of deprivation caused statistically significant differences in operant responding on a FI 15s

schedule. These results are meaningful as they suggest that responding was not due to level of deprivation but due to previous or relative deprivation level. In other words, homeostatic or baseline responding was the result of past experience with deprivation. Future studies should identify the potential combined effects of deprivation and evolutionary history on baseline responding.

Responsible Recycling in University District Restaurants

Tasha Hanley, Junior, Community, Environment, Planning
Mentor: Don Miller, Urban Design Planning

This project developed out of an unintentional observation (while dining out) of there being a lack of recycle bins in a local restaurant in the University District and an intent to change this. Analyzing how this particular restaurant could also improve in other broad aspects of recyclability resulted in four self-developed criteria. The foci are as follows: when possible, reusable items for eat-in, quicker compostable products for to-go, clear and visible reminders to recycle, and finally, recycle bins for paper and aluminum. An informal survey of seven independent restaurants on the "Ave" was conducted to determine how well each restaurant met these. While conducting the informal survey, interviewing restaurant owners on if they would be willing to implement these changes resulted in three major areas deterring change. First, belief of inconvenience, second, a lack of knowledge of why making the recommended changes would be beneficial to them, and last but most cited, a concern with cost factors. The hypothesis is if these businesses are presented with clear cost-analyses of compostable or recyclable products that show it is equal to or less than their current expenditures, they will willingly switch. Proof of market forces that support being more "green" will also be key. In addition, if recycle bins and the associated recycling cost can be partially subsidized or otherwise inexpensive, the restaurants will implement them for use. Other rewards may also be present, such as positive feedback from the community and city. The amount of refuse that gets redirected back to use as a result of recycling may be substantial, although the exact impact is unknown.

Whole Cell Patch Clamp Investigation of the Mechanisms of Spontaneous Synchronous Activity in Neonatal Mouse Cortex

Lauren Hanson, Senior, Neurobiology, Individualized Studies
Levinson Emerging Scholar, Washington Research Foundation Fellow
Mentor: William Moody, Biology

Spontaneous Synchronous Activity (SSA) plays a central role in mammalian nervous system development. In mouse cortex, SSA is vital for the development of neuronal characteristics necessary for normal information processing. As such, how the timing and generation of SSA are controlled is a major question in neurobiology. The Moody lab has determined that a discrete pacemaker region in mouse cortex is responsible for the initiation SSA. My research employs patch clamp technique to explore the cellular behaviors and properties of both pacemaker and follower cells in order to better understand SSA. I analyze single cell recordings to gather information about cell characteristics important for activity, such as input resistance, excitability, burst structure and resting potential. In comparison with follower cells, pacemaker neurons have shown increased burst duration, a quality that may play a role in the ability of these neurons to depolarize surrounding cells to threshold and initiate waves of SSA. Multi-cell calcium imaging has shown that increased extracellular potassium concentrations lead to an increase in SSA frequency. These data suggest the possibility that depolarizing cortical cells may either allow the pacemaker neurons to initiate activity more frequently or allow follow neurons to respond to a higher percentage of events in the pacemaker. High potassium patch clamp experiments will explore the cellular level mechanisms of this increase in burst frequency. The characterization of differences between pacemaker and follower neurons via patch clamp provides the opportunity to elucidate cellular properties that contribute to the initiation of SSA and shape brain development. Not until the mechanisms of pacemaker activity are fully understood can we begin to question the role that pathologies in SSA may play in disorders of the brain in the mouse model or human correlate.

Investigating Pathways of a Palladium Catalyzed Organic Reaction

Jane Hung, Sophomore, Pre-Major
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Xiaosong Li, Chemistry
Mentor: Christopher Moss, Chemistry

Palladium (Pd) catalyzed hydroamination—a no-waste method that has many applications in pharmaceutical development and organic synthesis—is studied using ab initio computational methods on the computer-modeling program Gaussian to find the intermediates, transition states, and thermodynamic properties of the system. In this reaction, the palladium catalyzes the formation of a heterocyclic ring and allows the functional group from the solvent to attach to the final product. The aim is to understand the reaction mechanism and the role of Pd(IV) species. It is expected that one of the computed mechanisms has a reaction profile that corresponds to experimental results and therefore indicates the process of the reaction. This information can be used to design

more efficient chemical processes for future research on chemical synthesis.

Design of a Microfluidic Biosensor with Capillary Electrophoresis as a Means of Separation

Leticia Huynh, Senior, Biochemistry
Amgen Scholar
Mentor: Daniel Chiu, Chemistry

Biosensors, devices for detecting and analyzing the biological effects of a chemical analyte, are a promising area of biotechnology. The Chiu lab seeks to create a microfluidic biosensor using a process in which the traditional components of the biosensor are created with microfluidic chips, which are blocks of polymer set with channels, chambers, and other designs and faced with glass. This biosensor would perform in three stages: firstly, the chemical mixture of interest is separated via capillary electrophoresis (CE) and secondly, each chemical component, together with a single cell, is encapsulated in a microfluidic droplet. Finally, the droplets are channeled into a chamber where the biological effect of the chemical component on the cell can be viewed via microscopy. Currently research is focused on integrating a single-layer membrane valve (developed in the Weitz lab) into the biosensor prototype for more precise control of droplet formation. This valve consists of an actuation chamber situated closely to the channel to be closed. Gas or liquid can be pumped into the actuation chamber, which causes the membrane between the chamber and the channel to flex across the channel and halt flow. This biosensor, once completed, would be the first to include CE as a means of chemical separation. In addition, due to its small scale, it would be capable of analyzing extremely small samples. It will have numerous applications, including drug efficacy testing in pharmacology, chemical warfare detection, and food or water contaminant testing.

Where's My Bus: King County Bus Visualization and Improvement

Mark Javate, Senior, Informatics
Daniel Nguyen, Senior, Informatics
Raman Ahluwalia, Recent Graduate, Informatics
Evan Hwang, Recent Graduate, Informatics
Alex Poon, Senior, Informatics, Mathematics
Mentor: David Hendry, Information School

With recent concerns over both global climate change and one's environmental footprint, there has been a renewed focus on the importance of public transportation. One way to promote the use of public transportation, in our case the metro bus system, is by making the system more appealing to commuters. Our project seeks to do just that by improving the availability of information for planning bus trips. Our project seeks to give people information to answer this simple question: "where's my bus?" To better understand the information needs of bus riders we performed semi-structured interviews with eighty people throughout the city of Seattle at bus stops and transit centers with the goal of identifying problems and issues commuters have with the current bus system. Analysis of the interviews provided support for the following features of an online bus tracking system: a visual map representation of bus stop locations, route information, bus direction, and schedule deviation (whether the bus is late, early or on time). After designing and implementing a prototype, we shall conduct a series of usability evaluations, assessing the ease of use and user satisfaction of these features. Our future goals focus on extending our program to a mobile phone application as well as continuous improvements in design and usability.

Event Detection for PET Scanner on Ambric Multiprocessor Chip

Chad Jerde, Senior, Electrical Engineering
Mentor: Scott Hauck, Electrical Engineering

For years Moore's Law, the doubling of processor performance every eighteen months, guided the computer industry. However, as excessive power consumption brings this scaling to an end processors have been shifting to a multiprocessor approach as a means to increase performance. This trend towards multiprocessors has also taken root in the area of reconfigurable computing with the emergence of massively parallel processor arrays (MPPAs). One such MPPA is the Ambric multiprocessor chip. I have been working with other undergraduates to determine the performance of the Ambric chip in various applications. My specific application is event detection. I have been working alongside a graduate student in order to mirror a portion of his work, "FPGA-Based Front-End for a PET Scanner" by implementing the event detection portion of his system on the Ambric Multiprocessor Chip. The purpose of this work is to compare performance of FPGA-based and multiprocessor-based designs; FPGAs being the standard for reconfigurable computing. Although the performance of the system relative to the FPGA has yet to be determined, a few limitations of the MPPA have been noticed. The Ambric chip contains 336 RISC processors, however these processors compute units are relatively simple and cannot compute divides. Look-up tables must be used as a result. This brings to light another limitation of the Ambric chip, which is that each processor only has access to 2K of memory due to its distributed memory, MIMD architecture. Another limitation of the Ambric MPPA is that it has no real-time clock, which limits it considerably in what types of applications it can be used. Although it has limitations, its massively parallel architecture allows for the potential of an enormous throughput and has great potential given appropriate applications.

Crown Complexity and Blocking Effect of Leaf-on and Leaf-off Tree Conditions

Philip Johnsey, Senior, Environmental Science Resource Management
Mentor: L. Monika Moskal, Forest Resources
Mentor: Guang Zheng, Forest Resources

Crown complexity is an important parameter in the assessment of general tree health and productivity. One of the new methods that is being used to obtain data on crown complexity is terrestrial light detection and ranging (LiDAR). Like all of the methods of remote sensing, terrestrial LiDAR has its limitations. One of the limitations is the blocking effect, the term used to describe the loss of information due to obstructions of a scanned object. The first part of this experiment is to scan a sugar maple (Acer saccharum) with terrestrial LiDAR during winter with the leaf-off condition and again during spring with the leaf-on condition. These scans will be analyzed to determine the amount of information relating to crown complexity that one is capable of obtaining when using terrestrial LiDAR. The second part is to set up geometric layouts on tables with one-inch cubes and determine how terrestrial LiDAR and blocking effect correlate. Height, angle, and distance will be measured independently of each other. As a consequence, this plan yields a total of three table layouts, each one set up twice for replication. The goal of this experiment is to assess how well terrestrial LiDAR is able to determine essential characteristics and components of tree-crown analysis by comparing perfect objects (cubes) to imperfect objects (leaves on the sugar maple). The results of this experiment could yield a foundation for retrieving such parameters as leaf area index, biomass, and crown dimension with terrestrial LiDAR. Those who will benefit from this research include, but are not limited to, foresters, tree nurseries, and researchers.

Analysis of Candidate Genes in Hereditary Neuralgic Amyotrophy Pedigrees Unlinked to the *Septin9* Gene

Jennifer Johnson, Fifth Year, Biology (Physiology)
Mentor: Mark Hannibal, Pediatrics
Mentor: Angela Collie, Pediatrics
Mentor: Phillip Chance, Pediatrics

Hereditary neuralgic amyotrophy (HNA) is a rare autosomal dominant disorder characterized by episodes of painful neuropathy in the shoulder region, followed by local muscle atrophy and paresis. Though often preceded by perturbations in immune system homeostasis, the mechanisms behind the attacks are unknown. Approximately sixty-percent of HNA cases have been attributed to causal mutations in the *septin_9* (*SEPT9*) gene, most residing in a highly conserved region of a single exon. However, genotyping analysis revealed some pedigrees are unlinked to the chromosome 17q25 region containing *SEPT9*. In order to identify causal mutations in these families, four candidate genes were screened based on current literature indicating interaction with the Septin9 protein. *SEPT7* and *SEPT11* were selected because their proteins form complexes with Septin9 via direct interactions with its N-terminus, possibly including the area mutated in other HNA families. HNA mutations in *SEPT9* have also been shown to disrupt Rho/Rhotekin signaling. Accordingly, *Rhotekin* (*RTKN*) and *ARHGEF18* – a septin-associated Rho guanine nucleotide exchange factor – were also screened. Three individuals with HNA unlinked to chromosome 17q25 and a fourth unaffected individual were selected for study. Whenever possible, cDNA constructed by reverse transcription of mRNA was utilized for ease of sequencing; to differentiate alternative mRNA transcripts and to obtain sequence at the extreme 5' and 3' ends of the genes, genomic DNA was used. Segments of the genes were amplified by PCR and sequenced following confirmation of the product by gel electrophoresis. Analyses of the sequences have revealed no HNA mutations to date, as alterations from the reference sequence have not been exclusive to affected individuals. Further work – including additional sequencing and a broader genomic single nucleotide polymorphism array – will ensue to identify other loci causing HNA. Hopefully the results will provide insight into the pathogenesis of HNA.

Involvement of Red Nucleus in Reward Prediction during a Spatial Task

Graham Jones, Senior, Biology (Physiology), Psychology
Mentor: Sheri Mizumori, Psychology
Mentor: Adria Martig, Psychology

It has been well established that dopamine (DA) plays an integral part in learning and memory processes, and is thought to be specifically involved in signaling a reward prediction error. The reward prediction error hypothesis postulates that learning takes place when an existent outcome is different from the predicted outcome, meaning that learning happens in the presence of a novel or surprising situation. The role of DA in reward prediction is evident when comparing neural activity with reward-related events, where dopaminergic neurons fire in response to an unexpected reward and are inhibited when an expected reward is not present. Red Nucleus (RN) is a midbrain structure that is typically known for its involvement in motor related behaviors. Yet, lesion studies have also indicated that RN contributes to the control of DA synthesis and/or release and modulates activity at dopaminergic terminals. In our current study, we employed electrophysiological techniques to record the neural activity from two cells in the rat RN over a 14-day period while the animal learned a spatial task. The task required the rat to find a fixed goal location on a

plus maze from several starting points. Then, after the rat learned the task we introduced several environmental manipulations to provide novel learning contexts. We analyzed each cell's activity within and across days to investigate correlations between cellular activity and behavior. Preliminary data suggest RN neural activity may play a role in reward prediction and that this activity corresponds with learning an appetitive spatial task.

Imaging the Electric Near-Field Surrounding Dimeric Plasmon Resonant Nanostructures

Erik Josberger, Junior, Extended Pre-Engineering
Mentor: Markus Raschke, Chemistry
Mentor: Andrew Jones, Physics

Surface plasmons are a coherent oscillation of a free electron gas at a metal-dielectric interface. In a plasmon resonant nano-structure, the spatial distribution of the electric field associated with an optical excitation around a nano-structure can be mapped through application of scattering scanning near-field optical microscopy (*s*-SNOM). The study of this distribution yields important information about the properties of the plasmonic excitation which is relevant for the development of nanoscale optical devices. In *s*-SNOM, we use an atomic force microscope (AFM) to scan the topography of a surface with an extremely sharp tip with 10nm resolution. By focusing a laser we excite surface plasmons upon metallic particles beneath the tip. The electric field associated with this plasmon is then scattered by the tip into the far-field and focused onto a detector. This allows for mapping of the spatial fields associated with a plasmon resonance with resolution limited by the curvature of the tip (10nm). In our research, we will set up an AFM and optimize it for use with light in the visible spectrum (wavelength 400-700nm). We will then employ this set up to map the near-field distribution around dimeric nano-structures. This is important because the interaction of the two nano-structures offers insight into the properties of plasmon coupling on the nano-scale.

Comparing Black Hole Accretion Disk Models to Gravitationally-Lensed Quasars

John Kalmbach, Senior, Physics, Astronomy
Mentor: Eric Agol, Astronomy

Quasars are among the furthest observable objects in the universe and as a result there are many challenges in observing and studying them. One of the problems that can arise is that a number of quasars are gravitationally lensed by matter between the source quasar and observers on Earth. Gravitational lensing occurs because massive objects are able to bend light from a source object subsequently distorting, magnifying, or producing multiple images of the source. Our work involves adapting existing computer models for black hole accretion disks which output model spectrums and radius sizes and comparing this model data to the observed spectrum and size of a gravitationally lensed quasar. We hope to come up with a model that will approximately reproduce the observed data. To accomplish this we use codes written in Interactive Data Language (IDL) and Fortran to develop our models and then compare many possible model outputs and to arrive at the best one through the use of a Monte Carlo Markov Chain technique. A successful adaptation of the models will provide quality matches to the gravitationally lensed quasar data. In turn, this will allow us to attempt to constrain the mass and accretion rate of the black hole in the gravitationally lensed quasar and help us better understand the inner spatial structure of the quasar.

Hearing and the Arrangement of Neural Fibers in Chickens

Daniel Kashima, Senior, Music, Neurobiology
Mary Gates Scholar
Mentor: Edwin Rubel, Otolaryngology
Mentor: Armin Seidl, Otolaryngology

Auditory nuclei in the brain are organized in a tonotopic manner: the sound frequency to which neurons respond best, progressively and predictably shifts with its anatomical position, preserving the neighbor relationships of the auditory sensory epithelium, the cochlea. In birds, the bilateral nucleus magnocellularis (NM) and nucleus laminaris (NL), both of which form a circuit involved in sound localization, are arranged tonotopically as well. In each nucleus, neurons in the caudolateral region respond best to low frequencies (LF) and those in the rostromedial region respond best to high frequencies (HF). However, it is not known whether axons projecting from NM to NL, which cross the midline and form the cross-dorsal cochlear tract (XDCT), are also arranged tonotopically. To shed light on this question, we developed an experimental method that employs detailed 3D-imaging of the region of interest using a whole-brain preparation. Two different colored dyes were electroporated along different tonotopic positions in NM. One dye was injected into the HF region and another into the LF region. Over several hours the dye was transported anterogradely along the axons across XDCT, and after the whole brainstem was fixed and made transparent, a montage of 3D-images was taken of the whole structure using confocal microscopy. The resulting images show dye injected into the HF region filling axons in the rostral region of the XDCT, while dyes injected into the LF region were incorporated into fibers running through a more caudal region. These results indicate that the XDCT, like the cells they originate from and project to, is arranged in a tonotopic manner. This result begs the question about the existence of possible molecular cues that might guide NM axons in an orderly fashion in XDCT.

Distribution of iron from the hydrothermal vents of Rumble III and Brothers Volcanoes on the Kermadec Arc, New Zealand

Celia Kelly, Senior, Oceanography
Mentor: Susan Hautala, Oceanography

Hydrothermal vents are not well studied as sources of iron to the oceans. This project will attempt to quantify the amount and distribution of iron using discrete samples of iron and manganese taken from three vent sources of varying depth at Brothers and Rumble III volcanoes in the Kermadec Arc, New Zealand. Manganese samples will be used as an indicator of biological and chemical impacts on the distribution of iron from the vents. The area of interest is a volcanic arc that is created by the subduction of oceanic plates below less dense continental plates which draws water, biologic material, and other impurities that try to escape to through the crust, taking with it molten material. This 2,500km long span of the ocean floor has many incidences of active venting, which vary in depth from the sea floor at ˜3km to the more shallow vents at ˜200m. Vents have the potential to be a source to the surrounding water column and mixed layers of the surface. It is even more likely to be a source for the shallower vent sites of subduction zones rather than the more commonly researched deep vents of mid-ocean ridges. This could be an important influence on local primary production. Areas in the ocean that are depleted in iron are a subject of interest and concern, since the iron is considered a limiting nutrient in the High Nutrient Low Productivity areas. Although this region is not considered to be HNLC, it is close to the Southern Ocean, which is one of the major HNLC regions of the world. By understanding the amount of iron produced by hydrothermal vents, implications of the global budget of iron may be better known.

Quantitative Analysis of Shoreline Erosion at Magnolia, Seattle

David Kiehl, Senior, Earth Space Sciences
Mary Gates Scholar
Mentor: Terry Swanson, Earth Space Sciences

The shoreline and bluffs of Magnolia hill in Seattle have undergone significant erosion since the last glaciation. The Puget Lobe of the Cordilleran Ice Sheet advanced southward from Canada and covered Seattle and the rest of the Puget Lowland. When the ice sheet advanced and withdrew from the Seattle area ˜15,000 years ago, it left thick deposits of unconsolidated glacial sediments. As sea level rose due to the melting of large continental ice sheets, wave and tidal action began to erode into the unconsolidated glacial sediment comprising the many drumlin-shaped hills along the Seattle shoreline, including Magnolia hill. Due to its high bluffs with ocean and mountain views, Magnolia has long been a desirable residential neighborhood, but its bluffs are also prone to frequent landslide activity that contributes to the long-term erosion of the hill. Little work has been done to determine long-term erosion rates, though this information would be useful to the scientific community as well as the city and neighborhood residents. The goal of this project is to establish relatively accurate erosion rates for the coastline of Magnolia using a variety of research methods. Analysis of LIDAR digital elevation models provides a baseline estimate for a long-term erosion rate, and measurements on historic aerial photos provide data on the variable nature of short-term erosion. Landslides from the coastal bluffs, primarily at Discovery Park, at the north end of Magnolia, and Perkins Lane, at the south end, deposit sediment and boulders on the tidal platform. By obtaining exposure ages for the boulder deposits (which were previously buried in their source stratigraphic unit) and surveying their location in relation to the present-day bluff, accurate bluff retreat rates for these locations were calculated. Cosmogenic isotope dating techniques were used to obtain exposure ages for the boulders.

Race and Sociodemographic Variables as Predictors of Effortful Control in Preschoolers

Diane Kim, Recent Graduate, Psychology
Nicole Stewart, Senior, Psychology
Mentor: Liliana Lengua, Psychology

Past research has shown that children belonging to a racial minority group are at increased risk for adjustment problems. This is thought to be related to experiences of discrimination from being a minority and to a higher prevalence of other sociodemographic risk factors in racial minority groups. However, little research has examined the possibility that the effects of sociodemographic risk factors on child adjustment might differ across racial and ethnic groups. This study explores the relations among race, sociodemographic factors, and effortful control in 3-year-old children. Effortful control is a core mechanism of self-regulation and is charaterized by processes that inhibit a dominant response in order to perform a subdominant response. Effortful control encompasses mechanisms by which development shifts from reactive to self-regulative behaviors, allowing children to manage their reactivity and engage in pro-social behavior (Rueda, Posner, & Rothbart, 2005). Previous literature suggests that certain sociodemographic risk factors that might be related to effortful control also co-occur with each other. For instance, being in a single-family household may increase risk of poverty. We posit that different races will be subjected to varying sociodemographic risk factors, which will in turn relate to differing levels of effortful control in children of different races. Effortful control was assessed using maternal responses on the Children's Behavior Questionnaire (CBQ). Sociodemographic variables, such as

low income, low parental education, single parent households; and family risk factors, such as stress, conflict, and maternal depression were assessed using maternal responses to a battery of parent questionnaires. Race was separated into 7 categories: African American/Black, Asian, Latino/Hispanic, American Indian/Alaskan Native, Native Hawaiian/Pacific Islander, European American/White, and Multiracial. We expect to find significant differences in effortful control among races related to differences in the presence of sociodemographic and family risk factors.

Sequence Diversity of TprK in Immunosuppressed Rabbits and Immunocompetent Rabbits

Eric Kim, Senior, Microbiology
Mary Gates Scholar
Mentor: Sheila Lukehart, Allergy Infectious Diseases
Mentor: Barbara Molini, Medicine

Treponema pallidum subsp. pallidum is the causative agent of syphilis. A proposed outer membrane protein of *T. pallidum*, TprK, has seven variable (V) regions that code for antigenic epitopes. Over the course of infection, these regions accumulate change that may allow the bacteria to evade the immune system. To ask whether the host's immune response selects for treponemes expressing variant TprK antigens, 10 rabbits were infected intradermally with *T. pallidum* so that syphilis skin lesions would develop. The experimental group (5 rabbits) was treated with an immunosuppressive agent, methylprednisolone, and the control group (5 rabbits) was untreated. At weekly intervals, lesion biopsies and blood samples were taken from each rabbit. The blood was tested using the VDRL (Venereal Disease Research Labratory) test to check for differences in antibody titers between the two groups. The VDRL tests showed that there was an expected lower antibody titer in the immunosuppressed experimental group compared to the control group, confirming that immunosuppression was effective in the experimental group. DNA was extracted from the lesion biopsies and the *tprK* gene was amplified by PCR. The PCR products were cloned in E. coli, and sequences were obtained from at least 10 clones per lesion. At day 28 post infection, there was a significant increase in sequence variation of V6 in the control group while the immunosuppressed group demonstrated a minimal amount of sequence change. This suggests that variant sequences accumulate in the *tprK* gene when the bacteria are under immune pressure. The fact that sequence diversity of *tprK* is significantly lower in immunosuppressed rabbits supports the idea that the immune response selects for treponemes expressing variant antigens and that TprK variation allows the bacteria to evade the immune system during infection. This may explain why there is chronic infection in untreated individuals.

Environmental Values: Tool for Greater Public Involvement in Environmental Issues and Law

Hoshihito Kondo, Senior, Environmental Studies (International Perspectives)
Mentor: Michael Reese, Program on the Environment
Mentor: Beth Bryant, Marine Affairs

Most Americans say that they care about the environment, but there is a disconnect between their concern for the environment and their actual level of engagement in environmental issues. Traditional demographic research has failed to address this disconnect. It is imperative that we understand this underlying disconnect if we are to address the increasingly grave and complex environmental issues today, such as global warming. In order to find out how the environment fits into people's broader worldviews, Earthjustice, the nation's leading nonprofit environmental law firm, created the Ecological Roadmap, a national study that organizes the American public into 10 worldviews according to how they rank more than 130 social values. Earthjustice's next step involved creating an Ecological Roadmap specifically for the Pacific Northwest, a pilot project called the Northwest Values Project. My externship project with the Seattle Earthjustice office builds off of this research and focuses on how to gather more support for Earthjustice's active legal cases. I utilized data from this research to assess whether any cases have the potential to increase participation by changes in messaging, issue focus, or party participation. I have found that in general, the 10 worldviews can be subdivided into 3 groups: the supportive, non-supportive, and the unknown. My recommendation is to focus on the unknown group, which makes up 44% of the American public, because they have the greatest potential to be more engaged in the environmental issues. My work will serve as a model for other Earthjustice regional offices in implementing similar strategies to mobilize long-term public support for conservation in a region. The broader implication of mapping social values in the Northwest is that it will allow leaders in the region to see exactly where there are opportunities to engage segments of the public and expand their base of support.

Hydrophilic and Hydrophobic Material Surface Modifications

Ursula Koniges, Senior, Chemical Engineering, Biochemistry
Mentor: Hongbo Zeng, Engineering, UC Santa Barbara

Many commonly used polymers, such as polystyrene (PS) and polydimethylsiloxane (PDMS), are hydrophobic and thus not ideal for applications which benefit from hydrophilic material surface properties (such as biomaterials or micro fluidic devices). Conversely, mica is hydrophilic and not ideal for applications which benefit from hydrophobic surface properties. Means of altering the surface hydrophobicity of materials while

maintaining bulk properties exist. This investigation concerns the surface modification of PS, PDMS, and mica via introduction of hydrophilic or hydrophobic functional groups to material surfaces. PS and PDMS are modified to increase surface hydrophilicity. Mica is modified to increase surface hydrophobicity. Introduction of hydrophilic functional groups is accomplished via UV-ozone treatment. Introduction of hydrophobic functional groups is accomplished via [3-Aminopropyl]triethoxysilane (APTES) solution immersion. The resulting surface energy effects are examined using sessile drop contact angle analysis. Surface forces apparatus (SFA) is used to measure deposited APTES monolayer thickness. Results indicate successful achievement of desired surface modifications.

Identification of Enzyme Targets of Anti-Malaria Compounds

Kuzma Kovzun, Senior, Biochemistry, Psychology
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Wes Van Voorhis, Allergy Infectious Diseases
Mentor: Gregory Crowther, Medicine

Malaria is a widespread infectious disease in the tropical and subtropical regions of the Americas, Asia, and Africa. Each year, there are approximately 300-500 million reported cases of malaria with 1 to 3 million deaths. The purpose of this study is to aid researchers in developing new and better anti-malaria drugs to combat this parasite, known as the Plasmodium parasite. The project consists of scanning libraries of known anti-malaria compounds from the Novartis pharmaceutical company and the Broad Institute. Using a high throughput "thermal melt" method, Plasmodium enzymes that have been expressed in E. coli bacteria are tested against a number of anti-Plasmodium compounds in order to determine whether any specific compound binds to and stabilizes the enzyme. Hit compounds from these thermal melt assays are then tested for their ability to inhibit enzyme activity, i.e., the enzyme's ability to convert substrates to products. After the compilation of data from the thermal melt assays and the enzyme activity assays, it will be necessary to test whether anti-Plasmodium compounds can inhibit the activity of their respective enzymes in living cells. At the conclusion of this project, researchers will have a good idea of which Plasmodium enzymes are acted on by which anti-Plasmodium compounds. This will be very beneficial in future drug development.

The Environmental Health of Puget Sound as Determined by Recent Puget Sound Foraminifera

Lynna Kvistad, Senior, Earth Space Sciences (Environmental), Biology (Ecology Evolution)
Mentor: Elizabeth Nesbitt, Earth Space Sciences

This study examines recent benthic foraminifera from Puget Sound in order to better understand the current ecological health of its bottom waters. Foraminifera, marine protozoa with calcium carbonate shells, are good indicators of the environmental conditions in which they grew. For this part of the project, grab samples were collected between 2001 and 2008 from Port Gardener, near Everett, at water depths of 21 to 22.5 meters. The particle size distribution of the site stayed relatively constant, with silt composing about 50% of the sediment, sand 40%, and clay 10%. Each sediment sample was washed through a 124 mm sieve and the foraminifera handpicked and identified. Between 155 and 242 foraminifera were collected per sample, and the number of foraminifera found per gram of sediment ranged from 3 to 65. The samples were numerically dominated by agglutinated species and common marsh inhabitants. Pollutants found in the water at the time of the sample collection, including heavy metals and organic compounds, were then correlated with the found species using concordance correspondence analysis. In addition to a comparison of the species composition of the collected foraminifera for several recent years, and the relative densities of foraminifera in the sediments as varied by year, the results show the extent to which various pollutants have affected the species composition. These results will help to understand how pollutants are affecting Puget Sound and the biota that reside in it.

Ultrafast Interferometric Investigation of Plasmon Polaritons and Coherent Phonons

Min-Tih Lai, Senior, Materials Science Engineering, Mechanical Engineering
Mentor: Markus Raschke, Chemistry
Mentor: Samuel Berweger, Chemistry

Various properties of materials can be inferred from a material's response to electromagnetic radiation. In nanoscale conductors, free electrons behave similar to a body of gas under the Drude model and can respond to radiation by forming polarized electric oscillations (plasmons). On the other hand, semiconductors tend to respond, on the atomic lattice level, with acoustic and optical lattice vibrations (phonons). A greater understanding of a material's electronic and structural properties can be learned by observation of how plasmons and phonons lose their coherence (dephase). This phenomena is observed using an ultrafast Titanium:Sapphire laser in an interferometric "pump and probe" setup. In the interferometer, the laser beam is split into two arms; the "pump" arm of the interferometer excites the system, while the "probe" arm provides the interferometric juxtaposition needed for detection. Dephasing mechanisms such as coupling and carrier interactions are inferred through analysis of the second harmonic interference signal attained. The extended knowledge and refined methods of plasmon and phonon excitation will be integrated into an

Atomic Force Microscope (AFM) as a means of studying the electromagnetic near-field properties in various materials with nanoscale resolution. These techniques can be used to better understand materials from solar cells to biomolecules.

The Quest for Meaningful Pedagogies: Cambodian Americans in Higher Education

Jimmy Lal, Senior, American Ethnic Studies
McNair Scholar
Mentor: Rick Bonus, American Ethnic Studies

Cambodian American students face social and academic challenges because of their underserved needs, lack of relevant curriculum, and misrepresentations of their community in U.S. higher education institutions. This study explores the educational experiences of Cambodian American students at the University of Washington through interviews with Cambodian American students and UW faculty. This research project examines two main things: 1) How Cambodian-American students make meaningful connections between their lives and education, and 2) How the perceptions, reflections and recommendations of faculty in higher education can create and improve pedagogies that are culturally responsive to the needs of these students. A significant outcome of this research is a proposed syllabus for a course on Cambodian American history and Culture that will be shared with all research participants. This project will both facilitate meaningful connections between Cambodian Americans and higher education and contribute to the growing literature on cuturally relevant education.

Expressions of Identity in Wikipedia with Userboxes

Linda Le, Senior, Informatics, Psychology
Mentor: David McDonald, Information School
Mentor: Ivan Beschastnikh, Computer Science Engineering

Wikipedia, a popular online encyclopedia, is composed by hundreds of thousands of editors. Underneath the placid surface of its articles, lives a thriving community of individuals from around the globe dedicated to improving Wikipedia. To facilitate communication and inspire collaboration among the editors, each person is allocated a user page. These user pages are similar to online profiles seen on social network systems. However, Wikipedia provides few structures or suggestions on how or what kind of information editors should present about themselves. In contrast, social networking sites like Facebook and MySpace suggest content fields that individuals can decide to use in their profile. Our research explores the subject of online identity; how do people present themselves? Given a semi-structured environment like Wikipedia, what information do editors choose to disclose? Through a content analysis of Wikipedia userboxes – small colored boxes designed to communication a single characteristic or attribute of an editor – we reveal the multiple categories of self expression that people choose to disclose. By analyzing the frequency and studying the wide range of userboxes, we seek to understand the alignment between structured and unstructured profiles. Our findings provide a better understanding of the information elements that may support more effective collaboration in large online communities. This research is an initial step towards exploring the relationship between identity and collaboration in Wikipedia and will influence the design of new tools that nurture teamwork and enrich collaboration in Wikipedia.

The Risk of Food-Borne Illness in University of Washington Students

Briana Ledesma, Junior, Anthropology
Mentor: Gene Kim, Office of Minority Affairs Diversity

Food-borne illness is a serious problem in the United States that is thought to affect more than half the population. The Center for Disease Control and Prevention and other public health professionals hypothesize that if people are more informed about food safety and optimally have taken a food safety class, they are much less likely to contract a food-borne illness. The goal of my study is to determine how at risk the University of Washington population is for food-borne illness and formulate a plan to help significantly lower this risk. The University of Washington is a good sample of different types of people from different backgrounds that are educated, but may be at great risk for food-borne illness. My study is in the form of a Catalyst Survey that will be sent to several students via different list serves. The survey includes 6 basic questions about individuals' backgrounds and 20 basic food safety questions designed to be answered quickly, the entire survey should take approximately 10 minutes. If students are at risk, they will continue through life preparing food for others, family, friends and potentially putting them at risk for these types of illnesses. If students are at the risk that I expect them to be an optimal solution would be to create a mandatory food safety class conducted at every advising and orientation session for freshman and transfers. This could help eliminate risk and other nutrition problems that are associated with students in college.

Single-Molecule Sensing Utilizing Solid-State Nanopores

Hyunae Lee, Senior, Chemistry, Biochemistry
Mentor: Bo Zhang, Chemistry

Cylindrical shape silica nanopores have been developed and utilized as sensors for single nanoparticles and single biological molecules. A nanopore-type sensor has a membrane separating two ionic solutions. A single nanopore in the membrane allows both the ionic species and electrolyte to pass through. A small volt-

age is applied to electrophoretically drive charged analyte molecules to translocate through the nanoaperture. The resulting ionic current is monitored to detect the translocation events. Our cylindrical nanopore sensors are fabricated by simply pulling a thick-wall silica capillary to form nanometer-scale channels, followed by sealing the tip of nanochannel in a glass capillary with low melting temperature and sanding to cut the length of the tip. These sensors have been applied in the detection of a number of different analytes, including single bovine serum albumin (BSA) molecules and polystyrene nanoparticles ranging from 20 to 50 nm. Future work will be focused on studying the transport of single molecules, like single-strand DNA.

A Merkel Cell Polyomavirus-Encoded MicroRNA in Merkel Cell Carcinoma

Sherry Lee, Junior, Biology (Molecular, Cellular Developmental)
Mary Gates Scholar
Mentor: Paul Nghiem, Dermatology
Mentor: Kelly Paulson, Pathology

Merkel cell carcinoma (MCC) is an uncommon but aggressive type of skin cancer that has a high mortality rate and greatly increased number of incidences in the past 20 years. To better understand MCC pathogenesis, we are studying a newly discovered human polyomavirus, called Merkel cell polyomavirus (MCPyV). Specifically, we are focusing on mechanisms by which the virus may escape immune detection and promote tumor growth. To avoid immune detection, the virus may use microRNAs, small, non-coding RNAs to selectively regulate the expression of genes that might be recognized by the host immune system. Using high-throughput sequencing of 6 MCC tumors and analyzing a total of 28.3 million sequences of small RNAs, we directly identified an MCV-encoded microRNA. This viral-microRNA was expressed in strongly virus positive tumors and not expressed in virus negative tumors. The expression of viral-microRNA in human Merkel cell carcinoma tumors was confirmed by a custom reverse-transcription quantitative PCR assay. The viral-microRNA was detected in 7 out of 14 MCC tumors (50%), which corresponded to 63.7% of virus positive tumors and 0% of virus negative tumors. A validated in silico algorithm called TargetScan was used to predict the viral-microRNA's human target genes, which we hypothesize will be downregulated in virus positive cells. A promising target we are investigating further is the gene PSME3. PSME3 normally augments processing of antigen fragments that are recognized by cytotoxic T-cells. This suggests that by reducing the expression of PSME3, the virus may be able to reduce the presentation of viral stimulatory antigens that trigger immune responses. With messenger RNA microarray analysis, we found that transcriptional expression of PSME3 is downregulated in most virus-positive tumors. A critical next step will be to introduce synthetic mimic microRNAs in order to determine how they affect protein levels in cell lines expressing target genes.

Effect of AZT Treatment on Oxidative Damage in Mouse Skeletal Muscle

So Lee, Senior, Biochemistry
Mentor: David Marcinek, Radiology

The goal of the research is to detemine if azidothymidine (AZT) treatment leads to increased oxidative damage and energetic defects in mouse skeletal muscle. AZT or Zidovudine (INN) (also called ZDV), is a well-known HIV treatment that is known to cause skeletal muscle dysfunction.I will compare oxidative damage in AZT treated and control mouse skeletal muscle and in transgenic mice with elevated mitochondrial antioxidants. To achieve my experimental goal I will use SDS gel electrophoresis and Western blotting to detect oxidatively damaged proteins. I will use gel electrophoresis to separate proteins by mass. After running the gel I transfer the separated proteins to a membrane and expose them to antibodies that detect oxidative damage modification of proteins. The more antibodies accumulated in certain protein band, the more oxidative damage there is. I expect to see more oxidative damage in mitochondria in a mice treated with AZT and that this oxidative damage will be reduced in the transgenic mice with elevated antioxidant. This measure of oxidative damage will be compared to measurements of mitochondrial function to determine if oxidative damage contributes to mitochondrial dysfunction with AZT treatment.

Identifying Genes Required for Stem Cell Function

Vivian Lee, Junior, Biochemistry
Mentor: Hannele Ruohola-Baker, Biochemistry
Mentor: Ellen Ward, Biochemistry

Adult stem cells remain undifferentiated and continue to divide throughout the lifetime of the organism. Proper regulation of adult stem cells is critical because reduction in their cell division can lead to tissue atrophy, and uncontrolled cell division may lead to cancer. In order to identify genes required for stem cell maintenance and cell division we are performing a genetic screen. Since many genes, when they are homozygous mutant it causes lethality, to determine if a gene is regulated in an adult tissue we are using the FLP/FRT system to make mitotic clones to remove the gene of interest. Through this loss of function genetic screen, we can identify genes required for stem cells to remain stem cells and/or are required for stem cell division. For the screen we use Drosophila germline stem cells as a model since they are easily identified. From the stock center, we receive fly lines with mutations on FRT-bearing chromosomes. The crosses are set up and the progeny are heat shocked to

induce clones. The female flies are then dissected and analyzed. Mutations and interesting genes express a phenotype with reduced germline stem cell progeny. Thus far, I have screened 128 lines with the result of 12 lines with reduced germline stem cell progeny. The most interesting of these results are kekkon-1, an EGFR-signaling gene, and abrupt, a transcription factor gene. For further research, secondary screens are being done with these lines. The secondary screen will verify that a given mutation is responsible for its phenotype. This is done by analyzing the phenotype at two different time points and calculating percentage of clones lost over time. Also I will obtain a second allele for genes kekkon-1 and abrupt and analyze mutant germline stem cells for cell cycle defects with a panel of cell cycle markers.

Comparing UIS3 Gene Expression of *Plasmodium yoelii* and *Plasmodium falciparum*

Leslie Ratzlaff-Minkler, Sophomore, Biology, Seattle Central Community College
Mentor: Vanessa Jacobs-Lorena, Global Health, Seattle Biomedical Research Institute
Mentor: Stefan Kappe, Global Health

It has been determined that in the rodent malaria parasite (*Plasmodium yoelii*) with the UIS3 gene deleted from the genome, the parasite life cycle cannot be completed. The objective now is to compare the *Plasmodium yoelii* UIS3 gene to that of *Plasmodium falciparum*, which is the parasite that infects humans, to determine whether both are expressed in the same stage of the life cycle, and if so, whether the resulting proteins are localized similarly for both organisms. This will be accomplished by constructing a plasmid which contains two important sequences. First, the plasmid will contain untranslated regions that will target the plasmid to an unessential protion of the *Plasmodium yoelii* genome and second, the *Plasmodium falciparum* UIS3 gene with an epitope tag. The completed plasmid will then be introduced into the genome of *Plasmodium yoelii*. If the introduced *Plasmodium falciparum* UIS3 gene is expressed, it will be detected with an antibody against the tag, and conclusions can then be drawn as to the function of this gene.

Identification of Quorum Sensing (QS)-Regulated Genes in *Burkholderia mallei*

Tiffany Lim, Sophomore, Microbiology
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: E Peter Greenberg, Microbiology
Mentor: Amy Schaefer, Microbiology
Mentor: Breck Duerkop, Immunology, UT-Southwestern Medical Center

Quorum sensing (QS) is a bacterial cell communication system that enables cells to measure the population density using chemical signals. In Gram-negative bacteria, such as *Burkholderia mallei*, these signals are often acyl-homoserine lactones (acyl-HSLs). QS depends on transcription factors belonging to the LuxR family of acyl-HSL-responsive proteins. *B. mallei* is a biosafety level 3 obligate mammalian pathogen with multiple QS systems. Previous research has shown that QS-deficient strains of *B. mallei* are less virulent than wild type strains. *B. mallei* BmaI1 mutants are severely impaired in virulence. BmaI1 produces the signal octanoyl-HSL (C8-HSL). C8-HSL binds to the *B. mallei* LuxR homolog, BmaR1. We hypothesize that the BmaR1-BmaI1 QS system regulates factors important for *B. mallei* pathogenesis, and that identification of the QS regulated genes will help us understand how *B. mallei* causes disease. To begin to test our hypothesis, we are screening a random genomic library of *B. mallei* DNA fragments to identify BmaR1 regulated promoters. We screen the library by transforming *Escherichia coli* containing a *bmaR1* gene with DNA fragments cloned upstream of a promoter-less green fluorescent protein (GFP) gene, and testing transformants for GFP expression with and without added C8-HSL. When a BmaR1 promoter is present, C8-HSL stimulates GFP production. We then sequence positive clones to determine the role of the QS-regulated gene in *B. mallei*. We have identified two positive clones, and have sequenced the promoter in one of them, which codes for a protein of unknown function. An understanding of QS and pathogenesis in *B. mallei* is important for the development of potentially novel QS therapeutics and drug development.

Mutagenization of scrm-D Seedlings to Locate scrm-D Suppressor Gene

Alex Lin, Senior, Biology (Physiology)
Mentor: Keiko Torii, Biology

Scream-d is a gain-of-function mutant allele in Arabidopsis which causes almost all protodermal cells (embryonic epidermal cells) to develop into stomata rather than into a mixture of stomata and pavement cells. Previous research suggests that the SCRM protein dimerizes with SPCH, a transcription factor that regulates the stomatal pathway, to push protodermal cells down the stomatal path. The key to this study is figuring out if there is another gene that suppresses the scream-d mutation. To create a suppressor mutation, the Torii lab performed a brute force screen using homozygous scream-d seeds and ethyl methylsulfonate (EMS). scream-d seeds were treated with EMS, a highly effective mutagen, then sowed onto sterile culture media and screened for healthy-looking plants. Scream-d plants are short and shriveled relative to wildtype plants because they lack pavement cells and the overabundance of stomata hinders photosynthesis. Therefore, a completely suppressed scream-d phenotype would look like wildtype Arabidopsis. Once a putative suppressor is found, reproducibil-

ity of phenotype and mode of inheritance will be tested. The success of this research could provide great insight into the mechanism of suppressor proteins and could also provide a potential general model for suppressor mechanism in both plant and animals.

Synthesis of a Novel Ruthenium Complex for Study of Hydrogen Atom Transfer

Alexander Lindsay, Senior, Chemical Engineering
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Jim Mayer, Chemistry
Mentor: Virginia Manner, Chemistry

Proton-coupled electron transfer (PCET) is important in a wide range of chemical and biochemical processes such as tissue inflammation and enzyme catalysis. The Mayer group studies a specific group of PCET reactions called Hydrogen Atom Transfer (HAT) in which the proton and electron are transferred from one molecule to another in a single mechanistic step involving no intermediates. We are currently assessing the effects of decreasing the communication between the redox site, where electron transfer occurs, and the acidic/basic sites, where proton transfer occurs. To study this, organic ligands are coordinated to the transition metal ruthenium. One ligand contains a carboxylic acid functional group, which is responsible for the acid-base chemistry. The metal is the redox site. After the inorganic compound is synthesized, it is reacted with various organic reagents, and the reaction rates are measured using an Ultraviolet-Visible (UV-Vis) spectrometer. Products are confirmed by Nuclear Magnetic Resonance (NMR) and Mass Spectrometry (MS). Preliminary results have led to a hypothesis that decreased communication decreases the rate at which HAT occurs and that in extreme cases the proton and electron transfers cease to be concerted. These experiments are establishing critical boundaries on HAT and are contributing to a better understanding of various chemical and biological systems, including combustion of hydrocarbons and charge transport in DNA.

Adaptive Evolution of Bacteria in Response to Changing Selective Pressures

Haley Lindsey, Senior, Biology (Ecology Evolution)
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Benjamin Kerr, Biology

We are interested in how organisms adapt in response to changing selective pressures. Specifically, we are exploring if organisms evolve different adaptive mutations in response to a gradual increase in selective pressure versus a rapid increase. Using Escherichia coli as our model organism, we have evolved four treatment groups by serial transfer for approximately 160 generations, subjecting the groups to different gradients of the antibiotic rifampicin to model different intensities in the increase of selective pressure. We then determined the rates of adaptation versus extinction in each treatment and the relative fitness and maximum levels of rifampicin resistance in bacteria from the evolved populations. In addition, we sequenced the rpoB locus of the common ancestor and isolates from the evolved populations to determine what kinds of mutations are responsible for resistance and increased fitness in each treatment group. For isolates with multiple mutations, we plan to use site-directed mutagenesis to engineer all combinations of the mutations and then separately measure their fitness effects in a common background. We expect our results to give insight into the fundamental question of how organisms adapt to changing environments. Our approach of looking at the severity and duration of changing selective pressures has relevance for the potential evolutionary effects of climate change on organisms. Using rifampicin and E. coli in our model also allows us to draw inferences about the evolution of antibiotic resistance under different conditions of exposure.

Breaking the Fortune Cookie Myth: Racially and Ethnically Constructed Asian American Identity

Wen Liu, Senior, Psychology
Kevin Lam, Senior, Psychology
Mentor: Sapna Cheryan, Psychology
Mentor: Jennifer Wang, Psychology

Research in the field of psychology has often used race and ethnicity interchangeably when they may be distinctively constructed categories for various groups. Specifically, Markus (2008) proposed that race is socially constructed and referring to power dynamics whereas ethnicity is seen in terms of culture and practices. In this survey study we examined the differences between race and ethnicity among Asian Americans, a group in which ethnic and racial identification are often used interchangeably yet may have very distinct meanings. We hypothesized that racial identity (i.e. Asian American) is more associated with experiences of discrimination and prejudice while ethnic identity (e.g., Chinese American) was more associated with cultural practices and activities among Asian American college students. Forty-four undergraduate students who identified as Asian Americans at the University of Washington participated in the survey. We asked participants to rate their agreement on 38 items we developed examining various aspects of identity, framed within both ethnic and Asian American prompts (e.g., To me, being Asian American means...). These items focused strength of self-identification, cultural customs, and perceptions of perceived discrimination. Using a within-subjects design, our findings suggest that when participants were racially primed, they rated higher on items focusing with discrimination and racial conflict including stereotype perception and blending their racial identity with the mainstream. When the

participants were ethnically primed, they rated higher on the importance of self-identification with their ethnic group. These findings support our hypothesis that racial identity for Asian Americans is more associated with discrimination than ethnic identity. Furthermore, our preliminary findings suggest that ethnic and racial identities are constructed differently among Asian Americans.

Variability in Behavior and Self-Regulation in Infants At Risk for ASD

Rachel Lowy, Senior, Psychology
Mentor: Sara Jane Webb, Psychiatry Behavioral Sciences

Children with Autism Spectrum Disorder (ASD) have been shown to have difficulty in regulating their emotions. As infants they tend to be more difficult to soothe, and they grow up to have more trouble when focusing attention and inhibiting negative emotion than typically developing children. This study investigates regulation of affect and emotion in infants who are at risk for ASD (because they have older siblings with the condition). We looked at affect and emotion across two 15-minute testing sessions that involved sustained attention to visual stimuli. We predict that infants at risk for ASD will show more negative affect, less sustained attention and greater variability in affect and attention both within and between sessions than typically developing infants. Participants were 16 six-month-old infants who had siblings with an autism diagnosis (at risk group) and 12-six-month old typical developing infants (control group). Visual tasks included a habituation task, a disengagement task and a preference task. The same tasks were repeated on two visits: one where infants were tested as soon as they arrived at the lab, and once where infants were tested after a 90-minute clinical session. Behavior during the visual attention tasks was coded online and offline into categories (e.g. movement, affect, attentiveness), and scored on a Llikert scale. Categories were plotted across time so that magnitude and variability of affection and attention over time in both populations can be compared. Data analysis is ongoing, but preliminary results suggest that at-risk infants are more variable in attention across sessions and are less attentive overall (increasing the difficulty of data collection). This pattern may influence their ability to perform standardized visual attention tasks and also reduce their capacity to learn from their visual environment.

Conch Shell Length from Prehistory to History in Carriacou, West Indies

Hazel Lozano, Recent Graduate, Anthropology, Biology (Molecular, Cellular Developmental)
Mentor: Christina Giovas, Anthropology
Mentor: Donald Grayson, Anthropology

Queen conch ("kongk," *Strombus gigas*) is the largest strombid and one of the largest shellfish species known to occur in the Caribbean. It is found as far north as south Florida and the Bahamas to as far south as Venezuela, and has been exploited as a source of meat, tools and tourist commodities wherever available. Studies of historic (within the last 50 years) and prehistoric Queen conch shell fossils in Middleton Cay (Turk and Caicos Islands, British West Indies) show a significant decrease in total shell length (TL) over time; the authors attribute this to increased fishing pressure, citing similar findings in Belize (Stager and Chen, 1996). This study tests the hypothesis that *S. gigas* shell length decline observed in Middleton Cay is present in other areas of the West Indies, presuming increased fishing pressure over time. Historic juvenile and adult samples from Windward Beach were compared to those from two prehistoric (CAL A.D. 400-1400) middens; all sites were along the Atlantic coast of Carriacou, West Indies. The adult historic mean conch TL and lip thickness (T) in this study coincides with measurements in other areas of the Caribbean; conversely, literature values for juvenile historic mean TL are larger than observed here. Limited data and small sample sizes excluded juvenile and adult samples for TL analysis, but indicate a statistically significant increase in juvenile body length (BL) over time: prehistoric juvenile BL=94.1 ± 21.6mm (P-values $<<$ 0.05); historic juvenile BL=167.4 ± 20.9mm (P-values $<<$0.05). Differences in the relative locations of each site (prehistoric vs. historic) from shore may account for the observed results; further analysis using Carriacou paleogeography and larger sample sizes is required in order to more rigorously test these findings.

The Effect of a Cesarean Birth on Subsequent Pregnancies

Shari Luchino, Fifth Year, Nursing
Mentor: Catherine Carr, Family Child Nursing

Cesarean births have dramatically increased over the last decade. In 1965, cesarean deliveries comprised 4.5 percent of all births in the United States. By 2002, 26.1 percent of all babies born in the U.S. were born by cesarean and in 2006 the rate was 31.1 percent. The risk of uterine rupture in labor after a prior cesarean has been publicized in both medical journals and lay media. However, the risks of the cesarean itself on subsequent pregnancies have had far less attention. The research aims for this project are: 1) examine the effect of a previous cesarean on subsequent pregnancy and 2) update this item for the Optimality Index-US (OI-US), a tool developed by Fullerton and Murray and used by Certified Nurse-Midwives (CNMs) to evaluate the processes of care for pregnancy and birth. The PubMed database was queried using the following limits: published in the last three years, Clinical Trial, Randomized Controlled Trial, Case Reports, Comparative Study, Controlled Clinical Trial,

English Abstract, Government Publications, Journal Article, Core clinical journals, Nursing journals, MEDLINE. 252 hits were obtained and 27 primary research articles were selected. Articles using Level II or higher evidence were cited. Each selected article was evaluated using the criteria of the OI-US. Women who had a previous cesarean delivery have an increased risk for complications with future pregnancies. These risks include placental abruption, placental accreta, placental previa, stillbirth and infertility. There are future costs to the rising cesarean rates in the US as well as in other industrialized nations. Nearly one in three babies is born by cesarean delivery in this country. The emerging research should be incorporated into evidence based practice that best explains the cost benefit ratio of a cesarean section, thus allowing women and their providers to make more informed decisions.

Effect of Lightning on Trans-Ionospheric Communications

Austin Lueck, Junior, Pre-Engineering
NASA Space Grant Scholar
Mentor: Robert Holzworth, Earth Space Sciences

When lightning occurs, it creates radio waves that propagate between the ionosphere and the earth, causing variations in the electron density of the ionosphere. In addition to lightning, neutral wind, temperature, and solar cycles can all alter the ionosphere. These irregularities are well-documented, but as yet there is no successful method of predicting when they will occur. The Communications/Navigations Outage Forecast System (C/NOFS) is a satellite that was recently launched to measure and predict these irregularities. The World Wide Lightning Location Network (WWLLN) based at University of Washington is able to detect the radio waves released by lightning, called sferics, and can record the location and time of a lightning event. WWLLN has only been operational since 2004 however, and data analysis still needs to be done. In particular, our work is focusing on lightning event densities, as opposed to simply locations, to allow for studies over greater time periods. C/NOFS will provide data on where and when ionospheric irregularities occur, and by coordinating this data with the data gathered from WWLLN, we can determine exactly how the lightning strokes contribute to the irregularities of the ionosphere, and to what extent in relation to the other contributing factors. By knowing all of the causes of ionospheric irregularities we may be able to predict when they will happen. This is important because ionospheric irregularities cause scintillations in trans-ionospheric radio signals, such as GPS communications. The ability to be able to predict ionospheric irregularities will therefore allow the military and commercial companies to know when satellite communications like GPS will be available.

Surface Analysis and Petrology of Flood Deposits in the Eastern Himalayan Syntaxis

Christopher Maffucci, Senior, Earth Space Sciences (Environmental)
Mentor: Katharine Huntington, Earth Space Sciences

The Siang River valley in Northeast India preserves a record of Holocene floods, including a well-documented modern flood from a landslide dam failure in 2000. In order to better interpret ancient flood deposits I characterized modern flood and monsoon deposits by examining the mineralogy, grain size, and spatial distribution and related them to characteristics of the flows that produced the different deposits. It has been hypothesized that there were massive floods in the past that were derived from glacial outburst dams (81-835 $km^3$of water). If I can relate sedimentary deposits to the flow characteristics from the modern floods I may be able to constrain the flow characteristics of these ancient floods to test the hypothesis that the past floods were indeed massive. The modern flood (˜3 $km^3$of water) produced a trim line 30-40 m above mean annual river elevation for $>$300 km. It produced sandy deposits containing quartz, micas, and in some samples garnet. These flood deposits ranged in height from 15 m to the maximum trim line elevation above the river. The ancient deposits have similar mineralogy, grain size, and spatial distribution suggesting a similar source of sediments. However, the ancient deposits were at a higher height above the modern river. This raises the question, was the river at the same elevation as it is today? If so, then that suggests larger ancient floods. Alternatively, if the river has incised the bedrock since ancient floods, then the ancient floods could be similar in size to the 2000 flood. This study lays the groundwork for future research to quantify flood recurrence intervals and hazard in this region and to inform policies for future hydroelectric projects planned upstream of the research area.

Student Activism: The Challenges and Contributions of Collaboration

Jaimee Marsh, Senior, Social Welfare
McNair Scholar
Mentor: Ratnesh Nagda, Social Work

Collaboration and coalitions are fundamental tools for promoting social change as they enhance activists' ability to address issues of oppression and inequality comprehensively. From this perspective, this study explores how leaders of student organizations invested in social change across cultures and issues of inequality engage in collaboration and alliance building, as well as how future relationships could be stronger and more effective. Data collection involved a combination of focus groups and individual interviews with student leaders from Registered Student Organizations (RSOs) and the ASUW Diversity Commissions at the University of Washing-

ton around four specific topics: (1) student leaders' visions of collaboration and its benefits, (2) the reality of how student collaborations do or do not presently occur, (3) strategies that facilitate student collaboration, and (4) hindrances of student collaborations. The interviews and focus groups brought student leaders together to increase networking and potential collaborations, and to share knowledge and the findings of this study in order to discuss strategies for implementing potential improvements. Preliminary observations and communication with students suggests institutional memory and collaborative relationships are inconsistent and complicated by multiple factors including the frequency of leadership transitions. The ability of student organizations to achieve their goals influences the lives of other students on campus seeking community within the larger institution and a voice for their concerns. This study is unique not only for its potential enhancement of social collaborations at the University of Washington, but also serves as a means to record the continuing histories and progress of student organizations and leadership - history that should be made available to current and future students, as well as to student leaders and organizations at other colleges and universities.

Acetominophen Interference in Organophosphate Pesticide Testing

Ryan Meek, Senior, Biology (Molecular, Cellular Developmental), Microbiology
Mentor: Gretchen Onstad, Environmental Occupational Health Sciences
Mentor: Christopher Simpson, Environmental Occupational Health Sciences

In Washington State, farm workers are tested for organophosphate (OP) pesticide exposure by monitoring serum cholinesterase activity. If as much as a 20% decrease in serum cholinesterase activity is detected, the workers must be removed from handling of cholinesterase inhibiting pesticides. OP pesticides compete with cholinesterase binding sites thus depressing the enzymes ability to break down important biochemical compounds such as the neurotransmitter Acetylcholine. Decreased acetylcholine breakdown leads to excess neurotransmitter in the synaptic clefts. This causes neurons to lose their excitability leading to physiological complications ranging from muscle fasciculation, to muscle paralysis at higher doses. The primary objective of this research is to identify pharmacological interferences with the test for pesticide exposure. In particular, regular dosage of Acetaminophen has been shown to alter liver enzyme levels which may in turn depress cholinesterase levels. To test this indirect inhibition of cholinesterase in-vivo, 15 healthy adults were administered Acetaminophen at dosages of 1 mg three times a day for 6 days. Serum samples were collected daily. Pseudo-cholinesterase activity was measured utilizing a photo spectrometric plate reader. For each subject, cholinesterase inhibition will be measured for each day. Significant inhibition is defined as a 5% decrease in activity. If Acetaminophen indirectly affects cholinesterase inhibition, then regular consumption of Tylenol could interfere with OP pesticide exposure tests in Washington state field workers. This could result in the incorrect diagnosis of OP pesticide overexposure and unnecessary removal from job sites. A future plan of this project is to perform an in-vitro study assaying Acetaminophen's ability to directly inhibit cholinesterase.

Endophyte Assisted Phytoremediation

Rachel Miller, Senior, Environmental Science Resource Management
Mentor: Sharon Doty, Forest Resources
Mentor: Zareen Khan, Forest Resources

More than 50% of SuperFund sites in the United States are contaminated with trichloroethylene, or TCE. TCE, a halogenated hydrocarbon, is one of the most common environmental pollutants and can persist in the environment for decades. It has been used extensively in industry and in the military primarily as a degreaser. TCE exposure can result in liver and kidney toxicity, and depression of the central nervous system. TCE is also a suspected human carcinogen. For these reasons, there is great interest in developing effective yet inexpensive methods for removal of this pollutant from the environment. Phytoremediation is the use of plants for the removal of contamination. This method of contamination removal is gaining significant attention as a more benign method than some of the current engineering practices. One of the major problems with phytoremediation is that even plants that are tolerant to the presence of these contaminants often remain relatively small, due to the toxicity of the pollutants that they are accumulating. This toxicity can be reduced using microorganism-assisted phytoremediation. Endophytic bacteria has only recently been considered in relation to degradative capacity as part of phytoremediation strategy. My research involves screening thirteen different willow species and three poplar species for TCE degradative capacity, and identifying the most effective species. I am propagating internally sterile plants of the same species for future comparison. My current research aims to discover that fast-growing willow and poplar could be more effective at removing TCE contamination if appropriate endophytes are present.

Modeling Glioblastoma Response to Radiation and Chemotherapy

Julia Moore, Senior, Applied Computational Mathematical Sciences (Biological Life Sciences)
Amgen Scholar, Goldwater Scholar, Mary Gates Scholar
Mentor: Kristin Swanson, Pathology
Mentor: Russell Rockne, Pathology

Glioblastoma is an extremely aggressive form of glioma, a uniformly fatal brain tumor characterized by diffuse invasion and an average survival time of 6-12 months after diagnosis. Currently, treatment of most glioblastomas follows a general pattern. MRI scans are first taken, along with a biopsy of the tumor. Surgical resection then occurs, followed by radiation therapy and concurrent and/or adjuvant chemotherapy. However, even with surgical resection, radiotherapy, and chemotherapy, tumor recurrence always occurs, invariably leading to death. One hypothesis for tumor recurrence is the inability of medical professionals to determine and target the full range of the tumor, due to both the diffuse nature of the tumor as well as limitations of current imaging technology. To better understand tumor growth, Swanson et al. developed a mathematical model that describes tumor proliferation (ρ) and diffusion (D) within the brain. Using this model as a foundation, we further extend it to incorporate the instantaneous and the delayed effects of radiation therapy and chemotherapy. By accurately modeling these effects, the hope is that better treatment plans can be developed that more effectively target the tumor and ultimately prevent recurrence.

Analysis of the Role of the Myc Oncoprotein in Immunoglobulin E (IgE) Production

Christie-Lynn Mortales, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Brian Iritani, Comparative Medicine

Immunoglobulin isotype E (IgE), an antibody produced by B lymphocytes, is involved in the protection against certain types of pathogens, especially parasites. Excessive IgE production, however, contributes to allergic reactions and other hypersensitive responses, such as asthma. Hence, it is important to identify the mechanisms that regulate the production of IgE in B lymphocytes. In this study, we are investigating the role of the Myc family of transcription factors in the generation of antibody-producing plasma cells, with a focus on IgE. Myc promotes proliferation and cell growth by controlling gene expression, but when deregulated, contributes to tumorigenesis and to the onset of various cancers. Since IgE production is mediated through germline transcription and DNA rearrangement, we hypothesized Myc to have a significant influence in the regulation of IgE production. To examine this, B cell-specific Myc knockout and Myc transgenic mice were immunized with keyhole limpet hemocyanin (KLH), where serum KLH-specific antibody levels were measured with enzyme linked immunosorbant assays (ELISAs) 11-14 days post-immunization. We also assessed the ability of purified naïve B lymphocytes from Myc knockout and Myc transgenic mice to differentiate into IgG1 and IgE producing cells in tissue culture. Results from ELISAs showed that Myc deficiency greatly increased IgE production in vivo, while Myc overexpression resulted in more IgM, and lower concentrations of IgG1, IgG2a, and IgE (with IgE being too low to quantitate). Intracellular flow cytometric analysis suggests that overexpression of Myc inhibits in vitro differentiation to IgG1 and IgE producing B cells. Data from our initial reverse transcription polymerase chain reaction (RT-PCR) amplification of germ-line transcription (GLT) for IgG1 and IgE shows a significant decrease of IgE GLT in Myc transgenic mice. These results collectively suggest that Myc may regulate the production of IgE by inhibiting the differentiation of naïve B cells into IgE producing cells.

Analyzing the Phylogenic Relationships of the Pathogen *Vibrio parahaemolyticus* in the Northwest Region of the United States by Multi Locus Sequence Typing

Matthew Muramatsu, Recent Graduate, Microbiology
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Vibrio parahaemolyticus is a bacterium that is found ubiquitously throughout the marine environment especially in coastal and estuarine areas. Currently it is the leading cause of seafood borne acute gastroenteritis in the United States and is responsible for the majority of cases in Japan, Taiwan and elsewhere worldwide. It has been associated with a variety of seafoods including sardines and codfish, but is mainly isolated from shellfish such as oysters and clams. *V. parahaemolyticus* strains are highly diverse at the genomic level and only a subset of stains are able to cause disease in humans. Presently it is unknown what factors are important for conferring virulence in *V. parahaemolyticus*. Additionally, there is a lack of reliable genetic markers that can be used to accurately distinguish virulent strains from less virulent ones. In this study, the phylogenic relationships between *V. parahaemolyticus* strains are analyzed by multi locus sequence typing (MLST), which compares the DNA sequences of a suite of housekeeping (HK) genes. Application of MLST to environmental and clinical isolates form the Pacific Northwest as well as strains isolated from around the world has led to a view that strains capable of causing illness from oysters harvested in Washington State form a distinct and unique clonal complex that differs from strains that cause disease elsewhere. This

study forms the basis for future determinations as to the genomic differences between clinical and environmental stains of *V. parahaemolyticus*, with the goal of identifying important virulence genes and accurate genetic markers that would aid detection and risk assessment methods.

The Role of Neurotensin in the Positive Feedback Control of GnRH/LH Secretion in the Mouse

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In female mammals, the hormone estradiol (E) triggers a surge of gonadotropin-releasing hormone (GnRH) and luteinizing hormone (LH), which is responsible for inducing ovulation. A specific region of the brain, the anteroventral periventricular nucleus (AVPV), is attributed to inducing such hormone surges, but it is unclear which neurotransmitters in this region are responsible for this activity. Previous studies have demonstrated that the neuropeptide neurotensin (NT) is a prime candidate for playing a role in ovulation. In the rat, E induces NT mRNA expression in the AVPV and inhibition of NT signaling blocks the E-induced GnRH & LH surge. We hypothesized that if NT indeed played a critical role in ovulation, increasing levels of E would result in higher NT mRNA levels in the AVPV of the mouse as well. Using *in situ* hybridization, we were able to measure and compare the number of cells expressing NT mRNA in the AVPV in two groups of mice. While all mice had their ovaries removed, one group was treated with E, and another group was treated with a vehicle (oil) implant. We found that E-treated animals had greater numbers of NT cells in the AVPV compared with vehicle-treated mice. We then conducted a double label in situ hybridization experiment to determine the extent of NT coexpression with mRNA for Kiss1, a gene whose peptide product is known to play a critical role in the GnRH/LH surge. We found that although NT- and Kiss1-expressing cells were identified in the AVPV, very few cells actually expressed both mRNAs. Thus, we conclude that NT neurons in the AVPV may act as a distinct circuit in mediating the E-induced GnRH & LH surge in mice.

The Presence of *Alexandrium Catenella* in Relation to Environmental Conditions in Quartermaster Harbor, Puget Sound

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The dinoflagellate, *Alexandrium catenella*, is one of a few species of phytoplankton that causes a form of harmful algal bloom (HAB) known as Paralytic Shellfish Poisoning (PSP). *Alexandrium catenella* germinates from cysts in the sediment to mobile phytoplankton, thus allowing them to be filter fed by shellfish and their toxin to be concentrated in shellfish tissue, making the shellfish harmful to humans and other mammals that ingest them. In an earlier NOAA/ECOHAB study of *A. catenella* cyst concentrations in the surface sediments of Puget Sound, Quartermaster Harbor (QMH) was found to have two orders of magnitude higher concentrations than anywhere else in Puget Sound. This is consistent with frequent shellfish closures in this area by the Washington State Department of Health due to unsafe harvest levels of above 80 μg toxin/100 mg of tissue. In order to determine what environmental conditions favor the development of *A. catenella* in QMH we sampled a seven station transect longitudinally through the bay monthly starting in October 2006. CTD profiles of standard water properties were collected. In addition, discrete samples were collected and analyzed for chlorophyll-a, dissolved oxygen, nutrients and phytoplankton. The presence of *A. catenella* is seen as early as April and as late as October in the 2008 QMH quantitative plankton counts and although present, does not dominate any one month; *A. catenella* does not have to bloom in high concentrations to reach dangerous levels in shellfish. In this analysis, we have examined the environmental conditions, such as light, chlorophyll, oxygen, nutrients and stratification, associated with the presence of *A. catenella* in QMH. Determining the environmental conditions that most favor the excystment and growth of *A. catenella* is the first step in predicting harmful algal blooms.

Increasing the Therapeutic Index of Arsenic Chemotherapy Treatment with Triptolide

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While arsenic trioxide is commonly known as an environmental toxic metal, it is also an FDA-approved chemotherapy drug for acute promyelocytic leukemia, and recent studies show that arsenic can induce apoptosis in a wide spectrum of other types of cancer cells. However, the severe side effects of arsenic treatment are a major obstacle to expanding arsenic clinical utility. Previous experiments with microarray technology have found that the signaling pathway in arsenic-induced cell death is different in cells lacking functional protein 53 (p53) when compared to normal cells. P53 is an important tumor suppressor that signals for cell cycle arrest in order to allow for DNA repair or apoptosis of cells with irreparable damage, and p53 inactivation is found in a majority of all human cancers. The finding of an alternative mechanism for arsenic toxicity in p53 deficient cells therefore suggests that, for a majority of cases, arsenic

causes cell death in cancer cells using a different pathway than in regular cells. By selectively increasing arsenic toxicity for only p53-deficient cancer cells through the addition of complementary agents, the efficacy of arsenic in cancer treatment can be enhanced. Therefore the amounts of arsenic required in treatment can be reduced, allowing for greater clinical utility. Triptolide is a compound found in the Tripterygium wilfordi hook F plant and was found to modulate similar pathways to the p53-independent pathway of arsenic. We are currently performing an *in vitro* study on wild-type and p53 deficient mouse embryonic fibroblasts to test the effects of arsenic when combined with the triptolide. Early results show that combined treatment with arsenic and triptolide results in higher levels of toxicity in p53-deficient cells than in wild-type cells.

Investigation into the Fluorescence Resonance Energy Transfer (FRET) of Novel Donor-Acceptor Pairs

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Fluorescence resonance energy transfer (FRET) is the process in which energy is transmitted from a donor fluorophore to an acceptor. A singular fluorophore is excited at a specific wavelength of light, causing it to fluoresce and emit light at another wavelength. However, when in close proximity to an acceptor fluorophore, the donor also resonates energy to excite the acceptor. This principle has been utilized to determine if two proteins closely interact by labeling one protein with a donor and another with an acceptor. Typically the labels, or "tags", used have been yellow fluorescent protein (YFP) and cyan fluorescent protein (CFP). Independently, these tags can be used to track individual proteins within living cells. When used together with FRET, a successful energy transfer indicates interactions between the individual proteins. In a previous experiment, core proteins in the spindle pole body (SPB) of the model organism baker's yeast (*Saccharomyces cerevisiae*) were tagged with YFP and CFP. Then the organization of the core proteins within the architecture of the SPB was measured and determined by FRET. This study utilizes the same core proteins from the yeast SPB in order to assess the donor-acceptor pairing of green fluorescent protein (GFP) and mCherry as an alternative to CFP and YFP. If proven to be successful, this novel donor-acceptor pair could become the preferred option in FRET analysis. Unlike YFP and CFP, GFP is highly photostable and has a lower spillover factor, allowing FRET analysis to become much more reliable.

Phytochelatins as a Bioindicator Suggesting Metal Stress in Douglas-fir Trees Treated with Municipal Biosolids

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Biosolids are materials removed from municipal wastewater treatment plants after undergoing treatment. Municipal biosolids commonly contain heavy metals such as arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Applications of municipal biosolids may result in elevated soil levels of toxic heavy metals. 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 and some fungi that act as an indicator of metal stress. Phytochelatins are synthesized from gluthathione, a component of the antioxidant defense system, in response to higher intracellular metal levels. This study examines the concentrations of phytochelatins, glutathione, and cysteine in Douglas-fir needles and roots collected from three plots treated with different biosolids amounts at Pack Forest, and these concentrations are compared with metal levels in soils and foliage. Phytochelatins, glutathione, and cysteine are quantified using high performance liquid chromatography (HPLC) with fluorometric detection. Our results show that the plot treated with intermediate biosolids amounts is higher in phytochelatin concentrations in Douglas-fir needles, in soil metal concentrations, and in the percentage of organic content in soil. Conversely, the concentration of phytochelatin in Douglas-fir roots is highest in the plot not treated with biosolids. Possible mechanisms responsible for these results are discussed.

An Investigation of the Mechanical Responses of Carbon Fiber Reinforced Plastic, Steel and Aluminum Under Low Velocity Transverse Impact Loading

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Mentor: Timothy Briggs, Mechanical Engineering
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High performance composite material systems, namely carbon fiber reinforced plastic (CFRP), due to their light weight and high stiffness and strength properties, are becoming the material of choice for many of today's engineering applications. However, the dynamic mechanical response and damage initiation and growth behavior

are yet to be fully understood for these novel materials, which makes it difficult to predict in-service loading behavior and appropriate design allowables. This investigation, therefore, examines the mechanical performance of three engineering material systems subject to low velocity impact loading – CFRP, Steel and Aluminum. Force-time response was directly measured from the impact experiments with the incident kinetic energy of the impactor held constant at 10 J for each case. Velocity-time and displacement-time responses were derived using Newtonian mechanics with the appropriate initial conditions, which allowed dissipative energy calculations to then be performed. Post processed data has been normalized by the material's density and specimen thickness to give additional insight and allow quantitative comparisons amongst the different materials. A clearly defined damage threshold load (DTL) was observed in the CFRP material, which is thought to be the onset of subsurface delamination, however, this phenomenon is absent with the steel and aluminum, which both show signs of strain hardening and localized plasticity. From the measured data, along with pre and post-impact optical micrographs, correlations have been elucidated in regards to the material composition, impact response mechanisms and damage formation and growth behavior. Finally, recommendations have been made based on these findings for appropriate engineering applications for each of the material systems.

The Role of Dopamine in Novelty and Taste Aversion Learning

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Mentor: Sheri Mizumori, Psychology
Mentor: Min Jung Kim, Psychology

Dopamine (DA) plays a crucial role in the neurobiology of learning and memory by providing information about reward prediction error, incentive salience of environmental cues, and the novelty value of a particular stimulus. The neural function of DA in the processing of rewards has been thoroughly explored in the last several years. More recent studies have begun to focus on the role of DA in response to aversive stimuli and conditioning. In the current study, we explore a form of aversive conditioning known as conditioned taste aversion (CTA). CTA is a type of classical conditioning in which animals remember a taste stimulus and avoid consuming it once they have experienced the pairing of a novel taste (CS, conditioned stimulus) followed by the sensation of nausea (US, unconditioned stimulus). In a typical laboratory experiment, a sweet taste such as saccharin is used as the CS, and LiCl (lithium chloride, a nausea-inducing agent) as the US. The dramatic changes in behavior after this aversive taste conditioning period have been well presented in previous studies. Our research focuses on both the dopaminergic neural activity as well as relevant behavioral reactions during the CTA process. Using a hyperdrive recording technique, neural activity of several single units can be simultaneously recorded while an animal performs a task. CTA learning targets neurons in the midbrain area, which is known to be a major source of dopamine in brain functioning. Our main interest in this study is how midbrain neurons process the same taste stimulus (e.g. saccharin) differentially according to the animal's familiarity or novelty associated with the CS. This study provides a new aspect of the dopaminergic role in reward processing, which can broaden our understanding in human domains of learning, such as drug addiction.

Rethinking our Future Uses of Wastewater in King County

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Evan Lewis, Senior, Geography, Community, Environment, Planning
Mentor: Dennis Ryan, Urban Design Planning
Mentor: Christopher Campbell, Undergraduate Academic Affairs

Almost all wastewater treated in King County is currently discharged back into local water bodies. However, modern technology now allows wastewater to go through additional treatment and be "reclaimed" for other uses, including recharging streams, irrigating parks, gardens, farms, and golf courses, recharging groundwater, wetland enhancement, and industrial processes. For this reason, King County is in the stakeholder outreach stage in creating its Reclaimed Water Comprehensive Plan. This stage will weigh the costs and benefits of expanding the County's capacity to produce reclaimed water. Several decades ago it was citizen activism that helped establish King County's current wastewater system. Once again, citizens have the opportunity to shape the course of King County's water and wastewater future by getting involved in the creation of the Comprehensive Plan. The UW Reclaimed Water Seminar informs and empowers students to become involved in this important planning process. The Seminar also serves as a case study for involving a new generation in local infrastructure planning. The rich history of citizen involvement in water and wastewater planning in King County led us to incorporate this case study into a broader research report on the people's history of wastewater in King County. This report will revisit King County's water and wastewater past, in order to more conscientiously predict and inform its future.

Using a Distributed Liquid State Machine Simulator to Explore Bursting Behavior in ex Vivo Cortical Cultures

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Cory Mayberry, Senior, Computing Software Systems, UW Bothell
Mentor: Michael Stiber, Computing Software Systems, UW Bothell

Cultures of dissociated cortical cells grown on multi-electrode grids are a tool used by computational-neuroscience researchers to investigate the computational behavior of cortical cells. Experiments using cortical cultures are often complicated by entire-culture bursting activity that is not present *in vivo*. Having a better understanding of this activity could allow researchers to better design and understand their experiments. To explore this phenomena, we developed a simulator using the (LSM) and leaky-integrate-and-fire (LIF) neuron models. Our model incorporates neurons with synapses whose facilitation and depression are dependent on their activity. Connectivity is dynamically modeled, with each neuron attempting to reach a state of equilibrium between input strength and connectivity radius. Previous attempts at exploring bursting behavior have run into a serious computational complexity barrier. In such attempts, complexity issues were mitigated by limiting the simulation size to a 10x10 array of neurons (100 neurons). Their results were primarily confounded by both the large percentage (36%) of neurons lying along the edge of the array and the almost complete level of connectivity between all of the neurons in the array. We propose to increase the size of the array to 100x100 (10,000 neurons). Projecting from previous research, such an increase will come at a projected cost of at least 80 days worth of computer time per simulation. Further complicating the project is the need to run numerous simulations in a search of our model's multidimensional parameter space for the parameters that produce spiking patterns most closely replicating data from real cortical culture experiments. Our solution is to custom build a distributed simulator with the capability of making use of our scientific computing grid. If we are successful, we will be able to investigate the cause of bursting activity and conduct further experiments with simulated cortical cultures.

The Influence of Alcohol, Instructional Set, and Cognitive Strategies in the Control of Female Sexual Arousal

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Mentor: Kelly Davis, Social Work

Women's ability to control their sexual arousal in a variety of contexts may have important implications for their sexual health. Although extant research suggests that women use cognitive mechanisms to deliberately control their sexual response upon instructions to maximize or suppress arousal, this data is limited. For example, sexual activity often occurs in the context of alcohol intoxication, which could impair women's cognitive abilities to control their arousal. To investigate these relationships, female participants (n = 178) randomly received either a control beverage, a low dose (.06%), a moderate dose (.08%) or a high alcohol dose (.10%). Once participants reached a criterion BAC, they were given instructions to either maximize or suppress their arousal while watching two erotic film clips. Physiological sexual arousal was assessed through vaginal photoplethysmography. Subjective sexual arousal and strategies to control sexual arousal were assessed through self-report measures. Analyses indicated that instructional set was significantly associated with the type of cognitive strategy used to control arousal. Instructional set also influenced the total number of strategy types used, in that women who received directions to maximize their arousal reported using a higher total number of cognitive strategies than those instructed to suppress. Women's perceived effort to maximize or suppress and their subsequent perceived levels of success were also influenced by instructional set, revealing that women instructed to maximize their arousal reported higher levels of effort and higher levels of perceived success than their suppress counterparts. Alcohol suppressed physiological arousal and increased subjective arousal regardless of instructional set. This study replicates previous findings regarding the effects of alcohol and instructional set on female sexual arousal and also presents novel information regarding the cognitive mechanisms women employ to control their sexual arousal. The implications of these findings for women's sexual health will be discussed.

Event History Analysis of Dengue Fever Outbreaks in 9 Different Endemic Regions

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Mentor: Darryl Holman, Anthropology

Dengue fever, the world's most common arbovirus disease, is a major public health concern. Disease modeling is an important component in public health surveillance and prevention systems, and the way demographic, biotic, and abiotic factors affect distribution and frequency of dengue outbreaks is an active area of research. This research examines how demographic and environmental factors (covariates) affect the duration of dengue epidemics and the time between outbreaks. A logistic model was used to analyze epidemic and inter-epidemic spells from 9 different endemic regions. Mean monthly temperature was the most important factor affecting time until outbreak, while the duration of outbreaks was significantly affected by average monthly temperature and vapor pressure. This research suggests that dengue epi-

demics are, in part, mediated by climatic factors.

Motivation of Math Students at the Community College: Do Personal Epistemological Beliefs Determine the Type of Motivation?
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Mentor: Allen Harbaugh, Science Math, Seattle Central Community College

In order to better understand the motivation of community college students who take a math class, students from various math classes, in three different colleges, were invited to participate in an online questionnaire. The questionnaires were given at the beginning of the quarter and at the end of the quarter. The following hypothesis will be tested: Students' epistemic beliefs are related to their Achievement Goals. If there is not a significant difference found between the epistemic category and one of the achievement goals, we should then analyze if there is a difference between the enacted and espoused values of the student. The questionnaire has a set of 25 quantitative questions to assess students' epistemic beliefs, using Factor Analysis, in one of the following five personal epistemic categories: certainty, simple, quick, innate, and authority. Likewise, Factor Analysis is used to analyze a set of 19 quantitative questions to measure students' achievement goals, namely: learning, performance, or work avoidant. Using a mixed-methods strategy, when the student's epistemic beliefs do not correspond with the expected motivation, we will look at responses for qualitative questions. The answers to this set of open-ended questions have been coded and analyzed with a special software package (we used N-VIVO) and these enacted values are compared with the espoused epistemic values to validate the instrument tool.

Cloud Detection over a Section of Sky in Antarctica
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A recent study uses a high-resolution optical spectrometer, a device located in Antarctica, to collect data about atmospheric temperature. However, clouds interfere with the data because they interrupt the spectrometer signal, so it is important to know about cloud presence before analyzing the study's results. The goal of this research is to study Antarctic cloud coverage by measuring the thermal radiation from the water particles that make up clouds. The cloud detector uses nine identical sensors that point in the eight compass directions and one straight up into the sky. Each sensor contains a thermopile, which measures the thermal radiation of the atmosphere, and a thermistor, which measures the temperature inside the sensor. The amount of cloud coverage can be determined by comparing these two measurements. So far, the instruments have been verified and determined to be working correctly, data has been classified and bad data has been discarded, programs that are used to process data have been revised, and calculations have been checked. This work should be able to reveal long term trends in cloud coverage and patterns in the development of weather conditions. Preliminary results show that the calculated cloudiness is similar to observations made by weather observers. However, the interpretations of the spectrometer measurements are more accurate and consistent with each other. In the future, this research can be used to study the earth's climate.

Canonical Wnt Signaling Pathway is Required for the Development of Median and Pectoral Fins in Zebrafish
Dai Pham, Senior, Biology (General), Biochemistry
Mentor: Benjamin Martin, Biochemistry
Mentor: David Kimelman, Biochemistry

The Wnt signaling pathway plays a variety of role in development such as cell-cell interaction, cell specification, and dorsal-ventral axis formation. We used two heat shock transgenic lines of zebrafish: HS::deltaC-TCF and HS::dkk1-GFP to temporally inhibit the canonical Wnt pathway at various development stages. They show consistent results of lacking both pectoral and median fins at five days post fertilization (dpf) when they were heat shocked between 15 and 25 Somite stages. We have determined that Wnt signaling plays a critical role in the initiation of all fin developments during this developmental window. We are now trying to determine what genes lie downstream of Wnt signaling during the initiation of fin development by looking at genes known to be involved in fin development.

"Don't Sell Your Children": An Analysis of Framing by Anti-Trafficking Organizations
Nancy Pham, Senior, Communication, French
Mentor: Nancy Rivenburgh, Communication

Media scholars have long known the effects of framing on public perception. This study looks at how anti-trafficking organizations frame the topic of human trafficking on their official websites. The focus of the study is on how the members of these organizations specifically use the "About Us" portion of their websites to present their organizations and talk about human trafficking as a whole. Different frames used about various organizations create different understanding of the issue among various audiences, such as the general public, governments, and potential donors. Different types of frames might provoke different types of response from those groups. Using a coding scheme based on Robert Entman's model of what constitutes a frame, a framing analysis was conducted on over 60 organization websites in order to discern what frames exist within anti-

trafficking discourse. Distinctively different frames were found correlated to organization size and region.

The Role of Activity State and Gender on Diving and Swimming Parameters in Southern Resident Killer Whales

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Mentor: Dawn Noren, Conservation Biology, NOAA NMFS Northwest Fisheries Science Center

There are inherent difficulties in inferring marine mammal activity state from surface observations, particularly because these animals spend much of their time underwater. However, the collection of individual behavioral data in conjunction with the collection of group activity state data may allow us to better quantify subsurface activity. The goal of this study was to understand how swimming and diving behavior differ by activity state and how these parameters vary by sex in Southern Resident killer whales. Dive duration, surface duration, swimming speed, and respiration rate were recorded continuously from individual focal whales in nearshore waters from May through August in 2006. The activity state (resting, foraging, traveling, socializing, defined by Ford 1989) of the group of whales associated with the focal animal was also recorded every 10 minutes. All diving parameters and swimming speeds varied significantly (all $p<0.001$) across activity states for both males and females. Most diving parameters and speeds also varied by sex. For example, during forage, dive durations of males (mean: 39.5 $\pm$ 2.0 SEM sec) were greater ($p=0.006$) than those of females (mean: 35.4 $\pm$ 2.7 SEM sec). Similarly, dive durations for males were longer ($p=0.004$) than those for females (44.5 $\pm$1.1 SEM sec vs. 40.5 $\pm$1.1 SEM sec) during travel. Also during travel, males swam faster ($p<0.001$) than females (2.3 $\pm$0.0 SEM vs. 2.1 $\pm$0.0 SEM m/s), while females had higher respiration rates ($p=0.029$). Conversely, speeds of foraging and resting and dive durations of resting killer whales did not differ significantly by gender. Differences in diving parameters and swimming speeds suggest that activity states differ in their function. Furthermore, sex differences in diving and swimming parameters within behavior states might be attributed to differences in social affiliations with other pod members and/or the sexual dimorphism in body size.

Making Ends Meet: Central Obesity and the Risk for Diabetes

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Christina Escoto, Senior, Nursing
Mentor: JoAnne Whitney, Biobehavioral Nursing Health Systems
Mentor: Dawn Corl, Clinical Education, Harborview Medical Center

Although considered a preventable disorder, diabetes has reached epidemic proportions, affecting 21 million Americans. Being overweight is the greatest single risk factor for the development of type 2 diabetes, therefore, weight reduction is essential. Waist circumference is an important and independent risk factor for diabetes. It also positively correlates with blood pressure, insulin resistance and cardiovascular events. Assessment of waist measurement or weight can be stressful for patients. To gain insight into the general public response to pre-measured waist circumference ribbons to assess and educate for diabetes and pre-diabetes risk. Patients will be more inclined toward an alternative, tangible, and numberless form of measurement that encourages weight loss and facilitates understanding about their risk of developing diabetes or how to improve their health in relation to diabetes. This descriptive study documents responses to the pre-measured waist ribbons. The sample will consist of a convenience sample that visit a diabetes information booth at Harborview Medical Center between the months of February and March 2009. Data will be collected at multiple Harborview Medical Center sites and a central location at the University of Washington. The study includes observations, documentation of interest, and a simple short survey. If the reaction from public participants is positive, waist ribbons could be implemented for standard use in primary care offices or in public health initiatives as a risk management tool for central obesity and diabetes.

Ultrasound Tongue Features in Relation to Craniofacial Skeletal Patterns in Open Bite

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Mentor: Zi-Jun (Zee) Liu, Orthodontics

To investigate anterior tongue motion in relation to craniofacial skeletal pattern in this specific ethnic group with and without Anterior Open Bite (AOB) using ultrasound and cone-beam CT(CBCT), ten 10-13 year-old East African subjects, 6 with AOB or AOB tendency (group A), and 4 without AOB(group C), were recruited. Ultrasound scans of the tongue were taken in sagittal and coronal projections from the submandibular location during rest, gum chewing, and water swallowing. Ultrasound images were traced and analyzed for the shape (curvature and thickness) and motion (range and velocity) of the anterior tongue by using MATLAB software. CBCT scans were taken when subject was asked to sit at rest. Scans were processed for linear, angular, and volumetric measurements to examine craniofacial skeletal pattern with CB-Works software. Non-parametric statistics was used to test the group differences and assosications between measurable variables. Compared to group C, subjects in group showed more flatten curvature of dorsal surface and larger thickness in the an-

terior 1/3 tongue; range of the motion during chewing and/or swallowing were significantly larger with tendency of faster velocity. On the other hand, group A tended to have smaller mandibular body length, ramus height, and bilateral condyle width. The gonial angle and internal ramus inclination also tended to be larger. Correlation analysis between tongue shape and motion were closely associated with craniofacial skeletal patterns, particularly in group A. The AOB children have an unusual shape of the anterior tongue at rest and the anterior tongue moves larger and faster during chewing and/or swallowing. Steeper mandibular orientation and reduced mandibular mass are the typical skeleton pattern of these AOB children. The tongue features may reflect the functional compension for skeletal abnormality. Further investigation on a larger sample size will help confirm obtained results.

Landscape Evolution Beneath the Cordilleran Ice Sheet: A Bedrock Erosion Study using Cosmogenic ^{10}Be

Zachary Ploskey, Senior, Earth Space Sciences (Environmental), Anthropology
Mentor: Terry Swanson, Earth Space Sciences
Mentor: John Stone, Earth Space Sciences

The timing of the retreat of the Puget Lobe of the Cordilleran Ice Sheet out of the Puget Lowland during the last glacial cycle is roughly understood by geographically scattered limiting dates. While beneath ice cover, many bedrock landforms were exposed to subglacial abrasion and plucking that eroded the surface. The magnitude of this erosion varies across the landform along the direction of ice flow, but few quantitative estimates of the amount of rock removed have been made. To date the deglaciation and estimate bedrock erosion rates beneath the ice sheet, five samples were taken from quartz veins in bedrock exposed near the summit and steep lee (down-ice) surfaces of Mt. Constitution, a bedrock landform on the eastern side of Orcas Island. By measuring the concentration of the radioactive isotope Beryllium-10 (^{1}0Be) using accelerator mass spectrometry (AMS), it is possible to estimate both the timing of ice sheet retreat past that point and the depth of glacially eroded rock. Since the ice retreated past Mt. Constitution, cosmic ray bombardment of the earth's surface has produced ^{1}0Be in quartz near the surface at a known rate. At sites where glacial erosion has removed enough rock to remove all of the ^{1}0Be accumulated prior to glaciation, cosmic ray exposure ages indicate the time since ice retreat. On the stoss (up-ice) side of the landform near the summit, where the subglacial erosion rate is thought to be lower, there may be bedrock that contains ^{1}0Be produced before the last glacial period, in which case the depth of rock removed by glacial processes can be calculated. These ^{1}0Be dates can help to further the understanding the retreat dynamics of the Puget Lobe and provide new estimates for the differential erosion rates experienced by subglacial stoss-and-lee bedrock landforms.

Building a Transportation Information System Using Only GPS and Basic SMS Infrastructure

Anthony Poon, Recent Graduate, Computer Engineering, Sociology
Mary Gates Scholar
Mentor: Ruth Anderson, Computer Science Engineering
Mentor: Gaetano Borriello, Computer Science Engineering

Transportation of goods and people is key to economic and human development, and many people in the world rely on shared transportation resources to obtain these goals. However many developing regions face barriers to efficient public transportation due to poor infrastructure and limited resources. The work presented here consists of two main components. A longitudinal ethnographic study was conducted in Kyrgyzstan that demonstrated the importance of transportation resources in the developing world and allowed us to plan for an appropriate information and communication technologies (ICT) solution. Secondly, a proof-of-concept system was engineered to create a bottom-up, transportation information infrastructure using only GPS and SMS. The system, *bus, involved the development of a hardware device, a *box, containing a GSM modem and a GPS unit, that can be installed on a vehicle and used to track its location. The *box communicates via SMS with a server connected to a basic GSM phone. The server runs route a prediction algorithm and users can send SMS messages to the server to find when a bus will arrive at their location. We discuss the system and early testing, as well as the development implications for a range of urban and rural environments where transportation is scarce or inefficient, and where a central authority or institution is not in a position to provide robust information resources for users. We describe how the solution is also situated within technology usage patterns common to the developing world. Transportation is a very important shared resource, and enabling efficient and effective use of such resources aids overall development goals.

Perfluorinated Carboxylic Acids in Water Samples from Quartermaster Harbor, Puget Sound

Shristi Prakash, Senior, Environmental Science, UW Tacoma
Mentor: Joyce Dinglasan-Panlilio, Interdisciplinary Arts Sciences, UW Tacoma

Perfluorinated carboxylic acids or PFCAs are synthetic chemicals applied in carpet, paper and textile industries to render products water and oil repellent. These compounds are also used as processing aids in the produc-

tion of fluorinated polymers typically used as non-stick coatings in items such as pots and pans. The chemical structure of PFCAs consists of a hydrophobic perfluorinated chain of various lengths and a carboxylic endgroup. The widespread detection and bioaccumulation of PFCAs in the environment is of increasing concern. Perfluorooctanoate (PFOA) the 8 carbon version of PFCAs has been detected in various environmental samples including sediment, biota, ground and surface waters as well as human blood. The potential toxicity of these compounds is also of concern. Studies have been done on rats, mice and monkeys where PFOA has been shown to cause cancer and immune system failure as well as reproductive and developmental toxicity. This study will present preliminary monitoring data on various PFCAs in water samples taken from Quartermaster Harbor in the Puget Sound. Samples will be analyzed using solid phase extraction (SPE) and quantified via liquid chromatography-tandem mass spectrometry (LS-MS/MS). There have been no studies examining the presence and concentrations of these organic contaminants in the Puget Sound to date. Restoration efforts on the Puget Sound should not only be limited to the clean up of legacy pollutants but also of examining levels of new and emerging classes of contaminants such as PFCAs.

Satellite Imagery Analysis of the Greenland Ice Sheet

Christopher Raastad, Senior, Computer Science, Mathematics (Comprehensive)
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Benjamin Smith, Polar Science Center, Applied Physics Lab
Mentor: Ian Joughin, Polar Science Center

This study is conducted at the Polar Science Center at the University of Washington who study mass balance of the Greenland ice sheet. The mass balance of an ice sheet quantitatively describes the total change of ice mass as a function of snowfall, run off (melting ice), and discharge (ice leaving the sheet in the form of icebergs).Thus, mass balance is a direct measurement of an ice sheet's contribution to sea level. My work focused on creating and optimizing methods of collection and analysis of European Space Agency (ESA) Advanced Synthetic Aperture Radar (ASAR) satellite data collected from every location on earth periodically about every two days. I constructed functions and scripts in MatLab to conveniently acquire and process ASAR data from existing databases to create usable images. After implementing these methods of data collection and processing, I observed the ice front locations of various glaciers of interest over the course of summer 2008 and compared ice front locations to winter 2005 data. I observed a recession in ice front position of glaciers Jakobshavn, Kangerlussuaq, and Helheim from June to August 2008, an observation consistent with summer melting. In addition, I noticed a recession in ice front position of Jakobshavn and advancement of ice front position of Kangerlussuaq and Heleim in comparison to the winter 2005 position. The advances are consistent with large scale, ice calving events that occurred just before the 2005 measurements. However, lack of prior summer ice front data allows no sufficient comparisons amongst yearly maximum recessions. Thus, my observations will serve as a summer baseline for future ice front measurements. In addition, my scripts will allow future researchers to collect imagery data of any specific region of Greenland efficiently from downloaded ASAR files.

Biological Function of an FMR1 gene protein isoform

Ayu Rahardjo, Senior, Biochemistry
Mary Gates Scholar
Mentor: David Morris, Biochemistry
Mentor: David Brackett, Biochemistry

Alternative splicing of the Fragile X Mental Retardation (FMR1) gene produces a family of structurally similar protein isoforms known as Fragile X Mental Retardation protein, FMRP. Transcriptional silencing of the FMR1 gene results in Fragile X syndrome which is the most common known cause of inherited intellectual disability and is an aggregate effect of the loss of the 12 protein isoforms. Although there is a great deal of ongoing research on full-length FMRP isoforms, an understanding of how the other truncated isoforms function is absolutely lacking; the specific contributions to brain development and behavior is unknown for most FMRP isoforms. The research I am presenting focuses on developing a mouse model that will enable an investigation of the function of a single FMRP isoform, isoform 12. It is the shortest protein product of Fmr1 gene and is retained in the nucleus due to a lack of nuclear export signal. This isoform is also missing phosphorylation and methylation domains that are important for post-translational modification. To better understand the mechanism of this disease and the biological function of this particular isoform, a "knock-in" mouse that only expresses isoform 12 is created. A mammalian targeting vector has been designed and constructed that will produce only isoform 12 when the Fmr1 gene is turned on. The construct is designed to undergo homologous recombination within the exon 1 of the Fmr1 gene. The recombinant mouse will allow us to study the contribution of this isoform 12 to brain development and behavior, and will provide insights into the mechanism of Fragile X syndrome.

Placing the Face in Social Context: Cultural Differences in Emotion Recognition Between Japanese and European Americans

Rika Reid, Recent Graduate, Communication, Psychology
Yuri Yano, Recent Graduate, Psychology
Mentor: Janxin Leu, Psychology

Culture influences emotion recognition in facial expressions. Masuda et al. (2008) demonstrated that Japanese may be more likely than European Americans to take into consideration the emotional expressions of surrounding people when judging a person's expressions. In this study, we tested the hypothesis that Japanese people would be more likely to use social context (i.e., other people, situation, social role) to judge a specific individual's emotion, than European Americans. We also hypothesized that European Americans may be more likely than Japanese to use facial features to judge an individual's emotions from their facial expression. One hundred and twenty-four Japanese and 179 European American participants were asked to view four pictures of smiling and angry facial expressions modeled by White and Asian females. Participants first completed open-ended questions about what the model is feeling and why the model is feeling that way. Then, participants rated the pictures on ten scales of emotion intensity, ranging from 0 to 8. The emotions included disgust, fear, happiness, contempt, sadness, anger, surprise, amusement, contentment, and pride. The open-ended data were reliably coded by four research assistants. The results showed that, Japanese mentioned a greater number of specific situation(s), other people, and specific roles the model could be filling to explain their judgment of a facial expression, compared with European Americans. On the other hand, White Americans were more likely to mention facial features such as smiles or frowned eyebrows as the reason for judging a facial expression. Our study replicated past research in showing that Japanese reference other people more than European Americans in judging facial expressions (Masuda et al., 2008). We also demonstrated that Japanese use more situations and imagined roles to judge an individual's emotional expression, compared with European Americans.

A Comparison of Analytical Methods for Detecting Renibacterium Salmonarium in Salmon Kidney Tissue

Michael Riederer, Junior, Extended Pre-Engineering
Mentor: Linda Rhodes, Aquatic Fishery Science, Northwest Fisheries Science Center
Mentor: Shelly Nance, Microbiology, NOAA Fisheries/ NWFSC

Bacterial kidney disease (BKD) in salmon and trout is caused by Renibacterium salmoninarum, a microbe that is endemic among Pacific salmon. BKD causes morbidity and mortality among wild and hatchery stocks, particularly in high susceptibility species such as Chinook salmon (Oncorhynchus tshawytscha). Enzyme-linked immunosorbent assay (ELISA) is the most widely used method of assessing infection, although quantitative real-time PCR (qPCR) is rapidly gaining popularity. Although each method measures different bacterial macromolecules (protein vs DNA), it was expected that the assays would provide related measurements of bacterial load. To test this assumption, infection assessment of free-living salmon was performed and showed that ELISA and qPCR levels are not necessarily correlated. Evaluation of naturally infected fish treated with macrolide antibiotics, which are protein synthesis inhibitors, was performed to characterize the post-treatment profile of infection. The results suggest each assay provides different information about the status of an infection.

DAKA

Katherine Riggs, Recent Graduate, Comparative History of Ideas
Undergraduate Research Conference Travel Awardee
Devin McDermott, Senior, Dance
Anh Nguyen
Alice Gosti, Recent Graduate, Dance
Mentor: Jennifer Salk, Dance
Mentor: Hannah Wiley, Dance

In the spring of 2008, Alice Gosti presented '3' an original dance composition for the Dance Major's Concert at the University of Washington. '3' began as an experiment, a study of the distinction between mere execution of movement and performance authored by three individuals. Alice's desire was to escape body virtuosity and meaningless movement. In other words, movment not just for movement sake, but rather for communication to their viewers. Each dancer was given a pen and paper, directed to write about central issues or ideas in their lives. For example: the over involvement in loved one's lives, managing communication and grappling with relationships. From then on, for nearly three months, the dancers created, added, cut, and played with movement derived and inspired from these writings. This developed into a coherent performance piece in which three solos happen at the same time. In the end, the solos appeared to have virtually no common elements yet succeeded in relating and talking to one another. Due to the success of '3', Alice and dancers formed DAKA (Devin, Alice, Katherine, Anh), an art collective to continue their experimentation in the art world, not just thinking of dance as their medium. In September 2008, DAKAwas invited to perform '3' at Anticorpi XL; Network di Giovane Danza d'Autore (Showcase for Young Dancers and Choreographers) in Italy. In our presentation we hope to share

with you some highlights from our touring experience: videos, photography, journal entries and one on one discourse about DAKA's adventure. As of now, DAKA continues to work on new movement and collaborations to build their repertoire in hopes to continue traveling and performing.

Spectroscopic Analysis of LDEF Craters
Michael Rodruck, Senior, Astronomy, Physics
Mentor: Don Brownlee, Astronomy

My research deals with performing x-ray spectroscopy on meteoroid impact craters from NASA's Long Duration Exposure Facility (LDEF) satellite. The craters are typically one millimeter in diameter and are formed by hypervelocity impacts of particles from asteroids and comets. LDEF was a large cylinder launched in orbit in 1984 and retrieved in 1990 by the space shuttle. It was gravity gradient stabilized so one end of the cylinder always faced away from Earth. We collected craters from the space facing end in order to get craters mainly due to meteoroid impacts and not space debris, which is composed of human generated junk, from discarded rocket boosters to paint chips. Typically, a meteoroid will create a bowl shaped crater with a fragile lip, containing varying amounts of residue. We use a high power optical microscope to pick out craters with significant amount of debris in them, and then use a Scanning Electron Microscope (SEM) to examine the craters in high resolution. Our SEM also has an x-ray detector that can perform spectroscopy, so we can determine the composition of the residue, and hence the meteoroid. When the electrons strike the crater, they create x-rays that are unique to each element found in the crater. However, our x-ray detector cannot "see" into the bottom of our craters, because any x-rays emitted from the bottom are blocked by the crater wall. We are currently in the process of building a magnetic beam bender, which will be able to bend the beam of electrons emitted from the SEM such that our x-ray detector will be able to see x-rays from the bottom of the crater.

Local Therapy for Prevention of Bacterial Infection in Implant-Tissue Interface by Titanium Binding Peptide- Antimicrobial Peptide Conjugates
Mary Rood, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Mehmet Sarikaya, Materials Science Engineering
Mentor: Candan Tamerler, Materials Science Engineering
Mentor: Hilal Yazici, Materials Science Engineering

Infections associated with implants are an uncommon but serious complication in transplant patients. Such infections have proven to be difficult to treat due to the unique microenvironment inside the human body that the implant device provides for microbes. Success of implants depends not only on the bone–implant integration, but also on the presence of a sterile environment around the implant, which will prevent bacterial infection. The generally prescribed oral antibiotics are not always effective in combating implant-associated infections for a variety of reasons including the inability to reach the infection site in bone tissue, and an increase in bacterial resistance. In the present study, we offer a means to distribute antimicrobial peptides at the site of implantation to help reduce the chance of bacterial infection around the implant device, through titanium binding peptide-antimicrobial peptide conjugates. We designed a bifunctional peptide that exhibits both antimicrobial and titanium-binding properties, by linking two previously discovered peptides: a titanium binding peptide (TiBPS1) and an antimicrobial peptide (AMP). The mechanism of action of this antimicrobial peptide, like others in its class, is still unknown, however, several models suggest that the cell membrane of microbes is disrupted resulting in the death of the microbe. Developing resistance to antimicrobial peptides of this nature has proven to be minimal, likely because it would require microbes to modify their cell membranes.

Surge Opposition Effect in Sloan Digital Sky Survey Asteroids
Amy Rose, Senior, Astronomy, Physics
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Andrew Becker, Astronomy

Little is known concerning the composition of a large majority of asteroids in the solar system. By loosely determining the surface composition of a few thousand individual asteroids we can gain a more general understanding of asteroids as a whole. Using asteroids found previously in Sloan Digital Sky Survey (SDSS) data, we plan to study the opposition surge effect. Marked by an increase in brightness, opposition surge occurs when the Earth approaches the line between the Sun and the asteroid. The strength of the surge is an indicator of small-scale surface texture and composition. By querying the Jet Propulsion Laboratory (JPL) horizons website for observations of each asteroid, we can obtain the observed brightness of each asteroid, and their solar phase angle. If there are enough observations of the asteroid at solar phase angles close to opposition, the strength of the surge can be determined, and a loose determination of surface composition can be constrained.

Pore Optimization through Directional Freezing and Mechanical Strengthening using Carbon Nanotubes in Chitosan Based Polymer Scaffolds

Michael Rossol, Senior, Materials Science Engineering
Mary Gates Scholar
Mentor: Miqin Zhang, Materials Science Engineering
Mentor: Narayan Bhattarai, Materials Science Engineering

In the field of tissue engineering the use of synthetic scaffolds has been a promising approach to promoting the re-growth of damaged tissue or new growth in missing tissue. Due to the diversity of structures and cells in the body, scaffolds must be tailored to each tissue type. For porous polymer scaffolds this means being able to tailor the scaffold's pore size and structure to best fit the tissue type with which it will be integrated. For almost all material types the use of directional solidification is a simple and extremely effective way to closely control the size and structure of a products microstructure. During the production of porous polymer scaffolds directional freezing will be used to control the pore size and structure of the ultimate scaffold. Directional freezing will be accomplished by insulating all but one end of the polymer gel with Styrofoam to the cold, forcing nucleation and growth of frozen solution to start at one end of the scaffold. Once the effect of freezing rate and direction on pore structure can be characterized and understood, directional freezing will allow for polymer scaffolds to be tailored towards applications with multitude of tissue types. While polymers are an excellent material for scaffold production due to their biocompatibility, low cost, and manufacturability, there low mechanical strength has been a limiting factor to certain applications. The addition of a reinforcing agent, such as carbon nanotubes, hydroxyapitate ceramic particles, or a stronger co-polymer, will be used in an attempt to strengthen existing chitosan based polymer scaffolds.

Studies toward the Activation of C-H Bonds with Pt(II) Complexes

Matthew Ruppel, Senior, Chemistry (ACS Certified)
Mary Gates Scholar
Mentor: Karen Goldberg, Chemistry
Mentor: Kyle Grice, Chemistry

The carbon-hydrogen (C-H) chemical bond in alkanes is notable for its lack of reactivity, meaning many compounds, such as methane, have few useful chemical applications. Much research has been conducted towards functionalizing these compounds, thereby increasing their value for research and industry. The study of transition metal catalysts has made great strides towards achieving this goal. In the 1970's, Alexander Shilov found that four-coordinate platinum(II) complexes were capable of activating and functionalizing methane into methanol in a process now known as the Shilov cycle. This cycle has three main steps: (1) The C-H bond is activated, broken by the Pt(II) complex, and the carbon is bound to the platinum center, followed by (2) the oxidation of platinum from Pt(II) to Pt(IV). Finally, (3) the platinum-carbon group is functionalized and released, regenerating the Pt(II) catalyst. This process is hampered by catalyst decomposition and use of an expensive Pt(IV) complex as an oxidant. Current studies in this field are working towards more stable catalysts for C-H activation. The work is directed towards developing platinum complexes that can activate C-H bonds and be stable in the presence of oxidants. Towards this goal, I have conducted a series of reactions with a platinum complex containing a phosphorus-nitrogen ligand with a nitrogen in the backbone in place of a carbon as prior studies have done. These studies have revealed that my complex can activate C-H bonds when heated, chemistry which is not observed in the analogous carbon-containing complex. This underscores the participation of the ligand in this reaction. I have characterized the intermediates and products and this research will now focus on delineating this new route by which platinum complexes can activate C-H bonds.

Localized Surface Plasmon Resonance-Based Anti-Maltose Detection Using Genetically Engineered Peptides

Matthew Rutherford, Senior, Chemical Engineering
Mentor: Mehmet Sarikaya, Materials Science Engineering
Mentor: Turgay Kacar, Materials Science Engineering

The development of new biosensors will need robust architecture that could detect analyte concentrations as low as a few molecules. To achieve this goal, molecular immobilization needs to be efficient and detection of target molecules should be specific. Apart from the conventional approaches containing chemical agents, e.g. silane and thiol based molecules, recent studies at our Center have shown that inorganic binding peptides isolated through phage display and cell surface display protocols can provide an alternative approach to protein immobilization with advantages. Genetically Engineered Peptides for Inorganics (GEPI) could provide opportunities in developing biosensors for a variety of target molecules when they are genetically fused with appropriate probes, e.g. Maltose Binding Protein (MBP), Alkaline Phosphatase, etc. to achieve oriented assembly. In this study, the detection of Anti-MBP was examined using a fusion protein of MBP and gold binding peptide (AuBP), i.e., MBP-AuBP, as a probe through Localized Surface Plasmon Resonance (LSPR) obtained from gold nanoparticles which display a strong UV-vis absorption band. They were immobilized on a silica surface through a bifunctional peptide composed of quartz and gold binding regions, i.e. QBP-AuBP. MBP-AuBP was then al-

lowed to bind to the gold nanoparticles and attachment was verified using LSPR by examining a red-shift in the maximum wavelength (λ_max) of the absorbance. Subsequently, introduction of Anti-MBP allowed for binding to MBP-AuBP and initiated another red-shift in LSPR λ_max. It was found that attachment of MBP-AuBP caused a red-shift of 40 nm. This biosensor allowed for detection down to ˜30 nM of Anti-MBP with a red-shift of ˜7 nm. Future research will be directed towards studying lower concentrations of Anti-MBP and detection in complex biological media, e.g. serum. The research is partially supported by NSF-MRSEC Program through the University of Washington GEMSEC (DMR 0520567) and NSF-BioMat program.

Separation and Modification of Chlorin Derivatives from Copper Chlorophyllin for Photodynamic Therapy

Scott Ryken, Senior, Chemistry (ACS Certified), Anthropology
Mary Gates Scholar
Mentor: D. Scott Wilbur, Radiation Oncology

Photodynamic Therapy (PDT) is a binary therapy that combines light irradiation with photosensitizing agents to kill tumor cells. To be effective, the light used must have a specific wavelength at which the photosensitizer efficiently absorbs, and the photosensitizer must have a specific structure that efficiently converts the absorbed energy into cell-damaging singlet oxygen and free radicals. While several combinations of light sources and photosensitizers have produced effective PDT agents, a major issue that limits their use in cancer therapy is the depth of penetration of the irradiated light. Circumventing that shortcoming is the overall objective of the research being conducted. Since light penetration in tissues increases exponentially with increasing wavelength, the research goal is to develop photosensitizing agents that absorb light at longer wavelengths. The initial task in the studies has been to obtain appropriate photosensitizing materials for chemical conversion to higher wavelength absorbers. Due to its relatively low cost, the material chosen to work with is copper chlorophyllin. The purification and separation of the components of copper (II) chlorophyllin yields three to four chlorin derivatives. These chemical components will be used as starting materials for the synthesis of the new photosensitizing agents. My research has been directed at separation and isolation of these light sensitive and easily decomposable components by high performance liquid chromatography (HPLC), and their characterization by proton NMR and mass spectrometry. From the isolated components, a variety of compounds with varying functional groups will be synthesized with the eventual goal of obtaining molecules having long wavelength absorptions (e.g. 750-850 nm), having functionality for conjugation to biomolecules, and being stable under a range of chemical and biological conditions.

The International Longshoremen's Association and the International Longshore and Warehouse Union: A Comparison of Union Organizational Structure

Carrie Sachse, Junior, Political Science
Jung Hwang, Sophomore, Political Science, International Studies: Asia
Hester Angus, Senior, Finnish
Mentor: Margaret Levi, Political Science

We are conducting a comparative study between two labor unions that represent waterfront workers in the United States. The International Longshore and Warehouse Union (ILWU) represents longshoremen working on the West Coast and the International Longshoremen's Association (ILA) represents longshoremen on the East Coast. We are interested in identifying as many similarities and differences between the two unions as possible, in an attempt to explain the unions' differences in political ideology and levels of internal corruption. The broader question we hope to address is as follows: What makes some unions work to advance a broad, socially progressive agenda while other unions focus strictly on the 'bread and butter' issues important to their memberships? The ILWU has a history of radical leftist politics, well-documented by its membership. The ILA has a history of rejecting leftist politics, and has also suffered from a great deal of internal corruption. What accounts for these differences? We use recorded interviews with retired longshoremen that Dr. Howard Kimeldorf (sociologist at the University of Michigan) conducted in the 1980's. We analyze these interviews to draw conclusions about what the workers themselves felt shaped their unions, and we are able to compare our conclusions with those of Dr. Kimeldorf and other scholars. We hope that our research will lend some insight to some of the contemporary labor issues being faced by America today: the decline of unionism in general, and the lack of a strong voice to advocate for working people.

Reducing Wingtip Vortices Strength using Vortex Breakdown Methods

Namiko Saito, Senior, Aeronautics Astronautics
Mary Gates Scholar
Mentor: Dana Dabiri, Aeronautics Astronautics

When an airplane departs, ensuing wingtip vortices create downwash behind its wings. In normal wings (a typical wing geometry for commercial airplanes), this downwash is so strong that it could flip over the airplane flying behind it. Therefore, it is necessary to have a long time separation between consecutive departures or landings. On the other hand, in delta wings (a typical wing geometry for fighter airplanes) this downwash is destroyed by vortex-breakdown phenomena. In this project, a normal

wing model with a delta wing tip was tested in a water tunnel using dye flow visualization as well as Digital Particle Image Velocimetry which allows for quantitative analysis of the flow such as velocity, vortex, and circulation field. The objective is to investigate the possibility of inducing vortex breakdown in normal wings, allowing more frequent departures and landings.

Climate Responses to Biomass Burning Aerosols over South Africa

Naoko Sakaeda, Senior, Atmospheric Sciences
Mentor: Robert Wood, Atmospheric Sciences

The effects of aerosols emitted by biomass burning on Earth's radiation budget are significant but their magnitude and extend are not yet fully undersood. Southern Africa is one large region where intense biomass burning emissions are observed especially during the months of June to October. A layer of aerosol particles lofted over the land is advected by the prevailing winds above clouds over the South Atlantic Ocean. These aerosols both reflect and absorb solar radiation, which changes the radiative balance of the lower atmosphere and may affect other fields of climate such as clouds, precipitation, winds, and temperature, that are all interconnected. We use a global atmospheric model, the Community Atmosphere Model (CAM) to examine the impact of the biomass burning aerosol layer in the regional and global scale. By comparing a 20 year simulation in which the aerosol layers are present with a simulation in which the aerosols are removed we can examine the effect of the aerosols on the climate system. Inclusion of biomass burning aerosols causes a net decrease in the incoming solar radiation over the region where the aerosols are concentrated. Effects on other climate fields are highly dependent on surface albedo, the reflectivity of solar radiation. Marked changes to clouds are found which modify the direct radiative effects of the aerosols. Cloud cover and precipitation decreases over land while opposite are seen over the ocean. Surface winds are weakened while mid-tropospheric winds are strengthened implying changes to the regional circulation. Additional work is required to ascertain the robustness of the results, and further simulations will be conducted to assess the mechanisms for how the aerosols drive changes in climate.

Pitch Synchronous Complex Modulation Envelope Extraction of Speech

Paramjit Sandhu, Senior, Computer Engineering, Electrical Engineering
Mary Gates Scholar
Mentor: Les Atlas, Electrical Engineering

A mathematical model for speech consists of a carrier and a modulator. The carrier can be visualized as the pitch content in speech, while the modulator shapes the pitch into distinct and informative phonetic sounds. Using this model, the existing techniques rely on the assumption that the modulation envelope for speech is real and nonnegative. However, it has been shown recently that a more useful model allows the envelope to be complex (involving imaginary numbers). Thus, we need a way to extract the complex modulator. Adapting existing technology, we have developed a new way to determine the complex modulator of speech (specifically voiced speech) by tracking the pitch information. In most applications, speech is analyzed using a short time window (20-30 ms) shifted along fix intervals. However, in our method these shifts are synchronized with the pitch information resulting in non-fixed shifts. Thus when the pitch is higher the shift rate is slower and vice versa. Moreover, we have shown that for a simple model consisting of harmonics (approximating voiced speech), and given a high enough sampling frequency, the resulting frequency domain spectrum does not have interference. Discrete frequency transform can then be further applied on parts (envelope) of this spectrum to yield the final modulation frequency spectrum. Our method is novel in that the modulator is both complex and free of interference. Although the results are theoretical they do have practical importance. In our research we hypothesized that using a complex representation of the envelope should yield better results in many speech processing technologies. One such example is the automatic extraction of one person's speech from a recording of multiple talkers. As we can show, a PhD student in our lab, Brian King, has been able to apply this theory to separate multiple talkers in a recording.

Mapping the Concentration of Alexandrium Catenella Cysts in the Surface Sediments of Quartermaster Harbor

Mitchell Schatz, Senior, Environmental Science, UW Tacoma
Mentor: Cheryl Greengrove, Environmental Science, UW Tacoma
Mentor: Julie Masura, Environmental Science, UW Tacoma

Alexandrium catenella is a marine dinoflagellate that produces saxitoxin, which when bio-accumulated in marine filter-feeders can result in Paralytic Shellfish Poisoning (PSP) for mammals that ingest the shellfish. Blooms of A. catenella occur at various locations around the world, including Puget Sound and have resulted in shellfish harvesting closures locally. A. catenella spends part of its lifecycle as a benthic cyst in the sediment and has been shown to germinate when temperatures exceed 13-14oC in Puget Sound. In 2005, a NOAA/ECOHAB study of Puget Sound found that Quartermaster Harbor (QMH), on the sound end of Vashon Island, has the highest concentration of A. catenella cysts of any surface sediments in Puget Sound. The NOAA/ECOHAB distribu-

tion study was based one sample in the bay. In 2008, we did a follow-on cyst mapping study, courtesy of funding from the Russell Family Foundation, by collecting and analyzing 24 surface sediments samples throughout QMH. These samples were processed, stained, and counted for A. catenella cysts. Sediment samples were also analyzed for particle size and total organic carbon (TOC). A map was created showing the relative concentrations of A. catenella cysts in the surface sediments of QMH. We found a higher concentration of surface sediment cysts in the inner bay of QMH than the outer bay. Lowest concentrations of cysts were in the outer bay near the mouth of the harbor. Knowledge about the distribution of cysts in the bay could help shellfish managers avoid high shellfish risk areas for harvesting.

Exploration of an Information Ground for the International Community

Jared Scott, Recent Graduate, Informatics
Mentor: Batya Friedman, Information School
Mentor: David Hendry, Information School

I build upon Karen Fisher's theory of information grounds – focusing on "place" and social interaction – to examine information flow within the *international community* at the UW Foundation for Understanding Through Students (FIUTS) Wednesday lunch. For purposes of this research, the term international community refers to a group of people who have interest in foreign cultures; membership is defined neither by race, culture nor ethnicity. Information grounds refer to environments that are created when individuals gather for a common purpose which lead to a spontaneous sharing of information. The FIUTS Wednesday lunch is a 2-hour weekly free event; anyone may come to eat and talk. Approximately 250 people attend weekly. To investigate how (if at all) the lunch functions as an information ground, data was collected consisting of documentation, 20 hours of observation, 20 surveys, and 20 in-situ interviews (8 males, 12 females, ages 17–75) with participants of the Wednesday lunch. The survey/interview consisted of 35 questions tailored to elicit understanding about the participant's activities, goals, and information sharing. The instruments took into account language proficiency as well as cultural dimensions. Results showed that (1) FIUTS volunteers and organizers did not regulate information flow; (2) information targeted toward participants was negligible; (3) most interviewees did not have an explicit information goal; and (4) most interviewees' primary motivation for attending the lunch was to interact with others in the international community. In addition, seven non-mutually exclusive role types were developed: Sages, Adventurers, Wallflowers, Tourists, Organizers, Ambassadors, and Socialites. This work may help inform organizers on how best to disseminate information to their subjects.

Evolution of Large Software Compilations

Scott Shawcroft, Senior, Computer Engineering
Mentor: David Notkin, Computer Science Engineering

Linux distributions are a compilation of hundreds or thousands of software pieces centered around the Linux kernel. Each of these pieces evolves largely independently of all the other pieces. Recently there has been discussion of synchronizing software development and distribution development. The hope is that the distributions will feature the latest software pieces leading to increased stability, features and security. However, this is currently not the case; different distributions accumulate new software at different times. Some distributions continuously accumulate new and updated software while others gather them in batches once or twice a year. We are studying the relationship between individual software developments and their addition to distributions. Some of the aspects we are looking at are the distribution's software management system, its purpose and its community. By looking at these aspects we hope to recognize possible optimizations to the release processes of both individual software and distributions. These optimizations will increase the likelihood that software in distributions are current.

Foreign Object Recognition Through Phagocytosis

Alyssa Sheih, Senior, Bioengineering
Amgen Scholar, NASA Space Grant Scholar
Mentor: Hong Shen, Chemical Engineering

Phagocytosis is the engulfment of particles by the cell membrane, often initiated by receptor-ligand binding. This process is employed by the immune system to clear foreign bodies such as bacteria and viruses. Although Fc-receptor-mediated phagocytosis has been extensively studied, little is known about how phagocytic targets are selected in various cell types. Here, we explore the size of particles as a possible criterion for target selection. Specifically, we are interested in how the size of spherical particles affects the efficiency of phagocytosis by different cells. Different sizes of fluorescent polystyrene beads, 0.05 – 3 μm, were presented to the following types of cells: monocytes, epithelial, neuronal and glial cells. For each size, we monitored phagocytosis kinetics and the number of ingested beads in each cell type. We expect different cells would exhibit distinct phagocytosis kinetics of different beads and a strong preference towards engulfing certain sizes of particles. Our studies would provide critical information for designing delivery platforms to avoid clearance by macrophages and more efficient uptake by targeted cells such as cancer cells. Furthermore, an immune response can be triggered or avoided by carefully designing the features of particles to prevent or promote phagocytosis by immune cells.

Water Properties in Quartermaster Harbor: Dissolved Nutrient Trends

Benjamin Shetterly, Senior, Environmental Science, UW Tacoma
Mentor: Cheryl Greengrove, Environmental Science, UW Tacoma

The phytoplankton species Alexandrium catenella has historically been found in Puget Sound waters, and continues to receive attention for its role in Paralytic Shellfish Poisoning (PSP) outbreaks. This dinoflagellate produces a neurotoxin called saxitoxin, which can become concentrated in shellfish, and lead to PSP if the shellfish are consumed by mammals. Located near Vashon Island, Quartermaster Harbor (QMH) sediments have been identified as containing a significantly high population of cysts of A. catenella, compared to other Puget Sound sites, and shellfish harvesting in QMH is closed on occasion due to potential poisoning. The University of Washington Tacoma has been conducting research in QMH, with the aim of better understanding environmental factors that may have led to this higher cyst concentration. A seven station transect was sampled approximately monthly from October 2006 to February 2009. CTD water property profiles (temperature, salinity, density, dissolved oxygen, fluorescence (chlorophyll a), and transmissivity) and discrete oxygen, chlorophyll a, dissolved nutrient and phytoplankton samples were collected. This study focuses on the temporal and spatial variability of nutrients in QMH and investigates possible causes of this variability as related to physical forcing conditions, such as seasonal weather patterns and tides, and general estuarine biological and chemical processes. The dissolved nutrient concentrations during the growing season show the inner harbor's surface waters tend to remain depleted or low in nitrate and phosphate from April to September, while less protected waters beyond the mouth of the bay rebound from the spring blooms' uptake of these nutrients. Stratification of the water column in the warmer months is a factor in these trends, as the pycnocline provides a favorable environment for certain phytoplankton species. Moorings and continued property monitoring in QMH will prove valuable when studied alongside phytoplankton population assessments.

Gas-Liquid Flow and Mass Transfer within Microchannels

Nasim Shomali, Junior, Extended Pre-Engineering
Mentor: Amy Shen, Mechanical Engineering
Mentor: Gengzhi Yu, Mechanical Engineering

With elevated carbon emissions and fuel shortages, the necessity for biofuels is accentuated. The current technology used to convert biomass to biofuel is accomplished through biomass gasification and followed by Fischer-Tropsch Synthesis (FTS) which initially had been designed for coal to fuel conversions, costs up to several billion dollars and as a result has low operation efficiency. I am investigating the interaction between the gas-liquid flow and the mass transfer within microchannels which can replace the former system by providing an affordable, highly efficient microreactor for biomass FTS reaction. In this work, I use a high speed camera and an inverted microscope to record the intrinsic properties of microchannels by varying the flow rates, surface hydrophobicity, and the device design. These parameters aide in the derivation of the capillary number and are useful for determining the gas-bubble velocity within the microchannel.

Analysis of Birth Practices in the Context of the Healthcare Systems in Indonesia, Thailand and the United States

Jane Silver, Senior, Nursing, Women Studies
Mentor: Catherine Carr, Family Child Nursing

Maternal mortality in 2006 for Indonesia, Thailand and the United States is as follows: 230, 44 and 14 (all per 100,000) respectively. Infant mortality is 38, 21 and 8 (all per 1,000) respectively (WHO). Government-mandated health practices, as well as the political climate surrounding birth practices and the relationships between the two predominant sectors of maternity care, obstetrical-medical and midwifery models, play a statistically significant role in influencing the above outcomes of birth–infant and maternal mortality. There are two components to this study; the first is to perform a critical literature review of maternity healthcare in the three systems being analyzed, and second is to conduct interviews with midwifery professionals to better understand their perspective of the state of maternity care within each country. A total of 6 articles related to Indonesia, 9 to Thailand and 15 to the United States with respect to healthcare and birth outcomes were collected from Pubmed using the following limits: published in the last 5 years, only full text links, English, and randomized control trial. Nine of these were relevant, selected and reviewed. A convenience sample of 7 birth practitioners were interviewed about the state of maternity care in their location. The investigator designed the open-ended interview questions. Interviews took place in person in Ubud, Indonesia, Chiang Mai, Thailand and Seattle, the United States. Content analysis is currently being conducted from the recorded interviews to identify underlying themes. The study is currently in progress. The results will be described in the context of the healthcare system and linked to birth outcomes from the literature review. If the results show significant themes, recommendations will follow from this analysis.

Development of Sensitive Skin for Use in Prosthetics and Robotics

Anthony Simon, Senior, Electrical Engineering
NASA Space Grant Scholar
Daniel Hemmons, Senior, Electrical Engineering
Brittney McKenzie, Freshman, Bioengineering
Mentor: Alexander Mamishev, Electrical Engineering
Mentor: Kishore Sundara-Rajan, Electrical Engineering
Mentor: Gabe Rowe, Electrical Engineering
Mentor: Glenn Klute, Electrical Engineering

Many people have lost limbs due to the secondary effects of diabetes, or from trauma. Although many improvements in prosthetic limbs have been reached, still there are many problems experienced by amputees. Standing effects of pressure and shear stresses between skin and prosthesis of amputated limbs frequently cause extreme pain and temperature fluctuations. Our focus is to develop a conformal sensor and cooling array which measures and regulates temperature, including shear stresses and pressure across the residual limb surface. This research will deploy micro-fabrication techniques to manufacture a "Sensitive Skin" comprised of polydimethylsiloxane (PDMS), a common synthetic rubber. Microfabrication and computer aided design/computer aided manufacturing (CAD/CAM) techniques will be used to develop manufacturing processes to create a system of cooling chambers into the thin layers of skin, allowing coolant to be pumped through to regulate temperature. Testing will likely include strain gauges and load cells which provide control measurements, determining a correlation between measured capacitance and the apparent shear and pressure applied to the skin. Anticipated results will be a successful test trial on a larger simple sensor array sample, which will be able to provide predictable results based upon a given sheer and/or pressure application. Upon successful results, the technology can be scaled down into a compact "Sensitive Skin" array, which has many useful applications. Because PDMS is a common material in bio-medical products, the likelihood of commercialization of developed technology is increased. Implications of the research results will help veterans and people with prosthetics to be more comfortable in and have a higher quality of life. Applications extend into the field of robotics, enabling robotic limbs to interact with foreign objects in the surrounding environment, creating breakthroughs in human-robot interfacing.

The First Record of Dinocephalians in Tanzania

Rachel Simon, Senior, Biology (General)
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Christian Sidor, Biology

Dinocephalians were very large Middle Permian ($\pm$ 288-260 million years ago) therapsids, a group of tetrapods distantly related to mammals. Dinocephalians radiated into a diversity of forms, including large carnivores with fierce-looking canines like Anteosaurus, to gigantic head-butting herbivores like Moschops. Climatically, the Middle Permian was a time of global warming, which permitted dinocephalians to thrive across Pangea. Their remains have been found on the supercontinent as far north as what is now Russia and as far south as South Africa (paleolatitudes of roughly 40 N and 60 S, respectively). Other dinocephalian records come from Zimbabwe, Brazil, and China. Despite their success, dinocephalians dwindled to extinction by the end of the Middle Permian, making them useful for biostratigraphic correlation of rock strata as well as for dating rock formations. In the summer of 2007, a team led by Christian Sidor discovered the first terrestrial vertebrate fossils from the Ruhuhu Formation of the Ruhuhu Basin in southern Tanzania. 'Talon and heel' morphology of the recovered teeth indicates that these fossils are dinocephalian in origin. Careful analysis of the teeth and other dinocephalian remains, and comparisons with other dinocephalian specimens will help identify the type of dinocephalian present in Tanzania as specifically as possible. Not only are these the first terrestrial vertebrate fossils to be found in the Ruhuhu Formation, but they provide us with an accurate constraint for its age. In addition, the newly recovered fossils provide us with a new geographical distribution for these important therapsids.

Data Management and Application of Methods for Digital Analysis of the Movements and Cocalizations of Neotropical Birds of Prey

Elizabeth Smith, Senior, Biology (Environmental Conservation)
Kayla Helem, Senior, Biology (General)
Scott Hardwick, Recent Graduate, Biology (General)
Mentor: Martha Groom, Interdisciplinary Arts Sciences, UW Bothell
Mentor: Ursula Valdez, Biology

Neotropical birds of prey are among the least studied bird species and little is known about their ecology and behavior. In this project, we developed methods to perform digital analysis of previously collected field data (U. Valdez, unpub. data), focusing on analyses of the movements and vocalizations of five species of forest-falcons from southeastern Peru: *Micrastur semitorquatus, M. ruficollis, M. gilvicollis, M. mirandollei*, and *M. buckleyi*. A data base in ACCESS was created to manage location data for individual forest- falcons studied in the field (n=25). This information was then processed using LOAS and spatial analysis software (ARCView) to generate maps with the frequencies of area use for all 5 bird species, which will be used for further analysis of species' activity ranges and area overlap that will be conducted by the principal investigator. In addition, we

conducted a preliminary visual analysis of forest-falcon vocalizations obtained in the field. Using sound analysis software (Raven 1.2.1) we examined the basic characteristics of the vocalizations of the 5 species of forest-falcons and generated sonograms, and measured 10 call variables such as frequency, amplitude, duration of call and maximum power. With these analyses we identified the basic characteristics of the vocalizations of each study species, which have been the first data analyzed for these birds of prey. These analyses form a foundation for future analysis and application as we begin to learn about these rare species.

Response Properties of Dopamine Neurons in the Ventral Tegmental Area during Spatial Learning and Changes in Context

Kelsey Smith, Senior, Psychology, Neurobiology
Mary Gates Scholar
Mentor: Sheri Mizumori, Psychology
Mentor: Adria Martig, Psychology

Hippocampus (HPC) is an area in the medial temporal region of the brain that is known to be involved in spatial learning and memory, context discrimination and novelty detection. Dopamine has been shown to modulate performance on spatial tasks such that learning is impaired when dopamine is depleted from HPC and enhanced when dopamine agonists are infused into HPC. Dopamine may influence spatial learning and memory through a reward prediction signal. In addition, dopamine neurons increase their firing rates in response to novelty. These types of signals from dopamine neurons in ventral tegmental area (VTA), to HPC are thought to enhance learning. It has been suggested that when HPC receives novel information from the environment, HPC relays the information to VTA, which affects the firing properties of dopamine neurons that project back to HPC. In this way, HPC and VTA may be involved in a functional loop, which facilitates learning. Our current study investigates how dopamine cells in VTA correlate with spatial learning and also if these same cells respond to changes in context. One rat was implanted with four independently moveable electrodes to obtain extracellular recording of neural activity in VTA. We recorded cellular activity from N=7 cells while the rat was learning a plus maze task and during context manipulations after the animal had learned the task. Preliminary analyses suggest that there are context and learning dependent changes in cellular activity.

Simulation of Anisotropic Growth of Gliomas Using Diffusion Tensor Imaging

Rita Sodt, Senior, Computer Science
Levinson Emerging Scholar, Mary Gates Scholar
Mentor: Kristin Swanson, Pathology

Gliomas are highly invasive brain tumors that account for nearly half of all primary brain tumors. Since current medical imaging techniques only detect a portion of these cancerous cells, a computational model was developed by Dr. Swanson to give more information about the extent of the tumor invasion below the threshold of imaging and to give a prediction of glioma growth that can be tailored to an individual patient's tumor. This computational model is based on two elements: cell proliferation and cell diffusion. In previous tumor simulations, cell diffusion was assumed to be isotropic, however, it is commonly accepted that glioma cells migrate preferentially along the direction of white matter tracts. To model this observed diffusion, I am writing a program that simulates the anisotropic growth of gliomas in a 3D virtual brain. To determine the direction of glioma cell migration at a given location in the brain, I use a published technique utilizing diffusion tensor images (DTIs), which show the directional orientation of brain matter and therefore indicate the direction that glioma cells tend to migrate. I will compare the results of our simulations to observed tumor growth to determine how accurately we can predict the growth of gliomas with anisotropic diffusion. We expect that after modifying the model to include anisotropic cell diffusion, the simulated tumors will more closely reflect the growth of tumors that we observe in vivo.

Evaluation of Benzaldehydes and Oxylamine Chemistry for Application to Bioconjugation

Casey Somers, Senior, Biology (Molecular, Cellular Developmental)
Mentor: D. Scott Wilbur, Radiation Oncology

We are evaluating oxime formation as a method for bioconjugation of molecules with monoclonal antibodies. There have been few literature examples of oxime formation as a method for bioconjugation, so little is know about what makes an optimal reagent for this reaction. Since concentrations of reagents are very dilute in bioconjugations, we are particularly interested in the rate of oxime formation at high dilution. In the investigation the relative rates of oxime formation from reactions of several substituted benzaldehydes and an oxylamine derivative are being evaluated and compared. Two important considerations arise from oxime formation in aqueous solution, those being water insolubility of reagents and Le Chatelier's principle regarding the reaction mechanism. First, lack of water solubility may limit the rate at which the reaction occurs. Addition of polar and hydrogen bonding substituents on benzaldehydes increases their water solubility and thus may increase reaction rates. The second important consideration arises from electronic affects of substituents on the two-step mechanism of oxime formation. The first step in this reaction involves the nucleophilic attack of the carbonyl carbon

by the free pair of electrons on the nitrogen of the oxylamine, forming a tetrahedron intermediate. This step of the reaction is favored by electron withdrawing groups either adjacent to or in resonance with the carbonyl carbon. In contrast, the second step of the reaction requires the dissociation of water, which is favored by electron donating groups. Since the reaction takes place in an aqueous solution, the presence of water in solution may shift the reaction equilibrium towards the tetrahedron intermediate (Le Chatelier's principle), in effect hindering the reaction. Thus, the investigation will help determine how the oxime forming reaction rate is affected by the type of benzaldehyde substituent (i.e. electron withdrawing groups (favors step 1) or electron donating groups (favor step 2)).

Remote Sensing by Satellites: A Comparison of an Active and a Passive Sensor in Deriving Cloud Fraction and Cloud Phase

Jayson Stemmler, Junior, Atmospheric Sciences
Mentor: Theodore Anderson, Atmospheric Sciences
Mentor: Robert Charlson, Atmospheric Sciences

At this time, satellite-borne instruments provide the ability to derive cloud properties through a variety of sensing techniques and post-processing methods. One common satellite product is 'cloud fraction' (CF), which provides the fractional coverage by clouds in a given domain. CF is critical for determining cloud albedo, or how much sunlight clouds reflect back into space. Cloud albedo is an important component in calculating the radiation budget for the Earth. Currently, the two main methods for the remote derivation of a CF product are through 1) passive sensing, such as that from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the AQUA and TERRA spacecraft and 2) active sensing such as that from the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) aboard the CALIPSO spacecraft. Satellite-derived cloud properties (including CF) result from significant post-processing of the raw data into a number of customized products, often with similar names but different inherent meanings. In this project, I compare the several CF products from MODIS to the array of CF products from CALIOP. Spatial and temporal collocation is essential to this comparison and was made possible by the fact that the Aqua and CALIPSO satellites fly in close formation. The purpose of this project is to guide further analysis - especially integration of passive and active data - to choose the most appropriate CF product from each sensing method appropriate to questions being pursued. After examining the array of CF products from an active and a passive sensor, it is clear that each method has its own attributes and shortcomings, especially in cloud phase detection. As a result, further studies utilizing CF should note the availability of an array of CF products from various remote sensing systems as opposed to relying solely on one product.

Predictors of Adherence to a Six-Month Yoga Intervention among Post-Treatment Breast Cancer Survivors

Rachael Stovall, Senior, Individualized Studies, French
Mentor: Alyson Littman, Epidemiology

In the United States, more women develop breast cancer than any other cancer. Given the relatively high survival rate, improving quality of life for breast cancer survivors is a concern. There is some evidence that yoga ameliorates mood and overall wellbeing, and it has been evaluated on cancer survivors in past epidemiologic studies. We conducted a pilot randomized controlled trial in 63 breast cancer survivors, in which half were assigned to perform yoga immediately and the other group was assigned to wait 6 months until beginning yoga. As part of the yoga intervention, women were encouraged to attend a weekly instructor-led yoga class at Fred Hutch Cancer Research Center (FHCRC) and to perform yoga on their own 4 days per week for 6 months. Participants completed baseline questionnaires that assessed their demographic characteristics and behaviors, and physical, mental, and emotional well-being. Additionally, their weight and height were measured at the beginning of the study. Many previous studies on adherence may not be generalized to breast cancer survivors practicing yoga because of their unique life circumstances. Therefore, the aim of this study is to determine predictors of adherence to a 6-month yoga intervention. To accomplish this goal, we are analyzing their questionnaires and attendance to class data. We will assess whether age, education, work status, body mass index (BMI), fatigue, yoga knowledge, distance from FHCRC, and social support, among other factors are associated with adherence. Preliminary analyses suggest that age, marital status, BMI, and fatigue did not predict adherence; employed women were more likely to adhere than unemployed women. Data analyses are ongoing, and results and conclusions are still being determined. Better understanding and identifying correlates may help to ensure high adherence in future, larger-scale studies.

Control of Pluripotency and Cardiac Differentiation Potential of Stem Cells using Defined Media Conditions

Nina Tan, Senior, Biology (Molecular, Cellular Developmental), Economics
Mary Gates Scholar
Mentor: Charles Murry, Pathology
Mentor: Lil Pabon, Pathology

Heart disease is one of the leading causes of death in the United States. Organ transplantation is the primary approach that is currently available to treat severe forms of cardiac dysfunction, but the demand for donor hearts

far exceeds availability. The application of stem cells to facilitate repair after a heart attack has exciting therapeutic potential. The maintenance of human embryonic stem cells (hESCs) in a pluripotent state, where they retain the ability to differentiate into any cell type, requires either the use of a fibroblast feeder layer or media that has been conditioned by fibroblasts. The common use of primary mouse fibroblasts not only presents a potential source of contamination, but also creates a level of variable experimental conditions that can affect differentiation efficiency. In order to use this technology in a clinical setting, it is important that differentiation conditions are as consistent as possible and that the human cells are free of contaminating products. We are testing whether hESCs can maintain pluripotency in maintained in fully defined media, and whether these cells can then differentiate efficiently into cardiomyocytes. We have examined two types of defined media (Stem Cell Techologies' mTeSR^{TM}1 and Lonza's X-VIVO10) and compared them to standard fibroblast conditioned media. We are currently analyzing the effects on pluripotency by assessing RNA and protein levels of markers of the undifferentiated state, such as Oct-4. We will characterize the effects on the initial stages of differentiation by analyzing the expression of the mesendodermal marker, brachyury T. Subsequent differentiation will be characterized using the early cardiac marker Nkx 2.5, and markers of more mature cardiomyocytes such as beta myosin heavy chain. The goal of this research is to achieve comparable and efficient cardiac differentiation using completely defined culture methods.

The Role of Design in Community Preservation
Sylvia Tatman-Burruss, Senior, Community, Environment, Planning
Mary Gates Scholar
Mentor: Michael Pyatok, Architecture

Affordable-housing design is sometimes given less priority over market-rate developments. Affordable-housing design often reflects the attitude that people of modest means need only a place to sleep and store their belongings. When designers recognize the need for attractive architecture both for the pride of residents and for the acceptance of the surrounding community, they are often limited to choosing between affordability, design and location, not a well-balanced union of the three. With careful design and planning strategies, however, architects can reach a balance where all parties are satisfied with a product which families can call home. Through my research, I will be conducting a retrospective case study to better understand the effect of architectural design and neighborhood context on the lives of residents of an affordable-housing community within the International District of Seattle. I will adapt some of my interview questions from Post-Occupancy Evaluation surveys and will also include questions related to neighborhood context on topics such as adequate transportation, convenient access to amenities, adequate childcare, etc. I will be interviewing the project architect, developer and property manager, as well as residents to discover if the original design and development intentions are meeting the needs of the current manager and residents who interact with the building and neighborhood on a daily basis.

Monoallelic Expression In Stem Cells
Brandon Thomas, Senior, Biochemistry
Mary Gates Scholar
Mentor: Tony Krumm, Radiation Oncology

The differentiation of stem cells to a variety of cell types is controlled by genetic and epigenetic mechanisms. In addition, there is compelling evidence that epigenetic alterations play a critical role in the pathogenesis of cancer, diabetes, and heart disease. These modifications are likely present in every cancer type, and many models now show that the driving force in tumorigenesis is epigenetic. One such example of an epigenetic mechanism relating to gene regulation is monoallelic expression. Diploid organisms are expected to express both their inherited paternal and maternal alleles at a given locus, but recent research shows that monoallelic expression of only one allele is much more widespread than previously thought. These genes are regulated in a way that limits expression to a single allele and with many current researchers directing their focus towards epigenetic studies, it seems urgent to understand how and why certain genes reduce expression to the level of monoallelic discrimination. It is currently unclear how these genes are regulated, but early work indicates that there may be key proteins involved in the insulation of specific genomic loci. We have developed an experimental strategy to identify genes transcribed on either the maternal or paternal allele across the human genome in order to categorize genes at the level of monoallelic expression. The ability to generate a catalogue of epigenetic alterations will provide molecular signatures that are essential to the development of novel tools in the diagnosis and therapy of human disease.

Objects as Stereotype-evoking Factors in a Classroom Environment
Amanda Tose, Junior, Psychology
Mary Gates Scholar
Mentor: Sapna Cheryan, Psychology

Stereotypes about computer science, such as its reputation for "geekiness" and masculinity, can affect women's interest in the field (Cheryan et al., 2009). Can objects in computer science evoke these computer science stereotypes? How might this affect feelings of identity within these environments? In my study, subjects are asked

to look at images of various objects (e.g., video games, Star Trek posters, tech magazines, lamps, nature posters, and general magazines) and answer questions about how much they feel the object is related to the computer science stereotype, how much they associate it with classrooms, and how surprising it would be to find it in a classroom. We hypothesize that there will be a difference between the objects in their levels of stereotypicality and association with classrooms. These results would suggest that the mere presence of objects in an environment can activate stereotypes. Stereotype priming of this nature is known to have an impact on behavior (Bargh, Chen, Burrows, 1996), and we will see if this also applies to women's interest in computer science. This study will help one of our main lab projects transition from looking at the effects of computer science stereotypes in a company setting to the effects in a classroom. The results will also be used to select appropriate stereotypical and non-stereotypical objects for another study in which subjects will encounter these objects in virtual environments. To better understand women's perceptions of computer science, future studies may also include an analysis of the objects' femininity/masculinity to see if a correlation exists between ratings of stereotypicality and masculinity.

Stimulating Antennal Muscles Leads to Path Changes in a Moth's Flight Trajectory
James Tse, Senior, Biology (Physiology)
Mentor: Tom Daniel, Biology

Previous work has shown that mechanoreceptors at the base of the antennae in the crepuscular hawkmoth *Manduca sexta* are necessary for stable flight control. They mediate flight responses by acting as vibrational gyroscopes, detecting Coriolis forces that appear during body rotations (Sane et al. 2007). We hypothesize that artificially introducing a force that is applied out of the antennae's vibrational plane should lead to compensatory reactions and therefore to changes in a moth's flight plan. To test this hypothesis, we created small tungsten electrodes that are implanted in the dorso-medial side of the scape, targeting specific extrinsic muscles that lead to antennal retraction (out of the natural vibrational plane). We used a low current 5 V square wave stimulus generated by an Arduino board at 100 Hz with a duty cycle turned to elicit an antennal retraction without suppressing flight behavior. The stimulus is delivered to the implanted electrodes via a cable of ultrafine stainless steel wire regulated by the X-Moth electrical stimulator. The moths are attached to the experimental apparatus and thus permitted to fly . Preliminary experiments show that, in 9 out of 16 animals in which electrode implantation was attempted, stimulation of the left antennal muscles leads to a high probability of left turns immediately following the stimulus. The direction of the elicited responses agrees with what is expected if antennae act as gyroscopic sensors. These results provide further evidence that moth antennae are crucial components of a mechanosensor-mediated flight control circuit.

In Out of the Rain: Client Perspectives of Medical Respite for Homeless Youth
David Tucker, Fifth Year, Nursing
Mentor: Josephine Ensign, Psychosocial Community Health Nursing
Mentor: Aileen Panke, Psychosocial Community Health Nursing

Homelessness among young people is a growing problem, and is associated with an increase in acute illnesses and injuries. The purpose of this project is to evaluate homeless youth perceptions of overnight medical respite and barriers to the use of MEDREST, a UW School of Nursing (UWSON) project designed to provide medical respite overnight stays for homeless youth ages 18 to 24. MEDREST is coordinated through the UWSON with the Country Doctor Teen Clinic and the 45th St. Teen Clinic in Seattle, WA. This research will attempt understanding of youth perceptions of MEDREST services and examine perceived and actual barriers to use of respite services. This project is an investigator designed program evaluation based on a focus session with homeless youth at the 45th St. Clinic and evaluation by providers and coordinators. A qualitative content analysis was performed and themes identified. MEDREST services were underutilized by the Seattle homeless youth population. I will attempt to explain barriers and strengths of the structure of the MEDREST program and give some solutions that could help future pilot programs providing medical respite to homeless youth.

Disinfection Byproduct Formation from Camping Water Treatment
Benjamin Vellek, Sophomore, Pre-Major (Arts Sciences)
Mentor: Gretchen Onstad, Environmental Occupational Health Sciences
Mentor: Christopher Simpson, Environmental Occupational Health Sciences

Chlorination is a widely used method of water disinfection but is known to produce carcinogenic disinfection byproducts (DBPs) when there are high levels of dissolved organic carbon in source water. Two types of organic DBPs are regulated by the U.S. Environmental Protection Agency including five haloacetic acids (60 μg/L total HAAs) and four trihalomethanes (80 μg/L total THMs). Formation of these DBPs is a function of the concentration of chlorine and the amount of chlorine consumed by the source water. This research focused on the formation of four THMs, chloroform, bromodichloromethane, dibromochloromethane, and bromoform through common methods of portable water dis-

infection like those used by hikers and campers. Source water for treatment was collected from urban surface water sites in Seattle. Applied treatments included methods with chlorination (MSR Sweetwater, MSR MIOX, Pur Packets) and those without (UV Steripen, iodine, and chlorine dioxide tablets). To collect data for these treatment methods a Hach colorimeter was used to measure residual chlorine as free and total chlorine. The THMs were then extracted by liquid-liquid extraction and run through a gas chromatograph with electron capture detection to determine which ones were present and their relative concentrations. By analyzing THM levels of different treatment methods the optimum portable water treatment method will be chosen.

Analysis of Usage Patterns of a Web Site for Patients with Chronic Obstructive Pulmonary Disease (COPD)

Rikki Voie, Fifth Year, Nursing
Mentor: Huong Nguyen, Biobehavioral Nursing Health Systems

As the population in the United States ages, chronic diseases are becoming increasingly prevalent; patients with chronic conditions are primarily responsible for their self-care. In order to facilitate patient autonomy, numerous web-based tools and online forums have been developed and are readily accessible to patients. These resources have the potential to help patients better manage their chronic conditions and improve their quality of life. The UW School of Nursing has been testing the effects of an Internet-based shortness of breath self-management program for patients with Chronic Obstructive Pulmonary Disease (COPD). Patients enrolled in the program have access to multiple web-based tools; however, we have very limited information on what tools are actually being utilized. To examine web site usage patterns by patients with COPD who are participating in an Internet-based shortness of breath self-management program. Patients have access to the following tools on the study web site: personal journal, exercise plans and tracking, symptom tracking, medication record, secure messaging, live text chats, discussion board, and audio-narrated education modules. We will analyze deindentified automated usage log data for up to 22 patients. The usage data will be analyzed in March 2009. The findings from this analysis will help us better understand the utility of various web-based tools to educate and support patients with COPD. This information will likely be useful for the management of other chronic conditions as well.

Variation in Social Rationales among Union Locals: A Cross Sectional Analysis of the ILWU

Igor Voloshin, Senior, Political Science
Mentor: Margaret Levi, Political Science
Mentor: John Ahlquist, Institute for Research on Labor Employment, UCLA

Conventional wisdom in America considers the domestic workforce and viable labor unions as motivated by narrowly rational calculations, strictly functioning to promote 'bread and butter' needs (e.g. improving working conditions and wages). However, within the labor movement, scholars have demonstrated the existence of "deviant" unions who provide their membership with bread and butter goods while also mobilizing their membership to act on behalf of political agendas that are not directly related to their personal economic calculations. After a historic 1934 victory against employers, the International Longshore and Warehouse Union (ILWU) established itself as such a case. Yet, even this 'radical' union is not a monolithic bastion of ideologues. Rather it's locals developed unique affinities for political causes prior to, and once in the union. This study explores how and why Seattle, Tacoma and San Pedro locals of the ILWU developed distinctive political beliefs that motivate aggregate behavior in the form work stoppages (my dependent variable). This comparative case study explains how institutional, cultural, sociological and environmental determinants have shaped the membership's collective preferences (which I term, 'social rationales'). For the methodological basis of my research, I compiled data on stoppages and strikes undertaken by the ILWU and its affiliated Locals from 1934 to the present to form a comprehensive timeline. The data was coded into a typology of stoppages: industrial, solidarity or political. This provides an empirical demonstration of how each local varied in its commitment to political causes. Sources include Pacific Maritime Association records, the ILWU newspaper, BLS reports, Congressional briefs, internal union documents and oral histories. I argue that the variation is a consequence of differences in the cadre of leadership and the institutions of the Local. I also examine the explanatory power of divergent histories, demographics, and the nature of work itself at the ports.

Effects of Neonatal Stress with/without Hypoxia/Hyperoxia on Proliferation of Hippocampal Neurons and Glia in Morphine-Treated Neonatal Mice

Gerard Wallace, Senior, Psychology, Neurobiology
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Sandra Juul, Pediatrics

Preterm infants are often exposed to a variety of stressful and painful stimuli in the neonatal intensive care unit (NICU). These stressors include painful medical procedures; hypoxia/hyperoxia; and maternal separation. Ad-

ditionally, they are often administered morphine in an attempt to reduce the pain and stress they experience. Opioids are regulators of glial activity and neurogenesis and may interact with stress to alter glail activity and neurogenesis. To study the effects of stress on neonates receiving morphine we have developed a mouse model of stress incorporating handling, maternal separation with gavage feeding, and hypoxia/hyperoxia. Using this model we have shown that neonatal stress and morphine interact to produce a dynorphin-mediated gliosis in the mouse hippocampus. We hypothesize that the hippocampal gliosis resulting from the interaction of our stress model and morphine treatment is dependent on exposure to hypoxia/hyperoxia. To investigate how hypoxia/hyperoxia contributes to hippocampal gliosis in our model, neonatal mice were subjected to one of four experimental conditions: morphine treatment, morphine treatment plus maternal separation, morphine treatment plus hypoxia/hyperoxia, and morphine treatment plus maternal separation and hypoxia/hyperoxia. All mice received injections of bromo-deoxy-Uridine (BrdU), which is incorporated into DNA during mitosis, allowing cell proliferation to be tracked. The hippocampus and nucleus accumbens were stained for gliosis using glial acidic fibrillary protein (GFAP), BrdU labeled cell proliferation, and cell death using terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL) and Fluoro Jade B. In a subset of animals urine concentrations of the stress hormone corticosterone were measured. Analysis of this data is ongoing. This data will allow us to determine the effect of the hypoxia/hyperoxia in our neonatal stress model on glial activity in the developing mouse hippocampus and to document any structural changes which may result from our stress model.

Mediating Cultural Influences on the Periphery of the Inka Empire: A Comparative Archaeological Study of Key Border Regions of Tawantinsuyu

Matthew Warren, Senior, Anthropology, Biology
Mentor: Donald Grayson, Anthropology

The Inka Empire, known as Tawantinsuyu ("The Land of the Four Quadrants"), was a vast polity stretching from northern Ecuador to central Chile, from the arid western coasts of South America across the Andes to the edges of the Amazon Basin. From its Andean capitol of Cusco, the Inka state exerted power over millions of people belonging to hundreds of ethnic groups. This diversity of peoples and environments resulted in differing degrees of resource input and attention from the Inka state across different regions. The manner in which the governing class maintained rule over its far-flung populations varied due to a number of factors such as distance from the capitol, the degree to which important resources could be extracted from particular regions, and the relative loyalty of different ethnic groups to the empire. Of particular interest are the provinces on the periphery of Tawantinsuyu, positioned at the extreme limits of direct state control and in close proximity to societies lying beyond the Inka realm. Through an examination of relevant literature, this study investigates the different ways in which the influences of these competing cultures were mediated by the inhabitants of three such "border zones" of the empire: the northern edge of Chinchaysuyu (the northernmost quadrant), the eastern boundary of Antisuyu (the easternmost province) on the edge of the Amazon, and the southeastern border of Kollasuyu, located in what is today northwestern Argentina. Based on prior research, this study hypothesizes that in each of these regions the degree to which local peoples conform to standard Inka practices, as evidenced in the artifact assemblages and structural features of relevant archaeological sites, is contingent upon both the relative input and investment of the state to these regions and the degree of influence exerted by cultures external to the empire.

Effects of Fire and Stand Management on Early Winter Habitat Formule Deer

Matthew Weintraub, Senior, Environmental Science Resource Management
Mentor: Aaron Wirsing, Forest Resources
Mentor: Dale Swedberg, Sinlahekin Wildlife Area, Washington Dept. of Fish Wildlife

Direct and indirect anthropogenic actions have contributed to a vast shift in available habitat for mule deer (Odocoileus hemionus) throughout Western North America since the onset of Euro-American colonization. While these animals generally prefer lands that can be described as open and park-like, much of this habitat has been altered by various means such as fire suppression, timber harvesting, and both urban and agricultural development. These landscape level changes have also facilitated the encroachment of white-tailed deer (Odocoileus virginianus) into regions previously only inhabited by mule deer. A case example of these changes can be found in North-Central Washington's Okanogan County and in particular, the Sinlahekin Wildlife Area (SWA). In an effort to promote native species, restore ecological regimes, improve forest health and safety, and increase usability by visitors, a prescribed burn and forest thinning were completed in 2005 within the SWA along with another burn on adjacent lands managed by the Washington Department of Natural Resources (DNR). While hazardous forest fuels were reduced, no quantitative study has been undertaken to determine if the restored ecosystem provides better habitat for the regions native mule deer population. This study will look at plant abundances, most notably understory shrubs and the nutrient contents of key browse species to determine whether or not the treatments were successful. Additionally, stand structure and relative use of the area by deer will also

be evaluated. I will determine whether or not the burns and thinning treatments completed all of their goals and if it should be recommended that these actions continue across a larger portion of the SWA.

Selective Bio-Sorption of Bi-Functional Peptides onto Patterns from Atomic Force Microscope Lithography

Kyle Wetzlar, Senior, Mechanical Engineering
Mentor: Marco Rolandi, Materials Science Engineering
Mentor: Jessica Torrey, Materials Science Engineering

The ability to reliably pattern and assemble biological molecules onto inorganic substrates is key for the development of hybrid architectures such as biological sensors, and bioassays. Bi-functional peptides, or short polymeric chains of amino acids that are selectively adhesive, are ideal candidates for the assembly of bioinorganic hierarchical structures. In this project, we investigate the specific assembly of bi-functional peptides onto silicon oxide patterns written with the sharp tip of an atomic force microscope and polydimethylsiloxane (PDMS) stamping. Experiments are conducted to determine the most effective oxide geometries for optimal peptide binding and assembly of functional nanoobjects. These experiments entail the exploration that varying parameters such as substrate preparation techniques, oxide deposition voltage, deposition rate, and surface pacification have to create a surface suitable for discriminate peptide binding. Of particular interest is enabling the assembly of gold nanoclusters on a silicon surface to develop applications in plasmonic waveguides, and surface plasmon resonance biosensors. The research is partially supported by NSF-MRSEC Program through the University of Washington GEMSEC (DMR 0520567) and NSF-BioMat program.

Interface Shear Strength of Polymer-Derived Ceramic Thin Films

Chris Wituchowski, Senior, Materials Science Engineering
Mentor: Kaishi Wang, Materials Science Engineering
Mentor: Raj Bordia, Materials Science Engineering

Polymer-derived ceramic thin films are becoming an extremely attractive material to coat metals that are exposed to high temperature corroding environments, such as those in coal power plants. The measured interfacial strength is strongly dependent on the surface roughness and the thickness of the film. Our analysis shows that there is an inherent interface strength that is approached as film thickness approaches zero. Experimental research, so far, has measured the interface strength for thick coatings (of the order of 10 – 20 microns). It is not possible to accurately predict the inherent interfacial strength from these measurements. My research is focused on making nano-scale ceramic coatings on metals and from these obtain the inherent interfacial strength. So far, several samples of thin films have been made on Inconel substrates, which will be inspected under a Scanning Electron Microscope to estimate their thicknesses. The samples will be fired at a range of temperatures (up to 800C) in air to convert the polymeric coatings to a ceramic. After pyrolysis, the samples will be tested in tension. Perpendicular cracks will begin to form in the coating until they reach a minimum spacing, which along with the tensile stress at the formation of the first crack and final crack will be related to the interface shear strength using available models.

Albedoes of Main Belt Asteroids

Brian Wold, Junior, Astronomy, Physics
Mentor: Lynne Jones, Astronomy

The purpose of this research was to calculate the albedo, or surface reflectivity, of several Main Belt asteroids. At visual wavelengths, sunlight is partially reflected by the surface of asteroids; the non-reflected light is absorbed by the asteroid, heating the surface and causing the asteroid to emit infrared radiation. By comparing the brightness of an asteroid at different wavelengths in the visual and infrared, it is possible to calculate the albedo. Understanding the albedo distribution of asteroids help us understand their physical composition and surface properties. In addition, knowing the albedo of an object allows us to predict the size of the object, and in the case of asteroids, can lead to size distribution estimates. We have obtained ground-based observations from the Canada-France-Hawaii Telescope (CFHT) to provide visual photometric measurements, taken in green and red filters, on January 22 and 30, 2004. Our infrared data comes from measurements made by the space based Spitzer telescope at approximately the same time as the ground observations. These observations were taken at 8 and 24 microns during the Spitzer First Look Survey – Ecliptic Plane Component (FLS-EPC). Combining the data will yield measurements for albedo. Particularly important is that these measurements were obtained close together in time - asteroids vary in brightness significantly at different times in their orbits, thus comparing visual and infrared measurements from the same time is necessary. Known asteroids were identified in the Spitzer survey observations. Their positions in the CFHT images were then determined using the ephemerides provided by the Minor Planet Center. The asteroids were then located in the visual images from CFHT. Photometry measurements were taken from these images and were combined with the Spitzer data. We will present an albedo distribution and compare it with theoretical expectations.

Preparation of Bioceramics with Precisely Controlled Pore Size

Yun Xiao, Freshman, Exchange - Arts Sciences
Mentor: Buddy Ratner, Bioengineering

PMMA template can be used to fabricate bioceramics with pore size precisely controlled. Bioceramics are ceramic materials used to repair, augment or replace diseased or damaged tissues. In bone tissue engineering, the scaffold material must be biocompatible and have enough mechanical strength to provide structural support during bone growth and remodeling. In addition to these, researchers show that a 3D interconnected porous structure is necessary for cell attachment and biofluid movement. Since the increase in porosity results in a decrease in mechanical strength, the pore size is very unique for the scaffold. A number of techniques have been developed to fabricate porous bioceramics for bone tissue engineering, but the pore size is poorly controlled. Using PMMA beads as sphere templates, we can fabricate materials with monodispersed, uniformly shaped pores. The PMMA template will sublime at the high temperatures during the process of casting the ceramic. Sol-gel process allows one to obtain glass of higher purity and homogeneity at a relatively low temperature. In this research, we will combine the sol-gel method with the PMMA template to fabricate porous materials. With pore size precisely controlled, we can investigate the influence of its size on the tissue response. This material can be an ideal tool to research what the proper pore size for bone tissue engineering is and balance porosity and mechanical properties.

Effects of Early Intervention on Face Memory Tasks in Young Children with Autism Spectrum Disorders

Linnea Xuereb, Junior, Pre-Major (Arts Sciences)
Mentor: Sara Jane Webb, Psychiatry Behavioral Sciences
Mentor: Emily Jones, Psychiatry Behavioral Sciences
Mentor: Kaitlin Venema, Psychiatry Behavioral Sciences, CHDD Autism Center

Children diagnosed with Autism Spectrum Disorder (ASD) exhibit social and communicative impairments; one contributing factor may be an inability to accurately process information from faces. Improving such face recognition skills may be a fruitful early intervention target. This study aimed to examine the efficacy of an intensive, randomized intervention on improving performance on facial recognition tasks for children with ASD. Toddlers were divided into three groups: those with general developmental delays (DD group), those with an ASD who participated in community intervention programs (ASD-C group), and those with an ASD who participated in the University of Washington Denver STAART model of intervention (ASD-UW group). The UW intervention (Smith, Rogers & Dawson, 2008) was a two year intensive behavioral therapy that included a face recognition training component. The face recognition test was administered when children were 24 to 60 months old. Toddlers were asked to "point to mom" from a compilation of six photographs which included distracters. Preliminary results indicate performance on the face recognition test did not differ significantly between groups. However, 26 /48 children tested scored 100% on the task. Notably, thirteen subjects from the ASD-UW group (68%) were able to successfully complete the entire task compared with only four toddlers in the ASD-C group (31%). Preliminary results suggest that toddlers in the DD, ASD-C and ASD-UW groups performed similarly on the face recognition tasks, although a ceiling effect may mask underlying trends. Toddlers in the ASD-UW group were three times as likely to complete the test as toddlers in the ASD-C group, suggesting that intensive intervention including training on facial picture identification might facilitate compliance during a testing situation. Further analysis includes examining the errors made by children during picture selection to examine individual differences in face recognition strategies.

Unraveling the Function of Agho in *Drosophila melanogaster*

Teiona Yoko, Senior, Biology (Molecular, Cellular Developmental)
Howard Hughes Scholar
Mentor: Barbara Wakimoto, Biology

Fertilization is a chain of events, in which a single interruption of any step can lead to sterility. For my research, I am using Drosophila melanogaster, the fruit fly, to understand the cellular processes and molecules involved in sperm function. The agho gene, when mutated, arrests fertilization immediately after sperm entry into the egg. Previous studies in the lab have shown this arrest is a result of a defect in the acrosome, which is a membrane-bound organelle that develops in the anterior end of sperm head. Specifically, the agho mutant produces sperm that completely lack an acrosome. Molecularly tagging Agho with Green Fluorescent Protein (GFP) allowed me to track Agho in cells and tissues using fluorescence microscopy. Complete rescue is observed when the trans-gene is introduced into the agho mutant background, supporting that the fusion protein is fully functional and can substitute for the regular protein. Agho-GFP is expressed in primary spermatocytes, cells which later give rise to sperm. Within these spermatocytes, Agho-GFP is present in the cytoplasm, and is particularly bright in what appears to be the Golgi, an organelle known to sort lipids and proteins and package them into vesicles for certain cellular destinations. Agho is not detected post meiotic elongation of spermatids or in mature sperm, suggesting that Agho may be involved in an early step in acrosome formation. In addition, a

second mutation of agho whose sequence predicts a truncation of the protein has shown to be viable, indicating that Agho does not play a role in necessary vital functions, but acts specifically on male fertility. It is my goal to not only discover the role of agho, but also understand how its loss results in loss of the acrosome in male germ cells.

Developing an Automated System to Recognize and Classify Denmark Strait Eddies

Krysta Yousoufian, Junior, Computer Science, Applied Computational Mathematical Sciences (Discrete Mathematics Algorithms)

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: James Girton, Applied Physics Laboratory

Mentor: Erika Harnett, Earth Space Sciences

The Denmark Strait Overflow (DSO) is a dense current flowing southwest through the Denmark Strait. Not only is the DSO a crucial current to the global ocean network, changes in it could also be an indicator of climate change due to its position near Greenland. Although the DSO is located deep in the ocean, it causes surface eddies, or circular currents, above its path. Because the eddies mix colder and warmer surface water along a temperature front, they appear on satellite images of sea-surface temperature (SST) taken by the Advanced Very High Resolution Radiometer (AVHRR). Our goal is to develop routines in the MATLAB data processing language that will automatically mark the size and location of eddies visible on AVHRR images and classify each eddy as one of three types: a "spiral," characterized by swirls of warm and cold water; a "blob" of cold water surrounded by warm water; or a "bump," a slight deviation in the path of the temperature front. The first step is to download AVHRR images from NOAA's Comprehensive Large Array-data Stewardship System. We then modify the image files with the NOAA CoastWatch satellite utilities and develop the routines using MATLAB, the M_Map software package, and the MATLAB neural network toolbox. Automation will enable large-scale collection of eddy data, allowing us to look for seasonal and interannual variability in the eddies. Tracking variability and changes in the eddies could potentially be a way to track changes in the DSO, which is a highly important current but is difficult to study directly.

Surprising Moments: Students Talk About Research

What surprised me most about my undergraduate research experience was…

…the people I met and their passion.

…how often "going back to the drawing board" really happens!

…how much respect, responsibility, and independence I was given; I always felt like an important part of the research team.

…how hard it would be.

…realizing the truth behind "you learn from your mistakes."

…how little I knew about my major.

…how much out there is still left to be discovered.

…the friends I made in the process.

…that learning never stops.

…how powerful psychological hurdles can be, yet how easily they can be cleared with help and encouragement from a mentor.

…the amazing work that is being done locally.

…the joy and sense of accomplishment I felt about developing and seeing the research project from start to finish.

Oral Presentation Session 1
1:00 - 2:30pm

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

SESSION 1A

ENGINEERING DEVELOPMENTS

Session Moderator: Paolo Feraboli, Aeronautics Astronautics

Mary Gates Hall Room 074

* Note: Titles in order of presentation.

Using Potential Differences in Trees to Power Electronic Circuits

Carlton Himes, Senior, Electrical Engineering
Mentor: Babak Parviz, Electrical Engineering

As vascular plants transport water, nutrients, and inorganic ions through xylem and phloem conduits, they produce standing electrical potential gradients which vary throughout the plant and relative to the soil. We performed experiments to characterize these electrical properties with a voltmeter in an effort to determine their viability as power sources for electronics. These experiments included testing a tree's ability to drive current into a variety of load resistances, as well as a week-long test to determine the stability and sustainability of the measured voltages. After finding voltages of sufficient magnitude and stability, we successfully powered two circuits: a low-voltage boost converter and a sub-Hz oscillator using only the internal potential differences of a Bigleaf Maple tree.

Crashworthiness and Energy Absorption of Carbon Composite Structures

Bonnie Wade, Senior, Aeronautics Astronautics
Mentor: Paolo Feraboli, Aeronautics Astronautics

The amount of energy a structure is able to absorb during a vehicle impact event is crucial in the design of a safe vehicle. Crashworthiness is the ability of a vehicle to sustain a crash event with minimal or acceptable damage to the occupants, cargo, and structure. Devices such as the tubular front end framework in cars and subfloor vertical stansions in airplanes are designed to dissipate energy under controlled collapse in order to improve the crashworthiness of the structure. Carbon composite devices have been shown to absorb larger amounts of energy more efficiently than metals, dissipating more energy away from occupants in a crash. There are currently no standard test methods for the characterization of specific energy absorption (SEA) of composite materials. In addition, an analytic model which appropriately matches the crush behavior of the physical test needs to be generated. Developing a standard test method and modeling guidelines for crushed composite specimens is essential in understanding crash performance and optimizing crashworthiness of composite structures.

Calibrating Spectroscopic Instruments for ZaP Flow Z-Pinch Plasma Investigation

Genia Vogman, Senior, Aeronautics Astronautics, Mathematics
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Uri Shumlak, Aeronautics Astronautics

The ZaP Flow Z-Pinch experiment is an innovative plasma confinement concept that uses a JXB 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 high-energy space propulsion and efficient fusion power generation, the latter of which can potentially make fossil fuels obsolete. 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 non-perturbative analysis of overall plasma behavior. 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, bulk velocity profile, and density. The latter measurement is of particular interest to understanding plasma characteristics; however, it relies heavily on the accuracy of spectroscopic measurements. To ensure accuracy in these measurements, it is necessary to define an instrument function by calibrating and normalizing each chord's intensity of response to the same light signal. The survey involves the use of discrete-wavelength ion lamps whose intensity versus position functions are used to compare optic fiber throughputs and generate calibration factors that when applied through code, correct for variance and thereby diminish instrument error significantly. 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.

Radiated Power Measurement on the HIT-SI Plasma Confinement Experiment

Mark Chilenski, Senior, Aeronautics Astronautics
Mary Gates Scholar
Mentor: Thomas Jarboe, Aeronautics Astronautics

A bolometer is a device that measures radiated power. 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). In SIHI, the magnitude of the total radiated power in the injector region is of particular interest. In the bolometers in use on and under construction for 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 new units are under construction for HIT-SI. This research will enable a better understanding of the power balance in plasmas formed with SIHI.

SESSION 1B

WETLANDS, WILDFIRES, BUGS, AND PEOPLE

Session Moderator: Michael Kucher, Interdisciplinary Arts Sciences, UW Tacoma
Mary Gates Hall Room 082A

* Note: Titles in order of presentation.

Nature's Fertilizers: Nitrogen-Fixing Endophytes from Willow and Poplar Trees

Jacob Bale, Senior, Biochemistry
Mary Gates Scholar
Mentor: Sharon Doty, Forest Resources
Mentor: Zareen Khan, Forest Resources

One of the major factors limiting plant growth is the availability of fixed nitrogen. This crucial nutrient is often scarce in the environment and is one of the main components of the fertilizers used to improve plant growth. Some plants, however, benefit from the ability to obtain fixed nitrogen through symbiosis with bacteria. Our lab has isolated and performed preliminary analysis on endophytic bacteria obtained from willow and poplar trees indicating that these bacteria may form a novel type of nitrogen-fixing symbiosis. If this is true, then these bacteria could be used to inoculate willows, poplars, and potentially a variety of other plant species, thus acting as a natural fertilizer to improve plant growth. In turn, this could increase the ability of plants to perform phytoremediation, to sequester carbon dioxide, and to serve as a source of biofuel. Research is currently focused on better characterizing the growth of these bacteria in nitrogen-free media, as well as constructing a knockout mutant of the nitrogenase gene cluster in one of the most extensively studied strains. Next, we will assess the ability of the endophytes to improve plant growth in nitrogen-limited conditions with the expectation that the nitrogenase mutant will not aid plant growth while the wild-type endophytes will. This research should not only increase the knowledge of bacterial interactions with plants, but also help to create a healthier planet.

The Effects of Temperature on *Zostera Marina* Seedling Development and Determination of Seed Viability

Frederick Dooley, Senior, Biology (General), Anthropology
Mary Gates Scholar
Mentor: Sandy Wyllie-Echeverria, Friday Harbor Labs
Mentor: Elizabeth Van Volkenburgh, Biology

Zostera marina is a species of seagrass that lives in temperate waters. It has recently declined in abundance in some areas and many hypotheses, some related to climate change, have been proposed for these declines. The purpose of this study was to test the possibility that seed viability and seedling survival is impaired by elevated seawater temperatures. First, seedlings were grown in mesocosms maintained with flowing seawater from the nearby bay. The effect of temperature on seedling survival and growth was measured over 10 days. Seedlings are very vulnerable to temperature stresses and have poor performance at temperatures of 25°C or greater. Temperatures of 30°C are almost always fatal. It has been noted that there is genotypic variation among seeds within sites and this could explain different tolerances. Another hypothesis would be that after the breaking of dormancy seedlings just die. While these explanations are unlikely they should be explored by expanding the number of replicates used within the experiment and possibly explore Z. marina plants through the lifecycle. In the second experiment, the viability of seeds collected in the Fall of 2005, 2006 and 2007 was determined by immersing a sub-sample in 1% solution of vital red stain (TTC) and seawater In this test, viability is determined by the amount of stain present on the cotyledon after 24 hrs. Viability declines with each consecutive year of storage and after three years drops below 50%. In Spring 2009, a follow up experiment is underway to assess the viability of stored seeds from the same years tested in Spring 2008 as well as those collected in Fall 2008. After this the relationship between the seed viability through the TTC staining method and the determination of true viability through germinations will be determined.

Temperate to Tropical: The Trouble with Using Temperate Aquatic Insect Analysis Methods in Costa Rica

Dana Giffen, Recent Graduate, Environmental Studies
Mary Gates Scholar
Mentor: Michael Reese, Program on the Environment
Mentor: Susan Bolton, Forest Resources

With the burgeoning concern for the ways climate change affects sensitive environments, especially in the tropics, finding reliable ways to characterize the biological integrity of aquatic systems has increased in importance. Using benthic macroinvertebrates to gain a holistic view of long-term stream quality has grown in popularity (Clark 2007). Aquatic insects live in the streams for extended periods of time and are therefore good indicators of long-term health. However, almost all analysis methods for families of aquatic insects have been developed for temperate streams, and these have only limited applicability to tropical systems. This baseline study examined physical properties including pH, hardness, alkalinity, canopy cover, substrate dynamics, fish populations, and the composition of aquatic insect populations in three headwater streams-the Jucó, the Grande, and the Chires-near Mastatal, Costa Rica. This study analyzed seven indexes developed for temperate waters; Family Biotic Index, Taxa Richness, Ephemeroptera-Plecoptera-Trichoperta Index, and Shannon-Wiener Index, Simpson's Index, number of endemic taxa, and one newly created index specific for Costa Rican aquatic insects– the Springer Index. The results illustrated the difficulties of determining the relevancy of indexes developed for temperate freshwater systems in analyzing tropical data. In this study, the seven indexes examined used widely variant tolerance values for different families, leading to inconsistent results based on the index used. The family-specific indexes did the poorest job of characterizing the streams, while generalized diversity indexes were more comprehensive. It appears that some of these indexes were not appropriate to assess tropical streams (Davis et al. 2003 and Deliz Quinones 2005). This research effort finds the need for more diagnostic studies to be conducted comparing the efficacy of various indexes, and cautions researchers to use a variety of indexes when attempting to characterize a reach of a river.

Energy Crisis and Catastrophic Wildfires: Can Management of Montana's Forests Solve these Problems?

Troy Lane, Senior, Environmental Science Resource Management (Sustainable Forest Management)
Mentor: Kristiina Vogt, Forest Resources
Mentor: Daniel Vogt, Forest Resources

Future demands for energy cannot be satisfied by the existing supply; necessitating the adoption of innovative and alternative energy production systems. Historical wildfire patterns in Montana and human responses to them suggest that changes in policies and treatments may provide biofuels while protecting multiple resources. Combined stocking levels and stand characteristics create a forest vulnerability index allowing for adaptive management alternatives. The vulnerability assessment along with wildfire causes, wildfire responses, and the quantity of fires indicates the need to manage forest health in the face of climate change and the increased probability of catastrophic wildfires. Furthermore, the forest vulnerability index identifies the counties within the state best suited for alternative wildfire management. The alternative management would mitigate both wildfire danger and forest management costs through sustainable forest thinning for methanol production. This research addresses constraints on sustainable thinning projects and options that may remove or by-pass such constraints.

A Study of Puget Sound Shorebirds at the Allyn Long Dock and their Possible Association with Degraded Shellfish Growing Areas: A Citizen Science Project

Lari Seever, Senior, Environmental Studies
Mentor: Julia Parrish, Aquatic Fishery Science
Mentor: Michael Reese, Program on the Environment

Water quality degradation due to bacteria is a significant problem in the United States due to the human health and economic implications. High levels of coliform bacteria will lead to closures of shellfish beds due to the risk that contaminated shellfish pose to human health. Bird feces has been implicated as the leading source of the coliform bacteria in certain shellfish beds surround the Port of Allyn. This project's goal is to build a citizen science program to find data on the birds which congregate and produce feces on and around the Allyn long dock. The data found will be analyzed and public outreach material will be developed to communicate the findings to the general public.

Analysis of Long Term Change in Arid Wetlands

Christopher Vondrasek, Senior, Environmental Studies
Mentor: Meghan Halabisky, Forest Resources
Mentor: L. Monika Moskal, Forest Resources

Wetlands are essential ecosystems. They offer critical habitats for plants, and both resident and migratory animal species. They provide important ecosystem services. Wetlands moderate seasonal water cycles, aid erosion control, help the recharge of groundwater supplies, and support a range of natural food sources. In arid climates, wetlands hold a key role as reservoirs of water and life. The possibility that we might understand these wetlands, especially their potential for change and persistence in a landscape wide context, can be increased with more complete and contextual knowl-

edge of them. Remote sensing and geospatial analysis technology provides tools that allow research to consider wetlands and the landscape around them in spatial and temporal terms. This research uses historical aerial photographs from 1970, 1987, and 2006 to quantify spatiotemporal changes in the wetlands of arid regions in Douglas County, WA. Wetlands from the 2006 aerial images were previously delineated using an hierarchical object-based feature extraction method and classified by texture, shape, and other identifying characteristics. The 1970 and 1987 historical photographs are georeferenced, and classified in the same way in order to quantify the spatiotemporal wetland dynamics. This research also tests whether these extraction and analysis methods are accurate ways to measure long-term change of arid wetlands.

SESSION 1C

POSTMODERN PHYSICS

Session Moderator: Gerald Seidler, Physics
Mary Gates Hall Room 085

* Note: Titles in order of presentation.

Improving Qubit State Detection Through Hardware
Aaron Avril, Senior, Physics, Mathematics
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Boris Blinov, Physics

We are testing the viability of Barium-137 as an optical qubit for quantum computation. The ion is contained in a Linear Paul Trap and manipulated with lasers tuned to stimulate desired electron transitions. I am assembling and programming a pulse programmer that will allow the lab to be controlled by a single program. It will serve as a central computer to the lab. This will synchronize all of our equipment to one clock, allowing for more precise control over trapped ions. It receives transistor-transistor logic (TTL) pulses as inputs that may be used to record data or as triggers for the program. To command equipment, the programmer outputs TTL pulses and sine waves with user-defined frequency, amplitude, and phase. This allows any desired waveform to be synthesized, which will improve the control that we have over our ion-manipulation lasers, thus improving the viability of our ion as a cubit.

Modeling Bose-Einstein Condensates in Double Wells
Cory Schillaci, Senior, Physics
Mary Gates Scholar
Mentor: William Reinhardt, Chemistry
Mentor: Douglas Faust, Physics

In 1924 the field of quantum physics was still in its infancy. Nevertheless, Einstein, while extending work done by Bose, discovered a curious phenomenon. He found that the new theory predicted an interesting phase of matter, in which a large fraction of the particles in a gas of bosons (particles with integer spin which lack the famous Pauli exclusion principle familiar to students of chemistry and physics) simultaneously populate the quantum ground state at small, but non-zero, temperatures. This novel state is now known as a Bose-Einstein condensate (BEC). Because the necessary temperature is incredibly small (typically on the order of nano-Kelvin), Einstein's prediction waited over seventy years to be realized experimentally in dilute gasses of Alkali atoms by Cornell, Wiemann and Ketterle in 1995. The field exploded and groups around the world were soon reproducing the feat; Cornell et al. were promptly awarded the 2001 Nobel Prize in Physics. BEC's are very exciting because they exhibit quantum behaviors, such as coherent matter wave interference, on a macroscopic scale. Where experiments flourish, theoretical tools are also necessary to make sure that the experiments are accurately interpreted. Several tools are available for the modeling of BEC dynamics, but the best known are effective only in certain limits. Gross-Pitaevskii theory allows physicists to model condensates which are trapped in "smooth" potentials. On the other hand, the Bose-Hubbard model is effective for condensates which are split by large barriers through which they cannot tunnel. Our project is to develop a simulation technique which is valid in the intermediate limit, with a weaker but non-zero potential barrier between two wells of a trap. I have extended the simulation from 1-D to 2-D, and used it to analyze the conclusions of an experiment by the Cold Atom Group at MIT.

Measuring the Mass of a Hill: Refining Precision Measurements of Gravitational Interactions
Carin Schlimmer, Senior, Physics
Mary Gates Scholar
Mentor: Stephan Schlamminger, Physics

Although General Relativity describes gravitational attraction very well, theorists are struggling to integrate it with successful descriptions of the other fundamental interactions observed in nature. Alternative ideas such as string theory, M-theory, and quantum gravity have been proposed, but many violate the long-held principle that all bodies fall with the same acceleration in a uniform gravitational field. The EötWash group at the University

of Washington is conducting a precision experiment to search for such modifications to gravity. Unfortunately, since gravitational interactions cannot be shielded, the experiment is also sensitive to masses in the vicinity of the laboratory. These masses produce false signals, which need to be established in a separate measurement. Of great concern to the EötWash experiment is the signal produced by the nearby hill, which varies in time as the moisture content of the soil changes. Currently, due to lack of a dedicated instrument, the field produced by the hill is measured only every few months. The interpolation between measurements is a major source of error in this experiment. We have designed and built a dedicated torsion pendulum experiment to measure the hill's gravitational field continuously. The mass distribution of the pendulum is optimized for maximum sensitivity to the hill's field. The pendulum is made of aluminum to reduce weight and allow for precise machining. To decrease electrostatic interactions between the pendulum and its environment, we coated the pendulum with gold. Disturbances due to air currents are eliminated by taking measurements in vacuum. The pendulum's position is recorded with a laser readout system built for this experiment. We calibrated the torsion balance's response by accurately placing known masses at specific locations, thus changing the field by a calculable amount. We hope to present the first calibrated measurements of the hill's gravitational field and its variations by late spring.

Investigating Claims of Perturbations in Nuclear Decay Rates During Solar Flares
Andrew Palmer, Senior, Physics
Mary Gates Scholar
Mentor: Alejandro Garcia, Physics

In a recent paper [arXiv:0808.3156] Fischbach and Jenkins make two bold claims. Their first claim is that the sun emits more neutrinos during a solar flare than it otherwise would during normal solar processes. The second claim is that neutrinos affect the decay rate of Manganese 54. Evidence is given for these claims through an experiment which measures the decay rate of Manganese 54 and shows dips in this rate which the authors interpret as corresponding to solar flares. Our project sets out to search for the claimed effect in order to either back up this extraordinary discovery or disprove it. Our experimental setup consists of a sample of radioactive Manganese 54 with a half-life of 312 days and a second sample of radioactive Americium 241 with a half-life of 432 years. In the experiment we record the number of nuclear decay events of both samples over time intervals of four hours (the same time intervals used in the original experiment) using a Germanium detector. The Americium is used as reference because of its very long half-life. Over the next few months we will constantly record these nuclear decay events and plot the resulting decay rate against solar activity data to see if there is any evidence of correlation between the two, either confirming or denying the original claim.

SESSION 1D

THROUGH A GLOBAL LENS: SHIFTING CONTEXTS OF IDENTITY, CULTURE AND POLITICS

Session Moderator: Roberto G Gonzales, Social Work
Mary Gates Hall Room 206

* Note: Titles in order of presentation.

Drawing Turkish Identity: The Atatürk Mausoleum Design Competition
Scott Claassen, Senior, Architectural Studies
Mentor: Brian McLaren, Architecture

The international competition to design Mustafa Kemal Atatürk's mausoleum is a record of the search for a Turkish national identity. Dramatic renderings reveal not only the form, but also the intent of the designs, which reflect the debate over the direction of the Republic of Turkey following Atatürk's death in 1938. Due to his role as the founder and first president of the new secular state of Turkey, Atatürk was a symbol of the Republic. He sought to maintain its legitimacy by creating a collective identity for the Turkish people that was both modern and rooted in nationalism. He strove to make Turkey competitive, while encouraging Turks to seek inspiration from the land of the Anatolians and Hittites, revered as the roots of their civilization. Projecting an image was crucial, and architecture became a tool for this. Competitions to design the new Grand National Assembly and the capital city of Ankara gave political ideas a graphic expression. In a similar manner, the drawings for the Atatürk Mausoleum Design Competition demonstrate a wide variety of approaches to how to express his legacy, as an addition to portraying the building form they allowed these architects to take a position on the issue of Turkish identity. How they represented modernity, nationalism and religion through the drawings demonstrates the conflicts within society as well as the aspirations of the new Turkish State.

Thick Passports, Thin Excuses: Debunking the Neocolonial Myth of Tourist Contact
Kristen Hogue, Senior, Communication
Mentor: Crispin Thurlow, Communication

"I think many of our problems as a country would be solved if people had thick passports." This assertion by celebrity Matt Damon was displayed prominently on a recent cover of the *Condé Nast Traveler* magazine, which also showed a centered, self-assured Damon in the foreground of an exoticized African landscape. This sentiment echoes a well-known quote from Mark Twain's *Innocents Abroad* published 140 years ago: "Travel is fatal to prejudice, bigotry and narrow-mindedness". Both comments reflect an enduring myth at the core of tourism: that travel is in itself sufficient for dissolving prejudices and bringing about intercultural, global understanding. In this presentation, I argue that the myth of tourist-host contact expresses a neoliberal ideal which itself is rooted in neocolonial visions of Other and postcolonial fantasies of equality. To this end, I consider exaggerated claims for the nature, extent and impact of contact between tourists and local people that are key not only to tourism discourse but also to social science discourse in the form of the well-known Contact Hypothesis (CH) proposed by Gordon Allport in his 1954 book *The Nature of Prejudice*. A careful review of the CH research literature in fact shows that the "optimal" prejudice-reducing conditions for contact cannot hold for tourism. The few CH studies that do address travel – as tourism or study abroad – also show far lower rates of decreased prejudice. In fact, some studies indicate that the kind of fleeting contact that characterizes both tourism and study abroad can actually increase prejudice. The truth, it seems, is that intercultural contact is hardly ever enough to overcome prejudice, least of all in the context of tourism where (a) the extent of tourist-host contact is greatly exaggerated to begin with, and (b) any contact is unavoidably structured by political, economic and historical relations of power.

Japanese Americans and Music Before and During the Incarceration Camps

Daniel Kashima, Senior, Music, Neurobiology
Mary Gates Scholar
Mentor: Christina Sunardi, Music

One response to the bombing of Pearl Harbor was the signing of Executive Order 9066 by President Franklin Delano Roosevelt on February 19, 1942. This Order resulted in the forced displacement of Americans of Japanese ancestry into ten desolate incarceration camps. This population included those who immigrated from Japan, the first generation Japanese (*Issei*) and their American-born children (*Nisei*) who were raised in a very different setting. While many studies have examined this incarceration—investigating issues including the government's violation of *Nisei* civil rights to the expression of cultural roots and identity through arts and crafts—there remains a paucity of research on music making in the camps. As a step towards filling this gap, I have interviewed camp survivors, members of survivors' families, and consulted written sources to examine the types and the roles of music for the Japanese Americans. I have found that Japanese Americans performed a variety of genres, including Western Classical music, swing music, and most likely practiced Japanese Classical music. Although the camps furnished the basic necessities of life such as food and shelter, it lacked the spiritual and humanistic aspects. I argue that Japanese Americans practiced music in this environment in order to fill this void. When people are placed into a senseless situation, they have to come up with activities to give some meaning and direction to their lives beyond that of physical survival. These stories help illustrate this point and are also valuable on their own as they help to preserve an important part of Japanese American and American history.

From "Isroel" to "Bukharskiye Yevrei" to "Bukharian Jews": Issues of Identity and Community for a Central-Asian Jewish Enclave

Ruben Shimonov, Senior, International Studies, Near Eastern Studies (Culture Civilization)
Mary Gates Scholar
Mentor: Martin Jaffee, Jackson School of International Studies

Bukharian Jewry, a group with a 2000-year history in Central Asia, has received minimal attention in academia. This is a shame not only because of the gap it leaves in our understanding of world Jewry, but also because of what the Bukharian experience can contribute to Near Eastern Studies. Furthermore, an analysis of Bukharian Jews can offer valuable information to Immigration Studies—since the majority of Bukharians have immigrated to the United States within only the past two decades. This project investigates forms of identity that have emerged among Bukharian Jews by looking at both their historical presence in Central Asia and their very recent immigrant experience to the U.S. The project's underlying theoretical link is the concept of "the other", as Bukharians have always constituted minority enclaves within societies in which they have lived—whether under Islamic empire, Tsarist rule, Soviet governance, or American society. To explore this project's main query—how various environments, in which Bukharians always formed minority communities, have affected their identity—this paper relies on both literary and ethnographic research. The literary research synthesizes the scarce textual information found in books, community newspapers, new media, and primary documents. The ethnographic research consists of both qualitative and quantitative work—i.e. in-depth interviews and mass surveys. The paper argues three points: Bukharian conception of what it has meant to be "Bukharian Jewish" is continuously transforming—

since Bukharian Jews have always been in close dialogue with the dominant, changing communities in which they have lived. Moreover, this evolution is in constant tension with the discourse of an essentialized Bukharian narrative. Both of these phenomena—the reformulating of identity and its tension with an internalized past—have come to play a key role in Bukharian U.S. immigrant communities; in such, the relationship between the historical narrative of Bukharian Jews and their current social predicaments in the U.S. is intimately linked.

Changing Body Image and Beauty Standards in China
Mckinley Smith, Junior, Anthropology
Mentor: Stevan Harrell, Anthropology

With the increased globalization of media imaging, the global nutrition transition, and the correlated increase of urbanization leading to higher accessibility of food and media marketing and distribution, eating disorders have gone global. The current generation of young women in China struggle when they encounter cognitive dissonance between the food rules and beauty expectations of their post-Mao China mothers, and their place in the globalization socioeconomic strata. My fieldwork in Western China focused on how young women in urban Chengdu, Sichuan have adjusted to a more global lifestyle, and how their interaction with western foods, cultural ideals, and media imaging have effected their body image and personal dietary ideology. I surveyed 20 women: ages 18-22, all students at Sichuan University, Sichuan Normal University, Sichuan Sports University, and Chengdu Modeling School. My study includes semi-structured interviews, anthropometric measurements, participation in the Chengdu cheerleading team, and magazine and modeling school observations. While the results gives insight into to broader impact of globalization on female body image in urban China, it only gives direct information on the current transition in Chengdu. I hope that through this study, I will assist the global efforts to recognize and assist in the prevention and treatment of eating disorders and disordered eating.

Small Land/Expansive Relationships: Tonga's Conflicting Identities on the International and Local Level
Andrea Waade, Senior, Earth Space Sciences (Environmental), International Studies
Mary Gates Scholar
Mentor: Holly Barker, Anthropology
Mentor: Deborah Porter, Jackson School of International Studies

As citizens of a small island developing state (SIDS), Tongans are currently experiencing the mounting environmental and political challenges of climate change. The government of Tonga has allied with other SIDS to gain support from donor nations under a banner that highlights the "inherent vulnerabilities" of their islands. These vulnerabilities include being spatially constricted and isolated. However, through interviews conducted within Tonga, I found the language the government uses on the international stage conflicts with how Tongans characterize themselves and their relationship to noticeable environmental changes. International emphasis on inherent spatial vulnerabilities fails to recognize how islanders identify with their land and community. These discursive differences led me to explore the intrinsic power behind spatial representations, and the relationship between the spatial discourse of islanders and their identity.

SESSION 1E

PSYCHOLOGICAL PERSPECTIVES

Session Moderator: Steven Buck, Psychology
Mary Gates Hall Room 228

* Note: Titles in order of presentation.

Correlates of Sexual Assault Perpetration in a Sample of Male Community Social Drinkers
Lauren Burris, Recent Graduate, Psychology
Mentor: Michele Parkhill, Alcohol Drug Abuse Institute
Mentor: William George, Psychology

Sexual assault is extremely prevalent on both college campuses and in the community. Recent studies have found that between 25% and 64% of men report perpetrating some form of sexual assault (Abbey et al., 2006; Davis et al., 2008; Koss et al., 1987) While most researchers focus on victimization, it is important to look at the characteristics associated with perpetrators in order to accurately inform prevention and intervention programs. The confluence model is a useful predictive model of sexual assault perpetration that focuses on two groups of risk factors – hostile masculinity and impersonal sex attitudes and behaviors (Malamuth et al., 1991, 1995). Although the model usually predicts the number of sexual assaults perpetrated, this study examined correlations between known predictors of perpetration and the severity of sexual assaults perpetrated. Participants were 167 men from the Seattle community who were 21 – 35 years old, single, and social drinkers. After filling out personality and experiential measures, men completed the Sexual Experiences Survey (Koss et al., 1987), which measures the frequency and severity of sexually aggressive behaviors. Men were categorized according to the most severe type of sexual assault reported:

nonperpetrators, forced contact, sexual coercion, and attempted/completed rape. It was predicted that adult sexual assault severity would be significantly and positively correlated to child sexual assault severity, impersonal sex attitudes and behaviors, sexual sensation seeking, general drinking behaviors, and both sex-related and general alcohol expectancies. As hypothesized, adult sexual assault severity was positively correlated with all of the independent variables except general drinking behaviors. These findings are consistent with previous work on the confluence model. These results demonstrate the need for prevention and intervention programs that focus on childhood sexual assault experiences in addition to alcohol consumption.

The Effects of Portraying Emotionally Complex Roles on the Actors Who Portray Them

Emily Atwood, Sophomore, Psychology, North Seattle Community College
Christi Proffitt, Sophomore, Psychology, North Seattle Community College
Nathan Weinstein, Junior, Pre-Sciences
Mentor: Melissa Grinley, Psychology, North Seattle Community College

Do actors experience lingering adverse psychological effects after playing an emotionally complex character? This study investigated whether or not actors experience this sort of emotional residue, and what the experience was like for them. Three actors were interviewed and asked to think about a specific, emotionally difficult role they have played and to describe their emotional and physical states before, during, and after the portrayal, as well as any applicable techniques they used to prepare, act, or disengage from that character. The interviews were recorded on an audio recording device, and the data was subsequently transcribed so the core responses to each question could be determined. Two participants reported clear emotional after-effects from playing emotionally difficult roles, and all 3 participants were found to put considerable preparation, effort and personal emotion into playing their roles. Suggestions for further research include a larger sample size and more detailed psychological inquiry into the processes actors go through to portray emotionally involved character roles.

Does Use of Select DBT Skills Predict Change in Young Adults' Drinking, Anxiety and Depression Levels?

Susan McKay, Senior, Psychology
Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Ursula Whiteside, Psychology
Mentor: Mary Larimer, Psychiatry Behavioral Sciences

This project includes the assessment of a psychological intervention designed for heavy drinking young adults who report that when they drink, most of the time it is for emotion regulation reasons. Beyond-BASICS is a one-session, one-hour intervention delivered in a Motivational Interviewing style (Miller & Rollnick, 2002). The aim of this intervention is to address the emotional component of drinking by introducing three select skills from Dialectical Behavioral Therapy (DBT) (Linehan, 1993): Mindfulness, Mindfulness of Current Emotion and Opposite Action. At the one and three month time points following the intervention, participants reported consuming fewer drinks per week, drinking less for emotion regulation reasons, and experiencing fewer episodes of binge drinking and the occurrence of drinking-related problems. We also found improvements in depression, anxiety and difficulties in regulating emotions. We wished to explore whether participants' utilization of the DBT skills introduced during the intervention was predictive of these changes seen in drinking and emotion regulation. Participants were contacted and asked to complete a short survey indicating whether or not they had practiced these DBT skills to help manage their feelings, and if so, to provide specific examples. This presentation indicates whether the practice of DBT skills predicts improvements seen in drinking, anxiety and depression within this population of heavy-drinking young adults.

Cluttered Workspace: A Distraction to Focus on Tasks

Patty Neil, Sophomore, Psychology, Business, North Seattle Community College
Soona Moxon, Junior, Psychology, North Seattle Community College
Norma Renteria, Psychology, North Seattle Community College
Li Min, Psychology, North Seattle Community College
Mentor: Melissa Grinley, Psychology, North Seattle Community College

Previous studies have shown that clutter in the workspace diminishes the ability to focus on a task. This experiment assigned a control group to clutter-free workspaces and an experimental group to workspaces cluttered with magazines, desk toys, and crumpled paper to test the ability of participants to complete a written test. Questions compiled from various standardized tests ranging from 8th grade to 10th grade difficulty as well as one question from the GRE test were included in the test. It was expected to require 20 minutes for completion. The allotted time for the test was 15 minutes to provide a range of completion for comparison between randomly assigned participants and to avoid a ceiling effect. The experimenters believed the data analysis would support the hypothesis that those in the cluttered environment would perform worse on the test than those in the clutter-

free environment.

Getting Better, Looking Better: Is It True?
Joscelyn Rompogren, Senior, Psychology
Diane Kim, Recent Graduate, Psychology
Mentor: Marsha Linehan, Psychology, Behavioral Research and Therapy Clinics

Many studies in the past have used specific instruments to assess whether an individual has benefited from therapy, but no research has been done to determine if a person simply looks improved after treatment. The current study seeks to establish whether there is a noticeable difference in a person's appearance post-treatment versus pre-treatment. Twenty-two participants have been selected from a pool of subjects who have completed Dialectical Behavior Therapy and obtained a score of 1 (very much improved) or 2 (much improved) on the Treatment Change Scale post-treatment. Each subject was videotaped during assessments both before and after the year of therapy. Two-minute video clips of the subjects have been identified both at pre-treatment and at the 12-month mark when treatment was completed. These clips will be shown on mute in random order to blind observers who will not be told which clip was taken at pre-treatment and which was post-treatment. The observers will be asked to guess, based on clients' appearance, which clip was taken before therapy and which was from the 12-month stage. The number of correct responses will be recorded. In a pilot trial of four video clips, observers were correct 100% of the time. Thus, we hypothesize that the number of correct responses will be significantly greater than chance. Implications from these findings may contribute to the growing research on stigma, since people suffering from mental illnesses may be treated differently based on how they look.

Effects of Appearance on Jury Decision Making
Zach Lym, Sophomore, Psychology, Design, Usability, North Seattle Community College
Jessica Benson, Junior, Extended Pre-Major
Eli Boer
Mentor: Melissa Grinley, Psychology, North Seattle Community College

During sentencing, judges and jurors are instructed to examine the severity of a crime; consideration by a juror of physical characteristics of the defendant would be morally compromising. Yet, prior research has shown attractiveness and appearance of the defendant subconsciously effects jurors' decision making. Our experiment linked a picture of either a "well put-together" or an "unkempt" woman (same woman with different makeup, clothing, and hair) with a fictional court case. Eighty six participants filled out a survey determining the amount of punishment, such as jail time, community service, and monetary fines, the woman should receive. The difference between the two groups was not statistically signifigant. However, we identified key problems with, and countermeasures for, our test manipulation and measures. The results of this study could prompt more rigorous research into the effects of appearance on sentencing to avoid possible discrimination by judges and juries in situations such as courthouse teleconfrencing.

SESSION 1F

NEUROBIOLOGY: EXCITABILITY, DEVELOPMENT AND DISEASE

Session Moderator: Martha Bosma, Biology
Mary Gates Hall Room 231

* Note: Titles in order of presentation.

Uncovering the Molecular Basis of Lou Gehrig's Disease
Kennet Ploeger, Senior, Biochemistry, Business Administration (Finance)
Mentor: Valerie Daggett, Bioengineering
Mentor: Amanda Jonsson, Biomolecular Structure Design

Amyotrophic Lateral Sclerosis (ALS), or more commonly known as Lou Gehrig's disease, affects over 30,000 Americans, and as yet there is no known cure. In ALS, the protein Superoxide Dismutase (SOD) undergoes conformational changes that lead to aggregation, which disrupts motor neutrons and eventually leads to the loss of control over voluntary movement. Through our research we look to understand the conformational changes in SOD, in the hope of developing insight into possible targets for drugs that could stabilize SOD and control the disease process. Based on the initial structure of SOD, we suggest two hypothesizes for the beginning of the conformational changes; either the two β-sheets that comprise SOD monomers separate in their entirety as whole sheets, or the individual strands comprising the β sheets separate and disrupt the sheets. Both of these processes would then lead to instability as the hydrophobic core of the protein is exposed to solvent molecules. To study this process, our lab uses computer molecular dynamics (MD) simulations it bypasses the need to prepare SOD in solution, a challenge that faces modern biophysical methods because of the tendency of the SOD aggregates -formed from unstable SOD monomers - to be insoluble. In MD simulations, each atom in the protein has its movement modeled through the use of Newtonian laws of motion. These simulations allow us to

watch changes in conformation over time and to characterize it through measurable properties. Preliminary research seems to support the first hypothesis, that SOD monomers first undergo a separation of the two β sheets which then exposes the hydrophobic core and destabilizes the protein.

Integration of Tumor Tissue and Mathematical Modeling of Glioma Growth and Invasion

Julia Hamilton, Senior, Biochemistry, Music
Mentor: Kristin Swanson, Pathology

Gliomas are brain tumors that grow and invade aggressively and are deadly even with treatments such as surgery, chemotherapy, and radiation. The lab focuses on bio-mathematical modeling glioma growth and diffusion informed by imaging techniques such as MRI. Dr. Swanson's mathematical model has been proven to accurately present and predict growth of untreated gliomas. The basis of the model is net invasion and net proliferation of glioma cells; these two parameters are specific to each patient. My research has two main goals: to connect immunohistochemistry of tumor tissue with the patient-specific model-defined metrics for proliferation and invasion kinetics. My research concentrates on determining how biological factors correlate with model-based metrics for growth and invasion of gliomas by associating model-predicted growth kinetics with tissue obtained from actual patients in the Swanson lab database via immunohistochemistry, among other techniques. Through immunohistrochemistry techniques, I will be able to look for biological factors present in the tissue such as Ki-67, which is a protein that serves as a cellular marker for proliferation. Ki-67 is a good marker to determine the growth fraction of a given cell population. Thus, Ki-67 provides a direct connection to the net proliferation rate from the model. Other important biological factors can yield a connection between tumor tissue and the imaging component of the lab; vascular endothelial growth factor (VEGF) signals proteins involved with angiogenesis. Among other contributions, high levels of VEGF stimulate vascular permeability which is typically excessive in highly proliferative high-grade gliomas. Through investigating biological factors such as Ki-67 and VEGF, these connections will link protein expression of tissue to the growth model and imaging. Analysis of these proteins will occur by first establishing the tissue bank of samples taken from patients in the Swanson lab database. This research contributes to the goal to lead to improved treatment and diagnosis of gliomas.

Anatomic Variation in Quantitative Measures of Glioma Aggressiveness

Mindy Szeto, Senior, Biochemistry, Sociology
Amgen Scholar, Mary Gates Scholar,
Washington Research Foundation Fellow
Mentor: Kristin Swanson, Pathology

Gliomas, the most common primary brain tumors, are extremely aggressive and uniformly fatal, recurring inevitably despite treatment by surgical resection, radiation therapy, and chemotherapy. This is especially true of high-grade, rapidly growing glioblastoma multiforme (GBM), which account for nearly half of all gliomas. Current medical imaging techniques are unable to assess the full extent of diffuse glioma invasion; the in vivo dynamics of each tumor remain unclear. Mathematical modeling is an ideal approach to enhancing the diagnosis and treatment of this insufficiently understood disease. Using a model for glioma growth that has been shown to have prognostic significance as well as spatial accuracy in predicting disease distribution, progression, and recurrence, GBM aggressiveness can be described in terms of the diffuse invasion (net dispersal rate D) and proliferation (net rate ρ) of malignant cells. My research investigates the influence of a glioma's anatomical location on its growth kinetics as quantified by the model parameters and the radial velocity of tumor expansion. Routine magnetic resonance imaging (MRI) data from 140 newly diagnosed GBM patients was reviewed to categorically assess the tumor's spatial relationship to central brain structures. Image analysis yielded tumor volumes and radii, allowing subsequent calculations of the patient-specific model parameters and velocity of tumor growth. Results from statistical analyses across all spatio-anatomic classifications showed no significant differences in range or variability for the distributions of D, ρ, D/ρ, or velocity, which implies that the biological aggressiveness of gliomas is independent of anatomic location. This is a direct contradiction to previous studies that have proposed a link between anatomical location and aggressive glioma behavior associated with poor patient survival. Future work will consider the effects of anatomic barriers and relative white matter location on observed differential growth patterns, while quantitatively controlling the rates of biological aggressiveness implicit in the model.

Activity-Dependent Regulation of 5HT-Positive Raphe Neurons in Developing Mouse Hindbrain

Mark Shi, Senior, Biochemistry, Neurobiology
Mary Gates Scholar
Deva Wells, Senior, Neurobiology
Mentor: Martha Bosma, Biology

In many regions of the developing nervous system, spontaneous synchronous activity (SSA) plays a role in synaptogenesis, cell positioning, ion channel development, and neuronal migration. SSA has been observed in the hindbrain, the most caudal of the three primary divisions of the developing vertebrate brain that develops into the cerebellum, pons, and medulla. These regions coordinate complex muscular movements, equilib-

rium, and autonomic functions. In previous studies, our lab has identified an internal pacemaker, which drives SSA during a discrete window of time during embryonic development; this pacemaker region is a cluster of serotonergic (5-HT) neurons located between rhombomeres (r) 2 and 3. We are currently examining the mechanism by which SSA develops in the hindbrain. Using intracellular calcium imaging to visualize electrical events, we have observed SSA primarily propagating rostro-caudally along the midline of hindbrains at embryonic day (E) 11.5. Culturing hindbrain tissue from E10.5 to E11.5 has allowed us to pinpoint requirements for SSA in vitro. We have shown that hindbrains cultured in the presence of ketanserin, a blocker of the 5-HT2 receptor, have SSA with reduced frequency at E11.5, and fewer 5-HT-positive neurons, as shown with immunocytochemistry. Tissues cultured in high concentrations of extracellular potassium or Valproic Acid (VPA), the latter of which is a model for autism in mice, exhibit an increased frequency in SSA. Furthermore, tissues cultured with VPA have SSA with greater amplitude that extends beyond the midline to lateral regions. We therefore postulate in this model of cultured hindbrain that activity itself is able to regulate the appearance and excitability of the cluster of 5HT-positive pacemakers that drive SSA in the hindbrain.

The Functional Fole of Tbr2 in Adult Hippocampal Neurogenesis

Roderick Yang, Senior, Biology (Molecular, Cellular Developmental), History
Mentor: Robert Hevner, Neurological Surgery
Mentor: Rebecca Hodge, Pathology

The dentate gyrus of the hippocampus 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 has only recently been demonstrated in mammals. There is a relationship between adult neurogenesis and many neurodegenerative conditions such as Alzheimer's and Parkinson's disease; in patients with such diseases, pathologies can arise in some specific regions of the brain involved in normal adult neurogenesis. Furthermore, neurogenesis in the adult hippocampus may have implications for memory and learning, as the hippocampus is an important structure in those functions. Our research is concerned with Tbr2, a transcription factor in the brain that 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 in early brain development. Tbr2 was also found to play a similar role in the adult hippocampus. In particular, it is expressed in an intermediate progenitor cell (IPC) population within the dentate gyrus; it may be important in regulating the maturation of the IPCs into neurons. However, the actual function of Tbr2 in this process is not clear. We use retroviral vectors to manipulate the expression and function of Tbr2 in order to gain some insight as to whether Tbr2 is necessary and what purpose it serves in adult hippocampal neurogenesis. Understanding the transcriptional program regulating adult neurogenesis is the first step in exploring new treatments for many diseases.

Correlation Transfer in Stochastic Based Neuron Simulations

Evan Thilo, Senior, Neurobiology
Mary Gates Scholar
Mentor: Eric Shea-Brown, Applied Mathematics

Populations of neurons in the retina, olfactory system, visual and somatosensory thalamus, and many cortical regions show temporal correlation between the discharge times of their action potentials (spikes). But how are these correlations transmitted throughout the brain? This study examines the transfer and creation of input correlations in simulated populations of neurons that receive partially overlapping inputs. These neurons are governed by differential equations derived in the Nobel Prize work of Hodgkin and Huxley in 1952. Previous studies using simplified spiking models such as the "integrate and fire" model showed that as the spiking rates increased, the transferred correlation among these spikes also increased. This has potentially important consequences for neural coding and information transmission. Since the leaky integrate and fire model is a simplified version of the Hodgkin-Huxley model, we hypothesized our system would display similar trends in firing rates and correlations. Using Monte-Carlo simulations to investigate our hypothesis, we found that the Hodgkin Huxley model displays more complex characteristics: there are regions in the parameter space where increases in spiking rates vary directly or inversely with correlation. These neurons display oscillatory, poisson-like, and bursting behaviors. Measuring correlation at certain timescales show that output correlation decreases within the parameter space that involves bursting. Our future direction is to see if input correlation is transferred over long timescales at the level of entire bursts rather than individual spikes, so that the bursting phenomenon is connected to unexpected trends in correlation.

The Effect of Membrane- Impermeable Cysteine-Modifying Reagents on Eag-1

Benjamin Drum, Senior, Neurobiology, English (Creative Writing)
Mary Gates Scholar
Mentor: William N. Zagotta, Physiology Biophysics
Mentor: Anne Carlson, Physiology Biophysics

Eag-1 is a voltage-gated K+ channel found in neural tissue. Although healthy somatic cells do not express Eag-1, it is expressed in every type of cancer cell studied thus

far, and is used clinically as a tumor marker. The channel also has a binding site homologous to cyclic-nucleotide binding sites, but it is currently unknown what role this domain plays in channel gating. Eag-1 channels are comprised of four subunits, each with six transmembrane domains (S1-S6), where S4 is the voltage sensor and S5-S6 make up the pore domain, analogous to the K+ Shaker channel. Very little is known about the physiology and significance of Eag-1, including its specific role in brain tissue and the pathways that regulate it. However, it is known that Eag-1 plays an important role in cellular excitability. I used intracellular patch clamp and applied cysteine modifying reagents to Xenopus oocytes expressing the mouse form of Eag-1 to help elucidate Eag-1's structure and function. There are eighteen cysteines per channel subunit, but it is unknown whether these cysteines are accessible or near the pore. I assayed the response of Eag-1 to two cysteine-modifying reagents, MTSET and MTSES. Because MTSET and MTSES are charged molecules, they are membrane-impermeable. MTSET is positively charged and MTSES is negatively charged. Thus, I assayed the role of various cysteines in the intracellular side of the protein. I determined that both reagents block the channel almost completely. This block occurs almost instantaneously with concentrations as low as 5 μM and is irreversible. In the next steps of my research, I will attempt to rescue the effect of MTSET and MTSES by mutating cysteine residues that are hypothesized to be near the pore.

SESSION 1G

DEVELOPMENTAL GENETICS OF HUMAN DISEASE

Session Moderator: Celeste Berg, Genome Sciences
Mary Gates Hall Room 234

* Note: Titles in order of presentation.

p120 Catenin and Signaling Pathway Necessary for Cell Motility

Cynthia Hsu, Senior, Biology (Molecular, Cellular Developmental), Biochemistry
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Merrill Hille, Biology

Gastrulation is a crucial step in embryogenesis, creating differentiation between ectoderm, mesoderm, and endoderm and forming necessary organs. On the molecular level, transmembrane and juxtamembrane proteins located at the adherens junction, such as cadherins and p120 catenin respectively, work together to either promote cell motility or adhesion, which we study using the zebrafish embryo model. We hypothesized that when p120 is at the plasma membrane, it binds and stabilizes the cadherins, causing cell clustering and increased adhesion, and when p120 is in the cytoplasm, it activates Rac1 and inhibits RhoA (two RhoGTPases), which causes cell motility. By morpholino induced knockdown, we found that p120 catenin depletion caused defects consistent with the loss of cellular migration. In addition, increasing levels of Rac1 in embryos are proportional to embryo abnormality rates, but Rac1 mRNA in moderation has the ability to rescue p120 catenin-depleted embryos. These results demonstrate that p120 catenin is crucial for normal cell motility in developing zebrafish embryos and suggest that a balance of supporting proteins is also necessary for normal embryogenesis. These studies on the regulation of cell motility can help to elucidate larger signaling pathways, leading to additional effects on cell survival, growth, and invasiveness, all of which may be caused by the upstream p120 catenin.

Isolating the DNA Binding Sites of the FGF-10 Protein and Identifying the Genes Which it Regulates

Bryson Hicks, Senior, Biochemistry
Mary Gates Scholar
Mentor: James Bassuk, Urology, Seattle Children's Research Institute

The mitogen Fibroblast Growth Factor 10 (FGF-10) plays a crucial role in the regulation of cell proliferation in urothelial cells. The body produces FGF-10 in the lamina propria and transports it to cell surface receptors on urothelial cells, where FGF-10 stimulates several cellular pathways. Urothelial cells endocytose FGF-10 and transport it to the nucleus, where fluorescent microscopy has shown FGF-10 to bind certain chromosomal regions. Recombinant FGF-10 has strong potential as a treatment for accelerating wound healing because it stimulates cell proliferation. However, previous research does not reveal which specific genes or DNA sequences FGF-10 binds or regulates. To learn more about FGF-10's effect on gene regulation, I have used the Chromatin Immunoprecipitation method to isolate the DNA sequences to which FGF-10 binds in vitro. As a part of this process, immortalized urothelial cells were grown and fed recombinant FGF-10, then the nuclear proteins were crosslinked to the DNA with formaldehyde. Next, the cells were collected and lysed in order to collect the nuclei, which were fragmented using sonication. After that, the crosslinked DNA-FGF-10 complexes were immunprecipitated using mouse- and goat-anti-FGF10 antibodies and centrifugation. It was then necessary to amplify DNA for sequencing. To do so, I used a commercial kit from Sigma-Aldrich called "Whole Genome Amplifi-

cation" (WGA). Bacterial cloning techniques were used to isolate each individual fragments from this amplified DNA. Following bacterial cloning, dideoxy-sequencing using the primers on the plasmid vector revealed the immunoprecipitated DNA sequences. Next, gel-shift assays will verify FGF-10 binding to the DNA motifs identified by sequencing. Performing a BLAST search will identify to which human genes these immunopreicipitated sequences belong. Before we can use recombinant FGF-10 for such applications as tissue engineering or wound healing, we must first understand with which genes FGF-10 interacts. This project has sought to identify these genes.

Identifying Genes Required for the Formation of Tubes

Philip Louie, Senior, Business Administration, Biology (Molecular, Cellular Developmental)
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Celeste Berg, Genome Sciences

The tube formation process is a significant step in development and leads to the construction of many organs in our bodies. Shortcomings in this process are responsible for birth defects that occur in 1 out of every 33 babies born in the U.S. each year. To learn about the complications involved, one must understand the actual process of development. We use the formation of the dorsal appendages (DA) in Drosophila melanogaster, the common fruit fly, as a model system to study tube formation. The fly genome, which contains approximately 16,000 genes, has been fully sequenced and exhibits remarkable conservation with the human genome. In order to investigate the biological process involved in tube formation, I study DA formation when altered by mutations. Specifically, I use the GAL4-UAS system to express RNA interference (RNAi) constructs in cells that make the DA tubes. RNAi is a mechanism that inhibits gene expression at the stage of translation or by hindering the transcription of specific genes. I conducted a genetic screen in which I interfered with 35 genes to observe effects on the follicle cells and dorsal appendages during oogenesis. From the screen I have selected two specific genes analyze their biological roles in follicle cells and DA formation. Act42a-RNAi and Act79b-RNAi both produced drastic phenotypic effects when expressed during oogenesis, including shorter appendages and smaller eggs. I am currently conducting further in-depth experiments to determine specific effects of Act42a-RNai and Act79b-RNAi constructs on a molecular level.

Comparative Analysis on the Effects of Lamin A Mutations that lead to Muscular Dystrophy

Sara Mamman, Senior, International Studies, Biology (Molecular, Cellular Developmental)
Mary Gates Scholar
Mentor: Steve Hauschka, Biochemistry
Mentor: Richard Frock, Biochemistry

The *LMNA* gene codes for lamins A and C, nuclear intermediate filament proteins, and mutations in the gene are associated with a spectrum of human hereditary diseases called laminopathies, including Emery-Dreifuss muscular dystrophy (EDMD), limb girdle muscular dystrophy (LGMD) and familial partial lipodystrophy (FPLD). A complete knockout of the *LMNA* gene in mice produces progressive muscular dystrophy with symptoms that are similar to EDMD in humans. However, a significant difference that separates EDMD in humans from the $Lmna^{-/-}$ model is that EDMD in humans is generally an autosomal dominant disease (where one mutant allele is sufficient to cause the disease) whereas heterozygous $Lmna^{+/-}$ mice that lack one normal copy of the gene do not exhibit muscular dystrophy. We hope to take the study of lamin-related muscular dystrophy a little closer towards understanding the molecular mechanisms of muscular dystrophy in humans by using retroviral infection to incorporate specific *LMNA* mutations into $Lmna^{+/-}$ muscle cells. Thus, this technique will mimic laminopathies in human patients by allowing cells to respectively have the equivalent of one normal and one mutated copy of the *LMNA* gene. Specifically, we would like to determine whether EDMD (R453W) and/or LGMD (Q312H) mutations result in increasingly delayed differentiation in $Lmna^{+/-}$ myoblasts and if there are differences with candidate myogenic factor regulation that are previously known to be perturbed in $Lmna^{-/-}$ myoblasts. We plan to infect myoblasts with retroviruses containing cDNA's of the various lamin mutation constructs. The most recent development in this project was the successful infection of our cDNA constructs into $Lmna^{+/-}$ myoblasts.

Identification of the DNA Motif that Binds SPARC Using Chromatin Immunoprecipitation

Adam Mina, Senior, Biology (General)
Amgen Scholar, Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: James Bassuk, Urology, Seattle Children's Research Institute

Secreted protein acidic and rich in cysteine (SPARC) inhibits the proliferation of urothelial cells in culture. Urothelial cells are the stratified squamous cells lining the ureters, bladder, and urethra. The goal of this project is to develop a recombinant form of SPARC protein that may be used as a therapeutic in the treatment of urological diseases. Specifically, this research is relevant

in developing treatments for bladder cancer, the fourth most prevalent cancer in the U.S. male population. Preliminary data indicates that SPARC may bind to DNA. We will better characterize the role of SPARC in cellular proliferation by identifying a DNA-binding site within the human genome. This sequece will help to elucidate the pathways that the protein may induce or inhibit as a transcription factor. We have isolated from human urothelial cells using chromatin immunoprecipitation (ChIP), a procedure that allows sheared DNA fragments bound by SPARC to be selectively enriched using antibody and agarose beads. DNA fragments of 400-1000 nucleotide base pairs have been pulled down by ChIP, and are distinct from DNA products obtained from a no-antibody negative control. The fragments obtained from ChIP have been amplified by ligation mediated polymerase chain reaction (LM-PCR). The amplified products are cloned and transfected into E. coli bacteria, using kanamycin antibiotic selection, and plasmids are isolated for sequencing. Sequence analysis will be performed to identify pathways that SPARC may regulate.

SESSION 1H

SOCIAL SCIENCE FOUNDATIONS TO GLOBAL POLICY ISSUES

Session Moderator: Luis Fraga, Political Science, Office of Minority Affairs Diversity
Mary Gates Hall Room 238

* Note: Titles in order of presentation.

Sex and the City: An Analysis of Trafficking
Phaik Goh, Senior, Psychology, International Studies, Law, Societies, Justice
Mentor: Arzoo Osanloo, Anthropology

Sex trafficking is a global phenomenon that involves the recruitment, harboring, transportation, provision, or obtaining of a person for the purpose of a commercial sex act. According to the U.S State Department, 600,000 to 800,000 individuals are trafficked across international borders every year. While globalization has inadvertently facilitated the trafficking of women, it has also allowed for an international awareness and consensus about the atrocities underlying sex trafficking. Yet, despite the proliferation of international institutions, conventions and agents united by a common agenda to combat trafficking, sex trafficking still a growing, transnational process. While it is easy to assert that developing countries lack the political and legal infrastructures to combat trafficking, how do we account for developed cities that serve as destination countries for similar rights violations? Why are women and children still being exploited as sex slaves despite the existence of domestic and international laws that are meant to protect them? This research project will examine the nature of rights protection and anti-trafficking policies in developed cities to eliminate the stereotype that sex trafficking is a phenomena of the 'developing world' and to identify the legal, social and political factors that trap women in the vicious cycle of trafficking. Through an analysis of three developed global cities of today, Tokyo, Dubai and New York, this research project will reveal patterns that underlie the factors that directly and indirectly facilitate sex trafficking. In particular, this project will demonstrate how domestic and international laws fail to effectively provide remedy for victims of sex trafficking.

DNA Determines Family Reunification: U.S. Refugee Programs Halted in Africa
Melody Hearten-Johnson, Senior, Interdisciplinary Studies (American Studies), UW Bothell
Mentor: Julie Shayne, Interdisciplinary Arts Sciences, UW Bothell
Mentor: Bruce Kochis, Interdisciplinary Arts Sciences, UW Bothell

In this paper I will address U.S. refugee law in relation to the recent use of DNA testing to verify family ties. Hundreds of thousand of people have been stranded in destitute and precarious conditions in areas of Kenya, Ethiopia, Uganda, Guinea, and Ghana due to civil wars. Yet on August 20, 2008, the Wall Street Journal reported that the U.S. State Department suspended refugee programs in these five nations. The suspension is due to DNA evidence showing fraudulent claims among applicants who reported family members living in the U.S. One of the top priorities of the U.S. Refugee Admissions Program is to reunite families, thus family reunification cases are given higher priority than first time refugee applicants. However, the process of determining family membership based on DNA testing has limitations. For example, defining family through DNA evidence carries implications that would violate an individual's human rights under the UN Declaration of Human Rights. The Universal Declaration of Human Rights does not explicitly define family, nor does it mention that family has anything to do with sharing the same bloodline. Article 16 states that "family is the natural and fundamental group unit of society and is entitled to protection by society and the State." In other words, the State is responsible for protecting the right to family regardless of DNA makeup. Through secondary source library research and meetings with human rights agencies in Washington, D.C. I consider the ramifications of

U.S. Refugee Programs which define family exclusively through DNA testing.

Enacting the VCCR in Domestic Legislation
Liam McGivern, Recent Graduate, Interdisciplinary Studies (Global Studies), UW Bothell
Mentor: Bruce Kochis, Interdisciplinary Arts Sciences, UW Bothell

The Vienna Convention on Consular Relations (VCCR) entered in to force on March 19, 1967. Since the VCCR opened for signature in 1961 over 165 states have ratified the treaty. "Enacting the VCCR in Domestic Legislation" establishes the Vienna Convention on Consular Relations as a mechanism for the protection of the human rights of individuals detained in a foreign land. Law enforcement authorities within the U.S. routinely fail to alert the foreign nationals they detain of their right to consulate with their native consulate upon their arrest. This issue came to a head when the Mexican government filed suit against the U.S. in the International Court of Justice (ICJ), alleging that 51 Mexican nationals arrested in the U.S. had not received notification of their rights under the VCCR. The ICJ ruled in favor of Mexico, ordering the U.S. to "review and reconsider" both the convictions and sentences of the individuals named in the suit, among them Jose Ernesto Medellin. The State of Texas refused to comply with the rul-ing and continued with its plans to execute Medellin. The case reached the U.S. Su-preme Court, where it was ruled that this treaty, which was ratified by the U.S. Con-gress, was not enforceable in state jurisdictions as it is not a "self-executing" treaty. This paper argues that in light of a United States Supreme Court ruling that the VCCR is not directly enforceable in U.S. courts, the United States Congress must pass legislation enacting the provisions of the treaty as domestic U.S. law. Failure to do so further weakens the reputation of the U.S. as a human rights leader, weakens the international human rights regime, and endangers U.S. citizens who live, work and travel overseas.

Task Force on Arctic Sovereignty and Governance
Kristen Olson, Senior, International Studies
Naama Sheffer, Senior, International Studies
Gustaf Andreasen, Senior, International Studies
Stephen Printz, Senior, International Studies
Andrew Schwartz, Senior, International Studies
Alison McKay, Senior, International Studies
Marta Schwendeman, Senior, International Studies
Julia Troutt, Senior, Comparative History of Ideas, International Studies
April Nishimura, Senior, International Studies
Mentor: Vincent Gallucci, Aquatic Fishery Science
Mentor: Nadine C Fabbi, Canadian Studies

The Arctic is a region increasingly capturing the attention of the world. The Polar Regions experience the effects of climate change with greater severity than anywhere else in the world and as a result of the rapidly melting ice the Arctic is becoming more open to marine shipping routes such as the Northwest Passage and Northern Sea Route that could reduce travel between the Atlantic and Pacific Oceans by thousands of miles. Furthermore, oil and gas beneath the continental shelves of the Arctic nations are targeted for increased exploitation raising environmental concerns. Finally, the region is the homeland for hundreds of thousands of aboriginal peoples who now find themselves at the center of worldwide attention. Although the Arctic nations of Russia, Canada, U.S., Norway, Denmark, have signed various Arctic and maritime agreements, and indigenous circumpolar organizations exist, issues such as the sustainable development of resources, navigation and shipping, environmental preservation, militarization, and national sovereignty remain unresolved. The Jackson School Task Force on Arctic Sovereignty and Governance has compiled a comprehensive set of policy recommendations for international and indigenous stakeholders in the Arctic. The Task Force report specifically addresses environmental concerns in the Arctic, multilateral governance, interests of Arctic nations, the emerging indigenous "voice" in international foreign policy, and navigation in the Arctic. The report was greatly influenced by a weeklong fact-finding mission in Ottawa where lead experts in Arctic diplomatic relations, science, and indigenous representation were interviewed about pressing concerns in the Arctic. The fate of the Arctic concerns the world. We believe that the policy recommendations in this task force report will contribute to the ongoing dialogue between state and non-state stakeholders regarding cooperative development of the Arctic.

Intellectual Property Rights in China: Formal Adjudication of Trademark Disputes through Court usage in Guangdong Province
Nathan Snyder, Senior, International Studies
Mentor: Dongsheng Zang, Law

The extent to which China has implemented a system that protects intellectual property rights (IPR) is a matter of contention for China scholars and institutional economists such as Douglass North. Economists suggest formal institutions that protect IPRs are a necessary condition for economic growth, but China has been growing at nearly 10% a year for three decades despite institutions that have been nearly universally recognized as imperfect at best or non-existent at worst. Paradoxically, many scholars suggest an institutionalized system that protects IPR will only be instituted once there is sufficient domestic demand. However, there is currently no method to quantify how much domestic demand is necessary to stimulate the creation of such a system, nor when such a

point is reached by a developing country. While China has a recently written a relatively well-developed legal system for IPR protections on paper, there has been little research of how effectively this system has been implemented. By surveying recent court cases on trademark disputes in Guangdong province, this paper attempts to better understand the extent to which the court system has been implemented and is being used to adjudicate IPR disputes in the most developed regions of China. The cases used are published by the Chinese courts and, while imperfect, are the most complete and extensive court data available. Given that Guangdong is one of China's most developed regions in terms of the need for domestic trademark protection, I expect to find a high level of domestic use of formal adjudication through the court system. This would suggest the most developed regions of China may have recently reached a level of development where a system of formal protections of IPR is now necessary to protect domestic trademarks.

SESSION 1I

PROFILES OF PLACE: LOCUS, IDENTITY AND SOCIOCULTURAL CODES IN METROPOLITAN SEATTLE

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

* Note: Titles in order of presentation.

Re-imagining The Ave: Culture, Place and Intercultural Exchange

Gillian Shepodd, Senior, Comparative History of Ideas
Mentor: Crispin Thurlow, Communication

Inspired by Guy Debord, Michel de Certeau and Henri Lefebvre, this paper reports my study of University Way (The Ave) as a site for the staging of culture, the production of place, and the creation of intercultural identities. I am particularly interested in examining how space influences or shapes culture and its performance within that space, following Edward Said's notions of Orientalism and "knowing by seeing". The University District is a unique Seattle neighborhood – a cross-section for cultural exchange and relations of power, especially those shaped by the "town and gown" ethos of the University community and those who share the neighborhood with us. I have organized this study of my own "backyard" around the three main dimensions of space described by Lefebvre: conceived (i.e. imagined), perceived (i.e. material) and lived (i.e. experienced). I have also used a range of approaches for exploring these dimensions: history, textual analysis, participant observation, and derivé. I start by examining how a "touristic" vision of the The Ave is imagined by both the University of Washington and the City of Seattle in such a way that overlooks or obscures certain cultural groups and not others. Then, in order to explore the material spaces of The Ave, I immerse myself by borrowing the idea of derivé, taking a "wander" through the neighborhood with a more critical, more open eye. Finally, to better understand life on The Ave, I place myself in key locations and "people watch," observing everyday interactions and other exchanges. By asking questions about space and the ways our identities are shaped by the meanings of space, my goal is to look a little more carefully and critically at the place so many of us call home.

Seattle's Martin Luther King, Jr. Way: A 40 Year Reflection on a Dream

Timothy Thomas, Senior, Sociology
Mary Gates Scholar
Mentor: Stewart Tolnay, Sociology

Since 1968, cities around America have memorialized Dr. Martin Luther King, Jr. through the renaming of public spaces in his honor. The renaming of streets, in particular, stimulates dialogue, controversy, and stigma, as well as honor. Road names are significant, even more so than commemorative buildings and parks, due to their influence in everyday lives as locations where people live, conduct business, and demonstrate for causes. My project focuses on profiling the area around Seattle's Martin Luther King, Jr. Way before, during, and after the name change from Empire Way in 1983. I will compare and contrast the characteristics of block-groups around MLK Way to the characteristics of block-groups in the greater city of Seattle from the 1970 Census to the 2000 Census using GIS and statistical analysis. These characteristics include educational attainment, family structure, unemployment, black population, total population, per capita income, and poverty. I will also compile an historical biography of the area derived from interviews and literature reviews to understand the events that took place during the name change, as well as investigate the iconology of designating a road in honor of Dr. King. My hypothesis is that the area around MLK Way will show evidence of socioeconomic decline through time contrasted with an era of prosperity for the rest of the city of Seattle. The MLK Way area will also have a higher concentration of African Americans as well as historical indications of controversy associated with the name change. This area might even include a common stigma that is found with other MLK streets across America as

a disadvantaged locus of high poverty and crime rates.

The Seattle Freeze: An Ethnographic Study of Discourse Surrounding a Local Social Phenomenon
Angeline Candido, Senior, English, Communication
Mary Gates Scholar
Mentor: Gerry Philipsen, Communication

This research focuses on the "Seattle Freeze", a phrase coined on a cover story run by Seattle Times to describe Seattleites' polite (i.e., agreeable) but distant (i.e., introverted) demeanor. The belief expressed in the discourse of the Seattle Freeze is that while Seattleites are very pleasant on the surface, beyond these social niceties they simply do not desire to extend invitations of friendship and instead prefer to either remain antisocial or entrenched in their already formed cliques. Although the term has made its way into the local discourse, little scholarship has been done on this social phenomenon. Using Speech Codes Theory as a heuristic and interpretive guide, the present study seeks to understand the Seattle Freeze as a speech code within the city and to uncover some of the rules and premises that underlie this supposedly chilly demeanor. Through an assembled corpus containing local texts from the internet and the media, I analyze the conversations surrounding the Seattle Freeze. Studying the placement of this communicative code within the city's discourse lends insight into the ways Seattleites uniquely construct and negotiate the socials rules of their everyday interaction—possibly constructing them in ways that others would deem impolite and antisocial.

Segmented Identities: Second Generation Cambodian Americans in Pursuit of Post-Secondary Education
Stephen Uy, Senior, International Studies
Mentor: Kathie Friedman, Jackson School of International Studies

The life journey of second generation Cambodian Americans is a unique and never-ending process due to their increased vulnerability to delinquency. Generally speaking, second generation Cambodian Americans are more likely to become involved in gang-related activities than their other Asian American counterparts. Although the existing literature on this subject is satisfactory, research on Second Generation Cambodians who have chosen the path of academic accomplishment through the pursuit of post-secondary education is inadequate. The objective of my study is to shed light on the factors that underlie these individuals' decision to pursue a post-secondary education. My data, which was collected through interviews and surveys, comes from university students in the Western Washington region. I consider cultural adaptation and compromises in cultural messages received at home and outside between generations of young and old. These messages are often at odds creating segmented identities in Cambodian youth. As a result, tensions between child and parent create an unstable relationship due to a lack of understanding of cultural differences. My research suggests that mentors from both inside and outside of the Cambodian community serve as the catalyzing force that bridges the gap in understanding between parent and child. The child's quest for academic success within this group is the product of the mentor's effort to foster an environment that facilitates the development of an affinity toward education. The role of the mentor bridges the rift between the cultural messages received outside of home and within. The pursuit of academic success in second generation Cambodian youth relies on the mentors ability to foster a compromise between external and internal environmental factors. This is crucial to the development of a self identity that fosters the motivation to continue their education. This research discusses the implications of these findings for understanding the segmented identities of second generation Cambodian American youth.

A Radical Food Politics: Struggles for Food Sovereignty in the Puget Sound Foodshed
Yecelica Valdivia, Senior, Anthropology, Women Studies
McNair Scholar
Mentor: Devon Pena, Anthropology
Mentor: Teresa Mares, Anthropology

Culturally/ethnically diverse and low-income communities are often excluded from the current dialogue of relocalizing the Puget Sound food system. My research seeks to open this dialogue through a historical, ethnographic, and political ecological study. First, I outline the historical and current state of the Puget Sound foodshed. I will explore the aforementioned food system and the local/regional programs and initiatives associated with it and how these initiatives fit into, and potentially challenge, the context of the range between food security and food sovereignty. One of the initial steps of the project is to create a series of maps depicting the state of the Puget Sound foodshed. One such map will depict the existing indigenous cultural regions accompanied by traditional knowledge of local flora and fauna, both for food and medicinal purposes. The second map, in conjunction with the use of archival and Web-based research, will depict current and developing Puget Sound food system alternatives (i.e. farmer's markets, CSA's, community gardening, urban farms/gardens, dumpster diving, and gleaning locations) as well as emergency services and resources. I will collect data on-site at ten locations within the vicinity of Seattle on the map throughout the February and May 2009 using participant observation and informal open interviews. In concurrence with on-site data collection, I will analyze local/regional initiatives and policies including the language in which these are writ-

ten. Lastly, I will propose future steps that communities, especially culturally/ethnically diverse and low-income communities and their allies in the Puget Sound can take in order to promote a more sovereign and just local food system in tune with the environmental, cultural, and political economic conditions in place.

SESSION 1J

GLOBALIZATION, GOVERNANCE, AND CITIZENSHIP

Session Moderator: Judith A Howard, Sociology
Mary Gates Hall Room 248

* Note: Titles in order of presentation.

NGO Professionalization: Public Advocacy in a New Era
Garrett Strain, Senior, International Studies, Economics
Elizabeth Lyons, Senior, International Studies, Economics
Mentor: Sabine Lang, Jackson School of International Studies

The latter half of the 20th century has seen the rise of non-governmental organizations (NGOs) as one of the dominant forms of civil society organization. Commentators generally perceive NGOs and their advocacy networks as inherently strengthening public spheres by providing platforms to otherwise disenfranchised citizens. This research traces the development of two interrelated phenomena in the NGO sector. First, civil society has undergone a process termed "NGOization," whereby civic actors, both large and small, have come to organize themselves in the form of NGOs. These organizations demonstrate increasing budgets in management, employee salaries, and fundraising expenditures over the past decade. This spike in NGOs' professional capacities enhances their ability to serve as "proxy publics" as they become more accessible, regulated and resource-strong. As "proxy publics," NGOs have become the go-to civil society actors for government, foundations, and the media. Involving NGOs in the democratic process has become synonymous with involving the broader public, however the true inclusiveness of an NGO dominated civil society must be closely reviewed. Does the proliferation of an NGO network advance the voice and capacities of the public, or does increased attention and bureaucratic structure create a business-like environment that limits organic public advocacy? These phenomena are explored through an empirical analysis of I-990 tax return forms from major national, feminist, urban development, Washington State, and local NGOs in the period of 1997 to 2005. An examination of income, expenditure, and employment data from these tax returns confirms our hypothesis that NGOs have become civil society juggernauts by expanding and professionalizing their operations. This quantitative analysis will be supplemented by responses from local NGO staff members collected through an anonymous Catalyst-published survey addressing staff duties and changes in organization structure over the past decade.

Saving the Women: American Transnational Feminist Advocacy in the Global War on Terror
Ashley Baker, Senior, Anthropology, French, Political Science
Mary Gates Scholar, McNair Scholar
Mentor: Arzoo Osanloo, Anthropology

The Global War on Terror has provided new opportunities for feminist organizations to inform policy affecting women internationally, especially women in Afghanistan and Iraq. This research will: 1) examine the relationship between the U.S. government and American feminist organizations working to improve women's conditions during the Global War on Terror and 2) consider what this relationship tells us about the limitations and opportunities of transnational feminist advocacy. While these feminists claim to be working toward the empowerment of all women, many scholars and locally based and focused women's organizations accuse them of being hegemonic and culturally insensitive. They argue that American transnational feminist advocates, consciously or not, work with the U.S. government to legitimate the Global War on Terror by taking agency away from the women they are purporting to help. I will do a discourse analysis of academic journals and government archives, as well as the primary sources available from three feminist organizations: NOW, Feminist Majority, and CODEPINK. These sources will explain what the objectives of these groups are, how they go about achieving these objectives, and both the academic and governmental response to these efforts. I will also use interviews with staff and volunteers from the three groups to explain how they perceive their role in the Global War on Terror and their relationship with the government. While American feminists have pressured the U.S. government to implement policy that they believe will benefit women, some charges of cultural incompetence are founded. Many of the policies that these organizations support have been formed without engaging directly with the women who will be affected. Working closely with the government may lead organizations away from their original principles, but it may also provide unique opportunities to influence broad change.

Internet Microfinance and the Re-Scaling of Citizenship
Roy Burstein, Senior, Art (Design Studies), Geography
Mentor: Matthew Sparke, Geography
Mentor: Stephen Young, Geography

Recent work on globalization has explored the possibilities for practicing citizenship beyond the scale of the nation-state. The emergence of the internet, the increasing globalization of both corporations and advocacy networks, and growing opportunities for travel, are seen as evidence of a world on the move. As such, new spaces, scales and practices of citizenship have also emerged, which shape and respond to these global mobilities. However, we still know relatively little about how inclusive, progressive and democratic these new global communities are in-practice. Our research focused on one example of a new forum for global citizenship. We examined the recent growth of KIVA, an internet-based microfinance organization. Taking inspiration from Mohammad Yunus' Grameen Bank, KIVA enables online members to make small loans to entrepreneurs of their choosing in the developing world, and thereby "build a global community expressing support and encouragement of one another." We have recently distributed a survey to KIVA members via their website to assess who is involved, how and why they decided to join, and what they believe it can achieve. My presentation will then draw from this primary research to examine the possibilities and limitations that KIVA presents for a new kind of global citizenship.

Global Silicon Valleys
Emily Cernak, Senior, Business Administration (Finance), Business Administration (Marketing)
Mary Gates Scholar
Jessica Salo, Recent Graduate, 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.

SESSION 1K

HEALTH MONITORING OF BIOLOGICAL SYSTEMS

Session Moderator: Wei-Chih Wang, Mechanical Engineering
Mary Gates Hall Room 251

* Note: Titles in order of presentation.

Engineering Robust Designs for Synthetic Biology
Alexander Bratt, Recent Graduate, 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 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 has been the goal of this project to find robust network schemes that can be used to generate computer models of GRNs that function properly under a wide range of conditions. Each GRN model comprises a series of differential equations representing the rates of degradation and synthesis of transcription factors in the network. One transcription factor in each network is

arbitrarily designated as the network output and model simulations are carried out deterministically. A genetic algorithm has been 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 is created. That population is then subject to fitness testing and selection whereby only fit networks are allowed to progress to the next generation. The results of this work show that network topology is a strong (if not absolute) determinant of robustness. It is hoped that the robust network schemes generated here will help guide future efforts to design transcriptional gene regulatory networks in vivo.

Application of Bioconjugate Techniques to AFM Cantilevers for Studies in Force Spectroscopy

Verne Donnet, Senior, Bioengineering
Mary Gates Scholar
Mentor: Wendy Thomas, Bioengineering

Specific adhesion and control of the colonization of a surface are of interest to bacterial researchers. Understanding how bacteria adhere to various surfaces, either by their own means or by introducing particular chemistries, assists in the development of clinical treatments and preventions for bacterial infection. This project addresses these needs twofold. First, it seeks to apply established chemistry in another field (protein conjugation) to applications in bacterial studies. Second, it will increase confidence in the studies that rely on Atomic Force Microscope (AFM) force spectroscopy by reducing unintended noise. The goal of this project is to apply the combination cross-linking and surface chemistry to the conjugation of bacteria to an AFM cantilever. Our aims include a high level of reproducibility (between cantilevers) and low noise (minimization of nonspecific force measurements taken with the probe). The application of the protocol should increase the level of certainty in measurements taken with the finished product and increase the confidence in comparisons between experiments which varied in conditions (different days, temperatures, etc.). The approach focuses on the application of covalent bonds, which should decrease charge effects present in many electrostatic methods. The procedure intends to preserve the cell so it can continue to grow/live even when conjugated to the surface. Current findings show successful immobilization of bacteria to treated surfaces and sustained function in these cells. Future work will include applying this method for studying the dynamic force behavior exhibited by various types of bacteria.

Evaluation of a Computer-Controlled Turbidostat for Long-Term Culture Growth and Evolution

Wayne Gerard, Senior, Computer Engineering
Mentor: Wenying Shou, Basic Sciences, Fred Hutchinson Cancer Research Center
Mentor: Justin Burton, Basic Sciences, Fred Hutchinson Cancer Research Center

A turbidostat is a continuously-stirred bioreactor, similar to a chemostat. Both devices maintain a constant volume of cell suspension in the culture vessel, and thus the supply rate of fresh medium must equal the dilution rate of cell suspension. However, in a chemostat, culture growth rate is set by the supply rate of fresh medium. The cell density of the culture is determined by the concentration of the limiting growth factor in the fresh medium and in the culture vessel, and can change during evolution. In contrast with a chemostat, a turbidostat adjusts the supply/dilution rate to maintain a constant biomass (turbidity, a measure of the cell density and cell volume suspended in the solution), and in theory, one could measure changes in growth rate based on the amount of dilution over a period of time. To study cooperative microbial consortia consisting of multiple species, the use of a chemostat could be problematic because growth of the consortia may be additionally limited by metabolites that species of the consortia exchange. Since we are interested in studying the evolution of cooperative microbial consortia, we have constructed a computer-controlled turbidostat. In our turbidostat, turbidity is measured via an infrared LED and detector, which is then used as feedback for controlling the dilution rate. A computer program, written in LabView, automates the measurement and dilution procedures for the turbidostat and exports the measurement data to be analyzed. We are currently evaluating the performance of our turbidostat. Preliminary results indicate the ability to maintain turbidity within a narrow pre-set range for an extended period of time. Once the turbidostat has been successfully implemented, we plan to use it to evolve a cooperative system and measure how growth rate changes over time.

Efficient Directed Evolution Using a Turbidostat

Alexander Leone, Junior, Pre-Engineering, Physics
Mentor: Eric Klavins, Electrical Engineering

Evolution can produce highly optimized systems with a minimal amount of design, but only with specific initial conditions, the right environment, and a time-scale of many generations. To enhance the efficiency of directed evolution, we use the feedback inherent in a turbidostat; turbidity, or optical density, of a constant volume of bacteria is controlled by changing the dilution rate. A laboratory instrument for effective directed evolution is essential in synthetic biology; synthetic enzymes often show very low activity. To improve performance, a

turbidostat is loaded with a strain of bacteria genetically modified to express the enzyme and controlled to give a selective advantage to bacterium with better synthetic enzymes. Because of the constant dilution by nutrient inputs, the bacteria are always in growth phase and have a generation time of 20 minutes. After only three days in the turbidostat, there will have been over 200 generations. To study the speed of directed evolution in a turbidostat, we will optimize lactose utilization in *E. Coli*. Previous results by Dekel and Alon, using a serial dilution method of evolution, took over 3 months. In a turbidostat, this process should take seven days. By building a turbidostat, we have made directed evolution a viable tool in synthetic biology.

A Force-Sensing Glove for Clinicians
David Linders, Senior, Bioengineering
Levinson Emerging Scholar, Mary Gates Scholar
Mentor: Wei-Chih Wang, Mechanical Engineering

For many clinicians, their effectiveness is dependent on the forces they apply to their patients. Physical therapists conduct strength tests and pain thresholds to diagnose new patients or to evaluate recovery after surgery. Chiropractors apply specific forces to muscles and vertebrae to treat spinal ailments. Although these forces must be accurate and repeatable to protect patients and give the most effective care, current strategies lack quantitative feedback to the clinician. Therefore, my objective is to develop a disposable 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 in a medical environment, and maintain patient safety, a fiber optic sensor has been developed for this application. The sensor's 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 through a series of corrugated teeth. The sensor itself is produced in two parts, sandwiching the fiber between alternating teeth. The base part secures the fiber on both ends while the thin top part deforms under an applied load to bend the fiber over the teeth. The amount of light lost depends on the amount of bending that the fiber experiences over the teeth. In this way, the force applied can be related to the light lost. The sensor, fabricated at 10 x 8 x 1 mm, achieved an appropriate clinical thickness while providing force feedback with a range of 20 pounds and resolution of 0.1 pounds. The sensitivity of the sensor followed an exponential relationship similar to theoretical calculations. This optical biomedical sensor will provide force feedback to improve clinical effectiveness for patient diagnosis and treatment in a wide variety of clinical applications.

Surface Modification of Polypropylene 96-Well Plates with Ultra Violet Ozone (O_3) Treatment to Improve the Matrix Chromatin Immunoprecipitation (ChIP) Assay
Daniel Mar, Senior, Bioengineering
Mentor: David Castner, Chemical Engineering
Mentor: Karol Bomsztyk, Medicine
Mentor: Gilad Zorn, Chemical Engineering

Epigenetics is the study of the environmental factors that cause changes in gene expression and of accompanying genetic activity, in contrast to inherited genetic information. Epigenetic processes have been shown to influence diseases such as cancer and diabetes. If these processes could be better understood, the treatment for such diseases would be dramatically improved. One way to understand epigenetics is to examine changes in chromatin using the chromatin immunoprecipitation (ChIP) assay. This method uses antibodies to quantify the amount of interaction between a protein and a particular section of DNA. A recently developed technology, Matrix ChIP, allows for the simultaneous tracking of multiple genes and is a substantial improvement over previous ChIP methods. The Matrix ChIP assay is based on first adsorbing Protein A onto the surface of the polystyrene 96-well plate wells. Then the antibodies, which are necessary to isolate the chromatin, are bound to the adsorbed protein layer. The final step of the assay involves heating to 98C, but since polystyrene deforms at that temperature the experiment must first be transferred to a polypropylene (PP) plate. Our overall goal is to allow the entire Matrix ChIP assay to be performed on PP plates, thus saving resources by avoiding a sample transfer and use of an extra polystyrene plate. In addition, consolidation of the entire assay onto one plate will be a major step toward high-throughput compatibility and clinical diagnostic use. PP plates are currently not used for the entire assay due to their limited Protein A binding capability. Our project aims to modify the surface of PP to improve Protein A binding capability. We investigated the effect of treating PP with UV and ozone and quantified these changes using contact angle and x-ray photoelectron spectroscopy (XPS). Subsequently we verified Protein A immobilization with colorimetric assays and Matrix ChIP.

A Microbead-Based Microfluidic Assay for Multiplexed, Point-of-Care Nucleic Acid Testing
Mark Sena, Senior, Bioengineering
Amgen Scholar, Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Xiaohu Gao, Bioengineering
Mentor: Paul Yager, Bioengineering

New diagnostic tools are needed for HIV nucleic acid testing (NAT) at the site of patient care. Current technologies for monitoring HIV viral loads rely on analyt-

ical systems found only in clinical laboratories. Meanwhile, cold-chain shipping of frozen patient samples to those laboratories is difficult to execute in low-resource settings. In order to address these issues, we are developing methods for extraction and stabilization of viral RNA from patient serum with the goal of eliminating the need to freeze samples before shipping them to a central laboratory. In addition, we are developing a microfluidic assay that measures levels of HIV nucleic acid markers with the goal of providing preliminary diagnostic information following patient sample collection. So far, we have found that 1) commercially available borosilicate-glass-fiber filters and plunger syringes can be used in place of expensive centrifuge-based miniprep kits for rapid HIV RNA extraction 2) magnetic and fluorescent microspheres conjugated to oligonucleotide probes can be used to optically detect mock HIV nucleic acid markers at the nanomolar concentrations, and 3) disposable, poly-laminate microfluidic cards that utilize magnetic separation have the potential to facilitate low-volume sample handling and increase the sensitivity of fluorescence detection. In collaboration the Program for Appropriate Technology in Health, we hope that this work will help improve HIV NAT for patients with limited access to standard testing facilities.

SESSION 1L

NEURAL SYSTEMS: FROM GENES AND CELLS TO BEHAVIOR AND DISEASE

Session Moderator: Horacio de la Iglesia, Biology
Mary Gates Hall Room 254

* Note: Titles in order of presentation.

Effects of Silencing Enkephalin Neurons using Viral-Mediated Gene Transfer on Haloperidol Induced C-fos Expression

Hannah Demeritt, Senior, Biology (General)
Mentor: John Neumaier, Psychiatry Behavioral Sciences
Mentor: Susan Ferguson, Psychiatry Behavioral Sciences

Addiction is a worldwide problem, making understanding the mechanisms underlying this disease a high priority. The striatum is a brain region thought to be critically involved in the processes contributing to addiction. While 95% of the neurons within the striatum are medium spiny projection neurons, these are roughly equally divided into neurons expressing either the neuropeptide enkephalin or dynorphin; these neurons have different synaptic targets and presumably different functions. A viral vector expressing Gi/o-coupled human muscarinic4 DREADD receptor (designer receptor exclusively activated by a designer drug; hM4D) was developed to exclusively infect enkephalin neurons, and is activated by the inert ligand clozapine-N-oxide (CNO). Activation of this receptor is thought to silence neurons through opening potassium channels to hyperpolarize the cell, and through decreasing activity of adenylyl cyclase. c-fos is a transcription factor expressed in response to increased adenylyl cyclase activity, among other stimuli, and can be used as a marker of neuronal activity. Haloperidol is a dopamine2 receptor antagonist that increases c-fos expression primarily in enkephalin neurons in the striatum. This experiment sought to confirm that activating hM4D receptors in enkephalin neurons results in functional silencing by measuring c-fos protein. To test this hypothesis, striatum of male Sprague Dawley rats were stereotaxically injected with enkephalin neuron specific viruses expressing either GFP or the hM4D receptor. After allowing 1 week for sufficient protein expression, CNO was administered (ip), followed by haloperidol (ip). After waiting 2 hours for maximal potential c-fos expression, rats were perfused and the brains were prepared for immunohistochemical detection of c-fos. Quantification of haloperidol induced c-fos expression is currently underway. We predict that rats given hM4D receptor virus should express lower levels of c-fos than rats given GFP virus. These findings will be useful in future experiments to clarify the role of enkephalin neurons in addiction.

Extent and Distribution of TAR DNA Binding Protein 43 (TDP43) Intracytoplasmic Abnormalities in Lower Motor Neurons of Amyotrophic Lateral Sclerosis

Jae Kim, Senior, Biology (Physiology), Biochemistry
Mentor: John Ravits, Neurology, Benaroya Research Institute

TAR DNA Binding Protein 43 (TDP43) has previously been shown to be of critical importance in Amyotrophic Lateral Sclerosis (ALS) nervous systems, but its role in disease pathogenesis is largely debated. Our study quantitatively examines the extent and distribution of TDP43 intracytoplasmic abnormalities in ALS nervous systems across the entire lower motor neuron column to further elucidate the importance of TDP43 in ALS nervous systems, and to determine whether these abnormalities can be formed as a topographic spreading of ALS as hypothesized by the neuropathological gradient in different studies. We thoroughly examined the nervous systems of controls (n=5) and ALS patients (n=20) on all 4 major neuraxis levels (medulla, cervical, thoracic, lumbar) and

determined that TDP43 abnormalities show enormous inter-nervous system variation and is not correlated to spread of disease, raising important new questions about the role of TDP43 in ALS.

Exploring Flight Control in Animals Using Implantable Electronics

Susan Loudon, Senior, Biology (Ecology, Evolution Conservation)
Mentor: Tom Daniel, Biology
Mentor: Zane Aldworth, Biology

All animals, including humans, use multiple sensory systems to drive multiple motor pathways to control movement. It is probable that a single sensory input may affect multiple motor outputs. We study the role played by multiple output factors in insect flight control. Insects use rapid body rotations that are generally considered to be initiated by the wings for flight control. Flight control is also mediated by movement of other body parts, such as the head, legs, or abdomen, to influence flight path. However, it is unknown to what extent abdominal movements themselves can be used to initiate changes in the flight path. To address this issue we elicited abdominal movement in flying hawkmoths (Manduca sexta) through direct electrical stimulation. Current was delivered using multisite tungsten microelectrodes implanted in the thoracic ganglion. We used multiple high-speed cameras to film the 3-D flight trajectories. Four body points were digitized from flight sequences, and used to extract flight parameters such as yaw and pitch, as well as the abdominal motion in the dorsal-ventral and lateral flexion planes. We used correlation analysis to determine the relationship between the abdominal movement and observed changes to the flight path. Three key results emerged from our study: (1) 100 Hz square wave stimuli via multisite electrodes effectively control abdominal flexion, extension, or lateral motion of moths during flight; (2) mean flexion responses of 16 degrees were observed during rigid tether (N= 4 animals); (3) abdominal movements correlated with changes in body rotation following stimulation in 8 of 11 trials (N= 5 animals). To remove possible artifacts of tethering, further investigation will include wireless stimulation. Taken together these results demonstrate that body attitude can be controlled by externally stimulated abdominal motions. Thus we show that, in addition to wings, abdominal motion plays a significant role in flight control.

Restricted Feeding Time Resets *Per1* Expression in the Liver Peripheral Oscillator but not in the Brain in Zebrafish

Erica Tartaglione, Senior, Biology (Physiology)
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Horacio de la Iglesia, Biology

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 clock genes. In rodents, the light-dark (LD) cycle *entrains* the master circadian clock located within the hypothalamic suprachiasmatic nucleus (SCN), which 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 peripheral organs entrain to 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 under both LD and constant light (LL) conditions 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. Under LD conditions animals with RFA during the night show a phase shift in the rhythm of clock gene *Period1* (*Per1*) within the liver but not within the brain. Under LL conditions, preliminary data show no phase shifts in *Per1* oscillations in the brain or liver of the randomly fed animals and in the brain of the scheduled fed group. In contrast, the liver of the scheduled fed group appears to have a similar *Per1* acrophase to the LD mid light fed group. Thus, clock gene expression in the liver suggests food availability in the absence of light cues can entrain the liver in a brain-independent manner.

Sensory/Motor Neuropathy with Ataxia (SMNA) and Candidate Gene IFRD1 on Chromosome 7q22-q23

Tiffany Vu, Senior, Biology (General)
Mary Gates Scholar
Mentor: Wendy Raskind, Medicine
Mentor: Mark Matsushita, Medical Genetics
Mentor: Zoran Brkanac, Psychiatry

The five-generation Irish-American family in this study exhibits a novel phenotype where affected members have symptoms of spinocerebellar ataxia (SCA) as well as hereditary sensory neuropathy (HSN). The affected members show signs of sensory loss in addition to loss of muscle control. Given the family pedigree, we conclude the mode of inheritance to be autosomal dominant. To date, more than 28 loci in the genome are reported to be involved with autosomal dominant SCAs. The main change at many of these regions is an expansion in a polyglutamine tract (CAG repeats), often leading to atrophy of the cerebellum, and eventual loss of motor con-

trol. Patients with sensory neuropathy experience a loss of sensation in their extremities due to degeneration of dorsal root ganglia and motor neurons. These effects are detrimental because patients lose the ability to sense injury to such areas, experience chronic ulcers, and may lose muscle mass in the legs and feet. A whole genome linkage analysis and fine-mapping analysis ruled out any known loci as the disease locus in this family, and instead revealed that a region on chromosome 7q22-q32 segregates with the disease. Following mass sequencing of the exons of 297 genes located in this approximately 22Mbp region (NCBI Build 36.2), single nucleotide changes were identified in three of the genes. We performed SNP Genotyping on controls to verify that each alteration was not an unreported benign polymorphism. Although more analysis is required to determine whether one of these mutations is pathogenic, we propose that the mutation in IFRD1 may disrupt gene function.

SESSION 1M

MOLECULAR AND CELLULAR BIOLOGY

Session Moderator: Hannele Ruohola-Baker, Biochemistry
Mary Gates Hall Room 271

* Note: Titles in order of presentation.

Probing Secreted Phospholipase A2 Function in Cells

Nathan Cermak, Senior, Biochemistry, Sociology, Applied Computational Mathematical Sciences (Social Behavioral Sciences)
Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: Michael Gelb, Chemistry
Mentor: Rob Oslund, Medicinal Chemistry

Secreted phospholipase A2 enzymes (sPLA2s) are interfacial enzymes, which bind to cellular membranes and release fatty acids from phospholipids. In humans, there are currently nine known sPLA2s. While the function of a few of these have been reasonably well-established, it is not clear what the others are there for. However, various sPLA2s have been linked to asthma, arthritis, atherosclerosis, and colon and prostate cancer. Furthermore, the catalytic activity of the enzyme suggests an important role in a wide variety of inflammatory processes. My research in the Gelb lab focuses on synthesizing and testing sPLA2 inhibitors. In this I use a variety of techniques including cell culture and confocal microscopy, radiolabeling assays, enzyme-linked immunosorbent assays (for detecting very small amounts of proteins in cells), and fluorescence assays for enzyme activity. My current project involves utilizing confocal microscopy with fluorescent sPLA2 substrates. I have been working to utilize a synthetic phospholipid which changes color when the fatty acid portion is released. This will allow for direct visualization of enzyme activity within living cells. If this experiment works, it will be possible to identify where and when the enzyme is active within cells. Furthermore, by adding inhibitors, we can identify whether the inhibitor is actually reaching and inactivating the enzymes, or whether there is any kind of barrier preventing this.

Enter the Domain of Death: Elucidating the Role of MyD88 in Fas Signaling

Alison Eastman, Senior, Neurobiology, Microbiology
Mary Gates Scholar
Mentor: Bill Altemeier, Medicine

Acute lung injury (ALI) is a sudden onset of respiratory failure following various insults to the pulmonary system including pneumonia, sepsis, and inhalation. It affects an estimated 190,600 Americans a year, of which 74,500 patients are expected to die of the condition. ALI is characterized by a period of inflammation consisting of an influx of neutrophils to the lung tissue after cytokine release, and followed by a fibroproliferative response characterized by collagen production. Implicated in the progression from the early inflammatory response to the fibroproliferative response is the cell surface death receptor Fas. Our lab has shown previously that death-domain containing intracellular adaptor protein MyD88 plays a role in modulating Fas signaling. Mice deficient in MyD88 (MyD88-/-) show a decreased inflammatory response to Fas activation with the Fas-activating antibody Jo-2. Other labs have shown that Jo-2 administered to wild type (WT) mice results in an increase in collagen content of the lung by day 21 (d21). We hypothesized that MyD88-/- mice treated with Jo-2 would show a decreased early inflammatory response combined with a reduced incidence of apoptosis at day 7 (d7) compared to WT mice, and a decreased fibroproliferative response relative to WT mice as indicated by collagen content at d21. Jo-2 or its isotype control antibody was administered at a dose of 2.5ug/gram body weight via oropharyngeal aspiration once daily for three days to either WT C57BL/6 mice or MyD88-/- mice on a C57BL/6 background. Necropsies were performed at d7 or d21 to assess lung inflammation, caspase activation, and collagen content. We found that MyD88-/- mice had decreased pro-inflammatory cytokine production at d7. However, in contrast to that reported in the literature, Jo-2 did not

result in increased collagen deposition at d21 preventing evaluation of the role of MyD88 in Fas induced lung fibrosis.

Enhancement of a Computationally-Designed Enzyme: A Contribution to the End of Global Warming

Catherine Louw, Senior, Biology (Molecular, Cellular Developmental), Biochemistry
Mentor: David Baker, Biochemistry
Mentor: Justin Siegel, Biochemistry

Global warming is a pressing issue worldwide and finding new ways to control excess carbon dioxide is becoming increasingly important. This study aims to develop a novel biological system which converts carbon dioxide into small sugars. To create this system, a new metabolic pathway is being constructed which employs six naturally-occurring enzymes and one computationally-designed enzyme called Formolase. Formolase is derived from a naturally-occurring enzyme, Benzaldehyde Lyase, which ligates two benzaldehyde molecules together, while the desired reaction of Formolase is to ligate three formaldehyde molecules together to create dihydroxyacetone. A computer program called Rosetta was used to create Formolase, identifying four mutations to make within the active site in order to drastically alter substrate specificity. The enzyme would now catalyze the polymerization of formaldehyde over that of benzaldehyde, and when tested, these mutations altered specificity as predicted. In order to further understand this change in specificity, I determined the contribution of each mutated residue to the activity on formaldehyde. This study illuminated the key mutations necessary to maintain desired activity, as well as mutations which could be changed in the future to improve the activity of the enzyme. Although Formolase demonstrates enhanced activity on formaldehyde, the activity must be increased further before it can be used in the metabolic pathway. Therefore, I am now working on mutating additional residues in order to enhance activity. We also plan to alter the structure of the protein by adding new loops and tails to form more contacts with the formaldehyde ligand, which we hypothesize will further improve our enzyme. Once sufficiently active, Formolase will complete the novel metabolic pathway and provide an alternative method for converting carbon dioxide into a more useful material. In this way, global warming can be controlled and the amount of carbon dioxide in the atmosphere decreased.

A Mystery Of p53 Degradation: Who Controls The Mdm2 And Mdmx Proteins?

Christopher Pierini, Senior, Biochemistry
Mentor: Rachel Klevit, Biochemistry
Mentor: Peter Brzovic, Biochemistry
Mentor: David Fox III, Biochemistry

Understanding p53 degradation is critical knowledge in cancer research as p53 plays a major role in cell viability. Over 50% of all cancers have a p53 mutation. The major regulators of p53 in vivo are the proteins Mdm2 and Mdmx. Mdm2 and Mdmx can exist separately as homodimers or form a heterodimer. These complexes are part of a signaling process called Ubiquitination. Ubiquitination is a highly conserved process which covalently attaches a protein called Ubiquitin to other proteins in a cell for recognition by the proteasome, ending in protein destruction. The ubiquitination process involves three critical proteins: an E1, E2, and E3. Eukaryote cells encode for 2 E1s, 20-30 E2s, and potentially thousands of E3s. Ubiquitination is highly dependant on the activity and specificity of an E2 and E3 protein interaction. Mdm2 and Mdmx are E3 proteins. My project seeks to answer two major questions. First, although the E3s for p53 are clearly established, what E2 proteins interact with the E3 homodimers and heterodimer? Previous studies of other E2 and E3 interactions indicate differential activity and specificity with homodimer and heterodimer protein pairs. Second, what mechanism exists for the transfer of ubiquitin to p53? Activity assays of the purified heterodimer and homodimers with different E2s will elucidate a possible signaling pathway. These complexes will be subjected to Nuclear Magnetic Resonance (NMR) spectroscopy, a powerful tool for determining the precise location of atoms in a protein. NMR will provide a testing ground for a functional understanding of Mdm2 and Mdmx interactions with p53, Ubiquitin, and E2 proteins.

miRNAs Play an Important Role in Human Embryonic Stem Cell Division

Jia Wang, Junior, Exchange - Arts Sciences
Mentor: Hannele Ruohola-Baker, Biochemistry
Mentor: Junlin Qi, Biochemistry

Embryonic Stem (ES) cells are the most pluripotent of all stem cells, derived from the inner cell mass of blastocysts during the early stage of mammalian embryo development. Because of their plasticity to differentiate into all cell types of the adult body as well as the potential to self-renew infinitely while retaining their undifferentiated and pluripotent state, ES cells have provided us both a potent tool for embryology and a promising tool for regenerative medicine. ES cells proliferate more rapidly than other cell types but how the careful regulation of cell division is accomplished is not fully understood. Recently a class of 21-nucleotide non-protein-encoding RNA molecules called microRNAs (miRNAs),which serve as genetic repressors of specific target gene expression by binding to their messenger RNAs (mRNAs) and causing mRNAs degradation or post-translational blockade, have been found to play

important role in suppressing cell cycle regulators in mouse ES cells. To further understand the mechanism by which miRNAs involved in human ES cell cycle, we has used RNAi technique to generate stable Dicer knockdown (KD) human ES cell (hESC) lines which have reduced microprocessor activity and thus reduced canonical miRNAs. My specific role is to characterize the efficiency of Dicer KD constructs by using quantitative PCR and Western Blot to check Dicer mRNA and protein expression level in knockdown cell lines. Dicer KD lines have shown slower proliferation, delayed G1/S and G2/M phase transition of human ES cell cycle and upregulation of some cell cycle inhibitors, suggesting that miRNAs regulate gap-phase checkpoints in human ES cell cycle. Further studies are needed to identify individual miRNA function in the process.

SESSION 1N

BEYOND EARTH

Session Moderator: Nick Cowan, Astronomy
Mary Gates Hall Room 284

* Note: Titles in order of presentation.

Extrapolating Martian History and Geology via the Analysis of THEMIS Images
Laura Mayorga, Sophomore, Chemistry
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Joshua Bandfield, Earth Space Sciences

Many questions about the development of Mars and its differences from Earth remain unanswered. By analyzing the Martian surface using infrared measurements, scientists are able to infer the processes that have shaped the Martian surface throughout its history. Most rock-forming minerals have characteristic colors at infrared wavelengths that allow for their identification using remote infrared observations. Specifically, this study uses images from the 2001 Mars Odyssey Thermal Emission Imaging System (THEMIS), which are in nine different thermal infrared wavelengths. Because these wavelengths cannot be seen with the human eye, false color images are constructed using combinations of three wavelengths, assigning a color (red, blue, or green) to each wavelength. Based on the color combinations of the terrain seen in the three images, the minerals in the rocks can be identified, providing compositional information about the rocks. Using a Geographical Information System (GIS) program called Java Mission-planning and Analysis for Remote Sensing (JMARS), the location of the the composition of interest within the image is identified and recorded. All of the information extracted from the images is cataloged in a spreadsheet and placed in context with compositionally interesting surfaces via a distribution map created in JMARS. From the petrology of the rock, inferences are made about the formation conditions present on Mars and how it compares to igneous and aqueous processes of Earth. For example, studies using THEMIS data have revealed the presence of highly evolved lavas on Mars that are produced by magmas that undergo crystal fractionation. This indicates that volcanic processes on Mars could rival those of Earth in complexity. The information acquired from the analysis of these images can be used for planning future missions and will eventually lead to an understanding of the geology of Mars and its history and assist in the search for life.

Forcasting the Weather on HD 189733b
James Bushong, Senior, Astronomy, Physics
Mentor: Nick Cowan, Astronomy
Mentor: Eric Agol, Astronomy

Apart from the Sun, there are many other stars in the galaxy that have planets of their very 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 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 infrared 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. We test two photometric methods and use a simple model to verify whether or not the planet's day-side exhibits any variability (storm cycles, etc) over a period of days, weeks or months. We find that the brightness of the planet's day side varies by 5-10% over a two year period.

Using Simulations to Determine the Evolutionary Processes of Galaxies
Lauren Pope, Junior, Astronomy, Physics
NASA Space Grant Scholar
Mentor: Thomas Quinn, Astronomy

The standard paradigm of galactic evolution involves the creation of large structured galaxies from repeated mergers with smaller dwarf galaxies. Analysis of simulations of these intergalactic acts of cannibalism help astronomers to understand the evolution of galactic structure and how galaxies are affected by mergers and interactions. Beginning with a smooth particle hydrodynamic model of a galaxy as it evolves, I created a detailed analy-

sis of the brightness of the bulge and disk components of several galaxies. I used a program called Sunrise, which creates images of the simulated galaxies that are comparable to telescopic observations of actual galaxies. With the images from Sunrise, I "observed" each galaxy and analyzed it using methods which are similar to those used by observers. I also decomposed each galaxy into it's individual bulge and disk components so that they could be analyzed separately and compared to the Sunrise images. Continued research in this area involves processing additional simulations of a variety of galactic interaction scenarios and further improving the efficiency and accuracy of simulating, imaging and analyzing these galaxies.

Template Rotation Curves for Simulated Galaxies
Whitney Kropat, Senior, Astronomy, Physics
Mentor: Fabio Governato, Astronomy
Mentor: Charlotte Christensen, Astronomy

As the Earth's speed around the Sun allows us to measure its mass, so the orbital speed of stars in disk galaxies can be used as a dynamical tracer of their mass distribution, which can then be explored by analyzing galactic rotation curves. In a recent observational study, Catinella et al (2006) created template rotation curves for a set of 2200 observed galaxies over a range of magnitudes. These template rotation curves characterize the distribution of dark matter within galaxies. Observers find that the ratio of dark matter to luminous matter in galaxies is related to both the galaxies' radius and mass. This ratio varies inversely with total galactic stellar mass, while in each individual galaxy it varies directly with radius, with dark matter dominating at large radii. Additionally, the slope of the rotation curve at high radii varies with galactic mass. We are seeking to reproduce their results with a set of 990 simulated galaxies. These simulated galaxies span a wide range of masses, and were created in two cosmological volumes using numerical simulations. We calculated template rotation curves for our simulated galaxies in a set of magnitude bins corresponding to those in Catinella et al (2006). Using these, we compared the shape of simulated and observed galactic rotation curves and found that the outer slope of our rotation curves becomes increasingly negative with higher luminosity. This is consistent with a lower dark matter to luminous matter ratio in high luminosity galaxies.

Probing Black Hole Outflows with Broad Absorption Line Quasar Variability
Kenza Arraki, Senior, Astronomy, Physics
EIP/Presidential Scholar, NASA Space Grant Scholar
Mentor: Scott Anderson, Astronomy
Mentor: Daryl Haggard, Astronomy

Most galaxies in the universe, including the Milky Way, are thought to contain a central supermassive black hole (SMBH), which can have up to 20 billion times the mass of the Sun. In some galaxies, the SMBH is accumulating material via a hot, bright accretion disk, thereby increasing its mass and emitting enormous amounts of light across the entire electromagnetic spectrum. Galaxies with a growing black hole are known as "active galaxies" and, if they are extremely bright, "quasars." Our research group studies broad absorption line quasars (BALQSOs) because these objects, in particular, probe the high velocity gas very close to the central black hole. Our project aims to determine what timescales are appropriate to detect changes in BALQSO spectra. The variability timescale can constrain the size of the emitting and absorbing gas cloud near the SMBH. We have observed seventeen BALQSOs with the Fred Lawrence Whipple Observatory's 1.5m telescope's FAST Spectrograph. These objects are first observed across 3 consecutive nights, then for one night at 9, 27, and 81 days, and later at 1, 2, and 6 years. We also obtain a set of control non-BAL quasar spectra, in which we expect to see little variability. We plan to create synthetic spectra using the interactive data language (IDL) to simulate variability by testing how the BAL region is affected when different kinds of outflows are added to real data. The spectra will be run through an IDL data analysis code to imitate the limits of our instruments and to determine whether or not we can detect the variability that has been added to the spectrum. We will then assess real variability in the observed spectra of our BALQSOs and determine what constraints our investigations have put on the outflows impacting the BAL region.

Adding the Spectral Energy Distribution of an Active Galactic Nucleus to a Polychromatic Radiative Transfer Code
Joel Leigh, Senior, Physics, Astronomy
EIP/Presidential Scholar, NASA Space Grant Scholar
Mentor: Thomas Quinn, Astronomy

Using a smooth body hydrodynamic model of a galactic merger as a template, the spectral energy distribution (SED) of a modeled, accretion-rate scalable active galactic nucleus (AGN) is assigned to the particle at the center of each merging galaxy which represents the supermassive black hole located there. Images are created using a polychromatic radiative transfer code. Ongoing diagnostics are performed to assess the accuracy of the radiative transfer code in processing the input SEDs. This involves calculating the broadband AB magnitudes of the model SED input into the radiative transfer code and making a comparison to the magnitudes measured in the output when the code is run in a non-scatter (i.e. no dust) mode. Some factors considered which could affect the accuracy of these output magnitudes include AGN particle size, obscuration/occultation by star particles, galactic

flux, wavelength range truncation, inappropriate assignment of AGN particles as young stars (causing dust obscuration), and possibly inconsistent interpolation methods used in scaling the SEDs. The galaxies are analyzed from a variety of simulated camera angles and in an array of filters to assess effectiveness and accuracy. The evolution of the model is then observed over an approximately two gigayear timespan to monitor the accuracy of the output SED at several significant epochs during the merger process. After finishing calibration of the input SEDs the radiative transfer code is run in its normal, dust scattering mode and the scattered images are analyzed.

SESSION 1O

GENES, BIOMOLECULES, AND EVOLUTION

Session Moderator: Benjamin Hall, Biology
Mary Gates Hall Room 287

* Note: Titles in order of presentation.

Increased Tolerance of Inhibitors during Biological Production of Ethanol and Xylitol by a Novel, Genetically Unmodified Yeast
F Kohlmeier, Senior, Biochemistry
Mary Gates Scholar
Mentor: Renata Bura, Forest Resources

The ability to convert residual woody biomass to ethanol could produce a powerful new renewable biofuels from products otherwise considered waste. The pretreatment of lignocellulosic (woody) biomass, however, produces fermentation inhibitors such as furfural, 5-hydroxymethyl furfural (5-HMF), and acetic acid. These compounds are known to decrease ethanol yields in yeasts normally used in bioethanol conversion. A novel, naturally occurring, yeast has been discovered by the Bioenergy Lab in the College of Forest Resources that may produce better ethanol yields in the presence of inhibitors. Using synthetic media to model the pretreated biomass, a systematic study of the effect of furfural, 5-HMF, and acetic acid on the fermentation of glucose and xylose by this yeast was conducted. The influence of furfural in different concentrations (from 1 to 5 g/L) on the growth of novel yeast under cultivation in synthetic nutrient media was small. The yeast grew well in presence of furfural and resembled controls in growth and fermentation. Ethanol and xylitol yield from glucose and xylose were of 90% and 70% of theoretical, respectively. Ethanol yields from glucose were not influenced by presence of furfural. However, xylitol biosynthesis was affected by the presence of furfural in the fermentation media. The effects of higher concentrations of furfural (10 and 20 g/L) and the effects of 5-HMF and acetic acid on the ethanol and xylitol yields will be presented as well. This yeast has the potential to improve the economics of commercial woody biomass to bioethanol conversion and this study is the first step in evaluating that potential.

Characterizing the Role of *SIR2* in Yeast Aging
Brett Robison, Senior, Chemistry, Biochemistry
Mary Gates Scholar
Mentor: Brian Kennedy, Biochemistry
Mentor: Kristan Steffen, Biochemistry

My research involves using yeast as a model organism to study aging. In the single-celled budding yeast Saccharomyces cerevisiae, the *SIR2* gene (Silent Information Regulator 2) has been implicated in regulating aging. Strains containing two copies of *SIR2* live longer (by ˜40%) than those with only one. The mechanism by which *SIR2* is believed to regulate aging is by inhibiting the accumulation of toxic extrachromosomal rDNA circles (ERCs). If two copies of *SIR2* extend lifespan, can additional copies extend it further? In fact, experiments have shown that overexpressing *SIR2* ˜50X is lethal. To characterize the role of *SIR2* expression in lifespan, I am currently creating strains in which it will be possible to control the expression between these two extremes. Genes in other organisms that are homologous to *SIR2*, called sirtuins, have been implicated in the regulation of aging in worms, flies, and mice; however, there is no evidence that toxic ERCs occur in these organisms. This suggests that there may be a conserved mechanism by which sirtuins regulate aging independent of ERCs. In order to explore the possibility of a conserved aging mechanism, I am engineering a strain with two truncated *SIR2* genes that will not be able to inhibit ERC formation to see whether the aging phenotype is retained. In a broader scope, diseases associated with aging have tremendous effects on the ability of people to live healthy lives, and only by understanding such processes in model organisms can we hope to gain insight into how these diseases are caused and ultimately how to treat and prevent them.

The Interaction of Two Growth Hormones in Arabidopsis Seedlings
Rachel Denney, Senior, Environmental Health
Mentor: Jennifer Nemhauser, Biology
Mentor: Cristina Walcher, Biology

Auxin(IAA) and brassinosteroids(BR) are two crucial hormones that control plant development. When present, they cause an increase in growth and an increase in expression of specific genes. These hormones are shown to have a synergistic relationship, implying that these

hormone pathways are interconnected. Currently we are performing a genetic screen to find plants with a greater response to BR and IAA. In our screen, we use two assays to visualize hormone response: expression of a reporter gene, which is sensitive to both BR and IAA levels, and measuring the length of the hypocotyls. We began by performing an EMS mutagenesis on SAUR15::GUS seeds. We then collected seeds from M1 plants and examined M2 seeds, looking for segregation of tall seedlings. Next, we performed a secondary screen using the assays mentioned above to find the best mutants for further study. Mutant plants were then crossed to a different accession (Landsberg), where we know that there are many sequence polymorphisms when compared to the mutant background. In the F2 generation, we grew seedlings in the presence of hormones to identify those seedlings showing a mutant phenotype. We then extracted and amplified the DNA from these tall seedlings at specific polymorphic markers spread throughout the genome. By utilizing the concept of genetic linkage, we looked for an increase in the occurrence of the homozygous mutant genotype in our mapping population–meaning that a marker is close to the gene of interest. We are now in the process of fine mapping to ultimately identify the mutation causing our phenotype. Once the gene is found, we will further study the functions and mechanisms of this specific protein for a better understanding of plant hormone pathways.

Who Wants to be a Model Anyway? Learning more about Floral Developmental Genes by Looking in an Early-Diverging Non-Model System

Anjelique Schulfer, Senior, Biology (Molecular, Cellular Developmental)
Mary Gates Scholar
Mentor: Veronica Di Stilio, Biology

Since the time when Darwin remarked on the incredible diversity of flowers, the mechanisms leading to this striking variation have comprised one of the most marvelous puzzles in biology. In several model systems, flower morphology is influenced by a gene (*MIXTA*) that encodes a transcription factor which belongs to a well known gene family. *MIXTA* is particularly known to cause epidermal cells to develop a conical shape. In the petal, this has been shown to make the color of the flower appear to be deeper and have more dimension, which has also been indicated in attracting pollinators. I have characterized a relative of the *MIXTA* gene from an early-diverging system, *Thalictrum thalictroides*. After determining the role of this transcription factor with a functional analysis project, I have been working to silence the gene in various species of *Thalictrum*. The results of these knock out experiments along with expression studies will give greater insight as to how this transcription factor relates to the development of conical cells. I will then be able to test how my findings hold in horticultural varieties (natural mutants) of *Thalictrum thalictroides*, one of which in particular appears promising in the study of *MIXTA* since it has been observed to have more conical cells than have previously been found in the wild type. This study of *MIXTA* in a lower eudicot lineage will allow for evolutionary implications to be assessed, since all plants where these genes have been characterized before are more recently derived eudicots.

Inferring Phylogeographic Relationships of *Rhododendron Macrophyllum*

Michelle Stitzer, Senior, Biology (General), Anthropology
Mentor: Benjamin Hall, Biology

Rhododendron macrophyllum is the state flower of Washington and a rhododendron native to the Pacific Northwest. Its range extends from British Columbia to as far south in California as Monterey Bay, and it is most closely related to Asian *Rhododendron* species. Fossil palynological evidence suggests dispersal of an ancestor of *R. macrophyllum* to North America by the mid-Eocene. Later, Pleistocene glaciations covered much of the current range of R. macrophyllum in Western Washington. This indicates that the *R. macrophyllum* populations present today are geologically young, either derived from glacial refugia in the Olympic or Cascade Mountains, or repopulated from a southern portion of the range that was less affected by climatic cycling. Previous work has identified genetic variation between plants of the Puget Sound region and those of the Cascade Mountains. I collected plants from the region between these populations, traveling to sites around the southern end of Puget Sound, and gathering samples at locations identified by the Western North American Rhododendron Species Project (WNARSP). To investigate the relationships between the samples, non-coding nuclear DNA from three genes was sequenced or genotyped. Evidence of regional variation among populations of *R. macrophyllum* is present in the genes examined, with heterozygosity for several markers along the geographic distance between the two populations, but no smooth clinal transition. The evidence points to a genetic bottleneck homogenizing individual populations, with subsequent radiation of the haplotypes. This observed genetic diversity may be accompanied by morphological difference, as plants from the Puget Sound have a traditional elliptical leaf shape, while some from the Oregon Cascade Mountains show an obovate leaf shape. Further work on variation and possible selective pressures between plants in the high elevation, mountainous habitat and those from the coastal habitat could provide evidence of speciation in action.

SESSION 1P

LINGUISTIC AND RHETORICAL RESEARCH

Session Moderator: Ellen Kaisse, Linguistics
Mary Gates Hall Room 288

* Note: Titles in order of presentation.

Praise, Blame and Advocacy: An Examination of President George W. Bush's Post-9/11 Discourse and the Rhetorical Genres That Define It
Joshua Hubanks, Senior, Communication
Mentor: Leah Ceccarelli, Communication

Numerous scholars of the social sciences and humanities have analyzed President George W. Bush's rhetorical response to the September 11th terror attacks on the United States. Whereas some have viewed his discourse as participating in the epideictic genre, designed as a non-argumentative attempt to unite Americans and identify enemies, others have noted its overt tendency toward implicit policy advocacy and viewed it as belonging to the deliberative genre. At present, no research has attempted to bridge the gap between these apparently disparate viewpoints. Should the rhetoric be viewed as an epideictic reaction to tragedy, extolling the values of America while condemning those of its enemies? Or should it instead be viewed as a deliberative attempt at advocacy, anticipatorily positing fear-based arguments for soon-to-be-made shifts in American foreign and domestic policy? Indeed, do simplified generic distinctions remain the useful tools of rhetorical classification that they once were, or has their inconsistent application since antiquity rendered them unimportant? Drawing from a number of studies in the humanities and social sciences, as well as from classical rhetorical theory, this study asks: On what rhetorical basis should George W. Bush's post-9/11 discourse be assessed, and to what extent can such an assessment be definitive and useful?

Morphological Integration of Foreign Elements in Russian: A Comparison of Bilingual Speakers in Lithuania and Estonia
Cameron Rule, Senior, Russian Language, Literature, Culture
Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Kat Dziwirek, Slavic Studies

Following the collapse of the Soviet Union, isolated Russian communities in the Baltic States have transitioned from predominant monolingualism to various degrees of bilingualism. Prolonged language contact has culminated in several structural shifts in the Russian language, providing multiple opportunities to examine language change in a dynamic and evolving environment. Upon comparison of studies conducted by Verschik (2005) and Avina (2006), I have identified key differences in the morphological integration of foreign elements by bilingual Russian speakers in Estonia and Lithuania. Data presented by Verschik indicate a consistent non-assimilation of Estonian morphemes into the Russian morphological matrix. Conversely, Avina's study shows fluid and comprehensive integration of Lithuanian morphemes by Russian speakers. My research analyzes the disparity in successful morphological integration by examining the phonetic, morphological, and phonological structures of Estonian and Lithuanian morphemes used by Russian speakers. I argue that the crucial factor influencing successful integration is the phonetic distance between a speaker's L1 (Russian) and L2 (Lithuanian or Estonian). Data used in my study was retrieved from online forums, blogs, as well as radio and television broadcasts. A thorough analysis has revealed several significant patterns in the morphological integration of Lithuanian and Estonian morphemes. First, Estonian morphemes ending in vowel phonemes are integrated with less success than corresponding Lithuanian morphemes. Second, Russian speakers pervasively hybridize Lithuanian morphemes with Russian derivational and inflectional affixes to create new parts of speech, whereas the hybridization of Estonian morphemes is restricted to a limited class of morphemes. The pattern of non-integration of Estonian morphemes suggests that the underlying phonetic and phonological structure of Estonian interferes with pervasive and successful morphological integration. Understanding how languages interact at a fundamental level provides us with the ability to better assess and predict the outcomes of language contact and their contribution to language evolution.

Effects of Style and Gender on Fronting and Raising of /æ/ and /ϵ/ before /g/ in Seattle English
Robert Squizzero, Senior, Linguistics
Mentor: Alicia Wassink, Linguistics

Contrary to popular belief, the comparatively understudied variety of English used in the Pacific Northwest has pronunciations that systematically distinguish it from other varieties such as "Standard American English." One piece of evidence for this is a difference in the quality of the vowels in words like "beg" /ϵ/ and "bag," /æ/ which in the Pacific Northwest are produced higher and more forward in the mouth than in other regions, merging with the vowel in "vague" /e:/. These vowels exhibit this effect when they occur before the consonant [g], which is the final consonant in the words "beg," "bag" and "vague." This study examines the effect of

sociolinguistic style on this variable. Style refers to the register of speech that a person uses in a particular social and interpersonal context. In other US dialects, the vowel in "beg" /ϵ/ is distinct from the vowel in "bag" /æ/ (Labov, 2006). Sociolinguists have found that mergers like "bag" – "beg" often begin in one speech style and spread to others (Labov, 1994). This study hypothesizes that the vowel in "beg" /ϵ/ will not change with style, but the vowel in "bag" /æ/ will vary. We expect these linguistic variations to be taking place primarily below the level of consciousness. Acoustic measurements will be taken on corpus data from the Pacific Northwest English Project (Wassink and Conn, in progress) for three male and three female speakers to establish scientifically if and how these vowels are merging. This study also examines the possible effect of gender on this merger, as it has been shown to influence variation of the vowel in "bag" /æ/ (Labov, 1994).

Stress-Affecting and Non-Stress-Affecting Suffixes in English: The Suffix Pattern Hypothesis
Michael McAuliffe, Senior, Linguistics
Mentor: Ellen Kaisse, Linguistics

The English language has undergone significant change in the past thousand years, especially in the area of stress, and as a result, there are two varieties of suffixes in English. Suffixes can either affect the stress of the stem they attach to or leave it intact. One suffix that leaves stress intact is *-ment*, as seen in *GOVernment*, which has stress on the first syllable just as *GOVern*. A suffix that affects stress is *-al*, so *governMENTal* has had stress shifted. The analysis that I present to explain this distinction is the Suffix Pattern Hypothesis, which states that the pattern which a suffix shows when it enters English with regards to affecting stress on a stem determines the pattern which future uses of suffix will use. In other words, if there is a consistent pattern of stress differences between suffixed and unsuffixed forms of the stem, then that suffix will be deemed as stress affecting, and will cause stress shift in future coinings with the suffix. The predictions of this hypothesis relate specifically to suffix origin. If a suffix came from Old English, then it cannot affect stress, as the Germanic stress system always placed stress on the first syllable, so suffixes would not have counted. If a suffix came from elsewhere, then it can be either stress-affecting or non-stress-affecting, depending solely on the pattern that it exhibited upon entering English. Despite its Germanic heritage, English currently has a stress system that is regarded as closer to Latin, which placed stress according to a syllable's position from the end of a word; thus suffixes affected stress in Latin. An appropriate explanation of the nature of suffixes in English is crucial to understanding the evolution of English's stress system.

Syntactic Processing in Pre-Adolescents: An Event-Related Potential Study
Vanessa Montoya, Senior, French, Speech Hearing Sciences (Communication Disorders)
EIP/Presidential Scholar, McNair Scholar
Mentor: Stacy Betz, Speech Hearing Sciences

The goal of this study was to use event-related potentials (ERPs) to investigate how children process grammatical errors. We were interested in syntactic errors involving tense and subject-verb agreement marking on verbs, specifically errors in the use of third person singular present tense –s (e.g., She walks every day). These errors can occur because of either an overt, inappropriate use or an omission of the grammatical -s ending. This study explored how the brain processes these types of syntactic errors. One way to measure neural processing is to use ERPs. ERPs measure the electrical changes of large groups of neurons in the brain when the subject is processing information. The timing and amplitude of these electrical changes can be used to determine how children process syntactic errors. We are investigating a well-established syntax-related ERP component, the P600. The P600 is a positive change in electrical potential that occurs 600ms after a stimulus is heard and is indicative of syntactic reanalysis and repair processes following the presentation of a syntactic error. Participants for this study were 24 children ages 12-14 years old. All participants were right-handed and had typical language, hearing, and intellectual abilities. ERP measurements were taken while children listened to sentences presented through loudspeakers. Sentences contained either an overt or omit error on the third person singular –s. We are currently analyzing the data to determine the presence or absence of a P600 following each error type. Based on previous studies we expect to find a P600 following both error types, but the amplitude and timing of the P600 may differ between conditions. The study of grammatical processing in typically developing children is important for understanding the characteristics of normal language acquisition. Future studies can use these results as a comparison group for investigations of children with language impairments.

Negative Quantification and Definiteness: A Look at Natural Language Quantifiers
Thomas Trimble, Senior, Linguistics
Mentor: Toshiyuki Ogihara, Linguistics

The linguistic study of meaning, Semantics, attempts to create a link between a native speaker's intuition of what a linguistic expression (word, sentence, etc.) means, and how the rules of language (grammar, syntax, etc.) put these pieces together. Studied intensely throughout Semantic literature, quantifiers (e.g. every, some, few, one) not only have interesting structural behavior, but also harbor some interesting semantic properties. Milsark's

Generalization (Gary Milsark), a theory of the ungrammaticality of the combination of existential sentences (there is/are...) and noun phrases with strong determiners (all dogs, every pig, etc.), has been studied, examined, and cited countless times. However, there are some interesting properties of the determiner "no" which are as of yet unexplained. Using empirical studies, I have looked for the properties of the negative quantifier and how it functions in relation to other quantifiers. Searching through native speaker intuitions and empirical support, my research has looked for a link between various readings and theoretical applications. My first results show a split between theory and intuition, such that intuitively, "no" can, in fact, denote or refer to specific entities. Within the framework of Semantic Theory predating the Minimalist Movement, the implications of such a claim would be hard to integrate. Current Semantic Theory also does not seem accepting of such claims. Therefore, it seems necessary to modify Semantic Theory in such a way to incorporate native speaker intuitions regarding the negative quantifier.

SESSION 1Q

PEACE, WAR, AND POLITICS

Session Moderator: Joel Migdal, International Studies
Mary Gates Hall Room 295

* Note: Titles in order of presentation.

Perceptual Realism and the Winter War of 1939
Julia Abelev, Junior, Philosophy, Political Science
Mentor: Elizabeth Kier, Political Science
Mentor: Moon Yeong Choi, Political Science

Frequently no single variable is capable of fully explaining an international event. In the case of the Winter War of 1939 between the Soviet Union and Finland, neither the systemic nor individual levels of analysis suffice. Consolidating the two approaches and developing the theoretical framework of perceptual realism allows for a more nuanced explanation of the conflict's inception. I combined them on the basis of accepting realism's assumptions regarding the distribution of power and anarchic nature of the international system, but removed the notion of states as unitary actors. Instead, individuals operate as the independent variables that perceive and interpret the balance of power and security threats. In this way, realism explains the contextual variables that incited tension and established the strategic importance of Finland, while the cognitive biases of Soviet leaders led them to consider war as the final option. Based on primary and secondary sources, the paper tests the explanatory power of perceptual realism through two lines of inquiry: 1) whether misperception was present in the decision-making process; and 2) whether misperception, not realism alone, explains the Soviet Union's policies. The evidence drawn from scholarly articles, first-hand accounts and government reports supports both hypotheses and shows that perceptual realism capably explains the Winter War. Further research will explore the theory's generalizability and its limitations.

Peace Through Democratization: Does It Really Work?
Elizabeth Cady, Senior, Biology (Ecology Evolution), Sociology
Mary Gates Scholar
Mentor: Stephen Sulzbacher, Psychiatry

Recent US foreign policy has worked on the theory that democratic states are more peaceful than their nondemocratic counterparts, and thus the way to create enduring peace in the world is to establish democracy in nondemocratic states. While a large body of research indicates that democracies tend not to go to war with each other (dyadic peace), it's less clear that democracy creates a more generally peaceful state (monadic peace). This paper focuses on monadic peace, to see if democratization reduces the incidence of internal conflict. Using Cox regression on the Political Instability Task Force (PITF) and the Pippa Norris Democracy Timeseries datasets, we aim to investigate both claims of monadic peacefulness and of the stability of transition between forms of government. As a result of this research we intend to present suggestions for US foreign policy under the new administration.

The Question in Algeria: French Intellectuals and Atrocities, 1955-1960
Gavin Campbell, Senior, History, Economics
Mary Gates Scholar
Mentor: Raymond Jonas, History

The Algerian War of 1954-1962 was a unique and brutal colonial war. The war, which ended one hundred and thirty years of French rule, was so brutal not just because of the French desire to preserve their colonial jewel and the important economic role Algerian goods and services played in France, but also because of the long-standing presence of some one million European settlers. Even though the Europeans represented one-ninth of the total Algerian population, many had roots that went back over a century, and many viewed Algeria as their home just as much as the indigenous Arab population did. In 1954, the FLN, an Arab nationalist group, began an uprising against the French authorities which would spread into a broader struggle for Algeria's future . In a war where the stakes were so high, both sides created propa-

ganda to justify the atrocities they committed: the French troops sent in to end the rebellion used torture systematically, while the FLN carried out attacks against dissidents and unarmed civilians, both Arab and European. These atrocities elicited strong reactions from French intellectuals, two of the most famous being Jean-Paul Sartre and Albert Camus. This research examines how these two intellectuals reacted against torture and civilian massacres, and how the context of the Algerian War itself shaped the reactions of both Sartre and Camus. Ultimately, we need to regard the opinions of both intellectuals as specific responses to the conditions of the Algerian War, not as broader treatises on the issue of wartime atrocities. We must remember this, as examples from the Algerian War are constantly brought up in modern discussions of the war on terror. This project seeks to examine the extent to which we can draw lessons for the present day from these intellectuals.

Family Matters: Implications of Family Ties of Undecided Voters in Game Theoretic Models of Presidential Elections

Alvin Chen, Fifth Year, Mathematics
Mary Gates Scholar
Mentor: Kazimierz Poznanski, Jackson School of International Studies

The family, as an institution, plays significant roles in many different arenas, including elections for the highest office. Family ties influence the choices of voters, and subsequently those of candidates. The project explores the role of family in Presidential Elections. The structure of the Electoral College, particularly the winner-takes-all rule, has spurred many debates concerning democratic representation. Does the rule favor residents in populous states over those in sparsely populated ones? Using a game theoretic model for presidential campaign resource allocation, Bram and Davis theorized that candidates allocate resources to a state in approximate proportion its electoral votes to the 3/2 power. Thus they argue that, under the current system, candidates favor inhabitants of populous states. Colantoni, Levesque, and Ordeshook challenged this idea, noting that in any given election, the competitiveness of a state matters more than its population. My research combines elements from the works of both sets of authors. First, at the heart of my research is a new game theoretic model, which reflects the strategic nature of elections similar to that of Bram and Davis. However, the model does not assume that undecided voters are homogenous. Instead, it accounts for the competitiveness of states by considering the family ties of undecided voters, which make them unequally attractive to the candidates. For instance, undecided voters of single-person households are prone to vote Democratic. In this model, at equilibrium, the resource allocation depends more on these family ties than on the overall population of the states.

Michele Bachelet: Chile's First Woman President

Xheni Diko, Junior, Interdisciplinary Studies (Global Studies), UW Bothell
Mentor: Julie Shayne, Interdisciplinary Arts Sciences, UW Bothell

This research paper is about Michelle Bachelet, Chile's first woman president. A textual analysis of her political experiences was conducted using methods such as biographies, interviews, and articles. The findings show Bachelet's political experience may have influenced her role as President. Bachelet was born on September 29, 1951 to Angela Jeria, an archeologist, and Alberto Bachelet, a General in the Chilean Air Force during democratically elected socialist Salvador Allende's administration (1970-1973). On September 11, 1973 Army General Augusto Pinochet led a coup against Allende. Michele Bachelet and her mother were detained, held captive for a few weeks, and tortured by Pinochet's secret police force, for her involvement with the Socialist Party. After her release, Bachelet and her mother were exiled to Australia and eventually East Germany where she enrolled at Humboldt University Medical School in Berlin. Upon Bachelet's return to Chile in 1979, she continued her medical studies at the University of Chile, graduating as a surgeon. She worked in the public health system until 1994 when she applied to work for the Ministry of Health. By 2000, President Ricardo Lagos (2000-2006) appointed Bachelet as the Minister of Health, but in 2002, assigned her as the head of the Defense Ministry. Bachelet stepped down from her position in 2004 to launch her presidential campaign. In 2006, Bachelet won the election with 53.5 percent of the votes. During the election, Bachelet focused on issues such as improving public schools, health care services, and social equality. In these three years as president, Bachelet has faced many challenges including multiple strikes. The world continues to watch her closely as she finishes the second half of her presidential term.

From Free Press to Nazi Propaganda: A Comparison

Evi Sztajno, Senior, Politival Science, European Studies, Seattle Pacific University
Mentor: Luke Reinsma, English, Seattle Pacific University

In 1932, Germany, although in political and economic turmoil, boasted of 3,362 newspapers – the largest amount of press in the world. Despite the burden of reparation payments, the spirit of democracy survived. One year later, following Adolf Hitler's election as Reich Chancellor, the idea of a free press in Germany disappeared. Replaced by state ownership or shutdown completely, newspapers slowly became another

tool for spreading Nazi propaganda. Goebbels' propaganda machine, imitated by later regimes, dictated the daily agenda of all mass media. This ten-minute presentation will follow the journey of one such publication *Die Berliner Illustrirte,* a weekly newsmagazine started at the end of the 19th Century and owned by the Ullstein family. Due to their Jewish heritage and democratic beliefs, the Ullstein's automatically lost ownership of their paper upon Hitler's election and were replaced by pro-Nazi employees. Though they were able to reclaim their publication after the war, Herman Ullstein's *Rise and Fall of the House of Ullstein* describes the chilling experience of suddenly finding oneself in the midst of a Nazi newsroom. *Die Berliner Illustrite* continues publication to this day, now known as *Die Berliner Morgenpost*. By comparing the time periods before Hitler's election as Reich Chancellor up to the beginning of World War II, this presentation will answer the question of how Goebbels' propaganda system affected print media. Specifically, the presentation will focus on a gradual two-phased transition from a free press into a Nazi version of *People* magazine. Finally, the presentation will seek to draw universal conclusions from the time period to the recent situation of the print media in the United States, particularly in regards to the Iraq war.

Reconciliation or Revenge: The Choices of Spaniards in the Face of Violence
Rachel Hug, Senior, Interdisciplinary Arts Sciences (Global Studies), UW Tacoma
Mentor: Amos Nascimento, Interdisciplinary Arts Sciences, UW Tacoma

Most people agree that peace is desirable and right. But ideas differ concerning how to achieve peace. In the classic apologetic, City of God, Augustine states that "even when men are plotting to disturb the peace, it is merely to fashion a new peace nearer to the heart's desire; it is not because they dislike peace as such. It is not that they love peace less, but that they love their kind of peace more." Thus, what is peace to one person may be perceived as oppression to another, and, therefore, deserving of a response such as war – all for the purpose of reaching towards a "higher" peace. For Spain, a country that only 65 years ago was bathed in the blood of the Spanish Civil War, and that now faces the very real threat of terrorism, peace is a fleeting concept. This paper explores Spain's historically varied responses to violence: reactions of both violent retaliation and peaceful, nonviolent action. Special attention is given to the religious motivation that often underlies both the Basque separatist group ETA and the nonviolent movements within recent Spanish history. The Catholic faith, inherent to the Spanish identity, has motivated divergent political expressions. Two different definitions of peace have emerged from the same religious canon, fueling distinctly dichotomous methods of pursuing those respective ideals of peace.

Economic Factors in the Fall of the Han Dynasty
John Yip, Senior, Business Administration (Finance)
Mentor: Patricia Ebrey, History
Mentor: Jeongwon Hyun, History

The Han Dynasty was a time of unprecedented national prosperity for China. Thus, its decentralization into three separate feudal kingdoms in 220 CE came as a shocking end to its former grandeur. Existing research on reasons for the fall of the Han Dynasty have identified numerous contributing causes, including the loss of the "Mandate of Heaven" legitimacy, Taoist fanaticism, and a political power struggle among the Confucian scholars, the eunuchs, and the empresses and their families. My research focuses on the economic reasons for the decentralization that toppled the Han Dynasty. By consulting primary texts by ancient Chinese historians and secondary texts by contemporary scholars, I discovered that even though the aristocracy and some merchants enjoyed lives of luxury, many peasants became destitute as a result of natural disasters and nomadic invasions. To sustain themselves, the peasants had to borrow resources from the wealthy at high interest rates, causing them to fall even deeper into debt. As a last resort, some peasants became feudalistic serfs, who worked in the landlords' manors, while others turned to rebellion. The subsequent rise of feudalism concentrated political, economic, and military power in the hands of the regional warlords rather than in the hands of the central government. When a Taoist peasant rebellion known as the Yellow Turban Rebellion devastated China in 184 CE, the warlords seized power in the name of protecting their serfs and formed small kingdoms, which would culminate in the fall of the Han Dynasty and the rise of the Three Kingdoms.

SESSION 1R

BEYOND EMBODIMENT: MOVEMENT, OBJECT, EXPERIENCE

Session Moderator: Phillip Thurtle, Comparative History of Ideas
Mary Gates Hall Room 389

* Note: Titles in order of presentation.

Augmented Experience of Movement and Energy in Film

Anna Czoski, Senior, Digital Arts Experimental Media, Individualized Studies
Mentor: Shawn Brixey, Center for Digital Arts Experimental Media
Mentor: David Halsell, Center for Digital Arts Experimental Media

Film allows an experience of time and image that augments our perception, which makes it an ideal medium for exploring motion. By using the *totalization* technique of stop animation with long exposures, I will investigate the way we can see changes in movement and energy. Our every day experience grounds us in the mindset that materials have a discreet mass, where objects are defined by states of being – stopped, moving, evaporating, etc. – in our cause-and-effect experience. The totalization method is a tool to develop an aesthetic environment set in a new visual physics, which encourages viewing objects in terms of potentials and paths of motion rather than simply state changes. I plan to use stop-motion animation to depict changing movement through time, so that the subject becomes energy and probability. I have begun experiments with isolated movements of the body, simple mechanical devices and other moving objects in order to define a visual language. Through this film, I hope to shift how people view objects towards seeing them as depictions of augmented experiences of space with indefinite histories and alternate futures.

Theremin Shirt: Hyper-Sensory Apparel

Sohroosh Hashemi, Junior, Business Administration (Entrepreneurship)
Mary Gates Scholar
Mentor: Axel Roesler, Art
Mentor: Phillip Thurtle, Comparative History of Ideas
Mentor: Jentery Sayers, English

How can spatial relationships be sonified through apparel? Can this sonification enable new ways of thinking? This question led me to the idea of sonic apparel, through which the wearer (and everyone else nearby) could actually hear the acoustic space of any given environment. To explore this possibility, I created a mock-up of a Theremin shirt, or a sound-producing t-shirt, after researching current technologies and projects in the field of wearable computers and wearable art. I used audio and video to develop an idea of how the Theremin shirt would sound and presented my mock-up, audio and video at the Jacob Lawrence Gallery. This investigative process has presented me with questions related to engineering, design, and music. When continuing this research, I will further examine how apparel can facilitate tactile, sonic, and visual interaction between the wearer and environments. By amplifying or repurposing the sensual interactions the wearer has with apparel, we can think and live in new ways. Ideally, this research will take the form of a fully functional Theremin suit.

Object History Awareness

Sol Hashemi, Senior, Art (Photography)
Mary Gates Scholar
Mentor: Phillip Thurtle, Comparative History of Ideas

My research has led to the production of a series of photographs that seek to reveal the agency and motion inherent in all objects. A chair causes you to move to it to sit down, just as you can then move the chair. Objects have a history full of movement and are shaped by their interactions with this world they inhabit. A scratch on a bucket is like the scar on my leg; both are the residual marks of specific events. I am also investigating space and time. Photographs of a floor or ceiling get placed on a wall and, when part of a grid, start to confuse the viewers' perceptions of gravity. A group of images is seen at once, compressing a duration into an instant. The photographs become exercises in awareness; they force one to link specific activities to still images as well as objects themselves. It is my hope that through these visualizations, one can come to better appreciate the world they share.

Wooden Sculptures

Jason Hirata, Senior, Art (Photography), Comparative History of Ideas
Mary Gates Scholar
Mentor: Paul Berger, Art

It is easy to get so close to a body of work that the idea itself - the topic of interest - begins to fade into patterns of repetition and changes of scale. Working as an artist using photography, Wooden Sculptures is a project I started by placing myself at a distance from the creative process. Friends and family come to my studio and are presented with a set of 14 wooden beams of different proportions. They are given tasks to be completed with the beams such as "place three long beams at least five feet above the ground, touching the floor only within the space four inches from the wall" or "touch the ceiling". As I identify participant's methodologies and propensities toward different types of structures I craft new objectives to either challenge or cultivate these concepts.

The Mediated Body and the Flattened Surface: Memory in Contemporary Times

Laura Paul, Senior, Comparative History of Ideas
Mary Gates Scholar
Mentor: Phillip Thurtle, Comparative History of Ideas

I am interested in the biology present in all things, and how it can be so easily forgotten in post-industrial spaces. I have confronted this idea in many ways, through traditional academic research, writing, film, photography, and installation art. I feel that these var-

ious mediums give the entirety of my work the ability to confront the controls and restraints prevalent in the spaces in which we live in unique and diverse ways. I am interested in the life of organic materials and creatures, such as a live animal or a piece of wood as their individual compositions determine how they act and react in very specific ways. Ultimately I aim to find what can be learned from these traces, and how we remember and capture these processes of life. While we as people may be contained in the vast multitudes of images and systems we are put in, we still have the ability to alter that environment in creative or destructive ways. Plant life may not be able to grow in the concrete confines of urban spaces, but it can survive a short time period with minimal soil and water. I see each aspect of my work as reminders of the permeability of all things. We all as living entities ultimately stand out as beings of life and rebellion in the self-made constructs and the impressing realms of the habitats we all live in.

Threshold

Allison Urban, Senior, Digital Arts Experimental Media
Mentor: Shawn Brixey, Center for Digital Arts Experimental Media
Mentor: David Halsell, Center for Digital Arts Experimental Media

Communication is a fundamental human technology and throughout history methods of conveying information accurately have iterated from symbolism, such as cave painting, to abstraction, such as language. We have arrived at a unique place in history where the rate of technological advancement is steadily increasing towards what is referred to as the technological singularity, or the point at which transhumanism, or the ability to transcend the limitations of the body through integration with technology, could potentially come to fruition. Closely associated with the concept of transhumanism is post literacy, or the idea that written language will be replaced by an unknowable, wordless medium that is more precise and articulate in facilitating communication. In this theoretical next chapter of human history, information is fluid, divorced from form, allowing for pure communication devoid of abstraction and interpretation. My research deals with creating objects that are representative of the threshold between current technological achievement and the technological singularity, between literacy and post literacy, between form and fluidity in information, between an embedded history and a shift to instantaneity. By utilizing artistic inquiry as my research medium, I am able to take advantage of an inherent flexibility in investigating ideas, and in connecting these various communication paradigms toward a coherent understanding of their tangible qualities, eminent poetry and relationship to the trajectory of human progress.

Surprising Moments: Students Talk About Research

What surprised me most about my undergraduate research experience was…

…that I developed a strong support system of faculty and graduate students.

…how long it took to build just the right circuit!

…how much fun it is!!

…the amazing travel opportunities it fostered.

…how integral my project became to my everyday.

…I could do it.

…how supportive other people working in the field were.

…how much respect and help professors and graduate students afforded me.

…I could write a 75 page paper.

…research never turns out to be the way you have planned!

…how exciting it was. I thought research would be boring.

…the graciousness of my mentors.

…realizing that research consists of hundreds of attempts and dozens of people coming together for that one 'aha!' moment.

Poster Presentation 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.

Age-Related Deficiencies of DNA Repair Pathways in Budding Yeast

Hossein Abadi, Senior, Biochemistry
Mentor: Daniel Gottschling, Genome Sciences, Fred Hutchinson Cancer Research Center
Mentor: Jessica Hsu, Medicine and Molecular Cellular Biology

The necessity for aging research is shown by the mortality rate of age-associated diseases, such as cancer; a disease that takes over six million lives globally every year. We believe a better understanding of the processes that govern aging will have enormous implications on medical communities. We are particularly interested in one specific aspect: to determine whether DNA repair pathways become deficient with age. DNA repair pathways are crucial to the health of a cell. Cells lacking these pathways accumulate irreparable mutations. Studies suggest that an increased cellular mutation rate or a gradual accumulation of mutations increases genetic instability within a cell. Genetic instability has also been implicated as a cause of aging and therefore could be the link between cancer and aging. By identifying DNA repair pathways that may become deficient with age, we hope to learn more about the biology of aging, and gain insight into the mechanisms linking aging and the development of age-associated diseases. To identify DNA repair pathways that become deficient with age, we will investigate how the response and tolerance to various DNA-damaging agents differ between young and old yeast cells. Each DNA-damaging agent causes a specific kind of lesion, which is then repaired by a particular DNA repair pathway. Studies in young yeast cells have shown that defects in certain DNA repair pathways result in a characteristic and unique DNA damage. For these aging experiments we will use our preliminary data to subject cells at various ages to extrinsic DNA-damaging agents, and assay for changes in DNA repair ability based on the resultant phenotype. We will further characterize and examine the specific components of the pathways that become defective with age. For any candidate proteins that are defective, we will test for aberrant protein modification and altered protein function and activity.

Analyzing Complex Genetic Interactions in Natural Strains of *Saccharomyces cerevisiae*

Vida Ahyong, Senior, Microbiology, Biochemistry
NASA Space Grant Scholar
Mentor: Aimee Dudley, Genome Sciences

The advent of personal human genome sequencing requires a fundamental understanding of genetic networks in order to be used as a predictive and preventative medical tool. Because of the complexity of the human genome and the difficulty of analyzing complex traits in human populations, the Dudley lab uses baker's yeast, *Saccharomyces cerevisiae*, to develop new methods and gain insights about genetic networks which can be applied to complex diseases in humans. We have characterized a collection of more than 80 *S. cerevisiae* strains isolated from a variety of sources (e.g. laboratory strains, clinical isolates, wine or sake brewing, soil samples) and geographic locations (e.g. North and South America, Europe, Asia, Africa, Australia). We have developed a rapid, automated method for isolating the recombinant progeny derived from crossing these parents, which will allow us to generate vast numbers of progeny from a single cross and score them for a variety of traits. The lab will use this information to help understand the extent of gene interactions in natural yeast isolates, to determine the structure of these genetic networks, and to develop computational tools to analyze complex traits in humans.

Exploring the Consistency of Organized Labor as an Interest Group in American Politics

Kyle Albert, Senior, Political Science, Sociology
Mary Gates Scholar
Mentor: Jake Rosenfeld, Sociology

This paper examines the persistence of labor in politics as represented in testimony before the US Congress and in congressional campaign contributions, despite severely diminishing union density rates and budgets in recent decades. To explore this topic, I am assembling a large dataset composed of a large sample of congressional hearings (obtained through the LexisNexis Congressional database) covering selected years since the early 1970's that are being coded based on whether persons affiliated with the labor movement provide testimony (and, if so, information about the affiliation of the person providing testimony). I am also collecting data on labor's donations to political campaigns to document the extent to which their contributions correlate with their representation in congressional testimony (and their falling membership rates). I hypothesize that the major unions are redoubling their efforts to influence congressional policymaking as a response to their diminishing membership rolls and loss of power in other areas of society; consequently, I expect my project to document the entrenched position that interest groups can take on Capitol Hill even as their constituency base shrinks dramatically.

Enhancing Diversity and Improving Stereoselectivity in the Three-Component Synthesis of Dihydropyridin-4-ones

Amanda Lynn Marshall, Senior, Chemistry-Biology, Seattle University
Mentor: Peter Alaimo, Chemistry, Seattle University

Since the passing of the Pollution Prevention Act in 1990, chemists have placed greater emphasis on devising synthetic methods that reduce or eliminate the use

and generation of hazardous substances. As a result of these efforts, many different "green" synthetic methods have been developed. Our lab has recently focused on the green production of biologically active molecules containing the 2,3-dihyproyridin-4-one (DHP) scaffold, because it is found in numerous alkaloids and biologically active synthetic targets. For example, DHPs are known to possess antifungal and antitumor properties, and are being investigated as enzyme inhibitors. Due to the therapeutic potential of DHPs as antitumor agents, we have developed a green tandem reaction that generates variously substituted DHPs using an indiumtrichloride-catalyzed imino-Diels-Alder reaction. Using this reaction a panel of DHPs was synthesized in good to excellent yield. Currently we are investigating an enantioselective variant of this reaction to produce enantiopure DHPs. This goal represents an important extension of our prior research since nearly all pharmaceuticals and their biological targets are chiral. This presentation will describe the strategy and results obtained to date.

Tactile Feedback for Neuroprosthetics
Anibel America, Senior, Bioengineering
Mentor: Ralph Lin, Bioengineering
Mentor: Yoky Matsuoka, Computer Science Engineering

Within the last decade, many advances have been made in neural control of prosthetic limbs. Numerous interface modalities such as cortical electrodes, EEG, nerve cuffs and EMG have been used to decode motor intent and move various robotic prostheses. However, nearly all of this work has been focused on open-loop control of efferent signals (motor output). We have taken a preliminary look at integrating afferent tactile signals for prosthetic control. Specifically, we are interested in examining reflex arcs, which have been shown to play a role in how humans adjust their grip force on an object. We present EMG data from subjects gripping an object subject to unpredictable loads and compare reflex responses resulting from cutaneous detection of slip to volitional force exertion on an object. We then propose how this EMG signal may be used for controlling grip forces and discuss several implications of reflex neural control of a prosthetic device.

The Age and Metallicity of the Bootes I System
Anne Bossi, Senior, Physics, Seattle University
NASA Space Grant Scholar
Mentor: Joanne Hughes Clark, Physics, Seattle University

We present photometry, in the Washington *CT1T2* filters, of the Bootes I dwarf spheroidal galaxy, discovered in the Sloan Digital Sky Survey. We detected 165 objects in the field, and we determined statistically that about 40% of them are not members of the galaxy, but are part of the Milky Way's halo. We find that there is a distinct main-sequence turn-off and subgiant branch. The best-fit theoretical model gives the galaxy an age of close to 14 billion years, with the stars being very poor in heavy elements. This sparsely populated dwarf galaxy is dominated by dark matter, and has a spread in chemical composition, which indicates the supernova ejecta of the first generation of stars was retained by the unseen mass of the system.

Measuring Recombination Efficiency in *Agrobacterium Tumefaciens*
Ashley Gregoire, Senior, Biology, Seattle Pacific University
Mentor: Derek Wood, Biology, Seattle Pacific University

Generation of insertional mutations in bacteria is facilitated by homologous recombination, a process mediated by the *recA* gene. In *Agrobacterium tumefaciens* C58, recombination requires a minimum of 1,500bp of homologous DNA. In contrast, efficient recombination in *Azotobacter vinelandii* requires only 300bp. In order to improve recombination in C58 we are replacing its *recA* gene with that of *Azotobacter*. To test the effectiveness of recombination in this strain we are constructing three test vectors that contain 0.5, 1.0, and 1.5kb of homologous DNA flanking a kanamycin resistance gene cassette. The vectors are designed to replace gene Atu0944 and the efficiency of this replacement will be tested for all three vectors in both wild type *recA* and *recAAvin* C58 backgrounds. Generating a recombination efficient C58 strain will support the development of functional genomics tools in this model organism.

Tandem Repeats: Protein Function, Toxicity, and Adaptation
Jacob Bale, Senior, Biochemistry
Mentor: Christine Queitsch, Genome Sciences
Mentor: Soledad Undurraga, Genome Sciences

DNA sequences repeated in a head to tail fashion, known as tandem repeats (TR), are present in many protein coding regions of eukaryotic genomes. These genetic elements can change size rapidly through polymerase slippage and unequal recombination. Mutations in repeat regions occur 10-10,000 times more frequently than in non-repeat regions and they often yield functional proteins. Thus, we hypothesize that intragenic TR facilitate rapid adaptation to changing environments. Plants are an ideal system in which to investigate this phenomenon because their immobility places them under high pressure to adapt quickly to changing environments. Of the over 13,000 intragenic TR found in the model plant Arabidopsis, we have chosen to focus on six, which are found in key genes of growth and development. One of these repeats is located in *PFT1*, a light-quality sensing and flowering time gene. This TR consists of a period-

ically interrupted polyglutamine repeat of 88-90 amino acids that is highly conserved in size, which suggests that this particular length confers optimal function to PFT1. In addition, pure polyglutamine repeats of this length are usually toxic, playing roles in disorders such as Huntington's disease in humans. Thus, the viability of plants containing this repeat indicates that periodic interruptions may mitigate toxicity. These hypotheses are being tested by the generation and characterization of transgenic plants containing *PFT1* with repeats of varying length and or purity. We expect the plants carrying TR lengths other than the 88-90 amino acids observed in natural accessions will exhibit altered flowering phenotypes. We also anticipate that plants carrying pure polyglutamine repeats will either cause lethality or will significantly change flowering time. This work should increase our knowledge of TR function and toxicity, including their role in medical disorders and rapid adaptation.

Integrating Germany's Muslims: Faces of the German Islam Conference

Angela Barnard, Senior, Political Science
Mentor: Steven Pfaff, Sociology

Germany today is the product of marked demographic change due to immigration, notably from Turkey. This change forces the citizenry to grapple with questions pertaining to integrating a cultural Other, in this case the Turkish Muslim immigrants, some of whom have different modes of dress, religious and cultural practices, and even linguistic distance from the ethnic Germans. Historically, more than other immigrant groups such as the Italians, Greeks, or Yugoslavs, the Turks have been "considered unassimilable because of allegedly unbridgeable cultural differences" (Lucassen 2005). In order to achieve sucessful integration, cooperation is needed from both groups, the Turks and the Germans. In recent years the German government has acknowledged this need and seeks to address it through dialogue with the principal Muslim organizations in Germany, including: The Alevi Society of Germany, Islam Council for the Federal Republic of Germany, The Turkish Union for Religious Affairs, The Association of Islamic Cultural Centers, The Muslim Coordinating Council, and The Central Council of Muslims in Germany. This study investigates the goals being pursued by the Muslim organizations and the German government at the annual German Islam Conference, founded in 2006. It is imperative that we understand what goals each group brings to the table in order to assess the perspective from which each is approaching negotiations at the conference, and to project what form of concrete results to expect from these proceedings. An understanding of the dialogue at the German Islam Conference can be applied to other political contexts where cross-cultural negotiations are necessary, or already taking place.

The Micro and Macro Level Impacts of Greece's Membership in the European Union

Aspasia Bartell, Senior, International Studies: Europe
Mentor: Carol Thomas, History

The European Community opened its doors to Greek membership in 1981. Since then the European Community (now the European Union) has made considerable financial contributions (through structural and regional funds) in an effort to improve Greece's economic performace, as well as increase its economic competitiveness in the common market arena. The EU planned to do this by utilizing community funds to rebuild Greece's aging infrastructure and increase opportunities for economic/business growth through economic integration. However, time has shown that the European Community/European Union's recipe for sucess has yielded varied results, providing for increasing successes at the macro level (government and business), but growing disappointment at the micro (citizen and consumer) level. This poster presentation will delve into the explanations for this phenomenon through an analysis of economic indicators and a review of existing literature on the topic. It will give an analysis of the current situation and will disucss possible future implications. It will also include information from 10 interviews conducted by the author on the ground in Greece.

Large Transported Boulders along the Eastern Sicily (Italy) Coastline

Janet Bautista, Senior, Earth Space Sciences
Mentor: Breanyn MacInnes, Earth Space Sciences
Mentor: Jody Bourgeois, Earth Space Sciences

The eastern Sicilian coastline has a prominent scattering of large transported boulders. Eastern Sicily has experienced several tsunamis as well as storms that generated large waves. The mechanics behind these powerful forces may be key to understanding how these boulders were deposited along the coastal terraces. I worked with a group of students at a locality called Capo Campolato located on the northern end of the Mt. Tauro Peninsula in Southeast Sicily, where we measured a beach profile, made lithologic descriptions, and mapped boulders. Many boulders are isolated, some have fossils indicating origin near sea level, and some were found in an area that has been farmed. Direct observations of each boulder (size, GPS location, and estimated weight) are being used to determine whether tsunami, storm, or a combination of both could have transported the boulder. Using certain approximations (uniform density, pre-transport environment, and ellipsoidal shape), I am working with sediment-transport equations to distinguish between tsunami and storm-generated waves as the mechanism of large-boulder movement. I will also use a case history from the 2006 Kuril tsunami to test my methods.

The Impact of Urbanization on the Microbial Community in Lakes of the Pacific Northwest
Helen Bekris, Senior, Biology (General)
Mentor: Claire Horner-Devine, Aquatic Fishery Science

The development of freshwater lake shoreline can greatly affect the resident microbial community. Twenty-one lakes in Western Washington State and Southern British Columbia, Canada were sampled and analyzed for bacterial enumerations, nutrient concentrations and other physical-chemical parameters at three depths. These lakes spanned a gradient of anthropogenic shoreline development that ranged from 0% (pristine) development to 100% developed. Bacterial abundance was determined by epifluorescent microscopy, and these data were compared to physical-chemical parameters to examine the impact of urbanization on microbial abundance. We found that in the epilimnion layer the average number of cells per milliliter was significantly correlated with shoreline development, where in both the hypolimnion and the metalimnion there was no relationship between abundance and development. We also did not observe a significant relationship between bacterial abundance and ammonium and phosphate concentrations in each layer. In ongoing work, we are examining variation in bacterial community composition in these same lakes.

Effect of High Insulin Levels on Dermal Fibroblasts Proliferation and Migration
Austin Bell, Senior, Biology (General)
Mentor: Anne Hocking, Surgery

In today's society, both type 1 and type 2 diabetes are a rising problem. Patients with diabetes show significantly impaired wound healing, often resulting in chronic non-healing wounds. A recent study in our laboratory investigating interactions between resident skin cells and bone marrow-derived mesenchymal stem cells has shown the promise of stem cell-based therapies to improve cellular response to cutaneous injury. We demonstrated that bone-marrow derived mesenchymal stem cells induce dermal fibroblasts to proliferate and migrate. My aim is to determine whether high levels of insulin, a condition characteristic of type 2 diabetes, effect fibroblast proliferation and migration. I will culture dermal fibroblasts in both high levels of insulin and no insulin, as a control, and then measure the effect on dermal fibroblast proliferation and migration. For the proliferation assay, I will count viable fibroblasts on days 3 and 4 after initiation of culturing in high levels of insulin and compare to cell counts of the control condition. Dermal fibroblast migration will be studied using a 'scratch' wound assay. In this assay, a confluent dermal fibroblast monolayer cultured in both control and high insulin conditions will be scratched. The percent scratch wound closure will then be determined by measuring the scratch area on each day. If insulin is shown to have a significant effect on fibroblast proliferation and migration, further investigation will determine whether elevated levels of insulin effect proven interactions between dermal fibroblasts and mesenchymal stem cells.

The Six S's to Success (6S): Controlled Porous Structured Biomaterial
Devon Benedict, Junior, Extended Pre-Engineering
Mentor: Buddy Ratner, Bioengineering

The Six S's to Success (6S) project developed a controlled porous structured material that acts as a host for directing cells down healing, regenerative pathways. At the point of contact between the cells and the 6S biomaterial, fibrous encapsulation is dramatically reduced while capillary blood vessel growth is increased. This causes normal tissue to be produced at the site instead of tough scar tissue. The pore sizes are experimentally determined and optimized for different types of cells in the body. The pores are connected by channels roughly 40% of diameter of the pore, which allows cells to penetrate deeper into the material. My part in the research project consists of making these materials and developing new fabrication methods to guarantee consistent and uniform structure. Both crosslinked silicone polymer and poly(2-hydroxyethyl methacrylate) (pHEMA) have been used for the biomaterial. The construction process consists of filling a mold with micron scale poly(methyl methacrylate) (PMMA) spheres and sintering them in the oven. The sintering process causes the beads to slightly melt together where touching, which later creates channels in between the pores. The interconnected bead cake is surrounded with the monomer of choice, which is then polymerized. Polymerizing the monomer causes it to solidify to a rubber-like consistency. The beads are then dissolved out using a solvent, and the product is a porous biomaterial. Some applications for the material being researched include continual functioning internal glucose sensors, permanent hip replacements, and reduced healing time for wounds.

Efficient Modeling of Disulfide Bonds with Rosetta
Spencer Bliven, Recent Graduate, Biochemistry, Computer Science
Mentor: David Baker, Biochemistry
Mentor: Jacob Corn, Biochemistry, Howard Hughes Medical Institute

The Rosetta macromolecular modeling suite has shown success in a wide range of structural biology problems such as structure prediction, protein design, and prediction of protein interactions. All of these problems rely on an accurate model of the energies involved in each system. One factor critical to the structure of extracellular proteins is disulfide bonds. The current version of Rosetta contains explicit energy functions to model

disulfides, but these require the position of both sulfur atoms to be known with high accuracy. This is suitable for many applications, but particularly computationally intensive methods speed up computation using a simplified model of amino acids where a single 'centroid' atom is substituted for the side chain atoms. The centroid method offers increased performance by reducing the number of degrees of freedom, but is incompatible with the disulfide energy functions based on sulfur atom conformation. As a solution, I have introduced energy functions which evaluate the strength of a disulfide bond in the centroid representation. Five factors are considered to coarsely model disulfides: the Cß-Cßdistance, centroid-centroid distance, Cα-Cß-Cßangle, Cα-Cß-Cß-Cα dihedral angle, and N-Cα-Cα-C dihedral angle. A statistically-derived energy function for each parameter was determined from disulfide configurations found in-PDB structures containing disulfide bonds. These energy functions will be essential to future enhancements to Rosetta, such as the prediction of disulfides bond formation during folding and the design of disulfide-containing proteins.

Trainmaster: Adaptive Flashcard System
Colin Booth, Senior, Informatics
Trisha Smith, Senior, Informatics, Mathematics
Mentor: Bob Boiko, Information School
Mentor: David Hendry, Information School

The International Phonetic Alphabet (IPA) is a special alphabet used by linguists to represent all the sounds present in human languages, with a one-to-one relationship between symbols and sounds. We are designing a web application to help students with the memorization of the IPA through the use of a dynamically generated question set. To design and create this application we conducted interviews with current phonetics students who are studying the IPA, working with them to refine our initial prototype design and to discover necessary functionality. Learning the IPA is an ideal candidate for a computerized teaching tool as it is a memorization activity that cannot be learned using traditional flashcard drills because sound is one of its core components. Additionally, one of the major shortcomings of flashcards is that they do not track user progress, nor do they scale question difficulty automatically. Our project addresses both of these limitations in order to make a more effective learning aid, allowing students to quickly judge what places they should focus their studies by showing students their progress for any given question. While we are developing this tool for a specific application, it is our desire to create a system that is able to adaptively help with student memorization tasks regardless of the type of data that is given. Programs currently exist for this type of answer-driven dynamic question generation; however, these programs are typically used to administer tests instead of being used as practice aids to assist learning.

Analyzing the Composition and Geology of Mars Using the Thermal Emission Imaging System
Jennifer Braun, Sophomore, Computer Science
NASA Space Grant Scholar
Mentor: Joshua Bandfield, Earth Space Sciences

The Mars Odyssey spacecraft, launched in 2001, is continuing to provide geologists with informative infrared images of Mars. Recently, anomalies discovered in the infrared images of the surface have given rise to questions regarding the supposedly uniform composition of the planet. Mars is thought to be primarily composed of basalt, a volcanic rock with a relatively low silica content. However, through analysis of Thermal Emission Imaging System (THEMIS) images using a program called the Java Mission-Planning and Analysis for Remote Sensing (JMARS), differences in the composition of the surface of Mars have been observed and recorded. JMARS allows these regions to be noted and visually mapped to allow for easy observation of patterns in the distribution of these areas. Reviewing THEMIS images has revealed the presence of an unidentified substance to the south and west of Olympus Mons that appears to be soft and easily eroded. This has yet to undergo spectral analysis, but the thermal inertia of this substance, a value derived by temperature, density, and thermal conductivity, has shown that this unit is composed of very fine particles. Thermal inertia, which can be translated to particle size, is calculated using a thermal model in a program called Davinci. In addition, deposits of olivine and areas with an unusually high silica content are being recorded and analyzed using JMARS and thermal inertia. Such minerals can provide evidence about the history and geology of Mars. For example, hematite, (iron oxide) which occurs in Terra Meridiani and Aram Chaos, is formed by water-based processes. This suggests that these regions' unique topography could have possibly been formed by water. Further studies of the unknown substance and silica-rich areas can provide information about the history of Mars as well and could provide future landing sites that will contribute valuable information about Mars.

National Identity and the Intersection of Gender Equality and Ethnic Minorities in Denmark
Kristiana Brix, Senior, International Studies
Mentor: Christine Ingebritsen, Scandinavian Studies
Mentor: Deborah Porter, Jackson School of International Studies

Denmark has faced serious challenges to integrating ethnic minorities (i.e. immigrants and descendents of non-Westerns nations) into Danish society. This paper evaluates the integration of ethnic minority women into Dan-

ish society since 2001. This exploration uses three areas of participation: legal, political, and economic measures, to assess the integration of both ethnically Danish women and ethnic minority women to compare how national identity affects equality initiatives. The paper analyzes EU, Danish government, and other primary publications detailing equality measures targeting these two groups. Denmark's traditional valorization of gender equality in its national identity has facilitated the government's approach to female immigrants as a unique demographic. As a result, ethnic minority women benefit from Danish gender equality norms. This is most effective and visible in native female labor market participation and small, yet successful programs aimed at engaging ethnic minority women in the workforce. As a result, this 'female' perspective allows Denmark to better integrate immigrant women through labor market institutions, which is one area of Danish society in which gender equality is particularly apparent. The analysis finds compelling evidence in support of expansion of labor market integration programs to more effectively include ethnic minority women in Danish society.

Ground-Truthing Remotely Sensed Sea Ice Data in the Arctic

Thomas Broomfield, Junior, Exchange - Arts Sciences
Mentor: Miles Logsdon, Oceanography
Mentor: Kristin Laidre, Polar Science Center

In April 2008, an aerial survey was conducted over Baffin Bay and West Greenland. Four independent observation platforms were equipped with bubble windows allowing complete visual surveillance of the track line straight below the plane. Four observers recorded marine mammal sightings from either side of the aircraft (two in front and two in the rear). Digital still images were collected every 10 seconds together with continuous video recordings. A protocol for trackline position indexing of 'ice presence' and 'ice absence' was created and applied to all tracklines. Satellite-based measurements of sea ice were obtained from the NASA MODIS (Moderate Resolution Imaging Spectroradiometer) sensor. This poster addresses the primary research questions of: 1) How well do fine resolution digital products obtained at low altitude agree with remotely sensed estimates of sea ice data products and 2) How much of large spatial extents of sea ice go undetected (over or under estimated) due to cloud cover or due to MODIS algorithm error. The surface reflectance data recorded by three of the MODIS bands between the 459nm - 670nm wavelengths, was resampled to a spatial resolution of 250 meter grid cells. This multi-spectral image was then classified into four classes of sea ice (open water, light pack, medium pack, and heavy pack) using the Isodata clustering algorithm available in the ERDAS Imagine 9.2 image processing software. Based upon the strength of absorption and reflectance at these wavelengths, the clustering algorithm achieved 95% confidence in assigning each 250 meter grid cell to the most similar classification of sea ice type. Visual inspection supported the classification by noting consistent regions and gradation between of open water and pack ice. These results will be used to improve accuracy in sea ice concentration studies as they relate to marine mammal in the Arctic.

Access, Visualize, Analyze: Wastewater Monitoring

Michael Canfield, Senior, Informatics
Dustin Dickson, Senior, Informatics
Mentor: David Hendry, Information School
Mentor: Batya Friedman, Information School

Critical infrastructures such as transportation systems, electricity generation, public health, water supply, and security services are essential to creating human sustaining environments. To control and monitor these complex infrastructures, engineers use Supervisory Control and Data Acquisition (SCADA) systems which consist of various data gathering and transmission technologies. This project addresses perhaps the most fundamental and vital system to humans: our water supply. A local wastewater district operates a SCADA system built upon legacy technology that uses paper printouts to both report and store system metrics. This system does not provide aggregate computations or afford rapid data analysis that could potentially lead to more efficient pump station usage and employee work practices. To better understand this problem, we conducted field observations and contextual interviews with wastewater district engineers. Research confirmed that real-time and historical analysis of data is difficult due to the high cognitive workload when analyzing static paper printouts. Engineers desired a web-based user interface to dynamically access and analyze digitally stored data. These research results drove an iterative design process involving sketches and rapid paper prototypes. Usability tests provided valuable user feedback that we incorporated into our design process. Using adaptable and extensible web technologies, we are developing a database, web service, and user interface that integrate with the current monitoring system. This provides web access and data storage for alarms, data visualizations, and real-time and historical reports used on a daily basis. These improvements will enable engineers to more comprehensively monitor the district. If our work is successful, this enhanced system will also help the wastewater district further protect their customers' health, provide support for increasing demands on their system, and to ensure work practices and resource allocation increase environmental sustainability.

Effects of Aging on the Perception and Neural Representation of Frequency

Jordan Cannon, Senior, Speech Hearing Sciences (Communication Disorders)
Mary Gates Scholar
Mentor: Kelly Tremblay, Speech Hearing Sciences
Mentor: Chris Clinard, Speech Hearing Sciences

It is well established that hearing declines with advancing age. However, even when hearing tests reveal no significant hearing loss, many older adults still complain about difficulties understanding speech. One hypothesis is that aging affects the physiological ability to encode frequency information contained within sound. For example, the frequency content of a signal helps people differentiate between vowels, consonants, and background noise. Little is known about the effects of aging on frequency coding so the purpose of this experiment was to evaluate the effects of aging on perception and the physiologic representation of frequency. Thirty subjects participated in a behavioral task where they were asked to discriminate between two tones of different frequency. The distance between the two frequencies was adjusted such that each subject's threshold, or difference limen, could be established. A small difference limen means a person could detect smaller frequency changes than someone with a larger difference limen. The physiology measure used was the frequency-following response (FFR), a steady state encephalography measure. The FFR is a physiological response from the central auditory nervous system (CANS) that is sensitive to the frequency of an auditory stimulus. FFRs were analyzed using amplitude and phase coherence (degree to which the FFR was synchronized to the stimulus) to determine how well each stimulus frequency was represented in the CANS. A FFR with high amplitude or phase coherence would indicate a good neural representation of frequency. Our results showed a decline in behavior and physiological responses with increased age. Behaviorally, this means that a person's ability to distinguish changes in frequency degrades as they get older. Likewise, the physiological measures decreased with increasing age, indicating the brain's ability to represent frequency also declines with age. Collectively, this evidence demonstrates a biological link to the age-related declines in perception experienced by older adults.

Characterizing the Relationship between Septal and Cortical Activity in the Neonatal Mouse Brain

Emily Cedarbaum, Senior, Biochemistry, Neurobiology
Mary Gates Scholar
Mitra Barahimi, Senior, Neurobiology
Mentor: William Moody, Biology

Spontaneous synchronous activity (SSA) has been observed in different regions of the CNS and has been shown to play critical roles in neuronal migration, axonal outgrowth, and synapse formation. The Moody lab has previously characterized SSA in the mouse neocortex, where it occurs as synchronous bursts of electrical activity and associated intracellular calcium transients generated by virtually all cortical neurons. In calcium imaging experiments, this activity originates bilaterally in ventrolateral pacemaker regions and propagates as a wave across both hemispheres. We have discovered SSA in the septal nucleus, a sub-cortical structure that is important in the reward and memory systems of the brain. SSA has not been previously reported in the developing septal nucleus. We have recorded about 900 waves of SSA at high time resolution (20-100 frames/sec) using a high-capture, low-power microscope that can image entire brain slices in a single field of view. Analysis of these image streams shows that septal activity can trigger the cortical pacemaker, be triggered by cortical SSA, or occur independently of cortical SSA. These data indicate a complex relationship between SSA in the two structures. In our next experiments, we will investigate the developmental time course of septal SSA and identify the neurotransmitters involved in its generation. This research has implications for pediatric neurology, given that it involves neural activity centered on the time of birth. Pediatric seizures can lead to long-term deleterious effects that may be caused by disruption of the developmental functions carried out by SSA. The unique intrinsic properties of developing neurons that make the infant brain more seizure susceptible than the adult brain also afford them the ability to generate SSA. Characterization of septal SSA will increase our understanding of the physiological basis of infant and childhood neurological disorders.

Normal and Shear Stress Tests of Long Beach Bridge Deformable Connector Tabs

Dean Chahim, Junior, Pre-Engineering
NASA Space Grant Scholar
Mentor: Jeffrey Berman, Civil Environmental Engineering

Earthquakes can cause extensive and dangerous damage to complex components of bridges that are time-consuming and costly to fix. As a means of limiting earthquake damage, structural fuses can be designed for bridges where the sacrificial fuse elements absorb seismic (earthquake) energy and protect the rest of the structure. Shear links are one such type of structural fuse and they can be designed to be easily replaceable, thus reducing post-event repair costs. Such links have been employed in the new west span of the San Francisco-Oakland Bay Bridge and are being designed for a proposed cable-stayed bridge in Long Beach, CA that will replace the aging Gerald Desmond Bridge. Since the shear links serve a critical function, it is important that their behavior be well-understood. Sophisticated com-

puter models of the shear links are being developed by others to analyze their behaviors under seismic forces. To assist with the calibration of these models, testing of the steel that will be used to fabricate the shear links will be performed. The testing will seek to characterize the stress-strain behavior of the steel under large cyclic shear and normal strains (on the order of 10%). A universal testing machine capable of applying cyclic loading will be used for the testing utilizing a unique apparatus that was designed this summer to carry out the testing in shear. Strains, deformations, and loads will be recorded using strain gauges, extensometers, and load cells respectively. Experimental control and data acquisition will be performed with LabView software and the data will be processed in Excel. The results of this testing will help accurately calibrate the computer models simulating seismic stress on the bridge, thus improving the safety and effectiveness of the final bridge design.

Water Purification using Zirconium Hydroxide
Hok Chan, Senior, Materials Science Engineering
Mentor: Raj Bordia, Materials Science Engineering

Zirconium Hydroxide was recently found to be a potential candidate for water purification. Research showed that it can help remove the natural organic matters (NOM) in water, which prevents the formation of harmful and regulated disinfection by –products (DBPs), and also removes taste, odor and color. The proposed mechanism of NOM removal was by adsorption – the Zr species has higher charge density, which significantly improves charge neutralization and subsequent NOM removal. In this research, experiments are being conducted to investigate the effect of processing conditions on the nature of the Zirconium Hydroxide and its effectiveness in NOM removal. Major variables for Zirconium Hydroxide processing are pH, ageing time and calcination temperature. The synthesized Zirconium Hydroxide will be studied using Thermogravimetry Analysis (TGA) and X-ray Diffraction (XRD). The performance of the fabricated Zirconium Hydroxide would be investigated by doing a batch test and a column test on water with controlled amount of types of NOMs.

Lifespan Extension via Decreased Protein Synthesis in *C. elegans*
Devon Chandler-Brown, Junior, Biology (General), Biochemistry
Mary Gates Scholar
Mentor: Matt Kaeberlein, Pathology
Mentor: Lara Shamieh, Pathology

Many environmental and genetic interventions are known to influence the rate of aging in model organisms, the best characterized of which is dietary restriction (DR). DR is defined as a reduction in nutrient availability in the absence of malnutrition and has been shown to increase life span in many species, including yeast, worms, flies, fish, spiders, and rodents. Recent studies suggest that life span extension from dietary restriction is mediated, in part, by reduced signaling through the Target of Rapamycin (TOR) kinase. Reduced TOR signaling in response to DR leads to increased protein degradation via autophagy and reduced mRNA translation through ribosomal S6 kinase and mRNA translation initiation factors. Our group and others have found that inhibition of TOR, mutation of S6 kinase or mutation of translation initiation factors is sufficient to increase life span in the nematode C. elegans. Based on these observations, we have developed the hypothesis that one mechanism by which DR may slow aging is by improving protein homeostasis through altered mRNA translation. Here we report the results of several experiments designed to test aspects of this hypothesis. We observed a significant decrease in reproduction in long-lived translationally deficient mutants, suggesting that reduced protein synthesis may result in a shift in energy expenditure from reproduction to somatic maintenance. We also observed that DR or mutation of S6 kinase lead to reduced mRNA translation and a decrease in growth rate and maximum adult body size. DR also induces autophagy, consistent with inhibition of TOR, and we are currently testing whether mutation of S6 kinase has any effect on autophagy in control and DR animals. Given the highly conserved nature of DR and TOR signaling as modifiers of aging, it is essential to understand which TOR-regulated targets also influence aging and the mechanism(s) by which they do so.

Structural and Functional Differences between Young and Aged Mice Type-I Collagen Extracts in 3-D Collagen Gel
Christopher Chang, Senior, Neurobiology
Mentor: May Reed, Medicine
Mentor: Mamatha Damodarasamy, Gerontology

The majority of past studies have focused on the various effects of aging on young and aged cells, using three-dimensional Type-I collagen to effectively mimic the extracellular matrix. Although a great deal of information has been found in regards to aging cells, less is known about the effects of age on the extracellular matrix itself. Type-I collagen from the tails of "young" mice (aged 4-6 months, n=10) and "aged" mice (aged 20-24 months, n=10) were extracted and then compared for functional and morphologic differences. Human fibroblasts from young and aged donors were obtained from the Coriell Institute for Medical Research's cell repository. SDS-PAGE with and without collagenase showed that the compositions of both samples were similar. However, when compared to young collagen, aged collagen formed fibrils at a noticeably slower rate. The fibrils were less densely packed and smaller in diameter (deter-

mined using transmission electron microscopy). Furthermore, the aged collagen gels were much more malleable and contractible by human fibroblasts. RT-PCR analyses, using a cell and matrix adhesion molecule pathway array, were performed on human fibroblasts cultured for 18 hours in young or aged collagen. The two cultures differed in transcripts for specific integrin subunits laminin subunits, matrix metalloproteinases (MMPs), transforming growth factor beta-1 (TGF-beta 1), and SPARC. Additionally, Western blots and zymography showed a decrease in transcripts for integrin alpha-2 while showing an increase in transcripts for SPARC. MMP-1 and MMP-2 expression appeared similar in both cultures. Polymerization, structural and physical properties, and the influence on gene and protein expression by fibroblasts differed significantly in collagen extracted from aged mice relative to that obtained from young mice. Further studies will examine the influence of young and aged collagen on expression of molecules that regulate benign and malignant cell growth, such as angiogenesis promoters and inhibitors.

Socioeconomic Status, Race, and College Major Selection

Sophia Chang, Senior, Sociology
Mary Gates Scholar
Mentor: Susan Pitchford, Sociology

Selecting a college major is a crucial point and dictates what profession or which graduate program the student will enter upon graduation. With this knowledge, we can find ways to better serve the college population, provide the necessary encouragement to certain students, and anticipate future needs. While scholars maintain that academic ability is the top factor of college major choice, socioeconomic status correlates with college major choice. Able working-class students who have already reached college are more likely to perceive college as a means of social mobility and are more likely to enter lucrative fields that are more technical, such as engineering or business. In contrast, middle-class students of similar academic ability perceive their undergraduate experience with a longer-term plan, enrolling in less lucrative fields that allow them to attend professional or graduate programs. Does the association of socioeconomic status with college major choice vary within different races? Despite the growth of community colleges that provide opportunities for students to continue their education in a postsecondary institution, it channels working-class, minority, and female students to the bottom of an "unofficial status hierarchy." Additionally, general arts programs within colleges are "dumping grounds" for minority and working-class students. Throughout minority students' lives, teachers lack the cultural context and understanding to properly teach and discipline students, and the teachers have given up on teaching students and hoping just to maintain some semblance of order in the classroom. I propose to use a nationally representative sample from the National Education Longitudinal Study (NELS) of 1988 in which eighth graders were initially surveyed and surveyed again with four follow-ups. I will do a regression analysis of the data from NELS to describe the association between a person's socioeconomic status and their college major choice, controlling for race.

The Effect of IR Radiation to Exclusion-Zone in Salt Solution

Ruying Chen, Freshman, Exchange - Arts Sciences
Mentor: Gerald H Pollack, Bioengineering
Mentor: Binghua Chai, Bioengineering

It is generally thought that the impact of surfaces on the contiguous aqueous phase extends to a distance of no more than a few water-molecule layers. However, some other studies showed that on hydrophilic surfaces, water molecule can form a more ordered structure very different from bulk water. Colloidal and molecular solutes suspended in aqueous solution will be excluded from this region, forming an "exclusion zone", or EZ. The size of such exclusion zones is not anticipated. It's typically a few hundred microns and can be observed in the vicinity of many types of surface. It's also found that radiant energy expands these zones profoundly, and presents evidence for a charge-separation-based mechanism underlying the expansion. Earlier studies showed that water has a strong absorption peak of Infrared (IR) lights at a wavelength of 3.05—3.10 μm, and the size of EZ expansion is a function of both time and intensity. The presence of such long-range forces between solutes could have significance for molecular interactions in both natural and artificial systems. On the other hand, the phenomenon of exclusion provides a new basis for water purification. My project is to study the effect of IR on different salt solutions. In this experiment, we used Nafion as the hydrophilic surface. At first, Nafion tubes of 3—4mm were taken and pre-treated in DI water for 5 min. Then Nafion tubing was placed in a NaCl and carboxylate-microsphere suspension in a chamber. The chamber was placed under a microscope with a LED source closely above the Nafion tubing. The Nafion tubing was exposed to IR for 5—15min. The EZ expansion was compared to the control group (without IR exposure). So far the test result showed the EZ increased for more than 1.5 times after 5 and 10 minutes IR exposure in 50mmol NaCl solution.

The Pursuit of Happiness in a Depressed Nation: Cultural Differences in the Influence of Positive Emotions on Depression

Hsiang Cheng, Senior, Psychology
Wen Liu, Senior, Psychology
Mentor: Jennifer Wang, Psychology
Mentor: Jennifer Wang, Psychology

Previous research has found mental health disparities between Asian Americans and White Americans in the past two decades. In addition, US-born Asian Americans have lower self-reported mental health (e.g., depressive symptoms) than immigrant Asian Americans (Takeuchi, Zane, Hong, Chae, Gong, Gee, Walton, Sue, & Alegia, 2007). Experiences of emotions may be important to examine in relation to these health differences. Experiencing negative emotions and stress have been found to be positively correlated (Folkman, 2008) whereas positive emotions have also been found to buffer against negative emotional reactivity and depression within North American contexts (Wichers, Myin-Germeys, Jacobs, Peeters, Kenis, Derom, Vlietinck, Delespaul, & Os, 2006). Bridging this literature with cross-cultural models of emotion, in this study, we examined if positive emotions mediate the relationship between depression and perceived stress among White American, U.S.-born Asian American and foreign-born Asian American college students. We hypothesized that negative emotions would partially mediate the relationship between perceived stress and depression for all three groups, but positive emotions be a protective buffer in the association between stress and depression for White Americans but not U.S.-born or foreign-born Asian Americans. Asian American (N = 168 foreign-born, 190 U.S.-born) and White American (N = 444) students from psychology courses in the University of Washington were recruited for a survey study. Using regression and mediational analyses, the results matched both of our hypotheses. Our results suggest that for all three groups, negative emotions partially mediated the relationship between perceived stress and depression, whereas positive emotions only partially mediated this relationship among White Americans. The findings suggest that positive emotions may be culturally specific and may be associated with differences in mental disparities.

Intraspinal Stimulation to Promote Motor Recovery Following Spinal Cord Injury

Kendra Cherry, Senior, Biology (Physiology)
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Steve Perlmutter, Physiology Biophysics
Mentor: Chet Moritz, Physiology Biophysics

Spinal cord injury (SCI) frequently results in debilitating loss of motor capabilities or paralysis. Recent studies show that electrical stimulation of the nervous system may have the capacity to improve motor function by promoting the plasticity of neural circuitry. Pairing activity at one site in the nervous system with stimulation at an adjacent site strengthens synaptic connections between the two sites. The objective of this project is to determine whether brain activity used to drive synchronous spinal stimulation can enhance the recovery of forelimb function in rats after incomplete cervical spinal cord lesions. Rats are trained to perform a forelimb reaching task to retrieve food pellets prior to spinal injury. Chronic electrode arrays are implanted over motor areas of the brain to record forelimb related activity. Stable neuron action potentials have been recorded from the brain for more than two months, with some neural modulation evident during forelimb movement. Spinal microwires are then chronically implanted in the cervical spinal cord and stimulated to evoke forelimb movements such as flexion and extension of the wrist and elbow. Low threshold currents were sufficient to evoke movements which were stable for up to 72 days. Subsequently, a recurrent Brain Computer Interface (BCI) will be used to establish artificial connections between cortical and spinal sites. Neurons in the motor cortex will be used to trigger synchronous stimulation of the spinal cord. We anticipate that this pairing will increase the recovery of corticospinal interactions and produce an increase in the rate and extent of forelimb motor recovery in rats with SCI. These experiments will determine the extent of neural plasticity possible after SCI and the potential use of electrical stimulation to strengthen and reorganize connections in corticospinal pathways. Ultimately, a similar approach could be implemented in human patients to promote motor recovery after SCI.

Relationship between Glutamate Concentration, the Anterior Cingulate Gyrus, and Fibromyalgia Patients

Shinn-Yi Chou, Senior, Applied Music (Orchestral Instruments), Biology (Physiology), Neurobiology
Mentor: Jaime Diaz, Psychology
Mentor: Jon Howe, Psychology, Behavioral Neuroscience

This preliminary project observes possible differences in Glutamate (Glu) concentrations between a fibromyalgia (FM) patient and a healthy subject. FM is a debilitating chronic disorder characterized by widespread musculoskeletal pain and hypersensitivity to noxious stimuli. Like other neuropathic pain syndromes, much effort is required to solidify our knowledge in its underlying etiology. Recent research suggested Glu imbalance within the central nervous system (CNS) as a possible pathology of FM. Studies using Proton Magnetic Resonance Spectroscopy (H-MRS) have shown that painful stimuli can possibly increase Glu concentrations in the anterior cingulate gyrus (ACg). Since ACg is implicated in the attentional, emotional, and expectational elements of pain, this suggests that elevated Glu in the ACg contributes to pain hypersensitivity. However, Glu have only been implicated in partnership with glutamine (Gln), an amino acid found in the Glu metabolic pathway. These two metabolites have similar molecular structures and

can only be distinguished with high resolution H-MRS and spectral editing techniques. Thus, it remains unclear whether Glu concentration increases specifically or whether it is a combination of the two molecules. Our primary goal will be to resolve and measure concentrations of Glu in the ACg specifically using a 3 tessla magnet. Secondly, we will compare baseline ACg Glu levels between a healthy and a FM subject. Based on previous studies, we predict that baseline ACg Glu level will be higher with FM. Finally, we will compare baseline ACg Glu concentrations of subjects to that in the primary visual cortex (V1), since we predict that Glu level will be higher specifically in the ACg, and not pain-unrelated domains such as V1. If we successfully resolve Glu specifically and examine baseline Glu concentrations in FM and healthy subjects, it could provide future research directions in understanding the neurological mechanisms of FM.

Standard Care for Babies with Disabilities: A Reality Check

Rebekah Clemen, Senior, Speech Hearing Sciences
Aaron Carasco, Senior, Early Childhood Family Studies
Mentor: Lesley Olswang, Speech Hearing Sciences
Mentor: Patricia Dowden, Speech Hearing Sciences

This research will examine the legal policies and the conceptual framework versus actual practice for services provided to children birth-to-three with disabilities. A review of current literature will provide an overview of the legal policies and the conceptual framework based on published research for standard care of children from birth to three years of age who are in need of specialized treatment. Participants will be children between the ages of 10 and 24 months with moderate to severe motor impairments who are receiving treatment at one of the following community Birth-to-Three Centers: South King Intervention Program (SKIP), Kindering Center, and the Little Red School House. Data regarding treatment will be collected for each participant using the centers' Individualized Family Service Plan (IFSP) and daily clinical notes. Data reduction will be accomplished by distilling the collected data into forms that capture the planned standard care (IFSP data) and implemented services (daily notes data). The reduced data will be analyzed using qualitative methodology to reveal themes and patterns that describe actual service delivery for each participant at each of the Birth-to-Three Centers. These data will be compared to the legal policies and the conceptual framework as presented in the review of the literature. This comparison will elucidate any discrepencies that exist between the scholarship of legal and conceptual guidelines and its use in practice.

The Role of Genetic Interaction in the Differentiation of Leaf Stem Cells in *Arabidopsis thaliana*

Marie Clifford, Senior, Biology (General)
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Keiko Torii, Biology

Stomata are the leaf pores that manage the flow of air and water into and out of the plant. These pores were one of the key evolutionary adaptations that allowed plants to colonize land 400 million years ago, and play a large role in how many land plants, including many of our crops, deal with heat stress and the logistics of photosynthesis. Using the dominant *scream-D* mutant of *Arabidopsis thaliana*, a model organism for plant genetics, our study attempts to explore the novel genes that control the process of stomatal differentiation. The *scream-D* mutant is characterized by a leaf epidermis composed exclusively of stomata, which facilitates the detection of repressor activity. In a process known as "activation tagging," mutant plants are exposed to a culture of agrobacteria containing a plasmid modified to include strong tandem enhancer elements derived from a plant virus. The agrobacteria act as vectors to insert the T-DNA region, which contains the enhancer elements and herbicide resistance, randomly into the genome of the plant. Following transformation, genes in proximity to the inserted plasmid will be upregulated. If the plasmid is inserted near a gene that codes for a repressor of the SCREAM-D protein, then the repressor could be expressed at a high enough level to counteract the overactive SCREAM-D in our mutant plants. This could manifest in a stomatal phenotype closer to that of a normal plant. After one generation, the plants are screened for this phenotype. Candidate suppressor mutations are characterized as recessive or dominant, and the genes are sequenced to determine if the mutation is known. Identification of a novel mutation may enhance understanding of genetic control of plant stem cell fate, with potential implications for understanding the ways in which plants will change to cope with global warming.

Long-Range Cascading Interactions in Aqueous Colloidal Suspensions

Jason Coult, Senior, Bioengineering
Mary Gates Scholar
Mentor: Gerald H Pollack, Bioengineering

Electrostatic interactions between charged particles have attracted sustained cross-disciplinary interest because of their fundamental role in governing the properties of many systems, including soft matter, colloidal suspensions, polyelectrolyte solutions, and various biological systems. In solution, such interactions are usually limited in strength by screening, as charged surfaces will attract a thin atmosphere of oppositely charged coun-

terions, resulting in a sandwich often called an electric double layer. Based mainly upon this double layer, the DLVO theory was introduced to describe colloidal particle behavior in water, and dictates that electrostatic interactions in solution be considered short-ranged, typically inconsequential at separations larger than 100 nanometers. However, many observations of colloidal systems cannot be explained quantitatively or qualitatively by the standard DLVO theory, especially in low electrolyte concentration. In this research project, long-range attractions in aqueous suspensions were observed between polymeric microspheres and between microspheres and a gel bead. Cascaded attractive displacements were consistently seen even between like-charged entities, and they were observed over spans as large as 2 mm. Such long-range attractions are unexpected and seem to violate the DLVO theory, which limits interactions in electrolyte solutions to the nanometer range. However, these interactions may reside in Richard Feynman's long known but not widely appreciated mechanism, coined "like-likes-like through an intermediate of unlikes." This controversial theory suggests that the attractive force among like-charged colloidal particles is fundamentally electrostatic in nature, arising from the arrangement of counterions between particles. The underlying mechanisms for the unexpected colloidal behavior observed in this research project are investigated through quantitative analysis of the microsphere-bead interactions. Possible explanations for both the long-range cascading behavior and attractive displacements between like-charged particles are explored, including Feynman's "like-likes-like" hypothesis.

Facial Processing and Habituation in Toddlers with Autism Spectrum Disorder

Ashley Danies, Senior, Art (Photography), Psychology
Mentor: Sara Jane Webb, Psychiatry Behavioral Sciences
Mentor: Kaitlin Venema, Psychiatry Behavioral Sciences, CHDD Autism Center

Individuals with Autism Spectrum Disorders (ASD) have symptoms that fall into three key domains: social behavior, communication, and restricted or repetitive behaviors. Since interpreting information from the face contributes to social and communicative understanding, it has been hypothesized that impairments in face processing may be observed in the early development of children with ASD. Studies have shown that these impairments in face processing in toddlers with ASD can indeed be seen both behaviorally (measured with a habituation paradigm) and neurally (measured with electroencephalography, or EEG). However, it is unclear whether these findings indicate a general face processing deficit, or whether they are each driven by different underlying pathologies. To investigate this question, we examined the correlation between neural correlates of face processing and habituation times to faces, in groups of toddlers with and without ASD. Participants were 20 children with ASD, and 20 children with typical development (comparison group) tested at 18- to 30-months of age. In the habituation experiment we tested how long it took the toddler to habituate to photographs of female faces versus control stimuli (photographs of houses). In the EEG portion of the experiment, we recorded electrical brain activity in response to repeated 500 ms still photographs of the child's mother's face and a stranger's face. For the ASD group, we predict that longer habituation times to faces will correlate with smaller and slower neural responses to faces, indicating shared atypicality. For the comparison group, we predict that longer habituation times to faces will correlate with larger neural responses to faces because habituation causes neural responses to decrease over time.

The Effect of Exposure to Air on an Intertidal Marine Snail

Amira Davis, Sophomore, Pre-Major, UW Bothell
Larisa Curta, Sophomore, Pre-Major, UW Bothell
Michael Podeszwik, Sophomore, Pre-Major, UW Bothell
Mentor: Rebecca Price, Interdisciplinary Arts Sciences, UW Bothell

Previous work suggests that the growth rate of marine snails is influenced by many environmental factors, including temperature, diet, wave action and exposure to air. Can one of these factors alone significantly retard the growth rate? In this study we measured the effect of air exposure on the shell and tissue growth of the intertidal marine snail *Nucella lamellosa*. We focused on the effect of exposure to air because, as with many marine invertebrates, the intertidal populations of *Nucella lamellosa* are much smaller than subtidal populations of the same species. Our specimens were collected from sites on San Juan Island, Washington, and then maintained in sea water tables at the Friday Harbor Laboratories. Each snail was housed in its own container with continuous flow of seawater, and barnacles were constantly available for food. We had three treatments. One group of snails was exposed to air for two hours, another group was exposed to air for five hours, and snails in the control group remained constantly submerged. At the beginning of the experiment and after 24 days, we measured the tissue mass, shell mass, and degrees of shell growth in each specimen. The two hour treatment grew significantly less than the control ($P << 0.001$ for all three measures of growth; ANOVA) and the 5 hour treatment grew significantly less than the 2 hr treatment (again, $P << 0.001$). Our data support the proposed hypothesis that exposure to air slows the growth of the intertidal snails. This result suggests that exposure to air suppresses growth rates in intertidal invertebrates, potentially explaining why indi-

viduals in subtidal populations of the same species have such larger body sizes.

The Use of Biophysical Characterizations to Predict Protein Crystal Growth for Drug Design
Jaclyn Delarosa, Senior, Biochemistry, Chemistry, Neurobiology
Mentor: Wim Hol, Biochemistry and Biological Structure

Protein crystallization plays a major role in structural biology and drug design. A crystallized protein is the basis for x-ray crystallography, wherein the passage of an x-ray beam through a crystal produces a diffraction pattern from which the arrangement of atoms within the crystal can be deduced. The Medical Structure Genomics of Pathogenic Protozoa (MSGPP) project intends to use protein x-ray crystallography to solve the three-dimensional crystal structures of proteins crucial to the functioning of the following pathogenic protozoa: *Plasmodium falciparum, Plasmodium vivax, Trypanosoma brucei, Trypanosoma cruzi, Leishmania major, Leishmania infantum, Toxoplasma gondii, Entamoeba histolytica, Giardia lamblia and Cryptosporidium parvum*. These ten selected pathogenic protozoa cause a global disease burden to hundreds of millions of people. An understanding of the molecular structure of critical proteins allows the identification of key functional sites that can be used for potential anti-protozoan drug developments. The current extensive knowledge about protein crystallization is insufficient to predict conditions for protein crystallization. It is hypothesized that biophysical characterizations can be utilized to predict the capability of proteins to crystallize. The following biophysical experiments were performed and applied to 82 proteins from MSGPP: reducing and non-reducing SDS Page, native gel electrophoresis, size exclusion chromatography, dynamic light scattering, limited proteolysis, and thermal melt analysis. These characterizations were used to assess the power of biophysical methods for predicting protein crystallization. The conclusion is that biophysical experiments greatly enhance the predictability of crystal growth much greater than DNA sequence-based analysis methods alone.

A Warm Embrace of Maximum Entropy
Brittany Dennison, Senior, Philosophy
Mentor: Phillip Thurtle, Comparative History of Ideas

For my research in thermodynamics, installation art, and sensorial perceptions, I focused on the notion of the "circle of life," the constant recycling of dead matter into new living entities. In this cycle of matter, our human bodies deteriorate and we are "reborn" as a new being; thus we, our bodies, are immortal in the sense that our bodies never exit existence. Yet, the circle of life is within a closed system (the universe); according to the second law of thermodynamics, every closed system, a system with self-contained energy, will eventually turn entirely from matter to heat. For my project, I created a piece that, without being solemn, would break the circle of life by putting forward the notion of heat death. I chose to have light being shown through a stencil of myself hanging above a heated table. The light shines through the stencil, creating a hazy image of a body that can be touched, and when touched, feels warm. Hopefully, by giving the opportunity to sensorially experience what our bodies will become, I am replacing anxiety in regards to death with solace.

Transport of a Hepatic Drug, Fialuridine, by Nucleoside Transporters
Hau Do, Senior, Biochemistry
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Jashvant Unadkat, Pharmaceutics

Hepatitis B is one of the most prevalent diseases in the world. Many drugs have been developed to treat Hepatitis B. These drugs are first transported into the cytosol, where they are phosphorylated to produce their therapeutic effect. Unfortunately, some of these same phosphorylated forms of the drug can cause mitochondrial toxicity. In the case of fialuridine (FIAU), this mitochondrial toxicity resulted in hepatic failure and death in patients with hepatitis B. FIAU is hydrophilic and cannot penetrate through the cell membrane in any appreciable quantity. We hypothesize that FIAU is transported into the cell via either the human Equilibrative Nucleoside Transporter 1 (hENT1) or the human Concentrative Nucleoside Transporter 1 (hCNT1). My project is to characterize, in vitro, FIAU transport by hENT1 or hCNT1 by determining the Michealis-Menten kinetic constants (vmax and Km) of this transport. We developed two cell lines, one overexpressing hENT1, and the other overexpressing hCNT1 on the cell membranes. These cells were subsequently used in the nucleoside drug transport assay, which provided the necessary data to determine the kinetic constants of FIAU transport. These kinetic values reflect the rate at which FIAU is transported into the cells. Studying these values is crucial for a better understanding of how the drug is transported into the cells. Moreover, these kinetic values might elucidate the transporter that is responsible for the movement of FIAU into the cell and then into the mitochondria to cause mitochondrial toxicity. These results may allow us to design future drugs that have antiviral activities, while minimizing their toxicity.

Tissue Engineered Hypospadias Repair
Rocky Eastman, Senior, Biology (Molecular, Cellular Developmental), Philosophy
Mary Gates Scholar
Mentor: James Bassuk, Urology, Seattle Children's Research Institute

Hypospadias is a birth defect affecting 0.7% of male newborns in which the opening of the male urethra is in the anatomically incorrect position. Current reconstructive techniques result in worldwide complication rates reported to be as high as 50%. Problems with the implanted tissue used to reconstruct the opening have been attributed to these complications, and urologists agree that there is much room for improvement when it comes to hypospadias repair. We hypothesized that properly differentiated epithelial tissue can be reconstituted onto collagen-coated tubular scaffolds by the in vitro propagation of human epithelial cells derived from the biopsy of a male hypospadias patient. This autologous tissue would lower the rejection risk associated with the insertion of foreign tissue to the urethra and offer a greater chance that the implanted tissue integrates with the unaffected urethra. Rabbit urethras, which were identified as anatomically similar to human urethras, were chosen as models. A biodegradable poly-L-lactide (PLLA) copolymer fabricated into a tubular scaffold proved mechanically suitable for urethral reconstruction. We determined ideal conditions for lyophilizing, cross-linking, and sterilizing the collagen coating the scaffold, and designed a novel bioreactor to facilitate seeding urethral epithelial cells onto the coated scaffold. Toxicity testing of silicone glue used to build the bioreactor demonstrated that the glue would not kill urethral epithelial cells. At this time, we are conducting proof-of-principle experiments to determine the efficacy of our hypothesis. We have shown that epithelial cells adhere to the luminal side of our collagen-coated scaffolds, and we are currently identifying conditions that encourage optimal tissue growth.

Does Environmental Enrichment Protect Mice From Neurodegeneration and Loss of Motor Performance?
Kiara Eldred, Sophomore, Biochemistry
Mentor: Richard Palmiter, Biochemistry
Mentor: Lisa Beutler, Genome Sciences

Environmental enrichment (EE) in mice has been shown to increase motor coordination, memory, and learning. It has also been shown that EE increases the number of dendritic spines, which are the site of excitatory synapses throughout the brain. The biological mechanisms through which this is accomplished have not been resolved. N-Methyl-D -Aspartate (NMDA) receptors are a kind of glutamate receptor that are located in the spines and important for learning and memory. In our lab, we have mice that lack NMDA receptors in neurons that express dopamine D1 receptors. These mice have comparable spine densities to normal mice when they are young, but over nine months dendritic spine density decreases and associates with the development of motor deficits. We set out to explore the possibility that EE would prevent the loss of dendritic spines and the motor deficits in these mice. In this experiment, 5-month-old knockout mice and control mice are placed in an enriched environment for eight weeks, and afterwards their motor performance (rotarod preformance) and spine density are compared to animals that have been housed individually in normal cages. If the mutant mice show increased rotarod performance or increased dendritic spine density compared to individually housed mutants, then we will conclude that EE can counteract the deficits that develop without the NMDA receptor in D1R-expressing neurons. If there is no increase in spine density or rodarod performance in the enriched knockout mice, then we know that NMDA receptor signaling is a crucial biological mechanism though which environmental enrichment increases motor coordination and synapse number.

Diversity and Distribution of Diatom Species along the Northeast Coast of North America
Claire Ellis, Senior, Aquatic Fishery Sciences
Mentor: Virginia Armbrust, Oceanography
Mentor: Kate Hubbard, Oceanography

Recent evidence suggests that the intensity, frequency, and geographic distribution of harmful algal blooms (HABs) are increasing around the world. The diatom genus *Pseudo-nitzschia* contains several HAB species that are capable of producing the neurotoxin domoic acid, which can lead to illness and death in marine mammals and humans. Previous studies have confirmed the production of domoic acid by *Pseudo-nitzschia* species along the eastern coast of the United States and Canada. The objective of the current study was to identify spatial and/or temporal patterns of *Pseudo-nitzschia* species distributions in samples from Georges Bank, the Gulf of Maine, and the Bay of Fundy. Identifying *Pseudo-nitzschia* species using microscopy is not always possible, because differences between some species are not readily distinguishable. Hence, our study determined the presence of *Pseudo-nitzschia* species using a DNA fingerprinting approach, Automated Ribosomal Intergenic Spacer Analysis (ARISA), combined with environmental sequencing of the internal transcribed spacer 1 rDNA region. Samples for DNA analysis were collected on four weeklong cruises, occurring during May, June, July, and August of 2008. Preliminary results from ARISA analysis showed that at least eleven putative species of *Pseudo-nitzschia* were detected in samples, and that one species, *P. delicatissima*, was present in all samples, regardless of cruise month or sample origin. Statistical analysis will be used to further determine patterns in *Pseudo-nitzschia* distributions over time and across different hydrographic regimes. A better understanding of how *Pseudo-nitzschia* communities are structured in these waters can provide insight on the occurrence and distribution of domoic acid production.

Infants' Ability to Segregate Simultaneous Speech Sounds

Patricia Erickson, Senior, Speech Hearing Sciences (Communication Disorders)
Mentor: Lynne Werner, Speech Hearing Sciences

Research shows that infants are unable to segregate sounds at the same signal-to-noise ratios as adults, due to their immature auditory systems. Most studies have examined infants' thresholds using octave-band noise centered on different frequencies. However, little has been explored in regards to detecting a speech stimulus on a speech background. Using Observer-based Psychoacoustic Procedure, 7-month old infants are presented with one of two speech conditions, one with an adult-directed (AD) speech sample or one with an infant-directed (ID) speech sample. Adult-directed speech is normal speech between two adults, while infant-direct speech is the distinct, fluctuating "baby talk" we recognize when adults address infants. The infant is then conditioned to respond to an intermittent /a/ vowel, which is presented simultaneously with one of the speech backgrounds. It is known that the prosodic modifications and exaggeration of speech distinctions in ID speech is salient and captivating to infants. It is our hypothesis that infants will be less able to segregate the vowel from the ID speech background and perform better in the AD speech background, which carries less auditory importance for the infant. Testing takes place in a sound proof booth with the infant seated on the parent's lap, while sounds are played through a foam ear-tip. The infant is trained to respond to the vowel on at least 80% of the trials when the vowel is very audible. Trials with no vowel presented are also included, and the infant must respond on no more than 20% of these trials during training. Correct responses to the vowel are reinforced with the activation of a mechanical toy. During the test phase, the signal-to-noise ratio of the vowel to the speech background is set at a level where the infant is expected to detect the vowel 70% of the time in the AD speech condition. We expect that infants will perform more poorly in detecting the vowel in the ID speech condition than in the AD speech condition.

Beryllium Isotope Ratios and Uranium and Thorium Content of the Spor Mountain Tuff

Ryan Erickson, Senior, Earth Space Sciences (Biology)
Mentor: John Stone, Earth Space Sciences

Much of the industrial beryllium (Be) produced in the United States has an anomalously high ^{10}Be/^{9}Be isotope ratio. This anomaly may be due to the geologic environment of the primary source for beryllium in the U.S., the beryllium-bearing tuffs at Spor Mountain, Utah. Ore-grade regions of this tuff also contain unusually high levels of uranium and thorium. The α-radiation produced by the radioactive decay of uranium and thorium can indirectly lead to the formation of ^{10}Be from ^{9}Be. To investigate the viability of this explanation, we are analyzing samples representing different regions and mineral assemblages within the Spor Mountain beryllium deposits to determine their ^{10}Be/^{9}Be ratios, as well as their beryllium, uranium, and thorium contents. The beryllium is extracted from the samples via fusion with KHF2 and subsequent precipitation as $Be(OH)_2$. The ^{10}Be/^{9}Be ratios are then determined by separation in an accelerator mass spectrometer. The uranium and thorium contents are determined by analysis in a multi-collector ICP mass spectrometer. Results of the analysis will be presented.

The Establishment of Rpl22L1 Gene Conditional Knock-Out Mice

Qing Feng, Junior, Exchange - Arts Sciences
Mentor: David Morris, Biochemistry
Mentor: David Brackett, Biochemistry

To solve the problem of analyzing the transcriptomes of individual cell types as they exist in a complex tissue, a mouse (RiboTag), has recently been engineered in Dr. David Morris's Lab that allows one to label specific cell types. In the application of this technology, an essential component of ribosome's 60S subunit, Rpl22 (ribosomal protein L22) can be labeled with an epitope tag (HA) by crossing the Ribo Tag mouse with a mouse expressing cell specific Cre recombinase. By immunoprecipation of this epitope tag, which is expressed only in specific cells, we can successfully isolate the ribosome-associate transcriptomes of these cells types from whole-tissue homogenates. However, this model still needs to be tested fully. One complicating factor in mammals is that there is similar protein named Rpl22L1 (ribosomal protein L22 like 1), whose primary structure is ˜69% similar to Rpl22, and may act as a functional "backup" to Rpl22. Our primary Q-PCR results show that Rpl22L1 is expressed within a 2-fold range of Rpl22 in a number of tissues, and that Rpl22L1 is associated with translating polyribsomes similarly to Rpl22, suggesting it is expressed in a similar fashion to Rpl22. To immelierate the function of this competitor protein I have begun making a knock-out of Rpl22L1 gene in the "RiboTag" background. This will eliminate the endogenous Rpl22L1 and prevent it from functioning as a backup to Rpl22. The conditional knock out strategy is based on "Cre-LoxP recombination system" which involves three steps: the subcloning and characterization of the Rpl22L1 locus into a mammalian targeting vector; homologous recombination in Embryonic Stem (ES) Cells; blastocyst injection and chimera generation and the following crossing breeding.

Building Resistance: Architecture & Anarchism / A (Sub)Cultural Landscape

Jessica Fikes, Senior, Comparative History of Ideas
Mary Gates Scholar, McNair Scholar
Mentor: John Toews, History
Mentor: Kathryn Merlino, Architecture

My research around the connection between political theory and constructed material form begins with the assertion that small groups of people, linked by a common guide such as a belief system, have a significant impact on the shape of vernacular architecture and cultural landscapes in the United States. My intent is to raise questions about praxis within the ongoing anarchist movement and to better understand how the shape of the built environment around it is important for its success. The organizational structure of the Rhizome Collective located in Austin, Texas self-identifies with basic tenets that I have found in historic as well as contemporary kinds of anarchist theory, and by conducting a case study/ post-occupancy evaluation of the landscape itself I have constructed an interpretation of the relationship it has with the ideas that went into its design and fabrication. My analysis is based upon my experiences with participation in and observation of programming and practice on-site, as well as architectural drawings produced and photographic data collected at The Rhizome Collective. As a researcher, I provide analyses from both architectural and (sub)cultural perspectives to support my feeling that this specific, anarchic model for life in the city can contribute in a unique and perhaps invaluable way to the larger cultural landscapes and architectural discourse around sustainable types of residential and mixed-use form. With this project I link three components: mixed-use vernacular architecture, Anarchist theory, and discourse on Cultural Landscapes, with respect to their being facets of the complex politics embedded in the making of the built environment, a process that can aid people in building their own resistance to the world as is, and help them to realize the one they envision.

The International Education Movement within the U.S. and the Asia Society

Katherine Fischer, Senior, History
Zesbaugh Scholar
Mentor: Walter Parker, Education

Professor Walter Parker has been looking at the recent 'international education' movement within public and private K-12 schools in the U.S. Dr. Parker asks what does this new movement means. In his article, "'International Education' – What's In a Name?" published in Phi Delta Kappan November 2008, he lists five justifications for needing 'international education' in public schools. These include economic competitiveness, military readiness, global perspective, cosmopolitanism, and an international student body. Using Dr. Parker's framework as a base, I created descriptions of the schools' curriculum and their reasons for needing international education within the Asia Society's International Studies School Network and then analyzed them based on Dr. Parker's structure. I created and organized profiles about each school in the network and looked at the language used to describe each school's focus and mission/goals in order to describe the schools. I then began to analyze the schools and see how they fit into Dr. Parker's research and in particular his framework. This way I could categorize them and show the reasons each school believes in international education in relation to the findings Dr. Parker found. Information was gathered from the Asia Society website, each school's individual website, and media coverage from newspapers of the schools was reviewed.

Amplified Present: The Delayed Beauty of a Bizarre Locale

Claire Fox, Junior, Comparative Literature, Comparative History of Ideas
Mary Gates Scholar
Mentor: Jentery Sayers, English
Mentor: Phillip Thurtle, Comparative History of Ideas

"They sat down to their unexpected festive midnight tea." On my first read of Vladimir Nabokov's short story, "Signs and Symbols," this sentence was unremarkable. On ensuing reads, however, the image of the 'unexpected festive midnight tea' became a familiar space where two characters create a bizarre locale in the weary familiar. The sentence wasn't beautiful, and then it was. I aim to construct and decode my own fictional locale by sculpting a narrative with moments in video, taking advantage of the medium's constant movement and characteristic instability to unearth an image-based, psychological space inspired by gestures from Nabokov's linear narrative. Those moments find their first iteration, however, as static illustrations: some as sketches and watercolors passing through memory as I recreate them on a page, others as photographs captured by impulse. As I throw distance between literary moments and video interpretation, I develop a more nuanced appreciation for each gesture, whether that gesture is human or inhuman. The resulting video works to create an environment rooted in the present, making use of blank space and musically inclined editing to engage the viewer while confronting him or her with the value of a single moment. It won't be beautiful, and then it will.

Measuring Neutrino Oscillations with T2K

Frank Garcia, Senior, Astronomy, Physics
NASA Space Grant Scholar
Mentor: R. J. Wilkes, Physics

Neutrinos are very light particles that interact only via

the weak nuclear force and gravity. They have been shown to come in three different varieties, called "flavors," and it is believed that they oscillate between these "flavors" in a manner described by the neutrino mixing matrix. While two out of three of the elements that make up this matrix are fairly well understood, attempts to measure the third value, theta-1-3, have resulted only in an upper limit being placed on its value. In order to measure theta-1-3, a particle accelerator at the Japan Proton Accelerator Research Complex (J-PARC) will aim a beam of neutrinos towards the Super-Kamiokande detector. By comparing the ratio of electron to muon neutrinos at J-PARC and at Super-Kamiokande, we should be able to determine the value of theta-1-3.

Female Participation and Firm Productivity: The Case of Transition Economies

Kristine Garcia, Senior, Political Science, Economics
Mentor: Judith Thornton, Economics

Examination of the transition economies of the post-Soviet Union can offer insights into understanding gender issues. One can see the pre-transition period as a time without any market forces where central planners and bureaucrats controlled most economic aspects of a country. At this time, firms were operating inefficiently due to a lack of cost-minimizing constraints. The transition to a market economy brought about many changes that affected firms, through a change in labor force participation of both men and women. Although there is quite a bit of literature that examines the effects of transitioning on the post-soviet economies, most of them focus on the macroeconomic aspects of transition such as trade, exchange rates, foreign direct investments, etc. Within the literature that discuss gender issues, only some touch upon the idea of using firm data to determine whether female participation had any effect on firm productivity. Most of the data used in these previous studies were household surveys that do not fully capture firm characteristics, such as whether the firm is part of a competitive market industry. Using a firm level data set, the Enterprise Survey from the World Bank, this study examines whether a percent change in the share of female workers has a significant effect on a firm's productivity. Similarly, whether this change varies between private and state-owned enterprises. The proportion of female workers is important for firms because if a high number of women relative to men result in higher firm productivity, then firms would hire more women than men to maximize their profits. At this point, the results of the study are still inconclusive. This research is conducted as part of an honors thesis for the University of Washington Department of Economics.

Analysis of Antimicrobial Compounds from Bacterial Symbionts of the Common Composting Earthworm *Eisenia foetida*

Ruth Go, Senior, Microbiology
Mentor: Seana Davidson, Civil Environmental Engineering

Eisenia foetida, a common composting earthworm, harbors bacterial symbionts (*Verminephrobacter* sp, *Actinobacteria* sp and *Flexibacter* sp.) which are horizontally transferred via deposition into their egg capsules. These bacterial symbionts colonize the earthworm gut and nephridia, a kidney-like excretory organ. Bacterial symbionts in their gut, which originate from the soil, act to break down organic molecules and modify the soil nutrient content and availability. Symbionts in the nephridia are believed to aid in amino acid conservation and ammonia detoxification. *E. foetida* embryos develop in egg capsules containing nutrient rich albumin and $>10^6$ bacterial cells/ml. These egg capsules are a good source of nutrition for predatory organisms in the soil, especially fungi. I hypothesize that the bacterial symbionts provide chemical protection for the embryos while they mature in the capsule. My early observations in the lab indicate that bacterial isolates from capsules produce compounds to defend the embryos against fungi isolated from the soil. The initial goal of the study is to show antifungal activity from isolated bacterial symbionts and determine if there is a protective role for the bacteria in the egg capsule. I intend to cure the egg capsules of the symbionts utilizing antibiotics and test the hatchlings for the removal of the symbionts. Once cured of the symbionts, egg capsules will be challenged with fungi and monitored for survival. I will then use bacterial genetics to determine the genes and gene products that confer this protective function in the egg capsule. There has been an increasing frequency of fungal infections as the cause of mortality in organisms. New infective fungi are arising which have antibiotic resistance to drugs that are typically used in treatment. The study of anti-fungal properties of the bacterial earthworm symbionts may contribute to discovery of new antifungal compounds that can fight these emerging diseases.

A Multidrug Combinatorial Microfluidic Device to Study Antibiotic Resistance.

Miliyard Gualu, Senior, Bioengineering
Mentor: Benjamin Kerr, Biology

It was not long ago when scientists were able to combat most death causing diseases with antibiotics. One hundred years ago, tuberculosis, pneumonia, and gastrointestinal infections were among the main causes of death. The development of antibiotics minimized these infections caused by different pathogens. However, currently the development of antibiotic resistant pathogens is a cause of great concern. These studies mainly fo-

cus on the development of multidrug therapy to minimize drug resistant pathogens. This proposal presents a design of a microfluidic device to analyze a specific response in bacteria. The response is categorized as death or survival of bacteria in response to chemicals present in their environment. The death or survival response refers to the application of antibiotics to bacterial cells in a special microfluidic device. This device will be used to analyze responses of *Escherichia coli* and *Pseudomonas aeruginosa* to applied antibiotics. When combining specific concentrations of drugs, we would like to arrive to the specific combinations where bacterial growth cease. For future work, the usage of a multidrug combinatorial microfluidic device could be upgraded to study the interaction between viruses (such as HIV), host cells and multiple drugs.

Stability, Dynamics, and the Onset of Multi-Pulsing in a Mode-Locked Laser Cavity using Phase-Sensitive Amplification

Simon Hachey, Senior, Computer Science, Mathematics
Mary Gates Scholar
Mentor: J. Nathan Kutz, Applied Mathematics

Using techniques of applied mathematics, we perform numerical simulations to investigate the feasibility of a hypothetical mode-locked laser. Mode-locked lasers have a number of real world applications, including precision micro-machining, ocular surgery, and nonlinear-optical imaging. In our work, we are investigating the possibility of a hypothetical mode-locked laser which uses phase-sensitive amplifiers (PSAs) to amplify the pulses it generates. PSAs are an experimentally viable technology that generate and stabilize the mode-locked pulse by sifting out any out-of-phase components through intensity discrimination. They are commonly used in stabilizing pulses sent out over long distances in fiber-optic communication lines, as well in optical storage. We derive a nonlinear fourth-order cubic quintic averaged differential equation which represents the evolution of the laser pulse over many round trips of the cavity. In a typical PSA system, the amount of gain added to the system at each PSA stays constant, but we introduce a novel variable-gain model, based on using a erbium doped fiber in addition to the PSA, that varies the gain depending on the total energy in the cavity. Such a model is the first of its kind to be considered theoretically in the context of the Swift-Hohenberg equation, and leads to a number of very interesting and useful stability properties of the system.

Immunologic Tolerance to Myelin Basic Protein and the Post-Ischemic Cellular Immune Response in Brain

Jessica Hadwin, Senior, English
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Kyra Becker, Neurology

Animals subjected to an inflammatory insult during middle cerebral artery occlusion (MCAO) tend to develop an inflammatory autoimmune response (TH1 response) to the brain antigen myelin basic protein (MBP). This immune response is associated with worse neurological outcome. The induction of a TH3 or T regulatory (TREG) response to MBP prior to MCAO via mucosal treatment is linked to improved outcome. Our study aimed to elucidate the immunologic outcomes associated with mucosal tolerance and stroke. Prior to MCAO, male Lewis rats were tolerized to either MBP or ovalbumin (OVA) by intranasal administration of the antigen. During reperfusion the animals received lipopolysaccharide (LPS; 1 mg/kg intraperitoneal) to simulate infection. One month after occlusion, splenocytes of the MBP tolerized animals generally exhibited a TH3/TREG response to MBP and were less likely to show an inflammatory autoimmune response to MBP than those that were tolerized to OVA. At both 1 month and 3 months after MCAO, animals exhibiting a TREG response to MBP were noted to have better neurological outcome. These data imply that deleterious autoimmune responses to brain antigens can be improved by inducing a TREG response to those antigens prior to stroke and that the TREG response improves outcome. To understand how the TREG response affects the cellular inflammatory response in brain following stroke, quantitative immunohistochemistry is being performed on a subset of brains from the study. Using the appropriate antibodies, the number of CD4+ T cells, CD8+ T cells and B cells in both the ischemic and non-ischemic hemispheres will be determined. Additionally, the expression of fractalkine, a chemokine with potent chemoattractant properties for T cells, and FoxP3, a gene product associated with TREG cells, will be assessed. Comparisons will be made between animals with and without a TREG response to MBP and over time (1 month versus 3 months).

Anthropogenic CO_2 Accumulation Rate in the North Pacific Ocean Estimated from Changes in $^{13}C/^{12}C$ of CO_2 in Seawater

Laura Hanson, Senior, Oceanography, Environmental Studies
Mentor: Paul Quay, Oceanography
Mentor: Johnny Stutsman, Oceanography

Oceans play a key role in determining the build-up rate of anthropogenic CO_2 in the atmosphere. About one-third

of the CO_2 generated by the burning of fossil fuels is adsorbed by the world oceans, establishing the ocean as a dominant sink for anthropogenic CO_2. Several different techniques and tracers have been used to estimate anthropogenic CO_2 uptake rates resulting in a range of magnitudes that are not in agreement. In the North Pacific Ocean, published anthropogenic CO_2 uptake rates range from 0.33 ± 0.05 to 1.3 ± 0.5 mol C m^{-2} yr^{-1}. Due to differences in magnitude and substantial uncertainties in these estimates, a convergence of rates by multiple approaches would improve our confidence in the rate estimate. By use of a carbon isotope tracer, the $^{13}C/^{12}C$ of CO_2, measured in seawater samples collected in the Northeastern Pacific Ocean during a research cruise in September 2008, an anthropogenic CO_2 uptake rate of 0.53 ± 0.17 mol C m^{-2} yr^{-1} was estimated for the region. The North Pacific region is a strong sink for anthropogenic CO_2 however, continued measurements using anthropogenic tracers are necessary to provide sufficient data to determine whether the North Pacific will become a stronger or weaker sink in response to climate change.

Pseudo-nitzschia and Domoic Acid in the Benguela Current

Diana Haring, Senior, Oceanography
Mentor: Gabrielle Rocap, Oceanography
Mentor: Michele Wrabel, Oceanography

Pseudo-nitzschia is a genus of phytoplankton that produces a toxin called domoic acid (DA). This toxin can cause Amnesic Shellfish Poisoning which can result in seizures, short-term memory loss, and even death. These symptoms have been reported in birds, sea lions, and humans as a result of eating contaminated shellfish or small fish like anchovies. It is important to study *Pseudo-nitzschia* because not all of the species produce DA and those that do are not always consistent in their production rates. I have been looking at the phytoplankton community structure in samples from the Benguela Current which runs along the southwestern coast of Africa. I measured each *Pseudo-nitzschia* cell for identification through the use of microscopy, defined each cell as one of three morphological groups, and classified the other organisms present to the genus level. *Pseudo-nitzschia* were seen at five different stations, and all three morphological groups were present at each station. There were different levels of DA at each station that could correspond with the dominant species of *Pseudo-nitzschia* present. To identify *Pseudo-nitzschia* to the species level a genetic fingerprinting technique will be done called Automated Ribosomal Intergenic Spacer Analysis (ARISA). This technique involves doing a PCR with specific primers for *Pseudo-nitzschia* species which will amplify the internal transcribed spacer region (ITS1). Species of *Pseudo-nitzschia* have different ITS1 lengths so this method can give a more accurate species identification. This method will clarify which species are high DA producers and along with phytoplankton community structure data, can help us understand more about this potentially dangerous phytoplankton.

Merging Galaxies and Black Holes

Marrissa Harrison, Freshman, Earth Space Sciences
Danielle Green, Junior, Astronomy, Physics
Mentor: Jillian Bellovary, Astronomy
Mentor: Thomas Quinn, Astronomy

Most, if not all galaxies in the universe contain a super massive black hole at their centers. As galaxies travel through space, they occasionally collide, resulting in the merging of these black holes. Through simulations of these galaxy mergers (one simulation containing a black hole, and one without), we were able to identify and measure differences in the resulting galaxy remnant. Through measurements of the radiation emitted in different wavelengths and at different radii from the center of the galaxy, we were able to discover that the galaxy containing the black hole is less luminous throughout and emits less radiation in the ultraviolet wavelengths at its center. This is because as the black hole accretes gas, energy is transferred to the surrounding gas, which is then heated, a process known as feedback. Thus, there is an absence of cold, dense gas near the black hole that would have allowed for the formation of new large, luminous blue stars. The absence of these new stars, as indicated by the lack of ultraviolet intensity, shows that there is a black hole present affecting the central galactic environment.

Temperature of Magmas during "Supervolcanic" Eruptions

Zurriya Hasnan, Junior, Earth Space Sciences
Mentor: Olivier Bachmann, Earth Space Sciences

The temperature and oxygen fugacity of magmas can be estimated with the composition of Fe-Ti oxides, minerals that are commonly found in volcanic rocks. The objective of this project is to determine and compare the temperature of oxide-bearing rocks from Colorado (the >500 km3, 28.6 Ma Masonic Park Tuff) using a variety of temperature calibrations for the Fe-Ti oxide system; Anderson & Lindsley (1985), Andersen (1991) and Ghiorso & Evans (2008). We performed over 80 electron microprobe analyses on different samples, and used the best data points to calculate magma temperatures. Results show that the temperature range at which the crystals formed varies for the different calibrations; average values are 745 C for Anderson & Lindsley (1985), 680 C for Andersen (1991) and 650 C for Ghiorso & Evans (2008). Knowing that magmas will solidify at ˜670-680 C for the estimated conditions of the Masonic Park magma chamber, the temperature of the latest calibration

(Ghiorso & Evans, 2008) appears too low. These anomalously low temperatures suggest that (1) this calibration underestimates magmatic temperatures or (2) the Fe-Ti oxides have partially re-equilibrated with cold, surface temperatures during deposition. Comparison with temperature results given by other mineral thermometers (Ti-in-hornblende, hornblende-plagioclase, two-feldspars), which yield high temperature (>700C) suggests that Fe-Ti oxides record non-magmatic temperatures.

Identifying RR Lyrae Stars for use in Galactic Mapping

Michael Hayden, Senior, Astronomy, Physics
Joel Leigh, Senior, Physics, Astronomy
Mentor: Chris Laws, Astronomy

Until recently the halo of our galaxy was thought to be made up of a uniform distribution of stars and dust governed by a power law drop at increasing distance from galactic center. New deep sky surveys like the Sloan Digital Sky Survey (SDSS) have allowed a more thorough examination of the galactic halo, revealing over densities within it. These rivers of stars represent the remnants of previous galactic mergers which have contributed to the current structure of the Milky Way. In order to map these over densities special variable stars known as RR Lyrae must be located and their distance calculated. The goal of our research is to study potential RR Lyrae candidates and classify their specific RR Lyrae type so that they can later be distanced and added to the evolving three dimensional map of the halo of the galaxy. To do this, observations were taken over the course of the summer at Manastash Ridge Observatory, maintained in the Cascade Mountains by the University of Washington. The stars were identified as potential candidates based on their colors observed in SDSS. Several observations were taken of each candidate star and changes in brightness relative to the average brightness of nearby comparison stars was measured. This initial step checks that the target star is indeed variable and corrects for variability caused by changing atmospheric conditions. Fourier analysis was performed on the observed light curves to determine relative frequency strengths and potential periods of variability. This analysis was used to fit the candidates variability to templates of archetypal RR Lyrae. The quality of fit is then analyzed to determine if the candidate is actually an RR Lyrae or possibly another class of variable star. Final results are contingent on further observations which will be taken over the coming summer.

How Caste and Sex Determine Brain Structure in Dampwood Termites, *Zootermopsis angusticollis*

Kayla Helem, Senior, Biology (General)
Mary Gates Scholar
Mentor: Sean O'Donnell, Psychology

Termites live in colonies in which individuals are specialized to perform different tasks that allow the colony to survive. These groups of specialized individuals are called castes; examples of castes include soldiers, workers, and those with the ability to reproduce. Termites are unique compared to most other eusocial insects because colonies contain both male and female workers. Little is currently known about termite neurology and how brain structure relates to caste and sex. This study explored the brain structure of the termite *Zootermopsis angusticollis*. The volumes of several regions of the brains of *Z. angusticollis* individuals were quantified, including the optic lobes, antennal lobes, and mushroom bodies. Previous studies have shown that in other eusocial organisms with both male and female workers, such as naked mole rats, brain structure and volume is not related to sex. Studies on neurology of other eusocial insects have shown that brain structure often varies between castes and relates to the specific tasks performed by the individuals within those groups. I will explore the relationships between the sex, caste, and the volumes of these brain regions in the termites. Based on previous work I expect to see no differences between the male and female termites within the same caste. I also expect to find that the volumes of different regions will vary based on caste, especially within the optic lobes.

An Inducible Exopolyphosphatase Assay for Studying the Function of Polyphosphate in Eukaryotes

Karen Hendricksen, Senior, Biochemistry, Biology (Molecular, Cellular Developmental)
Mary Gates Scholar
Mentor: Wenqing Xu, Biological Structure

Inorganic polyphosphate, or Poly P, consists of tens to hundreds of orthophosphate monomers. In *Escherichia coli* and other prokaryotes, the enzyme polyphosphate kinase, or PPK, catalyzes the synthesis of Poly P from the terminal phosphate groups of ATP molecules. While this reaction is reversible and also performed by PPK, an irreversible reaction also occurs in the presence of the enzyme exopolyphosphatase, or PPX. This enzyme hydrolyzes terminal residues of Poly P into its orthophosphate monomers. While PPK and PPX activity are known in many bacterial species and yeast, few analogous enzymes are known in high eukaryotes. This contributes to the difficulty of studying the function of Poly P in such organisms despite the fact that Poly P is abundant in all forms of life. While it has been shown that Poly P plays a critical role in bacterial survival, the exact function of Poly P in eukaryotes has yet to be determined. An enzyme with inducible PPX activity has the potential to be a very powerful tool as an assay for studying the role of polyphosphate in eukaryotic organisms. In *Saccharomyces cerevisiae*, PPX consists of two

highly conserved domains, between which lies the active site. Each domain, nonfunctional without the other, may be synthesized as a separate construct *in vitro*. The N-terminal domain consists of amino acid residues 1-256, while the C-terminal domain consists of residues 257-397. The N-terminal domain and C-terminal domain may be synthesized separately, each attached to a monomer of the the dimerization motif FKBP. These domains may then be fused together via the FKBP-dimerizer FK1012A to restore exopolyphosphatase activity. This assay may provide a useful tool in further studies of polyphosphate function in eukaryotes.

Characterization of a New AGATE (Advanced General Aviation Transport Experiments) Composite with Respect to Surface Preparation and Bond Quality

Curtis Hickmott, Senior, Materials Science Engineering
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Brian Flinn, Materials Science Engineering, UW SAMPE

The effect of surface preparation procedure on bond quality of a new group of AGATE (Advanced General Aviation Transport Experiments) fiber reinforced polymer matrix composites was studied. The surfaces of composite laminates manufactured from various fiber forms (unidirectional carbon fiber tape, carbon fiber fabric, and fiberglass fabric) pre-impregnated with Toray 2510 resin AGATE were examined both sanded and as-tooled. The as-tooled surfaces were prepared with polyester and nylon peel plies. Contact angle measurements were performed on as-tooled and sanded surfaces to determine the surface energy using six fluids; deionized water, tetrabromoethane, formamide, diiodomethane, ethylene glycol and dimethylsulfoxide. The Rapid Adhesion Test (RAT) was performed to evaluate bond quality on samples bonded using film adhesive EA 9696. Stereomicroscope and scanning electron microscope images were taken of the as-tooled and sanded material surfaces and fracture surfaces of the RAT samples for evaluation. The results showed that as-tooled nylon peel ply and sanded surfaces produced strong bonds, while the as-tooled polyester peel ply surface did not. Bond strength is discussed with respect to surface preparation procedure, surface morphology and surface energy. The surface energy found from contact angle measurements was compared to the fracture mode for quality assessment. The surface energies of the sanded surfaces were all very similar in their polar and dispersive components showing the same trend, indicating the removal of the affect of the peel ply. The bonded samples exhibited different modes of failure including interlaminar, cohesive and adhesion failure. The sanded surfaces showed a higher quality of bond to the adhesive represented by the larger amount of interlaminar failure. As tooled polyester surfaces made the weakest bond and failed in adhesion. The different failure modes can be used to evaluate bond strength for determining the proper surface preparation for bonding in aviation.

SNO Data Analysis Research

Chantelle Jacques, Junior, Pre-Engineering
Elizabeth Waldren, Sophomore, Electrical Engineering
Mentor: Nikolai Tolich, Physics

Our research focuses on solar neutrinos, which are created in radioactive decay reactions that take place in the sun. We are looking at data collected with the Sudbury Neutrino Observatory (SNO). SNO was designed to detect solar neutrinos using a large tank of heavy water, or D2O. Surrounding the water tank is a spherical configuration of photomultiplier tubes (PMTs), which detect very low intensity light. When neutrinos interact with D2O, light can be created in two ways: through charged current (CC) interactions and neutral current (NC) interactions. Both of these reactions produce electrons that emit a Chernekov cone of light. This cone of light is captured by the PMTs, and appears as a ring-like pattern of PMT hits. The NC reaction can produce multiple electrons, which results in multiple rings. CC reactions produces only one electron resulting in a single ring. In the past, attempts to analyze these patterns have been made in order to better distinguish CC and NC reactions using the separability derived from the analysis of specified data characteristics. Our goal is to create a data analysis program to further enhance this distinction. Some possible avenues we are exploring include image detection and noise suppression algorithms developed for machine vision.

Bayesian Estimation of the Probability of Detection for Target Tracking

Kevin Jamieson, Senior, Electrical Engineering
Mary Gates Scholar
Mentor: Maya Gupta, Electrical Engineering
Mentor: David Krout, Applied Physics Laboratory

We propose a Bayesian estimation method to sequentially update the probability of detection for tracking. The probability of detection is the probability that the amplitude of the return from the target exceeds a set threshold. A beta distribution is used for the prior, which can be centered on the best a priori guess for the probability of detection. The tracker's belief about whether it detected the target at the last scan is used to update the posterior estimate of the probability of detection. The method can be applied to any tracking algorithm that requires an estimate of the probability of detection. Experiments with the probabilistic data association (PDA) tracker show that the proposed estimation method can increase the amount of time a target is tracked and de-

crease the localization error when compared to using a fixed value. Experiments also show that for some values of the probability of detection, using an inflated value of the probability of detection in PDA can actually lead to better performance.

Bioengineered Peptides for Medical Applications

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Mary Gates Scholar
Mentor: Mehmet Sarikaya, Materials Science Engineering
Mentor: Marketa Hnilova, Materials Science Engineering

The immobilization of proteins and other biomolecules onto inorganic solid surfaces using self-assembly processes with high affinity and specificity is the main goal of our project. Current methods of binding and assembling biomolecules onto solid surfaces involve utilizing covalently bound chemical linkers (e.g. thiols and silanes). However, they have the disadvantages of limited control over molecular orientation and organization on the substrates along with little specificity in binding to various solid surfaces. A more versatile alternative may be through the use of combinatorially selected GEPIs (Genetically Engineered Proteins for Inorganics). With high specificity and affinity to different inorganic substrates, GEPI's can be patterned onto substrates to bind with a specific biomolecular orientation, and be tailored for a variety of functions, including binding, linking, and producing bi-functional units. We have previously demonstrated the utility of quartz-binding and gold-binding GEPI's (QBP's and AuBP's) as highly specific biomolecular linkers, along with the efficacy of immobilizing a maltose-binding protein (MBP) genetically fused with a GEPI linker onto a solid substrate. Here we will experiment with bi-functional peptides containing both gold- and quartz-binding sequence (AuBP-QBP), using soft lithography techniques. These bi-functional peptides are used to facilitate the self-assembly of gold nano-particles onto a quartz substrate in the microfabrication of patterned surfaces. The MBP fused with AuBP's and QBP's are then introduced onto the patterned substrate to demonstrate the specificity of their binding. As evidenced by a variety of experimental techniques, e.g. fluorescent microscopy (FM) and dark field microscopy (DF), we successfully immobilized various nanostructures and recombinant MBP onto solid surfaces via these peptide linkers.

Progress Toward the Synthesis of Chiral Quinones Attached to Porphyrins

John Tomlin, Recent Graduate, Chemistry, The Evergreen State College
Russell Kaehler, Junior, Mathematics, The Evergreen State College
Mentor: Peter Pessiki, Chemistry, The Evergreen State College

We have set out to synthesize and resolve a series of optically active protected hydroquinones that could be covalently link to porphyrins. Our initial target, 2,5-dimethoxy-α-phenylethylamine, was synthesized from 2,5-dimethoxyacetophenone utilizing the Leuckart reaction as described in the classic undergraduate laboratory text "Introduction to Organic Laboratory Techniques 1st Edition" by Pavia, Lampman, and Kriz. Attempts to isolate the (-) enantiomer by crystallization as the chiral tartarate salt from a 25:75 mixture of isopropyl alcohol and methyl alcohol were only marginally successful; other solvent systems were less successful. We extended our synthesis to other derivatives with the hope of finding an analog better suited for resolution. In addition, the amides of 2,5-dimethoxy-α-phenylethylamine and 4-bromo-2,5-dimethoxy-α-phenylethylamine were prepared by reaction with p-toluoly chloride in preparation for substitution onto an acid chloride porphyrin. Progress on linking both optically active and racemic mixtures of α-phenylethylamine and its derivatives will be discussed.

Dynamical Behavior of Izhikevich Neural Models

Travis Johnson, Senior, Applied Computational Mathematical Sciences (Discrete Mathematics Algorithms)
Mentor: Eric Shea-Brown, Applied Mathematics

A neural 'integrate-and-fire' model investigated by Shea-Brown and colleagues showed that in a simple network of two neurons with a proportion of shared input, the correlation between these two neurons increased with the firing rate of the shared input. This has important implications in large-scale brain activity. However, there are some indications that this correlation might break down on more complicated models, like the more physically realistic but still computationally tractabile model proposed by Izhikevich. The question, then, is whether these previous findings can be extended to more realistic models of neural firing. A dynamical systems-style bifurcation analysis of the Izhikevich model provides the parameters we wish to examine via large-scale computational simulation. From time series data of neuron spiking, the spike train are generated for each of the two neurons, then the spike train correlation coefficient will be computed. The Izhikevich model is proving more complicated to analyze analytically than the previously considered models, but still possible.

Recurrent Hypoglycemia and the Neuroendocrine Counterregulatory Response

Julia Kabacka, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Dianne Figlewicz Lattemann, Psychiatry
Mentor: Salwa Al-Noori, Psychiatry Behavioral Sciences

Diabetes mellitus, a disease associated with defects in insulin secretion or insulin action, is a chronic disease without a cure affecting millions of people worldwide. It results in hyperglycemia, abnormally high blood glucose levels. Effective treatments for diabetes involve the use of either insulin administration or oral medications, which act by restoring normal blood glucose levels. However, a complication secondary to these treatments is an abnormally low blood glucose level, or hypoglycemia, the symptoms of which might include sweating, seizures, and even coma. In order to correct iatrogenic hypoglycemia by restoring the normal glucose levels, the body induces the neuroendocrine counterregulatory response (CRR) via the hormonal release. The CRR becomes impaired with recurrent hypoglycemia (RH). The goal of the study is to better understand the mechanisms involved in the impaired CRR. Experiments were performed on rats to induce single and recurrent hypoglycemic episodes. During the surgery, chronic venous catheters were implanted to allow subsequent insulin administration and blood collection during the experimental procedure. Day one of the experiment involved two infusions of insulin, or saline for the control animals, and the third infusion of insulin was administered on day two. Subsequent blood samples were collected during hypoglycemic bouts for hormone analysis. My current work involves processing the blood samples for analysis and performing glucose measurements as well as cryostat sectioning of the harvested brains and performing immunohistochemistry assays for quantitating the expression of a transcription factor FosB. FosB is a marker for the changes in the CNS associated with recurrent hypoglycemia. Increased activation of FosB in the medial hypothalamus in response to RH marks it as an essential region of the brain involved in CRR. Identifying the types of neurons involved in CRR and associated mechanisms can lead to the advancement in diabetes treatment.

Investigating Abnormalities in the Sleep Architecture of Individuals Suffering from Epilepsy

Tyler Kapp, Senior, Electrical Engineering
Mentor: Shahin Hakimian, Neurology, UW/Regional Epilepsy Center at Harborview

The sleep architecture of healthy adults, as revealed by scalp electrical activity of the brain on electroencephalogram (EEG), is the subject of much interest and active research. Depending upon the stage of sleep, a healthy individual's sleep architecture typically has features described as "sleep spindles", "K-Complexes", "Vertex" and other slow-wave (delta) activity. The anatomical micro-architecture of sleep, however, is only partially understood. There is even less known about the sleep architecture of individuals suffering from certain neurological disorders, including epilepsy. For example, while it is known that certain seizure types or seizure-related discharges occur in sleep, it is unclear how these patterns interact with normal sleep architecture. We hypothesize that there are abnormalities present in the sleep architecture of these patients. Preliminary analysis of EEG recordings from one epileptic patient indicates that abnormal electrical activity is present and occurs preferentially in association with sleep architecture. These abnormalities, which are localized to the side of the brain where this patient's seizures originate, may help reveal how the anatomic architecture of sleep is affected by the presence of focal abnormalities. Quantitative analysis of this patient's EEG recordings is being performed in an effort to develop a methodology that can be applied to other patients diagnosed with epilepsy. These include spectral, time-frequency, and phase related measures of background EEG. The hope is to not only learn about sleep architecture, but how it can be disturbed and how it is affected in epilepsy. Further, these analyses may be used to develop tools for identifying locations of abnormal brain function from sleep architecture of individuals suspected of having neurological disorders.

Identity Formation and Social Roles and Relationships in Female Escorts

Kelsey Rote, Senior, Psychology, Sociology, Seattle Pacific University
Mentor: David Diekema, Sociology, Seattle Pacific University
Mentor: Karen Snedker, Sociology, Seattle Pacific University

The purpose of this study is to investigate the impact of working as an escort on identity formation and social relationships. Research has studied street and brothel prostitutes, but little research has been conducted on escorts. While not technically prostitution, law enforcement estimates that 90-95% of escorts are involved in the sale of sexual activity. Understanding the lives of escorts is becoming increasingly important as the sex industry becomes more dependent on the internet for its practices. Research on street and brothel prostitutes has discussed compartmentalizing one's identity, so that each has a 'work self' and a 'real self.' Research in deviance shows the taking on of a negative self-image due to the shame of prostitution and the breaking of societal norms; others argue that sex work can help one gain power, control, understanding, and a sense of belonging. Involvement in sex work seems to affect family and friend relationships, as well as social roles such as daughter, mother, and cit-

izen. Romantic relationships are especially challenging and appear to be complicated both when the partner does know and when they do not. Approximately ten female escorts will be recruited through agencies and personal websites in and around the Pacific Northwest. Through in-depth, semi-structured interviews with female escorts, I will examine how their job and the stigma attached to it affect them. The positive and negative consequences will be viewed in light of personal identity – how does the stigma and working in the profession cause them to view themselves. The effects of sex work on social roles and relationships will also be examined. I will explore how escorts manage mixing their work life with their personal life, especially with family, friends, and romantic partners. Interviews will be recorded, transcribed, and analyzed for similarities and differences.

Development of Expression Cassettes for Increased, Endothelium-Specific Expression Using Helper-Dependent Adenovirus

Jordan Kho, Senior, Biology (Molecular, Cellular Developmental), Microbiology
Howard Hughes Scholar, Mary Gates Scholar
Mentor: David Dichek, Medicine
Mentor: Nagadhara Dronadula, Cardiology

Gene therapy, delivered to vascular endothelium, is a potential strategy for prevention and cure of atherosclerosis. Helper-dependent adenoviral vectors (HD-Ad) are good candidates for vascular gene delivery because they achieve efficient gene transfer to endothelium, promote prolonged transgene expression, and are less inflammatory than first generation Ad. However, for effective gene therapy, high-level transgene expression is also required. The CMV promoter is widely used for transgene expression due to its capability to drive high-level expression. CMV promoter-driven expression, however, depends on inflammation and is not endothelium-specific. Here, we aimed to develop expression cassettes that are less dependent on inflammation, more endothelium-specific, yet also highly active. We also tested whether transgene expression could be increased by using a genomic rather than a cDNA clone. Using rabbit interleukin 10 (IL-10) as a non-immunogenic reporter gene, we constructed HD-Ad that expressed the IL-10 cDNA (cIL-10) or gene (gIL-10) from the CMV promoter, a minimal mouse endothelin-1 (mET-1) promoter, or the minimal mET-1 promoter with added endothelium-specific enhancer elements. Gene expression was analyzed by quantitative RT-PCR of RNA from cultured, transduced bovine aortic endothelial or smooth muscle cells (BAoEC or BAoSMC). Our results revealed that expression of IL-10 was higher in cells transduced with the cIL-10 vectors than the gIL-10 vectors. IL-10 expression from the mET-1 promoter was also higher in BAoEC than BAoSMC, indicating the cell-type specificity of the mET-1 promoter. However, mET-1-driven IL-10 expression in BAoEC was only 10% of levels obtained with the CMV promoter. Using plasmid transfection, addition of endothelium-specific enhancers to the mET-1 promoter increased IL-10 expression in BAoEC up to 8-fold, to a level similar to a CMV-containing cassette. We conclude that incorporation of endothelium-specific transcriptional regulatory elements in HD-Ad is a promising approach for achieving tissue-specific high-level expression of therapeutic genes in vivo.

Identification of Neuroprotective Agents in Coffee and Tobacco against Parkinsons Disease

Derek Khorsand, Senior, Biochemistry
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Leo Pallanck, Genome Sciences

Neurodegenerative disorders affect over 50 million Americans every year. Although their prevalence might suggest otherwise, most of the nearly 600 cataloged neurodegenerative disorders are poorly understood. Of these, Parkinson's Disease (PD) is the second most common and one of the most expensive in terms of total-care costs. Recent literature suggests that coffee consumption and tobacco use reduce the incidence of PD as well as the exhibition of its pathology: the death of dopaminurgic neurons in the substantia nigra of the midbrain as well as the accumulation of proteinacious inclusions known as lewy bodies. Another indication of PD is the presence of 4-hydroxy nonenal (HNE) within the nervous system. HNE is known to react with the protein product of α-synuclein, a gene implicated in the development and onset of PD, to create substances toxic to particular neurons. This project aims to identify the specific components of coffee and tobacco responsible for its neuroprotective effects. Treatments consist of drosophila food containing the separate fractions of coffee and tobacco extracts. Flies are administered this food then analyzed at end of life for PD pathology. This may implicate a specific component in coffee and tobacco resopnsible for their possible neuroprotective nature. The successful identification of such a compound may allow the development of pharmaceuticals capable of treating PD patients.

Biometic Deposition of Hydroxyapatite Coating on Porous Titanium

Peter Khuu, Senior, Materials Science Engineering
Mentor: Nik Hrabe, Materials Science Engineering
Mentor: Raj Bordia, Materials Science Engineering

Solid titanium is commonly used in load bearing implants like artificial knee, hip joints, screws and plates. However, it is dense and its adherence to and integration with the bone is poor. This leads to a range of problems leading to discomfort for the patient and

in many cases, a second surgery. Well-designed and engineered porous titanium implants are possible replacements due to their lower density and larger surface area for integration of the bone with the implants. Hydroxyapetite coating on the surface of the implant is desired to promote bone growth and integration. Hydroxyapetite($Ca_5(PO_4)_3(OH)$ is an inorganic mineral that makes up 70 percent of the human bone. In my research, we are using a previously developed method to biometrically grow hydroxyapetite coatings on the surface of solid titanium. Our focus is to investigate the feasibility of using this approach to grow conformal hydroxyapetite coatings on porous titanium samples. A variety of techniques will be used to investigate the chemical and physical nature of the coatings. These include X-ray diffraction (XRD) to determine the crystal structure, scanning electron microscopy to investigate the coating morphology and electron dispersive spectroscopy for chemical analysis.

Stereotypes of Computer Science and Its Effect on Women's Career Pathways

Saenam Kim, Senior, Psychology
Anisha Garg, Senior, Psychology
Mentor: Sapna Cheryan, Psychology

The number of women in computer science has been decreasing as the years progress, in comparison to other fields like biology and mathematics, where the percentage of female students has been increasing (National Science Foundation 2008). Specific stereotypes about the computer science field (i.e. "geeky" or "nerdy") may be deterring women from computer science. The present study examines whether cues found in computer science classrooms can be seen as inviting or unwelcoming to women. We hypothesized that if an environment is more stereotypical of a computer science classroom, then women would be less interested in that class. Using computer software Second Life™, we created two virtual classrooms, one portraying a stereotypical computer science classroom and the other depicting a non-stereotypical classroom. Sixty-four students at the University of Washington, Seattle participated in this study (28 males, 36 females). Each participant then "walked through" two "Introduction to Computer Science" classrooms and was asked to indicate which class they would prefer to take. Their choice in classroom was then analyzed along with their gender. Results revealed female participants preferred the non-stereotypical room over the stereotypical room, whereas there was no statistically significant difference in preference among male participants. Our hypothesis was supported, confirming that environmental cues can cause and perpetuate underrepresentation. This study suggests that altering environmental settings of computer science classrooms would help computer science programs recruit more females. This ultimately benefits society by getting a female perspective in computer science as well as opening new doors for female career prospectives in the future.

Novel Iridium Catalysts for Alkane Activation

Elizabeth Korsmo, Senior, Chemistry
NASA Space Grant Scholar
Mentor: Karen Goldberg, Chemistry
Mentor: Sara Buzak, Chemistry

Alkanes are very stable and unreactive organic compounds. This makes it difficult to directly use alkanes for chemical synthesis. The Center for Enabling New Technologies through Catalysis (CENTC) coordinates collaborative research to develop efficient and environmentally friendly methods of converting alkanes to higher value organics such as alcohols or alkenes. One promising route towards this involves catalysis by ligand-stabilized metals such as iridium and rhodium. Chelating ligands including PCP, POCOP, PNP and PONOP have been studied in iridium complexes for such reactions. My work has focused on discerning the properties of (PONOP)Ir complexes, as they are new compounds which have not been extensively studied. PONOP (2,6-(OPtBu2)2C5H3N) is a novel tridentate ligand which binds to a metal center through its nitrogen and two phosphorus atoms (the moniker PONOP derives from the non-carbon atoms along its backbone). My projects have included growing crystals of [(PONOP)Ir(cyclooctene)]PF6 and (PONOP)Ir(phenyl), which may then be analyzed by X-ray (to determine the crystal structure) or by elemental analysis (to confirm the composition of the substances). As these complexes are highly reactive in the presence of oxygen, all processes—ranging from synthesis of the complexes to preparation of samples for NMR—were carried out under vacuum or an inert atmosphere (such as nitrogen gas). Both 1H and 31P Nuclear Magnetic Resonance imaging were used to monitor reaction progress and assess the purity of products.

Signaling Network Deregulation and Liver Cancer

Amanda Koszarek, Senior, Biology (Molecular, Cellular Developmental)
Mentor: William Grady, Medicine

Phosphatase-and-tensin homologue (PTEN) is a tumor suppressor gene that is commonly mutated in many types of cancers, including liver cancer. Its mutation leads to increased activity of the PI3K/AKT signaling pathway. The inactivation of PTEN ultimately leads to resistance to apoptosis, increased proliferation, and other tumor promoting effects. Another signaling pathway commonly deregulated in liver cancer is the transforming growth factor-ß(TGF-ß) pathway, which paradoxically is both a tumor suppressor and activator. Deregulation of the TGF-ßpathway results in increased cell prolifera-

tion, decreased cell differentiation, decreased apoptosis, increased angiogenesis, and extracellular matrix remodeling. Since both the PI3K pathway and TGF-ßpathway are commonly deregulated in liver cancer, we assessed if the two pathways cooperated to cause the formation of liver cancer in a mouse model that lacks PTEN and the TGF-ßreceptor TGFBR2. Together with Patty Trobridge, Ji-Yeon Baek, and William M. Grady, I mated *Alb-Cre* mice with *Pten(flx/flx)* mice and *Tgfbr2(flx/flx)* mice to obtain mice that lack PTEN and TGFBR2 in the liver. We are comparing these mice to mice that only lack PTEN or TGFBR2 in the liver. After obtaining the appropriate genotypes, the mice have been followed to approximately one year of age and then sacrificed with assessment of the liver at that time. We have found that the *Alb-Cre;Pten(flx/flx); Tgfbr2(flx/flx)* mice, which lack PTEN and TGFBR2, develop hepatic carcinomas at approximately 1 year of age. Approximately 80% of these mice (N=7/9) had hepatocellular carcinomas and they had 9 tumors/liver on average. Moreover, these mice also commonly have a condition called Non-Alcoholic Steatohepatitis (NASH) which may have influenced the formation of the tumors. Our results suggest that PTEN inactivation and TGFBR2 loss can in fact cooperate to induce liver cancer formation.

Images are More Emotional than Words

Lainey Rokkan, Sophomore, Psychology, North Seattle Community College
Sarah Cornell, Junior, Psychology, Women's Studies, North Seattle Community College
Elena Barker, Sophomore, Psychology, North Seattle Community College
Mentor: Melissa Grinley, Psychology, North Seattle Community College

Research has shown that when confronted with intense visual messages the human brain will shift active processes from the language-based, logical left side to the emotionally interactive right side. The limbic system is the part of the brain responsible for both the experience and the expression of emotion. It has been shown that the frontal limbic system responds the same when confronted with real life situations as it does when confronted with vivid imagery, (Restak, 2003). The experiment of Holmes, Mathews, Mackintosh and Dalgleish (2008) found that when combining an image presented to participants with a personal mental image the emotional response was much stronger than when combining the image with a verbal sentence. In order to show that news articles containing images along with the text would induce stronger emotional responses participants were randomly assigned into two groups. Both groups were asked to read four articles, two of which contained the articles original image and two that contained only text. In this way, each group acted as a control for two of the articles.Then the particpants were asked to rate their emtional response to each article using two basic numerical scales per article. These scales were numbered 1-5; 1 representing a neutral emotional response and 5 respresenting a very strong emotional response. The first scale was for a positive emotion such as happiness and the second scale was ment to rate a negative emotion such as saddness. It was believed that the articles containing visual images would result in stronger emotional responses.

Trypanosoma Brucei* Methionyl-tRNA Synthetase and Histidyl-tRNA Synthetase Gene Products are Essential for Viability *In Vitro

Jocelyn Lam, Senior, Microbiology
Mary Gates Scholar
Mentor: Frederick Buckner, Medicine

Tropical parasitic pathogens such as *Trypanosoma brucei*, the causative agent of African sleeping sickness, afflict millions and produce high mortality rates in endemic areas. Current treatments available are toxic and therefore the discovery of more effective drugs is of great interest. We are doing research to identify critical biochemical pathways that may serve as new drug targets in *Trypanosoma brucei.* My work involves two genes that encode tRNA synthetases, enzymes that catalyze the linkage of amino acids to transfer RNAs and are critical for protein production. The objective of my RNA interference (RNAi) assay was to determine if the methionyl-tRNA synthetase (MetRS) and histidyl-tRNA synthetase (HisRS) are required for *T. brucei* proliferation *in vitro*. To study its growth, I constructed two tetracycline-inducible plasmids containing the genes and transformed separate cultures of *T. brucei.* On day 4 of the study, the MetRS cultures that contained tetracycline demonstrated a 100-fold inhibition in growth and the HisRS cultures with tetracycline showed 1,000-fold inhibition. The RNAi experiment suggests that these synthetases are essential proteins in *T. brucei*. Future studies will analyze levels of mRNA in cultures to confirm knockdown as well as enzyme activity and drug assays. This work brings us closer to finding more effective drugs to combat trypanosoma infections.

Synthesis of Structurally Related N4S Novel Ligand Systems: Spectroscopy and Reactivity of a New Pyridine Based Thiolate–Ligated, Non-Heme Iron Superoxide Reductase (SOR) Model Complex

Leah Landsem, Junior, Biochemistry
Mary Gates Scholar
Mentor: Julia Kovacs, Chemistry
Mentor: Santiago Toledo, Chemistry

Superoxide reducatse (SOR) is a non-heme iron enzyme found in anaerobic organisms that catalyzes a selective one electron reduction of superoxide to hydrogen perox-

ide. Superoxide is a toxic oxygen derived radical that results from the adventitious one electron reduction of dioxygen and it has been implicated in diseases such as cancer and Parkinson's . One way to study metalloenzymes is through biomimetic modeling of the protein's active site. Synthetic small molecule analogues of SOR help to elucidate the structural, spectroscopic and reactivity properties of the enzyme and provide crucial information on transient intermediates in the catalytic cycle of superoxide detoxification in nature. Herein we present the synthesis of two novel pyridine based ligands as precursors to the synthesis of new thiolate containing pyridine-based non-heme iron metal complexes as models for the active site of SOR. The chemistry and structure of these ligands and complexes was analyzed through nuclear magnetic resonance, mass spectroscopy, UV-Vis and X-ray crystallography methods. Preliminary results towards superoxide reduction and dioxygen activation are also presented. This study aims at understanding how small structural changes in the metal's coordination environment affect the model's chemistry and will lead to a greater understanding of superoxide reductase reaction mechanism.

Investigating the Molecular Mechanism of Lamotrigine

Ignatius Lau, Senior, Neurobiology
Mary Gates Scholar
Mentor: Nicholas Poolos, Neurology

Almost three million Americans currently have been diagnosed with epilepsy, making it one of the most prevalent neurological conditions in the United States today. Despite recent advances in pharmacological and nonpharmacological treatment, 25-30% of patients diagnosed with epilepsy do not achieve satisfactory control of their seizures with antiepileptic drug (AED) therapy. Most AEDs currently being prescribed act directly on ion channels. Our current research focuses on an AED called Lamotrigine (LTG) and its effect on hyperpolarization-activated cyclic nucleotide gated ion channels (HCN channels). Multiple studies have shown that HCN channels decrease neuronal excitability when upregulated. However, LTG does not act directly on HCN channels. Recent research suggests that LTG activates p-38 Mitogen Activated Protein Kinase (p-38 MAPK), a special protein that can phosphorylate its substrate and modify its biophysical properties. P-38 MAPK then initiates a phosphorylation cascade that upregulates HCN channels. We would like to know where LTG acts in the phosphorylation cascade. We hypothesize that LTG upregulates p-38 MAPK by acting directly on p-38 MAPK or on an upstream kinase of p-38 MAPK. I will use western blots to determine if LTG increases the relative concentrations of p-38 MAPK and its upstream kinases in rodent hippocampal neurons. Relatively higher concentrations of a specific kinase in the presence of LTG will suggest that it plays a role in LTG's mechanism. By elucidating the mechanism of LTG, we hope to contribute to the development of more versatile and effective AEDs.

A Computational Approach for Selecting Protein Targets in *Plasmodium falciparum* to Pursue in Antimalarial Drug Development

Adrian Laurenzi, Sophomore, Biochemistry
Mentor: Ram Samudrala, Microbiology

This study makes use of a variety of computational techniques in order to assist in identifying protein targets to pursue in the development of antimalarial drugs. The goal is to select a protein target from *Plasmodium falciparum*, the parasite that causes malaria, for which an inhibitor would be least likely to produce side effects in humans. This will be achieved by comparing a set of 14 target proteins, with experimentally determined structures that are available from the Protein Data Bank (PDB), to the proteins in the PDB from humans and other organisms commonly used in drug development. For each protein global and local comparisons will be performed. So far global comparisons have been performed using TM-align and Dali which look for similarities in the full 3D (tertiary) structure of the proteins. The local comparisons will assess the homology among functional sites, which are short amino acid sequences involved in binding and catalysis. No algorithm exists that is capable of performing local comparisons on this scale, but this can be achieved by combining a meta-functional site prediction algorithm with BLAST at the amino acid level. An inhibitor that targets the protein in *P. falciparum* found to be most dissimilar to those in humans should be least likely to cause side effects. The results of this study could help to narrow down lead inhibitors to pursue in antimalarial drug drug development. Techniques similar to those described above will also be used to relate drug-protein interaction to protein structure. This will be achieved by investigating similarities among human brain receptors and plant proteins that biosynthesize compounds that are active on those receptors.

Life Span Extension from Osmotic Stress in *Caenorahbditis Elegans*

Anna Le, Senior, Individualized Studies, Biochemistry
Mary Gates Scholar
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). DR is defined as a reduction in nutrient availability without malnutrition. We are study-

ing 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. We have observed that increasing the osmolarity of the growth medium, by addition of excess salts, peptone, or carbohydrates, is sufficient to increase life span in *C. elegans* by up to 50%. A mutation resulting in resistance to osmotic stress, osr-1(RB1032) also increases life span, suggesting that genetic or environmental induction of the osmotic response promotes longevity in *C. elegans*. Epistasis experiments support a model that osmotic stress promotes longevity in a pathway parallel to insulin/IGF-1-like signaling by reducing food intake. Thus, we propose that osmotic stress acts as a dietary restriction mimetic to slow aging in C. elegans.

Fourier Transform Infrared Measurement of Acetonitrile Using Different Solvents

Hyung-Sup Lee, Senior, Biochemistry, Chemistry (ACS Certified)
Mentor: Munira Khalil, Chemistry

The goal of my project is to understand solvation dynamics of acetonitrile dissolved in various hydrogen-bonding solvents using Fourier Transform Infrared (FTIR) spectroscopy. The study focuses on understanding how the position, amplitude and line shape of the cyanide stretching vibration varies with increasing concentration of acetonitrile in water, methanol and ethanol. We will show how the change in concentration, and solvent affects the cyanide frequency. Using this information, we will get to closer to understanding how particular solvent molecules interact with acetonitrile in solution.

VidRack: Video Search and Reference Site

Wendy Lee, Senior, Informatics
Algernon Carpena, Senior, Informatics
Heather Lahde, Recent Graduate, Informatics
Mentor: David Hendry, Information School
Mentor: Batya Friedman, Information School

When searching for videos on the internet, users are often faced with challenges that make locating or playing their desired video difficult. Traditionally, individual video searching sites implement proprietary methods for saving videos, making it impossible to save different videos from multiple sites in one location. As a result, the process can be very frustrating and time consuming for users, leaving them to select from the following options: (1) create an account on each individual video sharing site, (2) bookmark the video URL, or (3) memorize the keywords and the searching site associated with the given video. The VidRack project aims to streamline this process by allowing users to search multiple video sites from one location, and create and save playlists with videos from any current video searching site available. To design and implement VidRack, we followed a user-centered design process, consisting of these steps: First, we developed and administered a survey in paper and electronic form to determine the importance of features found on video searching sites. Next, we created multiple iterations of paper prototypes and conducted interviews to evaluate the overall design and clarify our survey results. Finally, we developed a fully functioning web-based application. The data obtained from our survey and interviews have shaped the features and overall design that is shown in our final site, and addresses all of the difficulties mentioned above that users face when using video searching sites. Looking ahead to the future, there is great potential to expand the VidRack project to a larger audience. Based on time constraints, we have been unable to incorporate support for multiple languages, and adding this feature will allow a greater number of users to experience the benefits VidRack has to offer.

Individual Differences in ITD and ILD Sensitivity

Ann Lin, Recent Graduate, Speech Hearing Sciences
Mentor: G. Christopher Stecker, Speech Hearing Sciences

The purpose of this study was to develop a test battery for studying individual differences between ITD and ILD sensitivity. Interaural time difference (ITD) uses the difference between the onset time of a sound that reaches each ear. Interaural level difference (ILD) uses the difference in sound level for each ear. Research has shown that typically listeners vary in sensitivity to the cues. At this point, it is unknown as to which reasons are responsible for this preference and also unclear as to which cue the majority of individuals prefer. This study used cognitive, such as working memory tasks, and perceptual tests, including 4 ITD and ILD discrimination tasks, 2 click train rate discrimination tasks, and 2 gap detection tasks. The perceptual tasks involved listening to three intervals of sound. The first interval was the reference or the "norm." The listeners were asked to choose between the second and third interval as to which was perceived to be different. Differences were presented in a variety of ways such as location and pitch. Preliminary data collected from 15 university student subjects will be compared across tasks and contribute to a more comprehensive population study on individual differences between ITD and ILD sensitivity.

The "Sea Tramp": An Inductively Recharging Mooring Profiler

Sean Livingston, Sophomore, Pre-Engineering
NASA Space Grant Scholar
Mentor: Matthew Alford, Oceanography, APL/UW
Mentor: Tim McGinnis, Ocean Engineerding, Applied Physics Lab

Although scientists know a great deal about what inhabits the ocean, there are many unknowns about how the ocean works. The current method of taking ocean measurements over a prolonged period of time is through the use of a moored profiler that carries several sensors and moves vertically from the sea surface to the sea floor and back along a mooring cable. The endurance of modern profilers is limited to about 6 weeks by the capacity of their battery power supply, which is the problem that the Applied Physics Lab's project addresses. We hypothesize that an inductively recharging battery system will allow a profiler to operate for a 12-month period of time. The only effective method of gathering data with enough resolution to be able to detect tidal currents and enough duration to detect seasonal changes is to conduct a vertical profile several times a day throughout the course of a year. In order to take measurements over a full year, existing profilers can only take one profile per day which under-samples most of the important parameters. The HOT mooring profiler that is being developed utilizes the new inductively recharging battery system which will allow near continuous (96% duty cycle) profiling for 1 year. The ALOHA mooring has been successfully profiling and recharging during a two-month trial period in Puget Sound, where it is taking measurements of conductivity, temperature, and depth. The system is shown to work, which implies that an inductively recharging battery system will power a profiler mooring for a full year. This improved operational lifespan will allow scientists to gain a much more complete picture of the processes that occur in the ocean and will provide insights into important issues such as global climate shift.

Collateral Vasodilatation towards Improved Clinical Outcomes for Ischemic Stroke

Paul Lu, Senior, Neurobiology
EIP/Presidential Scholar, Mary Gates Scholar
Samuel Kim, Sophomore, Pre-Sciences
Mentor: Al Ngai, Neurological Surgery

Stroke is the third leading cause of death in the United States, only behind heart disease and cancer. Ischemic stroke, which accounts for approximately 80% of all known and recorded strokes, occurs when cerebral arteries or arterioles are occluded. Currently, recombinant tissue plasminogen activator (rTPA) is the only effective and FDA approved therapy for ischemic stroke. Although this therapeutic method is highly effective, an extremely limited number of patients receive this treatment (˜5%) due to the recommended 3-hour treatment window. The increasing risk of hemorrhage over time makes rTPA dangerous if used after three hours post-stroke onset. Therefore, improved clinical treatments for patients must be discovered to curtail the neurological and morphological defects associated with prolonged deficiencies in cerebral blood flow. A possible means for improving blood circulation during blockage involves the collateral circulation, where neighboring blood vessels respond by vasodilatation and diversion of blood to occluded regions. To potentially enhance collateral blood flow, a rat model is used to evaluate the effect of a vasodilator when applied to the ischemic area. Adenosine is a known neuroprotectant and vasodilator, and may be able to increase vasodilatation above natural capacities. To investigate these effects, the cranial window methodology, laser-Doppler perfusion measurement, laser speckle contrast imaging, and remote filament MCAO technique are simultaneously utilized. The adenosine A2A receptor agonist, 2-p-(2-carboxyethyl)-phenethylamino-5'-N-ethylcarboxy-amidoadenosine (CGS 21680), is applied through the cranial window; vasodilatation of blood vessels as well as increased residual blood flow to the occluded site is monitored. Twenty-four hours after reperfusion, neurological deficit and ischemic damage is assessed. The goal for this project is to determine if pharmacological agents such as adenosine can extend the treatment window for rTPA or other stroke therapies, ultimately to improve patient outcome.

Boeing Industrial Engineering Research

Shan Lu, Senior, Art (Painting and Drawing), Industrial Engineering
Edwin Heymann, Senior, Industrial Engineering
Belinda Leung-Tiberio, Fifth Year, Computing Software Systems, UW Bothell
Mentor: Richard Storch, Industrial Engineering

University of Washington's Industrial and Systems Engineering Research group was presented with the unique challenge of proposing a facility design to move parts of a ball-valve assembly line from Boeing Renton to Boeing Auburn. A smoother work flow was the driving force for the change. The research group reduced the project into two main areas: workbench design and layout design. To begin, the group chose four Industrial Engineering methodologies to focus on: 5S, Lean, ergonomics and quality assurance. The team gathered time study data, part and inventory storage dimensions, and floor layout plans for the Auburn plant. Afterward, they analyzed the data and developed multiple options for the workbench and layout. Each workbench option earned points on the criteria of functionality, size, and cost. The team decided on proposing a J-shaped bench that had an estimated payback of $10,671.21 per year. The layout options were judged on, ease of implementation, accessibility and workflow. The final layout choice was to replace a table currently at Boeing Auburn, with a single J-shaped workbench. Most importantly, the proposal for the new workbench and layout comprised of several small changes packaged together. This way, Boeing

could at least implement some of the suggestions without committing to an all-or-nothing approach.

Simulating Dwarf Galaxy Halo Collisions
Ryan Maas, Senior, Physics, Astronomy
Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: Julianne Dalcanton, Astronomy

Dwarf spheroidal galaxies are much smaller than the Milky Way and have surface brightness profiles that fall off exponentially rather than the power law dependence of disk galaxies. It is not well known how these galaxies can be heated as much as they are without having collided into a larger galaxy. One possibility may be related to another cosmological theory known as hierarchal merging. From simulations it is believed that the largest galaxies in the universe were formed by the collision of much smaller clumps of matter, and that the mass distribution of objects in the universe tends heavily to these halos that are less massive than the dwarf spheroidals themselves. While we do not see the number of dwarf galaxies predicted by hierarchal merging, an abundant presence of smaller dark matter halos may have a gravitational impact on the morphology of objects like dwarf spheroidals. We test this hypothesis by simulating a dwarf galaxy colliding with surrounding dark matter and comparing the results with observed data on dwarf galaxies to determine an upper limit on the heating produced. To approximate the maximum displacement of star particles in the dwarf galaxy, simulations are run in which a concentrated dark matter halo from the surrounding substructure collides perpendicular to the disk of the galaxy. Preliminary results show that while star particles disperse slightly over time, the largest plausible collision from a single dark matter halo does not significantly affect the shape of the galaxy. The simulation parameters are varied further to test different halo orientations and distributions of multiple halos.

RibeyeB, a Ribbon Synapse Protein, is Expressed in the Lateral Line Hair Cells
Frederica Mackert, Senior, Biology (General)
Mentor: Arminda Suli, Biological Structure
Mentor: David Raible, Biological Structure

The lateral line is a sensory system found in fishes and amphibians that helps in prey detection, predator avoidance and schooling behavior. These behaviors are mediated through the mechanosensory hair cells of the lateral line, which reside on the surface of the animal and are stimulated by water motion. The lateral line hair cells convert the mechanical signals from the water displacement into electrical signals for the nervous system. Ribbon synapses are critical structures of the hair cells that are found at the interface of the hair cells with the fibers of the afferent neurons to which they signal. Ribeye is a protein initially isolated from bovine retinal ribbon synapses. Two Ribeye homologues have been found in zebrafish, namely RibeyeA and RibeyeB. We found that only RibeyeB is expressed in the zebrafish lateral line. We are currently performing in situ hybridization to assess the expression of Ribeye mRNA in the regenerating hair cells following their death by ototoxic drugs. Furthermore, we are engineering constructs that will allow us to follow in vivo the dynamics RibeyeB expression and localization in the lateral line hair cells during regeneration.

Pachelbel vs. Mona
Jennifer Mao, Senior, Art (Photography), Psychology
Mary Gates Scholar
Mentor: Jentery Sayers, English
Mentor: Phillip Thurtle, Comparative History of Ideas

I am interested in the phenomenon of synesthesia, when an experience within one sensory modality elicits a concurrent experience within a separate, unrelated modality. My research focused on investigating this biopsychological phenomenon through the lens of artistic practice. The notion of synesthesia was intriguing because it seemed to embody the complications and limitations that arise from our existence as organisms capable of experiencing a spectrum of sensory interpretations. One manifestation of synesthesia is through the sound/color pathway, when visuals correspond to characteristics of experienced sounds such as pitch and timbre. Drawing inspiration from this, I composed a visual representation of Pachelbel's Canon in D Major by assigning video clips to pitches and arranging their presentation to mimic the original piece. The second component of the installation imagined the undocumented relationship between tactile and visual senses through the topographical representation of the Mona Lisa. This piece was meant to act as an interactive canvas for the time-based video to be projected upon, and is also designed to be touched by viewers. By projecting the visual manifestation of sound upon a visual piece that has been translated into a primarily touchable work, an immersive sensory experience was created that confuses the traditionally automatic acceptance of our perceptual processes.

The Civil War and American Values: The Changing Moral and Religious Perspectives of the Home Front, 1861-1865
William Mari, Senior, History, Communication (Journalism)
Mary Gates Scholar
Mentor: Robert McKenzie, History

The goal of my research project with Prof. Tracy McKenzie has been to explore the shifting attitudes of the Civil War's home front, highlighting the debate over a number of critical moral questions, including the role

of patriotism, racial and gender equality, civil liberties, the idea of "just war" and faith. To do so, I have read contemporary sources, including family papers, eyewitness accounts, letters and newspaper reports, assisting Prof. McKenzie by finding illuminating anecdotes for his book project that illustrate the worldviews of the participants in their own words, and how they changed these views in response to several key events, including the actual outbreak of the conflict, the Emancipation Proclamation, Gettysburg and Vicksburg, Sherman's "march to the sea," Lincoln's assassination, Lee's surrender and the war's aftermath. I have sought to answer questions that deal with the moral and religious ambiguity civilian participants faced, exploring their written thoughts, and encompassing such dilemmas as, "How did religious people come to terms with these events, especially when it seemed as if God was not on their side? How did Christians in the South reconcile their beliefs with the institution of slavery and its subsequent collapse?" The goal in answering these and other questions has been to get as close as possible to the "ordinary" American of the period, in order to gauge his or her thoughts on how their views of faith and morality were affected by the war, and how these views changed over time. The insights provided have revealed the emotionally complex and nuanced feelings that Americans of faith expressed during a turbulent time in our nation's history.

WAPing and SLAPing for Pain: A Study into Acoustic Temporal Summation

Abigail McClintic, Junior, Pre-Major
NASA Space Grant Scholar
Trevor Dickey, Senior, Biochemistry
Mentor: Pierre Mourad, Neurological Surgery

In order to diagnose and treat painful sensations, we must know the location of the sensitive tissue. Current techniques, however, lack sufficient anatomical specificity, or test only a subset of the candidate pain generators. 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. Moreover, iFU causes differential sensations in normal versus damaged tissue, whether that damage is inflammatory or neuropathic. Specifically, when we applied iFU to normal and damaged rat paws, rats exhibited a withdrawal response to a given dose on their damaged side but showed no response to that same dose applied to their contralateral paw. Wind-up is a type of sensation amplification based in the central nervous system in which a stimulus applied repeatedly (1 – 20 times per second) causes more sensation than a single application of that same stimulus. We hypothesized that iFU protocols incorporating repeated short applications of iFU ('wind-up acoustic protocol' – WAP) would create a sensation in damaged tissue at a lower net acoustic dose and intensity than a single short application of iFU - SSAP. Our results are consistent with the hypothesis. Therefore, iFU may generate a wind-up mediated sensation in damaged tissue. Interestingly, we found that a single, long application of iFU (SLAP) with the same net on time as the WAP protocol required less acoustic energy than the WAP protocol. Calculations suggest that the difference in dose can be explained by their different ability to generate heat – where perfusion – a heat-reduction mechanism plays a role in a WAP but not a SLAP. Therefore, while WAP may induce wind-up based sensations, its sensation induction may also, or instead, arise due to its ability to generate significant *net* temperature increases in tissue.

Principal Component Analysis of SDSS Stellar Spectra

Rosalie McGurk, Senior, Astronomy, Physics
Undergraduate Research Conference Travel Awardee
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 (SDSS) 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. We make publicly available the resulting high signal-to-noise spectral shapes. These data can be used to generate high quality spectra for an arbitrary combination of temperature, metallicity, and gravity. The SDSS stellar spectroscopic database and the PCA results presented here offer a convenient method to classify new spectra, to search for unusual spectra, and to train various spectral classification methods.

Search for Planetary Nebuale in the Galactic Halo

Jean McKeever, Senior, Astronomy, Physics
Mentor: Bruce Balick, Astronomy
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. Only about twelve of the thousands of planetary nebulae (PN) cataloged in the Milky Way Galaxy

(MWG) are believed to be associated with the halo, the area surrounding the disk of the galaxy. The goal of our study is to discover additional MWG halo PN. We are using the Sloan Digital Sky Survey (SDSS) data, which has five different color filters, to select candidate halo PN based upon various scenarios, including the colors of six MWG halo PN that are in the SDSS database. We then follow up on candidates by doing colored filter photometry with g and [O III] filters on the 0.5-m telescope at Apache Point Observatory. The g filter is a basic color of SDSS and PN are very bright in [O III] compared to normal stars. A "g-[O III]" index is formed, so that objects with strong [O III] emission can be picked out. Future steps involve further observations and getting spectra, the distribution of light over the continuum, for the candidates.

Temperature Effects on the Life History of *Daphnia Magna*

Anna McLaskey, Senior, Aquatic Fishery Sciences
Mentor: Frieda B. Taub, Aquatic Fishery Science

Zooplankton play an important role in aquatic ecosystems as a link between primary producers and larger organisms. *Daphnia* are a widespread and abundant zooplankton and influence many systems because they are efficient grazers and are important in nutrient cycling. Their life history patterns cause effects throughout ecosystems by affecting trophic levels above and below them by determining both grazing pressure on algae and the food resources of planktivorous organisms and fish. As climate change begins affecting ecosystems around the world it will often be cascading effects such as these that affect the system as a whole. Closed ecological systems can be useful in studying these effects because they depend on the interactions of producers and consumers through the nutrient recycling which is the basis of all ecosystems. To test the effects of temperature on the survival and life history traits of *Daphnia magna* and mixed algae, twelve identical closed ecological systems were created in glass bottles, each with 250 mL of chemically defined and complete medium, including 10% mixed algae in a chemically defined solution and six *D. magna* individuals, two that were large and carrying eggs, two medium, and two small juveniles. Six of these sealed systems were then incubated at a constant 20C and six at a constant 25C, all with twelve hours of light. Preliminary results indicate that at the higher temperature, reproduction occurred sooner, but the population quickly started to decline. These effects compare with prior studies that indicated that increased temperatures decreases the age at sexual maturity but also decreases life span. Understanding how temperature changes may affect zooplankton communities will be vital to predicting how climate change will affect aquatic ecosystems.

Astronomical Data Processing

Devon McMinn, Junior, Mathematics
Andrew Barr, Junior, Astronomy
Mentor: Jacob Vanderplas, Astronomy
Mentor: Sarah Loebman, Astronomy
Mentor: Andrew Connolly, Astronomy

A problem common to anyone working with large amounts of data is manipulating it to make it useful and usable. Our research concerns the classification of galaxies—a subjective process that often requires human judgment—and aims to automate this process as much as possible. We are doing this by using simulated galaxies, which can give us ideas of the relationships of the different variables that determine what a galaxy looks like. In order to isolate these relationships, we used the previously developed Locally Linear Embedding (LLE) algorithm. This works by reducing dimensionality in data while preserving the relationships between the data points. In this case, dimensionality refers to distinct measurements of each data point. The reduction is accomplished by treating these dimensions of data as spatial dimensions and calculating geometric distances between points. When the distances between a data point and its K neighbors, where K is the number of objects closest to it, are calculated, it is possible to quantify the geometric relationships of the variables. These geometric relationships make it much easier to detect correlations that may go unnoticed in higher dimensional data. This algorithm has also been applied successfully to image processing. We make use of the LLE algorithm to create plots of our simulated galaxies to spot variable correlation. From these plots, we are trying to systematically categorize galaxies based on pictures obtained from the Sloan Digital Sky Survey.

Analysis of Volatile Oils Isolated from *Mentha spicata* and *Mentha suaveolens* using Headspace Gas Chromatography-Mass Spectrometry

Micaela Marquez, Senior, Chemistry, The Evergreen State College
Kate Reimer, Junior, Chemistry, The Evergreen State College
Mentor: Peter Pessiki, Chemistry, The Evergreen State College

We have been successful in our goal of establishing a garden that supplies research and teaching labs with a sustainable source of plant materials suited for laboratory science and chemical analysis. The garden is located on a patch of land called the Organic Farm, which is part of The Evergreen State College campus. Our focus has been growing plants that produce volatile oils that can be readily isolated by steam distillation or ethereal solvent extraction. These isolated constituents are suitable for analysis by Gas Chromatography-Mass Spectrometry (GC-MS), our primary analytical tool. A recent addition

to our instrument, a Headspace Analyzer, has allowed us to expand our initial studies by eliminating the extraction part of the process, which has introduced some new challenges in data interpretation. This poster reports and compares our results using this newly obtained Headspace-Gas Chromatography technology (HS-GC) with data obtained from the traditional method of distilling the plant material followed by direct injection into the GC-MS as neat samples.

Measurement of MRI Imaging Modalities for Modeling Glioma Growth

Larissa Miller, Junior, Materials Science Engineering
Amanda Ly, Junior, Pre-Health Sciences
Mentor: Kristin Swanson, Pathology

Gliomas are highly aggressive brain tumors with origins in the brain's glial cells. Glioma growth is described in terms of net rates of migration (D) and proliferation (ρ). These parameters differ for each patient but can be determined by using pre-treatment serial imaging. Only a portion of the actual tumor can be seen by any imaging of the brain, therefore this patient-specific model increases our ability to effectively treat the tumor and predict the life expectancy of patients by detecting tumor invasion below the imaging threshold. Measuring cancer growth for use in the model utilizes MRI scans of different modalities and a MATLAB-based program. The abnormality depicted depends on the appearance of hyperintense regions in different modalities of the scan and the therapy the patient has undergone such as radiation and chemotherapy. Two observations are made for each imaging set in order to gain an accurate tumor volume measurement. Our lab routinely uses four primary imaging modalities to describe tumor dynamics. Because of the diffuse invasion of the glioma cells, the edge of hyperintense regions is not always clearly defined. Comparison of a T1 modality, which depicts excess blood, and a T1Gd modality, which depicts bulk tumor mass, necrosis, and excess blood, prevents blood from affecting the volume calculation. T2 and FLAIR modalities depict surrounding edema as well as bulk tumor mass. Treatment information is necessary for understanding cancer progression over time and what each scan actually depicts. Treatments may change what appears on the actual image, and we can distinguish these changes by comparing images pre and post change. An increased understanding of tumor invasion as it is represented on these various imaging modalities is essential to developing more accurate models and a better understanding of glioma growth.

Factors Influencing Nonword Repetition Performance in Adults with Specific Language Impairment

Kelsey Milne, Senior, Speech Hearing Sciences (Communication Disorders)
Mary Gates Scholar
Mentor: Stacy Betz, Speech Hearing Sciences

Specific language impairment (SLI) disrupts language in the absence of hearing loss, low nonverbal intelligence, or obvious neurological deficits. Adults with SLI perform poorly on nonword repetition tasks that require them to listen to and repeat nonsense words; however, the factors underlying this poor performance are unknown. This study investigated factors that may influence nonword repetition, to determine how these tasks might be used to diagnose adults with SLI. Verbal memory may contribute to the ability to store and recall nonwords. Lexical ability, or knowledge of the words in one's language, is another potential factor; individuals may use similar words in their own languages to "reconstruct" the memory of a nonword. In addition to these cognitive-linguistic factors, properties of the nonwords may affect performance. These factors include length, phonotactic probability (a measure of the frequency with which sound sequences within a word are likely to occur) and wordlikeness (similarity to the actual words of a language). In this study, adults with SLI completed three nonword repetition tasks. The nonwords differed in length, phonotactic probability, and wordlikeness. Subjects also completed tasks that measure verbal short-term and working memory, lexical knowledge, and visuospatial short-term and working memory. Preliminary results indicate that adults with SLI score lower than typical adults on both cognitive-linguistic and nonword repetition tasks. Ultimately, statistical regression models will be used to compare the nonword characteristics, as well as scores from the cognitive-linguistic tests, to accuracy measures of nonword repetition performance, in order to discover which factors significantly predict nonword repetition scores. These results will help determine whether a particular nonword repetition task best differentiates adults with SLI from typical adults. Then, our knowledge of factors that influence performance could be used to fine-tune the task so that it more accurately identifies those with the disorder.

Imitation and Face Processing in Patients with Autism Spectrum Disorder

Amy Moretti, Senior, Psychology
Mary Gates Scholar
Mentor: Raphael Bernier, Psychiatry Behavioral Sciences

Autism spectrum disorders are characterized by social impairments, deficits in social communication, and restricted or repetitive interests and behaviors. It is well

documented that people with autism have a variety of deficits in social cognition, such as difficulties in theory of mind, empathy, imitation, face processing, and joint attention. While many of the relationships between these impairments have been examined, no published studies to date have explored the relationship between imitation and face processing impairments observed in autism. The primary aims of the present study are to explore the relationship between these two areas of social cognition, examine their impact on autism severity, and to explore the possible relationship with a neurological mechanism, the mirror neuron system. To achieve these aims we propose to examine behaviorally assessed face processing and imitation abilities, autism severity, and mirror neuron activation in a sample of adults with autism. Correlational analyses of this previously collected data will be conducted to examine the relationship between both aspects of social cognition. Further secondary analyses will assess their relationship to the mirror neuron system, and additionally, the effect of these social abilities on symptom severity. We hypothesize that facial imitation ability and face processing ability will correlate across all individuals, and that imitation impairments and deficits in face processing will significantly impact symptom severity.

Triblock Copolymer Micelles for Encapsulation of Indocyanine Green to Promote Dye Stability and Targeting Specificity

Christopher Mount, Senior, Bioengineering
Mary Gates Scholar
Mentor: Tae Hee Kim, Bioengineering
Mentor: Suzie Pun, Bioengineering

Near-infrared (NIR) imaging has several significant advantages over other types of tissue imaging. Light at these wavelengths (700-900nm) experiences less absorption and optical scattering than visible or infrared light in the body, and the background autofluorescence levels in this range from tissues is minimal. Combined with the use of a contrast agent, this allows greater imaging depth and sensitivity. Indocyanine Green (ICG) is currently the only FDA-approved NIR dye for routine clinical use to assess liver and heart functions. However, its use is limited by several properties, including rapid aqueous, photo, and thermal instability, nonspecific binding to blood proteins, and rapid clearance from the body. Recent research has shown that encapsulation of ICG in polymeric micelles is a promising approach for overcoming these qualities. My research is directed towards characterization of micelles composed of a PEO-PHB-PEO triblock copolymer. Following synthesis of the triblock copolymer, characterization will begin with quantitative determinations of the critical micelle concentration, micelle size distribution and stability, stability of micelle-encapsulated ICG, and ICG loading efficiency. Then, cytotoxicity of ICG-loaded micelles will be assessed in HeLa cell cultures. In a separate time-course study, HeLa cells will be treated with both ICG and micelle-encapsulated ICG to assess whether improved dye stability is observed under in-vitro conditions, and if cellular uptake of the dye is enhanced by micellar encapsulation. Preliminary data with similar copolymers suggest ICG stability is improved by micelle encapsulation, and we plan to ascertain whether similar stabilization occurs in these new micelles.

Effects of Historical Biosolids Application on Mycorrhizal Communities of Managed Douglas-Fir Forests at Pack Forest, Washington

Jill Mountford, Senior, Environmental Science, UW Tacoma
Mentor: Erica Cline, Interdisciplinary Arts Sciences, UW Tacoma

Biosolids, one byproduct of wastewater treatment, are commonly applied as a fertilizer to agricultural or forest soils and early experimental applications sometimes contained toxic heavy metals which can persist in the soil for decades. Mycorrhizal fungi symbiotically associated with tree roots can protect from heavy metal toxicity, but it is not clear whether some species may be more effective than others. We measured soil characteristics and identified mycorrhizal fungi on Douglas-fir roots in summer 2008 at the UW Pack Experimental Forest from eight fixed plots within each of three treatments: an untreated control, a stand with moderate biosolids application in 1982, and a stand with heavy biosolids application in 1978. The biosolids-treated stands had a higher moisture content and lower pH than the control stand. While the number of distinct morphotypes were similar among the three treatments, Cenococcum and Rhizopogon, the two most abundant taxa, were more abundant in the control than in either of the treated stands. Further identification using DNA sequencing is on-going to further explore potential patterns in mycorrhizal species among the different treatments.

Simulation of a Geo-Neutrino Detector

John Mower, Junior, Electrical Engineering
Mentor: Nikolai Tolich, Physics

Geo-neutrinos are produced by the naturally occurring decay of terrestrial thorium and uranium. We would like to understand to what extent the estimated 44Terawatt of heat produced by the earth is attributed to the decay of these particular elements. Current estimates of the Earth's content of these radioactive elements are derived from meteorites; it is believed that the Earth is comprised of similar materials. The estimated quantity of these elements and their rate of decay does not account for the measured amount of heat produced on this planet. A reliable measurement of geo-neutrinos could help us to un-

derstand this difference. One past experiment has measured geo-neutrinos but with a large background of neutrinos originating from relatively nearby nuclear reactors adding a large error to the measurements. A new detector, located in the Homestake mine in South Dakota, would not suffer from this large background flux of neutrinos. In order to minimize costs, we are considering new designs such as an array of long rectangular detectors that would also allow for easier placement into the ideal mine location. To evaluate the design we will construct a simulation of these detectors. The simulation should allow for us to discover whether we can distinguish geo-neutrino interactions from ones caused by radioactive decays originating in the materials of the detector.

Pilot Experiment to Generate Age Fields for Coastal River Plumes

Melyssa Nagamine, Junior, Civil Engineering, Biochemistry
Mary Gates Scholar
Shaun Bevan, Senior, Civil Engineering
Mentor: Alex Horner-Devine, Civil Environmental Engineering

In environmental engineering, it is essential to understand the manner in which water transports nutrients, contaminants, and other particles that affect the health of aquatic systems. The chemical and biological processes related to these substances are dependent on the residence time of the particular constituent and often proceed exponentially, making them sensitive to small variations in the age of a fluid parcel in the system. In practice, residence time is difficult to measure and is often estimated by a quantity known as hydraulic residence time, which represents a case of ideal behavior. However, in environmental flows, vortices and other singularities often cause large deviations from the ideal case, causing this to be an inaccurate representation of actual residence time. In the present experiment we study how the spatial distribution of age changes with time in the specific case of a coastal river plume. In order to measure two-dimensional fields of age we are developing a new technique that uses linear mixing of two different color dyes to create a timescale, which is applied to images of the flow to map age. The validation of the new image-based age technique will facilitate its use in more comprehensive experiments involving other environmental flows. This experiment will also provide data about the age fields in coastal river plumes, which is relevant in the consideration of sediment loading into the oceans. It will also provide a basis for understanding how coherent structures in the flow are affecting the age distributions. Our preliminary results suggest that the first fluid to enter the flow is trapped in the center of the plume. The younger fluid then appears to circle around the central mass and discharge up along the simulated coast.

The Engedi System

Nathaniel Dupuis, Senior, Electrical Engineering, Seattle Pacific University
Jon Battershell, Senior, Electrical Engineering, Seattle Pacific University
Austin Clark, Senior, Electrical Engineering, Seattle Pacific University
Bradley Rogers, Senior, Electrical Engineering, Seattle Pacific University
Jordan Wirth
Mentor: Don Peter, Electrical Engineering, Seattle Pacific University

The Engedi System is a sleeping and waking system designed to maximize comfort and flexibility. It does this via an extensive suite of features, each customizable for the user's sleeping preferences and schedule. Most alarm clocks have limited methods of waking people up. The typical alarm uses an obnoxiously loud beeping noise that immediately disturbs the peaceful state of the user. Abrupt, startling alarms do not allow for the body to awake naturally. The Engedi System provides a healthy, customizable alternative. The entire system is conveniently controlled via a single alarm clock. There are four main components in the system: a heating/cooling mattress pad, a wireless light dimmer, a wireless electrical receptacle, and the alarm clock itself. The heating and cooling mattress pad is the largest piece of the system. In addition to controlling temperature through a thermoelectric circulating water system, the mattress is fitted with vibrators which can function as an alarm by gently shaking the user awake. A wireless light dimmer simulates a rising sun or provides lower intensity light for other activities. A wireless electrical outlet allows for innumerable possible gadgets to be activated on cue such as a crock pot, record player, or coffee maker. If the previous subtle features fail to wake the person up, then an audible alarm can be set. This will use an mp3 player as the source of music. All these features are fully controlled via a user interface based on an attractive graphical color touch screen integrated into the alarm clock.

Wnt/ β-catenin Signaling Occurs in Cortical NG2+ Progenitors and is Increased in the Glial Response to Traumatic Brain Injury

Ryan Nathe, Senior, Neurobiology
Mary Gates Scholar
Mentor: Philip Horner, Neurological Surgery
Mentor: Bryan White, Pharmacology, Program in Neurobiology and Behavior

Wnt/β-catenin is a cell signaling process involved in embryogenesis, cancer, cell differentiation and regeneration. Wnt/β-catenin signaling in the brain can influence the proliferation and differentiation of progenitor

populations in the hippocampus and subventricular zone, known germinal centers in the adult mouse brain and is therefore involved in neurogenesis and gliogenesis. Manipulation of this pathway is a possible clinical therapy for traumatic brain injury. Using a Wnt/β-catenin reporter mouse (BATGAL mouse) and immunofluorescence we show that Wnt/β-catenin signaling occurs in NG2+ progenitors in the cortex and in subcallosal zone progenitors. Cells with Wnt/β-catenin signaling increase in the cortex and subcallosal zone following traumatic brain injury. Initially after traumatic brain injury, Wnt/β-catenin signaling is predominantly increased in a subset of NG2+ progenitors in the cortex and one week later the majority of Wnt/β-catenin signaling has shifted to occurring in reactive astrocytes. Over a period of 28 days the distribution of BrdU+ β-catenin expressing cells in the cortex shifts from deeper tissues of the cortex toward the parenchyma. Through studies injecting animals with BrdU or infusing animals with AraC, we show that the increase in Wnt/β-catenin signaling occurs in newly born cells and is dependent on cell division. These data argue for manipulating the Wnt/β-catenin pathway after traumatic brain injury as a way to modify posttraumatic gliogenesis (scar formation).

Radiocarbon Correlation of Archeological Strata in the Kuril Islands

Stephen Newman, Recent Graduate, Earth Space Sciences
Mentor: Jody Bourgeois, Earth Space Sciences

Deciphering the archeological history of indigenous peoples, who within the last few thousand years populated the Kuril Islands, hinges upon careful excavation, artifact typology, and reliable dating methods. Though radiocarbon (14C) dating is a reliable tool for determining the ages of recent geologic deposits, using this technique when dating archeological deposits is more difficult. Radiocarbon dates in these cases are commonly derived from organic artifacts (often charcoal or plant matter) which humans often move or rearrange in an archeological setting. Moreover, artifacts such as structural wood, utensils and charcoal may stem from old wood. Thus radiocarbon dating of these artifacts is not always reliable. This appears to be the case in archeological pits on Simushir, an active volcanic island in the central Kurils. To confirm or constrain the ages of these archeological strata, we will correlate layers of volcanic ash and cinders (tephra) from said archeological excavations with reference tephra deposits from nearby, non-archeological pits. To correlate these layers, we are analyzing characteristics including color, thickness, mineralogy, glass content and chemistry, size-distribution, relative stratigraphic position, and grain density and angularity. Samples of organic material such as peat taken from these reference pits are not likely to have been influenced by humans, and thus should yield more robust radiocarbon ages, which will better constrain the ages of the reference tephra layers. Having correlated tephra layers from the reference sites to the archeological sites, we can then more firmly date the archeological strata. In turn we will gain a better knowledge of how and when indigenous peoples lived and migrated among the Kuril Islands.

Expression of a Rapidly Evolving Seminal Fluid Protein

Eric Nguyen, Senior, Computer Science, Biology (Molecular, Cellular Developmental), Philosophy
Amgen Scholar
Mentor: Willie Swanson, Genome Sciences
Mentor: Joe Gasper, Genome Sciences

Lectins are a class of sugar-binding proteins often involved in interactions between cells. Some lectins are found in seminal fluid, including three in Drosophila. When expression of these three lectins is inhibited, male sperm is less effectively stored by their female mates. A recently-discovered seminal fluid protein in Drosophila, Sfp24F, has been shown to be rapidly evolving, and has sequence and structure similar to those of lectins. Given that Sfp24F is similar to lectins in many respects, it is possible that this rapid evolution is happening because of selective pressure to improve the efficiency of male sperm storage in female mates. The object of this project is to create purified Sfp24F protein for use in further experimentation. This process involves a number of steps, beginning with using PCR to isolate the Sfp24F gene sequence. We then cloned that sequence into a plasmid vector, and transformed that vector into E. coli cells. Restriction digest and gel extraction of the desired sequence fragment resulted purified DNA, which was ligated into an expression vector. The expression vector will be transfected into Drosophila S2 cells, which, once grown, will be selected for cells containing the Sfp24F protein. Once this is complete, the protein will be purified using a western blot and affinity column. Expression of the Sfp24F protein will enable experimentation on its protein-protein interactions, shedding light on its possible roles in sperm storage.

Regional Variation of IGF-1 and Microglial Cell Expression throughout the Brain of R/6 Mice: An Animal Model of Huntington's Disease

Vidang Nguyen, Senior, Biochemistry, Danish, Neurobiology
Mary Gates Scholar
Mentor: Thomas Moeller, Neurology
Mentor: Elsa Raibon, Neurology

Microglia, the resident immune cells of the central nervous system, are involved in the pathophysiology of many diseases, including Huntington's Disease (HD), a devastating neurodegenerative condition characterized

by progressive motor and cognitive impairments. Insulin Growth Factor 1 (IGF-1), which is fundamental to neuronal development and is mainly produced by glial cells in the brain, can slow disease progression in ALS. Moreover, our laboratory found reduced IGF-1 expression levels in HD and R6/2 mice brains, with a lower basal expression in microglial cells. The R6/2 mouse is an animal model for HD. This strain is trangenic for the 5' end of the human HD gene carrying the mutant exon 1 along with polyglutamic expansions. My project aims to study microglial cell activation and IGF-1 pattern of expression within the brain of transgenic R6/2 mice as the disease develops. Microglial cells and IGF-1 were visualized with immunohistochemistry on collected sections of multiple brains embedded in a single block. Studying samples from multiple timepoints, the development of the immune response can be followed and characterized. We found a clear pattern of activated microglia within the striatum of R6/2 mice. Interestingly, microglia-like-morphology-IGF-1 positive cells were mainly found in other brain areas. Additional studies are required in order to elucidate the role of IGF-1 in HD and to ascertain whether microglia are involved in the IGF-1 response. When HD develops, the regional neuronal cell death is concomitant to microglial activation in the striatum of HD patients. However, it still remains to be figured out if the increased activity of microglia is a cause or consequence of HD. The results of my project are important to understanding the effects of HD on the striatum and the consequences of the immune response at disease onset. The knowledge gained from studying this animal model could provide big step towards finding a way to slow down the motor and cognitive impairment of the disease and alleviate pain for HD patients.

Ribosomal Binding Site Measurements and Translation Rate Standardization

Alec Nielsen, Senior, Bioengineering, Electrical Engineering
Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Sean Sleight, Bioengineering

The ability to easily and reliably engineer biology is an exciting prospect that could benefit fields such as medicine, energy production, information processing, and bioremediation. Design and implementation of functionally dependable systems would be augmented by the standardization of fundamental components in synthetic biology; this would reduce variability and help eliminate unexpected behavior in engineered systems. Specifically, the translation rate of a protein, a vital parameter in biological systems, is regulated by the sequence of an associated ribosomal binding site (RBS). While this makes the RBS a useful means of control in biological systems, translation rate can also be affected by mRNA secondary structure interactions near the beginning of the protein-coding sequence. In an effort to reduce translational dependence on the protein-coding sequence, a possible method of standardizing translation is investigated. Specifically, insertion of a standardized nucleotide sequence at the beginning of the protein-coding sequence has the potential to homogenize the mRNA secondary structure across different RBS-protein combinations, resulting in complete dependence of translation rate on the RBS sequence. This standardized nucleotide sequence would be translated along with the regular protein coding sequence to create a protein with an amino acid 'tag'. N-terminus tags have been utilized as degradation markers, fusion protein linkages, and for affinity purification purposes. This research proposes extending the utility of N-terminal tags into the domain of translational regulation. Fluorescence measurements are presented for different reporter genes translated downstream from identical RBSs. These measurements are supplemented with computer simulation predictions for mRNA secondary structure stability.

Longitudinal Effects of Maternal Depression and Paternal Antisocial Personality Disorder on Children's Psychopathology

Megan O'Brien, Senior, Psychology
Mentor: Ted Beauchaine, Psychology

Considerable research indicates that most psychiatric disorders, including mood disorders, tend to run in families. We propose to examine the effects of maternal depression and paternal antisocial personality disorder (ASPD) on the expression of psychopathology among children. Participants include 212 families with a child diagnosed with depression, conduct problems, both conditions, or neither condition. Families participated over the course of three years and children ranged in age from 8-12 at the start of the study. We hypothesize that children of parents with high levels of maternal depression and paternal ASPD will exhibit escalating psychological impairment over the three years, over-and-above their baseline levels of psychopathology. Changes in maternal depression across three years—including the more severe melancholic subtype—will also be examined.

Thomson Scattering as a Diagnostic Tool for the ZaP Flow Z-pinch Experiment

Rachel Oberto, Senior, Aeronautics Astronautics, Physics
Mary Gates Scholar
Mentor: Uri Shumlak, Aeronautics Astronautics
Mentor: Raymond Golingo, Aeronautics Astronautics

The ZaP Flow Z-pinch Experiment is a study of the effects of sheared flow on a magnetically confined column of plasma and has applications to fusion energy and rocket propulsion. Two of the defining characteristics of

a plasma are its temperature and density. One of the few diagnostics capable of measuring these properties locally is Thomson scattering. Thomson scattering measures the temperature and density of the electrons in a plasma by firing a laser through it and analyzing the scattered light. On the ZaP experiment, a ruby laser is used to irradiate the plasma. The scattered light is then collected, resolved with a spectrometer, and measured by an array of photomultiplier tubes. Preliminary data has been collected and analyzed. The preliminary electron temperatures are calculated to be in the range of 50 – 100 eV, which is consistent with previous estimates from spectroscopy measurements of ion temperature and radial force balance. Further calibration is needed to improve the reliability of these results and to calculate the electron density.

Computational Fluid Dynamics Study of Flow Through a Water Tunnel

Kyle Odland, Senior, Aeronautics Astronautics
Mary Gates Scholar
Mentor: Dana Dabiri, Aeronautics Astronautics

The small water tunnel in the University of Washington Aeronautics & Astronautics Fluid Mechanics Lab has two main sections. In the contraction section, the fluid flow is contracted both horizontally and vertically, from its initial area at the inlet to a smaller cross-section at the exit. The flow exits the contraction section into the test section, where experiments can be performed to study turbulent flow. In order for the experiments to produce viable results, the flow entering the test section must be free of turbulence or any secondary flow. With the current geometry of the tunnel however, secondary flow has been observed in the corners of the contraction section of the tunnel. In order to minimize or eliminate the unwanted vortices from the contraction section, the geometry of the water tunnel must be redesigned. In order to do this, I am using the computational fluid dynamics package FLUENT to model the geometry of the tunnel and simulate the behavior of the flow. In order to ensure that the simulation will work, I first created a model of the existing tunnel. I ran the simulation of flow with a variety of flow parameters, and was able to reproduce the turbulence that was observed experimentally. I have begun to change the shape of the contraction section, in order to find a geometry that will minimize the turbulence that is generated, or remove the vortices all together. So far, I have been successful in reducing the size of the vortices, by moving the inflection point in the curve of the tunnel farther back in the contraction section and by eliminating the vertical element of contraction. At present, our studies are still continuing. More variations of the contraction curve need to be tested, and promising results will be verified by further testing.

Quantifying the Benefits of Infant Directed Speech

Marina Oganyan, Senior, Biology (Physiology), Linguistics
Mentor: Richard Wright, Linguistics
Mentor: Nairan Ramirez-Esparza, Institute for Learning Brain Sciences

Previous studies indicate that infant directed speech (IDS), especially its prosody, is important to child language acquisition. However, no studies yet have quantified the relationship between phonological development and amounts of IDS exposure. I hypothesize that the amount of exposure to and the degree of exaggeration of IDS will positively correlate with progression through the stages of phonological development. Similarly, I hypothesize that the exposure amount and degree of exaggeration will interact such that exaggeration has a multiplier effect on the benefit of exposure length. In this study, infants aged 14 months wore recorders for 8 hours a day for four consecutive days. A speech detection algorithm randomly sampled 30 second segments from each day. For each segment I participated in the orthographic transcription of parental utterances. I used the IPA to transcribe the infant utterances following internationally accepted protocols. Based on the transcriptions, child utterances will be categorized into CV, (C)VCV or (C)VC or (C)VV, stress-feet and phonological words (Demuth, 1996). Babbling will also be categorized as variegated versus non-variegated and by frequency of intervocalic consonants. I will perform an acoustic analysis of the parental signals to determine the frequency, duration, and degree of exaggeration in IDS. The acoustic indicators of exaggeration in parental IDS are syllable duration, pitch range, pause frequency, and pause duration. A statistical analysis will be used to determine the correlations between IDS (exposure, exaggeration) and the advancement through the stages in phonological development. I predict that the results will show a positive correlation between frequency of exposure to parental IDS, particularly exaggerated IDS, and the relative frequency of advanced infant productions.

Chemical Vapor Deposition of Cadmium Telluride

Dayne Olmstead, Senior, Materials Science Engineering
Mentor: Y. K. Rao, Materials Science Engineering

Solar power is the most widely available alternative energy source worldwide. To date, the most commonly available means of capturing solar energy is through photovoltaic panels, which convert incoming photons to electrical energy. Photovoltaic panels are dependent upon the operation of a semiconductor media that functions as a photodiode, generating a continuous stream of energized electrons as the substrate is bombarded with high energy photons. The most common semiconductor material used today is crystalline silicon, which is

costly both to refine and manufacture panels from. It is predicted that an adequate supply of affordable crystalline silicon will not exist to meet future growth in demand for Photovoltaic applications. Cadmium Telluride is an alternative material to crystalline silicon for PV panels, and affords a similar level of electronic performance at a fraction of the manufacturing cost. Since it is not widely used, the processing technique for generating thin films of cadmium telluride has not been widely researched. Recent attempts to grow CdTe from alkyl precursors have resulted in reports of defects originating from the deposition of carbon during the growth reaction. This study investigates the deposition of CdTe from a stream of gases in a controlled environment. These gases may include halides of cadmium and tellurium, as well as hydrogen. The thermodynamic properties involved include gas pressures and temperatures, as well as the volumetric feed rate for each gas. Determining an ideal case for the deposition of CdTe crystals is the first step in the development of a processing technique that can ultimately help lower the cost and increase the availability of defect-free CdTe as a semiconductor material. This will help to ensure the long term viability of photovoltaic devices as a solution to our global energy dependence.

The Use of Barcoding on Separation of Multiplexed DNA Samples in One Sequencing Run

Amy Olson, Senior, Biology (Physiology)
Mentor: Jay Shendure, Genome Sciences
Mentor: Emily Turner, Genome Sciences

Conducting research on diseases and phenotypes, as well as diagnosing them, involves sequencing the DNA of many patients. Lowering the cost of sequencing would therefore be a huge benefit in medical and research applications. Currently, the cost to sequence a patient's DNA is approximately 10,000 dollars, the price of a customized array chip. Barcoding is a procedure that would allow more than one person's DNA to be hybridized to the same array, thus greatly reducing the cost per person for resequencing. The basic idea behind this technique is that "tagging" each person's DNA allows it to be recognized after being mixed on an array with the DNA of other patients. During shotgun library manufacture, a small sequence of base pairs, or "barcode," is added to each segment of genetic material, with a different barcode used for each set of DNA. We explored a novel technique of barcoding that allows these sets of DNA to be separated from each other using PCR primers that are complementary to only one barcode. This resulted in the successful amplification of each library separately, which we were then able to sequence. Thus far, we have successfully multiplexed eight samples.

Toxicity of Mixtures of Carbaryl and Imidacloprid in Juvenile Rainbow Trout: Implications for the Control of Burrowing Shrimp in Willapa Bay, Washington

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Donna Krell, Senior, Landscape Architecture
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Nathaniel Olsen, Junior, Environmental Science Resource Management
Mentor: Christian Grue, Aquatic Fishery Science

Carbaryl has been used to control burrowing shrimp within oyster beds in Willapa Bay and Gray's Harbor, Washington for 6 decades. These shrimp destabilize sediments onto which young Pacific oysters are seeded. Imidacloprid is currently being tested as an alternative to carbaryl and its toxicity to non-target fishes appears to be less than that of carbaryl. However, efficacy trials suggest imidacloprid may not be effective in controlling shrimp in all situations, and that a combination of the two pesticides may be necessary. Data on the toxicity of mixtures of the two insecticides to non-target fishes, particularly salmonids are lacking. In an initial effort to determine the toxicity of mixtures of the two insecticides, we exposed juvenile trout (ca. 10 g) to 0, 0.1, 1.0, 10, 100, and 1,000 ppb carbaryl alone and with 5.6 ppm imidacloprid for 96 h and quantified behavior and mortality. The imidacloprid concentration represented the maximum predicted above treated oyster beds in 10 mm of water. In a second test, we exposed trout to 0, 66, 78, 92, 108, and 128 ppm imidacloprid alone and with 39.1 ppb carbaryl for 96 h. Imidacloprid concentrations were selected based on earlier tests that indicated overt effects would occur at concentrations above 66 ppm; the concentration of carbaryl was the maximum reported in waters above or adjacent to treated beds. All fish survived the carbaryl and carbaryl plus imidacloprid exposures and brain AChE inhibition was not altered by the presence of imidacloprid (5.6 ppm). Overt effects (lethargy, erratic swimmimg, and on-bottom gilling) increased with imidacloprid concentrations and brain AChE inhibition was 30-50% of that expected suggesting imidacloprid at the concentra-

tions tested reduced the uptake of carbaryl. Results suggest that mixtures of the two insecticides at concentrations expected in Willapa Bay will not potentiate toxicity in non-target fishes.

In Situ Biomineralization Using Bifunctional GEPI: Kinetics of Hydroxyapatite Formation via Surface Plasmon Resonance Spectroscopy

Jun Park, Junior, Bioengineering
Mary Gates Scholar
Mentor: Mehmet Sarikaya, Materials Science Engineering
Mentor: Brandon Wilson, Materials Science Engineering

In recent years, there has been an increase in interest in the understanding of mechanism of hydroxyapatite (Hap) deposition in both biological and synthetic environments due, in particular, to the potential application in orthopedic implants and regeneration of hard dental and bone tissues. Researchers have sought methods for synthesizing Hap with controlled structures using a variety of synthetic and biologically inspired approaches. Based on previous research in the use of genetically engineered peptides in Hap formation, here we use bifunctional peptide to mineralize a Hap film on a gold substrate. The experiments were carried by combining a gold-binding peptide (AuBP) and Hap-binding peptide (HaBP) sequences into a single construct. The biomineralization process was monitored by surface plasmon resonance (SPR) spectroscopy which detects the change in refractive index due to Hap formation on the surface. Biomineralization was controlled, in the presence of catalyzing HaBP in various concentrations and solution conditions. Scanning Electron microscopy (SEM) and Atomic Force Microscopy (AFM) techniques were used to examine the film morphology and to determine the film adhesion to the gold surface.

Are Inferred Flow Characteristics of the Whidbey Formation Analogous to those of the Modern Day Snohomish Delta?

Nathan Peters, Senior, Earth Space Sciences
Mentor: Katharine Huntington, Earth Space Sciences
Mentor: Jody Bourgeois, Earth Space Sciences

The Whidbey Formation on Whidbey Island, WA, comprises unlithified sediments including channel facies of silt, sand, and gravel, which suggest fluvial deposition in a tidally influenced deltaic environment. Although the age of the Whidbey Formation has been fairly well constrained to an interglacial period between 100,000 and 120,000 years ago, less work has been done to determine the flow characteristics affecting its deposition. It is easy to imagine that the Whidbey Formation deposits are analogous to the Snohomish delta, as both are interglacial, in close proximity, and have the same general flow direction. Through detailed analyses of the Whidbey Island deposits and sedimentary structures, it may be possible to infer the paleoslope and tidal influence on stream flow and compare them to present day conditions in the Snohomish delta. Beach cliffs along Double Bluff Beach provide excellent vertical exposures for measuring and sampling deposits of interest. Sediment samples were collected from these sites for analysis with a Camsizer to determine the distribution of grain size and shape. Expected settling and stream-flow velocities can be calculated from grain sizes, using basic sediment-transport and channel-hydraulics concepts. Comparing the sediment analyses with observations of sedimentary structures in the field should help to test the accuracy of results. Analyzing samples from the modern Snohomish delta, with a known channel slope, flow velocity, and tidal range, will act as a crosscheck of methods and reveal any similarities between the modern and paleo flow environments.

Analyzing Antibodies to GAD65, IA2, and Insulin in Diabetes Patients

Thanh-Hien Phan, Sophomore, Chemistry
Mentor: Christiane Hampe, Medicine

In 2007-2008, the University of Washington collected 120 blood samples from diabetic patients in the Seattle area. The purpose was to see if different forms of diabetes could be distinguished. Correctly identifying and classifying the different forms of diabetes is important to assure optimal patient care and counseling. Accurate diagnosis may help doctors find a link in past family diseases and provide better care for the patients. This investigation focuses on the different reactivity levels for type 1 diabetes (T1D) and type 2 diabetes (T2D) patients to three commonly produced antigens in the body: GAD65, IA2, and insulin. The autoantibodies to these antigens were detected using a method called the Radioligand Binding Assay (RBA). By using the RBA, we were able to distinguish between T1D and T2D based on their overall reactivity levels to the two autoantigens. T1D patients also show a higher reactivity to exogenous insulin, possibly caused by their underlying autoimmune response. Moreover, we identified two patients, who appear to have been misdiagnosed with T2D as they present autoantibodies to GAD65. We concluded that autoantibody testing is a powerful method to aid in the correct diagnosis of diabetes and recommend standard testing for autoantibodies in all diabetes patients.

Acculturation and the Educational Aspirations of the Children of Immigrants

Anthony Poon, Recent Graduate, Computer Engineering, Sociology
Mary Gates Scholar
Mentor: Charles Hirschman, Sociology

America has often been referred to as a melting pot, a nation comprised of people from diverse ethnic and cultural backgrounds whose differences are reduced over time, particularly across generations. Although the melting pot image has only modest empirical support, there was remarkable assimilation of the children and grandchildren of disadvantaged European immigrants who came to the United States in the early 20th Century. The descendants of these immigrants have adopted – and also changed – American culture as they gradually obtained economic success and become part of the mainstream middle-class. In recent decades, new sociological theories have risen to try to explain the much slower process of assimilation experienced by recent immigrants. A key issue is the relationship between cultural and socioeconomic assimilation. Classical Assimilation Theory argues that cultural assimilation, or acculturation, is generally a prerequisite for positive economic assimilation. The Immigrant Optimism Hypothesis suggests that immigrants usually have a stronger will to succeed than natives and that this advantage can be lost with too much cultural assimilation. Segmented Assimilation theorists take this argument further and argue that in the spatially-segregated nature of the American class structure, most immigrants have more contact with underclass than middle-class culture. Thus, acculturation can have a negative impact on socioeconomic assimilation, perhaps leading to joining the underclass. In my research, I draw upon these theories to examine the effects of acculturation on the higher educational aspirations and attainment of the children of immigrants relative to comparable youth of native born parents. Using data from the Beyond High School study, conducted by the University of Washington, Department of Sociology, I also examine the effects of peer and parent expectations on the development of college aspirations. The goal of this research is to gain is a clearer understanding of the role of community factors on immigrant assimilation.

Lunar Environment within the Terrestrial Magnetotail

Jennifer Porter, Senior, Physics, Mathematics
NASA Space Grant Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Erika Harnett, Earth Space Sciences
Mentor: Robert Winglee, Earth Space Sciences

The Moon's interactions with the terrestrial magnetotail are not negligible due to the fluctuations in the terrestrial magnetic field and plasma ion exposure. During its orbit, the Moon spends seven days in the Earth's magnetotail, where it interacts with the terrestrial magnetic field and the plasma structures within the tail. We seek to study the effects of the magnetotail on the Moon. Additionally, we are investigating the effects of solar storms on the Moon, including the ability of the magnetotail to potentially mitigate or enhance the effects of solar storms and the ability of solar energetic particles (SEP's) to approach the lunar surface during the Moon's travel through the tail. Our model employs three-dimensional, high-resolution, multi-fluid computer models to dynamically simulate the magnetospheric conditions in the Earth-Moon system during a given time period and its conditions. The resulting models are then compared to satellite data taken during recent periods of interest, such as storm conditions. Accurate, high-resolution models of the Earth-Moon system offer the potential to enhance scientific understanding of stages of lunar exposure to SEP's and magnetic activity, and to generate understanding of the deflection provided to particles near the Moon by the terrestrial magnetosphere. These models offer relevance to any future missions to the Moon, as well as satellites deployed to orbit the Earth, as they help predict radiation exposure to an object near Earth.

Estradiol Regulation of Caspase Activity during Ischemic Stroke

Preethi Raghu, Senior, Neurobiology
Mary Gates Scholar
Mentor: Phyllis Wise, Physiology Biophysics
Mentor: Candice Brown, Physiology Biophysics

Ischemic stroke results from deprivation of blood flow to the brain, creating a cerebral infarct consisting of a core area devoid of any live tissue and an ischemic penumbra that is less damaged. During ischemic injury 17β–estradiol (E2) decreases apoptotic cell death in the penumbra by suppressing the expression of pro-apoptotic genes in caspase-dependent and caspase-independent cell death pathways. Caspases 3, 8, and 9 are key enzymes that induce caspase-dependent apoptosis after ischemic injury. Caspases 8 and 9 participate in two separate pathways that are located upstream of caspase 3 and therefore serve as initiator caspases that regulate activity of caspase 3. While it is known that E2 regulates caspase 3 activity, whether and how E2 regulates caspases 8 and 9 is unclear. I hypothesize that E2 regulates this mechanism by downregulating either caspase 8 or 9 at transcriptional, translational, or post-translational levels. Middle cerebral artery occlusion was used as a model of stroke injury in wildtype mice that were ovariectomized and treated with an oil vehicle (OVX+Oil) or ovariectomized and E2-replaced (OVX+E2). Total RNA and protein were isolated from mouse brains collected 24 hours after ischemic injury. To determine whether E2 regulates caspase activity at the transcriptional level, differences in caspase gene expression between OVX+Oil and OVX+E2 treated mice will be quantified using quantitative reverse transcriptase PCR (qRT-PCR). In addition, we will assess whether E2 regulates caspase activity at the translational level using

Western blot analysis. Finally, to determine whether E2 regulates caspase activity at the post-translational level, we will conduct caspase activity assays. Taken together, these studies will deepen our understanding of the neuroprotective mechanisms employed by E2 during stroke injury and will help to elucidate potential therapeutic targets for women who experience ischemic stroke.

An Inventory of Ectomycorrhizal Fungi in the Elwha River Valley

Katri Rahkonen, Senior, Environmental Science, UW Tacoma
Mentor: Erica Cline, Interdisciplinary Arts Sciences, UW Tacoma

Construction of the Elwha Dam in 1913 and the Glines Canyon Dam in 1927 cut off over 70 miles of salmon spawning habitat on the Elwha River in northwestern Washington State. The two dams are currently scheduled for demolition in 2012, which represents a large and unique ecological experiment on the effect of dam removal on the diverse array of organisms currently present in the Elwha valley. The objective of this study was to survey and inventory ectomycorrhizal fungi within the Elwha River Valley prior to dam removal, as part of a larger study of biodiversity within the valley. Sampling was conducted in the spring of 2008 at three locations; at each location nine soil cores were collected from four species of conifer adjacent to the Elwha River. These samples yielded a total of 900 root tips which were sorted by morphotype and location. Genomic DNA was extracted from a subsample of 101 root tips for DNA sequence analysis. From this we are preparing a preliminary ectomycorrhizal fungal species list of the Elwha River Valley. Further and more extensive survey and inventory is strongly needed prior to the removal of the Elwha Hydroelectric Dam and the Glines Canyon Hydroelectric Dam in 2012 to take advantage of this momentous opportunity which exists to evaluate the environmental effects of a unique ecological experiment.

Predicting the Best Sites for Future Geoneutrino Detectors

Natalie Ramien, Senior, Astronomy, Physics
Mentor: Nikolai Tolich, Physics

The radioactive decay of uranium (U) and thorium (Th) inside the Earth is believed to be the main source of energy for mantle convection, which causes earthquakes and volcanoes, among other things. As well as heat, the decay of U and Th produces geoneutrinos, which can be used to measure the U and Th throughout the Earth in an effort to check the accuracy of models of the Earth's composition. Because the crust is not uniform in size, the contribution to the geoneutrino flux from U and Th in the mantle and the crust depends on detector location. Therefore, if only a single measurement is made, we are not able to determine what fraction of the observed geoneutrinos come from the crust verses the mantle. However, by measuring the geoneutrino flux at multiple locations, we may be able to determine the distribution of U and Th content in the Earth's crust and mantle. We currently have a measurement from one detector, and by comparing it to the predicted values from various other detectors, we will be able to predict the best sites to locate future geoneutrino detectors and determine the optimal number of detectors to build.

Foraminiferal Biofacies Map: A Tool for Monitoring the Health of the Puget Sound

Paul Richardson, Senior, Earth Space Sciences (Biology)
Mary Gates Scholar
Mentor: Elizabeth Nesbitt, Earth Space Sciences

Species and numerical density and diversity of foraminifera from Puget Sound are being analyzed to determine their utility as biological markers for assessing the Sound's ecological health. A critical step in determining the usefulness of foraminifera as biomarkers is creating a biofacies map of dominant foraminiferal species. Sediment samples have been collected over the length of the Sound for the last 10 years by the Puget Sound Ambient Monitoring Program from the Washington State Department of Ecology. Our initial results indicate a considerable flux in species abundance and diversity between different sites in the Sound on both a temporal and geographical basis. Low species abundance and diversity is common in the South Puget Sound while high abundance is common at sites in Bellingham Bay in the North Puget Sound. Statistical analysis of chemical data from the Puget Sound exhibits a correlation between pollutants and the presence of certain foraminiferal species, but no method has currently been employed to quantify the differences in foraminiferal species abundance and diversity between different spatial regions of the Puget Sound. By utilizing ArcGIS software (by ESRI), it is possible to create extensive maps of the Puget Sound that monitor variations in species data over time and highlight the most abundant species at each station site. A biofacies map of the entire Puget Sound is a critical step in quantifying the relationship between known foraminifera, chemical, and geological data, which will help characterize the regional ecological health.

Changes in Arctic Sea Ice and the Impacts on the Marine Planktonic Ecosystem- Modeling of Past, Present and Future Conditions

Kira Rombeau, Senior, Oceanography
Mentor: Jinlun Zhang, Applied Physics Laboratory

Arctic climate and the condition of Arctic sea ice have undergone significant changes in recent decades. An in-

crease in surface atmospheric temperatures parallels a reduction in sea ice area and thickness, leading to an overall decline of sea ice. A diminishing sea ice cover leads to an increase in sea surface area exposed to solar radiation, increasing habitable conditions that promote phytoplankton growth. This trend is likely to have a significant impact on the marine planktonic ecosystem. Past observations and future projections aim to interpret the large-scale interactions between arctic sea ice, upper ocean, and marine planktonic ecosystems. Phytoplankton primary productivity is measured using chlorophyll a concentration data obtained by SeaWiFS, a satellite program operated by NASA. This data is synthesized and interpreted using a program called Interactive Data Language (IDL) to recognize large-scale changes in primary productivity. Preliminary model observations show an annual overall increase in productivity in concurrence with decreasing sea ice area from 1998 - 2007, with the greatest primary production concentrated along the continental shelf. In order to examine future impacts of a retreating ice cover on the structure and productivity of the marine ecosystem, a coupled pan-arctic Biology/Ice/Ocean Modeling and Assimilation System (BIOMAS) was constructed. BIOMAS synthesizes physical and biological observations through calibration with IDL models and data simulation. The use of IDL and BIOMAS are key to understanding the critical decline of Arctic sea ice and the future impacts on the productivity of the marine planktonic community.

Identifying Sites of Convergence of Stress and Drug Abuse in the Dynorphin Kappa Opioid System

Clarisse Roth, Senior, Neurobiology
Mary Gates Scholar
Mentor: Charles Chavkin, Pharmacology
Mentor: Julia Lemos, Neurobiology Behavior

Drug addiction is a chronic disease that affects millions of people worldwide, and effective treatments are still lacking. A principal problem is that currently available treatments for drug addiction are not able to prevent relapse. We know that the main cause of relapse is stress. The Chavkin lab focuses on identifying the neurological pathways and molecular mechanisms responsible for stress-induced relapse in order to develop new therapies. Both stress and drug use have been shown to activate the kappa-opioid receptor (KOR) through its endogenous neuropeptide, dynorphin. Using mice as a model organism our lab is identifying the molecular changes in the brain caused by stress and drug exposure. In previous experiments we have shown that an important molecular intermediate involved is KOR and its downstream signaling effector P38 MAP kinase (P38). Using immunohistochemistry and confocal microscopy to measure P38 activation in brain regions involved in stress and drug abuse: the dorsal raphe, nucleus accumbens, basolateral amygdala, and hippocampus, we are defining the time courses, localization and intensity of KOR and P38 activation. This data allows us to identify the regions of the brain involved in this stress-response. Currently, we are comparing the molecular effects of four behavioral assays all shown to induce relapse into drug abuse: 1) social defeat stress, 2) swim stress, 3) U50,488 (a synthetic agonist of KOR) injection, and 4) cocaine injection. We expect to find a specific brain region that is commonly activated in these assays. These results will guide future studies necessary to design a molecular therapeutic that can block relapse in drug-addicted mice.

Vowel Quality Assimilation in Russian-English Bilinguals: Using Acoustic Analysis to Quantify Language Interaction

Cameron Rule, Senior, Russian Language, Literature, Culture
Undergraduate Research Conference Travel Awardee
Mentor: Richard Wright, Linguistics

Much of our current knowledge about language's structure and evolution has developed from research investigating the phenomenon of bilingualism. Within the field of acoustic phonetics, the examination of bilingual speech has only recently become prominent as a viable and productive research topic. Recent studies have shown that bilingual speakers' inherent knowledge of their native language (L1) influences the pronunciation of sounds of their second language (L2), resulting in L2 sounds pronounced with an L1 accent. Further research has revealed that a bidirectional relationship more accurately represents language interaction. My study explores the bidirectional nature of bilingual language interaction by analyzing the acoustic structure of Russian-English bilingual speech. I predict that bilingual speakers' pronunciation will exhibit subtle yet reliable convergence of their two languages and that the direction of the encroachment will be modulated by external factors, such as the frequency of L2 use and age of L2 acquisition. The core of my study focuses on quantifying the interface between languages by comparing the acoustic features of bilinguals' pronunciation with that of monolingual speakers. LPC spectral analysis is used to determine the frequencies of the first (F1) and second (F2) vocal tract resonances. These frequencies, known as formants, provide useful information for determining vowel quality which is used for cross-speaker comparisons in order to establish overall vowel similarity. The results of this comparison are statistically compared with sociolinguistic data provided by participants in order to determine what external social and linguistic factors influence the degree and direction of acoustic convergence among Russian-English bilinguals. Initial results of my research suggest that increased L2 use may cause acoustic con-

vergence of bilingual speakers' L1 toward their L2. To date, very little comparable research has been conducted testing this hypothesis and a strong empirical data set is conspicuously absent.

Dietary Food Cues That Influence Aging In *Caenorhabditis elegans*

Jennifer Sager, Senior, Microbiology, Biochemistry
Mentor: Matt Kaeberlein, 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, and 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 in our lab, it has been found that BD increases both survival and stress resistance by a 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. Recent experiments conducted in our lab have focused on characterizing these soluble bacterial component and the mechanisms by which worms sense them. We have hypothesized that bacterial autoinducers, chemicals produced by bacterial cells to communicate with other bacterial cells, may be one such soluble dietary component. Preliminary data suggest that autoinducers may partially suppress the life span extension by bacterial deprivation and experiments are in progress to confirm this observation. We are also investigating the role of AWA and AWC neurons in the sensing of life-limiting bacterial cues. Here we report that volatile odorants sensed by these neurons can influence life span.

Homeless in Seattle

Sandra Scanlan, Sophomore, Psychology, North Seattle Community College
Angela Rickerson, Sophomore, Psychology, North Seattle Community College
Sir William Cunningham III, Sophomore, Psychology, Sociology, North Seattle Community College
Mentor: Melissa Grinley, Psychology, North Seattle Community College

Homelessness is often caused by circumstances beyond people's control such as addiction, mental disorders, or lack of resources (Gore, 1990). This study explores how participants make attributions about the cause of homelessness when anonymous. Previous research shows that people under social pressure respond differently than if anonymous (Lautenschlager, Flaherty, 1990). Using a survey, the participants were randomly assigned into two separate conditions. In the first condition, the participants received the survey, put their name on it, were watched completing it, and then handed it back to the researchers. In the second condition, participants read instructions in an empty room, anonymously took the survey, and turned it into a box. The study is expected to show that participants place more blame on the homeless person (internal attribution) rather than on their circumstances (external attribution) when anonymous. The findings will give a more complete understanding of the nature of social desirability's impact on participant's responses.

Measuring Patient-Centered Communication Skills among Pediatric Residents

Stephen Sanoja, Senior, Psychology, Biology (Physiology)
Mentor: Elizabeth McCauley, Psychiatry Behavioral Sciences
Mentor: Paula Lozano, Pediatrics
Mentor: Bryan Hartzler, Alcohol Drug Abuse Institute

Behavior change counseling is an important part of pediatric practice. Adaptations of Motivational Interviewing (MI) have been used to help promote health behavior change in medical settings. There is a growing understanding of the need to assess provider skill. Although researchers are able to measure MI skill in the context of research studies, there is a need for practical and accurate tools for assessing provider MI skill in clinical settings. The current study is an evaluation of a proposed paper-and-pencil instrument in comparison to the more resource-intensive Motivational Interviewing Treatment Integrity (MITI; Moyers et. al., 2004) scale. The new HRQ-for Pediatrics (HRQ-P) is an adaptation of Helpful Responses Questionnaire (HRQ; Miller, 1991). In the proposed study, the HRQ-P was piloted as means of evaluating changes in the MI skills of pediatric residents over time. The study also employed the previously validated MITI applied to Objective Standardized Clinical Evaluations (OSCEs) in which standardized patients (SPs) portray parents of children with asthma in three clinical scenarios with Pediatric Residents. This pilot evaluation of the HRQ-P includes determining its scoring reliability, evaluating its internal consistency, examining its concurrent validity with conceptually similar MITI constructs and specifying its responsivity to the effects of a brief resident training program. Its relative utility and cost effectiveness was also explored. If shown to be sufficiently correlated with the MITI, the HRQ-P may be useful for assessing MI skill in pediatric settings.

Brain Physics: Power Laws in Brain Waves as Insight to Brain Function

Conor Sayres, Senior, Physics, Astronomy
Mary Gates Scholar
Mentor: Larry Sorensen, Physics

My research is an investigation of possible power law scaling within electrocorticography (ECoG) signals from the brain, and more specifically how this power law may scale with cortical surface area. So what does this mean? ECoG signals are achieved through an invasive procedure in which an array of electrodes is placed directly on the surface of the brain, and they detect electric potentials induced by firing neurons. The data we analyze comes from consenting subjects who have undergone the procedure for epilepsy treatment. The low frequency bands (1Hz–70Hz) of brain signals have been extensively studied in the past due to the dramatic and variable peaks in the region and ease of resolving lower frequency information. Previously the high frequency bands (70Hz-200Hz) seemed less exciting: no major peaks, relatively low intensity, and hard to measure. Now, however, research within our group and throughout the field is discovering that the high frequency bands adhere to a broadband power law, and that these previously known low frequency peaks may be masking the answer to how the brain truly works. Many physical systems exhibit power law behavior, and this research hopes to make steps towards understanding brain function. Recent literature exhibits dissenting measurements on the exponent of this power law between different electrode sizes used. Since different sized electrodes sample different amounts of neurons, it would be interesting to investigate how the power law scales with neuron sample size. The answer could provide insight to how local neuron activity translates into global brain computation.

Calorimetric Measurements of Adsorption Energies of Well-Defined Species on Single Crystal Surfaces

Carolyn Schoenbaum, Senior, Chemistry, Physics
Mary Gates Scholar
Mentor: Charles Campbell, Chemistry
Mentor: Matthew Crowe, Chemistry

The production of most industrially important fuels and chemicals involves solid catalysts. Catalytic converters are used in cars to reduce the toxicity of emissions from engines, and some of the most promising technologies for alternative energy production involve catalysts. These materials work by providing an alternative mechanism that lowers the activation energy that must be overcome in order for a reaction to occur. The Campbell Group pursues experimental research regarding the surface reactions that happen on catalysts, and the metal-oxide interfaces which are common in industrial catalytic materials. By better understanding the mechanisms taking place at these surfaces, we can help improve their efficiency and applications for future opportunities in energy and environmental technologies. The group uses a novel microcalorimeter to measure the heats of adsorption of a variety of well-defined species on solid surfaces whose adsorption energies cannot be measured using other techniques. We have the only apparatus in the world that can be used to study these heats for reactions that are known to occur only at low temperatures, or between metals and solids. Our current project is aimed at determining the heat of formation of adsorbed hydroxyl species (OH), which is considered an essential reaction intermediate in many important catalytic reactions.

Spinal Cord Injury and Remyelination with Neuregulin

Phillip Setran, Senior, Neurobiology
Mary Gates Scholar
Mentor: Philip Horner, Neurological Surgery
Mentor: Jurate Lasiene, Psychology
Mentor: Berit Jacobson, Neurological Surgery

Traumatic spinal cord injury (SCI) has devastating effects on an individual's motor and sensory function. One main consequence of SCI is axonal loss. Axons are the information pathways of the nervous system; many axons together constitute a nerve, so loss of axons equates to loss of motor or sensory function. Currently, there is no known way to restore dead or severely damaged axons. However, axons that survive SCI often lose part of their protective, conductive, and nutritional coat called myelin, interrupting conduction and leading to axonal degeneration. Natural processes can help restore some of the lost myelin, but new myelin is not normal and is slow to appear. Enhancing the speed and quality of remyelination after injury could help prevent loss of function in SCI. Thus, we have elected to investigate which substances might promote proper remyelination. A likely participant in remyelination is the Neuregulin-1 (NRG1) family of compounds, which are growth factors found throughout the central nervous system (CNS). In this study, we examined the effects of treating animals with two compounds of the NRG1 family, NRG1 Type I and Type III, after SCI. We did not observe any significant locomotor changes among treatment groups and untreated controls, but did observe several differences in cellular dynamics among groups. Using immunohistochemical staining, we counted the number of proliferating cells and found a significant increase after treatment with NRG1 Type III compared to controls. Next, we phenotyped these dividing cells and found an increase in the total number of new myelinating cells with Type III treatment. Finally, using electron microscopy, we found that myelin thickness was significantly increased compared to controls after treatment with NRG1 Type III. This study is the first to demonstrate modulation of myelin dynamics by NRG1 following injury in the adult central

nervous system.

Attention and Emotional Responses to Social and Non-Social Stimuli in Infants at High Risk for Autistic Spectrum Disorders.
Jacob Shapley, Senior, Psychology
Mentor: Michael Murias, Psychiatry

Abnormal patterns of attention, difficulty regulating emotions, and difficulty with social interaction are hallmark characteristics of autism-spectrum disorders (ASD) in young children. Several accounts predict that the roots of these difficulties begin in infancy, with decreased interest in the social environment (e.g. Dawson, 2008). One way to evaluate this hypothesis is with prospective studies of infants with siblings with ASD, who are at increased risk of developing ASD themselves ('at-risk infants'). This study examines attention and emotion regulation in at-risk infants, and a comparison group of infants without familial ASD risk, during a visual attention task with social and non-social stimuli. We hypothesized that the at-risk group will pay less attention and show less positive emotional responses to the social stimuli. We also predicted that attention and emotional responses to the non-social stimuli will be similar in the at-risk and control groups. Participants were 28 infants tested at 6-months of age, 16 in the at-risk group and 12 in the comparison group. All infants viewed two 1 minute videos, one social (women speaking nursery rhymes) and the other non-social (toys moving). Emotional affect was coded offline using a Likert scale of emotions for each 33ms frame of the videorecording. Attention in response to social and non-social stimuli was coded offline for each frame as focused attention (looking at stimuli with movement suppression), casual attention (looking at stimuli without movement suppression), or no attention (not looking at the stimuli). Data analysis for this project is currently ongoing. We will analyze affect (rating of positivity) and attention (seconds spent in focused or casual attention) in a two group (at-risk versus comparison) by two condition (social versus non-social) design.

Comparison of Generic and Standard Aided Audibility Index on Consonant Recognition
Sarah Shepherd, Senior, Speech Hearing Sciences (Communication Disorders)
Mentor: Pamela Souza, Speech Hearing Sciences
Mentor: Marc Brennan, Speech Hearing Sciences

Hearing loss affects approximately 37 million individuals in the United States, for which hearing aids are a common remedy. The primary purpose of hearing aids is to ease communication by making speech audible to the listener. The Aided Audibility Index (AAI) is a measure that determines the amount of auditory stimuli audible to an individual listening with hearing aids. The measure provides audiologists and researchers with a tool to see the effects of different hearing aid parameters on audibility. In the clinic, shaped broadband noise rather than speech is often used to calculate the AAI. However, it is not clear how well the AAI based on broadband noise predicts actual performance. This study compared AAIs generated from broadband noise and consonant-vowel syllables. Thirteen subjects with mild-to-moderate sensorineural hearing loss were tested. Eight consonant-vowel syllables were presented at 50, 60 and 71 dB sound pressure level, representing soft, normal and loud speech volumes. Sound pressure level (SPL) is a logarithmic measure of sound pressure relative to a reference value and is commonly stated simply as dB. Probe-tube measurements at the tympanic membrane were taken for both broadband noise and the consonant-vowel syllables and used to calculate the AAI. Preliminary results suggest little statistical difference in the predictive abilities of AAI generated from broadband speech noise and consonant-vowel syllables. Small differences in the AAI between the two sources were discovered and the significance of these differences will be discussed.

Prey Species Selectivity of Wolves (*Canis lupus*) in Northern Alberta
Carolyn Shores, Senior, Biology (Environmental Conservation)
Mentor: Samuel Wasser, Biology
Mentor: Andreas Chavez, Biology

The Tar Sands of Northeastern Alberta are the site of rich oil reserves and make Canada the single largest supplier of foreign oil to the United States. However, the oil is very difficult and costly to extract, and may have a negative impact on resident wildlife. A species of special concern in the Tar Sands region is the Woodland Caribou (*Rangifer tarandus*), which is listed as a threatened species in Canada, and whose numbers have been decreasing in the last century. The recent concern over the status of Woodland Caribou has caused speculation that wolf (*Canis lupus*) predation may be contributing to their decline. Caribou populations may also be threatened by other factors, such as oil extraction, mining, forestry and agricultural expansion. To assess the importance of caribou in the wolves' diet, I will be performing a food habit analysis from wolf scat. Scat is currently being collected during this winter season of 2008-2009. I will identify the various prey present in the scat by examining the cuticular scale patterns of hair collected from the feces. Other prey species which are potentially important in the wolves' diet are moose (*Alces alces*), white-tailed deer (*Odocoileus virginianus*) and beaver (*Castor canadensis*). The findings of this study will be useful for the management of wolves in Alberta, as well as in other areas of North America where wolf and caribou coexist.

The Effects of Shade Tree Eensity on Stomata Densities of *Coffea arabic*a var. *catuai* Coffee Plants in Tarrazu, Costa Rica

Rebecca Singer, Senior, Environmental Science, UW Tacoma
Mentor: Erica Cline, Interdisciplinary Arts Sciences, UW Tacoma

Global coffee sales exceed $60 billion per year, providing an important cash crop for many tropical countries. Coffee grows best in partial sunlight under shade trees that help to protect from excess sun. As part of a larger study of sustainable coffee production, we sampled ten coffee farms representing a range of shade tree densities within the Tarrazu region of Costa Rica in January 2009, measuring soil moisture content, root biomass, and stomata densities. Shade tree density is weakly positively correlated with soil moisture content and weakly negatively correlated with root biomass. Analysis of stomata densities is in progress. We anticipate that the coffee plants in farms with lower shade tree densities will have lower stomata densities as a response to moisture stress.

Modeling Directional Tuning in the Neurons of Macaque Monkeys

Cosmo Smith, Senior, Physics, Computer Science, English (Creative Writing)
NASA Space Grant Scholar
Mentor: Steve Perlmutter, Physiology Biophysics

Neurons are the basic components of the nervous system, which are responsible for translating our brain signals into physical movements. In the primate lab, we study the relationship between the activity of neurons and arm movement in macaque monkeys. Each neuron receives multiple inputs, both inhibitory and excitatory, through molecular diffusion of neurotransmitters from adjacent neurons across synapses (gaps between neurons). These signals generate action potentials, all-or-none changes in the neuron's membrane potential, which are propagated down the neuron's axon and allow it to pass the signal on to other neurons. By testing the firing rate of action potentials in a neuron as a monkey moves its arm in different directions, we can determine whether a specific neuron prefers, or is directionally tuned, towards a particular type of movement. I will be using MATLAB to mathematically model the directional tuning of a neuron before and after blocking the input of the inhibitory neurotransmitters, GABA (Gamma-aminobutyric acid) and glycine, by using the receptor antagonists bicuculline and strychnine. In this way, I can determine how inhibition affects directional tuning in the neuron and form both a more accurate model of the neuron and a better understanding of what produces directional tuning. By understanding the nervous system, we may eventually create technology to help paraplegics or others who have lost control of limb movement.

Ottoman Text Archive Project: Svoboda Diary

Cameron Sparr, Junior, Near Eastern Studies (Languages Civilization)
Rukia Fahim, Senior, Near Eastern Studies (Languages Civilization)
Emily Cimber, Senior, Near Eastern Studies (Languages Civilization), Comparative Religion
Mentor: Walter Andrews, Near Eastern Languages Civilization
Mentor: Stacy Waters, Near Eastern Languages Civilization

The Ottoman Text Archive Project aims to make texts from the Ottoman Empire more readily available to scholars, decision-makers, and the general public. The Ottoman Empire was one of the last great empires of modern times and its influence is still present in the Balkans, Central Asia, the Near East, and North Africa. Unlike the texts of the other familiar powers of early modern times—the Spanish empire, the British, the Hapsburgs, the French—many of the most significant Ottoman texts exist only in manuscript or in rare and defective editions. Imagine thinking that you would like to read one of Shakespeare's plays or Don Quixote and being told that you would need to travel to London or Madrid; then, after waiting 6 months for permission to use the library, you would find that you could only look at a handwritten version of the text for a limited time in a special reading room under the watchful eye of a librarian. This is the situation with many Ottoman texts. It is easy to imagine the obstacles this presents to those wishing to make these texts available to scholars and to a general public through translations or information about their contents and contexts. Our project is supporting Nowf Allawi, an Iraqi researcher living in Baghdad, in her creation of an annotated text and translation of a late nineteenth century travel diary written in Arabic by a native English speaker living in Baghdad. Because the present conditions in Iraq make it impossible for Ms. Allawi to do research, our team is using digital technologies to help her with the creation of a tagged digital Arabic script transcription of the diary, a translation edited and formatted for web and print publication, and research on the the notes and glossary.

Does Knowledge of Medical Diagnosis Affect Judgments of Voice Quality?

Alicia Sroka, Senior, Speech Hearing Sciences (Communication Disorders)
Mary Gates Scholar
Mentor: Tanya Eadie, Speech Hearing Sciences

Speech-language pathologists (S-LPs) frequently evaluate patients with voice disorders using auditory-perceptual judgments. These evaluations often are performed after they have received medical diagnoses from referring physicians. Medical diagnoses associ-

ated with disordered voice qualities include functional (i.e., healthy larynx), organic (e.g., polyps), or neurogenic (e.g., vocal fold paralysis) causes. Although there is no direct relationship between pathology and voice quality, it is unknown whether receiving the medical diagnoses before performing auditory-perceptual evaluations biases S-LPs who make judgments of voice severity. Further, it is unknown whether such information differentially affects clinicians with varied experience levels. Therefore, the objective of this study is to determine whether knowledge of medical diagnosis and listener experience affect auditory-perceptual judgments of voice quality. To complete this study, twenty-six speakers with varying types of voice disorders and 4 normal controls provided speech recordings. Twenty novice and 10 experienced clinician-listeners are currently participating in evaluating speech samples for roughness and breathiness using visual analog scales. In one condition, the samples are presented without diagnostic information; in the second condition, the voice samples are presented in conjunction with the medical diagnosis. Group means of roughness and breathiness judgments made by novice and experienced listeners will be calculated across conditions. It is hypothesized that there will be an interaction between experience level and knowledge of diagnostic information. Specifically, it is expected that knowledge of diagnosis will increase the severity of novice clinicians' judgments (i.e., an "expectancy" effect), but not experienced clinicians' judgments, of voice quality. Post hoc analyses will determine whether results relate to specific diagnoses or severities. The results of this study will reveal whether diagnostic information may be a source of bias that needs consideration before S-LPs with different experience levels evaluate voice disorders.

Scaling of the Ram Accelerator to 155-mm Bore

Isaac Statnekov, Senior, Aeronautics Astronautics
Mary Gates Scholar
Mentor: Carl Knowlen, Aeronautics Astronautics

The ram accelerator is a chemical based launching system which draws from the technology of a ramjet/scramjet engine to accelerate a projectile to hypervelocities. The applications of the ram accelerator are diverse ranging from military to commercial but one of the most lucrative applications would be to replace the first several stages of a launch vehicle that would send non-human payload, such as satellites, into orbit. Part of the research I have participated in up to date has focused on the scaling up of the University of Washington 38-mm-bore ram accelerator to meet the aero-ballistic requirements of the Office of Naval Research (ONR) for the purpose of sounding rocket application. Currently there are a number of ram accelerator facilities around the world with bore diameters ranging from 20 to 120-mm. The specifications of the new system would require that it have an bore diameter of 155 mm, a muzzle velocity of 2.5 km/s, and that it be capable of firing several times a day at variable inclinations. Further, the system must be readily transportable and must be practical to set up within 24 hours of arrival at a testing location. The most important technical challenges associated with scaling such as the acceleration losses expected in the new system and structural concerns are being addressed.

Feeding Preferences of *Strongylocentrotus Franciscanus* on Three Species of Fresh versus Aged Kelps

Tiffany Stephens, Senior, Aquatic Fishery Sciences
Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Megan Dethier, Biology

As generalist herbivores, urchins inhabit locations with both fresh and detrital kelp. Previous studies have focused on the advantages amongst varying fresh algal tissues or the benefits of consuming detrital algae, but none have addressed preferences of fresh versus aged (detrital) kelp or how different aging treatments affect an urchin's choice. Detrital kelp tends to have lower phenolic concentrations and higher nitrogen levels due to microbial colonization, and therefore may be a better food choice than fresh. This study aims to answer if urchins, specifically *Strongylocentrotus franciscanus*, prefer aged to fresh kelp; and if so, if preference for aged kelp increases with increasing detrital age. I conducted feeding trials in which *S. franciscanus* was offered both fresh and aged kelp from a single species and their choice was recorded. Detrital kelp was simulated with two aging treatments and administered in six feeding trials (three trials per treatment). I found that in kelp with no or little polyphenolic content (i.e. *Nereocystis luetkeana* and *Saccharina subsimplex*), urchins prefer aged samples; whereas, in kelp with higher concentrations of polyphenols (i.e. *Agarum fimbriatum*), fresh is preferred to aged samples. In addition, results with *N. luetkeana* and *S. subsimplex* demonstrate that preference for aged kelp increases with increasing age of kelp.

Harnessing the Regeneration Potential of the Mammalian Retina

Samuel Sudar, Senior, English, Neurobiology, Philosophy
Mary Gates Scholar
Mentor: Thomas Reh, Biological Structure
Mentor: Mike Karl, Biological Structure

Regeneration of the mouse retina to restore functionality after damage does not occur naturally. However, our lab has shown *in vivo* that regeneration can occur after damage if the retina is exposed to certain growth factors. A supporting cell type called Müller glia reenters the cell cycle and is responsible for the regeneration. We hy-

pothesize that this Müller glia proliferation will be more substantial if performed *in vitro*, and we are working to optimize the parameters of *in vitro* culture to maximize Müller glia proliferation. This entails damaging the retina in different ways, including with neurotoxins and bright light, and subsequently applying different growth factors to try and induce regeneration. We then use immunohistochemistry to assess to what extent the protocol was effective. Development of a successful paradigm would provide a high throughput screen for assessing the potential of additional factors to cause more robust regeneration. Ultimately this research could have implications in restoring vision and could lead to a method of treating several diseases that cause blindness, including glaucoma, the leading cause of blindness in humans.

Using Microvertebrates to Evaluate Faunal Diversity Leading Up to the Cretaceous-Tertiary Extinction

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Howard Hughes Scholar
Katherine Wayland, Junior, Earth Space Sciences (Biology)
Mary Tang, Senior, Biology (Molecular, Cellular Developmental)
Evan Yount, Junior, Microbiology
Jane Kirkland, Senior, Biology (Ecology Evolution)
James Maveety, Senior, Biology (General)
Cameron Pinkham, Senior, Psychology, Physics, Earth Space Sciences (Physics)
Jessica Warner, Senior, Biology (General)
Michele Wilson, Senior, Biology (Environmental Conservation)
Mentor: Gregory Wilson, Biology
Mentor: Jeremy Riedel, Biology

The Cretaceous-Tertiary (K-T) extinction that occurred 65 million years ago eliminated up to 70% of life on this planet, including the dinosaurs, the most dominant terrestrial vertebrates. By analyzing past extinctions, we can better understand the mass extinction currently underway. Fossil localities from the uppermost Cretaceous time period near the extinction boundary were examined. These localities are non-marine deposits from northeastern Montana and sample vertebrate faunas over the two million years leading up to the K-T boundary. The samples are part of the Hell Creek Formation, which is a 100-meter thick interval of sediments representing the two million years. The localities examined were, from oldest to youngest: "Tuma" (UWBM loc. C 1103), "Hartless" (UWBM loc. C 1153), and "From Mars" (UWBM loc. C 1151). We used these vertebrate faunas to document temporal changes in taxonomic composition, species richness, and relative abundances during this temporal interval and test hypotheses for the K-T extinction. The hypothesis that the K-T mass extinction was sudden and caused by an extraterrestrial impact would predict very little faunal change leading up to the boundary. The alternative hypothesis that the K-T mass extinction was more gradual and caused by cumulative effects of climate change, volcanism, and an extraterrestrial impact operating over longer time scales would predict marked faunal changes leading up to the K-T boundary. Our preliminary results show changes leading up to the K-T boundary but none that are considered dramatic. Thus, our analysis supports a more sudden rather than gradual extinction at the K-T boundary.

Photoconvertible Proteins as Tools for Examining Neurogenesis in Danio Rerio Dorsal Root Ganglia

Tanya Swarts, Senior, Biology (General)
Howard Hughes Scholar
Mentor: David Raible, Biological Structure
Mentor: Andrew Prendergast, Neurobiology and Behavior

The neural crest is a multipotent cell population which gives rise to multiple tissues, including the sensory neurons and glia in the dorsal root ganglia (DRG). DRG are situated in a spatially reiterated fashion and transmit the sensations of touch, temperature, pain and movement. Danio rerio is an ideal model organism to study neurogenesis in the DRG because of their transparent embryos and the wide array of available genetic tools for study. One recently available tool for genetically-encoded lineage labeling is the photoactivatable fluorescent protein (PAFP). PAFPs are fluorescent proteins able to be converted to a different color of fluorescence comparable in intensity to the original fluorescence upon excitation with a specific wavelength of light. By photobleaching a specific cell, we are able to observe the diffusion of the photoconverted cell and track its movement. To better examine cell proliferation and fate decisions in DRG we are using the upstream regulatory elements from three genes in PAFP reporter constructs: the early neural crest gene Sox10, the proneural gene Neurogenin1, and the late neural marker NeuroD. We are using these constructs to create stable transgenic fish lines. These lines allow us to label cells expressing these genes and observe how they proliferate and differentiate.

Analyzing the Robustness of Fractional Differentiator Model of Neuronal Adaptation

Faezeh Talebiliasi, Senior, Neurobiology, Physics
Mary Gates Scholar
Mentor: Michael Famulare, Physics
Mentor: Adrienne Fairhall, Physiology Biophysics

In many neurons, in response to sudden changes of a stimulus, the firing rate undergoes a rapid change which is then followed by a slow return to a steady firing rate. This is called rate adaptation. The state of adaptation of the neuronal firing rate is hypothesized to convey infor-

mation about the changes in the stimulus statistics. It has been unclear how the temporal pattern of adaptation is correlated with the changes in the stimulus parameters. Recently, Lundstrom et al proposed that the neuron's firing rate can be modeled as a fractional derivative of the slowly varying stimulus parameters. This model predicts that in response to a time-varying stimulus, a neuron's firing rate will have a frequency-independent phase lead that is proportional to the order of differentiation. Fractional differentiation, unlike integer differentiation, is a non-local operation and therefore predicts a dependence of firing rate on the history of stimulus over long timescales. Lundstrom et al also demonstrate that it is possible to build a spiking model to implement fractional differentiation by including properly-tuned slow currents. Through computer modeling in MATLAB, we test the robustness of this fractional differentiator model with respect to changes in timescales and maximal conductances of the slow currents.

Neural Regeneration and Dependency on Cell Specific Damage in the Mouse Retina

Kristine Tan, Senior, Biology (Molecular, Cellular Developmental)
Howard Hughes Scholar
Mentor: Thomas Reh, Biological Structure
Mentor: Mike Karl, Biological Structure

The retina is the innermost layer of the eye and consists of multiple neuronal layers that interact in a pathway to produce an image-forming signal that is then transported to the brain, via the optic nerve. When the pathway is disrupted, (i.e. a specific cell in the pathway is destroyed) the ability to see becomes disrupted as well. Glaucoma is caused by the loss of ganglion cells in the ganglion cell layer. Photoreceptor cell loss is the leading cause of blindness in the adult human. In this study, we investigate neural regeneration in the mice retina by using neurotoxicity to destroy amacrine and ganglion cells, and injecting a combination of growth factors into the eye to stimulate regeneration of damaged cells. We investigate the dependency of regeneration on cell specific damage, meaning that the destruction of a specific cell encourages regeneration of the same cell upon injection with growth factors. Results of this study could potentially serve as a viable treatment to restore vision in those who have lost it, due to a variety of causes.

The Industrial Assessment Center Motor Management Plan

Alfonsus Tanoto, Senior, Electrical Engineering
Anthony Simon, Senior, Electrical Engineering
Mentor: Alexander Mamishev, Electrical Engineering

The University of Washington Industrial Assessment Center (UW IAC) consists of undergraduate students from various engineering disciplines whose goal is to improve energy efficiency for manufacturers. The US Department of Energy (DOE) sponsors the UW IAC to visit industrial facilities, to observe any inefficient system that operates, and to conduct research to optimize the use of energy inefficient systems with the more efficient ones. The industrial facilities that implemented our recommendation have saved millions of dollars in utility cost, received significant amount of rebate from the utility company, and reduced emission level in their area. One of the most frequently used systems in an industrial facility is motor. When a motor brakes, the typical action that most facilities take is to rewind the motor or replace it with an identical one. Rewinding a motor can cost up to 80 percent of a new motor cost, which means that replacement is a wiser choice. Most industrial facilities use standard-efficiency motors with efficiency rates of around 80 percent. Many of them are unaware of the existence of NEMA (National Electrical Manufacturer Association) premium-efficiency motors, which efficiency rates range from 90 to 97 percent. Over a ten-year life of a NEMA motor, the energy savings are enough to purchase three replacements NEMA motors. Most utility companies provide rebates to facilities that replace their standard-efficiency motors with NEMA motors. For every standard-efficiency motor, there is an equivalent NEMA version to replace it. Our motor management plan provides detailed information about the existing standard-efficiency motors that a facility possesses and their identical NEMA replacements. Our motor management plan is beneficial for helping facilities to keep track of their motor inventory as well as introducing them to NEMA motors. Thus, motor management plan is beneficial for improving the energy efficiency and generating operational savings from less power consumption.

Pedunculopontine Tegmental Nucleus in Calculating Prediction Error of Reward

Cortney Taylor, Senior, Neurobiology, Psychology
Mary Gates Scholar
Mentor: Sheri Mizumori, Psychology

Midbrain dopamine (DA) neurons in the Ventral Tegmental Area (VTA) and the Substantia Nigra Pars Compacta (SNc) have been studied extensively as they pertain to learning. Specifically, they are hypothesized to play a role in computing reward prediction error signals. The DA system is studied so thoroughly because of its important general function and its major applications towards multiple human disorders, including Parkinson's disease, Schizophrenia, and drug addiction. Although much is known about the properties and functions of the midbrain dopamine neurons, the areas of the brain that supply this system the necessary information to perform the reward prediction error computation are much less understood. One such area that is beginning to be explored is the Pedunculopontine Tegmental Nucleus

(PPTg). This area, which is a small structure in the mesopontine tegmentum, is known to be a major source of glutamatergic and cholinergic inputs to DA neurons in both the VTA and SNc. Although the exact role of the PPTg is not yet clear, it is an area known to have important clinical applications. For example, electrical stimulation of the PPTg improves gait and posture in Parkinson's patients and that the rewarding effects of nicotine are transmitted through the PPTg. In this experiment data were collected from six rats that were trained to run an eight-arm radial maze where each arm was baited with a reward and salient visual cues were present. Electrodes were implanted into the PPTg area of the rat brains and extracellular recordings were made during the completion of this spatial memory task. Our general hypothesis is that the PPTg has a fundamental role in computing reward prediction error signals. Specifically we expect to find that PPTg neurons code information about the actual reward received, as well as expectations about future rewards.

Use of Local Media in the Israeli-Palestinian Conflict
Talya Ten Brink, Sophomore, Pre-Major (Arts Sciences)
Mentor: Stephen Sulzbacher, Psychiatry

News media greatly affects a society's perception of identities. In a conflict setting, media can either facilitate or hinder reconciliation between conflicting groups. Media is a major factor that affects the perception of the opposing group and also defines the role and responsibilities of each group. With two other students, I explored the effects of local news media in Israel and Palestine on the Israeli-Palestinian conflict. We focused on how the mainstream Israeli and Palestinian online news media helped or hindered resolution of the conflict. We investigated the uses and limitations of media in conflict resolution and analyzed the online versions of the two most popular Hebrew Israeli and Arabic Palestinian newspapers, Yedioth Ahronoth and Ma'an News Agency, as well as some other news sources. We analyzed the content of articles, comparing descriptive terminology use to describe the same "objective" events or facts. We determined how each source portrayed the Palestinian and Israeli roles in the conflict and compared the portrayal of three solutions to the Israeli-Palestinian conflict in the two news sources. Our preliminary work suggests that Israeli media reinforced stereotypes about Arabs, promoted paranoia, supported settlers despite their illegal activities and focused on the victimization of the Israelis. Media in Palestine did not provide context for Israeli military actions and focused on the victimization of the Palestinians. Based on our research, we recommend that the local media in Israel and Palestine exert more effort than they currently exert to promote dialogue between Israelis and Palestinians, perhaps through a feature series about the experiences of both Israelis and Palestinians could promote dialogue. Ultimately, the local media in Israel and Palestine can aid a resolution of the conflict by helping Israelis and Palestinians overcome their own bias and understand each others' suffering.

Maintaining and Expanding WALTA Data Upload Software
Robert Thompson, Senior, Physics, Computer Science
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: R. J. Wilkes, Physics
Mentor: Hans-Gerd Berns, Physics

Washington Large Area Time Coincidence Array (WALTA) is an attempt to involve local high school physics classes in cutting-edge physics research. Each class sets up cosmic ray air shower detectors with materials provided by UW and submits the data for review at a later time. The goal is to recreate a large-scale air shower detector with the large area the schools are spaced in. The shower data is uploaded to a server at UW and analyzed to ensure the data is valid. The submitters are given back a rough analysis including a direction of origin of the air showers. This project's goal is to streamline the data uploading software and includes: eliminating any bugs in the existing software, documenting the software for both users and future developers, and returning a more detailed report after data is uploaded. It is hoped that these changes will encourage teachers to use the system in classrooms and thus better prepare future physics students while providing the WALTA project with valuable data.

Role of High Frequency EEG Oscillations in Children with Autism Spectrum Disorder
Jasleen Tiwana, Senior, Neurobiology
Mentor: Michael Murias, Psychiatry

Autism spectrum disorder (ASD) is characterized by impairments in communication skills, social interaction, and presence of stereotyped repetitive behaviors. An influential theory regarding the mechanism of ASD hypothesizes that symptoms of autism arise from an increase in excitation (or alternatively a decrease in inhibition) in cortical and subcortical neural systems (Rubenstein and Merzenich, 2003). This is consistent with high rates of seizure activity found in individuals with autism. To investigate this hypothesis, we examined spontaneous gamma range (30-80Hz) electroencephalographic (EEG) oscillations in 6 and 7 year olds. Previous work in our lab found increased resting state beta amplitude in adults, and increased gamma amplitude has been shown in children with autism during a state of visual attention (Orekhova et al., 2007). We tested high functioning children with autism using dense array EEG, which provides superior spatial resolution than previous research. While spontaneous gamma EEG activity has not been

extensively examined in humans, evoked and induced gamma activity is thought to represent the synchronization of neural networks during sensory, motor, and higher level cognitive tasks. Increased spontaneous gamma activity could alter evoked or induced gamma activity during cognitive tasks, contributing to cognitive deficits observed in autism.

Probing Diastereoselectivity of Cyclizations of Chiral Amino Alkenes

Katarina Tu, Senior, Biochemistry, Chemistry
Mentor: Forrest Michael, Chemistry
Mentor: Carolyn Rosewall, Chemistry

Controlling diastereoselectivity and enantioselectivity of chemical transformations are important in organic synthesis because stereochemistry can determine the biological activity of a compound. In our study we used palladium catalysts with or without an oxidant to cyclize chiral amino alkenes and investigated the diastereoselectivity of the reaction. These reactions include hydroamination, which is the addition of hydrogen and nitrogen across the alkene, or oxidative additions such as diamination which functionalize both carbons of the alkene. To synthesize the chiral amino alkene substrates we used (*R*)-(+)-2-methyl-2-propanesulfinamide as a chiral auxillary which directs attack of nucleophiles to favor formation of the *R* stereocenter. We replaced the sulfinyl group with a carbamate protecting group and then subjected these to cyclization reactions that result in the formation of two stereocenters on the heterocycle, one of which is directed by the other we set in the synthesis of the substrate. We determined the diastereoselectivity via spectroscopic methods such as proton nuclear magnetic resonance spectroscopy (^{1}H NMR) and chiral high performance liquid chromatography (HPLC). The results of these experiments will potentially lead us to useful organic synthesis preparations of molecules with multiple stereocenters in high enantiomeric excess.

Flare Rates on Dwarfs: Observing Program

Nicholas Ule, Recent Graduate, Physics, Astronomy
Undergraduate Research Conference Travel Awardee
Mentor: Suzanne Hawley, Astronomy
Mentor: Eric Hilton, Astronomy

M dwarfs are stars with masses much less than our Sun and are the most numerous stars in the universe. Despite their great numbers there is still much to learn about them, particularly their activity rates. We present the observing program of a multi-year observing campaign to statistically determine M dwarf flare rates and energies as a function of spectral type and activity level. Our observations consist of over 100 hours of monitoring M dwarfs on four telescopes. We will continue our campaign for approximately 18 more months, at which time we can expect to have several hundred hours of monitoring. The telescopes are: the 30 inch student run telescope at Manastash Ridge (MRO), the New Mexico State (NMSU 1m) 1.0 m robotic telescope, the Apache Point Observatory (APO) ARC 3.5 meter telescope, and the ARC Small Aperture Telescope (ARCSAT) remote 0.5 meter telescope.

An Investigation of the Effects of Behavior Problems in Children with Autism Spectrum Disorder on Mothers' vs. Fathers' Stress Levels

Danielle Ung, Senior, Psychology
Mentor: Annette Estes, Psychiatry Behavioral Sciences

Studies have found behavior problems in children with Autism Spectrum Disorder (ASD) to be associated with increased stress in mothers. However, only a few studies have investigated the impact of behavior problems on fathers' stress levels. Therefore, this study aims to investigate the association between the severity of externalizing behavior problems in 6-year-old children with ASD and stress levels in their mothers and fathers. Participants include mothers and fathers of 6-year-olds with ASD from a larger longitudinal study called the Early Development Study (EDS). This study investigated the developmental course of children with ASD at ages 3, 6, and 9 years. The sample included seventy-five children with ASD and their parents. Participants were recruited through local parent advocacy groups, community agencies, clinics, hospitals and public schools (Estes, 2008). Mothers and fathers completed questionnaires that measured parental stress level and child behavior problems. The questionnaires that will be examined are (1) the Questionnaire on Resources and Stress, which measures stress associated with parenting in mothers and fathers, (2) the Child Behavior Checklist, which is used to assess behavioral problems in children, and (3) the Aberrant Behavior Checklist, which is used to assess behavioral problems in children with developmental disabilities. Based upon previous research, this study hypothesizes that 1) mothers will experience higher overall stress levels compared with fathers and 2) as the severity of behavior problems increases, mothers' stress levels will also increase, more so than fathers. If it is found that mothers' stress levels are higher than fathers' stress levels, future studies will be needed to specify why this is the case. Perhaps mothers may be taking on more child caretaking responsibilities or they identify more with their children, or they may simply report higher stress levels even if the caretaking responsibilities are equal between the mothers and fathers.

Intermittent Fluorescence Emissions of Individual Molecules

Maria Vanushkina, Senior, Chemistry, Biochemistry
Mentor: Bart Kahr, Chemistry

Single molecule (SM) spectroscopy is one of the truly transformative themes in 21st century chemistry. The ability to study phenomena on a SM level allows scientists to obtain information that otherwise would disappear in the ensemble average. Recent studies of absorption and emission of individual luminophores (LPs) have uncovered a curious phenomenon - "blinking". Blinking is the intermittent fluorescence emission visualized as periodic alternation between bright "on" states and dark "off" states. Currently, we do not have a clear understanding of why individual molecules turn "off". Using confocal microscopy, the labs of Bart Kahr and Phil Reid have begun to study fluorescence emission patterns of individual LPs confined in a crystal lattice (CL). Compared to disorganized media, the restrictive environments provided by CLs prolong the fluorescence lifetimes of individual molecules. Our initial work focused on organic SM LPs. Nano-sized semiconducting crystals termed quantum dots (QDs) exhibit patterns of emissive and dark periods very similar to SM LPs. Studies have shown that both QDs and SMs are very sensitive to interactions with their nano-environments, and it may be that these interactions are the key to understanding blinking. To start, we needed to gather QD data to compare to the data we have on SMs in potassium acid phthalate (KAP). We made solutions of QDs in 15 salts in an attempt to incorporate them in a CL. All the salt solutions made at 25C formed aggregates. At 5C, QDs made stable colloidal suspensions in KAP, urea, and glycine. The resulting KAP crystals have been examined spectroscopically. The presence of blinking indicates that we have successfully incorporated QDs into the KAP CL. Our next step is to make crystals with varying concentrations of QDs and examine their photophysical behavior under varying conditions.

Non-Invasive Determination of Intracranial Pressure by Means of Vibroacoustography

Pavan Vaswani, Senior, Neurobiology, Biochemistry, Computer Science
Goldwater Scholar, Mary Gates Scholar, NASA Space Grant Scholar, Washington Research Foundation Fellow
Mentor: Pierre Mourad, Neurological Surgery

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 tissue phantom and ex vivo tests.

The Effect of Concentrated Air Particulates (CAPs) in Exacerbating Cardiovascular Disease in Transgenic Mice

Alyssa Vivas, Junior, Environmental Health
Mentor: Dan Luchtel, Environmental Occupational Health Sciences
Mentor: Karen Jansen, Environmental Occupational Health Sciences

Exposure to particulate matter (PM) in ambient air has been associated with adverse cardiovascular health effects, such as heart failure, angina pectoris, cardiac arrhythmias, and myocardial infarction. The lungs are the entryway for PM into the body and once in the lungs, are thought to have several mechanisms of toxicity. Due to their extremely small size, ultrafine PM can enter the circulatory system and be transported to the heart and other organs. Another hypothesis is that when PM deposits in the lungs, inflammation occurs and inflammatory cell mediators become blood borne and target the cardiovascular system. The current project utilizes apolipoprotein E-null (apoE-/-) mice to evaluate the cardiovascular effects of exposure to concentrated air particulates (CAPS). It is a part of a five-city study on the effects of ambient air PM on acute and chronic mortality and morbidity in animals and humans. Mouse inhalation studies will be done in: New York, NY, Riverside, CA, East Lansing, MI, Research Triangle Park, NC, and Seattle, WA. In each location, transgenic mice will be exposed to either clean filtered air or CAPS for 6 months (5 days/week, 6 hours/day) via inhalation. An air particle concentrator is used to concentrate the particle number about ten times over the ambient concentration. The apoE-/- mice are a transgenic model for early onset of atherosclerosis. Transmitters are implanted in the mice and computerized telemetry is used to collect Electrocardiography (ECG) and heart rate variability data. After the Seattle exposures are completed, mice will be shipped back to New York University for ultrasound measurements and histopathology. As of February 2009,

data collection is in its second month and results are only beginning to be analyzed. The data that will be collected will include heart rate variability, ECG abnormalities, and progression of atherosclerosis.

You Be Fine: A Secondary Analysis of Asian Americans and Access to Mental Health

Jonathan Wagner, Senior, Sociology
McNair Scholar
Mentor: David Takeuchi, Sociology

Historically Asians and Asian Americans have been welcomed to the United States with disdain and seen as perpetual foreigners. In 1882, the Chinese were excluded from even coming or staying in the United States, and then by 1924 new immigration reform was created to ban all Asians from immigrating to the United States for employment. However since the Immigration and Nationality Act of 1965, Asian and Asian Americans account for the second largest growing population in the United States. Despite growing exponentially, there has been very little scholarship regarding Asian Americans and access to mental health. More specifically this is true for Americans of Southeast Asian descent. By incorporating a theoretical framework that involves racial identity theory and theories of assimilation into my research, I will attempt to find any correlation between assimilation, discrimination and its affect on ethnic identity. In order to accomplish this I have conducted a secondary analysis of the 2006 National Latino and Asian American Survey. Preliminary work suggests that stronger ties to ethnic identity will decrease receptiveness to mental health care to due to cultural beliefs and shame.

In-Situ Pb Isotopic Ratios in Minerals and Glasses of Large Explosive Volcanic Eruptions: A Probe for Magma-Crust Interactions

Lucy Walsh, Senior, Earth Space Sciences
Mentor: Olivier Bachmann, Earth Space Sciences
Mentor: Janina Klaus, Earth Space Sciences

Pb isotope ratios are one of the most sensitive measures of the interaction between magmas and their surrounding wall rocks. Enrichments in $^{2}06$Pb, ^{207}Pb and ^{208}Pb with respect to ^{204}Pb indicate that the parent magma, commonly derived mostly from the mantle (which has low ^{206}Pb, ^{207}Pb and ^{208}Pb over ^{204}Pb), has undergone crustal assimilation (incorporation of solids and fluids present in the Earth's crust with high ^{206}Pb, ^{207}Pb and ^{208}Pb over ^{204}Pb). This project aims to quanitfy the amount of crustal assimilation that occurred in some of the largest and most explosive silicic volcanic deposits of the active Aegean Arc (Greece). In contrast to common petrogenetic interpretations, preliminary data using other isotopic systems (Sr and Nd isotopic ratios) suggest the magma that erupted to form these extensive volcanic deposits has interacted very little with surrounding crust. We analyze Pb isotopic ratios in Pb-bearing minerals and glasses in-situ by using laser ablation techniques (providing the Pb isotope composition of a ˜50-100 microns spots). This data should lead to a refined view on how such large and explosive magma bodies form.

Hyper-Attentive Learning in Alternative Settings

Sarah Wang, Senior, Informatics
Mary Gates Scholar
Mentor: Jentery Sayers, English
Mentor: Mike Eisenberg, Information School

Recognizing that hyper-attention, or the ability to multitask between different sources of information, is becoming increasingly prominent in many aspects of modern life, I am exploring how it can be utilized, instead of discouraged, in a variety of learning environments. Ultimately, I aim to develop a model for collaborative learning that facilitates interactions and the exchange of information between instructors and learners. By treating the gallery space at the Jacob Lawrence Gallery at the University of Washington (UW) as an environment for alternative learning, I experimented with these ideas. Through my experimental installation, visitors were able to use mobile technologies, such as mobile phones, to leave their comments in a real-time, virtual guestbook, which was projected on a gallery wall. In the upcoming year, I plan on incorporating results from this study into my senior capstone project, where I further investigate the interactions between hyper-attention and alternative learning spaces located physically and virtually around the UW campus.

HCN Channel Expression in Epileptogenesis and the p38 MAPK-Mediated Modulation of HCN Channels by Anti-Epileptic Drugs

Lindsay Warner, Senior, Neurobiology
Mary Gates Scholar
Mentor: Nicholas Poolos, Neurology

Epilepsy is one of the most common neurological conditions: in the United States alone, three million people have been diagnosed with epilepsy. Though some types of epilepsy are hereditary, many epilepsies are acquired after neuronal injury, and cannot be effectively treated with existing anti-epileptic drugs (AEDs). We are investigating how hyperpolarization-activated cyclic nucleotide gated ion channel (HCN channel) expression contributes to epileptogenesis, and the mechanism through which Lamotrigine, a particularly effective AED, modulates HCN channel activity. My current work seeks to quantify the timescale of HCN channel loss during epileptogenesis, and will indicate whether post-translational mechanisms of HCN channel regulation contribute to the development of the epileptic state. Our preliminary findings suggest that HCN channel expression is significantly downregulated during epilep-

togenesis. Additionally, I have found that the in vivo modulation of a HCN channel-targeting kinase known as p38 mitogen-activated protein kinase (p38 MAPK) can impact the seizure frequency of epileptic animals. This work will eventually allow me to determine whether the antiepileptic action of Lamotrigine depends on p38 MAPK activity. Completing these projects will further elucidate the contribution that HCN channels make to the acquisition and maintenance of the epileptic phenotype, and may guide the development of more effective AEDs.

Using Genetic Methods to Increase Hydrogen Production in *Rhodopseudomonas palustris*

Palmer Weaver, Senior, Biology (Molecular, Cellular Developmental)
Howard Hughes Scholar
Mentor: James 'Jake' McKinlay, Microbiology
Mentor: Caroline Harwood, Microbiology

Addressing the global demands on diminishing carbon-based fuels and the welfare of the environment calls for new forms of energy that are both renewable and ecologically friendly. A promising solution to the fuel crisis is the utilization of hydrogen gas (H_2). H_2 can be obtained from numerous renewable resources, and upon combustion it forms water instead of carbon dioxide. The photosynthetic nitrogen-fixing bacterium, *Rhodopseudomonas palustris*, produces H_2 as an obligatory product of its nitrogenase reaction. Thus, in the process of fixing nitrogen gas to ammonia, *R. palustris* harnesses light energy to convert organic waste into H_2 and materials for cell growth. We are studying *R. palustris* metabolism behind H_2 production to see if the H_2 yield can be increased. Previous metabolic flux analysis performed in the lab revealed two metabolic pathways involved in CO_2 fixation that compete for electrons with the H_2-producing nitrogenase. We are testing aspects of our model by genetically eliminating enzymes thought to be involved in these CO_2 fixation processes. Mutants are created using standard molecular biology approaches, including the techniques of Polymerase Chain Reaction, plasmid purification, restriction enzyme digestion, and ligations. The effect of these mutations on H_2 yield (product made versus substrate consumed) will be assessed, employing methods of Gas Chromatography to measure H_2 accumulation and High Performance Liquid Chromatography to measure substrate consumption. By curtailing flux through the CO_2-fixing pathways, we hope to reroute more electrons into nitrogenase activity and observe increased hydrogen yields.

Excellence for All?: Politics and Practice of the Southeast Education Initiative at Rainier Beach High School

Maia Williams, Senior, Comparative History of Ideas
Mentor: Meredith Honig, Educational Leadership Policy Studies
Mentor: Claire Fraczek, Education

To explore the question of how to best implement educational initiatives, my research analyzes the implementation of the Seattle School District's Southeast Education Initiative (SEI) at Rainier Beach High School as a case study. The case study was designed using classroom observations, teacher interviews, and district and media publications related to Rainier Beach and the SEI, as well as historical district and media documents concerning previous district policies affecting Rainier Beach and educational equity. The results suggest that the success of the SEI has been hampered by political factors such as sudden personnel changes and budgeting, leading to inconsistencies in policy over time and a lack of needed resources to fulfill the objectives of the initiative. Teachers involved in initiative implementation were also excluded from the decision-making process in several instances. Future school reform initiatives should contain stronger provisions to lock in budgets and personnel, and should include those involved with implementation in the decision-making process.

Changes in Infected Immune Cells During Tuberculosis Pathogenesis and Granuloma Formation

Kathryn Winglee, Senior, Computer Science, Microbiology
Levinson Emerging Scholar, Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Lalita Ramakrishnan, Microbiology
Mentor: Muse Davis, Immunology Molecular Pathogenesis, Emory University

Tuberculosis (TB) is a bacterial disease that infects and kills millions of people each 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. The TB granuloma has been considered a key host protective structure but recent data from our laboratory suggest that it is actually a structure built and co-opted by the infecting bacteria to expand infection. This surprising discovery was made possible by the study of zebrafish embryos infected with *Mycobacterium marinum. Mycobacterium marinum* is a close relative of *Mycobacterium tuberculosis*, the causative agent of human TB. Zebrafish embryos are transparent, allowing real-time observation of the course of infection. To further exploit this model, I have developed a program that is capable of tracking fluorescent *M. marinum* and host immune cells. We find that in addition

to macrophages, host neutrophils also enter granulomas, move around rapidly and phagocytose dead infected cells to become infected themselves. My program has been used to analyze changes in morphology and motility of neutrophils in granulomas as a result of mycobacterial infection, showing that infected neutrophils are larger and rounder than uninfected neutrophils, but speed remains unchanged. In contrast, macrophages have been found to slow down upon infection. The distinct behavior of these two cell types participating in infection within the TB granuloma is likely to have functional consequences and we are exploring this area.

Improving Tracking Methods and Group Unity Through Phase-Coupled Oscillator Models

James Wong, Junior, Bioengineering
NASA Space Grant Scholar
Mentor: Kristi Morgansen, Aeronautics Astronautics

Phase-coupled oscillator models, types of algorithms that can be used to control robot movement, have been used to help robots like the RHex move around with synchronized legs. Lately, these models have been used to synchronize groups of robots. In our experiment, we are attempting to provide a more efficient way for robots to move in unison while using less communication. This will be helpful underwater, where water disturbances make it difficult for robots to communicate. For our experiment, we are using C++ to implement an alteration of a phase-coupled oscillator model into three robotic fish. Each fish has two pectoral fins for depth maneuverability and a tail for translational movement. We aim to program a phase-coupled oscillator model into our robotic fish to have them track a robot shark as a group without straying from one another. To test the algorithm, the fish are placed into an 8 foot by 20 foot by 8 foot pool with a single robotic shark that can be manipulated by a human controller. The three fish are then tasked with tracking the shark as a group. If our algorithm works, the three fish will be able to form an organized cluster and remain as an organized cluster as they track the shark. This has potential to be helpful in environments where robots can not receive signals from other robots. Ultimately, this algorithm will allow for robots to efficiently complete a collaborative task without controller input.

The Chick Chorioallantoic Membrane as an *In Vivo* Model for Measuring Inflammatory Response to Protein Coated Implants

Jennifer Wu, Junior, Biology (Physiology), Biochemistry
Mentor: Marisa Sylvester, Bioengineering
Mentor: Buddy Ratner, Bioengineering

Upon implantation, medical devices are subject to rapid protein adsorption, infiltration of inflammatory cells and finally fibrous encapsulation. In the case of implantable sensors, this encapsulation leads to reduction of sensitivity and often failure. In order to tailor this response toward healing rather than scar tissue formation, a number of bioactive surface coatings have been developed. The chick chorioallantoic membrane (CAM) of developing chicken embryos was utilized to evaluate encapsulation and the healing response of our surface coatings. Our research utilized a collagen affinity coating to present fibronectin, heparin, biglycan, decorin, and osteopontin on model surfaces. Samples for implantation were prepared by dipcoating 3 mm long 4-0 silk sutures in poly-2-hydroxyethyl methacrylate (pHEMA), covalently immobilizing type 1 collagen via 1,1' carbonyl diimidazole surface chemistry, and immersing in solutions containing potential healing molecules. One implant from each treatment was evaluated using electron spectroscopy for chemical analysis (ESCA) to ensure successful coating of surfaces. Fertilized chicken eggs were incubated at 37 C and 60% humidity in a Hovabator. At day 4 of gestation, a 1.5 cm^2 window was cut into the top surface of the shell. At day 7 of gestation the implants were placed on the CAM and allowed to incorporate into the membrane until explantation on day 14. The suture and surrounding tissue were fixed in 10% formalin, embedded in paraffin, and sectioned. Sections were stained with Masson's trichrome and the extent of collagen deposition at the implant sight was evaluated. Due to processing and sectioning challenges with the thin CAM membrane, the capsule thicknesses were qualitatively evaluated rather than directly measured. Qualitative observations provided very similar healing responses between the different coated surfaces. Continued analysis is required to determine if this method has the sensitivity required to detect differences in encapsulation of implants.

Investigating the Effects of Mitochondrial Dynamics in Neuronal Apoptosis

Cody Wyles, Senior, Neurobiology
Mary Gates Scholar
Mentor: Richard Morrison, Neurological Surgery

Mitochondria perform a variety of critical cellular functions, most notably serving as the primary energy-generating system within the cell. Mitochondrial dynamics, or the ability of mitochondria to regulate their morphology by fusion and fission, is a vital process by which mitochondria can communicate with each other and meet differential energy requirements throughout the cell. This is especially significant in neurons where regions of high ATP-requirement, such as synapses, can be located up to one meter away from the cell body. In healthy neurons, mitochondria exhibit a characteristically short, tubular morphology, facilitating their transport throughout the cell. Imbalance between the processes of fusion and fission can lead to cell death and neurodegenerative disease. We have investigated the relationship between mitochondrial dynamics and cell

death in neurons using primary mouse postnatal cortical neurons in conjunction with immunohistochemistry and western blotting techniques. Previous work in non-neuronal cells has demonstrated excessive mitochondrial fission preceding cell dysfunction and death. However, we have shown mitochondrial fusion is an early response to genotoxic stress that induces p-53-mediated apoptotic cell death. Further, preventing mitochondrial fusion or enhancing mitochondrial fission reduces apoptosis in these neurons. DNA damage-induced mitochondrial fusion occurs in association with a p53-mediated decrease in cellular levels of Dynamin-Related Protein 1 (Drp1), an enzyme responsible for mitochondrial fission. Drp1 is being shown to have complex interactions with two major antagonistic proteins, pro-apoptotic BAX and anti-apoptotic Bcl-xl, in the determination of mitochondrial integrity and consequently, cell viability. Together, this suggests that beyond its function as a fission protein, Drp1 may play a critical role in p53-dependent apoptotic pathways by directly interacting with apoptotic machinery. More complete exploration of these possibilities may render Drp1 a viable therapeutic target for the prevention of neuronal death associated with neurodegenerative disease.

The Relationship Quality Between Parents and their Children with Autism

Kai Yam, Senior, Psychology
Mentor: Annette Estes, Psychiatry Behavioral Sciences

Studies have shown that child temperament is largely neurologically based and heredity has a great influence on temperament (Buss & Plomin, 1984; Loehlin, Willerman, & Horn, 1985). Children with an autism spectrum disorder (ASD) may display difficult temperament that may affect parents' stress level as well as marital satisfaction (Kasari & Sigman, 1997). The purpose of this study will be to investigate how having a child with ASD affects both parents. In particular, this study will examine the following factors: parents' level of stress, marital satisfaction, and children's temperament. Participants will be 29 parents and their 6-month-old children (n=16 ASD; n=13 control). Each parent will be instructed to fill out 1) the Questionnaire on Resources and Stress to assess coping and adaptational responses to his/her child, 2) the Dyadic Adjustment Scale to assess marital satisfaction, and 3) the Infant Behavioral Questionnaire – Revised (IBQ-R) to assess the child's temperamental characteristics. It will be hypothesized that parents of children with ASD will experience a higher level of stress and lower marital satisfaction. It will also be expected that higher level of stress and lower marital satisfaction will be associated with difficult temperamental characteristics. If infant temperament is related to increased parent stress and decreased marital satisfaction, this will replicate previous studies. The result of this study may aid the development of family-based intervention. It is hoped that future family-based intervention will focus on helping parent with children with difficult temperaments and identifying ways to help alleviate parents' stress.

Developing an Objective Healthcare Assessment for Children in Community Based Rehabilitation in Developing Countries

Zachary Ward, Senior, Global Health Management, Seattle Pacific University
Mentor: Kevin Neuhouser, Sociology, Seattle Pacific University

Meaningful healthcare assessments that are easily administered and culturally appropriate are needed for use with children with disabilities in Community Based Rehabilitation (CBR) in developing countries. In response to this need the Standard Capability Assessment (SCA) was developed as a proxy health-related quality of life assessment. The objectives of this work are to examine the performance of the SCA as a CBR-appropriate instrument, and to test its main psychometric properties. The SCA is a 26-item, objective, clinician-based assessment comprised of three domains: physical, mental, and social. Its psychometric properties were analyzed using data obtained from a population of children with disabilities in Dar es Salaam, Tanzania (n = 54). Data was collected during the course of the regular home visits of Comprehensive Community Based Rehabilitation for Tanzania (CCBRT). The SCA was tested for criterion validity with the WHO-QOL BREF, a quality of life instrument developed by the World Health Organization. The SCA was highly correlated with WHO-QOL BREF scores ($r = 0.751$, $p = 0.000$, $n = 29$). The convergent validity of SCA with clinical measures was also very high ($r = 0.950$, $p = 0.000$). The SCA showed excellent reliability, with inter-observer and internal consistency reliability having a Cronbach's Alpha of 0.996 and 0.946, respectively. There were no significant differences between the scores by gender ($p = 0.363$) or by district location ($p = 0.700$). These results indicate that the SCA has excellent psychometric properties of reliability and performs very well in preliminary tests of validity. Overall, the objectivity, simplicity, and brevity of the SCA make it an appropriate instrument for CBR environments. More widespread adoption and further testing could establish it as an important assessment for children with disabilities in developing countries.

Gold Coated Multi-modal Fluorescent Imaging Probe for Cancer Biomarker Detection

Xiaohai Zhang, Senior, Bioengineering
Mentor: Xiaohu Gao, Bioengineering

Quantum dots (QDs) are inorganic fluorescent nanocrystals that have novel optical properties such as size-tunable emission and simultaneous excitation. These

properties render QDs excellent fluorophores for wavelength-and-intensity multiplexing. In recent years, studies have shown that QDs with different intensity levels and colors can be encoded into mesoporous microbeads at precisely controlled ratios to code up to one million nucleic acid or protein sequences. This spectral coding is opening new opportunities in gene expression studies, high-throughput screening, and medical diagnostics such as cancer biomarker detection. Due to the heterogeneity nature of cancer, the ability to detect multiple biomarkers is critical in order to obtain an accurate diagnosis. However, current detection techniques such as the enzyme-linked immunosorbent assay (ELISA) and protein microarrays lack the ability to detect biomarkers with both multiplicity and high sensitivity. In this study, we synthesized a novel multi-modal fluorescent imaging probe by depositing colloidal gold to form a shell around mesoporous silica beads doped with QDs. The outer layer of gold serves to provide an easily functionalized platform for bio-conjugation as well as increases bead stability in solution. This type of beads is expected to significantly increase detection sensitivity and stability of currently existing imaging probes.

Effects of Mutant PKCγ on Protein Aggregation, Protein Insolubility and Cell Death
Yunlin Zheng, Senior, Biology (General)
Mentor: Dong-Hui Chen, Neurology

Spinocerebellar Ataxia 14 (SCA14) is a neurodegenerative disease, characterized by a progressive loss of motor coordination and by Purkinje cell death in the cerebellum. The PRKCG gene encodes PKCγ, a protein kinase expressed primarily in the neurons. The role of PKCγ in cell function includes cell signaling, proliferation and differentiation. Mutations in PRKCG have been identified in SCA14 patients, with most mutations clustered in the protein's binding domain. The pathogenesis of mutant PKCγ in Purkinje cell degeneration is not known. However, other neurodegenerative diseases like Alzheimer's and Huntington's have reported protein aggregation, increased protein insolubility and cell apoptosis. The project I am involved in evaluates the effect of PKCγ mutations on cell function and toxicity by in vitro studies. Cells are transfected with GFP-tagged PKCγ constructs containing the disease-causing mutations. PKCγ-GFP proteins are expressed 24-hours post transfection, and cells are analyzed for protein aggregation, protein insolubility and apoptosis rate. Our preliminary data show mutant PKCγ form intracellular aggregates in transfected cells when viewed under fluorescence microscopy. Protein insolubility levels of mutant PKCγ are analyzed by Western Blots. Our preliminary data show that compared with wild type, insolubility is increased in some mutations, and the increase is correlated with aggregation rates. The protective role of mutant PKCγ in cell apoptosis is evaluated by adding the oxidase H_2O_2 to induce cellular stress and apoptosis in transfected cells. Cells are stained with an apoptosis marker and subjected to flow cytometry. Our preliminary data reveal cells with mutant PKCγ have higher apoptosis, indicating its reduced protection against cellular stress. These preliminary data are encouraging and may result in a better understanding of mutant PKCγ effects on cell function. We are currently studying additional mutations and will investigate subcellular changes, including the co-localization of aggregates and organelles in accordance to each mutation.

Brackish Water Pretreatment for Electrodialysis Reversal (EDR) and Reverse Osmosis (RO)
Peiran Zhou, Junior, Exchange - Arts Sciences
Mentor: Mark Benjamin, Civil Environmental Engineering
Mentor: Zhenxiao Cai, Civil Environmental Engineering

As greater demands are placed on our limited supply of clean fresh water, society is forced to look to lower-quality sources for drinking water, especially in arid and semi-arid areas. One such source is brackish water, from which salt must be removed to make the water drinkable. Currently available processes for doing this include membrane-based systems, such as electrodialysis reversal (EDR) and reverse osmosis (RO). However, for these processes to work reliably and economically, contaminants other than salts (e.g., particles and dissolved metals, such as iron, manganese, and aluminum) must be removed in so-called 'pre-treatment' steps. My project focuses on developing a low-cost, energy efficient, simple and reliable pre-treatment system to remove these contaminants from brackish water. In the system, the feed is aerated and then dosed with chlorine and manganese dioxide (MnO2) particles. The MnO2 particles collect (adsorb) Mn2+, Fe2+ and Al3+ ions on their surface, and the chlorine oxidizes the Mn2+ and Fe2+ to Mn4+ and Fe3+, respectively. These oxidation reactions form more solids (Fe(OH)3 and MnO2), which facilitate further reaction with the contaminants in the feed. A membrane is then used to separate the pre-treated water from the particles, before it is sent to the EDR or RO unit. When the particle concentration in the reaction vessel becomes excessive, a fraction of the accumulated particles are discharged, and the whole process is repeated. Currently, I am working to optimize the reagent doses and aeration time to achieve optimal removal of all the ions in this novel pre-treatment process.

Characterizing Immune Cell Migratory Aspects of Multiple Sclerosis Pathology
Eric Zimmerman, Senior, Neurobiology
Mentor: Nephi Stella, Pharmacology
Mentor: Michelle Sexton, Pharmacology

Multiple Sclerosis (MS) is a demyelinating autoimmune disease of the central nervous system characterized by neurodegeneration. Specific neuro-protective treatments for MS have not yet been identified. The endogenous cannabinoid signaling pathway has been implicated as a mediator of many MS disease processes. Specifically, the migration of macrophages to the brain during MS is thought to be partially mediated by the Cannabinoid CB2 receptor. Our group seeks to characterize the role of the CB2 receptor in the cell-migratory aspects of MS pathology using human cells in a cell migration assay engineered specifically to mimic the human blood-brain barrier. The first step in this analysis is to optimize the parameters of the cell migration assay for use with human cells, specifically the HL60 myeloid cell line. In the cell migration assay, cells are induced to migrate across a physical barrier, which separates the cells from a chemoattractant, simulating disease. The present work will optimize the design of this barrier, using human endothelial cells and human astrocytes as integral parts of its design. Using human cells for this specific type of assay will provide an accurate model of in-vivo human physiology that is meant to simulate the blood-brain barrier, which macrophages migrating to the brain must navigate before exerting their effects. In the central nervous system, optimization of this cell migration assay will provide a valuable tool for further analyses of migrational properties of a number of different human immune cell types and for possible clinical studies. A wide variety of neurodegenerative diseases exhibit an autoimmune cell-migratory response and the development of this migration protocol will provide a powerful tool for future investigations of these diseases.

Unique Opportunities: Students Talk About Research

What did research allow you to do that you wouldn't have done otherwise?

Be a scientist! Classes can only teach you so much, and it's not until you actually start living out the scientific method day by day that you begin to understand what science is all about.

I traveled to Germany and interviewed key government officials and leaders within the Muslim immigrant community and had the chance to discuss a currently very debated topic with those who are decision makers regarding its role in German society today.

I was able to spend time in the Harris Hydraulics Laboratory, which is a very historic and interesting place!

I was able to meet professors that I never would have had the courage to learn from.

I was chosen to be part of a select research team that flew out to an isolated research station in a tiny bush plane. I learned so much and had an incredible amount of fun in a very short period of time.

I was able to craft my learning: pick the topic and how to approach it without the convenience of a programmed curriculum. It was very gratifying!

Conducting the research has opened up many doors which I felt were closed to me before.

Oral Presentation Session 2
3:30 - 5pm

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

SESSION 2A

ADVENTURES IN COMPUTER SCIENCE

Session Moderator: Steven Seitz, Computer Science Engineering
Mary Gates Hall Room 074

* Note: Titles in order of presentation.

Utilization of Illusory Perceptions for Cybernetic Calibration and Rehabilitation Systems
Johnathan Lyon, Fifth Year, Computer Science
Mentor: Yoky Matsuoka, Computer Science Engineering

Through distortion of human sensory perceptions, interaction systems may be developed that respond to human adaptation in meaningful ways. Manipulation of simultaneously active human senses has been shown to be very effective in rehabilitation settings. The coupling and decoupling of actual and perceived constraints in a recovery exercise can be used to encourage the human user to adapt to changes more rapidly, thus improving rehabilitation performance. By placing persons in an immersive virtual environment with haptic interaction, we can utilize varying techniques of feedback distortion and sensory de-coherence in order to gain insight into the fusion of the senses and their relative multi-modal biases. We can also use such techniques to assess the effectiveness of automated sensory adaptation as well as various levels of immersion and augmented reality in cybernetic and rehabilitative systems. Currently, we are assessing previous experimental models in order to develop a standardized software framework, drawing on the paradigm of 3D game development, in order to provide a simplified development pipeline and standard toolset suitable for a variety of plug and play peripherals and laboratory settings. The initial task is to provide a basic core experimental system for real-time manipulation and tracking of haptic controls based on aural, visual and haptic tactile distortions while remaining open for future modular enhancements. Such a system would allow for rapid-fire iteration of interaction experiments and allow for readily shareable and repeatable experiments across research units for collaborative enhancements. Although the current research is driven by the need for adaptive therapeutic systems, the software is intended to be broadly applicable and can be extended to variety of related research domains including cybernetics, telepresence, serious gaming, experimental philosophy and bio-enhanced interface design.

Improving the Scalability of Synonym Resolution in the TextRunner's Search Engine
Bo Qin, Graduate, Computer Science Engineering (BS/MS Program)
Mentor: Oren Etzioni, Computer Science Engineering

TextRunner is a web information extraction system that extracts facts from the web and allows users to search for specific facts. Synonym Resolution (SR) refers to the problem of merging synonymous words. Resolver is the current SR system for TextRunner that merges synonymous words extracted by TextRunner, so TextRunner's search engine can return related results when the user searches for certain facts. For instance, if the user searches for "who killed JFK", he may also be interested in results returned by the query "who murdered JFK" since "killed" and "murdered" are synonyms. Increasing the amount of information processed in SR is a way to improve the accuracy of merging synonyms, but the quantity of data that can be processed by Resolver is limited by the memory of a single machine. This paper presents P-Resolver, a parallelized version of Resolver's algorithm that runs on a cluster of computers using Hadoop's distributed computing framework, allowing it to process more data. As a result, it makes SR more accurate.

Virtual Zoom: Augmented Reality on a Mobile Device
Sergey Karayev, Senior, Psychology, Computer Science
Mary Gates Scholar
Mentor: Steven Seitz, Computer Science Engineering

The world around us is photographed millions of times a day, and a lot of images find their way online. Among these, tourist landmarks are particularly well represented. We present a way to augment reality through a mobile phone using this data: with our application, the user can take a low-resolution picture of a distant landmark and then virtually zoom in on it using other people's photographs, returned from an online server. Our system relies on a 3D scene modeling back-end that computes the viewpoints of photographs in a large, unordered photo collection. We present and discuss our implementation of the client application on the iPhone platform, our approach to picking the best views to offer a zoom path, and the complexities and limitations associated with mobile platforms.

The Limits of Adiabatic Quantum Computation
Alper Sarikaya, Senior, Computer Science, Chemistry (ACS Certified)
Mentor: Dave Bacon, Computer Science Engineering

Quantum computation has long been known to offer an exponential speed-up over classical computational algorithms for some algorithmic problems. Quantum algo-

rithms evolve by repeatedly applying an infinitesimal operator, the Hamiltonian, to the initial state and end in a final quantum state. Adiabatic quantum computation is one of many quantum methods that utilize the properties of quantum mechanics in order to arrive at a final solution (or more correctly, state). The qualifier *adiabatic* is needed to show that this class of algorithms is perpetuated by a simple Hamiltonian that never gets excited past the ground state. In this project, I am investigating a large class of adiabatic algorithms to elucidate the magnitude of the speed-up between them and classical algorithms, demonstrating that this class of adiabatic quantum algorithms do not offer an exponential increase in efficiency. Based on previous observations, I postulate that efficiency increase of adiabatic quantum algorithms over classical ones are limited to just a polynomial speed-up for a specific set of adiabatic algorithms. I have attempted to prove this prediction by simulating a adiabatic algorithm classically, and compare the real-time efficiency of it to the theoretical runtime of the adiabatic quantum computation. I have shown this to be true for a simple case and am currently working on demonstrating the polynomial effect for a Markovian operator (utilizing two time-dependent Hamiltonians). In doing so, the goal is two-fold: (1) I hope to disprove the evidence that some adiabatic quantum algorithms offer a exponential speed-up over their classical counterparts and (2) present quantum computation in a manner that is simple and straightforward manner for the general university community.

Windows Mobile 6.1 Help System User Research Project

Jacob Warren, Senior, Technical Communication
Mentor: Karen Kasonic, Human Centered Design Engineering

At the request of Microsoft, our team of student researchers from the department of Human Centered Design and Engineering conducted user research activities to measure the effectiveness of the online help documentation for Windows Mobile 6.1, an operating system for mobile devices. Our goal was to understand how easily users of the help system could access desired information. To do so, we evaluated user expectations and observed how successfully users completed specific tasks. Our studies took place within the University of Washington's Laboratory for Usability Testing and Evaluation (LUTE). We performed three activities. The first, a Wants and Needs Analysis, required a group of approximately five participants to brainstorm the qualities of an ideal online help system and then to rank their ideas. For the second activity, Card Sorting, the help system's topical headings were individually printed on index cards. Approximately five participants were asked to arrange the cards into a hierarchy. Their final result represented the kind of information structure that users would expect from the help system. During the third activity, Scenarios, individual participants were prompted to accomplish specific objectives using the online help system. Their interactions with the system were observed in order to understand where difficulties occurred. We used the results from these activities to compose recommendations for Microsoft, recommendations that focused on improving the effectiveness of the help system by revising its information architecture, revising its interactive design, and establishing consistency across various help media. With our recommendations, Microsoft will be able to revise the existing help system to better meet user expectations and needs.

SESSION 2B

ENVIRONMENTAL ETHICS, RELIGION, AND EDUCATION

Session Moderator: Amos Nascimento, Interdisciplinary Arts Sciences
Mary Gates Hall Room 082A

* Note: Titles in order of presentation.

Innate Knowledge and Environmental Consciousness

Ashley Cameron, Senior, Interdisciplinary Arts Sciences (Self Society), UW Tacoma
Mentor: Amos Nascimento, Interdisciplinary Arts Sciences, UW Tacoma

In this paper, I review various philosophical views regarding environmental consciousness and innate knowledge. Following the ancient philosophies of Socrates and Plato, I explore the idea that humans have an innate understanding of our place in nature. Regarding some of the fundamental theories in the history of philosophical thought, I seek to understand their insight on the Theory of Forms, Theory of Knowledge, and Mind-Body Dualism. In contrast with the historical perspectives of these ideas, I consider both Empiricist and Rationalist theories of knowledge and the insights of contemporary environmental philosophers such as Attfield, Frede and Frodeman. Finally, I discuss virtue and ethics in an attempt to connect this discussion with the topic of environmental consciousness and find a holistic approach that recognizes our responsibility as members of the environment. I find that many humans have learned to assign value to their species alone, and conclude that we must recognize our moral obligation to preserve the environment and re-

establish our relationship with nature for the future of all species on earth.

Descartes' Dysfunctional Mechanics and the Rise of Systemic Thinking

Jiwon Lee, Sophomore, Pre-Major, UW Tacoma
Mentor: Amos Nascimento, Interdisciplinary Arts Sciences, UW Tacoma

This research paper attempts to provide a deeper understanding and awareness of the modern mechanistic mind-set. The first section of the paper will discuss the emergence of the mechanical perspective by exploring the Scientific Revolution, more specifically focusing on Descartes' analytical method. Then, it will move on to critique and present the consequences of the modern mechanistic and technological perspective, which has leaked into all aspects of modern society. It will refer to selected intellectuals for support such as Martin Heidegger, who forewarns us of the dangers of the technological mind and Jacques Ellul, who critiques modern technology as a system of autonomy that is not only impervious to outside forces but has further promoted the domineering mechanistic mindset. Lastly, the paper will provide a proposal on how to address the overreliance on the mechanistic perspective through systems science, which provides a holistic approach to understanding the world. The problem of the mechanistic perspective is that it is limited by methodological and analytical thought that leads to the current state defined by Daniel Dennett as "greedy reductionism": the idea that every explanation can be reduced down to the linear relationship of parts. This ultimately ignores the undivided uniformity and interconnectedness of the world, which is recognized in the systems theory, an interdisciplinary study of the nature of complex adaptive systems in nature, science, and society.

Dispensational Eschatology and the Environment

Joshua Tom, Senior, Philosophy, Sociology
Mentor: Steven Pfaff, Sociology

Historically, religious beliefs have been largely marginalized in favor of demographic explanations for the environmental attitudes of individuals. However, research in the mid-1990's showed that eschatology, religious beliefs concerning the end of the world, was a significant predictor of environmental attitudes; this ignited renewed interest in the study of religious beliefs as having explanatory power in regards to environmental perspectives. Previous research has solidly established the role of eschatology in the shaping of environmental attitudes, specifically the Christian eschatology of dispensationalism. Aspects of this eschatology, such as the belief in the rapture of believers and the decay of the world before its eventual end, motivated the original research establishing the connection between these religious beliefs and environmental attitudes. While this connection has been shown in several studies, no research has attempted to pinpoint the particular facets of these beliefs that contribute to those attitudes. My research seeks to bridge that causal gap, thereby contributing to the growing literature on the content of religious belief as motivating individuals. I hypothesize that the key variable in these beliefs involves the relative imminence of the eschatological events; a more imminent eschatological timeline makes it more likely that the individual holding these beliefs will have negative or apathetic attitudes toward environmental issues. I look to support this hypothesis through the statistical analysis of the 2006 Religion and Public Life Survey, first by confirming the effect of dispensational eschatology on environmental attitudes, and secondly by isolating the imminence variable as the relevant aspect of these religious beliefs. I also discuss a theoretical framework for describing how this imminence variable causally affects environmental attitudes, suggesting that the shortened time horizon of dispensational eschatology combined with a high social discount rate provide the link between religious and environmental beliefs.

Environmental Education, Ontology, and Sustainable Living Habits

Tamara Nichols, Senior, Interdisciplinary Arts Sciences (General Studies), UW Tacoma
Mentor: Amos Nascimento, Interdisciplinary Arts Sciences, UW Tacoma

There is a difference between scientifically understanding environmental problems and acting in an environmentally friendly way. One can learn about the different environmental problems and issues we are facing today and yet do nothing to help find the solutions. For example, many have heard and/or studied global warming and its effects, yet some ignore the issue and continue to do things that are causing environmental problems. This paper argues that it is our duty, as humans living on this earth, to take better care of the environment and help it become more sustainable. Moreover, the paper adopts an ontological perspective and suggests that the best approach to motivate environmental actions would be educating people and creating a more sustainable environment. The paper presents several examples of concrete initiatives and environmental actions in the Puget Sound area, concluding that environmental education based on an ontological paradigm is an important tool that can impact and motivate many people. Environmental education has, therefore, an important role in helping people become sustainable and develop more sustainable living habits.

Time Travel and Climate Change: A Learning Unit for High School Students
Ronald Carnell, Senior, Interdisciplinary Studies (Science, Technology, and the Environment), UW Bothell
Mentor: Rebecca Price, Interdisciplinary Arts Sciences, UW Bothell

I present a case study that combines a science fiction story with real scientific data. The story, called "Channel Six," is a short time travel narrative that compares current and distant future climate conditions of the Pacific Northwest region of the United States. Local weather reporter, Sara Fahrenheit is lost in a flood during an El Niño year and is "unearthed" by a young archeologist who lives far into the region's tropical future. The story assumes that the anthropogenic release of greenhouse gases has at least partially caused the transformation of Chinook Valley to a tropical climate similar to what dominated the area during the Eocene epoch 60 million years ago. Interspersed throughout the story are five boxes that present scientific claims related to global warming and global climate change, learning objectives and student activities. The claims are researched from a variety of online and print scientific sources, and the learning objectives target different levels of Bloom's Taxonomy. The activities guide students to become familiar with basic paleoclimatological modeling, distinguish between weather and climate, connect their lives to specific changes predicted by global climate change, such as new medical and agricultural challenges, and to estimate their own carbon footprints. This case study makes scientific research less of a challenge for advanced high school and early college students who might resist science curriculum and more fun for those with higher levels of interest and achievement.

SESSION 2C

MATHEMATICS IN THE APPLIED AND COMPUTATIONAL WORLD

Session Moderator: J. Nathan Kutz, Applied Mathematics
Mary Gates Hall Room 085

* Note: Titles in order of presentation.

Determining the Stability Spectra of Stationary Solutions of Integrable Equations
Nathaniel Bottman, Senior, Russian Language, Literature, Culture, Mathematics (Comprehensive) Goldwater Scholar, Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: Bernard Deconinck, Applied Mathematics

Recent years have seen a lot of activity around the stability analysis of stationary 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. Bernard Deconinck and I have proposed 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 give an overview of the results produced by this method so far. Specifically, I will present explicit determinations of the stability spectra of all stationary solutions of the defocusing nonlinear Schrödinger equation and of the Korteweg-de Vries equation, and partial results towards analytically determining the stability spectra of stationary solutions of the focusing nonlinear Schrödinger equation.

The 150-year Journey of the Four Color Theorem
Ruth Davidson, Senior, Mathematics (Comprehensive)
Mentor: Sara Billey, Mathematics

The Four Color Theorem (4CT), first formulated as a conjecture in 1852 by Francis Guthrie, states that every planar graph can be colored using at most four colors. One familiar representation of a planar graph is a map of the United States. Attempts at proving this conjecture motivated many important developments in graph theory and influenced other fields of combinatorial mathematics. The first proof of the 4CT was published in 1977 by Appel and Haken. Another proof of the 4CT, published in 1997 by Robertson, Sanders, Seymour, and Thomas refined the techniques of the 1977 proof. In both instances computer assistance was used to verify that certain claims crucial to the structure of the proof held for hundreds of cases. The 1977 proof was controversial because it could not be completely verified by hand. In contrast, the 1997 proof provides a more transparent logical correspondence between the implementation of necessary algorithms and a potential hand-check of all cases by a human being. These two proofs employed methods developed over the course of more than a century by many mathematicians including Kempe, Heawood, Birkhoff, and Heesch. We explore the historical connections between research relevant to the eventual proof of the 4CT as well as the motives for certain definitions and procedures used in the 1977 and 1997 proofs. We will reimplement the algorithms used in the 1997 proof using

SAGE, an open-source mathematics software system.

Nonunique Solutions to the Discrete Inverse Problem for Electrical Networks
Chad Klumb, Senior, Mathematics (Comprehensive)
Mary Gates Scholar
Mentor: James Morrow, Mathematics

Consider an electrical network, that is, a collection of conductors which are connected to each other in some way. Suppose that we have access to only a few of these conductors; perhaps the network is very complicated, and we cannot physically reach other conductors, or perhaps much of the network is contained in some larger structure which we cannot (or do not wish to) breach. We may impose voltages on the conductors which we have access to, and we may measure the induced currents through these conductors (let us call these boundary measurements). A question arises: from these boundary measurements, can we determine the conductivity of every conductor in the network? In general, the answer is no. One simple example of this phenomenon is a network consisting of two conductors connected in series. Assuming we have access to the end of each conductor which is not connected to the other conductor, from the boundary measurements all we can determine is the equivalent conductivity of the series connection; we cannot determine the conductivity of each conductor separately. In this case, there are infinitely many possible conductivities which will give the same boundary measurements. The case in which there are only finitely many conductivities giving rise to the same boundary measurements, but nonetheless we cannot determine the conductivity of each conductor uniquely, is of some interest. The existence of networks with precisely two conductivies giving the same boundary measurements has been known for several years, and more recently strong evidence of a network with precisely three conductivities giving the same boundary measurements was discovered. By considering an electrical network associated to (but in general, not equivalent to) a given network, one can show that for every positive integer n, there exists a network with precisely n conductivities giving rise to the same boundary measurements.

Methods of Computing the Prime Counting Function
Robert Ohana, Junior, Mathematics (Comprehensive)
Mentor: William Stein, Mathematics

In the study of prime numbers, we are frequently interested in the prime counting function – usually denoted $\pi(x)$ – which is defined as the number of primes less than a given value. There have been three principle methods of counting prime numbers. Classically, we found all the primes less than a given value of x and simply counted how many there were. It was quickly found that the most efficient classical method of counting primes was implemented by using the Sieve of Eratosthenes. Following Riemann's Hypothesis – around 1860 – there was a great surge in the interest of computing larger values, and as such, new methods developed. Specifically the mathematician Legrendre made the simple realization that the number of primes less than a given integer is simply the number minus the number of composites and the number of units. Using that fact and some clever observations about counting composites, his method was used and extended to become faster than any other method for the next 100 years. During the 1980s and '90s, a number of mathematicians – Lagarias, Miller, Odlyzko, Deléglise, and Rivat – have developed two new methods for the evaluation of $\pi(x)$. The first is a heavily modified version of Legrendre's method, and the second is a completely new approach using Riemann's Hypothesis. The first of the two methods has been used in almost exclusivity in the computation of $\pi(x)$ recently, even though the second is far more efficient theoretically. We will look at a few of these methods and their implementations in depth.

SESSION 2D

BACK TO THE FUTURE: WHAT YESTERDAY CAN TELL US ABOUT TOMORROW

Session Moderator: Jennifer Nemhauser, Biology
Mary Gates Hall Room 206

* Note: Titles in order of presentation.

Development, Regeneration and Evolution of Ptychoderid Hemichordates
Barbara Bengtsson, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Billie Swalla, Biology

Hemichordates are bottom-dwelling marine worms that have become increasingly important for research into our ancestry, the origin of vertebrates. Hemichordates share several characteristics with chordates, a Hox-specified anterior-posterior axis, pharyngeal gill slits, a dorsal central nervous system (CNS) and a postanal tail in some species. Ptychoderids are the more complex of the motile hemichordates and their planctonic larvae share many similarities with echinoderm larvae. We describe here developmental, morphological and molecular characteristics that distinguish ptychoderid hemichordates from direct developing harrimanid hemichordates, such as *Saccoglossus kowalevskii*. We show dramatic morpho-

logical differences as well as differences in the development of the larvae. External characteristics were examined in live animals that were relaxed with magnesium chloride, and photographed with a Leitz microscope. Internal morphology was elucidated after fixed larvae and adult worms were embedded in polyester wax and sectioned before being treated with antibodies for immunofluorescence, followed by Milligan's trichrome stain to see tissue organization. An additional interesting property of the ptychoderid hemichordates is their amazing capacity to regenerate. We have been comparing the development of the CNS in ptychoderid hemichordates during metamorphosis and regeneration. Surprisingly, development of the central nervous system appears to be similar and is dependent on the dorsal vessel, suggesting that there may be some signaling property in the dorsal vessel. We suggest that ptychoderid hemichordate worms are more likely to represent the hemichordate ancestor, and therefore the deuterostome ancestor, than saccoglossid worms.

Using Distance Sampling to Estimate Population Size of Black-Tailed Deer on Blakely Island, WA

Luke Davies, Senior, Biology, Seattle Pacific University
Mentor: Eric Long, Biology, Seattle Pacific University

Columbia black-tailed deer (Odocoileus hemionus columbianus) are a subspecies of mule deer primarily located in low-land coastal regions east of the Cascade Mountain range in Oregon, Washington, and British Columbia. There have been very limited studies of small island populations of these deer. Blakely Island (17.8 km2) is a privately owned island in the San Juan archipelago of Washington State. The only predation of deer on Blakely is limited hunting by humans. During June-September of 2007, and again in summer 2008, I used distance sampling to estimate population density of black-tailed deer on Blakely Island. Distance sampling is a well established method that is used to estimate population density. In line transect distance sampling an observer traveling along a straight line survey path records distances from the transect line to subject, here black-tailed deer. From the distribution of these observed distances, a population density of the research subjects can be generated. Data from both years were compiled and, using DISTANCE 5.0, I estimated a population density of approximately 44.9 (95% CI: 36.8-54.8) deer per km2. Compared to mainland studies (7 deer per km2) and other island studies (28.5 deer per km2), this population density is very high. It is important to study this isolated island population to get a better understanding of what the population capacity of the island is, and future studies will also investigate the impact of such high density deer populations on the island's ecosystem.

Climate Analysis of the Thomas Ranch Leaf Fossil Assemblage

Sheridan Mack, Senior, Environmental Science, UW Tacoma
Mentor: Sian Davies-Vollum, Interdisciplinary Arts Sciences, UW Tacoma
Mentor: Caroline Stromberg, Biology

Studies of fossil vegetation allow us to infer ancient climates and environments. The Pacific Northwest, during the late Early to early Middle Eocene, had a much warmer climate than the present day, and also the coastlines were located farther east. This study focuses on a fossil leaf assemblage from Thomas Ranch, located in the Okanogan Highlands in lower British Columbia. These fossils were preserved in a lake bed that had been covered in volcanic ash. The fine grain size of the ash has allowed for the preservation of great detail in the leaf fossils. The purpose of this study was to perform a climate analysis using a variety of published techniques including Leaf Margin Analysis, as well as Climate Leaf Assemblage Multivariate Program (CLAMP) that use the relationship between fossil leaf morphology and the climate in which the leaves grew. These analyses require the leaf fossils to be separated into morphotypes and each morphotype analyzed in terms of its specific morphological characters. The Leaf Margin Analysis uses the leaf margin as a guide to determine the climate. Each different morphotype is classified as having smooth edges or teeth and the percentage of smooth-edged leaves is used to infer climate. The CLAMP analysis is done by scoring morphotypes based on aspects such as venation, size, and margin type and applying a multi-variate analysis to this. Based on supporting research the Eocene was the warmest period in the Cenozoic. It is expected the Thomas Ranch assemblage should coincide. The data should indicate that the climate was warmer than present day and equable, meaning low seasonal variation in temperature and little frost, but potentially varying rainfall.

The Role of Insects in Nutrient Cycling in Spirit Lake, Washington

Cameron Marshall, Senior, Environmental Science, UW Tacoma
Mentor: Jim Gawel, Environmental Science, UW Tacoma

Spirit Lake, a high alpine lake at the base of Mount St. Helens in Washington State, was changed dramatically after the large volcanic eruption in May 1980. Pre-eruption, Spirit Lake was a deep, oligotrophic lake. Post-eruption, the lake was raised by roughly 60m and the blast created a shallower basin with a larger surface area, which has allowed for higher productivity in the nearshore area, while deeper portions of Spirit Lake remain oligotrophic. In order to better understand nutrient cycling at Spirit Lake, all aspects of the lake's nearshore

nutrient budget must be quantified. This research focuses on the role of insect emergence in the nutrient cycle as part of a larger nutrient model for Spirit Lake. In particular, the flux of nutrients due to insect emergence in correlation to lake depth and timing of emergence is being measured. Insects collected via emergence traps are being taxonomically identified, counted, analyzed for nutrient amounts, and extrapolated across the study area based on observed depth distributions. It is anticipated that insect emergence will present a significant flux of nutrients in the nearshore environment of Spirit Lake. The design and deployment protocol for the floating emergence traps used during this study are also being examined. An estimate of nutrient loss via insect emergence and future trap design considerations will be presented.

A Survey of the Arthropod Communities In Tank Bromeliads in the Andean Cloud Forest
Daniel Parker, Senior, Anthropology
Mentor: John Edwards, Biology

Some epiphytic plants hold pools of water, called phytotemata, within which small ecosystems develop, comprising micro-organisms, and animals, both vertebrate and invertebrate. Tank bromeliads, an epiphytic plant capable of holding water, are common in the Andean Cloud Forest; therefore they offer repeatable, discrete ecological units for observational studies. In this project, the fauna of tank bromeliads was sampled by removing the plant and its contents and noting the aquatic and semi-aquatic occupants. One species of frog (*Hyla antoniiochoai*) and 25 species of arthropods were found in five samples. Order *Diptera* dominated the surveyed populations however *Culicidae* were the only family present in all samples. Significant differences in faunal composition were found, suggesting that colonization is stochastic and that pioneer species influence community composition. The findings of this project may aid in explaining the influence of pioneer species on the composition of communities in larger geographic units.

Ancient Marsupials: Size Estimates Based on Tooth to Mass Ratio in Dentally Conservative Marsupials
Peter Smits, Senior, Biology (Ecology Evolution)
Mentor: Gregory Wilson, Biology

Body size is an important variable among mammals that is strongly correlated to a wide range of ecological and natural history traits, including metabolic rate, reproductive rate, and home range size. Recognition that body size is also strongly correlated to tooth size has led paleontologists to develop taxon-specific regression formulae based on extant mammals. These formulae are then used with fossil tooth size to estimate body mass in fossil "insectivorans," primates, marsupials and other taxa to better understand body size evolution and paleoecology of these taxa. The quality and appropriateness of the data and methods used to develop these taxon-specific regression formulae vary greatly across studies. In this study, we measured length, width, and occlusal area of over 450 didelphimorph and dasyuromorph specimens with tag mass data. This database represents an improvement over previous studies that use mean body masses from the literature and lack adequate specimen sample sizes and taxonomic breadth. Applying least-squares regression analysis to our data, we developed a formula to estimate body mass in dentally conservative fossil metatherians from the Cretaceous and Paleocene of North America. Preliminary results document an expansion of metatherian body size ranges that is truncated by the Cretaceous-Tertiary (K-T) extinction event and subsequent expansion of eutherian body size ranges.

SESSION 2E

BIOENGINEERING CHALLENGES AND SOLUTIONS

Session Moderator: Shahram Vaezy, Bioengineering
Mary Gates Hall Room 228

* Note: Titles in order of presentation.

Effective Cancer Treatment Comparison: Calibration Phantom Analysis Project
Yogesh Saletore, Senior, Computer Science, 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. An effective method of diagnosing caner is to use dual-mode positron emission tomography and x-ray computed tomography (PET/CT) scans. 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 files 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 hypothesis is to use the Otsu threshold to take

advantage of the high contrast in the PET image to localize each sphere. These are then used to find more precise ROIs in the CT image, which shows better anatomical structure. The average and maximum radioactivity levels of each sphere can be found within each ROI on the PET image, which will be the data that 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 be used to allow for a more reliable comparison of PET/CT images, and a more accurate diagnosis of cancer treatment effectiveness.

Design of an Image Processing Algorithm for the Measurement of Enamel Thickness Using Ultrasound

Jeremy Hua, Senior, Bioengineering
Mary Gates Scholar
Mentor: Yongmin Kim, Bioengineering
Mentor: Curtis SK Chen, Oral Medicine

Dental erosion is growing increasingly prevalent in today's society with the rise in consumption of heavy starches, sugars, coffee, and acidic beverages. In addition, various disorders, such as Gastroenterological Reflux Disease (GERD), have symptoms of rapid rates of tooth erosion. There has also been scientific research to link teeth bleaching to loss of erosion and reduction in tooth density. The measurement of enamel thickness is important for dentists to diagnose the progression of enamel loss from all forms of erosion, attrition, and abrasion. The most popular current technique to measure enamel loss is with various subjective indexes that can be interpreted in different ways by different dentists. The introduction of an objective method to measure enamel thickness quantitatively and accurately would greatly advance the study of such a widespread disorder. The gold standard for dental imaging of internal tooth structure is Computed Tomography (CT), however, CT imaging is highly ionizing and costly to operate. B-mode ultrasound is inexpensive and produces no measurable ionizing effects on humans, so it was determined to be the most clinically feasible instrument for measuring enamel thickness. This project involves constructing a container to reproducibly hold extracted human teeth in a gelatinous medium, and obtaining longitudinal images at 1mm-spaced intervals with a diagnostic B-mode ultrasound machine. An image processing algorithm was designed using MATLAB to further refine both the outer tooth boundary as well as the dentin-enamel junction (DEJ) in the images by utilizing their grayscale pixel values. The processed ultrasound images, along with corresponding CT images, were given to dentists for enamel thickness measurement. The results were analyzed to determine the effectiveness of the algorithm.

Immuno-Laser Capture Microdissection: Designing a Process for RNA Extraction from a Homogenous Cell Population

Ngoc Nguyen, Senior, Bioengineering
Mentor: Yanfeng (Mei) Speer, Bioengineering

In recent years, there has been a growing need for understanding cardiovascular calcification (CVC), a process in which blood vessels lose their compliance due to calcium phosphate deposition. Natural aging processes and tissue damage have been believed to be factors contributing to CVC. Recent research has indicated that CVC is a cell-mediated, well-regulated process where vascular smooth muscle cells (SMCs) undergo a specialized phenotypic change (or lineage reprogramming) in response to environmental changes, such as locally increased phosphate levels. The objective of this project is to design a quick, low temperature immunohistochemical (IHC) staining that maintains cellular RNA integrity and identifies osteochondrogenic precursor-like cells in calcified blood vessels. Selectively obtaining cells at a given differentiation stage allows for more accurate differential gene expression studies, which may help determine a molecular trigger or mechanism of CVC. The antibodies used will recognize Runx2/Cbfa1, which have been found to be involved in embryonic bone development and remodeling. Laser microdissection will then be utilized to selectively capture the stained cells. Finally, a microscale RNA extraction and amplification of the captured cells will be employed, and RNA quality will be analyzed. Normally, IHC staining protocols take between 3-4 hours or may involve overnight incubation - processes that would degrade RNA. A 30-minute staining at 4C was developed to minimize exposure time of tissue sections in aqueous solutions as well as slow down enzymatic reactions, specifically RNase activity. By applying this methodology to target Runx2/Cbfa1 and alpha-actin, a protein found on SMCs, differential gene expression analysis of CVC is promising. The effectiveness of the developed protocol will be based on specificity of the staining, staining intensity, and the quality and quantity of RNA.

Characterizing Msx1-Positive Cells for Finger Regeneration

Andrew Zhou, Senior, Bioengineering
Mary Gates Scholar
Mentor: Christopher Allan, Orthopaedics Sports Medicine

Digit amputation is very common and even the smallest of these injuries can be significantly problematic for the patient. Current treatment options for patients, such as prosthesis fitting and reattachment, are very limited since

none of these methods can restore full sensory and motor function and all have potentially severe side effects. In the future, regenerative medicine provides great hope in helping these patients. Since current knowledge on digit regeneration is limited, this project will study cells involved in digit regeneration with an end focus on tissue engineering as a solution for digit loss. A recent study on human digit repair showed that Msx1 (muscle segment homeobox 1) is expressed in the developing and healing human fetal digit. Msx1 expression in cells is thought to keep cells in an undifferentiated state. Therefore, these cells are hypothesized to be similar to stem cells in that they can become multiple cell types. In order to characterize these cells, we will attempt to drive them down a chondrogenic (cartilage-forming) or osteogenic (bone-forming) pathway. We have just recently been able to successfully isolate a primary cell culture from the fetal digit tip. Reverse transcriptase PCR was used to show that the Msx1 gene is indeed active in these cells. These cells are currently sitting in differentiation media and will be imaged in the near future. Meanwhile, we tested our differentiation protocols on a human bone marrow mesenchymal stem cell line. Results from chemical stains were inconclusive and antibody staining for collagen type II was negative. This study is still in progress, but if our results show successful differentiation, we will have further evidence to support the hypothesis that these Msx1-positive cells are indeed similar to stem cells and that Msx1-positive cells may be used as the competent cells required for digit tissue engineering.

Towards Skeletal Muscle Tissue Engineering using Muscle Derived Stem Cells: Optimization of In Vitro Method

Daria Amiad Pavlov, Senior, Bioengineering
Mary Gates Scholar
Mentor: Michael Regnier, Bioengineering

The recent conflict in Iraq and the global war on terrorism have increased the occurrence of explosives related large scale wounds that result, among others, in large scale muscle tissue loss and consequent function loss. Current repair surgeries for such wounds focus on stabilization of the bone and coverage with skin grafts. However no treatment is currently available for repair of the lost muscle or its reconstruction. The discovery and isolation of myogenic cells from skeletal muscle tissue, and more recently muscle derived stem cells (MDSC's), holds a great promise for the field of skeletal muscle tissue engineering, that aims to generate functional muscle tissue constructs using muscle stem cells derived directly from the patient. In order to optimize a method for in vitro muscle engineering, MDSC's in different densities are combined with collagen gel scaffold and seeded on specially designed frame. The resulting construct is allowed to grow while the frame assisting in cell alignment. The construct is then tested for cell survival, proliferation, differentiation and mechanical function, at several time points. Histological analysis of the constructs shows the ability of MDSC's to proliferate and differentiate into parallel aligned myotubes, while inside the collagen gel scaffold. Nevertheless, myotube density is too low to produce force and contraction; therefore present efforts are focused on achieving higher myotube density to allow mechanical analysis.

HIFU Dosimetry for Optimal Lesion Formation and Ultrasound Visualization

Ria Sutedja, Senior, Bioengineering
Mentor: Shahram Vaezy, Bioengineering

With the increasing number of tumor-diagnosed patients, a safe and effective tumor treatment is crucially needed. Based on previous and current studies, ultrasound-guided High-Intensity Focused Ultrasound (HIFU) treatment has been proved to be a potential procedure to ablate the tumor. HIFU is a noninvasive medical procedure that uses high-intensity acoustic waves to heat and destroy tissues rapidly. Meanwhile, large tumor size has been a challenging problem for the HIFU therapy because multiple sonications (HIFU applications) need to be applied to cover the volume, and thus inducing pre-focal damages to the treated tissue. Therefore, to prevent the damages due to excessive heat exposure, a solution of using low intensity acoustic waves is proposed. The low average output intensity can be composed of high peak intensity with a very short duty ratio. In this way, it is hypothesized that the ablated region (lesion size) will be enlarged without inducing pre-focal damages. The hypothesis is proven by some preliminary results that show increasing lesion volumes as the intensity is decreased and duty ratio is decreased. Ranging between 1 - 300 mm3, the lesion volumes in general display a linear behavior. In real applications, these investigations may be useful to serve as parameter standards in future studies in US-guided HIFU tumor abalation therapy.

Three-Dimensional Temperature Mapping for a Physical Therapy Device: Application to Cancer Treatment Using Hyperthermia

Kevin Chang, Senior, Bioengineering
Mentor: Shahram Vaezy, Bioengineering

Ultrasound Hyperthermia, used as a combination therapy with radiation therapy or chemotherapy, can increase tumor regression significantly. The primary advantage of using this treatment as a cancer treatment is its ability to delivery thermal energy to the body without requiring any incisions. The mechanism of hyperthermia is to expose the target tissue to about 42 C and maintain that temperature for a proper duration of usually 30 minutes per session. Maintaining the desired temperature remains challenging because of the blood flow

in human body; however, the degree of the successfulness of the treatment depends on the given thermal dose and the temperature distribution around the target. Currently, there is no method to visualize the 3D temperature distribution of the acoustic field. My project aims to investigate the temperature behaviors on chicken breast tissues and provide a visualizion of the temperature distribution under an ultrasound transducer. An experiment protocol and an experimental device for housing the chicken breast tissues are designed to obtain the temperature measurements. The setup includes the ultrasound device, thermocouples with a Labview algorithm, and a designed chamber. At this moment in time, the temperature measurements are obtained and a MATLAB algorithm is implemented to construct the temperature data into a 3D temperature mapping to obtain a visualization of the temperature distribution at a particular time point of treatment. In addition, 3D or 4D movies will be assembled for a better visualization for how the temperature distributes and varies with time. The relationship between the temperature distribution and the acoustic intensity emanating from the ultrasound transducer will be investigated. In conclusion, these results will help to understand the temperature behavior and distribution on the tissues. These results may be valuable for building the hyperthermia machine.

SESSION 2F

GENE AND DRUG DELIVERY

Session Moderator: Suzie Pun, Bioengineering
Mary Gates Hall Room 231

* Note: Titles in order of presentation.

Design and Optimization of Mouse and Human Chimaeric Regulatory Gene Cassettes for Human Muscular Dystrophy Gene Therapies
Melvin Donaldson, Senior, Biochemistry
Amgen Scholar, Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Steve Hauschka, Biochemistry
Mentor: Robert Welikson, Biochemistry

Previous studies in our lab have identified the transcriptional regulatory regions of the Muscle Creatine Kinase (MCK) gene as potentially useful for controlling therapeutic gene expression in the treatment of muscle disease. In this study, we have created regulatory cassettes using human genetic sequence that are analogous to previously developed cassettes made from mouse. In rat neonatal cardiomyocytes and mouse skeletal muscle cells, the mouse cassettes drive significantly higher levels of reporter gene transcriptional activity than do their human homologs. The enhancer region of the gene contains a number of transcription factor binding sites that have been shown to be critical for high-level muscle-specific transcriptional activity in regulatory cassettes, including a MEF-2 site, two active E-boxes, Six4, and a CArG site; however, careful examination of mouse and human enhancer sequence shows notable divergence in some of these transcription factor binding sequences. We hypothesize that these differences account for the lower activity observed with human MCK constructs in rodent cells. We assume that, due to evolutionary forces, human gene promoters are optimized to function in the human body and so regulatory cassettes derived from human DNA sequence will be more transcriptionally active in humans than will be analogous cassettes made from mouse DNA. To test this hypothesis, I have created chimaeric constructs of mouse MCK promoter with the human enhancer, and vice-versa, driving a quantitatable Luciferase reporter gene. I am also generating site-directed changes in the human MCK enhancer to "murinize" the MEF-2 site and E-boxes. I will compare the activity of the constructs in cell culture using mouse and human embryonic skeletal myoblasts and rat neonatal and human ES-derived cardiomyocytes. A species-dependent transcriptional enhancement would suggest that the human versions of these cassettes would be better suited for gene therapy in humans than mouse analogous cassettes.

Gene Therapy and the Adrenergic Response: L48Q cTnC Virally Transduced Adult Cardiomyocytes
Kate Buckley, Senior, Bioengineering
Levinson Emerging Scholar, Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Michael Regnier, Bioengineering
Mentor: Steven Korte, Bioengineering

Heart disease is the leading cause of death in the United States. After a heart attack (one of the most common causes of heart disease), the heart undergoes an extensive remodeling process that leads to depressed myocardial function. At the University of Washington exciting new therapeutic strategies are being developed to improve and repair heart function. Gene based therapies that target cardiac myofilaments offer a way to halt or even reverse cardiac dysfunction by enhancing contractility of the heart. Genetic overexpression of a mutant of the myofilament regulatory protein troponin C (L48Q) offers potential as a therapeutic tool to improve function of surviving myocardium by enhancing myofilament response to Ca^{2+} activation. Recent results in our lab indicate that overexpression of L48Q cTnC in rat cardiomyocytes results in a greater extent and rate of cell shortening. However, if this therapy is to be useful *in vivo*,

normal myocardial adrenergic responsiveness must be maintained. This project will investigate the adrenergic response of L48Q cTnC transduced adult rat cardiomyocytes from infarcted and non-infarcted hearts. Adrenergic responsiveness will be assessed using contraction and relaxation parameters following application of the beta-adrenergic receptor agonist isoproteronol in a dose-dependent manner. Measurements will be made on individual cardiomyocytes using video microscopy coupled to computer software that measures cell and sarcomere length changes. After completing studies in cultured cardiomyocytes, studies will be extended to an animal model of gene transfection to determine the effect of L48Q cTnC *in vivo* and at the whole organ level in normal and infarcted animals. These studies are essential to determine if this gene therapy is potentially clinically relevant by reducing or reversing changes leading to heart failure. If so, L48Q cTnC has great therapeutic potential for several forms of cardiac disease.

Targeting HER2-Positive Breast Cancer with Antibody-Polymer Mediated Delivery of siRNA

Fan Lee, Senior, Bioengineering
Washington Research Foundation Fellow
Mentor: Patrick Stayton, Bioengineering
Mentor: Maria Corinna Palanca-Wessels, Hematology

The discovery of RNA interference has lead to a promising tool in cancer treatment that utilizes siRNA to silence genes contributing to tumor development. However, the application of siRNA therapeutics has been limited by cellular pathways that prevent cell penetration and cause enzymatic degradation of biomolecules. This project aims to design and synthesize a pH-responsive polymer carrier for siRNA therapeutics that exploits the cellular endosomal pathway, allowing the polymer-siRNA complex to stably cross the membrane. The polymer consists of two components, a cationic block to condense the negatively charged siRNA and a pH-responsive block that mediates endosomal release after being endocytosed into the cell. Upon experiencing the lower cellular pH, the hydrophilic polymer becomes protonated and experiences a conformational change that mediates membrane disruption and allows for the release of siRNA therapeutic into the cytoplasm of the cell. Additionally, the polymer carrier system consists of an antibody moiety that targets human epidermal receptor (HER2), overexpressed in 20% of breast cancers. The polymer is synthesized using RAFT polymerization and conjugated to antibody through stretavidin-biotin technology. The efficacy and specificity of the antibody-polymer mediated siRNA delivery is evaluated in vitro on breast cancer cell lines ZR75-1 and SKRB3. Flow cytometry is used to quantify the uptake of the antibody-polymer-siRNA conjugates and fluorescent microscopy is used to visualize the intracellular trafficking of the delivery complex. Gene knockdown by the therapeutic is evaluated by examining RNA expression through real time reverse transcription polymerase chain reaction (RT-PCR) and protein expression through Western Blot. Lactate dehydrogenase (LDH) cytotoxicity assay is used to determine the optimal concentrations for in vitro delivery.

Targeted siRNA Delivery to Liver Cancer Cells using pH-Responsive Polymers

Andrew Shubin, Senior, Bioengineering
Mary Gates Scholar
Mentor: Patrick Stayton, Bioengineering

Small interfering RNA (siRNA) have shown great potential in treating various forms of cancers by knocking down the expression of over-expressed genes resulting in the restoration of the normal cell cycle and cell death. However, an effective targeting and delivery mechanism needs to be developed for any potential siRNA therapeutic to be effective. This project aims to develop an effective targeted siRNA delivery system that will be designed using the latest pH sensitive polymers to target liver cancer cells. In this project, variants of pH-responsive polymers with potential targeting moiety sites have been created using reversible addition-fragmentation chain transfer (RAFT) polymerization. The presence of a significant amount of sites availible for targeting moieties on the polymer has been verified by 1H-NMR analysis. These polymers have shown the ability to be hemolytic and could potentially deliver siRNA. siRNA will be covalently conjugated to this polymer and its efficacy will be tested on a liver cancer cell line (HEPG2). The siRNA being delivered is designed to knockdown the expression of the Cyclin E1 gene which is over-expressed in liver cancer. Research into the effects of knockdown Cyclin E1 expression by Li Et. al has shown that knockdown in expression of this gene results in cancer cell apoptosis and reduction in tumor growth. This project plans to test the ability of this polymer carrier in causing cell apoptosis via siRNA-induced knockdown of Cyclin E1 expression. In addition, the polymer will be engineered to promote siRNA stability in serum, and to decrease non-therapeutic induced cytotoxicity.

Fabrication of a Biodegradable Multidrug Delivery System Using Layer-By-Layer Deposition to Prevent Bacterial Infection

Ji Park, Senior, Bioengineering
Mary Gates Scholar
Mentor: Buddy Ratner, Bioengineering

Hospital-acquired or nosocomial infections are the fourth leading cause of death in the United States with 5 billion dollars in costs to treat them annually. Approximately, 65 % of these nosocomial infections are caused by bacteria adherent to the surface of biomedical devices or implants. As bacteria aggregate and secrete extracel-

lular polysaccharides, biofilms are formed. Biofilms protect the encased bacteria from host defense mechanisms as well as from toxins and antibiotics. Therefore, conventional antibiotics work poorly against chronic bacterial infections as the number of drug-resistant bacteria has increased due to the overuse of antibiotics. Furthermore, an alternate solution using a silver nitrate coating has a short half-life and is impractical for disposable devices. In order to overcome these shortcomings, the project aims to examine the feasibility of constructing biodegradable polyelectrolyte multilayer films for coating biomedical devices. Each film will sequentially release charged antibacterial agents (Gallium nitrate and salicylic acid) as it is degraded by the bacterial enzymes. The multilayer films will be fabricated by the alternate adsorption of oppositely charged polymers (chitosan and carboxymethylcellulose sodium salt) using Layer-by-Layer (LbL) deposition, with the layers stabilizing one another by electrostatic interactions. We have constructed and investigated the multilayer films using x-ray photoelectron spectroscopy (XPS) and time-of-flight secondary ion mass spectrometry (TOF-SIMS). This prolonged multidrug delivery films will contribute to the further development of a low-cost, multidrug releasing coating method to reduce biofilm-related medical device failures.

Optimization of an HIV gp41-Derived Peptide Sequence for Endosomal Escape of Non-viral Gene Delivery Vehicles

Sylvie Liong, Senior, Bioengineering
Mary Gates Scholar
Mentor: Suzie Pun, Bioengineering
Mentor: Ester Kwon, Bioengineering

The purpose of gene therapy is to deliver nucleic acids that modulate gene expression for the treatment of disease. The efficiency of gene delivery by synthetic carriers has been limited by poor escape of delivery vehicles from endosomes. In order to overcome this major barrier, a 24-amino acid long membrane-active peptide (HGP) derived from the endodomain of HIV gp41 was found to improve endosomal escape when covalently attached to cationic polymer delivery vehicles. Incorporating short peptides is desirable to minimize disruption during vehicle formation and because their manufacture is more cost-efficient and less labor-intensive. The purpose of this project is to investigate whether shorter peptide sequences based on HGP can maintain activity comparable to the full length 24-amino acid peptide. In addition, a shorter peptide sequence was engineered for potential enhancement in membrane-lytic activity. These peptides were then tested for their ability to transfer a reporter gene in vitro in several cell lines. By addressing endosomal escape through lytic peptides, this work contributes towards the development of more efficient non-viral gene delivery vehicles.

Anti–Cancer Nanopods: Rational Design of a Peptide-Based Gene Delivery Vehicle Targeted to Hepatocarcinoma

Kathy Wei, Senior, Bioengineering, Computer Science
Amgen Scholar, Goldwater Scholar, Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Suzie Pun, Bioengineering
Mentor: Rob Burke, Bioengineering

Each year, liver cancer is diagnosed in 20,000 new patients in the United States and causes 662,000 deaths worldwide, making it one of the three deadliest cancers in the world. Current treatments, such as surgery, radiation, and chemotherapy, often involve significant damage to healthy tissue and can typically only extend the life of patients for about a year after diagnosis. Gene therapy, which aims to replace defective genes inside cells in order to treat diseases, holds promise for treating liver cancer because of the various pathways it can exploit. For instance, one could alter a patient's immune system to recognize cancerous cells, replace the malfunctioning genes needed for proper cell regulation and function, or enhance the sensitivity of cancer cells to chemotherapy. Modified viruses have been used for gene therapy, but their use is limited by safety concerns and large-scale production difficulties. Nonviral materials have the potential to overcome these concerns, but they are currently limited by inefficient delivery and nonspecific targeting. The goal of this project is to design, construct, and test novel peptide-based materials specifically targeted to hepatocarcinoma, which is the most common form of primary liver cancer, for use as systemically administered gene therapy vectors. The peptide material consists of a nonaarginine DNA condensing component linked to a hepatocarcinoma-specific binding peptide (sequence: FQHPSFI). This material will form an anti-cancer "nanopod" that both protects the DNA therapeutic from degradation and acts as a guidance system to deliver the genes preferentially to the target. Successful completion of this project will result in an efficient, specific gene therapy delivery vehicle that can be further developed into an effective treatment for liver cancer.

SESSION 2G

RACE, ETHNICITY, AND IDENTITY: COMMUNITY IMPLICATIONS

Session Moderator: Bradley Portin, Educational Leadership Policy Studies
Mary Gates Hall Room 234

* Note: Titles in order of presentation.

Kibre ab Sidet (Honor in Exile) Following Eritrean Youth in the U.S. Diaspora: Acculturation, Identity and Adaptation
Yordanos Fesehaye, Senior, Anthropology, Comparative History of Ideas, Individualized Studies
EIP/Presidential Scholar, Mary Gates Scholar, McNair Scholar
Mentor: Rachel Chapman, Anthropology

Eritrea has a history of conflict, poverty and changes of government. The 30-year struggle for independence from Ethiopia led to the displacement of thousands of Eriteans and contributed to a large Diaspora in the United States. Widening generation gaps between different generations of Eritreans living in the Diaspora have led to increased tension within the household and growing visibility of youth involved in conflict in the public space. Youth brought up in these two vastly different cultures are pulled away from some of the values, roles and aspirations of their older family members. While there is significant literature on acculturation patterns of different generations, few have looked at how Eritrean identity formation diverges as the population moved from homeland to the Diaspora. Examining notions of honor, gender, history, healing and aspirations, my research focuses on the values across generations and on where theses values overlap and diverge. In order to achieve this goal, I will conduct participant-observation and formal and informal interviews with Eritreans living in Seattle, Washington. Broadly stated, my research questions are as follows: to what extent do acculturation patterns vary across generations? What are the social practices Eritrean youth feel pressure to adapt to? Where do these practices and values diverge from their parent's expectations? What are the consequences of generational non-understanding? This research will serve as a cross-generational bridge between Eritreans in the Diaspora. It will also contribute to theories of identity divergence among the children of refugees and immigrants.

When Being too Asian is Bad: White Americans React Negatively to Strongly Identified Asian Americans in Situations of Finite Resources
Jessica Kang, Senior, Psychology, English
Mary Gates Scholar
Mentor: Cheryl Kaiser, Psychology

Asian Americans are often associated with positive stereotypes such as industriousness, self-discipline, and intelligence (Ho & Jackson, 2001). Due to these positive attributes, Asian Americans have been labeled the model minority in the United States (Petersen, 1966). As these stereotypes convey competence, they may result in Asian Americans becoming the target of prejudice in situations in which there is competition with White Americans for scarce resources (Maddux, Galinsky, Cuddy & Polifroni, 2008). The current research seeks to understand how Asian Americans' group identification level affects application of these stereotypes and how limited resources might cause such objectively positive stereotypes to threaten Whites. In study 1, 33 White American undergraduates were asked to consider the typical characteristics of either a strongly or weakly group-identified Asian American man. Participants then rated the target on a series of model minority-relevant stereotypes. Participants rated the strongly identified Asian American target as more industrious, self-disciplined, and intelligent than the weakly identified Asian American target. The second study investigated the effect of realistic threat situations and level of identification of the Asian American target on White American attitudes, emotions and behavioral tendencies towards the Asian American target. White American participants were assigned to experience realistic threat through imagining a competitive classroom scenario or no realistic threat. Afterwards, participants rated a fellow Asian American classmate who is either strongly or weakly identified with his racial group. In the realistic threat condition, we hypothesized that strongly identified Asian Americans should be evaluated more negatively than weakly identified Asian Americans. In the non-threatening condition, this effect should not occur. These initial findings suggest that strongly identified Asian Americans may be viewed more negatively than weakly identified Asian Americans if the former are seen as possessing positive attributes that threaten White Americans.

Reducing Racial Prejudice
Joshua Newson, Senior, Psychology, Neurobiology
Mary Gates Scholar
Mentor: Sapna Cheryan, Psychology

The goal of this research is to gain a better understanding of a form of racial prejudice exhibited by the vast majority of White Americans: implicit prejudice (Dasgupta & Greenwald, 2001). Implicit prejudice is defined as automatic biases against a group. Previous research demon-

strates that an individual's automatic bias against Blacks can lessen after seeing both Blacks and negative Whites (in the same session). Further research has shown that the reduction in implicit prejudice is not seen when presented only with the positive out-group members (Joy-Gaba & Nosek, under review). Therefore, we take the next step and compare the effects of presentation of a) positive Blacks and negative Whites with b) the presentation of negative Whites alone and c) a flower and insect control condition. We predict that the above two presentations will have the same effect: reducing implicit prejudice. Further, we hypothesize that the magnitude of this effect will be equal. This study will enable researchers to learn more about how to diminish implicit biases against Blacks.

Centering *Mixed Identities and Racialized Bodies*: Creating a Curriculum

Jessica Norberg, Senior, Comparative History of Ideas, Women Studies
Samantha Gonzalez, Senior, English
Joseph Thompson, Senior, Comparative History of Ideas, Music
April Nishimura, Senior, International Studies
Christopher Paredes, Senior, English, American Ethnic Studies
Sarah Stork, Senior, Individualized Studies, Comparative History of Ideas, Anthropology
Landon Tan, Sophomore, Pre-Social Sciences
Mentor: Steve Woodard, Office of Minority Affairs Diversity

In the last hundred years, academia has drastically changed in progressive ways. The 1960's Civil Rights Movement brought recognition to a variety of social inequalities, and the subsequent changes in laws and policies came to be reflected not only in the general public relations, but also in the subject offerings made available at the university level. Academic fields that opened up conversations about different racial and ethnic positionalities, such as American Ethnic Studies departments, blossomed all over American campuses. As our population demographic continues to change, and as identity groups continue to work for recognition, we are met with another opportunity for the academic community to expand its discourse. By acknowledging the lack of multi-racial/multi-ethnic perspectives within academic classes and texts, we aim to locate such texts and bring them to the forefront, while creating a ten week curriculum centering on these perspectives. To expand upon–and potentially move away from–current monoracial discourses, we are engaging in weekly discussions and research concerning many issues from pedagogical applications and methods, to racial formation theory and mixed raced/ethnic identity narratives. We will be teaching our compiled research as a class titled WOMEN 290: Mixed Identities and Racialized Bodies, in collaboration with the Women Studies department at the University of Washington.

Institutionalizing Anti-Racism in the INTER Program

Farah Nousheen, Senior, Comparative History of Ideas
Mary Gates Scholar
Mentor: John Toews, History
Mentor: Jessica Salvador, Educational Leadership Policy Studies

Through a Critical Race Theory (CRT) lens, this paper examines the racialization process of an undergraduate program that was sparked by a yearlong student-initiated qualitative research study and activist project to implement antiracism in the program. Formed in late 1970s, the interdisciplinary undergraduate program INTER (alias used) aims to foster an intellectual and social learning community emphasizing international study, pedagogical innovation, experiential learning, critical thinking, and conflict resolution through dialogue. Historically the program has had a predominantly white administration, instructor base, and student body, although diversity efforts have been in place in the past five years to change the demographics of the program as well as the courses offered. Using Participatory Action Research, this research project was conducted to talk about race in the program, learn about experiences of students of color, and investigate the opportunities and obstacles of implementing an anti-racist framework in the program. The data for this project comes from structured and unstructured dialogue, focus groups, meeting minutes, listserv emails, and online discussion posts. I also examine documents written and disseminated by students that challenge the curriculum, content, and pedagogy of two INTER courses on their racial literacy. The final analysis report employs tenets of CRT and identifies the specific ways that white liberal racism and colorblindness manifested in INTER, the policy changes implemented as a result of the research project, and the continuation of work necessary for the program to strive towards an anti-racist learning community.

Proyecto Acceso: Understanding the Opportunities to Learn for Latino Students in Washington

Luis Ortega Sanchez, Junior, Pre-Major (Arts Sciences)
Zesbaugh Scholar
Arthur Sepulveda, Junior, History
Mentor: Frances Contreras, Education

In 2008, the Washington State Legislature and Governor Gregoire approved ESHB-2687, a bill that calls for a study on the academic achievement gap for minority students. The Commission on Hispanic Affairs commissioned researchers from the University of Washington's College of Education to conduct this study as it pertains

to Latino students. The central questions of this research include: 1) Do Latino students possess the same opportunities to learn as their peers in urban, suburban, and rural contexts? 2) What are the perceptions of parents and students with respect to their experience in school and with school staff? 3) What are viable policy recommendations for raising Latino academic achievement in the state of Washington? Proyecto Acceso, (Contreras, et. al., 2008) uses a multifaceted approach to data analysis, and a mix-method study (interviews, surveys, focus groups) to capture the perceptions and characteristics of Latino students, parents, and teachers within rural, suburban, and urban contexts in Washington. The research team visited 14 schools in 8 school districts and 18 community events all across the state over a period of seven weeks. The final product of our work is a policy report – Understanding the Opportunities to Learn for Latino Students in Washington – which was submitted to the Commission on Hispanic Affairs and presented at hearings for the House Education Committee and the Senate Early Education and K-12 Committee. Our presentation will focus on a background and context overview of Latinos in Washington, key findings from our research, and our policy recommendations. Latinos are the fastest growing minority in the state and U.S.; understanding the needs and opportunities for Latino students in the education system is integral to the economic and social structure of our society, our research is the first step to understanding the opportunities to learn for Latino students in Washington.

SESSION 2H

PHYSICAL AND CHEMICAL INFLUENCES ON MARINE MICROBES

Session Moderator: Virginia Armbrust, Oceanography
Mary Gates Hall Room 238

* Note: Titles in order of presentation.

Physical and Biological Factors Affecting Dissolved Oxygen Concentrations in the San Juan Channel, WA on a Spatial and Temporal Scale during Fall 2008
Kelsey Powers, Senior, Biochemistry, Chemistry (ACS Certified)
Mary Gates Scholar
Mentor: Jan Newton, Oceanography

The San Juan Archipelago is part of a complex hydrological and ecological system. Dissolved oxygen (DO) is not only affected by many physical and biological processes, but it also affects the biological systems in the region. This study focused on the factors affecting the DO in the San Juan Channel during the fall 2008 season. DO, fluorescence, temperature, and salinity were sampled using CTD sensors with calibrations at two stations to asses the spatial and temporal variations. Evidence revealed that physical factors were the main driver of variance between the stations, and throughout the season; however, biological processes did have an impact on the DO concentrations. More specifically, winds, downwelling indices, and tides were the main drivers. Higher DO was observed when upwelling occurred, and after the fall transition on Oct.27 there was a shift to downwelling and lower DO prevailed due to higher oceanic influences.

Marine Bacterial Community Diversity in a Hypoxic Fjord
Andrea Kunkle, Senior, Biology (Physiology)
Mary Gates Scholar
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 several months and oxygen is used up. The hypoxic state is worst at the southern end, leading to fish kills in 2002, 2003, 2004, and 2006, but the extent and severity varies by time of year, geographic 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 roughly bimonthly from June 2006 to June 2007 from five stations and at multiple depths at each station. My involvement began with the collection of the whole water samples which I filtered, preserved and froze. To analyze community composition I 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 from species to species. I extracted DNA from each whole community sample and amplified the ITS regions using PCR to generate products of varying length, representing different species in the community. Preliminary ARISA analysis indicates that the largest influencing factor on diversity and abundance of marine bacterial communities is time of year. In contrast, depth and geography appear to have little to no effect on community composition. I am currently processing and analyzing the remainder of my samples, and am developing a more complete, statistically significant

picture of the influences of marine bacterial community structure.

Nitrogen Limitation and its Effects on Growth Rate and Gene Expression of the Diatoms *Fragilariopsis Cylindrus* and *Pseudo-Nitzschia Multiseries*

Franziska Lutz, Senior, Oceanography
Mentor: Sara Bender, Oceanography
Mentor: Virginia Armbrust, Oceanography

Phytoplankton are microscopic organisms that live in the world's oceans, wherever there is sufficient sunlight and nutrients for photosynthesis. Nitrogen (N) is an example of a required nutrient. When available N is limited, phytoplankton cells become stressed. This changes their growth rate as well as their gene expression. Under this condition, genes can either be up- or down-regulated, to better adapt to the new environment. Tiling arrays, a type of microarray using short fragments as probes to cover an entire genome, were used to test which genes up- or down-regulated in limited and nutrient-replete cultures of the diatom *Thalassiosira pseudonana*, also the first diatom to have its genome sequenced. Following these experiments on *T. pseudonana*, we chose two diatoms, a subset of phytoplankton, *Fragilariopsis cylindrus* and *Pseudo-nitzschia multiseries* to understand the effects of N-starvation on these cells. In silico analysis conducted on *F. cylindrus, P. multiseries* and *T. pseudonana* identified numerous conserved genes. Based on these results, we chose several genes of interest for further analysis. Significantly up-regulated genes included those encoding Mitochondrial import translocase subunit (TIM16), Acetyl-CoA synthetases (ACS), and Phosphoglycerate mutase (PGM). Those genes that were significantly down-regulated under N-starvation included those encoding a harvesting protein, Cytochrome c peroxidase (CCP) and a RuBisCo-Expression Protein (cbbX). These genes will be analyzed with Quantitative PCR (qPCR), and primers specifically designed to target and amplify the genes in question in both the *F. cylindrus* and *P. multiseries* genome under limiting and control conditions. A 10-AU Flourometer will be used to monitor the changes in the Relative Fluorescence Units (RFUs) to calculate growth rates. N-starvation is expected to stress the diatoms, causing them to decrease their growth rate and limit the number of genes responsible for N-metabolism (down-regulation), in order to effectively photosynthesize (up-regulation of photosynthetic genes).

Response of *Prochlorococcus* Ecotypes to Phosphate, ATP and Ammonium Additions

Zachary Thomson, Senior, Oceanography
Mary Gates Scholar
Mentor: Gabrielle Rocap, Oceanography
Mentor: Emily Nahas, Biological Oceanography, Center for Environmental Genomics

Prochlorococcus is the smallest known oxygen evolving autotroph, ranging from 0.4-0.8 micrometers in size. This marine cyanobacteria is highly abundant in the subtropical and tropical oligotrophic oceans particularly between 40and 40. The genus *Prochlorococcus* can be broken down into two distinct light physiologies, high and low light adapted. From these physiologies, *Prochlorococcus* can further be subdivided into six ecotypes based on their genetic differences. In the open ocean, nutrients, specifically nitrogen and phosphorus, can limit the growth of *Prochlorococcus*. However, it is not known which forms of these nutrients are preferred by each ecotype. In November of 2007, a cruise in the South Atlantic took surface samples on a W-E transect. Quantitative polymerase chain reaction (QPCR), which allows for the quantification of these ecotypes by using the internal transcribed spacer (ITS) of rDNA, was performed on these samples. Preliminary data shows that the ecotypes eMIT9312, eMED4 and eNATL2A were present in all of the surface samples while eMIT9313 was not. Incubation experiments were also performed on the cruise from surface samples. These samples, besides the control, were spiked with one of three nutrients: PO4, ATP, and NH4. The incubations were then filtered after 24, 48, and 72 hours. QPCR experiments will be run on the filtered incubations to determine the effects of the nutrients on each ecotype. Preliminary measurements of chlorophyll indicate a large increase due to the ATP addition, but chlorophyll could be any photosynthetic organism. QPCR will allow for the quantification of changes in ecotype populations due to nutrient additions and comparison to the control incubation.

The Annotation of Chloroplast Genomes: Discovering the Evolutionary History of Algal Stramenopiles

Kyle Frischkorn, Junior, Biochemistry, Microbiology
Mentor: Gabrielle Rocap, Oceanography

300 million years ago the stramenopile branch of the tree of life was created when a eukaryotic cell engulfed another photosynthetic cell. This occurrence is known as secondary endosymbiosis because the stramenopile ingested a red alga cell that had undergone primary endosymbiosis by ingesting and retaining a photosynthetic cyanobacterium. The engulfed cells remained undigested and became the cellular organelles referred to as chloroplasts. This single event spawned a diverse lineage as some stramenopiles lost photosynthetic ability or integrated chloroplast genes into their nuclear genomes. Although there are fourteen known classes of photosynthetic stramenopiles, their evolutionary history remains a mystery. By analyzing chloroplast genomes and inferring phylogenetic relationships based on genetic similarities, we are able to parse out the evolutionary events that led up to today's photosynthetic marine organisms.

The process starts with assembling a complete chloroplast genome for each species. All cellular DNA is fragmented and portions of each fragment are compared to a database of known sequences. Identified chloroplast fragments are sequenced entirely and pieced together into the complete chloroplast genome. My responsibilities include running the assembled chloroplast genomes through a program that translates DNA to amino acids, amino acids to proteins, and proteins to their function in the cell. Because these annotations are computationally assigned, it is necessary to make sure the results make biological sense. The predicted regions of translation on the genome must be scrutinized and protein names and functions must be checked for consistency across species. Ultimately, analyzing the data uncovers the relationships of stramenopiles to one another. Additionally, noting similarities to other photosynthetic taxa supports and clarifies the endosymbiosis theory and gives clues as to when these evolutionary changes took place. Finally, the project offers insight into the biology of marine autotrophs—organisms with immeasurable environmental and commercial importance.

Discovering Common Cell Wall Genes in Marine Diatoms using Genome Comparison and qPCR
Tiffany Truong, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Virginia Armbrust, Oceanography
Mentor: Colleen Durkin, Oceanography

Diatoms are unicellular eukaryotic algae that thrive in both marine and freshwater habitats. Their unique heavy silica cell walls aid in the transport of fixed carbon from the surface to the deep ocean. Thus, diatoms are major components of carbon and silica cycles. Out of more than 10,000 species of diatoms, four species have had their entire genomes sequenced; *Thalassiosira pseudonana, Fragilariopsis cylindrus, Pseudo-nitzschia multiseries,* and *Phaeodactylum tricornutum*. The genes responsible for cell wall processes in *T. pseudonana* have been previously identified using tiling array experiments. This study identifies the genes shared between the four diatoms and investigates whether they have a common function in controlling cell wall formation. We hypothesize that if the four diatom species are grown under the same silicate and nitrate limitation, then the shared and conserved genes will be expressed similarly, providing support for common functions in cell wall processes. Acclimated cultures of *F. cylindrus* and *P. multiseries* were grown under silicate and nitrate-deplete media and collected at the onset of stationary growth. The gene expression of targeted genes was analyzed using quantitative polymerase chain reaction (qPCR). This analysis will reveal whether the patterns found in *T. pseudonana* are applicable to understanding cell wall processes in other diatoms. These genes can then be used to analyze cell wall processes in diverse field populations of diatoms in order to better understand the role of diatoms in global carbon and silica cycles.

SESSION 2I

THE DIGITAL HUMANITIES AND TECHNOLOGY-FOCUSED CULTURAL RESEARCH

Session Moderator: Jentery Sayers, English
Mary Gates Hall Room 242

* Note: Titles in order of presentation.

Diagraming Research at the University of Washington
William Damon, Senior, Law, Societies, Justice, English
Mary Gates Scholar
Mentor: Axel Roesler, Art
Mentor: Jentery Sayers, English

In the modern academic landscape a curious mind has to sort through a huge number of different departments, laboratories, and lines of inquiry to find a subject of interest to study. Given recent trends towards increased undergraduate, non-expert, and outsider participation in collegiate research, as well as increased specialization and the 'de-centering' of important research areas, the need for practical tools to aid in networking and targeting special interests seems immediate. While some students may have some idea of what they want to study, for the rest selecting a research area is a difficult endeavor with serious consequences. My research maps the connections and relationships which make up the University of Washington's research environment. As it currently exists my research consists of a wire-frame or mock up of what a functioning digital map would look like. The basic unit of my map is the individual researcher. Data for the map would be supplied voluntarily, by researchers interested in having more of a public presence. Interconnections would be made by users, with the final aim of having the map actually create new connections, rather than merely describing existing ones. Digital mapping techniques are an exciting new frontier, capable of stimulating knowledge of work being done on campus.

New Directions for the Non-Directive: Integrating Technology into Writing Centers
Nichole Poinski, Senior, Comparative Literature
Mary Gates Scholar
Mentor: Kimberlee Gillis-Bridges, English

The integration of technology is a growing trend in university and college Writing Centers across the nation. By "technology", I am referring to everything from the use of the Internet to inform tutoring practices to the actual presence of computers in the Writing Center. Each institution employs variable methods of integrating technology into their space of what has historically been considered personal, collaborative, and conversation-centered. My research investigates the implications of technology on tutoring methods, and asks the questions: If the Writing Center priviledges face-to-face, non-directive tutoring methods, how can the Writing Center keep these valued, associative practices while incorporating technology? Is there a way to achieve scholar Stephen North's goal of 'making better writers' without reducing Writing Center theory to series of practices that are easily translatable to an online, computer-mediated environment? An extensive literature review has historicized my research, revealing several patterns across institutions and years. Dialogues with Writing Center professionals have contextualized my questions stemming from the literature review. However, the crux of my research is the creation of a platform from which to further explore the implications of technology in Writing Center. My platform focuses on learning opportunities to be had by Writing Center administrators, tutors, and student writers.

Textual Remediation of Literature
Andrew Battenburg, Junior, Pre-Sciences
Mentor: Jentery Sayers, English

Traditional forms of media are in a transformative period of digitization, and some forms, such as newsprint, suffer from diminished circulation while electronic media (including the PDF and Adobe Flash) faces increased exposure and acceptance. By remediating books into digital copies, I can archive and distribute texts, provide accessibility features, reduce material costs, and possibly engage in alternative learning and reading styles. This dramatically changes who has access to literature and gives a broader audience a new set of expectations and challenges: do I analyze this new medium as a film, a book, or as something completely new? What does it mean for literature to be remediated into an interactive medium and not a Hollywood blockbuster? When form, design, movement, typography, and sound all come together interactively to highlight the text in its new digital space, new critical practices begin to emerge such as emphasizing important passages, swapping typed notes with peers, and building connections between literature and other media. The USA Trilogy by Dos Passos, a work that drew heavily from the media of the early 20th century to present its own remediation, poses an opportunity to isolate animation practices and translate and expand the text. When separating content from presentation, I keep the original text intact while playing with the aesthetic and design properties that make such a remediation entertaining and engaging. Flash media is simple to author and can quickly distribute and display a text while easily accommodating the movement, colors, and design of a remediated text, including using The USA Trilogy. A single Flash file can store text and textual presentation, embed links, play animation, and appear on nearly every computing platform for anyone with access to a personal computer and the Internet, which is what makes this type of remediation so powerful and exciting.

Modeling Birth
Gretchen Cook, Senior, Women Studies, Art (Design Studies)
Mary Gates Scholar
Mentor: Dominic Muren, Design
Mentor: Jentery Sayers, English

This project grew out of research done during the 2008 Summer Institute in the Arts and Humanities, "Media and the Senses." There, I compiled birth scenes present in popular media to emphasize the dramatization, and how it could be used to influence the viewer about the birth process. The popularized image of birth is the only interaction many people have with the birth process; thus the viewer accepts that the image is a true depiction, and not entertainment. However, popular media is only one form of birth education. The maternity care system in the US is a complex web of information. One must be well informed to expect a safe outcome. Neonatal Mortality Rates published in 2000 show that the US ranks 42nd in the world. In 2005, the Maternal Mortality Rates data ranks the US last among industrialized nations. However, the US out spends other industrialized nations on maternal/infant healthcare. How does one tackle a complex problem to find where change can make an impact? How can those changes be assessed? Applying my visual design education to the critical analysis skills learned in Women Studies and Design Studies, I am utilizing a comparative method to create a collection of diagrams and models to visually depict the connections between stakeholders and results. These models are non-linear tools, meant to enhance the understanding of written and statistical information. They are not indented to simplify a complex problem. Instead, my aim is to make the complexity of maternity care and birth education in the US less of a barrier for everyone involved, creating a common point of origin to make change possible.

Googling Race and Gender: Decoding the Digitization of Asian Women
Seungwha Lee, Senior, Communication
Mary Gates Scholar
Mentor: LeiLani Nishime, Communication
Mentor: Jentery Sayers, English

My research examines the experience of Googling race

and gender online in order to identify the "natural" assumptions about Asian women and articulates how they are visually represented, particularly in the shift from print to digital culture. The Internet is another institution that effectively and implicitly reinforces the existing ideologies in society, affirming stereotypes of race and gender of print culture. Accordingly, my research demonstrates the notion that there is a correlation between the commodification of the images of Asian women online and Asian women offline. This presentation discusses how Asian women have been visually constructed and sexualized online, and explores the ramifications of these sexualized representations by pressuring of Asian women as "Lotus Blossoms" or "Dragon Ladies". These iconic images represents both passive and aggressive exotic sexuality of Asian women visually on both print and digital media. Whereas there is a clear distinction between producer and consumer of these images in the print culture, the producers and the consumer of the Internet content becomes indistinctive online. I suggest a reformulation of the printed mass media, producer-consumer model to a more tailored adaptation model for Internet studies, where the producers and consumers become integrated through interactivity.

Into the Eyes: Proprioception and Body Space in Interacting with Environments

Tharinduni Nanayakkara, Senior, Comparative History of Ideas
Mary Gates Scholar
Mentor: Axel Roesler, Art

"Into the Eyes" explores the roles embodied vision and proprioception play in creating ecologies, or sets of relationships among observers, objects, and environments. First, I examined the perceptual conditioning implicit in visual media interfaces such as screens. During summer 2008, I collaborated with Kendal Lund and William Damon to create "Quantum Learning," a three-channel video installation, to illustrate how the body actively orients itself and how media enter proprioceptive space. To explore human-object interaction further, I created LAMP, an observational video account of how location and motion in reference to an object might affect the way an observer relates to it. Vision is not only localized in the eyes but infused in proprioception, which allows observers to sense their own body in space. Using these projects as a starting point, I mobilize James J. Gibson's model of active visual perception as the product of an observer directing views while moving through an environment to focus not only on vision, but on the superimpositions of tactility and movement involved in vision. Specifically, I ask how observers might use their bodies as a scale and how interacting with objects can change observers' perceived body scale and body boundaries. To approach my questions, I am designing a qualitative research study, where I plan to make field observations of workers using specific kinds of tools and objects in three types of work environments and understand what senses and affordances such interactions might provide. I hope to use my research to inform the design of technologies and objects that will not only act as extensions of the body, as Gibson states, but surround, permeate and utilize the enactive potentiality of the body.

Poetic Crossroads: Roman Elegy (re)Constructing a Poetics of Choice

Nicholas Rupert, Senior, English, Classics, Philosophy
Mary Gates Scholar
Mentor: Stephen Hinds, Classics
Mentor: Catherine Connors, Classics

The image of Sophocles' Oedipus Rex at the crossroads, killing his father and determining his fate, looms large in modern culture. Less known is the once popular moralizing fable of Hercules at the Crossroads, in which Hercules makes a decision between personified Virtue and Vice. The choice of Paris, a choice between Venus and Juno, causes the Trojan war. By the time of Sextus Propertius and Roman elegy in the first century B.C., all of these myths were contributing to the literary environment in which the Latin love elegists wrote. Propertius lives in an age when political, social, and literary magnates choose paths that decide the fate of their societies and the Western civilization to come: Cicero, Caesar, Augustus, and Livy each halts at a proverbial crossroads, looks around, and points down paths that Petrarch, Napoleon, Mussolini, and Machiavelli follow millennia later. Propertius centers poem 4.7—his most discussed elegy from his most complex book—around the image of crossroads, and this image in turn mirrors the themes of polarization and choice that pervade his fourth book. Other elegists, particularly Ovid in his Amores, also utilize the image of the crossroads to emphasize the choices and questions latent in their poetry. Thus, poetic crossroads become an image through which Roman elegists emphasize and assert the diverse power of their poetry, its power to express contradictions, to function as both political satire and love poetry, and ultimately its power to mean different things to different readers.

SESSION 2J

WORLD FINANCIAL CRISIS: AN EXPLORATION OF COMPONENTS OF THE CRISIS

Session Moderator: Michael Verchot, Business and Economic Development Center
Mary Gates Hall Room 248

* Note: Titles in order of presentation.

The Quantity Theory of Money and its Effects on Inflation

Britteny Caldwell, Senior, Business Administration (Finance), UW Tacoma
Mentor: Douglas Wills, Business, UW Tacoma

There exist many theories in regards to what causes inflation. One theory that has not received much attention is the "Quantity Theory of Money" (QTM). Its origins can be traced to the 1700's, and has had an impact on monetary policy since currency existed. The theory states that as the quantity of public money increase, inflation increases. Economists studying QTM developed this equation, known as the Fisher Equation (after Economist Irving Fisher): MV=PT, where M is public money supply, V is velocity of circulation, P is average price levels, and T is the volume of transactions. Therefore, Money x Velocity = Total Spending. There is evidence to support this theory, but inflation is a complicated idea, and many argue against it. Although there is ample research and studies to support QTM, many economists, such as the famed J.M. Keynes, have argued it is not correct. In my research, I explain the origins of QTM and what it is. I will also compare the arguments for and against the validity of QTM. Finally, I will look at possible implications the QTM has on today's economy and inflation. Ultimately, through research and observation I believe that QTM as well as other factors, such as the Federal Reserve Interest Rate, has effects on inflation.

Crude Commodity Futures: A Speculators Game?

Rachel Waszkewitz, Senior, Economics
Mentor: Larina Davis, Economics

In the five years prior to the end of 2008, aggregate crude commodity prices increased more than at any other time in United States history (Veneroso 2007). It was widely believed that this trend could be explained by rapid growth in the world economy until the summer of 2007 when the economy began to show signs of a recession and yet commodity prices continued to soar. Blame has now been directed toward the influx of speculators into the futures commodities markets as the major contributors to the steep upward trend (Masters 2008). Because actual physical commodity prices are benchmarked to the price levels of commodities futures, crude spot price dislocations from traditional economic supply and demand influences will have real and material impacts on the economy. Empirical studies to date have not yet determined the extent to which crude speculators affect futures markets, and if indeed this factor is the primary driving force behind crude trends. To address this material omission in the literature, I plan to econometrically test the significance of crude oil speculators via a standard Arbitrage Pricing Theory model. I will regress crude oil futures contract prices on fundamental economic indicators (a la Elton, Gruber, and Mei 1994): LIBOR swap spreads, interest rates, exchange rates, GNP, and inflation; and variables to proxy for crude speculation that differentiate between index and non-index speculators, market momentum based on the S&P 500 Index, and factors of crude oil supply and demand. My empirical work hopes to provide insight into factors driving current crude trends, as well as focusing in particular on the true level of influence that speculators have in these markets.

Investigating Management's Choices to Revise its Earnings Forecasts

Robert Stoumbos, Senior, Accounting
Mentor: Lloyd Tanlu, Accounting

Earnings forecasts are voluntary disclosures used by managers to provide more information about expected firm performance. One aspect of earnings guidance that has received little attention in the accounting literature is the revision of management forecasts. I study forecast revisions for several reasons. First, the quantity and direction of forecast revisions can signify the economic environment surrounding the firm making the forecast. Second, forecast revisions are signals of the quality of the managers making the forecast, as well as indications of how credible the forecasting process is within a firm. Third, forecast revisions can either strengthen or undermine the credibility and informativeness of a firm's voluntary disclosures. My preliminary findings indicate that revisions are: (a) positively associated with uncertainty; (b) positively associated with analyst following; and (c) more often revise downward. Furthermore, I expect that the magnitude of negative short-run stock returns following downward revisions will be on average greater than the magnitude of positive short-run returns from beating a forecast. Since many managers follow this pattern in their revisions, this finding suggests that they are not behaving in the best interests of the firm. Finally, I also expect to find that firms that revise their forecasts more frequently are less likely to manipulate their actual earn-

ings.

Going Public through the Back Door: A Comparative Analysis of SPACs and IPOs
Daniel Chang, Senior, Business Administration, UW Bothell
Mentor: Ufuk Ince, Business Administration, UW Bothell

We examine the operating and financial performance of 84 special purpose acquisition companies (SPACs) before and after consummating a merger with a private company. Using a proprietary database for the period 2003 to 2008, we analyze the effects of industry, firm, and deal characteristics on the performance of the merged entity. In addition, we compare the characteristics of the firms that choose the SPAC format to become a public company with those that choose the traditional IPO format. The statistical analysis is conducted using linear as well as logistic regression methodologies. We find that the prestige of the underwriting investment bank, the sector and country focus, and the quality of management affect the success of a SPAC transaction positively. Further, SPAC targets carry more debt, are smaller, and have less growth potential than the firms that conduct a traditional IPO.

SESSION 2K

NUTRIENTS, LONGEVITY, TISSUE MAINTENANCE, AND RENEWAL

Session Moderator: Weiqing Li, Biological Structure
Mary Gates Hall Room 251

* Note: Titles in order of presentation.

Cellular Cooperation in Spatially Structured Environments
Zackary Scholl, Senior, Physics, Applied Computational Mathematical Sciences (Engineering Physical)
Mentor: Wenying Shou, Basic Sciences, Fred Hutchinson Cancer Research Center

Cooperation promotes the evolution of complexity. Multicellular organisms have evolved from their unicellular ancestors, like the lichen forming from the symbiosis between green algae and fungi. To model the evolution of cooperation we created a system of Cooperation that is Synthetic and Mutually Obligatory (CoSMO). CoSMO consists of a pair of genetically modified yeast strains that are non-mating (and hence acting like two species) and that exchange essential nutrients (obligatory cooperation). In a well-mixed environment, viability of CoSMO depends on supply and consumption properties of the two cooperating partners, and on initial conditions such as total population density and partner ratio. In a spatially structured environment, such as on an agar pad, there is a time delay in nutrient availability caused by the diffusion of nutrients. Thus, the problem of cooperation in a spatially structured environment can be broken down into three parts: (1) release of nutrients; (2) diffusion of nutrients; and (3) consumption of nutrients coupled with cell growth. I have successfully established a protocol for measuring the coefficient of diffusion of ink on agar by measuring the change in ink concentration versus time and distance in a spectrophotometer. Currently I am developing a protocol to measure the concentration gradient of metabolites along an agar pad from a point source. I plan to measure the combined effects of nutrient release and diffusion by growing cooperators on an agar pad and measuring nutrient distribution as a function of time. Nutrient availability will be linked to growth by microscopically observing cell growth on agar pads supplemented with various concentrations of nutrients. Integrating the nutrient supply and consumption properties of the two partners and the diffusion behavior of the nutrients will help us understand how spatially structured environments affect cooperation.

Conservation of Function of GCN4 Orthologue ATF-5
Alexander Huh, Senior, Biology (Molecular, Cellular Developmental)
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Matt Kaeberlein, Pathology

Humans have always made an effort increase their longevity and improve health during old age. 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 shed some light on the pathways that may be essential for increasing lifespan in more complex organisms. Two commonly used model organisms in aging research are the budding yeast Sacchromyces cerevisiae and the nematode Caenorhabditis elegans. Our group has recently shown that the stress responsive transcription factor Gcn4 is an important downstream mediator of life span extension in response to dietary restriction and reduced signaling through the target of rapamycin (TOR) kinase (Steffen et al., Cell 133:292, 2008). In response to DR, TOR activity is reduced, globale mRNA translation is impaired, and Gcn4 is up-regulated by differential translation of GCN4 mRNA. This up-regulation of Gcn4 is required for life span extension in yeast. The goal of this project is char-

acterize the function of the C. elegans Gcn4 homolog ATF-5 and determine whether ATF-5 plays a similar longevity-promoting role. We will determine whether ATF-5 is translationally regulated in a manner similar to Gcn4 by monitoring protein expression in response to different physiological stresses, such as starvation, reactive oxidative species, and proteotoxicity. We have also observed that mutation of ATF-5 leads to reproductive and longevity phenotypes and we will examine whether loss of ATF-5 modulates life span extension by DR in worms. These studies will help determine whether Gcn4 homologs are conserved longevity factors and may provide insight into the potential for targeting this family of proteins to treat age-associated diseases in people.

Molecular Identification of a New Activator of Insulin Signaling in the Nematode *C. elegans*
Shyam Bhansali, Senior, Biology (General)
Mentor: Weiqing Li, Biological Structure

Insulin signaling has been shown to be a major regulator of longevity in the nematode *Caenorhabditis elegans*. Down-regulation of insulin signaling in adults leads to a doubling of lifespan compared to wildtype animals. This extension is dependent on the activity of DAF-16, an ortholog of the mammalian FOXO transcription factor. We have isolated *qb10*, a new mutant allele that increases longevity in *C. elegans*. My preliminary data shows that the lifespan extension of *qb10* mutants is dependent on DAF-16, as knockdown of *daf-16* mRNA levels through RNA-mediated interference (RNAi) suppresses the long-lifespan of *qb10* animals. This suggests that *qb10* is a mutation in a gene whose wildtype function is to activate insulin signaling in *C. elegans*. We have tentatively named this gene *ais-1* (*a*ctivator of *i*nsulin *s*ignaling-*1*). My current goal is to identify the molecular nature of the *ais-1* gene. To do this I am employing a single nucleotide polymorphisms mapping strategy to locate the position of the *qb10* allele in the fully sequenced *C. elegans* genome. I have already found that *qb10* is linked to a region that does not contain any of the other genes known to extend lifespan in the worm. This suggests that *ais-1* represents a new component of insulin signaling and longevity in *C. elegans.* I hope that with some finer scale mapping I can establish a smaller sized interval that can be screened for candidate genes. To do this I will use RNAi to knock down the activity of genes that are known to map to this interval in wildtype worms. Any gene whose knock down by RNAi results in an increased longevity phenotype will be considered a candidate gene for *ais-1* and will be sequenced in the *qb10* background in order to find the mutation.

Determining the Role of Runx2/Cbfa1 in Vascular Calcification through Runx2/Cbfa1 Knockdown and Inorganic Phosphate Induction in In Vitro Mouse Aortic Smooth Muscle Cells
Pranoti Hiremath, Senior, Bioengineering
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Yanfeng (Mei) Speer, Bioengineering
Mentor: Cecilia Giachelli, Bioengineering

Vascular calcification, the deposition of calcium phosphate in the cardiovascular system, has been linked to high cardiovascular death in patients with chronic kidney disease and type II diabetes. At the cellular level, induction with inorganic phosphate induces calcification of smooth muscle cells (SMCs) and phenotypic change of the vascular cells to an osteogenic state. Studies have shown that Runx2/Cbfa1 is an osteogenic transcription factor that is a necessity for bone formation and an early indicator of SMC transdifferentiation. We studied the effect of blocking Runx2 expression in in vitro mouse aortic SMCs. Expression of Runx2/Cbfa1 was recapitulated when vascular SMCs were cultured in medium containing high phosphate. Knockdown of Runx2/Cbfa1 in SMCs via RNA interference led to a near complete block of phosphate-induced matrix calcification. These results are the first to identify a role of Runx2/Cbfa1 in phosphate-induced SMC calcification.

Cloning of the Fluorescence Indicator Protein for Inorganic Phosphate (FLIPPi) Construct for Use In Mammalian Cells
Stephanie Huynh, Senior, Biology (Molecular, Cellular Developmental)
Amgen Scholar
Mentor: Cecilia Giachelli, Bioengineering
Mentor: Maria Festing, Bioengineering

In healthy individuals, an appropriate balance between specific factors that inhibit calcification and growth factors that promote bone formation is present. In patients affected by vascular calcification (VC), inhibitors of bone formation in vessel walls are lost or reduced and promoters of bone formation are stimulated, resulting in improper ectopic deposition of hydroxyapatite within the vasculature. Previous studies have indicated that high influxes of inorganic phosphate (Pi) via Pit-1 (SLC20A1), a Type III sodium-dependent phosphate co-transporter, play a significant role in phosphate-induced calcification of vascular smooth muscle cells (VSMCs) and differentiation of VSMCs into osteoblast-like cells in vitro. Since Pi is an essential molecule in all cells with unique subcellular localizations and plays a critical role in VC, it is necessary to monitor Pi concentrations in living VSMCs. This will be accomplished via the pairing of fluorescence resonance energy transfer (FRET)-based technology with the fluorescence indicator protein for inorganic

phosphate (FLIPPi-30m). This chimeric protein is an in-frame fusion of cyan fluorescent protein, the truncated Pi-specific binding protein PiBP, and yellow fluorescent protein. The pRSET vector containing the protein was obtained, but needed to be cloned into a plasmid that can be expressed in mammalian cells. This new construct was engineered by means of enzyme digestion and ligation of FLIPPi-30m from the pRSET-FLIPPi-30m plasmid into the mammalian vector pcDNA3.1(+). The construct will consequently be transformed into chemically-competent E. coli cells, from which more plasmid will be harvested. Enzyme digestions and gel electrophoreses were used to confirm correct engineering through evaluation of DNA fragment sizes. The pcDNA3.1(+)-FLIPPi-30m construct will be used in future studies as a Pi-sensitive sensor in aortic smooth muscle cells that are wildtype and Pit-1 null. Studying the mechanisms of Pi regulation will enable the elucidation of new potential therapeutic targets in the attempt to regulate VC.

Modeling BCRP (Breast Cancer Resistance Protein) Structure and Function using FRET (Fluorescence Resonance Energy Transfer) Microscopy

Michelle Mark, Sophomore, Pre-Major
Mary Gates Scholar
Mentor: Qingcheng Mao, Pharmaceutics
Mentor: Zhanglin Ni, Pharmaceutics

The Breast Cancer Resistance Protein (BCRP) is a member of the ATP-Binding Cassette (ABC) superfamily of drug transporters that transport a variety of substrates across cell membranes using ATP-hydrolysis. Substrate efflux plays an important role in protecting tissues of the blood brain barrier, liver, ducts and lobules of the breast, and placenta from toxins. However, it has been observed that BCRP confers multi-drug resistance to cancerous tissues overexpressing the gene because BCRP prevents the accumulation of chemotherapeutic drugs in cells. Thus, it is essential to develop better BCRP modulators, which requires further knowledge about the structure and function of the protein. Past literature suggests that BCRP functions as a homodimer bonded by disulfide bonds (bonds between two Cysteines); however, it is still unclear which regions of BCRP are critical for homodimerization and function. Our project aims to elucidate the roles of two regions in previous literature: the Cys603 and the extracellular loop spanning amino acids 590-622. We used PCR mutagenesis to remove the extracellular loop of interest and mutate the Cys603 to Alanine, thereby eliminating any existing disulfide bonds. We expect to observe drastically reduced homodimerization and function only for the deletion mutant because we believe Cys603 is not essential for function and homodimerization. We will measure and compare homodimerization and function of the BCRP and the BCRP mutants using Fluorescence Resonance Energy Transfer (FRET) microscopy and flow cytometry assays, respectively. Thus far we have prepared the BCRP and BCRP mutants for FRET microscopy by fusing the BCRP/BCRP-mutant DNA with donor and acceptor fluorescence proteins. Interactions between donor and acceptor fluorescence proteins will provide the distance between our BCRP/BCRP-mutant proteins and indicate homodimerization. We hope the findings of our research will clarify the molecular mechanism of BCRP, aiding further pharmacological development of BCRP modulators and better cancer treatments.

Generation of Human Induced Pluripotent Stem Cells Using Foamy Virus Vectors

Jordan Kho, Senior, Biology (Molecular, Cellular Developmental), Microbiology
Howard Hughes Scholar, Mary Gates Scholar
Mentor: David Russell, Medicine
Mentor: Iram Khan, Medicine

In 2007, a major breakthrough was reported whereby pluripotent stem cells could be generated from human fibroblasts by virus-mediated transduction of four transcription factors. These so-called induced pluripotent stem (iPS) cells appear to resemble embryonic stem (ES) cells and have brought an unprecedented promise of potential patient-specific cell therapy. This technology, however, still has some limitations, a major one being the use of either gamma-retroviral or lentiviral vectors. Both viruses have strong preferences for integration within genes or near transcription start sites and can thus possibly lead to tumor formation by insertional mutagenesis. My research aims to test whether induction of pluripotency can also be achieved using foamy virus (FV) vectors. We anticipate that FV vectors can be a safer alternative system because they have a much lower preference for integration within genes and near transcription start sites. Thus, we constructed FV vectors that contain different transcription factors (Oct4, Sox2, Nanog, Lin 28, Klf4, and c-Myc) and double selection markers (HyTk and Tkneo) to enable both positive and negative selection. We also aim to reduce the number of viral integrations per cell by incorporating multiple transcription factors on a single viral vector and loxP sites inserted into the 3'LTR so that the whole vector provirus can be excised out of the genome once the cells turned pluripotent. The ongoing project is to generate iPS cells from human fibroblasts through transduction with different combinations of the constructed FV vectors. Once generated, we plan to characterize the pluripotent status of the reprogrammed cells by checking the ES cell-specific gene expression, telomerase activity, epigenetic status, and the capacity to differentiate into advanced derivatives of the three germ layers in vitro and in teratomas.

SESSION 2L

ENVIRONMENTAL FUTURES

Session Moderator: Stevan Harrell, Anthropology
Mary Gates Hall Room 254

* Note: Titles in order of presentation.

Collapsing Financial Systems, Climate Deterioration, and Widening Social Inequalities: An Empirical Exploration of Cause/Effect, Coincidence, and Hope
Nathan Angle, Senior, Individualized Studies
Juliane Popelka, Senior, Economics
Whitney Stovall, Junior, Environmental Studies
Gonzalo Thienel Carrasco, Graduate, Forest Resources, Global Trade, Transportation Logistics
Mentor: Dorothy Paun, Forest Resources

Is today's concurrent collapse of global financial systems, climate deterioration, and widening social inequities merely coincidence or cause and effect related? Our research goal is to explore these issues within an empirical framework. Companies with shares trading on stock exchanges are required by law to issue financial statements so that owners, lenders, suppliers, and managers can assess financial health and performance. A widening group of stakeholders (i.e., any person or group that can affect, or be affected by, a company's actions) continue to advocate for more transparent environmental and social responsibility performance reporting, and, while currently voluntary, an increasing number of firms are issuing sustainability / environmental / corporate social responsibility reports (hereafter called sustainability reports). Such reports provide information and data that can be extracted for investigating potential positive and negative relationships among environmental, social, and financial performance. Using 2007 annual financial and sustainability reports from companies in the United States and Canada, we collected and compared data for a sample of firms from the energy, food and beverage, forest products, electronics, banking, and entertainment industries. In total, we studied 106 variables: 41 environmental (e.g., climate change initiatives, recycling practices, green purchasing preferences for eco-friendly or reduced life cycle environmental impacts materials and products); 57 social (e.g., human rights, social responsibility management systems for social, health, and safety, community volunteerism); and eight financial (e.g., net income, revenues, owners' equity, long term debt). Study findings offer insights on similarities and differences among triple bottom line performances (financial, environmental, and social).

Analysis of Water Projects in Yangjuan and Pianshui, The Search for Development in Rural China
Geoffrey Morgan, Senior, International Studies, Civil Engineering
Mary Gates Scholar
Mentor: Stevan Harrell, Anthropology

Over the last decade there has been a push from NGOs to reach a larger number of people and to reach them in more isolated and impoverished regions. However, the success rates of these projects, particularly drinking-water projects, is quite low and in some cases can leave the people they were designed to help in worse off conditions than before the addition of the project. In the 2007-2008 academic year I conducted an independent research project in the mountains of southwest China to gain insight into why these success rates are so low. My research was located in two Nuosu villages called Yangjuan and Pianshui which had received 4 water projects from various NGO groups. I was able to analyze these projects to see how they affected the villagers and whether or not they still were functioning to their original design intentions and if not, why. As a culmination to my work I was able to make marked improvements to a water project and come up with several factors as to why NGO water projects can fail. The primary reason that the water projects have such a low rate of success is due to the fact that NGOs tend not to pay close enough attention to the environment in which they are building their project. This includes factors such as placing enough attention on the importance of localized information, analyzing the ability for local infrastructure to sustain the introduction of an imported technology, the local sociocultural and political issues with the area and how it may alter with the addition of a project, making sure the benefits of the project are known before hand or are taught in conjunction with the addition of the project, and by utilizing women's roles in the oversight and management of the project.

Architectural Implications of the Biophilia Hypothesis
Vanessa Nevers, Senior, Architectural Studies
Mentor: Louisa Iarocci, Architecture

In 1984, evolutionary biologist Edward O. Wilson published the book, *Biophilia* in which he proposes that biophilia is the innate human affinity for nature and an essential aspect of human development. The question posed here is whether biophilia can be translated into a set of architectural design principles that lead to improvements in human health and well being, and an increased sense of responsibility for the environment. Examination of the biophilia hypothesis indicates that it is

a valid basis for rethinking how our built environments are designed. An increasing number of people are living in urban settings and are spending the majority of their time indoors. Architecture that does not respond to biophilic design principles can further isolate its inhabitants from nature. Analysis of past and current research on biophilia as well as publications on biophilic design theory indicate that a lack of ecology of place can lead to a sense of disconnection and weaken individual attitudes towards ecological responsibility. This investigation will attempt to reveal the powerful potential of architectural design to affect the quality of human life and its relationship to the environment.

The Viability of Shipping Through the Arctic: An Analysis of Risks and Risk Management for Shipping Lines

Naama Sheffer, Senior, International Studies
Mary Gates Scholar
Mentor: Anne Goodchild, Civil Environmental Engineering

Recent receding levels of the Arctic ice pack are bringing the use of the northern passages closer to significant implementation, connecting the north Atlantic with the north Pacific, and changing international trade patterns in a notable way. These Arctic routes could significantly shorten the traveling distance for certain current routes and imply faster delivery of goods at lower shipping costs due to lower fuel usage, lower labor costs per journey due to fewer man-hours, and lesser passage fees. However, as a business, shipping lines have as an objective the on-time delivery of their full cargo to the port of destination, with a healthy crew on board and minimal damage to the ship. The harsh environment, minimal infrastructure and many unknowns in the progression of change in the Arctic present uncertainties as to the cost effectiveness of these routes (for example, through higher insurance rates). While states and international organizations are already creating policy recommendations for dealing with the management of shipping through the Arctic, the shipping industry is still skeptical about the feasibility of using the northern passages in the coming years. Planning for responsible use and the predictability of future Arctic shipping depend on good risk assessment and risk-management recommendations. This research intends to address these issues and is two-staged: the first stage will identify the current origin-destination routes for which Arctic passage would provide benefit, and understand potential demand on these routes. This stage will also define the risks of shipping through the Arctic based on readings and expert interviews, and include initial options and recommendations for dealing with these risks. The findings of this stage will be presented at the symposium. The second stage will interview representatives of shipping lines, and compare current risk-management strategies applied on non-Arctic routes with measures needed to ship through the Arctic.

A Comparison of Environmental Stewardship and Social Responsibility in Europe and North America

Elizabeth Tran, Senior, Environmental Science Resource Management
Mentor: Dorothy Paun, Forest Resources

The World Commission on Economic Development defines sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Around the world companies are issuing sustainability reports to communicate with various stakeholders. Sustainability reporting (i.e., environmental reports, corporate social responsibility reports) refers to disclosing social responsibility and environmental activities and performance. These annual reports are useful for transparency as well as comparing sustainable practices among different firms over time. This study compared the environmental and social responsibility practices of European and North American businesses by analyzing data contained in corporate sustainability reports. The sample of 68 publically traded firms was chosen from the Pacific Sustainability Index database. Sixty-eight firms (54%) were from Europe and 31 (46%) from North America, with corporate headquarters in 13 countries (Belgium, Canada, England, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and the United States). The sample represents 12 industries (banking and insurance, chemicals, computing and office equipment, electronics, energy, food and beverages, forest products, metals and mining, pharmaceuticals, telecommunications, transportation, and utilities). The following variables were investigated: 1) climate change initiatives; 2) green purchasing preferences for eco-friendly or reduced life cycle environmental impacts materials and products; 3) social responsibility management systems for social, health, and safety; and 4) screening procedures to evaluate suppliers that help fulfill the firm's sustainability policies and principles. Study findings indicate that North American firms lag European counterparts in all of the variables.

SESSION 2M

COMBATING HIV

Session Moderator: Zihuan Yang, Laboratory Medicine
Mary Gates Hall Room 271

* Note: Titles in order of presentation.

Development of a High Throughput Method for Screening Merck Ad5 Vaccine Vector and HIV-1 Insert Genes in Vaccinated Individuals
Luis Acevedo, Senior, Biology (Molecular, Cellular Developmental)
EIP/Presidential Scholar
Mentor: Tuofu Zhu, Laboratory Medicine

The recent failure of the Merck Ad5 HIV-1 vaccine in the STEP phase II clinical trial has prompted many questions regarding the use and biological function of adenovirus vectors. Understanding how adenovirus serotype 5 (Ad5) vectors interact with the host's immune system is essential since Ad5 is commonly used for gene therapy and vaccination. Currently it is unknown whether the Merck Ad5 vaccine vector persists in humans post vaccination. We believe this is primarily due to the lack of methodologies with the sensitivity to detect a single nucleic acid. Here we have developed a new ultrasensitive multiplex PCR assay to determine the persistence of the Merck Ad5 vaccine in PBMC of humans post-vaccination. We designed primers and fluorogenic probes specific for detection of the Merck vaccine vector and HIV-1 transgenes. MRKAd5 gag, pol and nef plasmid DNA were serially diluted and spiked with donor PBMC to simulate patient sample conditions. The effectiveness of the primer/probe designs utilized in this novel PCR system was examined by a first round limiting dilution multiplex PCR and second round Nested Real-Time PCR. This assay is able to conclusively differentiate and quantify the Merck vaccine Ad5 vector and HIV-1 transgenes gag, pol and nef. We found this assay is sensitive to detect 1 DNA copy for all target genes in the presence of a large cellular DNA background. Our newly developed method provides an ideal combination of sensitivity and reliability for testing samples on a large-scale and can be utilized to test whether the Merck vaccine persists in study subjects post-vaccination. This study may directly influence the engineering of next-generation HIV-1 vaccine candidates, by helping to determine the utility of using similar vectors as an effective strategy for future HIV-1 prevention or viral load control efforts.

Stabilizing the APOBEC3H Protein to Recover Antiviral Activity Against HIV
Bora Chang, Senior, Biochemistry
Mary Gates Scholar
Mentor: Michael Emerman, Human Biology, Fred Hutchinson Cancer Research Center/UW
Mentor: Nisha Duggal, Biology

APOBEC3H, or apolipoprotein B mRNA-editing enzyme catalytic-polypeptide-3H, is one of seven APOBEC3 genes found in primates. The APOBEC3 genes encode for antiviral proteins that function as cytidine deaminases which cause hypermutation during viral reverse transcription, thereby rendering the viral genome defective. In the human population, there are four haplotypes of APOBEC3H in varying proportions amongst global ethnic groups. Three of these haplotypes translate proteins with a very short half-life (about 30 minutes) and only one translates a stable protein (half-life over 6 hours). It is not known at this time if the stability/instability of the different APOBEC3H haplotypes is due to selection, or due to genetic drift in the absence of selection. However, the instability of some haplotypes likely reflects a loss of function of the APOBEC3H protein. We wish to address the mechanisms that govern APOBEC3H proteins stability since we know that the stable (but not unstable) proteins retain their function as antiviral proteins against viruses in general, and in particular, HIV. Our strategy is to use inhibitors of the two major degradative pathways in mammalian cells to inhibit the proteolytic pathway or the lysosomal pathway, or both, to see the effects on the level of protein in the cells. Preliminary data suggests that the four haplotypes of APOBEC3H are degraded in different pathways. Currently, I am conducting antiviral activity assays to determine whether transiently stabilized APOBEC3H proteins have retained any cytidine deaminase activity, and are able to counteract viruses. The APOBEC3H/HIV interaction is a promising host cell factor and viral interaction that may be important in elucidating how the previous genetic history of humans has rendered them more susceptible to HIV and may offer insights into ways to counter HIV in the future.

Isolation and Characterization of Monocyte-derived HIV-1 from Discontinued Anti-retroviral Therapy Patients
Gregory Dann, Senior, Biochemistry
Mary Gates Scholar
Mentor: Tuofu Zhu, Laboratory Medicine
Mentor: Tong Wang, Laboratory Medicine

Monocytes harboring HIV-1 are the primary source of virus in tissue macrophages throughout the course of infection. Current anti-retroviral therapy (ART) targets cells undergoing active viral production and is thus able to effectively suppress HIV-1 in CD4+

T cells. However, due to distinct differences in viral replication and transmission, HIV-1 in monocytes/macrophages plays an integral role in the perseverance and reestablishment of virus in the host during and after discontinuing ART. Studies have shown that HIV-1 in monocytes/macrophages evolve independently from that in CD4+ T cells. It is our hypothesis that monocyte/macrophage-derived and CD4+ T cell-derived HIV-1 isolates from the same patient are genetically and phenotypically distinct. Peripheral blood mononuclear cell (PBMC) samples were obtained from HIV positive patients 1690, 1696, and 1175 of the Seattle Primary Infection Cohort at time points 2 days before therapy as well as 6.7 and 0.4 years after their stopping ART, respectively. Highly purified patient monocytes and CD4+ T cells (>99% purity for both) were then co-cultured separately with PHA-stimulated, CD8+ T cell-depleted, healthy donor PBMC. HIV-1 p24 concentrations in the co-cultures were monitored by ELISA assays to detect viral replication. Each isolate was evaluated through sequence analysis, determination of co-receptor usage, and viral fitness in monocyte-derived macrophage co-culture. Co-cultures of monocyte-derived HIV-1 from patients 1690, 1696, and 1175 (1690M, 1696M, and 1175M) first demonstrated p24 positives on Day13, Day19, and Day18, respectively. Co-cultures of HIV-1 from CD4+ T cells (1690T, 1696T, and 1175T) were first positive on Day12, Day13, and Day0. Viral stocks were harvested during the exponential stages of each expansion, and their final p24 concentrations all exceeded 100ng/mL. For the first time, infectious CCR5-tropic HIV-1 were successfully isolated from highly purified infected patient monocytes. These isolates are genetically and/or phenotypically distinct from CD4+ T cell derived HIV-1.

Characterizing HIV-1 Superinfection Cases

Ozge Dogan, Senior, Microbiology
Mary Gates Scholar
Mentor: Catherine Blish, Medicine
Mentor: Julie Overbaugh, Human Biology

Superinfection with HIV-1 occurs when an individual already infected with one strain of HIV-1 becomes infected with a second strain. To characterize the conditions under which superinfection occurs, we evaluated superinfection cases caused by heterosexual transmission of the virus among female sex workers in Kenya. In order to determine whether deficits in the neutralizing antibody responses to HIV-1 contributed to superinfection in these women, we cloned and characterized the envelope genes of both the initial and superinfecting HIV-1 variants. We found that most of these women became superinfected despite pre-existing antibodies capable of neutralizing their superinfecting strain. Overall, we found no deficits in the neutralizing antibody responses of women who went on to become superinfected. Currently, we are using similar methodology in order to identify and characterize potential superinfection cases in Washington State. We are amplifying and sequencing two regions of the HIV-1 genome by reverse transcription-PCR from the plasma of local HIV-1 cases who have $>$ 1 year of follow-up. By comparing the sequences from early and late viruses, we will be able to identify additional cases of superinfection by the appearance of a phylogenetically distinct virus population at the later time point. If any cases are identified, we can then go back to intervening samples in order to pinpoint the timing of the superinfection. This research will help us to further characterize immune responses during superinfection.

Viral Evolution in an HIV-1 Breakthrough Vaccine With Sustained and Undetectable Viral Load

Sergei Ivanov, Senior, Microbiology
Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: Tuofu Zhu, Laboratory Medicine

Current vaccine efforts are largely driven towards a goal that has proven achievable in SIV-monkey models; namely, any vaccine that fails to prevent infection should inhibit the virus to such low levels that the likelihood of transmission and disease progression would be significantly reduced. However, fundamental differences between SIV and HIV-1 preclude direct extrapolation of vaccine correlates from monkey models to human infection. The need for pioneering new approaches to AIDS vaccine design became even more apparent after Merck's leading candidate, MRKAd5, which showed promising control of virus levels post-infection in monkeys, failed to provide any degree of protection against or control of HIV-1 infection in humans. Thus, understanding how to protect against HIV ultimately requires evaluation of its natural host - humans. Bearing this in mind, we present a case study examining an HIV vaccine trial participant who became infected in spite of receiving a series of vaccinations, but has naturally controlled HIV-1 levels and maintained healthy CD4+ T cell counts throughout nine years of follow-up. Specifically, we longitudinally characterized the earliest CTL epitopes (4) identified before or near seroconversion. Over the first three years of infection, three of the early-identified epitopes, which involved largely conserved amino acid sites, were replaced with escape mutations while the fourth epitope remained unchanged. In addition, one of the escape mutations later reverted back to its original, highly conserved, amino acid sequence and was associated with a mutation in its flanking region. Interestingly, a sporadic rise in viral load followed this reversion. This study of multiple CTL responses demonstrates a possible correlation between the occurrence of ultra-early escape mutations and preservation of undetectable plasma viral load. Further-

more, mutations at epitope flanking regions may afford epitope escape through other mechanisms, allowing reversion of lower fitness escape mutations and potentially leading to increased viral loads.

Genetic Analysis of Drug-Resistant HIV-2 Isolates from Senegal, West Africa
Moon Kim, Senior, Biology (Molecular, Cellular Developmental)
Paul Lu, Senior, Neurobiology
Mentor: Geoffrey Gottlieb, Allergy Infectious Diseases
Mentor: Robert Smith, Pathology

Human immunodeficiency virus type 2 (HIV-2) infects 1-2 million people worldwide and is endemic in West Africa. 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. However, the genetic pathways of NRTI and PI drug resistance are not well understood in HIV-2. In order to assess the emergence of reverse transcriptase (RT) and protease (PR) drug resistance mutations, we sequenced HIV-2 pol genes from drug treated HIV-2 subjects from Senegal. Highly recurrent amino acid substitutions acquired under drug selective pressure were considered as likely candidates for drug resistance. Select mutations were then chosen for site-directed mutagenesis to quantitatively assess NRTI and PI resistance. Initial results indicated seven potential positions within PR that are involved in protease inhibitor resistance: V20I, I54M, V62A, I82F, L90M, A92S/T, and L99F. Many of these changes occurred in combination, such as the I54M substitution present with I82F (100%). For RT, three amino acid substitutions were considered: K65R, Q151M, and 184V/I. Cell culture assays showed that as few as two amino acid substitutions produced high-level resistance to AZT and 3TC, and that three amino acid changes produced class-wide NRTI resistance (Smith et. al., J. Infect. Dis., in press). Thus, the NRTIs typically used in West Africa to treat HIV-2 infection are sub-optimal. We hypothesize that the observed amino acid substitutions for PR listed above will produce cumulative resistance. However, the role of natural polymorphisms in PR remains unclear. Additional virologic and clinical studies are necessary to determine the most advantageous drug combinations for treating HIV-2 infection.

SESSION 2N

IMMUNE RESPONSE AND PATHOGEN DETECTION IN AQUATIC ORGANISMS

Session Moderator: Steven Roberts, Aquatic Fishery Science
Mary Gates Hall Room 284

* Note: Titles in order of presentation.

Development of Non-Invasive Biomarkers for Stress in Octopus
Rachel Thompson, Senior, Aquatic Fishery Sciences
Mentor: Steven Roberts, Aquatic Fishery Science

Octopuses are an important part of our marine ecosystem and provide excellent scientific models to examine behavior and cellular processes. In addition, octopus are major attractions to aquariums and are a preferred food product in some regions. In the Pacific northwest wild populations have experienced declines. These declines have been attributed to several stressors including the deterioration of habitat caused by pollution and large scale climate processes. In order to develop techniques to better evaluate the physiological condition of octopus, non invasive sampling methods were examined to determine potential effectiveness. The specific research objectives of this project were to 1) identify biomarkers of stress and 2) validate effectiveness of biomarkers. The non-invasive sampling techniques used are reliant on protein analysis of epidermal mucus. Heat shock protein 70 was detected in a senescent female octopus using western blot analysis in relation to varying environmental conditions. This technique for assessing octopus wellfare provides a valuable tool to better assess octopus physiological status in the wild and in captivity.

A Molecular-Based Approach for Identifying the Etiological Agent of Viral Erythrocytic Necrosis in Pacific Herring
Jolene Vanderpol, Senior, Microbiology
Mentor: Evi Emmenegger, Biology, DOI/USGS/Western Fisheries Research Center
Mentor: Gael Kurath, Aquatic Fishery Science, USGS

Transmission electron micrographs of erythrocytes from Pacific herring Clupea pallasii infected with erythrocytic necrosis virus (ENV) demonstrate the presence of cytoplasmic inclusions containing icosahedral-shaped virions with electron dense cores typical of iridoviruses. The disease, known as viral erythrocytic necrosis (VEN), is

characterized by the presence of inclusion bodies, visible by light microscopy, within the cytoplasm of infected erythrocytes. Clinical signs of VEN include lethargic swimming, pale gills due to anemia and severe blood dyscrasias. VEN is suspected of causing mass mortalities among different populations of herring that comprise the major food source for Pacific salmon. Thus it is important to learn more about the cause of this disease and devise a way to detect it quickly. The goal of this study is to develop a rapid diagnostic assay for ENV based on polymerase chain assay (PCR) methodology. To obtain candidate sequences of the virus we are using a technique known as suppressive subtraction hybridization (SSH), which compares two populations of RNA and generates clones that are expressed in one population but not in the other. Currently we are comparing RNA populations from erythrocytes of naïve and ENV infected herring. Differentially expressed genes will be analyzed and compared against public viral databases to determine if the virus is in fact an iridovirus and to develop primers for a diagnostic assay.

Assessing Withering Syndrome Resistance in California Abalones (*Haliotis spp.*): Pink (*H. corrugata*), Red (*H. rufescens*), and Pinto Abalone (*H. kamtschatkana*)

Yeu-Ru Chou, Senior, Aquatic Fishery Sciences, Chemistry
Mentor: Carolyn Friedman, Aquatic Fishery Science
Mentor: Nate Wight, Aquatic Fishery Science, School of Aquatic and Fishery Sciences
Mentor: Lisa Crosson, Aquatic Fishery Science

Withering syndrome (WS), a catastrophic bacterial disease of abalone, is one of the main factors responsible for enormous losses of some West Coast abalone species. Many populations of black abalone suffered more than 98 percent mortality within a few months or year of exposure to WS. Studies found that a Rickettsiales-like organism (RLO) is the etiological agent of WS; the RLO infects gastrointestinal epithelia. The common symptom observed in infected abalone weakness and an inability to adhere to the substratum, due to atrophy (withering) of the foot. Yet, the potential of some abalone species to develop resistance to WS is still unclear. This research is examining the vulnerability of three California species (*Haliotis spp.*) to WS, including *H. corrugata*, *H. rufescens*, and *H. kamtschatkana*. Furthermore, interspecific differences in the host response to infection will be characterized among these three *Haliotis spp*.

Secretion of Rainbow Trout Interferons

Melissa Sugiura, Senior, Biology (General)
Mentor: John Hansen, Pathobiology, Western Fisheries Research Center

Salmonids are plagued by a variety of viral pathogens and a growing body of research indicates that the innate immune response is critical for limiting and controlling infection. Type I interferons (IFN) elicit potent antiviral activity during infection upon secretion from infected cells and as such, represent a major component of the innate immune system in all vertebrates. In rainbow trout (*Oncorhynchus mykiss*), 2 distinct transcripts (termed IFN1s and IFN1L) are produced from the IFN1 gene by alternative splicing and both transcripts are induced during viral infection. Interestingly, the IFN1s cDNA encodes a 22 amino acid, consensus signal peptide and a short 5' unstranslated region (5' UTR), whereas the IFN1L transcript possesses a truncated signal peptide (6 amino acids) and has a much longer 5'UTR. As signal peptides guide proteins to their final destinations, we hypothesize that trout IFN1L will not be secreted from cells since it does not possess a true, full-length signal peptide. To test our hypothesis, we have cloned the open reading frames for the IFN1s and IFN1L transcripts into epitope tagged expression vectors (pcDNA3.1-Myc/His) to determine if tagged proteins are secreted from transfected cells by biochemical analysis. The overall goal of this project is to learn more about the basic mechanisms of innate immunity in fish and to provide insight on how specific vaccines can protect fish.

SESSION 2O

FROM BALSAMROOT TO DUNGENESS CRAB: STUDIES OF HUMAN IMPACTS ON OUR ENVIRONMENT

Session Moderator: Andrea Ogston, Oceanography
Mary Gates Hall Room 287

* Note: Titles in order of presentation.

Complex Effects of an Invader on the Reproduction of a Native: Direct Inhibition but Indirect Facilitation

Carolyn Bauer, Senior, Biology (Ecology Evolution)
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Joshua Tewksbury, Biology

While invasive plants are well known for their direct negative effects on native plants, invasive plants may also have some indirect, beneficial effects on native plants. The purpose of the study was to examine whether the unpalatable, invasive plant *Euphorbia esula* (leafy spurge) protected the native plant *Balsamorhiza sagittata* (ar-

rowleaf balsamroot) against certain types of herbivory. We examined *Balsamorhiza* herbivory damage inside and outside of *Euphorbia*-invaded areas and found that while association with *Euphorbia* had an overall negative effect on *Balsamorhiza*, there were lower rates of leaf herbivory on *Balsamorhiza* growing within Euphorbia stands.

Identification of Microbial Isolates Capable of Degrading Trace-Level Wastewater Contaminants

Sarah Koser, Senior, Chemical Engineering
Mentor: John Ferguson, Civil Environmental Engineering
Mentor: Heidi Gough, Civil Environmental Engineering

Trace-level contaminants migrate through wastewater to receiving waters of municipal wastewater treatment facilities. While wastewater treatment removes large proportions of these trace contaminants, removal levels are often insufficient. For example, documented environmental impacts of triclosan at low concentrations include disruption of algal communities and survival of bullfrogs. Last year I established a robust triclosan-degrading mixed culture. After developing a method for making defined media agar plates with low levels of triclosan, I obtained an isolate by picking single colonies from the solid media. The isolate (designated SK-1) was identified as a *Ralstonia* relative. Early indications suggested SK-1 was capable of degrading triclosan. However, later transfers lost this ability though SK-1 still grew in the fully defined minimal media, where the only carbon and energy sources were triclosan and vitamins (added as growth nutrients), suggesting that SK-1 was growing using extremely low vitamin as substrate. Reisolation from preserved enrichment stocks resulted in a new isolate (designated MC-1) related to *Sphingomonas* that continues to actively degrade triclosan. BIOLOG plate analysis suggests that both MC-1 and SK-1 are capable of respiring many different carbon sources. Currently, I am performing experiments to determine if MC-1 degrades triclosan in the presence of multiple carbon sources. Once confirmed, MC-1 will be transferred back into triclosan media to ensure the culture has not lost its ability to degrade triclosan. Additionally, my colleagues and I inoculated samples from West Point treatment plant into media containing ibuprofen, naproxen, triclosan, triclocarban, and gemfibrozil (a control). Degradation of ibuprofen, naproxen, and triclosan has been confirmed, and I am now working towards obtaining a ibuprofen-degrading isolate. This will be done by repeatedly transferring single colonies from microbial enrichments on solid media to liquid media. The isolate will be identified by sequence analysis and further characterized by its substrate range.

Spices and Citizen Science: An Active Connection to Our Local Aquatic Environment

Allison Myers-Pigg, Sophomore, Oceanography, Environmental Studies
Britta Voss, Senior, Oceanography
Mentor: Rick Keil, Oceanography

Spices are organic chemicals produced by plants and synthesized on massive scales by humans for use as flavoring agents in multiple products. However, a significant portion of these compounds pass unaltered through the body and sewage treatment processes. Dr. Richard Keil's lab group at the University Of Washington Department Of Oceanography measures these compounds to demonstrate a direct connection between everyday human activities and their impact on the aquatic environment from a light-hearted perspective. The water sample analysis involves a solid phase extraction onto hydrophobic-lipophobic balance cartridges, elution of the compounds of interest in ethyl acetate, and analysis with gas chromatography-mass spectrometry. Our lab has sampled various sites in Puget Sound and treated effluent samples from the West Point Wastewater Treatment Plant in Seattle for over two years. We have observed interesting seasonal trends (such as a spike in cinnamic acid immediately following Thanksgiving) and regional differences (such as the absence of synthetic spices in pristine water samples). Recently, this project has expanded water collection efforts by involving a volunteer network of citizens in collecting samples all around Puget Sound. Volunteers collect water samples, perform simple pH tests, and then mail the sample to our lab for analysis. Through this direct involvement, citizens are vested in the research and its implications to the health of Puget Sound. As the Sound Citizen Program becomes fully operational, volunteers will be able to track their sample's progress during analysis and download any processed sample's data. By creating awareness and generating interest in environmental spices, we are developing a base of citizens actively engaged in the health of their local aquatic environment.

Sediment Transport in the Marine Environment: The Study of Sediment Resuspension and Transport on the Elwha Delta

Margot Mansfield, Senior, Earth Space Sciences
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Andrea Ogston, Oceanography

The Elwha River watershed restoration project is scheduled to remove two dams on the lower reach of the river by 2012, releasing almost a century's worth of sediment stored in the reservoirs. A 4-mo study of sediment resuspension and transport in ˜20-m water depth explored relationships between sediment delivery by the Elwha River and oceanic processes (including winds,

waves, tides, and currents) operating in the Strait of Juan de Fuca during low-flow river conditions. Data were collected via in situ bottom boundary layer instrumentation (tripod) and merged with river discharge and wave buoy data. Nine storm events associated with suspended-sediment resuspension were characterized based on buoy, river, and tripod data; the largest storm occurred in February 2008 with peak suspended-sediment concentration of 9 mg/L. Suspended-sediment concentrations did not appear to vary in response to river discharge, but rather, with storm intensity in the Strait. The net movement of water (based on currents) and suspended-sediment was in the northeast direction. Seasonal variation in resuspension and transport events was difficult to determine due to the short duration of the study, highlighting the need for extended studies.

SESSION 2P

FISH BIOLOGY AND CHANGING ENVIRONMENTS

Session Moderator: Vincent Gallucci, Aquatic Fishery Science

Mary Gates Hall Room 288

* Note: Titles in order of presentation.

Genetic Techniques Provide Evidence of Chinook Salmon Feeding on Walleye Pollock Offal

Thaddaeus Buser, Senior, Aquatic Fishery Sciences
Mentor: Lorenz Hauser, Aquatic Fishery Science
Mentor: Nancy Davis, Aquatic Fishery Science
Mentor: Isadora Jimenez, Aquatic Fishery Science

Declining runs of Chinook salmon in western Alaska have focused interest on the ocean condition and food habits of Chinook salmon in the Bering Sea. Observer sampling by the U.S. North Pacific Groundfish Observer Program (NOAA Fisheries) provided stomach samples of Chinook salmon caught during winter. Examination of the stomach contents revealed isolated pieces of skin, bones, and fins belonging to large bodied fish, suggesting that Chinook salmon were feeding on fish offal. These pieces were determined to be either Pacific cod (Gadus macrocephalus) or walleye pollock (Theragra chalcogramma), but differentiation between the two species was impossible by physical means alone. To confirm the species identification of the fish parts, we used genetic techniques to match DNA sequences of the samples to known sequences of walleye pollock and Pacific cod. Novel mitochondrial DNA (mtDNA) primers were designed to amplify a 174 base pair (bp) long section of the Cytochrome oxidase subunit I (COI) gene, which was sequenced and compared with sequences downloaded from the GenBank database. Typically, much longer sections of DNA are used for species identification (˜700 bp), but due to the state of digestion of our samples, long sequences of DNA were no longer present. The specific design of our primers, however, allowed us to make positive identification and differentiation of walleye pollock and Pacific cod. Of the 15 offal samples, 9 yielded usable sequences, all of which were positively identified as walleye pollock. Our results clearly demonstrate the utility of a short COI sequence for species identification of Chinook salmon stomach contents that might otherwise be unidentifiable due to the state of digestion, or because the salmon consumed isolated body parts (offal) rather than the whole fish. These results suggest that walleye pollock offal supplements the diet of Chinook salmon during winter.

Ecosystem Snapshot Based on Dogfish Data from Over a Half Century Ago

Meegan Corcoran, Senior, Aquatic Fishery Sciences
Mary Gates Scholar
Mentor: Vincent Gallucci, Aquatic Fishery Science
Mentor: Ian Taylor, Aquatic Fishery Science

The health of Puget Sound is in peril. Estimating the extent of ecosystem changes is a challenge due to of the lack of ecosystem historical data. The stomach contents of opportunistic feeders, such as spiny dogfish (Squalus acanthias), can be used to determine changes within an ecosystem over time. Using data collected in the 1940's determinations were made as to prey species abundance and presence. The results thus far are (1) significant variation of prey between seasons, (2) the greatest prey diversity and abundance were during the summer months, and (3) large spiny dogfish ($>$ 800mm) primarily preyed upon benthic organisms. Ecological changes can be identified by using spiny dogfish diets as indicators. Comparing data from over a half century ago to today allows us to observe changes within the Puget Sound ecosystem.

What Human Mediated Fire Regimes Mean for Aquatic Macro-Invertebrate Assemblages and Salmon Diets in Central Idaho

Zachary Radmer, Senior, Environmental Studies (Ecology Conservation), Biology (Ecology Evolution)
Mary Gates Scholar
Mentor: Peter Kiffney, Forest Resources, Northwest Fisheries Science Center
Mentor: Beth Sanderson, Northwest Fisheries Science Center, NOAA Fisheries

Fire suppression and forestry practices in the Pacific Northwest over the last two centuries have applied a fire

regime that is unlike what was previously experienced by wildlife. Yet we know very little about how fires affect the premier Northwest icon and threatened species: the Pacific Salmon. I am measuring how fires in stream catchment areas affect aquatic macro-invertebrate availability and what salmonids are eating. The study system is a series of mountain tributaries to the Salmon River in central Idaho (Boise National Forest) where large fires in 2007 burned up to 90% of the catchment basin of several steams that we were already researching. Other studies using reference streams have found a variety of results that depend on chemical and physical river traits, but this is the first study to compare stream and diet data collected before and after the wildfire event. Pacific Salmon populations are rare and sensitive this far inland, yet little is known about the effects of wildfire except that aquatic systems can take decades to recover. I am looking for quantitative and qualitative changes in salmon food supply that are associated with increased runoff, canopy loss, ash deposition, and a switch from allochthony to autochthony. Any diet changes I establish may be used in the future to improve growth models and assist land managers in restoration efforts and fire management decisions.

Decreases in Stream Velocity due to an Increase in Streambed Roughness Caused by Sockeye Salmon Redd Formation in Four Southwest Alaskan Streams
Marissa Smith, Senior, Aquatic Fishery Sciences
Mentor: Daniel Schindler, Aquatic Fishery Science

Salmon provide a myriad of benefits to freshwater ecosystems. One benefit that is currently underresearched is the reduction in stream velocity caused by salmon redds. Using salt (NaCl) as a molecular marker, the decrease in water velocity caused by an increase in the roughness of streambed topography due to sockeye salmon (*Oncorhynchus nerka*) redd digging was documented. Four streams in Southwest Alaska were examined for streambed morphology and flow velocity prior to salmon arrival and again after salmon were spawning at peak density. Isolating the salmon effect on stream velocity from the effect of the decrease in stream discharge, a clear decrease in stream velocity caused by salmon redd digging is evident. By slowing stream velocity, salmon increase the availability of nutrients they bring to freshwater ecosystems as well as the benthic invertebrates they dislodge from the sediment and suspend.

Adaptation and Extinction in Changing Environments
Susan Taylor, Senior, Pre-Major
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Benjamin Kerr, Biology

In the face of global climate change, it's crucial we understand evolution in changing environments. Specifically, will populations persist or go extinct? If they persist, how will they adapt? Our real-time evolution project tests if the same selective pressure, applied at different rates, favors different mutations. Over the course of 160 generations, we exposed *Escherichia coli* populations to escalating antibiotic concentrations, until they all reached a specified concentration. Some treatments experienced a rapid increase while others experienced a gradual increase. Since the impact of a mutation depends on the organism's environment we predicted that the way the environment changed may have affected which mutational paths each population could access. These different paths would cause the rate of extinction and the fitness of the surviving populations (as measured by growth rate) to differ depending on treatment. The preliminary data analysis shows that compared to the rapidly increased treatment the gradually increased treatment had fewer extinctions and a lower mean fitness but it also had more variability and included the fastest growing individual populations. For each population we sequenced a region for mutations engendering antibiotic resistance. We found that populations in the gradual treatment tended to have high variability and multiple mutations, while populations in the rapid treatment tended to have one of only a few mutations. To understand these evolutionary differences we are now deconstructing their genetic changes, mutation by mutation. First, we are using genetic engineering to construct all possible orderings of the observed mutations. Second, we are sequencing strains frozen at various points during the experiment to determine the historical order of mutations. Since the changing environment may have affected which genetic paths were accessible to each treatment we can compare the possible paths with the ones actually followed to start to understand how changing environments influence adaptive evolution.

SESSION 2Q

BETTER LIVING THROUGH LIGHT AND CHEMISTRY

Session Moderator: Pierre Mourad, Neurological Surgery
Mary Gates Hall Room 295

* Note: Titles in order of presentation.

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

Nicholas Anderson, Senior, Chemistry (ACS Certified)
Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: David Ginger, Chemistry
Mentor: Kevin Noone, Chemistry

Inexpensive, solution processed organic solar cells offer an inexpensive alternative to current crystalline silicon technologies. Colloidal semiconductor quantum dots (QDs) also offer the promise of inexpensive solution processing, and provide potential advantages over organics in that they exhibit broad absorption spectra and that their energy levels are size-tunable. The near-infrared bandgaps of lead selenide (PbSe) QDs could be utilized for the fabrication of photodiodes sensitive to a range of wavelengths not currently accessible to devices made from purely organic materials. However, devices incorporating PbSe QDs have yet to achieve encouraging efficiencies. In this work, we synthesized PbSe and cadmium selenide (CdSe) QDs using the hot injection method and characterized them using absorption spectroscopy. We carried out device studies on the bulk heterojunction blends of poly-3-hexylthiophene (P3HT) and [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) and then compared to blends of P3HT with PbSe QDs. The PbSe devices show significantly lower efficiencies than the devices containing PCBM or CdSe QDs as the electron acceptor. A possible explanation for these lower efficiencies is non ideal alignment of the energy levels between the P3HT and PbSe. With this in mind, we have begun to explore polymers with varying ionization potentials and electron affinities for use in bulk heterojunction blend devices with PbSe quantum dots. One such polymer, poly(5,7-bis(3-dodecylthiophen-2-yl)thieno[3,4-b]pyrazine-alt-1,4-bis(decyloxy)phenylene) (BTTP-P), has exhibited charge transfer in blends with PbSe quantum dots, as shown in photoinduced absorption experiments. We present device studies with PbSe/BTTP-P blends to further explore the viability of these materials in solution processed solar cells.

Gold Nanocages for Contrast Enhancement in Optical Coherence Tomography

Phillip Guan, Senior, Bioengineering
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Xingde Li, Bioengineering

Optical coherence tomography (OCT) is an emerging imaging modality capable of producing high axial resolution (1-10um), in vivo cross-sectional images up a depth of three millimeters in highly scattering biological tissues. An OCT imaging system is generally implemented with fiber optics, thus allowing minimally invasive OCT imaging within the body. In addition, OCT imaging can be performed in real time (up to hundreds of frames per second). Considering these abilities, OCT is well positioned to function as a tool for minimally invasive detection of microstructural changes associated with various diseases. However, inherent tissue contrast among healthy and diseased tissue can be limited for effective diagnosis, in particular at early stages of diseases; therefore there is critical need for OCT contrast agents. Gold nanocages, which are biocompatible and can be easily modified with gold-thiol bioconjugation for molecular targeting, are one viable option for an OCT contrast agent. Gold nanocages have previously been used to convert near infrared light into heat (photothermal heating) to destroy cancer cells in vitro. In this study targeted photothermal heating was used to induce local changes in refractive index. Refractive index changes were detected using a 1300 nm common path swept source OCT system and analyzing the phase of the returning OCT signal during photothermal heating. This method of contrast enhancement takes advantage of the excellent phase stability seen in common path OCT configurations as well as the unique absorptive properties of gold nanocages. Our results indicate that phase change is unique to areas of tissue phantom doped with gold nanocages. We have also used the common path OCT system and phase analysis without gold nanocages to differentiate between motile and fixed tumor spheroids. These preliminary results are the first step towards the development of phase sensitive contrast mechanisms in OCT.

Sub-Diffraction Optical Imaging by High-Spatial-Resolution Photodetectors and Fourier Signal Processing

Milad Hashemi-Olia, Senior, Electrical Engineering
Mary Gates Scholar
Mentor: Lih Lin, Electrical Engineering

With the advance of nano-lithography and nano-fabrication, individual sizes of electronic, photonic, and mechanical components, as well as their integration densities, have progressed steadily towards the sub-100 nm regime. Therefore, being able to image such feature sizes becomes imperative. Many conventional high-resolution imaging tools either require operation under high vacuum or slow scanning across the sample. A far-field optical imaging instrument would thus be highly desirable. Optical imaging, however, is subject to the diffraction limit, which limits the size of the smallest resolvable feature to be ˜λ/2, where λ is the wavelength of the imaging light. Recently, negative-index materials and super lenses have been proposed to overcome this limit and achieve high-resolution optical imaging. We propose a different approach to achieve sub-diffraction limit optical imaging with far-field microscopy. The technology

builds on a high-spatial resolution quantum-dot (QD) photodetector with high sensitivity that we have demonstrated. The photodetector consists of several nanocrystal QDs between a pair of electrodes with 50-nm width spaced ˜25 nm apart. The proposed sub-diffraction limit optical imaging system consists of an array of such photodetectors. We performed theoretical simulations assuming a two-slit source and then pixilated the far-field diffraction pattern to simulate the photodetector array. A Fourier transform of the detector signal is then performed to determine how much of the original aperture information remains. Using a wavelength of 500 nm and a screen distance of 10 cm, we found that, as expected, the quality of the resultant image generally degraded with larger pixilation size. With 50-nm one-dimensional spatial resolution at the detection plane, it appears that the original slit image with 100-nm width and 300-nm spacing can still be restored.

Built-in Field Measurements of Polymer Photovoltaic Devices

Noah Horwitz, Junior, Chemistry (ACS Certified)
Mary Gates Scholar
Mentor: David Ginger, Chemistry
Mentor: Bradley MacLeod, Chemistry

Generating electricity from sunlight would be an attractive solution to our current energy problems. However, the high cost of processing the materials for silicon photovoltaics has limited the widespread use of this technology. Solution processable organic semiconductors could offer an inexpensive route to utilizing this clean and abundant energy source, but devices made from these materials are currently too inefficient to be economically viable. Photovoltaic devices utilize energy from an absorbed photon to generate free charge carriers, producing an electric current. Some losses in efficiency may occur during the separation of charge carriers, which is driven by the built-in electric field of the device. We have measured this field directly using electroabsorption spectroscopy. Initial measurements on sequentially deposited indium tin oxide (ITO)/polymer/metal structures have indicated that the built-in field follows the difference in electrode work functions, for contacts with work functions within the polymer energy gap. Future work will focus on correlating built-in field measurements of more complex device structures with electrode work function and device efficiency.

Palladium Catalyzed Carbohydroxylation of Alkenes

Tyler Mann, Senior, Biochemistry, Chemistry (ACS Certified), Mathematics
Mentor: Gojko Lalic, Chemistry

Drug design and natural products chemistry rely on the availability of enantioselective transformations. Separate stereoisomers of a biologically active molecule can have different effects, in ibuprofen one isomer has desired anti-inflammatory properties, and the other is inactive. In thalidomide one isomer has therapeutic properties and the other is a potent mutagen. As alkenes are a pervasive functional group in organic chemistry, we seek to develop a method of additions to terminal alkenes that would add both an organic fragment, and a heteroatom in one step in a stereospecific manner. To affect enantioselectivity, such a reaction would need to rely upon chiral ligands around a metal center, most likely palladium. The Wacker process is an industrially important oxidation of alkenes to aldehydes and ketones. It is well studied and proceeds by alkene complexation to the metal. This activates the alkene to nucleophillic attack by water producing an alkyl-palladium species. This complex usually undergoes beta-hydride elimination; recent studies show that aryl iodonium salts can oxidize the palladium complex and circumvent this pathway, adding an organic fragment. To achieve this transformation, our laboratory has synthesized a series of tridentate ligands in order to stabilize and isolate the alkyl-palladium complexes. This way we can study each step of our multistep reaction in isolation before recombining them into a full catalytic cycle. We expect addition of water to the catalyst-activated alkene to proceed smoothly in polar organic solvents. Finding appropriate conditions for the oxidation by iodonium will present a greater difficulty. Continuing research will include screening to determine precise reaction conditions, and attaching chiral ligands to the metal center in order to make the reaction enantioselective.

Trapping of Listeria Cells, and Formation of a Grid Using an Optical Tweezer

Timothy Mentele, Senior, Bioengineering
Amgen Scholar
Mentor: Lih Lin, Electrical Engineering
Mentor: Benjamin Wilson, Electrical Engineering, Photonics Lab
Mentor: Suzie Pun, Bioengineering

In the study of cells it often becomes necessary to manipulate cells in a controlled environment. In many instances optical traps or optical tweezers are used to do this. In optical tweezers light from a focused laser beam is refracted though a cell. The resulting change in momentum of the incident photons leads to a net force which pulls the cell into the center of the beam. Conventional optical tweezers often require high optical intensity to achieve sufficient forces. The tweezers used for this experiment use a random array of gold nano-particles (AuNP) to reduce the required intensity of the laser beam. Excessive optical exposure can damage cells. Therefore reducing the intensity required for trapping leads to less cell damage and longer possible exposure times. To observe the trapping of the Listeria

cells an optical microscope with a 100x objective was used. So far theoretical modeling and basic visualization have been performed. According to previous results the trapping force of our plasmonic tweezer is anticipated to be approximately one pico-Newton according to calculations based on previous results with other particles. Cells have been visualized against the AuNP array and have been shown to survive exposure to the laser beam. However, trapping force has yet to be evaluated. This step will be performed using a gradually increasing flow over the cells and calculating the drag-force from the velocity of flow that dislodges the cell from the trap. Also in future experiments we hope to observe controlled listeria rotation by varying polarization of the laser beam.

Production and Spectroscopic Characterization of Photoactive Yellow Protein
Lara Schrier, Senior, Biochemistry
Mentor: Munira Khalil, Chemistry

Photoactive yellow protein (PYP) and its associated photon absorbing p-coumaryl chromophore is found in the bacteria Ectothiorhodospira halophila and provides a novel system for the study of signal transduction in biologic molecules. When the chromophore absorbs a photon of light it experiences a trans to cis conversion and becomes protonated. This change in the orientation of the chromophore within the protein induces a conformational change in the protein that ultimately allows the bacteria to move away from potentially harmful UV radiation. Current research tells us detailed information about the structure of PYP and the conformational changes in the protein upon irradiation of the chromophore using conventional spectroscopic methods. The Khalil group is interested in looking at the transduction of the signal from the chromophore through the protein on a femtosecond time scale using multidimensional infrared spectroscopy. This technique will likely add significant molecular detail to our understanding of the process. The role of my project in the aforementioned research is to optimize the production and purification process of photoactive yellow protein and its chromophore which together constitute what is called the holoprotein. Two methods are being utilized. The first involves the use of a two plasmid system. One plasmid codes for enzymes that facilitate production of the chromophore and the other codes for the protein which together produce the holoprotein within E. coli. In the second method, one plasmid is used that codes for PYP and the holoprotein is formed in vitro through the addition of p-coumaric anhydride to the purified apoprotein. I will describe both of these methods in detail along with spectroscopic characterization of the purified protein.

SESSION 2R

INTRACELLULAR MECHANISMS MEDIATING DISEASE

Session Moderator: Ian Sweet, Medicine
Mary Gates Hall Room 389

* Note: Titles in order of presentation.

Interaction of β-carbolines related to Parkinson's Disease with Plasma Membrane Monoamine Transporter
Zhiyi Cui, Freshman, Exchange - Arts Sciences
Mentor: Joanne Wang, Pharmaceutics

β-carbolines (BCs) are heterocyclic molecules derived from tryptophan, tryptamine, and serotonin. BCs can be formed endogenously or enter the body from external sources such as fried meat and fish. BCs are structurally similar to the dopaminergic neurotoxin 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) and its active metabolite 1-methyl-4-phenylpyridinium (MPP+). In vivo and animal experiments have suggested that BCs are toxic to dopaminergic neurons and central nervous system (CNS) exposure to BCs may be an environmental factor for idiopathic Parkinson's Disease (PD). While the neurotoxic properties of BCs have been well documented, the mechanisms governing brain disposition of BCs are still unknown. We recently identified and cloned a novel human plasma membrane monoamine transporter (PMAT) which efficiently transports MPP+. PMAT is abundantly expressed in the human brain and is highly enriched at the blood-cerebrospinal fluid (CSF) barrier. Here we hypothesize that PMAT transports BCs and plays an important role in brain exposure to BCs. In this study, we will investigate this hypothesis by first testing whether BCs interact with PMAT. We will determine the inhibition constant (Ki) of BCs towards PMAT using human embryonic kidney HEK-293 cells ectopically expressing the PMAT gene. We will then test if over-expression of PMAT enhances cellular sensitivity to BCs toxicity using [4,5-Dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide (MTT) assay. This study will provide novel information regarding the role of PMAT in brain exposure to environmental PD toxins.

Understanding Obesity and Metabolic Disease: The Role of Adipose Inflammation
Harpreet Dhaliwal, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Mario Kratz, Epidemiology
Mentor: Brian Van Yserloo, Medicine

With increasingly sedentary lifestyles and poor diets, obesity has become a prevalent epidemic in the United States. In obesity, adipose tissue grows from an increase in the number of mature adipocytes. Adipocytes not only store large amounts of fat, but also secrete a number of hormones that are critical in maintaining glucose homeostasis and satiety. When fat mass increases, an inflammatory response is triggered. The consequent release of inflammatory proteins interferes with the functions of hormones secreted from adipocytes, leading to metabolic diseases, such as type II diabetes. A key focus of our research is to determine the cellular mechanism that causes this inflammatory response. We believe adipose inflammation comes from macrophages somehow infiltrating adipose tissue and becoming activated. If this is true, then we may be able to develop interventions to curb the inflammatory response and improve metabolic disease symptoms. Currently, we are performing a study to specifically test the hypothesis that a diet rich in n-3 polyunsaturated fatty acids (n-3 PUFA) can reduce adipose inflammation. As part of the study, moderately overweight to obese men and women were recruited and asked to eat a diet rich in n-3 PUFA, or a control diet of similar caloric value. To determine the effects of the diet, baseline and post-diet biopsies of abdominal subcutaneous fat were taken from the patients. These adipose tissues are being assayed for expression of pro-inflammatory genes and for macrophage marker genes, which indicate the inflammatory activation of macrophages. We expect the expression of pro-inflammatory and macrophage marker genes will be reduced after consumption of the n-3 PUFA rich diet. With a growing understanding of the factors affecting obesity, it may be possible to develop effective treatment therapies for obesity and related metabolic diseases.

Method Development for the Measurement of Oxygen Consumption to Resolve Metabolic Oscillations in Pancreatic Islets

Kelli Geiger, Senior, Spanish
Mary Gates Scholar
Mentor: Ian Sweet, Medicine, Diabetes Endocrinology Research Center Islet Core

In a normally functioning pancreas, the beta cells in the islets of Langherhans secrete insulin in an oscillatory manner. Loss of these oscillations is a characteristic of Type 2 diabetes. To develop treatments for the disease, we must discover the mechanism driving the oscillatory behavior. Since other cell types exhibit metabolic oscillations, we hypothesize that beta cells also metabolize in an oscillatory manner, and that these metabolic oscillations could be the driving force behind oscillatory insulin secretions. To test this hypothesis, we will quantify islet metabolic activity by measuring the oxygen consumption rate (OCR) of a single islet. The OCR data must offer enough precision to accurately resolve both the frequency and the magnitude of the metabolic oscillations. We are currently developing a new method which utilizes a lipophilic oxygen-sensitive fluorescent dye that distributes into the plasma membrane of the islet and changes in intensity in response to oxygen level. Since the signal strength is linked to the amount of oxygen surrounding the cell, measuring single islet OCR is done by placing the dyed islet in a chamber over the objective of an inverted fluorescent microscope attached to a digital camera. Preliminary experiments have shown that the dye maintains its sensitivity to oxygen when bound to the plasma membrane, that the dye will remain in the membrane for an adequate amount of time to do a standard experiment, and that islet viability is preserved when dyed islets are incubated overnight. To establish the optimal dye concentration we will measure insulin secretions from dyed islets to determine the conditions that yield the most reliable signal while still preserving optimal islet viability. Proof of metabolic oscillations will provide an important clue in the unraveling of the mechanism behind insulin secretion oscillations, and steps in this mechanism could be potential targets for treatment of type 2 diabetes.

Validating Malaria Antigens as Vaccine Candidates in a Mouse Model

Andrew Ishizuka, Senior, Biochemistry
Mary Gates Scholar
Mentor: Patrick Duffy, Global Health
Mentor: Cate Speake, Pathobiology

Malaria has a major global impact, causing approximately 400 million cases and 1 million deaths annually. Timely delivery of an effective and safe vaccine is imperative. We are using the new technology of DNA vaccination to screen a large number of candidate genes for protection against malaria in a mouse model. Thirty genes were selected from a microarray/qPCR study for being up-regulated in the liver stage of malaria infection. These genes are being cloned into a plasmid-based DNA vaccine. Translation of each gene is validated in vitro using polyclonal antisera and Western blots. Vaccine constructs that are translation-competent in mammalian cells are then used to immunize mice in vivo by intramuscular injection and by gene gun routes. Mice are subsequently challenged with infectious rodent malaria parasites six weeks after initial immunization. If the vaccine fails to activate the immune system effectively, malaria infection proceeds unchecked. Remaining parasite levels are assessed two days after challenge by measuring parasite ribosomal RNA in the mouse livers using qPCR, giving us a metric for how effective each gene is at providing protection. By classifying these genes as being protective or non-protective in a mouse model, research can move forward to optimize delivery of the antigens for use in

future human trials.

Polymorphism of Pseudouridine Synthase 1 Reveals Function in Toxoplasma Gondii Differentiation

Michelle Kriner, Senior, Biochemistry
Amgen Scholar, NASA Space Grant Scholar
Mentor: John Boothroyd, Microbiology Immunology, Stanford School of Medicine
Mentor: Matthew Anderson, Genetics, Stanford University

Differentiation between two asexually-reproducing forms, called tachyzoites and bradyzoites, is essential to the persistence and propagation of Toxoplasma gondii parasites. Insertional mutagenesis of a gene encoding a putative pseudouridine synthase, PUS1, disrupts the ability of Toxoplasma to differentiate, suggesting that PUS1 plays an essential role in the differentiation process. Furthermore, previous results show that polymorphisms of PUS1 influence differentiation because introduction of PUS1 from a T. gondii strain that differentiates in vitro (Type II) into a strain that does not differentiate efficiently in vitro (Type I) results in a fully differentiating Type I(Type II PUS1) strain. In order to examine rates of polymorphism at the nucleotide and amino acid level, the genomic locus of PUS1 was sequenced in exotic strains of Toxoplasma. The results revealed tight nucleotide conservation of pus1, with little variation observed in the PUS domain itself. In contrast, amino acid substitutions occur at a much higher rate in PUS1 with most of these substitutions in the N-terminal region of the protein, which has unknown function. Examination of conserved motifs in the unknown region provides no further insight. The extensive variation of the region of PUS1 with no known homology coupled with a lack of polymorphism of the pseudouridine synthase domain suggests that the unknown region plays a role in differentiation, either by specifying RNA targets for pseudouridylation or through novel activity independent of the PUS domain.

Leptin Sensitivity in PKA Cβ Null Mice

Hannah Richards, Senior, Biology (Molecular, Cellular Developmental)
Mentor: Warren Ladiges, Comparative Medicine
Mentor: Linda Enns, Comparative Medicine

Mice of the BL6/C57 strain lacking the Cβ catalytic subunit of Protein Kinase A exhibit resistance to obesity. Leptin regulates body weight by suppressing appetite and increasing metabolic rate through the melanocortinin pathway. We found that Cβ null mice have similar food intake and an increased metabolic rate compared to wild type (WT), with lower serum leptin levels. We thus hypothesized that the Cβ null mice are less leptin resistant than WT. To test our hypothesis, we fed 6 PKA Cβ null females and five WT littermates on a high fat diet for 12 weeks, monitoring food intake and body weights over this period. The mutants maintained a lower average body weight than the WT in accordance with their obesity-resistant phenotype. After 12 weeks, we switched the mice back to a regular diet. Over the course of 6 days, we administered either leptin or PBS (control) injections twice daily, and monitored their food intake and weight loss. The results show that leptin suppresses appetite for both genotypes, with appetite suppression slightly greater in the mutants. However, leptin had no effect on weight loss of WT mice, while causing a dramatic increase in weight loss in the mutants. We can conclude that leptin does have a greater effect on the mutants than on the WT, and that the Cβ null mice are less leptin resistant than WT. In future research, we will be measuring metabolic rate on these mice and looking at elements of the melanocortinin pathway. We will investigate whether metabolic rate in leptin-treated WT mice slows to compensate for the reduction in food intake and look to see if this does not occur in PKA Cβ null mice.

Flow Cytometry as a Novel Method to Isolate *Helicobacter pylori* Cell Shape Mutants

Chelsea Stern, Senior, Neurobiology, Microbiology
Mary Gates Scholar
Mentor: Nina Salama, Human Biology, Fred Hutchinson Cancer Research Center
Mentor: Laura Sycuro, Human Biology, Fred Hutchinson Cancer Research Center

Helicobacter pylori is a spiral-shaped bacterium that populates the human stomach and causes adverse outcomes such as gastric ulcers or cancer in 15-20% of those colonized. It is thought that the spiral shape of *H. pylori* may contribute to its pathogenicity. Previously, our lab discovered four loci involved in *H. pylori*'s shape determination by individual inspection of 2,000 transposon library clones using light microscopy. We defined three classes of cell shape mutants: straight rods, curved rods, and irregular doughnut-shaped cells. We aim to develop more high thru-put methods of identifying rare cell shape mutants in a complex population. Using a highly sensitive flow cytometer, we defined spectra for our known mutant morphologies and showed that these cells differ from spiral wild type cells in their forward scatter, an indicator of cell width. We also empirically demonstrated the ability of our flow cytometer to sort each class of shape mutant from 1:1 and 1000:1 mixtures of wild type:mutant. Using a gate to include only cells with low forward scatter (cells with narrow width, e.g. straight and curved rods), we sorted 600 clones from a population of 200,000 cells from our 10,000 clone transposon library. Upon visual inspection of 70 clones from this sorted population, 50% appeared to have shape abnormalities. Using PCR with transposon and locus-specific primers, we confirmed that our 600-member pool con-

tains shape mutants with insertions in all of our previously discovered shape loci. We are currently mapping the transposon insertions in our sorted population to identify new shape loci, which will be confirmed by targeted deletion and complementation. Having demonstrated that flow cytometry can be used for rapid, high throughput sorting of bacterial cells according to morphology, we plan to use this technology to saturate our transposon library screen for shape-determining genes in *H. pylori*.

Evolution of Competitive Interactions among Bacteria from the Cystic Fibrosis Lung
Brandon Wu, Senior, Individualized Studies
Mary Gates Scholar
Mentor: Matthew Parsek, Microbiology
Mentor: Snow Peterson, Microbiology

In many cystic fibrosis patients (CF), Pseudomonas aeruginosa and Staphylococcus aureus colonize the lung and potentially interact. For many of those infected with both P. aeruginosa and S. aureus, colonization of the lung can persist for many years as a chronic infection. A study that characterized some of the genetic changes in P. aeruginosa which accumulated over the course of infection found that some genetic changes or mutations were observed in isolates from many different patients, suggesting these changes represent favored adaptations. We hypothesize that S. aureus acts as a selective pressure leading to the accumulation of mutations as a result of competition with P. aeruginosa. I have shown in work to date that P. aeruginosa clinical isolates, collected periodically during long term infections from the same patient, vary in their ability to kill S. aureus. Ongoing and future research will identify the mutations in P. aeruginosa that affect the ability to kill S. aureus. Overall, this research will attempt to address the role of S. aureus on the adaptation of P. aeruginosa during chronic CF lung infection. This is an important area to study in helping map the course of CF infection by possibly predicting the effects of S. aureus on P. aeruginosa over time.

SESSION 2S

RESEARCHING PERFORMANCE/PERFORMING RESEARCH IN DANCE, MUSIC, AND THEATRE

Session Moderator: Juliet McMains, Dance
Meany Hall Studio 267/266

* Note: Titles in order of presentation.

Training the Dancer as Well as the Dance
Charles Hodges, Senior, Dance
Mentor: Jennifer Salk, Dance

My research investigates the mental and/or analytical contributions necessary for a dancer to become a more active participant in the classroom, in rehearsal, and on stage. Dancers are living instruments. As such, training for any dancer should be two-fold: to learn what the dance is, and to learn who the dancer is. Because rehearsal and technique class investigate the dance, I have focused my research on the latter portion of this duality. Ultimately, my research will produce an educational booklet with a companion DVD intended for distribution to University dance departments and companies nationwide. The program will walk a user through a series of definitions, applications, and exercises. The goal is that the dancer will finish the program with a greater understanding of his/her potential, an ability to self-teach, and a new sense of personal responsibility within the world of dance. Furthermore, the program will be paralleled with exerpts from the prolific works of a legendary American choreographer, Twyla Tharp. Thus, while a dancer discovers a new approach to active participation, he/she also learns about 20th/21st century late dance history.

An Aerial Soundscape: Improvisational, Collaborative Exploration of Aerial Rope to Beatbox
Brynn Lydum, Senior, Neurobiology
Mary Gates Scholar
Mentor: Louis Gervais, Dance

Aerial performance as a movement-based art goes hand-in-hand with musical accompaniment, yet there are several challenges to utilizing music effectively. Performance on rope, a vertical aerial apparatus, is innately bound to drastic changes in tempo as the performer ascends the rope using strength to counteract gravity, then descends in submission to its force. Beyond differing paces of movement, there are varying intensities of

movements that may require emphatic, energetic music or subtle, sedate music in close proximity. As such, working with recorded music in a constant meter can limit the artistry of an aerial performance. In this collaboration to explore live beatbox with aerial rope, we will utilize the freedom of a solo musician and a solo aerialist to take advantage of constant variability and the possibility of improvisation; aerialist responding auditorily and beatboxer reacting to visual cues. We will create our piece as leaders, but also follow the work and each other as we proceed through it. We will explore unusual time signatures, contrasting beat changes and vocal sound effects to enhance the visual and emotional experience of an aerial act with auditory correlates. The result of our exploration in the studio will be a performance piece that is part pre-planned and part novel improvisation.

Bachata: A Dominican Dance Style Influenced by a Growing Telecommunications Industry

Brittney Patterson, Junior, Economics
Mentor: Juliet McMains, Dance

Bachata is a dance and music style that developed in the rural hills of the Dominican Republic. It developed as a more popular style of dance in the urban cities. Since the beginning of its popularity, it could never compete with Merengue, the national music and symbol of Dominican identity. This is partly due to its low socioeconomic status and association with blackness which was looked down upon by the white elite. But starting the early 1990's there have been many artists who have made a name for Bachata outside of the Dominican Republic, consequently making it more socially accepted in its home country. However, two distinct styles of Bachata have developed: the more traditional Dominican style and the more modern international style. I believe that technological developments and migration have played a hand in the development of Bachata. Dominican migration to New York has helped to account for its popularity and acceptance. Youtube, myspace, and other telecommunities have made it easier for people to share their culture with one another. My research explores how modern technology has brought these two styles of Bachata into dialogue. Through field research, interviews, and extensive research on youtube and myspace, I was able to answer some of the questions that I initially developed. But I also realized that my research was limited due to my geographic location despite being able to communicate in ways that were not available to researchers before me. I realized that my research was still one sided and that without being able to immerse myself in both communities—traditional and modern—I could not answer all of the questions brought up by my initial research.

***The Grind Show*: An Internationally Bound Collaboration from the Perspective of American Youth**

Laurie Roberts, Senior, Drama
Mary Gates Scholar
Mentor: Andrew Tsao, Drama

The economy is in tatters and the job market is slim. We have been in school for as long as we can remember, and now it is time to decide: What comes next? Many of us have been following the "educational conveyer belt" system since birth, and now the idea of making a choice to leave is daunting. The voice of the American youth, though growing in strength, is wrought with underlying fear. Fear of the unknown, of what's to come, of change. In response to these fears that so often stymie our ability to live well, the School of Drama's TBA Collaborative created *The Grind Show*. This piece explores the journey of an unborn child refusing to enter life. He is instead sent to a circus where he meets some unusual acts: A set of conjoined twins who sometimes stay conjoined, a trick knife thrower who throws knives at herself, and a calculating ringmaster who refuses to lose control. This ringmaster tries desperately to fit this unusual child into an act, but in the end the child must make a decision that could leave the circus broken. Having already mounted a successful production of *The Grind Show*, the TBA Collaborative is working to bring this piece to the 2009 Edinburgh International Fringe Festival, the largest theater festival in the world. The festival is a unique community of international creative artists. It is an annual meeting place of ideas, aesthetics and innovative theater praxis. With our play revolving around a dismal and stagnant turn of the century American circus, which is intended to parallel aspects of the world we live in today, we send a message as the youth of America. We are greatly burdened by fear, yet we are self aware, thoughtful, and capable of change.

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When I applied to the Undergraduate Research Symposium, I was nearing the end of a research project, and coming to a close on my research. However, the symposium gave me incentive to continue my research beyond the project, and I made breakthroughs that I had not even considered before. Without the Undergraduate Research Symposium, I wouldn't have been able to complete my research, and now I have had that opportunity I am very grateful.

-Thomas (T.J.) Trimble, Senior, Linguistics

I feel extremely privileged to have been able to carry out 2/3 of my project in the international setting. It was an amazing opportunity to combine my work experience abroad with the research I started at home. I hope to find more international research opportunities in my future career.

-Jane Silver, Senior, Nursing and Women Studies

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