Fostering a Community of Student Scholars in the Sciences, Social Sciences, Technology, Arts, and Humanities

University of Washington’s
Ninth Annual Undergraduate Research Symposium
A Celebration of Undergraduate Research and Scholarship

19 May 2006
Mary Gates Hall
12:00 – 5:00 PM

Proceedings

Created by the Undergraduate Research Program with the support of the Office of Undergraduate Education, the Office of Research, and the Mary Gates Endowment for Students.
The Ninth 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: www.washington.edu/research/urp.

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Jentery Sayers, Graduate Student Assistant
James Hong, Student Assistant
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The Undergraduate Research Program is a unit of the UW’s Office of Undergraduate Education.
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**ADDITIONAL OPPORTUNITIES FOR UNDERGRADUATE RESEARCHERS!**

**Travel Awards for Undergraduates to Present Research**

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

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

**Mary Gates Research Scholarships**

Through participation in research, undergraduate students learn about the essential role of inquiry in a vital society. These competitive research scholarships are available to enhance the educational experiences of students across campus who are engaged in research with faculty. For more information visit the Mary Gates Endowment website: [http://www.washington.edu/oue/mge/becoming_research.shtml](http://www.washington.edu/oue/mge/becoming_research.shtml)

**Library Research Award for Undergraduates**

The University Libraries, in cooperation with the Undergraduate Research Program, is sponsoring the “Library Research Award for Undergraduates” competition, recognizing University of Washington students who produce significant inquiry requiring use of information resources, the library, and its collections. Application deadline: May 22, 2006. For more information visit the Odegaard Undergraduate Library website: [http://www.lib.washington.edu/researchaward/](http://www.lib.washington.edu/researchaward/)

*Competition awards are funded through the Kenneth S. Allen Library Endowment.*
STUDENTS HONOR THEIR MENTORS

Participants in the 2006 Undergraduate Research Symposium were invited to submit a haiku poem honoring their research mentors. Included in this volume is a selection of the wonderful poems that we received. Posters and slide shows of all the submissions are on view throughout Mary Gates Hall. A complete list may also be viewed on the Undergraduate Research Program website, www.washington.edu/research/urp

Student: Nauzley Abedini - Biology, Comparative History of Ideas
Mentor: John Silber - Neurological Surgery

I appreciate
John’s openness and trust in
My abilities

Student: Lauren Brown - Anthropology, Public Health
Mentor: Stevan Harrell - Anthropology

Click send the email
When does he sleep it returns
like an echoing

Student: Derrick Jefferies - Art
Mentor: Ellen Garvens - Art

Calm and thoughtful hand
Things made flat and flesh again
Kinship among things

Student: Jayson Bowen - Electrical Engineering
Mentor: Maya Gupta - Electrical Engineering

With guidance and help
Joy of learning discovered
Her kindness, unique

Student: Sarah Bowerman - Biology
Mentor: Mary Lidstrom - Chemical Engineering

Ever inspiring
In the ways, mysteries of
Methylothrophy
POSTER SESSIONS

PLEASE NOTE
Abstracts are listed alphabetically by the presenter’s last name.
Association of low apurinic endonuclease activity with pediatric onset temporal lobe epilepsy
Nauzley Abedini, Sophomore, Cellular, Molecular, & Developmental Biology, Comparative History of Ideas
Mary Gates Scholar
Mentor: John R. Silber, Neurological Surgery

Pediatric onset temporal lobe epilepsy is frequently associated with appreciable cognitive decline compared to adult onset temporal lobe epilepsy patients. Early onset is associated with greater neuronal loss and glial scarring, which may underlie the decline in mental performance. Seizures generate reactive oxygen free radicals that kill cells by producing a wide range of DNA damage, including lethal abasic sites. Apurinic endonuclease is a DNA repair enzyme that initiates the removal of oxidative damage. Our goal is to determine whether intrinsically low apurinic endonuclease activity is a risk factor for pediatric onset of temporal lobe epilepsy. Medial temporal lobe tissue excised from patients undergoing surgery for pediatric and adult onset temporal lobe epilepsy will be used. Apurinic endonuclease activity will be quantified by a biochemical assay that measures the conversion of plasmid DNA from super-coiled to relaxed form by incision at the abasic site. The activity will then be shown to correlate with expression of the major human apurinic endonuclease activity, Ape1/Ref-1, by Western Blot. Finally, abasic sites in epilepsy and control brain will be quantified using an aldehyde reactive probe assay. Apurinic endonuclease activity is expected to be significantly lower in early onset patients than in histologically normal brain and adult onset patients. Also, low apurinic endonuclease activity is expected to coincide with decreased expression of the Ape1/Ref-1 protein and/or messenger ribonucleic acid as well as an increase in the number of abasic sites that accompany elevated oxidative stress. This data would support our hypothesis that pediatric onset temporal lobe epilepsy patients intrinsically produce low amounts of apurinic endonuclease, thereby subjecting them to increased oxidative damage of the temporal lobe. With time, compounded damage of the temporal lobe could lead to the mental decline documented in early onset epilepsy patients.

Targeting phytoplankton with shotgun proteomics and LTQ-FT Mass Spectrometry
Jocelyn Aker, Senior, Biochemistry
Mentor: David Goodlett, Medicinal Chemistry

Recently, the first phytoplankton genome for Thalassiosira pseudonana was completed, addressing many questions concerning their evolutionary history and raising contentions issues on biochemical pathways present in the ocean. Over 11,000 protein domains are predicted from the genome, but full confirmation of these domains remains to be completed. We have begun to annotate and validate the genome using a shotgun proteomic-based approach using mass spectrometry. To aid in this proteomic-based annotation we are fractionating the organism into select organelles to help narrow the putative genome annotation. Cell cultures of T. pseudonana were filtered and lysed to give whole cell lysate, membrane and soluble fractions. All fractions were digested with trypsin and separated on a nano-liquid chromatography system. Precursor values were measured in the Fourier Transform-Ion Cyclotron Resonance (FT-ICR) cell, and selected for MS/MS in the linear ion trap. The data was searched, using SEQUEST, against the predicted genomic annotation. Afterwards, matches of tandem mass spectra to peptide sequence were sorted using a 0.9 minimum probability with ProteinProphet, and the high mass accuracy of precursor ion scans acquired in the ICR. Together this allowed over 650 proteins to be identified in a first pass analysis of the whole cell lysate. Using this same confidence interval, over 500 proteins were identified in the membrane fraction. For all fractions analyzed to date the average protein sequence coverage (discarding single hits) was approximately 25 percent. This high percentage is likely accredited to the implementation of gas-phase fractionation (GPF) on the samples. Preliminary data suggests that the attempt to isolate certain organelles is successful, and this will help to refine the data and classify these previously undetected proteins. The goal of this project is to confirm or refute genomic open reading frames predicted by traditional alignment tools.

Tobacco as a Trap Plant for the Greenhouse Whitefly
Thalassiosira pseudonana
Patra Alatsis, Senior, Biology
Mentor: Jennifer Ruesink, Biology

The greenhouse whitefly, Trialeurodes vaporariorum, has become one of the most predominant pests in many ornamental and vegetable greenhouses throughout the world. The integrated pest management system utilized in the University of Washington greenhouse seeks to control whitefly via food web interactions. This study focuses on the effectiveness of tobacco, Nicotiana tabacum, as a greenhouse trap plant for whitefly. I hypothesized that the attractiveness of tobacco to whiteflies would vary with nutrient level, because many of the secondary chemicals produced by tobacco are nitrogen-based. Nutrient level was manipulated with three different nitrogen solutions added to the soil, and attraction was measured by counting the adult whitefly present at the top of each plant and the larvae present at the bottom at regular intervals over a seven-week period. After five weeks, adult whiteflies were significantly more abundant on high-nutrient plants, and by the end of the study larvae were also more abundant on these plants. These results are significant because they show that tobacco plants infused with excess nitrogen maximize attractiveness to whitefly, indicating the greenhouse integrated pest management system might benefit from nitrogen-enriched tobacco as more effective trap plants to reduce pest pressure on other plants. To further understand how these two species fit into the greenhouse food web, a
follow-up study will focus on predator interactions in the next trophic level and is currently underway.

**Assessing Sustainability in Seattle’s Neighborhoods: Development of a model for measurement**

*Sean Anderson, Senior; Community and Environmental Planning*

*Mentor: Christopher Campbell, Urban Design and Planning*

Sustainability is a concept that is increasingly important to the fields of urban planning and policy. The generally accepted model is based on three kinds of indicators: social indicators, economic indicators, and environmental indicators. Because of the breadth of this model, finding ways to operationalize the concept has been difficult and has stirred much debate. One problem in particular is that we still do not know how this concept should be applied to everyday practices. The purpose of this research is to better understand what sustainable practices look like at a neighborhood level. To this end, I have developed a survey that will be tested on four neighborhoods in the Seattle area. This survey was developed by deriving several key criteria from community based indicator reports from across the U.S. By collecting 50 surveys from each of the four neighborhoods, I will be able to compare different forms of sustainable practice at the neighborhood level.

**Effect of Activity on Dim Light Melatonin Onset in Females of Childbearing Age: A Pilot Study**

*Germaine Andres, Senior; Nursing*

*Mentor: Martha Lentz, Biobehavioral Nursing and Health Systems*

*Mentor: Karen A. Thomas, Family and Child Nursing*

Background. Maternal entrainment of infant circadian rhythm in the home environment is not fully understood due to the lack of methods to test mothers’ melatonin levels in their natural environment. Studies have shown that the timing of dim light melatonin onset (DLMO) is an unbiased marker of circadian phase. It is unknown whether mild activity affects DLMO because no published studies on the effects of low activity on DLMO have been found. Furthermore, DLMO determination is limited to laboratory settings due to the unproven requirement of bed rest throughout the procedure. Purpose. The purpose of this pilot study is to test and compare the effect of activity on DLMO under two conditions, rest and activity. Methods. A randomized quasi-experimental design will be utilized. On two consecutive evenings, serial salivary samples will be collected at 20-minute intervals, from nine women of childbearing age, over a six hour period using two conditions, low activity and rest. Salivary melatonin will be measured using Enzyme-Linked Immunoassay (EIA). Timing of DLMO will be determined and the difference of DLMO in the two conditions will be compared using paired t-test. Results and Discussion. Nine volunteers have been enrolled and eight have completed the study. The data is currently being entered into SPSS. The results from the nine volunteers will be compiled and analyzed in the beginning of Spring Quarter. If the results show that low activity does not alter melatonin onset, studies for home-based study of DLMO will be developed, expanding the study of maternal and newborn sleep and circadian rhythm to natural environments.

**Using Eye Movement Research to Prevent Space Sickness**

*Elicia J. Andrews, Senior; Biology*

*Mentor: Jim O. Phillips, Otolaryngology-HNS*

During and after space flight, astronauts experience inaccurate eye movements and visual instability causing serious health and safety issues. Our lab is addressing these concerns by looking at the precision of eye movement in monkeys after experimental manipulation that mimics what astronauts encounter in space. To measure eye movement accuracy, we look at fast, voluntary eye movements called saccades. Such movements are continuously recalibrated to maintain accuracy. This is called saccadic adaptation. We trained two rhesus macaques to follow a laser spot which moves horizontally with respect to head position. We measured saccades using an electromagnetic search coil surgically implanted in one eye. To adapt eye movements, we moved the target to a new location during the animal’s saccade, so the eye movement was perceived as being either too small or too large. The brain then adjusted the magnitude of each saccade accordingly. We tested to see if gravitational changes could be used as cues to alter saccade size. To create gravitational changes, we tilted the monkeys either forward and backward or right and left, at a 45-degree angle. We adapted for an increased saccade size in one orientation and a decreased size in the opposing orientation. After adaptation, we tested saccades in both orientations. We found that there was no significant difference in relative saccade size when monkeys were tilted forward and backward. When tilted left and right, however, relative saccade size was smaller on one side and larger on the other. Our results imply that a change in gravity is a context cue that triggers a change in saccade size. This suggests that NASA may be able to adapt astronaut’s eye movements for zero gravity conditions before flight. This adapted state would then be triggered by the change in context once they reached space, resulting in accurate saccades.

**Arsenic Cycling in Relation to Physical and Chemical Parameters in Lakes of South Puget Sound, Washington**

*Jessica Asplund, Senior; Environmental Science, UW Tacoma*

*Mentor: Jim Gawel, Environmental Science, UW Tacoma*

South Puget Sound’s environment has been greatly
affected by the operation of various industries in the region. The ASARCO copper smelter operated from 1890 through 1986, releasing metal pollutants into the atmosphere, resulting in atmospheric deposition of lead and arsenic to the surrounding area. Previous studies have examined the continuing effects of arsenic in terrestrial soils, but little work has yet been done in this region on arsenic mobility in urban lakes. For this study, twelve lakes in the South Puget Sound area, with varying levels of atmospheric input from the ASARCO plant, were selected for study in the summer of 2005. Physical and chemical parameters were examined, including sulfide, arsenic, iron, and manganese concentrations in filtered and unfiltered samples, as well as temperature, specific conductivity, dissolved oxygen, pH, and nutrient concentration. Sediment cores were also collected. Our results show that arsenic concentrations are higher in lakes in the dominant direction of atmospheric transport. Arsenic and sulfide concentrations increased in the hypolimnia of contaminated lakes with the highest levels found in Angle, North, and Steel Lakes. Our analyses of aqueous and sediment arsenic concentrations and other physical and chemical limnological factors will be used to elucidate the mechanisms responsible for arsenic mobility in South Puget Sound lakes. This information is critical for assessing human and ecological health risks in these urban waters.

**Cell cycle control in cryptic variation in Drosophila melanogaster**

Kevin Bacha, Senior, Microbiology  
Mentor: Suzannah Rutherford, Division of Basic Sciences, Fred Hutchinson Cancer Research Center

The Hsp90 heat shock protein is implicated in cancer progression through its role in cellular signaling. Hsp90’s ability to chaperone specific signal transduction proteins buffers signaling pathways keeping variation in check. In Drosophila, as in humans, many Hsp90 client proteins and pathways are cell cycle and developmental regulators. Deficiency of Hsp90 in Drosophila increases the expressed morphological mutation rate and uncovers cryptic variation for a deformed eye trait (dfe). Using artificial selection in Drosophila melanogaster we created high penetrance lines enriched for as many as 9-17 variant genes (polymorphisms) causing eye deformity. Varying maternal age, temperature, or nutrition (all of which may change cell division rates) changes the number of flies with deformities, as does decreasing dweel kinase, a key cell cycle inhibitor. Based on these observations, we believe that slowing down cell division allows eye development to compensate for dfe polymorphisms. To test this idea we will: 1) Raise isogenic flies on increasing concentrations of glucose which will increase the rate of cellular division. We have shown that flies raised on low glucose exhibit lower penetrance (fewer deformed flies) than flies having been raised on high glucose. 2) Test known cell cycle regulators for genetic interactions on dfe penetrance. We expect genes causing faster cell cycles will increase eye deformities as shown with Dweel mutants. 3) Increase and decrease the rate of cellular division during eye development by driving expression of cell cycle genes using eye-specific promoters in transgenic flies. This will specifically test the idea that local control of cell division in the eye can compensate for the dfe polymorphisms.

**Using Lichen Species Diversity and Heavy Metal Analysis to Determine the Impact of the ASARCO Plume 20 Years Later**

Mary M. Bacon, Senior, Environmental Science, UW Tacoma  
Mentor: Cheryl Greengrove, Environmental Science, Interdisciplinary Arts & Sciences, UW Tacoma  
Mentor: Lia Wetzstein, Environmental Science, Interdisciplinary Arts & Sciences, UW Tacoma

This study analyzed the environmental effects of industrial by-products of the ASARCO smelting facility in the south Puget Sound region. The effects of the ASARCO plume were quantified by analyzing lichen species diversity and also the lead and arsenic content of one lichen species, Platismatia glauca, across several sites characterized by proximity to the smelter and direction with respect to prevailing winds. Lichens were collected at each of four sites (Pt. Defiance, Titlow Beach, Dash Point State Park, and Wildwood Park), and lead and arsenic content of P. glauca was determined via acid digestion and atomic absorption. Lichen species diversity and relative abundance was determined in the laboratory. We tested the hypothesis that heavy metal content and lichen species diversity would be higher and lower, respectively, in areas heavily impacted by the plume.

**Cell Adhesion and Motility in Zebrafish Embryos**

Arya J. Bahrami, Senior, Molecular, Cellular, and Developmental Biology  
Mentor: Merrill B. Hille, Zoology

Cells in the growing embryo are held together by transmembrane proteins called cadherins. p120ctn delta 1 is a protein shown to regulate cadherin stability on cell membranes during embryogenesis. Stability of the cadherins allow cells to effectively adhere to each other. p120ctn delta 2 is a similar protein that is highly conserved, but its function is unknown. To determine its role in embryogenesis, this project seeks to create a fluorescent probe for p120ctn delta 2, and to utilize it in an in-situ hybridization to localize the protein in various stages of zebrafish development. I began the process by isolating a partial sequence for p120ctn delta 2 through PCR. The isolated DNA fragment was then inserted into a plasmid, and transformed into bacteria. The sequence was then determined using DNA sequencing. The plasmid was then selectively digested with restriction enzymes, creating a position where single stranded RNA probe
would stop. A single stranded RNA antisense probe, complementary to the p120ctn delta 2 RNA, was then created using Dig labeled nucleotides. In order to observe the presence of p120ctn delta 2 compared to p120ctn delta 1, I prepared zebrafish embryos, which were fixed, and hybridized with a single probe. Each embryo had an antisense p120ctn delta 1 probe, antisense p120ctn delta 2 probe, or a non-binding sense p120 D2 probe as a control. For detection, antibodies against Dig-labeled nucleotides coupled with an alkaline phosphatase are available. The antibodies bind to the probes, and made a fluorescent precipitate when exposed to a coloring medium. I am imaging these labeled embryos using fluorescence and confocal microscopy. In locations where protein being probed is present, the embryo will fluoresce. This will show where the protein is being translated, and will provide insight as to its function in embryogenesis.

Identification and Quantification of Microbes in Complex Microbial Mixtures
Kyle Bailey, Senior, Biochemistry
Mentor: Peter Nobel, Civil and Environmental Engineering

Hybridization of rRNAs to microarrays is a promising approach for prokaryotic and eukaryotic species identification. Typically, the amount of bound target is measured by fluorescent intensity of probe-target duplexes and assumed that a direct relationship exists between target concentration and signal intensity. Using eukaryotic LSU rRNA sequences as targets, we have assessed current approaches for predicting intensities of perfect match short oligonucleotide probe-target duplexes by comparing G° calculations to experimental results. Our AGibbs free energy (evaluation revealed a poor statistical relationship between predicted and actual intensities). Further investigations revealed that current high-density microarray identification schemes are severely compromised by nonspecific hybridization, resulting in numerous false-positive and false-negative calls, and they lack an adequate internal control for assessing quality of the identification. As for the low-density microarray identification schemes, in addition to these problems, they do not provide enough probes to allow for statistically robust results. To circumvent these problems, we have developed a novel approach for the routine identification and quantification of microorganisms using high-density planar microarrays (such as NimbleGen) in samples that have expectable compositions. We show proof of principle of this approach.

The Proximate and Ultimate Factors Driving Diel Vertical Migration of Lightfishes (Teleostei: Stomiiformes) in the Western North Atlantic Ocean
Zachary H. Baldwin, Junior, Aquatic and Fishery Sciences, Biology
Mary Gates Scholar
Mentor: T. W. Pietsch, Aquatic and Fishery Sciences

Many pelagic organisms, both in freshwater and marine environments, undergo daily movements up and down the water column, a phenomenon called diel vertical migration (DVM). The DVM pattern consists of migration to greater depths during the day and lesser depths at night. The goal of this study is to establish which genera of the teleost order Stomiiformes exhibit DVM. I analyzed data for 45 of the existing 51 genera of the order based on approximately 16,000 records from the western North Atlantic Ocean. All specimens to be considered were caught with fishing gear that sampled discretely, thus providing more depth distributions. To account for the broad temporal and geographic scales encountered in this study, I transformed the local time of capture to a corrected time that represents position in a solar day. I expect that most genera will exhibit at least some DVM because mesopelagic fishes at all trophic levels are under strong adaptive pressures to migrate. These factors include (1) escaping predation (the anti-predation hypothesis), (2) increasing the likelihood of encountering prey or moving to where the prey are concentrated (hunger-driven hypotheses), and (3) to maximize metabolic efficiency (the metabolic efficiency hypothesis). For those groups that do migrate, I will employ isotopic tools, specifically carbon-to-nitrogen ratios, to address these hypotheses. Characterizing DVM patterns of an entire order will allow me to trace the evolution of behavioral and trophic characteristics within a diverse group of fishes.

Influence of Narrative Fragmentation, Acculturation/Ethnic Identity, and Disclosure on Posttraumatic stress disorder (PTSD) severity
Anusuya Banerjee, Senior, Psychology, Women Studies
Mentor: Lori Zoellner, Psychology

The diagnosis of Posttraumatic stress disorder (PTSD) is characterized by avoidance, hyperarousal, and re-experiencing symptoms, which persist for a minimum of one month after a traumatic event such as, rape, serious accidents, or physical assault (APA, 2000). Approximately 70% of the US population experiences trauma, with 24% developing PTSD as a result (Kessler et al. 1995). Past research suggests that factors such as trauma narrative structure (Pennebaker, 2004) and trauma disclosure (Brown et al., 2001) may predict the development of psychopathology following trauma. In addition, it has been suggested that level of ethnic identity (Hofstede, 1991) and acculturation to dominant culture (Ullman et al., 2001) may affect trauma disclosure. In the present study, we aim to predict psychopathology (PTSD severity and depression) with levels of disclosure and fragmentation, and to predict trauma disclosure using the variables of ethnic identity and acculturation. We have several main hypotheses of this study. First, we hypothesize that increased narrative fragmentation will be associated with greater PTSD and depressive symptoms. Second, we
hypothesize that low levels of trauma disclosure will be associated with greater PTSD severity. In addition, we hypothesize that higher levels of acculturation to the U.S. culture will predict higher levels of trauma disclosure, and that stronger ties to ethnic identities (non-dominant) will predict lower levels of trauma disclosure. We will use multiple hierarchical regression analyses to explore all of our hypotheses. Findings may have important implications for mechanisms of PTSD development and for culturally sensitive and effective methods of prevention, assessment, and treatment of PTSD.

Willing, Able and Ready: Motivational Techniques and Teen’s Health and Educational Choices
Megan Benton, Senior, Nursing
Mentor: Patti Brandt, Family and Child Nursing

Teenagers make decisions regarding their health that set the trajectory for the rest of their lives. Individuals are often aware of healthy behaviors, but lack the knowledge of how to change habits. Motivational strategies show promise in changing adult health behaviors, particularly with smoking and alcohol use. This pilot study aimed to enhance teen’s use of motivational techniques for personal health and career choices. A convenience sample of 83 middle and high school students (4 groups: (n) = 18, 18, 22, and 25) taking part in the UW Gear-Up Program were enrolled. Students participated in two, one hour workshops addressing motivation, change as being willing, able and ready, obstacles to change, techniques to improve motivation, goal identification, and change initiation. Investigator designed questionnaires querying the major components were administered after the workshop. The concepts included: content understanding, confidence/self-efficacy, planning, implementation and receptiveness. Descriptive statistics summarized findings and content analysis will be used to review written responses. 78.4% high school participants answered content questions correctly. Regarding evaluation of readiness to change, on Likert type scale (1 to 10, ten being greatest) high school students had a mean of 8.2 (SD 1.6); in evaluation of confidence, groups rated themselves at 8.5, (SD 1.5) and 8.7, (SD 1.3); and in estimation of future use 6.167, (SD 2.5) and 7.3, (SD 1.5). Preliminary findings in this pilot project provided feasibility evidence for teaching motivational techniques to teenagers in this format.

Locally-infused Testosterone Reduces Seasonal Regression of HVC in Gambels White-Crowned Sparrows
Peter Berberian, Senior, Neurobiology, Anthropology
Mentor: Eliot Brenowitz, Biology, Psychology, Neurobiology & Behavior

Adult neurogenesis and seasonal plasticity—the incorporation of new neurons into fully-developed circuits—has been observed in a range of animal species. Gambels White-crowned sparrows are seasonally-breeding songbirds that experience a growth of the song system nucleus HVC in the spring and regression of the same group of neurons upon completion of the breeding season. Each of these events is accompanied by changes in circulating testosterone (T) levels, which are significantly lower during the regressed phase. Locally-infused T has already been shown to promote growth of HVC in birds held under non-breeding conditions with fully-regressed song systems. This study investigates whether T applied locally prevents HVC neuron loss in birds with fully-developed song systems. The hormone was unilaterally infused over HVC in birds undergoing a transition from long day to short day conditions. After perfusion their brains were sectioned and stained for cell bodies, and comparisons of neuron number, size, and density were made between the treated and control hemispheres of each bird. Preliminary data indicates a neuroprotective role for T and or its metabolites, suggesting a potential for the sex steroid in the treatment of neurodegenerative ailments like Alzheimer’s and Parkinson’s diseases, as well as head trauma and ischemia.

Developing a Rhesus Macaque (Macaca mulatta) EST Database to Examine the Similarity between Humans and Macaques
Herley Beyene, Junior, Biochemistry
Mentor: Robert Palermo, Microbiology
Mentor: Michael Katze, Microbiology

The use of non-human primate models for human disease is a long established practice that has become increasingly important in studying the host response to viruses including HIV, Ebola, and SARS. The closest genetic relatives to humans are the great apes which have high sequence homology to humans at levels of both the genome and the transcript. However, due to ethical and logistical concerns, great apes are rarely used as research models for disease. The next closest alternative is old world monkeys, specifically macaques and African green monkeys. Understanding their differences at a molecular level allows for a more accurate assessment of how they model human disease. This leads to improvements in the development of drugs, therapies, and vaccines. Recently, there has been significant progress in generating rhesus macaque (Macaca mulatta) resources including a 4.6x version of the genome and our lab’s development of the transcriptome. Our development of the rhesus transcriptome involved creating cDNA libraries from multiple tissues. As a comparison, some libraries were constructed using two other macaque species: Macaca nemestrina (pigtailed), and Macaca fuscicularis (cynomolgous). cDNA libraries are constructed by isolating total RNA and priming reverse transcription using the poly-A tail. The product is then cloned into a vector, and colonies are isolated for EST sequencing under selection by antibiotic. Based on these sequences, there is approximately 98% homology between
human and rhesus at the transcript level, and even higher conservation between rhesus and pigtailed macaques. For these same genes the homology between humans and rhesus at the level of translated protein is much lower. Surprisingly, given the high sequence homology at the DNA level between rhesus and pigtailed macaques, decrease in homology between the translated proteins still occurs. This highlights the need for developing macaque specific resources for models at the sequence and proteome levels.

**Tapping the Brain with Ultrasound for the Non-Invasive Determination of Intracranial Pressure**

Dan Blizzard, Junior, Bioengineering  
Undergraduate Research Award, Summer  
Undergraduate Research Program  
Pavan Vaswani, Freshman, Electrical Engineering  
Mentor: Pierre Mourad, Department of Neurological Surgery and Center for Industrial and Medical Ultrasound (Applied Physics Laboratory)

Intracranial Pressure (ICP), the pressure exerted on the brain, is a critical determinant of brain function which is measured following trauma or other serious neurological conditions (tumors, bleeds, hydrocephalus, etc.). Elevated ICP can result in permanent neurological impairment with prolonged increases leading to death. Currently, ICP is measured invasively by placing a transducer through a hole in the cranium, a procedure requiring the skill of a neurosurgeon. The inherent risks and potential complications of this procedure must be weighed against the increased diagnostic capability provided by monitoring ICP. Given that neurosurgeons, through digital probing, have qualitatively confirmed an increase in brain tissue stiffness under increased ICP, we propose a non-invasive methodology which uses focused ultrasound and diagnostic ultrasound to transcranially palpate and measure brain tissue displacement, respectively. Our prototype device controls the applications of high-intensity focused ultrasound (HIFU) and A-mode (diagnostic) ultrasound in sequence, eliciting a tissue deflection with HIFU and then monitoring the rate of relaxation with A-mode ultrasound. This method, known as acoustic radiation force imaging (ARFI), uses displacement measurements recorded at a known repetition frequency to calculate the rate of tissue relaxation following a palpating pulse. By analysis of the ultrasound backscatter we can quantify tissue stiffness, which is correlated with ICP. We present some initial experimental results obtained using our prototype device.

**Temporal Relationship Between Chloroplast DNA Replication and the Cell Cycle**

Megan Linn Burger, Senior, Biochemistry  
Shalana Bria O’Brien-LaBayen, Senior, Biology  
Mentor: Rose Ann Cattolico, Biology

As autotrophic eukaryotes, stramenopiles are responsible for the fixation of at least 40 percent of the carbon on earth. Some stramenopiles adversely affect ecosystem health through the formation of toxic blooms, while others provide homes for many vertebrate and invertebrate species by creating dense algal forests. Given their importance to the health of the global ecosystem, it is surprising that little molecular data exists on the regulation of chloroplast biogenesis. *Heterosigma akashiwo*, a multiplastidic stramenopile and a recognized model system for chloroplast biogenesis studies, will be used in these analyses. The objective of this study is to determine the time at which the chloroplast DNA of *Heterosigma akashiwo* replicates when the alga is grown on a 12-hour light/12-hour dark synchronous cell cycle. *Heterosigma* cells will be harvested every hour during synchronous cell growth. Quantitative real-time PCR (qPCR) will be used to detect a doubling of the chloroplast DNA. Since there are 1000 to 2000 copies of each chloroplast gene in a *Heterosigma* cell, determination of a doubling should be an achievable task. QPCR has been optimized for experiments using total DNA extracted from *Heterosigma* cells. Primers of the ideal length and specificity for qPCR were designed for several chloroplast version of the genome and our lab’s development of the transcriptome. Our development of the rhesus transcriptome involved creating cDNA libraries from multiple tissues. As a comparison, some libraries were constructed using two other macaque species: *Macaca nemestrina* (pigtailed), and *Macaca fascicularis* (cynomolgous). cDNA libraries are constructed by isolating total RNA and priming reverse transcription using the poly-A tail. The product is then cloned into a vector, and colonies are isolated for EST sequencing under selection by antibiotic. Based on these sequences, there is approximately 98% homology between human and rhesus at the transcript level, and even higher
conservation between rhesus and pigtailed macaques. For these same genes the homology between humans and rhesus at the level of translated protein is much lower. Surprisingly, given the high sequence homology at the DNA level between rhesus and pigtailed macaques, decrease in homology between the translated proteins still occurs. This highlights the need for developing macaque specific resources for models at the sequence and proteome levels.

**N-methyl D-aspartic Acid (NMDA) and the Hypothalamic Pituitary Gonadal (HPG) Axis**

*Alissa Byquist, Senior, Neurobiology*

*Mentor: Robert Steiner, Physiology and Biophysics*

Gonadotropin-releasing hormone (GnRH) is a decapptide involved in regulating reproduction through stimulation of the anterior pituitary to release the gonadotropins luteinizing hormone (LH) and follicle stimulating hormone (FSH). Although several neuropeptides that cause GnRH secretion have been identified, their interdependence and mechanisms of interaction remain largely unknown. A newly identified secretagogue, kisspeptin, is a product of the Kiss1 gene. Kisspeptin neurons stimulate their receptor, GPR54, which resides on GnRH neurons. Despite the vast heterogeneity of GnRH neurons, the majority of them express GPR54. Disruptions in GPR54 cause hypogonadotropic hypogonadism, affirming the pivotal role of GPR54 in gonadotropin release. In the GPR54 knock out mouse (GPR54 KO) kisspeptin no longer activates GnRH, despite GnRH neurons being phenotypically normal. As a result of the distribution of GPR54 among GnRH neurons and the significant phenotype of GPR54 KO mice, we wanted to determine if other GnRH secretagogues are functional in the absence of GPR54. We chose to test whether N-methyl D-aspartic acid (NMDA), a glutamate agonist, can stimulate gonadotropin release in the absence of GPR54. NMDA is a potent activator of GnRH secretion in mammals and NMDA receptor stimulation results in precocious puberty in rats and monkeys. I.p. injections of NMDA or vehicle were delivered to both GPR54 KO and WT mice. Sera samples were collected and LH levels were measured. Preliminary results suggest that NMDA causes an increase in LH in the GPR54 KO, but LH levels were only half that of WT mice. If this continues to hold true, it is likely that NMDA is acting through pathways both independent and dependent upon GPR54 signaling, indicating a redundancy in the pathways for GnRH secretion. Such a finding could help reveal the etiology and treatment of certain reproductive disorders and offer a basis for new approaches to hormonal contraception.

**Investigating Neurodegenerative Disease Pathways in ALS Transgenic Mice**

*Philamer Calses, Senior, Cellular, Molecular and Developmental Biology*

*Mentor: Patrick Weydt, Laboratory Medicine*

*Mentor: Albert R. La Spada, Laboratory Medicine, Center for Neurogenetics and Neurotherapeutics*

Amyotrophic Lateral Sclerosis (ALS) is a progressive adult-onset neurodegenerative disease commonly known as Lou Gehrig’s disease. It is characterized by the loss of large motor neurons in the spinal cord, brainstem, and cerebral cortex, which leads to muscle atrophy, paralysis, and eventually death, usually 3 to 5 years after the onset of symptoms, typically due to respiratory failure. There is currently no cure for ALS. Animals transgenic for the human SOD1 gene, which is mutated in some familial forms of the disease, are an in vivo model of the disease. They are widely used to identify novel therapeutic targets in ALS. Motor neuron degeneration in ALS may involve programmed cell death pathways. To elucidate the role of programmed cell death in ALS pathogenesis, we crossed mice with defective cell death pathways to ALS-SOD1 mice. We hypothesized that by knocking out such pro-apoptotic genes, we will observe a delay in disease progression. In order to test this hypothesis, I will describe the clinical phenotype of these crosses. Building on my experience with the classic ALS-mice, I will report the onset and progression of the disease within three biological parameters: motor performance, body weight and Paw Grip Endurance (PaGE) Test. I will also determine the usefulness and efficacy of these tests in assessing disease progression in ALS mice with defective cell death pathways. The ultimate goal of this study is to identify therapeutic targets for the development of new treatments for ALS.

**The Justification for the Japanese Internment During WWII: Was Race a Decisive Factor?**

*Kelley Y. Chaddock, Senior, Interdisciplinary Arts and Sciences, Global Studies, UW Bothell*

*Mentor: Alan Wood, Interim Vice Chancellor for Academic Affairs, UW Tacoma*

In 2004, a controversial book titled *In Defense of Internment: The Case for Racial Profiling in WWII and the War on Terror* was published in the United States. The author Michelle Malkin, a renowned author and syndicated political journalist sets out to debunk and correct U.S. history about the internment of Japanese American citizens and Japanese Nationals residing on the west coast of the U.S. in 1942. Malkin contends the internment was justified based on U.S. government reports of Japanese espionage in Hawaii and along the west coast of the U.S after the bombing of Pearl Harbor. Malkin emphatically denies the Japanese community was a target for imprisonment and rejects the notion that the internment was based on racism, wartime hysteria or failure of leadership by the U.S. government. The purpose of this essay is to investigate whether Malkin’s claims of espionage are justified to
Gliomas, the most common primary brain tumors, are uniformly fatal lesions known for their resistance to treatments showing recurrence despite surgical resection, radiation therapy and chemotherapy. Glioma development requires the excess consumption of nutrients including oxygen. The resultant depletion of oxygen, or hypoxia, of the tissue surrounding the tumor leads to the production of biochemical factors responsible for the subsequent formation of new blood vessels, or angiogenesis. Recent evidence suggests that hypoxia may be a factor in tumor recurrence because current treatments target removal of the bulk angiogenic mass of the tumor, but not hypoxic regions. The link between angiogenesis and hypoxia has not yet been explored sufficiently in vivo. In our study, we are trying to understand the link between hypoxia and angiogenesis in human gliomas by combining mathematical modeling with clinical imaging. Standard clinical gadolinium-enhanced T1-weighted magnetic resonance images (MRI) can detect angiogenic tumor regions. Fluoromisonidazole (FMISO) is a radioactive tracer used for detecting hypoxic using positron emission tomography (PET). We have developed a semi-automatic Matlab program to analyze MRI and PET images. Based on the data collected for 35 patients receiving both MRI and FMISO-PET images, we have found a statistically significant relationship with a p-value less than 0.001 between the surface areas of hypoxic and angiogenic regions but no such relationship exists between volumes of these regions. A mathematical model has been designed by our mentor, Dr. Kristin Swanson, which predicts the growth of tumor before surgery and treatment. Our target is to interpret these data to develop a similar mathematical model that can determine the probability of tumor recurrence post surgery and treatment along with the growth pattern of the glioma. Through this project, new developments may be made in treatment following surgery that will improve patient prognosis.

**Protein Structure Prediction**

*Baishali Chanda, Junior, Computer Science*
*Mentor: Ram Samudrala, Microbiology*

A fundamental biological challenge is to understand how the linear information in an organism’s genome is processed to produce the resulting behavior or phenotype. Genes, made up of DNA, are transcribed into RNA, and translated into proteins which together form the vast majority of functional elements in an organism. Evolutionary processes ensure that these functional elements interact with their environment in a manner that is beneficial to the organism, using a variety of molecules to catalyze reactions, recognize cellular signals, build cellular structures, and to perform a host of other diverse biological functions. Our research aims to understand these processes performing sophisticated analyses on genomic sequence data to predict and understand relationships between the sequence, structure, and function of DNA, RNA, proteins and metabolites, at both the molecular and the genomic/systems levels. Our goal is to develop a coherent picture of molecular and organismal structure, function, networks, and evolution within a fundamental scientific framework. Our specific aims are to develop novel methods to: predict three-dimensional coordinates of biologically important molecules (with focus on proteins) given their sequence; and predict function using the resulting models with the aid of available experimental information.

**Capillary-Like Morphology of Endothelial Cells on Aligned Collagen**

*Timothy Chao, Junior, Bioengineering, Computer Science*
*Mentor: Shaoyi Jiang, Chemical Engineering*

In this study, I investigated the differentiation of endothelial cells cultured on aligned collagen fibers. Alignment of collagen fibers was accomplished by applying hydrodynamic flow of the collagen solution on freshly cleaved mica surfaces. Atomic force microscopy (AFM) was used to visualize the collagen fiber structures. Collagen fibers, microfibers with and without D-periodicity, varied depending on the presence and absence of potassium ions in the buffer solutions. Bovine aortic endothelial cells (BAEC) were cultured in Dulbecco’s modified Eagle’s medium (DMEM) and supplemented with 5% fetal bovine serum (FBS) after seeding. Phase contrast images of BAE cells were taken to assess the cellular morphology and confocal microscopy was used to examine the structures that developed during cell culture. Herein, I showed that aligned collagen fibers with D-periodicity can induce the differentiation of endothelial cells into tube-like structures resembling microvessels.
Biochemical and structural characterization of human BARD1 Ankyrin and BRCT domains and their interaction with CstF50
Cameron Chase, Junior, Biochemistry, Biology
Bill and Melinda Gates Millennium Scholarship
Mentor: Rachel Klevit, Biochemistry
Mentor: David Fox, Biochemistry

Two structurally very similar proteins, Breast cancer associated protein 1, or BRCA1, and BRCA1 associated RING domain protein 1, or BARD1, form a heterodimeric complex involved in critical cellular functions including transcription, homologous recombination of sister chromatids, DNA repair and cell cycle checkpoint regulation. These homologous proteins have two important regions, or domains, that dictate their roles and function within the cell; one is the RING domain and the other is a set of two tandem BRCT domains. Additionally, BARD1 has a unique region of predicted structure known as Ankyrin repeats. BRCT and Ankyrin domains are known to mediate diverse protein-protein interactions, including the interaction between BARD1 and the Cleavage stimulating factor subunit 50, CstF50. CstF50 is a polyadenylation factor required for 3'-mRNA processing. Interestingly, an ovarian cancer associated mutation, located between the Ankyrin and BRCT domains of BARD1, disrupts interaction with CstF-50. This could potentially be inhibiting proper mRNA processing. It is this set of interactions that intrigue me most. The goal of my project is two fold; I would like to characterize the structure of the Ankyrin and BRCT domains of BARD1 and the interaction of these domains with CstF50. To achieve this goal, I will first clone and develop protocols for the purification of BARD1 Ankyrin and BRCT domain constructs. Then, I will begin to structurally characterize these constructs using limited proteolysis, circular dichroism, nuclear magnetic resonance spectroscopy and x-ray crystallography. Finally, I will use these techniques to characterize the interaction of BARD1 with CstF50. Characterizing the structure of the Ankyrin and BRCT domains of BARD1 and their interaction with CSTF-50 will provide clues about the functional role and importance. Hopefully this will lead to a greater understanding of the cancer susceptible mutation between the Ankyrin and BRCT domains.

Treatment of Hemophilia A by Gene Transfer of Murine Factor VII in the Murine Model
Amy Chen, Senior, Biology
Mentor: Carol Miao, Pediatrics

Hemophilia A is an X linked recessive genetic disease that results in an inability to initiate the clotting cascade due to a defective or deficient factor VIII. Factor VIII is a protein involved in the intrinsic pathway of the clotting cascade. Current treatment involves giving patients regular injections of factor VIII; however, some patients produce antibodies against the added protein making the treatment ineffective. An alternate treatment for patients who developed inhibitory antibodies is the introduction of activated factor VII (FVII). We have developed a gene transfer method to introduce FVII into hemophilia A mice. The murine model is used as a close representation of the disease in humans. Site specific mutagenesis was used to add a cleavage site into FVII cDNA for the furin protein family. The cleavage site allows the factor to be activated immediately after synthesis and secreted in this form. This activated FVII is more readily available to partake in the clotting response upon vascular injury. The gene, cloned into a liver specific expression vector in our lab, is then injected into hemophilia A mice and the clotting response is measured by PT/APTT clotting assays. As a safer approach, another construct containing the zymogen FVII was also made and tested for the wild type response. The concentration of the FVII protein can be quantified by Western blots. Nevertheless, the antibodies against murine FVII are not commercially available. Thus, the wild type murine FVII was cloned into the GST vector and expressed in bacterial cells. Cellular contents were purified to yield the FVII protein. Polyclonal antibodies against the protein will be produced in rabbits. These antibodies will be very useful in our experiments to identify different forms of FVII expressed in mice following gene transfer as well as calculate specific activities from these different forms.

Molecular Wrangling: The Development of Genetic Tools for the Manipulation of an Earthworm Bacterial Symbiont
Cathy Chen, Sophomore, General Biology
Mentor: David Stahl, Civil and Environmental Engineering
Mentor: Nicolas Pinel, Microbiology

Bacteria related to the genus Acidovorax have been reported to inhabit the nephridia (excretory organs) of earthworms from the annelid family Lumbricidae. Symbionts were found in several species of earthworms. We are studying symbionts isolated from the earthworm Eisenia fetida in order to better understand the interactions between nonpathogenic bacteria and their hosts. The bacteria have been isolated in pure culture and analysis of their 16S rRNA gene sequences placed them in the Betaproteobacteria division. In addition to being readily maintained in the laboratory, the bacterial symbionts can be eliminated from the earthworms through the use of antibiotics and reintroduced in the embryonic stage, making this an ideal model system for experimentation. Our present objective is to develop genetic tools for manipulating the symbionts in order to facilitate the experimental exploration of the association. A 2.7 kb plasmid was discovered in a closely-related species of bacteria. We are currently studying the nature of the plasmid in order to determine its suitability as a cloning vector for the isolated symbionts. Previous experiments have succeeded in transposon mutagenizing
bacterial species closely related to the symbionts. We are in the process of implementing a transposon mutagenesis system, based on a modified Tn5 transposon, that is suitable for the symbionts. Prior to introducing such a transposon, it is necessary to determine the minimum inhibitory concentration of the antibiotic that will serve as a selectable marker. We are currently investigating various antibiotics for use as selective markers. So far we have determined that kanamycin at a concentration of 25 µg/mL completely inhibits the growth of the symbionts. Once we have established an effective transposon mutagenesis system, we can introduce mutants into the earthworms and begin identifying the genes involved in the interaction between the bacterial symbiont and its host.

Gambling Problems in Asian Populations
Cindy Chen, Senior, Psychology
Mentor: Mary Larimer, Psychiatry and Behavioral Sciences
Mentor: Ty Lostutter, Psychology

Pathological gambling is a chronic impulse control disorder characterized by gambling behaviors that disrupt personal, family, or vocational pursuits. Problem gambling is considered to be a milder condition that does not yet meet the diagnostic criteria for pathological gambling. Cultural variables, such as values and beliefs, the outcome of acculturation, and help seeking behavior, can play an important role in the development and maintenance of gambling problems. Several cultural groups with high rates of problem gambling originate from Asia. My research will assess whether the rate of problem gambling varies among college students, with a higher rate found in students of Asian ethnicity. University students will serve as participants using the Psychology Subject Pool and complete a series of measures. The South Oaks Gambling Screen will assess for pathological gambling, while the Belief in Good Luck Scale will assess for a belief in good luck. Measures for locus of control, acculturation, belief in fortune telling, help-seeking behavior, and perceived familial and cultural norms will also be used. Demographic information will then be obtained. Rates of disordered gambling for the sample will be compared to previous rates of problem and pathological gambling in the general population of Washington. Demographic variables analyses will be conducted to compare the rates of problem and pathological gambling within the sample, particularly between sub-groups of people of Asian descent. The influence of belief in good luck, locus of control, acculturation, belief in fortune telling, and help-seeking behavior will also be examined. If students of Asian ethnicity hold cultural beliefs that influence their frequency and quantity of gambling compared to other ethnicities, this would support the theory that cultural variables are an integral part of gambling behavior. Understanding the role of culture and its relationship to gambling may aid in finding ways to reduce problematic gambling.

Renibacterium salmoninarum Genome Sequencing Project
Donald Chen, Junior, Molecular, Cellular, and Developmental Biology, Computer Science
Mentor: Mark S. Strom, Microbiology, NOAA Fisheries

Renibacterium salmoninarum, a Gram-positive bacterium and member of the Micrococcaceae family, is the causative agent of bacterial kidney disease (BKD) in salmonids. By creating lesions primarily in the kidneys, the fitness and survival of these fish are compromised by BKD, creating a large threat to hatcheries, aquaculture programs and conservation programs worldwide. At the present, prevention of BKD infections with antibiotics and vaccines have had limited success. Due to its slow growth rate and difficult growth conditions, R. salmoninarum has been difficult to study molecularly. By sequencing and annotating the entire genome, we hope to identify virulence determinants and targets for novel treatments for the prevention and care of BKD infected salmonids using in silico analysis. The genome was sequenced and assembled by the UW Genome Center then automatically annotated by Integrated Genomics, Inc. Following the automated annotations by IG, about 37% of the open reading frames (ORFs) in the genome remained without assigned function. Utilizing various bioinformatics tools, these ORFs were checked for similarity to known genes, motifs and protein domains to manually assign annotations. In addition to unidentified ORFs, many ORFs are represented as several small fragments of a whole gene in the sequence data due to erroneous ORF predictions. To resolve these irregularities, the DNA trace files will be reviewed for discrepancies and any problems in the sequence will be corrected. Upon completion of the final annotations on the genome, the sequence data will be made publicly available on Genbank. Current studies of antibiotic inducible genes have revealed various genes of interest in the genome. However, further studies are required to confirm these findings and to develop new treatments.

Role of p120ctn in Regulating Morphogenesis of Danio Rerio
Terry Chen, Junior, Biochemistry, Biology
Mentor: Merrill Hille, Biology

Several proteins are involved in the movement of cells during development. The protein p120ctn is hypothesized to play a vital role in cell migration during zebrafish morphogenesis by regulating cadherins. Understanding the function of p120ctn in zebrafish embryos is vital to understanding vertebrate development as a whole. My research focuses on the relationship between p120ctn and cadherins during development in zebrafish embryos. I am investigating the function of p120ctn by injecting morpholino oligonucleotides into zebrafish embryos to block the expression of p120ctn. The morpholinos will target pre-mRNA and create an early stop codon, thereby
blocking p120ctn expression through mutation. Thus far I have worked on sequencing the p120ctn gene and have obtained morpholinos for injection. Ideally, we will be able to see changes in embryo phenotype after injection. When the embryos are analyzed on a Western blot, there should be a decrease in the expressed level of p120ctn. This knockdown of p120ctn should cause a decrease in the level of cadherins. I have successfully visualized all the controls needed for my experiments using Western blotting. Conclusions are in progress because my experiments are ongoing.

**Effects of Blocking Spontaneous Electrical Activity in the Developing Mouse Cortex**

**Sarah Chisholm, Senior, Neurobiology**  
**Mentor: William J. Moody, Biology**

Spontaneous electrical activity has been implicated in many of the basic processes of nervous system development, ranging from the development of ion channels to neuronal migration. Electrical activity in early brain development commonly occurs in the form of synchronous, transient increases in intracellular calcium, caused by influx of calcium through either voltage gated calcium channels or NMDA receptors. This type of activity has been found in the retina, hippocampus, spinal cord, and neocortex. Past experiments have found that, in the developing mouse cortex, this activity peaks on the day of birth (P0) and results in calcium influx during electrical activity. By blocking this activity, using cultured slices grown in the presence of tetrodotoxin, we have been able to investigate the effects of this activity on the maturation of ion channels and firing properties of the cortical cells. Calcium imaging has shown that slices cultured in neurobasal medium with 1μM tetrodotoxin from E18-P4 show robust synchronous activity at postnatal day 7 (P7), a time during which both control cultured and acute slices do not show significant activity. This activity resembles that normally seen at P0 and suggests that when electrical activity is blocked between the cells, they may reconfigure so as to regenerate the spontaneous electrical activity that was blocked by the toxin when the block is removed. Preliminary evidence has suggested the involvement of various neurotransmitters in this system, and research is being done to further explain the mechanisms which underlie this activity, as well as the consequences that blocking this activity has on firing properties and ion channel development.

**Utilization of Potential N-linked Glycosylation Sites in the V4 Region of the HIV Envelope and Effects on Viral Phenotype**

**Brianne Chittenden, Senior, Biochemistry, Molecular, Cellular, and Developmental Biology**  
**Mentor: Leonidas Stamatatos, Pathobiology**

The HIV virus has been able to evade the action of neutralizing antibodies, in part due to its utilization of a “glycan shield.” These glycans, which constitute 50% of the mass of the viral envelope glycoprotein, create conformational stability for the virus, while also preventing strong envelope immunogenicity. They also decrease neutralization by blocking potential epitopes for antibodies. In an effort to evaluate the protective role of specific glycosylation sites in the HIV-1 envelope, I created asparagine to glutamine mutations, via site-directed mutagenesis, at glycosylation sites in the envelope variable region 4 (V4) of the SF162 strain of HIV, specifically at residues 382, 388, and 392. Thereafter, I checked actual utilization of these glycosylation sites by western blotting wild type virus and the mutants and I measured the ability of the mutated viruses to enter host cells via a luciferase assay. By obtaining this entry baseline, I am now measuring the neutralization susceptibility of the mutated viruses, via luciferase assays, against various monoclonal antibodies to determine whether and how these glycosylation sites are involved in HIV neutralization and escape.

**Japanese Military Sexual Slavery**

**Jung Yoon Choi, Sophomore, Women Studies**  
**Mentor: Yong-chool Ha, International Studies**

Sexual slavery by Japanese Military is unprecedented systematic rape that was conducted by Japanese government during WWII. The victims of sexual slavery were forced into serving as sex-slaves at where Japanese military resided. Among the victims were Korean, Japanese, Taiwanese, Chinese, Indonesian, Philippine, Burmese, Netherlanders. This research particularly focuses on the sexual slavery of Koreans, who composed eighty to ninety percent of entire population of sexual slaves. Most of the victims are passed away and living victims struggle to gain recognition by Japanese government, who denies the fact that they forced the victims into the slavery, claiming they were paid prostitutes. The victims demands their public apology and compensation. The object of this project is 1) to explain the historical background of the event, and 2) to distinguish the particularity and commonality of sexual slavery as an example of war crime against women and 3) find effective ways to raise awareness on the urgency of solving this issue in international community. I looked into the collection of Korean victim’s testimonies and interviews, academic journals, articles, editorials, publications and several books written in Korean.

**Ritual at Starbucks®: A Cognitive-Linguistic Analysis**

**Samuel Eric Christensen, Junior, Political Science**  
**Thomas Weissey Chung, Junior, Chemistry**  
**Frances Rose Johnson, Senior, Anthropology**  
**Ernest Yang, Junior, Psychology, Biochemistry**  
**Kristen Roller, Senior, Finance**  
**Anthony Herman, Sophomore, Finance**  
**Mentor: Mark V. Calogero, Interdisciplinary Arts and Sciences, UW Bothell**
We analyze observations, interviews, and experimental participation in the ritual of procuring a coffee drink and other sundry items to further a model of cognitive-linguistic processing of cultural products and processes exhibited at a popular commercial venue—Starbucks. Our proposed model considers that ritual participants and observers process metaphorical meanings (cf. Johnson, 1987) embedded within various participatory segments of the Starbucks’s ritual as well as within the venue’s physical architecture. We find that a ritual-participant’s “parsing” (whether consciously or unconsciously) of the metaphorical meanings conveys influence the formation of a fleeting identity, create temporary status and affiliation, and at times shine “spotlight threats” (Steele, 1991) that alter a person’s ritual participation (e.g. shorten its length in time). We made two extended morning (and several follow-up) visitations to a prototype Starbucks venue located in an upper middle class residential neighborhood of Seattle. The specific ritual elements we examined included: the coffee drink (and container), the Starbucks Card, the ordering line, and the venue’s physical layout and social atmosphere. Our qualitative observations support in part our initial cognitive-linguistic analysis of the ritual domain while causing revisions to other parts. Some of the metaphorical structures we compiled (e.g. “all paths lead to service”; “affiliation is a container”) had instantiations of their messages recurrently threaded through the ritual experience and involved categorically distinct objects, actors, and experiences. Other metaphorical structures (e.g. “language is a lure”) were evident at narrower focal points and imbued specific elements embedded within separate strands of the ritual. Still others (“all paths lead to service”) were elaborated (e.g. into “some paths to service dead end”) when salient elements of the Starbucks-ordering script conflicted with other experimentally-invoked scripts (e.g. a restaurant-ordering script). Participation in the Starbucks ritual engenders choices and behaviors partly influenced (i.e. unconsciously primed) by specific metaphorical meanings that pervade the ritual path.

Investigating the Interaction of Nonlinear Electro-Optical Chromophores with DNA

Thomas Weisey Chung, Junior, Chemistry (ACS Certified)  
Mary Gates Scholar  
Mentor: David P. Rangel, Chemistry  
Mentor: Bruce H. Robinson, Chemistry

A hi-tech transformation is on the horizon as today’s largely electronic world is nearing the brink of being converted into a new age of computing and telecommunications functioning on the energy of light. This global reform in technology will in part be achieved as a result of development and application of organic, nonlinear optical (ONLO) chromophores. ONLO chromophores are potentially valuable components in electro-optic devices, or gadgets that work by modifying the optical attributes of some material, because of their capability to handle information in the form of optical signals. Recently, Grote and coworkers have shown that DNA may have ideal properties as cladding and support materials for these chromophores. Therefore, we have studied the interaction of ONLO chromophores, in particular Dihydroxy Furan TetraCyano Indane (DOHFTC), with DNA using various spectroscopic techniques, including absorption, circular dichroism, and IR-spectroscopy. Absorption spectroscopy experiments were carried out on various DNAs to determine the mechanism of binding. Aqueous based salmon sperm DNA, cationic salmon sperm DNA, and complexes of DNA with charged cationic liposomes at varying stoichiometries were studied. Cationic DNA was achieved from a mixture of salmon sperm DNA and divalent metal ions of copper(II) (Cu$^{2+}$). DNA compaction was induced by divalent Cu$^{2+}$ ions binding to DNA (Hackl, 1997). Given that ethidium bromide intercalates into DNA and distamycin A binds to the outside of DNA, the results from these DNA–small molecule complexes were used in comparison when investigating the possible interaction between ONLO chromophores (i.e. DOHFTC) and DNA by looking for an isosbestic point (Berlett, 2000). In general, an isosbestic point is diagnostic for DNA interaction (Berlett, 2000). This work discusses and demonstrates the ability of UV-visible absorbance studies and other spectroscopic techniques to determine the interactions and extent of binding of ONLO chromophores and other small molecules to various forms of salmon sperm DNA.

A Comparative Limnological Analysis of Lakes Inside and Outside of the Blast Zone - 25 Years After the 1980 Eruption of Mount St. Helens

Joe Chynoweth, Junior, Environmental Studies, UW Tacoma  
Mentor: James Gawel, Environmental Science, Interdisciplinary Arts and Sciences, UW Tacoma

The May 1980 eruption of Mt. St. Helens sent vast quantities of ash, mud, and tephra debris into the surrounding area. Several lakes, including Spirit, Meta, and Ryan Lakes were subject to huge infusions of organic and inorganic materials that drastically altered their chemistry. Several post-eruption studies of the affected lakes were completed in 1980 and then again in 1993. In the present study, I follow up on these studies, exploring the regenerative processes of the affected lakes after 25 years by comparing their chemistry to that of Merril and McBride Lakes, two nearby lakes that were unaffected by the 1980 eruption. Samples of water were collected and analyzed for metal concentrations and sediment cores were collected, dried, ground up, acid digested, and atomically analyzed for iron, manganese, and other metals. Comparisons of the affected lakes to the unaffected lakes indicate a remarkable ability of the chemistry of the lake to return to its pre-eruptive state in a very short period of time.
Efforts to protect natural resources through conservation have been underway for decades. However, conservation methods that are not sustainable may end in failure. Northwest Trek Wildlife Park was established in 1971 to preserve and protect native Northwest flora and fauna. 25 years later, much of the habitat has become degraded. In this study, we compared the number of plant individuals and species found inside the free roaming area (FRA), which encloses herds of bison, elk, deer, sheep, and goats, with the number of individuals and species found in the relatively pristine and undisturbed areas outside the fence. We found that while the raw numbers of individuals and species were roughly equivalent, invasive non-native species were far more abundant inside the FRA, while trees and shrubs, abundant outside, were virtually non-existent inside. If this habitat continues to degrade, it may become unable to support the fauna that rely upon it. The implications are important not only for Northwest Trek, but for all similar human-managed ecosystems.

Cellular differentiation in the flower perianth by a MYB transcription factor and the evolution of insect pollination in Thalictrum
Caitlin Connelly, Junior, Biology
Mentor: Veronica Di Stilio, Biology

Floral phenotypes are often the result of adaptive pressure to attract pollinators or pollinating vectors. As a result, wind and insect-pollinated plant species have evolved to have different phenotypic characteristics. Amongst other adaptations, insect-pollinated species often have larger flowers with colorful petals. The goal of this project is to understand the genetic basis of this variation in petaloidy. Petaloid features of the perianth have been shown to be related to the expression of a transcription factor, MIXTA, in Antirrhinum majus, snapdragon. The expression of MIXTA in the epidermis of snapdragon petals results in the formation of conical-shaped cells, which absorb more light and make the petals appear more colorful, and of trichomes, multicellular hairs which trap pollen and guide pollinators to nectar. Our goal is to isolate a homolog of MIXTA from the genus Thalictrum and to characterize its expression in species with varying floral characteristics and pollination mechanisms. The genus Thalictrum, a basal Eudicot in the Ranunculaceae, contains a wide variation of floral morphologies with both wind and insect-pollinated species. These species have varying degrees of petaloidy in their perianth and stamens. Preliminary SEM characterization of the perianth epidermis showed the presence of conical cells in a petaloid, insect pollinated species, T. thalictroides, and of flat cells in sepaloid, wind pollinated T. dioicum. We have cloned and sequenced the MIXTA gene from the perianth of T. thalictroides. Using this sequence to design gene-specific primers, we will use Reverse Transcriptase-PCR to explore the expression patterns in other species of Thalictrum. We expect to find a correlation between the expression of MIXTA homologs and the presence or absence of conical cells and trichomes, which in turn correlates with petaloidy and insect pollination. We plan to extend the SEM characterization of cellular types and gene expression analysis to species with petaloid stamens.

Family outings: Sexual identity disclosure to parents
Libby Cope, Senior, Public Health, Psychology
Mary Gates Scholar
Mentor: Kimberly Balsam, Psychology

In contrast to other minority groups, sexual minorities face a unique challenge in that their minority status is initially unknown and unacknowledged by others, including their immediate family members. Thus, many lesbian, gay, bisexual, transgender (LGBT) individuals experience the challenge of coming out to their parents and the as a stressful process. The current study utilized qualitative methodology to investigate the unique stressors and coping mechanisms associated with LGBT identity disclosure to parents and parental relationships following disclosure. Data for the study was obtained during Phase 1 of the Rainbow Project, a larger 3 phase study on LGBT identity, stress and coping. Each of the 119 individuals in the study participated in one of either 12 focus groups or 17 key informant interviews taking place in rural and urban Washington State. Participants came from diverse demographic backgrounds; 47% were ethnic minorities. Focus groups and interviews were semi-structured with a set of open ended questions. The first of these questions prompted a discussion of participants’ levels of outness, and how their outness varies over time and in different contexts. Individual key informant interviews also addressed the topic of outness, which was discussed at both the personal and community perspectives. Transcripts from the focus groups and key informant interviews are being analyzed using a grounded theory framework and results will be discussed as they relate to current literature in the area of sexual identity disclosure and parents.

Processes of sediment transport across the Galápagos Platform: A geophysical study of Canal Isabelia
Allison Cougan, Senior, Oceanography
Mentor: Mark L. Holmes, Oceanography

Submarine canyon systems provide major pathways by which sediment and other particulate matter is transported from continents and oceanic platforms to the deep sea. This transfer process plays a dominant role in the transport...
of nutrients, the recycling of carbon, and the movement of pollutants. Examination of existing bathymetry maps (1947) of the Galapagos Islands suggested that Canal Isabela, between the islands of San Salvador and Isabela, is the site of a major canyon whose role in the movement of particulate matter across the Galápagos Platform had not been studied. It was thought that the canyon would be the site of one or more turbidity current channels, whose geometry would permit calculation of turbidity flow volumes, speeds, and recurrence intervals. A geophysical survey of the central part of Canal Isabela was carried out aboard R/V Thomas G. Thompson in January 2006. A Simrad EM300 multibeam system, together with 3.5 kHz sub-bottom profiling, was used to map and characterize the major geologic and geomorphic features of the canyon system. Data were obtained along 210 km of track, resulting in a full coverage sea floor image covering ~160 km². The swath mapping and subbottom profiles show conclusively that large submarine landslides, not turbidity currents, are the dominant process moving sediments from the islands to the platform and thence to the deep basins. Canyon slopes are commonly 20° and in places are greater 25°; these slopes exceed the angle of repose for marine sediments. The sea floor imagery shows the existence of previously unknown volcanic cones on the floor of the canyon; these cones are aligned with similar features on adjacent islands. Two of the cones, now partially destroyed by faulting or landsliding, form a dam across the northern outlet of the canyon system, thereby trapping much of the material moving down slope.

**Studying Supreme Court Agenda Setting Through Legal Reasoning**

*Paul Counts, Senior, Political Science*

*Mentor: Bryan D. Jones, Political Science*

There are currently two datasets of US Supreme Court cases that are prominently used by scholars when studying the Court. On the one hand there is the dataset developed by Harold Spaeth, which is primarily used for analyzing Supreme Court decisions at a legal reasoning level. On the other, there is the dataset that was created by the Policy Agendas Project, which classifies cases based on their policy implications and is primarily used for studying policy agendas. Although these two datasets are classifying the same cases, because of the differences in their respective purposes, cases are classified quite differently. In this investigation, I am currently cross-coding all Supreme Court cases listed in the Spaeth and Policy Agendas datasets. After all cases are coded under both the Spaeth and Policy Agendas topics, the similarities and differences between the two datasets will be analyzed. The purpose of this project is to better understand the reasoning behind the Spaeth dataset, and to find out if it has any value for studying agenda setting. It would be very useful to policy scholars if any value can be found in the Spaeth datasets as an effective tool for studying policy and agenda setting in the Supreme Court.

**Schlieren Imaging of High Intensity Focused Ultrasound Transducers**

*Melissa Cowan, Junior, Electrical Engineering*

*Mary Gates Scholar*

*Mentor: Shahram Vaezy, Bioengineering*

High intensity focused ultrasound (HIFU) is a medical therapy method with potential applications in tumor treatment and hemorrhage control. This method requires well-calibrated HIFU transducers that produce highly focused beams, without aberrations, side lobes, or grating lobes. Schlieren imaging is a technique used for optical characterization of HIFU transducers. The purpose of this project is to use an in-line schlieren imaging system to characterize HIFU transducers that have been designed and fabricated by members of the lab. Ultrasound waves applied in water create a gradient of index of refraction. When collimated light from a laser transmits through the gradient it is refracted due to Snell’s Law. In schlieren imaging the light from the laser that is not refracted is focused by a lens and filtered out, allowing only the refracted light to pass. The resulting image, projected onto a screen, is a 2D visualization of the ultrasound beam. Schlieren images provide a qualitative representation of the sum of all parallel ultrasound waves in each dimension. The schlieren imaging system in this project uses a 5 mW HeNe laser with an expanding lens to expand to a laser beam, a collimating lens (f = 600 mm) to generate parallel rays to pass through the water tank in which ultrasound is applied, and finally a focusing lens (f = 300 mm) to focus the rays that were not refracted by the ultrasound generated gradient. When used to characterize HIFU transducers schlieren images provide information about the position of the focus, relative intensity, and beam structure of the ultrasound. In conclusion, an in-line schlieren imaging system has been shown to provide an effective method of visualization of the beam pattern of HIFU transducers.

**How does geoduck aquaculture affect eelgrass in south Puget Sound?**

*Carrie Craig, Sophomore, Biology*

*Mentor: Jennifer Ruesink, Biology*

Geoduck (*Panopea abrupta*) aquaculture happens on a large scale in south Puget Sound in some of the same areas that harbor eelgrass (*Zostera marina*), a protected species in Washington. It is crucial to understand the impacts of geoduck aquaculture on intertidal ecosystems, especially on eelgrass, in order to make informed management decisions. In long-term surveys, eelgrass showed strong seasonal patterns in the following variables: prolific branching of the rhizome in spring; high density, individual plant biomass, and internode length in summer; and high growth rates in summer, except during periods of heat stress. We experimentally tested how eelgrass responded to nutrients, disturbance, and geoducks by manipulating each of these factors. The presence of geoducks reduced...
Male and female mammals experience different hormonal environments in the days immediately following birth. In males (but not in females), testosterone exposure during the neonatal critical period “hardwires” the development of the anteroventral periventricular nucleus (AVPV) in the forebrain by inducing apoptosis of a subset of neurons in this nucleus. In the female, neurons in the AVPV play a critical role in the regulation of reproductive function by activating other neurons in the forebrain that produce the preovulatory surge of gonadotropin-releasing hormone (GnRH). Recently, kisspeptins (a family of neuropeptides encoded by the Kiss1 gene) and their receptor, GPR54, have been implicated in the activation and support of GnRH secretion. Kisspeptin neurons are located in the AVPV, and we postulated that these cells are targets of testosterone action. If this were true, the number of kisspeptin neurons in the AVPVs of adult females treated neonatally with testosterone (to simulate the neonatal milieu of the normal male) would be similar to that of normal adult males. To test this hypothesis, we measured and compared cellular levels of KiSS-1 mRNA in the AVPV of normal male and female rats, as well as female rats that were treated neonatally with testosterone. We observed a large sex difference in the expression of KiSS-1 mRNA in normal intact adult males and females, with much higher expression in females. Moreover, females treated with testosterone had levels of KiSS-1 mRNA that were indistinguishable from those of normal males. These findings indicate that the expression of KiSS-1 mRNA in the AVPV is sexually differentiated by the action of testosterone during the neonatal critical period. We infer that sexual differentiation of KiSS-1 mRNA expression in the AVPV may help to explain the molecular basis for the preovulatory GnRH surge mechanism, which is present in females but not in males.

### Sexual Differentiation of Kiss1 Gene Expression in the Brain of the Rat

**Angela Crown, Junior, Neurobiology**  
**Mentor: Robert Steiner, Physiology, Biophysics**

The hippocampus, a region in the brain that controls memory and learning, is broken up into two components of a circuit: Ammon’s horn and the dentate gyrus. The dentate gyrus plays a role in memory processing and previous studies have shown that different regions within the dentate gyrus have different functions. These regional differences are thought to be due to differences in gene expression. The Allen Institute for Brain Science developed an online two-dimensional (2D) map of gene expression in the adult mouse brain. Using the Allen Brain Atlas, genes that exhibited high expression and showed clear dorsal-ventral boundaries in the dentate gyrus were chosen and used for models representing these regions. Each image on the atlas is spaced 200 µm apart and gene patterns can change significantly within this distance. For this project male adult mouse brains were sliced at smaller increments (50 µm) in order to fully capture the pattern. The mRNA expression pattern for genes of interest was mapped using *in situ* hybridization. Digoxigenin-labeled probes were hybridized to the sections of tissue and visualized with fluorescence microscopy. Once completed, the sections were scanned and stitched together to create digital images showing these expression patterns. This 2D data was translated to a 3D reconstruction in order to visually represent the boundaries between dorsal and ventral gene expression. We have identified at least one boundary that distinguishes the dorsal region from the ventral. This model will later be used to correlate patterns of genetic expression with function within the dentate gyrus. Understanding the genetic expression patterns of the dentate gyrus may help in understanding the mechanisms driving region-specific gene expression in the brain. A long-term goal of this project is to understand how the dentate gyrus is involved in the hippocampal circuit and how this circuit affects memory processing.

### Constraining the Global Hydrogen budget: Isotopic analysis of H₂ Soil Uptake

**Archana Dayalu, Senior, Chemistry, Environmental Studies**  
**Mentor: Paul Quay, Oceanography**

Since Hydrogen (H₂) is likely to become one of the top fuel choices on a global level it is necessary to analyze the biogeochemical cycle of atmospheric H₂ such that any potential impacts on atmospheric chemistry and global climate have been assessed in the early stages of its economic institutionalization. The budget of H₂ sources and sinks has uncertainties of approximately 50%. My
research focuses on the uncertainty surrounding the soil sink (soil microbe uptake of H₂); it has been approximated to 75% of the global hydrogen sink, but there has been little research done in this area. There are potential discrepancies between this estimate and data provided by isotopic analysis of the deuterium to hydrogen ratio (D/H) in atmospheric H₂. This technique, which uses naturally occurring variations in isotopic composition, is a chemical fingerprinting method to trace origins of H₂ since each source and sink imports a characteristic D/H ratio. My research involves conducting soil uptake experiments to test D/H fractionation and consists of a time-series collection of air samples from a steel chamber placed over a patch of soil. The experiments are done in a variety of environments to account for the effects of soil moisture and temperature on the fractionation process. Experiments have taken place in the University of Washington Arboretum in the winter and spring under varying temperatures and levels of moisture. The samples are then analyzed for H₂ concentrations using a gas chromatograph reduction gas analyzer analytical system. Following this, the samples are passed through a cryogenic vacuum line to separate H₂ from the majority of constituents in air, and the concentrated H₂ is measured for its D/H ratio by mass spectrometry. The D/H ratio is plotted against time, and the reaction rates of H₂ vs. HD uptake by soil microbes are compared.

**Plasma Space Thrusters: The Way of the Future**

*Joni DeBoever, Senior, Aeronautics & Astronautics  
Mentor: Robert Winglee, Earth & Space Sciences*

Magnetized Beamed Plasma Propulsion (or MagBeam) represents a hybrid between advanced electric propulsion, beamed energy systems, and plasma sail technologies that will provide high thrust, high speed and high payload fractions for robotic and human exploration of the entire solar system. High Powered Helicon Plasma Thruster of the second kind (HPH2) is a state of the art electrodeless plasma thruster and is basically the hardware behind the MagBeam concept. The spectrometer is my specific project on HPH2 which is a scientific instrument that uses fiber optic cable to beam a light down the center of the chamber looking directly at HPH2 to take measurements on light emitted from Argon reactions. The important data collected gives us the different energy state levels of Argon in the chamber. This can tell us how much of the neutral is remaining a neutral and how much is ionizing, or turning into plasma.

**Analysis of Tsunami Deposit from Kamchatka, Russia**

*Amanda Delgado, Senior, Earth & Space Sciences  
Mentor: Joanne Bourgeois, Earth & Space Sciences*

Geologists are currently unable to predict tsunamis, and constructing a geologic record of past tsunamis based on deposits is one of the only ways to assess the reoccurrence interval of tsunamis in an area, which places great importance on the study of tsunami deposits. Characteristics of a deposit, such as grain size and deposit thickness, can provide useful information about the height, energy level and extent of a tsunami event. I will be analyzing a tsunami deposit from Mutnaya Bay of Kamchatka, Russia, in order to gain more insight into the wave event that formed the deposit. The results of my work may contribute to the work of others who are attempting to form a more complete geologic record of the area. I have five cylindrical sample tubes and three larger rectangular samples from the Kamchatka deposit to work with. I am x-raying the samples in order to find out if any sedimentary structures, such as graded bedding or rip-up clasts, are evident from these images. Another technique I am using to observe structure is sample peeling, which, as the name implies, is when a layer is peeled off the deposit to clearly expose graded bedding and flow patterns. Analysis of grain size within the deposit will also provide useful information. Grain size can be used to determine wave velocity and size, and characteristics, such as fining inland, can indicate direction and extent of the tsunami event. Once I have completed all the tasks involved in sample analysis, I will have a collection of data to examine in hopes of gaining further knowledge about the size and velocity of the tsunami that deposited these sediments, which will contribute to the geologic record in the Kamchatka region.

**A Comparison of Concentrations of Macronutrients and Chlorophyll a in High and Low Chlorophyll Concentration Areas around the Galapagos Islands**

*Tamra Dickson, Senior, Oceanography  
Mentor: Roy Carpenter, Oceanography*

The Galapagos archipelago is a hot spot of life in an open ocean of low production. The ecosystem of the islands depends on dissolved nutrients, which determine how much and what types of phytoplankton occur. This then determines size and distribution of micro- and macrofauna that feed in the nutrient-rich waters. On R/V Thompson G. Thompson cruise 189 from January 20th to January 28th, 2006, waters west of Isla Isabela were colder and had higher nutrient and chlorophyll concentration than waters east of Isabela. These results were confirmed by satellite images of sea surface chlorophyll concentrations taken the week of the cruise. It was also determined to be a “normal” non-El Niño year with upwelling in the western part of the archipelago. All measured nutrient concentrations increased with depth. Nitrate concentrations (between 15 μM and 25 μM) were higher in high chlorophyll concentration areas to the west than low concentration areas to the east. Silica was the opposite with concentrations (between 1 and 5 μM) being generally higher in the eastern stations. This was likely due to fewer and smaller diatoms not using as much silica. Ammonium was below 1.0 μM for all stations because it is preferred more than nitrate and takes less energy and dissolved iron to be used. Phosphate (1 μM to 5 μM) was higher at stations closer to shore than further stations.
While a majority of people interviewed stated gender project in Zimbabwe, including 23 women and 23 men. Project (ZiCHIRe), a behavioral STD/HIV prevention Zimbabwe Community Health Intervention Research Washington conducted interviews with employees of the factor. Four undergraduate interns from the University of important to relate gender issues in intervention programs often measured as a human rights indicator. It is also Gender is understood as a key factor in development and effective than those that attempt to make wide assumptions about gender.


During the past 20 years, both medicine and robotics have seen a lot of progress. Finally, the two fields have been improved enough so that they are able to come together in the operating room. New techniques using minimally invasive surgery (MIS) with surgical robots allow surgeons to perform operations both on-site and remotely. The goal of this project is to improve the design of a surgical robot in order to make MIS safer and easier. A surgical robot is a device that reacts to input that it receives from a master console controlled by a surgeon. The robot is helpful because its small tools have more degrees of freedom and dexterity than traditional MIS, resulting in faster healing times for the patient. Improving the design of the surgical robot will lead to more widespread use in operating rooms and improve MIS techniques. Through extensive collaboration between the Department of Electrical Engineering BioRobotics Lab, Department of Surgery, and the Center for VideoEndoscopic Surgery (CVES), a next-generation surgical robotic system has been designed and fabricated. My research focuses on the testing and debugging of various components of the surgical robot. The next steps in the project include the integration of two arms into the robotic system and animal testing.

The Importance of Gender Relations to Public Health and Behavioral Change Interventions

Gender is understood as a key factor in development and often measured as a human rights indicator. It is also important to relate gender issues in intervention programs focusing on reproductive health/STI prevention because interventions that ignore gender miss a large socio-cultural factor. Four undergraduate interns from the University of Washington conducted interviews with employees of the Zimbabwe Community Health Intervention Research Project (ZiCHIRe), a behavioral STD/HIV prevention project in Zimbabwe, including 23 women and 23 men. While a majority of people interviewed stated gender roles were one of the most important factors related to the prevention of STIs, most were surprised when queried about how gender roles had affected their personal lives, and did not express strong feelings about their impact. This strong difference between theoretical and applied gender attitudes is particularly interesting to the interns. While female employees feel women are not empowered to introduce condoms into their relationships, even though this has a significant effect on HIV rates, they do not consider gender to have been a barrier in their own lives. This indicates that Zimbabwean women do not consider their gender to be a negative factor in their own lives, thus HIV prevention methods must be sensitive to this fact. It is necessary to promote programs that implicitly rather than explicitly discuss gender in terms of prevention, as suggested by the observations of these interviews. Although women recognize the role of gender in HIV transmission, this does not indicate that women perceive themselves as disadvantaged by their gender, and so intervention methods should not make this assumption. As a result, prevention methods that work within cultural paradigms to help women protect themselves will be more effective than those that attempt to make wide assumptions about gender.

Radar Based Three Dimensional Forecast Model Analysis of Portland, Oregon
Timothy Downing, Senior, Atmospheric Sciences Mentor: Sandra Yuter, Atmospheric Sciences

The desire of our research is to use radar technology to better evaluate forecast model output in the Portland, Oregon area. The first task in completing our goals is to gather radar data from storm cases that move through the Portland area. With these data sets, we can construct three-dimensional pictures of storm structures. We can then use these images to compare 3-dimensionally how well our forecast model reproduced what actually occurred. In our research this year, I have collected radar data from all storms occurring in Portland, OR from November through January from the Portland WSR-88d radar. I am currently converting this data into a form that we can easily interpret. The next step in our research is to identify key patterns within each storm case that we can compare against the model output. For instance, this might be the identifying a certain precipitation pattern for all storms with a given wind direction. We will then compare these results with the output from the forecast model. I am also exploring quantitative ways to rank how well the model reproduced what actually happened. We hope to design a program, using the C++ or Python, which will numerically determine the accuracy of the forecast model output. Such a program would allow us to compare our data sets using biases and localized statistics. An example of how this would be helpful is that maybe the forecast model does well at reproducing the weather overall, but it consistently misrepresents the

offshore. Measurements of macronutrient concentrations around the Galapagos Islands help to understand nutrient cycling as well as variations in microflora and fauna size in different locations in the archipelago.
vertical structure of the storms. These are the type of discoveries we hope to make through our research.

**Building a Scanning Calorimeter to Examine Double Critical Fluctuations**

*Jenne Driggers, Sophomore, Physics*

*Mary Gates Scholar, NASA Space Grant Scholar*

*Mentor: Gerald Seidler, Physics*

The goal of this project is to examine the divergence of heat capacity of ternary liquid mixtures with double critical points. Many examples of phase transitions exhibiting so-called critical phenomenon exist. This means the system exhibits ever-growing fluctuations between two phases as the transition temperature is approached. Ferromagnetic transitions are the ‘classic’ example, but another example is provided by many liquid mixtures. For example, a water and 3-methyl pyridine mixture will separate at low temperature but mix again at higher temperatures. The rate law for the divergence of the fluctuations in such systems is described by a power law in the difference between temperature and the transition temperature. The exponent in the power law is called a critical exponent. Observing fluctuations that are extremely large is usually difficult because it would require being extremely close to the transition temperature. In some systems, the critical exponents are doubled, making it far easier to observe critical fluctuations having a length scale of tens of microns. Our long-term goal is to determine how the existence of these fluctuations affects the surface tension and other interfacial properties of the unusual, dynamically fluctuating liquid. In order to reach this goal, we must first convince ourselves that we can indeed make a liquid mixture exhibiting a double critical point. Toward this end I have built, and am in the process of testing and calibrating, a scanning calorimeter which will be used to measure and calculate the heat capacity of samples. I have been responsible for many aspects of this instrument’s development, including wiring, calibrating thermometers, and machining components. I have written software in LabVIEW that interfaces between measuring instruments and the calorimeter. I am currently testing the calorimeter with a chromium sample, and hope to begin studying ternary liquid mixtures in the near future.

**Alternative Landscapes: Cartography and Traditions of Land Perception in Native North American Societies**

*Kara Dunn, Senior, English*

*Mentor: Brian Reed, English*

Western cartography emphasizes the stability of place, the assurance of distinct and proper locations for objects in the physical world. Native American cartography is instead concerned with space, and how a place is transformed by the presence of people, animals, or spiritual forces inhabiting the landscape and moving through it. Native American cartography provides an alternative way of understanding the function of cartography and perceiving the landscape through maps. Different functions include using maps as figurative language, historical and political documentation, performance art, mapping philosophical or theological landscapes, and the familiar use of maps as a tool for navigation. Since human perception is mediated through the limitations of our physical bodies and selective senses, we must seek to make up for those limitations by incorporating a wide variety of perspectives into our view of the world. Western cartography has become so ingrained in our culture – in our educational systems, economy of tourism, networks of communications – that it is important to be reminded that these maps are only one perspective among the many truths of the mappable world.

**P58IPK Involvement in Double-stranded RNA Pathway Mechanisms of an Influenza-A Virus Infected Cell**

*Alison Eastman, Sophomore, Microbiology*

*Mentor: Michael Katze, Microbiology*

*Mentor: John Kash, Microbiology*

Double-stranded RNA (dsRNA), produced during the viral life cycle, is a key early indicator of infection. Several cellular proteins, including TLR3, PKR, and RIG-I, recognize dsRNA and activate expression of many antiviral response genes, including interferon (IFN). Induction of IFN expression following dsRNA-mediated activation of the transcription factor IRF3 results in the expression of hundreds of genes to combat infection and propagates the antiviral response to nearby cells to stop the infectious cycle. Thus highly-pathogenic viruses, including influenza, encode proteins that inhibit activation of the dsRNA/IFN response. Our laboratory has previously shown that during infection, the influenza virus hijacks a key regulator of PKR, called P58IPK, to help prevent activation of the dsRNA response. At present, the role of P58IPK with the other dsRNA response proteins is unknown; however, we hypothesize that P58IPK is likely an important regulator of the other components of the dsRNA response to infection. To test this hypothesis, we will infect genetically engineered mouse embryonic fibroblasts (MEFs) that lack expression of P58IPK with influenza virus and compare their overall dsRNA/IFN response pattern to that of normal infected MEFs. To determine the global host response to influenza infection, we will employ functional genomics technologies and bioinformatics to measure the relative expression of over 22,000 genes simultaneously. Additionally, we will monitor the activation of several key dsRNA response proteins, including IRF3 and RIG-I, to understand how P58IPK expression modulates their activity. By combining traditional biochemical approaches with cutting-edge functional genomics technologies, we will gain novel insight into activation of the immune response and how highly pathogenic viruses, like influenza, circumvent this response. As the threat of an influenza pandemic looms, understanding of the various interacting pathways is integral to the identification of genetic
signatures of different viruses and to the development of new therapeutic methods.

Application of Quasi-Elastic Light Scattering to Protein Aggregation Studies

Ryan Emerson, Senior, Biochemistry, History
Mary Gates Scholar
Mentor: John I. Clark, Biological Structure

Under stress conditions, proteins can become unfolded or misfolded and self-associate into large disordered bodies termed aggregates. Protein aggregation has been implicated in diseases such as cataract, age-related macular degeneration and Alzheimer’s disease. Experiments to date have used UV-visible spectrophotometry to measure the thermal aggregation of proteins in solution. Our goal is to be able to measure and quantify protein aggregation in a more sensitive manner than is possible with previous methods. The present study uses Quasi-Elastic Light Scattering (QLS) as an alternative means of measuring and monitoring protein aggregation in solution. In QLS, the intensity fluctuations of a laser beam directed through a sample solution are used to calculate particle size, and therefore determine the extent of protein aggregation. Alcohol Dehydrogenase, a protein whose aggregation properties are well known from previous studies, was used in the experiments to demonstrate the ability of QLS to accurately monitor protein aggregation. In the test system QLS accurately measured protein aggregation with higher sensitivity and using less material than UV-visible spectrophotometry.

Using Oceanic Seismometers to Track Fin Whales

David Englund, Freshman, Mathematics
NASA Space Grant Scholar
Mentor: William Wilcock, Oceanography
Mentor: Andrew Barclay, Oceanography

The Keck Endeavour Seismic Network is an array of eight seismometers used to monitor seismic activity around hydrothermal vents on the ocean floor. The array is located along the Endeavour Segment of the Juan de Fuca plate in the Pacific Ocean. After recovering the first year’s worth of data, it was discovered that the seismometers were picking up the calls of various whales passing by the network. It was then hypothesized that the network could be used to locate whales in a manner similar to locating earthquake epicenters. In order to do so, each whale call had to be marked in the database on each sensor. The seismic data was filtered to look only at frequencies between 8 and 30 Hz, which encompasses the fin whale’s typical song frequency of around 22 Hz. The time difference between each sensor’s reception of the call made it possible to triangulate the whale’s location at the time it vocalized. The primary method for doing this involved a “guess-and-check” program using matrix algebra. Employing current knowledge regarding fin whale behavior, it was possible to better estimate their depths within the water and therefore increase estimation accuracy. With these calculations, the whale’s location over a time interval could be plotted and analyzed. In the two instances this was attempted, the plots illustrated clear paths while the whale was within two kilometers of the network. In conclusion, we were able to determine that the fin whales could be located and tracked using the seismic network.

Assessing Undergraduate Nursing Students’ Knowledge of Elder Mistreatment

Deborah Eraker, Senior, Nursing
Mentor: Maggie Baker, Biobehavioral Nursing and Health Systems

Elder mistreatment (EM) affects 500,000 to 1.2 million persons aged 65-and-older annually in the US. As the 65-and-over population increases from 12.4% of population in 2000 to 19.6% of population in 2030, incidence of EM is expected to rise. Understanding basic information about EM is necessary for nurses to effectively intervene in EM cases. When compared to nursing curriculum content about child abuse and intimate partner violence, EM content has received the least amount of attention. There are no national nursing curricular requirements for EM content. The study purpose was to assess undergraduate nursing students’ knowledge of EM. With Human Subjects approval, an anonymous survey containing multiple choice and true/false questions about EM was administered to Junior (n=89) and Senior (n=78) undergraduate nursing students at the UW School of Nursing. Students’ age groups were: 18-25 (n=88), 25-35 (n=57), 35-or-over (n=18). Juniors’ scores averaged 50.9% (range 30-80%). Seniors’ scores averaged 50.8% (range 30-80%). Questions answered correctly most frequently included definition of EM (n=166), assessment of EM victims (n=148), risk factors for long-term care residents (n=117), and EM victim profile characteristics (n=116). Questions answered incorrectly most frequently included likely explanation (theory) for EM (n=2 correct), most common perpetrator (n=18 correct), and EM prevalence (n=29 correct). Students’ experience with elder mistreatment included popular literature or media (n=90), course work or previous schooling (n=78), clinical or work setting (n=45), personal life (n=14), and none (n=21). Undergraduate nursing students have partial EM knowledge deficit. Results support inclusion of additional EM content in undergraduate nursing curriculum.

HOT DNA, R-Loops and Recombination

Lesley A. Everett, Senior, Biochemistry
Mentor: Robert J. Crouch, Biochemistry

Ribonuclease HI (RNase HI) is an evolutionarily conserved endo-ribonuclease that degrades the RNA molecules of RNA/DNA hybrids. The formation of RNA/DNA hybrids is essential to genomic replication and repair.
The cell uses RNA primers to initiate DNA replication, but these RNA/DNA hybrids must be degraded in order to prevent the initiation of replication at sites other than the normal origin of replication. E. coli ribonuclease HI is a non-essential protein but its absence leads to at least three interesting phenotypes. These phenotypes have been attributed to longer-lived RNA/DNA hybrids that can be used to initiate DNA replication. [1] DnaA is important for initiation at the normal origin, OriC, but when it is non-functional replication can initiate at other sites if RNA/DNA hybrids are stabilized. This can be accomplished with only a modest decrease in RNase HI activity. [2] RecBCD is a protein involved in recombination and it too is not required for growth. However, in the complete absence of RNase HI the recB or (recC) gene becomes essential. [3] Heat DNA is able to accumulate in RNase HI negative cells and requires RecBCD. Recombination between sister chromosomes leads to the formation of small circular DNA molecules that were originally thought to contain “other” origins of replication. These molecules can be transformed into and “replicated” in rnhA mutant strains but not wild type strains. Utilizing partial function mutants and multi-plasmid complementation assays, we are developing a mechanistic model to fully explain these phenotypes of interest. Preliminary work indicates the existence of at least three “rescue” genes which likely prevent or resolve topological problems in the RNase HI /RecBCD mutants.

The Effects of Aging on Tumor Growth and Angiogenesis are Tumor-Cell Dependent

Daniel Eyman, Senior, Biology
Mentor: May Reed, Medicine

It is generally accepted that histologically similar tumors grow more slowly and have less vascularization in aged mice relative to young mice. TRAMP-C2 prostate cancer cells, a line not previously examined in aging, were subcutaneously implanted into syngeneic C57/Bl6 young (4mo) and aged (20mo) mice and compared tumor growth and angiogenesis. Unexpectedly, the prostate tumors grew as fast in aged as in young mice. Angiogenesis into TRAMP-C2 tumors was robust, with no differences between the young and aged mice in the number of vessels, distribution of vessel sizes, or features of vessel maturation. Aged mice had lower levels of serum testosterone than the young mice. VEGF levels were similar in the tumors and sera of the young and aged mice. Comparisons with tumors previously examined in aged mice (such as the B16/F10 melanoma), showed that, as expected, B16/F10 tumors grew minimally in the aged mice. In contrast to the B16/F10, TRAMP-C2 tumors had an extracellular matrix with significantly higher levels of MMP2 and MMP9 expression and activity. These unique results demonstrate that tumor progression can be as robust in aged tissues as young tissues. The ability of aged mice to grow large, vascularized prostate tumors is associated with high levels of MMP2/9 activity, thereby creating a permissive environment for tumor growth and angiogenesis.

Drug Resistance in Malaria

Naheel Fatafah, Senior, Biochemistry
Mentor: Carol Hopkins Sibley, Genome Sciences

Plasmodium falciparum is a parasite that is transmitted to humans via the Anopheles mosquito. Currently, malaria threatens 1/3 of the human population. It thrives mainly in the tropical areas of Asia, Africa, and South and Central America, and claims as many as 2.7 million of its victims yearly, mostly infants and children. Pyrimethamine and chloroclyguanil are two antimalaria drugs used currently to treat malaria in many areas. Both drugs are competitive inhibitors of the dihydrofolate reductase (DHFR) enzyme that is responsible for the synthesis of dTMP, methionine and histidine. Resistance to drugs of this class has arisen due to point mutations in the DHFR gene, rendering these them useless in many regions. No significant resistance has yet been demonstrated against the new DHFR inhibitor, WR99210. The goal of my research is to identify possible point mutations in the DHFR gene that do cause resistance to WR99210. We have developed a yeast expression system, in which the yeast lack endogenous DHFR expression, but depend instead upon expression of a P. falciparum DHFR gene. In these yeast, inhibitors of the P. falciparum DHFR enzyme, like WR99210 inhibit yeast growth. This approach allows the study and identification of mutations in the P. falciparum dhfr gene that confer resistance to WR99210. I will assess the role of particular mutations in the P. falciparum dhfr gene by measuring the amount of the WR99210 required to inhibit growth of the transformed yeast by 50% (the IC50 value). This work will allow us to identify mutations in the gene that could arise in the parasite population once the WR99210 is used to treat malaria in the field.

Fos expression in the paraventricular nucleus (PVN) after intragastric hyperosmotic NaCl in rats without a rise in plasma osmolality: gut osmotic clamp

Dominic Femiano, Senior, Psychology
Mentor: Douglas Fitts, Psychology

After eating a salty meal, we get thirsty. There are two ways this could happen: (1) the salt is absorbed into the blood, making the blood extra salty (hyperosmotic), and this is sensed directly by specialized nerve cells in the brain (osmoreceptors); or (2) osmoreceptors may exist in the gut itself to signal the brain in advance of the absorption of the hyperosmotic load. To test the second hypothesis, we have been isolating the osmoreceptors in the gut to determine what parts of the brain are activated in this process and to see which neural pathways are used. This experiment is done by giving rats a hypertonic (salty) solution directly into their gut and infusing water into their veins simultaneously, thus forming a gut osmotic clamp. The water infusion
prevents a change in blood plasma osmolality and allows us to attribute any thirst responses solely to that of the gut osmoreceptors. Initial results show that the gut osmotic clamp did not activate the circumventricular organs of the brain that are sensitive to changes in plasma osmolality. However, we found that there was activation in the PVN, specifically in the lateral magnocellular and ventromedial parvocellular regions. Further research will be done to examine more of the neural pathways and brain regions involved in the gut osmoreceptor signaling process.

Exploring Brain Maps: Development of callosal topography in visual cortex of normal and enucleated rats
Yasuko Fujiike, Junior, Biochemistry
Mentor: Jaime F. Olavarria, Psychology, Neurobiology and Behavior

In the brain, neural systems exhibit a hierarchy of functional organization that reflects distinct arrangement of axonal connections. For a proper coordination of the visual world, the brain forms neural maps that represent the environment. Understanding how maps develop in the brain will help us better define how the orderly sets of synaptic connections that underlie our sensory and cognitive functions are established. This understanding is crucial for preventing and treating neurological disorders resulting from abnormal development of axonal connections. Here, the interhemispheric connection through the corpus callosum (callosal connection) was studied as a model. In normal rats, callosal connections in striate cortex are non mirror-symmetric, whereas in neonatally enucleated rats, they are mirror-symmetric. Furthermore, the rat’s retina input specifies the topography of callosal projections by postnatal day 6 (P6). How retinal input guides development of callosal maps was investigated by studying the topography of emerging callosal connections at, and immediately after P6 in both normal and enucleated rats. The patterns of callosal connections were revealed by histochemical processing after tracer injections into the visual cortex and microscopic data acquisition. The result showed that the two distinct patterns in normal and enucleated rats are present at P6-7, just as collateral branches of simple architecture emerge from their parental axons and grow into superficial cortical layers. The results support the idea that retinal input specifies the sites on the parental axons from which interstitial branches will grow to invade middle and upper cortical layers. This ensures that the location of invading interstitial branches is accurately related to the topographical location of the soma that gives rise to the parental axon. Moreover, the patterns in enucleated rats suggest that the signals that determine the mirror-symmetric callosal map exert only a weak control on the topography of fiber inward growth.

Mutator Phenotype of Murine Embryonic Fibroblasts

Harboring Mutant DNA Polymerase-δ
Evan Fuller, Senior, Biochemistry
Mentor: Lawrence Loeb, Pathology
Mentor: Ranga Venkatesan, Pathology

DNA polymerase-delta (Pol-δ) is involved in chromosomal DNA replication, DNA repair, and genetic recombination. Although the primary sequence of Pol-δ has diverged, amino acids at the active site are highly conserved. The active site includes the three conserved motifs A, B and C. In this study, we used site-specific mutations to investigate the function of Leu604 in motif A of Pol-δ in cultured murine cells. Previously, the Loeb laboratory has generated two transgenic mouse strains that harbor either a glycine or lysine substitution at Leu604. The heterozygous L604G and L604K mice are tumor-prone, and we therefore asked whether fibroblast cell lines derived from these animals exhibit an elevated mutation rate, i.e., a mutator phenotype. To examine this question, we immortalized embryonic fibroblasts (MEFs) from wild-type, +/L604G and +/L604K animals, and I am now determining mutation rates at the HPRT locus. The HPRT gene encodes a non-essential purine salvage enzyme (hypoxanthine-guanine phosphoribosyl transferase) that converts the purine analog 6-thioguanine (6-TG) to the cognate nucleoside monophosphate. When incorporated into DNA, the nucleotide analog causes cell death. Cells harboring HPRT mutations that confer resistance to 6-TG proliferate, allowing determination of spontaneous mutation rates. I have observed that the average mutation rate for three trials of two different +/L604G cell lines is elevated 5-fold relative to wild-type, and I am currently analyzing +/L604K lines. To determine the nature of mutations that confer 6-TG resistance, I have cloned and expanded 45 independent, 6-TG resistant +/L604G lines and isolated total RNA. I am currently sequencing HPRT cDNA to identify the mutations, and will do the same for +/-L604K 6-TG resistant lines. These preliminary results indicate that cultured cells from +/-L604G animals exhibit a mutator phenotype in vitro, and that elevated mutation rates may account for the tumor-prone phenotypes of the +/-L604G and +/-L604K animals in vivo.

The Conservation of the Gettysburg Cyclorama
Kylie Fullmer, Junior, Art History
Mentor: Susan P. Casteras, Art History

Cycloramas were a popular form of entertainment in pre-cinematic America and Europe in the late 19th-century. Massive in size, these 360-degree oil on canvas paintings, typically about 40’ high and 360’ in circumference, were displayed in specially designed circular auditoria and enhanced with 3-D landscape features, real objects, and/or life-sized figures. Standing on a central platform, viewers would thus feel literally surrounded by and thrust into the center of the highly realistic scenes, many of which depicted historical events. One cyclorama, “The Battle of
Cellular solids, affectionately known as “foams,” are an important part of our everyday lives. They make up the cushions in our chairs, the sponges in our sinks, the trees on land, and the coral in the sea. The widespread applications and realizations of foams make the importance of a continued study of polymer foams obvious. However, much of the studies of foams to date have been conducted from phenomenological (system-specific) effective medium theories involving simplifying unit-cell models of foams. While these approaches can provide a good deal of information about foams, they are incomplete. The goal of this project is to develop a method of calculating cell statistics involving a combination of distance-mapping and the watershed algorithm. By applying a distance-map filter and a watershed filter in succession, it is possible to segment 3D images of open- or close-celled foams and then use a variety of utility programs to extract a variety of useful cell statistics. Researchers in the lab have already collected data for a variety of foam structures using micro computer tomography. Ideally, analysis of the statistics for these foam structures obtained via watershed segmentation will show a strong correlation between the micro-scale and macro-scale properties of the foam. The calculated statistics will then be compared to statistics generated from simulations of soap froths and statistics gathered using effective medium theories in order to establish the watershed algorithm as a viable alternative means of calculating cell statistics of polymer foams.

**Computerized Characterization of Cellular Solids**

*Robert Gay, Junior, Computer Science, Mathematics*

*Mentor: Gerald Seidler, Physics*

Cellular solids, affectionately known as “foams,” are an important part of our everyday lives. They make up the cushions in our chairs, the sponges in our sinks, the trees on land, and the coral in the sea. The widespread application and realizations of foams make the importance of a continued study of polymer foams obvious. However, much of the studies of foams to date have been conducted from phenomenological (system-specific) effective medium theories involving simplifying unit-cell models of foams. While these approaches can provide a good deal of information about foams, they are incomplete. The goal of this project is to develop a method of calculating cell statistics involving a combination of distance-mapping and the watershed algorithm. By applying a distance-map filter and a watershed filter in succession, it is possible to segment 3D images of open- or close-celled foams and then use a variety of utility programs to extract a variety of useful cell statistics. Researchers in the lab have already collected data for a variety of foam structures using micro computer tomography. Ideally, analysis of the statistics for these foam structures obtained via watershed segmentation will show a strong correlation between the micro-scale and macro-scale properties of the foam. The calculated statistics will then be compared to statistics generated from simulations of soap froths and statistics gathered using effective medium theories in order to establish the watershed algorithm as a viable alternative means of calculating cell statistics of polymer foams.

**Thermo-dynamic examination of the aqueous oxidation of sulfides in Europa’s ocean**

*Lars A. Gilmour, Senior, Earth and Space Sciences, Biology*

*Mentor: Mike Brown, Earth and Space Sciences*

Jupiter’s moon Europa has a deep ocean (>100 km depth) beneath a thin veneer of ice that may provide an environment compatible with the origin and evolution of life. The Europan ocean is likely an aqueous solution dominated by magnesium and sodium sulfates. Recent studies have discussed a range of possible solute concentrations, specifically MgSO4 aq. from 0.0 Kg/ltr (Zolenski, 1988), 0.001 kg/ltr H2O (Mckinnon,1999) up to 0.20 Kg/ltr (Kargel, 2000). The wide range of estimated concentrations results from differing ideas concerning Europa’s evolution following accretion from chondritic material. For example it is unlikely that high concentrations of sulfate were the product of leaching from CI meteorites, it is much more likely to have been the result of hydrothermal alteration that produced aqueous oxidation of sulfides present in the accreted material. Inherent in efforts to understand the evolution of Europa’s ocean is the use of chemical models to determine the thermodynamic equilibrium of complex multi-component systems. Therefore, calculated results may not be in agreement for identical thermodynamic conditions. I will investigate chemical reactions associated with sulfide solubility and sulfate formation in a pressure/temperature regime relevant to the rock/ocean hydrothermal interface at the base of Europa’s ocean. Pressures are near 1 to 2 kilobar with temperatures from 0° C to 100° C. Using
The Search for Natural Mass-Dependent Nickel Isotope Fractionation

Jennifer B. Glass, Senior, Earth and Space Sciences, Oceanography
Mary Gates Scholar
Mentor: Bruce K. Nelson, Earth and Space Sciences

The opportunity to study natural variations in stable metal isotope ratios has been revolutionized by recent technological advancements in high-resolution mass spectrometry. Investigations using the new technology have discovered significant fractionation in Fe, Cu, Mo and Zn isotopes resulting from redox cycling and biological uptake. We are attempting to detect natural, mass-dependent Ni isotope variations in a high-Ni environment in northern Italy. The ecosystem of Monte Ferrato may show mass-dependent Ni isotope fractionation as Ni is transported in fluids from ultramafic (high-Mg) rocks to their alteration products (serpentinite); from the rocks to soil microbial communities; and from the soil to a Ni-hyperaccumulating (1% dry mass) plant species *Allysum bertolonii*. Initial work focused on developing analytical protocol for Ni isotope measurement, and correction for instrumental mass fractionation, on the Multi-Collector Inductively-Coupled-Plasma Mass Spectrometer in the UW Isotope Geochemistry Laboratory. Using the delta (per mil, ‰) notation for the ratio of the heavy isotopes (58Ni, 59Ni and 60Ni) to the lightest isotope (56Ni), normalized to a standard, instrumental mass fractionations were found to be +60‰, +91‰ and +122‰, respectively. The proportionality of instrumental mass fractionation to mass difference indicates insignificant elemental or molecular spectral interference. We measure High Purity Ni standard isotopic ratios to precisions (2σ) of 0.05‰, 0.10‰ and 0.10‰, for δ59Ni, δ58Ni and δ60Ni, respectively. Doping experiments with neighboring-mass and isobaric interferences (Fe and Co) show Ni measurements are sensitive to matrix effects so Ni-purification of samples is essential. Future work will include Ni-separation column chemistry with Eichrom Nickel Resin® (containing dimethylglyoxime) and pH-adjusted ammonium citrate. For other metals, biological uptake has been found to favor the light isotopes; we hypothesize that the light 58Sr isotope will be enriched as Sr moves from rocks to plants through the Monte Ferrato environment.

The Search for the transcription factor *Broad* in Non-

Insectan Arthropods

Nicholas Goehner, Senior, Biology (Physiology)
Mentor: Lynn M. Riddiford, Biology

The *broad* gene encodes a highly conserved transcription factor that regulates morphogenetic changes during insect development. It is hypothesized that a shift in the expression of *broad* could have played a role in the evolution of metamorphosis. In the hemimetabolous, direct developing insect *Oncopeltus*, *broad* is expressed early during embryonic growth and has been shown to be necessary for anisometric growth of the wing pads. *Broad* expression must then disappear in order to progress to the adult stage. In holometabolous insects, *broad* expression is restricted to the pupal stage and is necessary for transformation of imaginal primordia. Mounting evidence points to the insects arising from a direct developing crustacean. I have cloned *broad* from the direct developing gammarid amphipod, *Apholyte pugettensis*. This intertidal crustacean may have some resemblance to the putative insect ancestor. Preliminary expression data reveals *broad* to be present from the early embryonic stages through to the juvenile, but absent in the adult. Similar investigation of the metamorphic barnacle *Balanus glandula* reveal *broad* to be transiently expressed in the embryo, in later naupliar development, and continuing to the adult stage. Thus, *broad* seems to be important for morphogenetic changes in both insects and crustaceans. Supported by the Friday Harbor Laboratories Research Apprenticeship Program (Washington Research Foundation), Mary Gates Scholar Program of the University of Washington, and grants from NSF (REU supplement) and NIH to LMR.

Identification of E2 interaction with the *C. Elegans* heterodimer BRCA1-BARD1

Paul Goetsch, Senior, Biochemistry, Chemistry
Mentor: Rachel Klevit, Biochemistry
Mentor: Devin Christensen, Biochemistry

There are mutations in the breast cancer susceptibility gene 1 (*BRCA1*) that increase the risk of developing breast cancer from roughly one in eight to well over one in two. Such a drastic increase in susceptibility has promoted intensive studies into the cellular function of the BRCA1 gene product. BRCA1 associates with another protein BARD1 to form a heterodimer. This heterodimer forms to act as an ubiquitin ligase that mediates the transfer of ubiquitin from an ubiquitin conjugating enzyme (E2) to a protein substrate. *In vivo* experiments such as genetic manipulations of a model organism would be helpful in determining the cellular significance of this ubiquitination pathway. Unfortunately, such *in vivo* functional studies in systems like mammalian cell lines tend to be experimentally difficult due to their complexity. Therefore, a simple model organism with homologous proteins would be ideal. Recently, homologues of the human BRCA1 and BARD1 have been identified in the nematode *C. elegans* genome.
A biochemical functional analysis of these homologues is first necessary to validate in vivo studies. My goal is to screen through the twenty-two possible C. elegans E2’s to find the proper E2 that functions with the C. elegans BRCA1-BARD1 heterodimer. I will use a yeast-two-hybrid screen and electrostatic model computations to identify the proper E2. This will help to better understand the biochemical function of the C. elegans ubiquinination system, allow for comparisons to be determined between the C. elegans and human pathways, and thus help validate future in vivo research in the C. elegans model organism.

**Linking Cerebellar Pathology to Functioning in Individuals with Autism**

*Rebecca Groen, Senior, Psychology*
*Mentor: Sara J. Webb, Psychiatry*

While the specific cause of autism is still unknown, there has been a substantial amount of research documenting cerebellar dysfunction in individuals with autism. Research assessing the effect of cerebellar deficits in individuals with autism can provide us with more information about the link between cerebellar anatomy and functioning in individuals with autism. The focus of this study is to examine eye movements, visual attention, and fine motor movement tests to investigate the nature of cerebellar deficits in a wide range of children with autism spectrum disorders. These behavioral tests include three adaptation measures (in which the child must adapt motor movements to changes in visual input), two visual attention assessments, two visuomotor precision tasks, and tests of fine manual motor movement. In this study, we plan to examine correlations between measures of eye movement, standardized behavior measures, as well as autism symptoms to assess the relation of cerebellar functioning to behavioral symptoms in autism. We predict that children with autism will perform more poorly than matched children with typical development on tests of visual attention and eye movement, and that these behaviors will correlate with autism symptoms. This research will enhance our current knowledge of cerebellar functioning and leave room for other studies to build upon their knowledge of how cerebellar functioning is related to common behaviors in children with autism.

**GPS Interface for an Autonomous Jeep**

*Laura Grupp, Senior, Electrical Engineering*
*Mentor: Andy Crick, Electrical Engineering*

This last summer I was a member of a team who worked on Rudolf, an autonomous ground vehicle, in preparation for the DARPA Grand Challenge (see GrandChallenge.org for more information on the challenge). When I joined the team, many of Rudolf’s systems were already functional and he was able to complete short courses by independently making nontrivial decisions. Testing, however, revealed the expected necessity for modifications. Part of my participation this summer was testing the functionality of these systems, both before and after modifications were made. In addition to the general testing and debugging of Rudolf’s operation, I focused on our interface with the GPS. My first task after we completed the baseline testing of Rudolf’s functionality was to create a pictorial display of the information about individual satellites that the GPS system uses. In addition to receivers being able to locate themselves on the earth, our receivers can locate the GPS satellites’ positions in the sky. My goal was to create and display a map of the satellites given their coordinates. This clear display of information was useful to us when we were trying to understand why certain GPS anomalies occurred. Rudolf’s ultimate goal was to travel a course across the desert according to certain GPS coordinates. When I began my work, there was a crude system for collection of these “waypoints,” and my second task was to make improvements on this system. After I modified the program, we were able to create multiple lists of waypoints more easily and cleanly edit already existing lists.

**The Unseen Agenda: The Supreme Court and Cert Denied Cases**

*Lianna Hall, Senior, Political Science*
*Anthony Ching, Junior, Political Science, Communications*
*Mentor: Bryan Jones, Political Science*

This project examines the impact of Supreme Court cases denied the writ of certiorari on the public policy agenda of the Supreme Court. By researching and comparing Supreme Court cases that were granted a writ of cert against those that were denied cert, we hope to uncover new information about what influences the Court’s agenda setting process, including how public opinion might shape important rulings. Our study examines a sample of cases that were denied cert between 1947 and 1957. We will be using the Policy Agendas Project’s codebook to assign policy topics to the cases in our sample. After this, we will compare the results with previous research conducted on cases granted cert as well as public sentiment. The data will come from the US Reports, the official publication of the Supreme Court, as well as lower court summaries from LexisNexis. The comparison between cases granted and denied cert with public sentiment at the time is a topic that has never been researched before. Our research will reveal the relationship between what the public believes is important and how the Court correspondingly sets its agenda.

**Coordinating an Extended GLAST Satellite Orbit Simulation with Multiple Computers**

*Scott Hanes, Junior, Physics*
*Mentor: Toby Burnett, Physics*

The GLAST (Gamma-ray Large Area Space Telescope) satellite, scheduled to launch in late 2007, will detect and
localize gamma rays and their sources to greater precision than its predecessor, EGRET. While construction of the module is currently taking place, we plan to conduct a large-scale simulation of GLAST in orbit. In this simulation, the Data Challenge, GLAST will operate for an orbital precession period of 55 days and encounter every kind of particle it might need to filter out in space. However, this process is exceedingly taxing on desktop computers, sometimes requiring as long as an hour to simulate one orbit second. To make the Data Challenge more feasible, we want to employ many machines that will take samples of GLAST’s simulated orbit. It is therefore necessary that these machines be coordinated such that the individual simulations reflect the science of the whole. In particular, we wish to implement the Condor task manager, which delegates jobs to machines in a pool for optimal processing power over time. We also want to make use of Python, a programming language that is particularly suited for automating Condor and analyzing the simulated data we extract from our simulation. My work consists primarily of developing this interface which we can use to manage the Data Challenge in a reasonable fashion.

The Dynamics of Defense: Public, Politics and the Power of Defense Spending
Brandon Hawkins, Senior, Political Science, European Studies, German Language and Literature
Adam Thorne, Senior, Political Science, Economics
Mentor: Bryan Jones, Political Science

In 2002, the United States spent $370.7 billion on defense programs, making the United States the largest defense spender in the world, spending more than the next thirteen highest spending countries combined. Over the past half century theories and studies have produced efforts to ascertain the root causes of government spending for defense. What this research will hopefully provide is a more thorough explanation of which factors influence U.S. defense spending. Using resources available at the Policy Agenda Project, we will look at the role that political elites play in agenda setting, specifically Congress and the president, and the language they employ concerning defense spending. We will code the State of the Union speeches from 1950-2002 and the number of defense references cited in each speech. To determine the amount of attention Congress has given to defense spending, we will use every committee hearing on defense from 1950-2002. We will also seek to identify the ability of international pressures and the economy to influence defense spending. Using data sets from the Policy Agendas Project we will compare defense spending to outside events which may affect the amount allocated on defense. We will also compare percent change of defense spending on a year to year basis with the strength of the economy to determine if any correlation exists. This research challenges previous findings by scholars that defense spending is episodic, that is, is not influenced by actors such as the president, Congress or the economy.

Famine and Structural Adjustment in Niger
Marina Hench, Senior, International Studies
Mentor: Wolfram Latsch, International Studies

Beginning in late 2004 and early 2005, the sub-Saharan West African country of Niger experienced a wave of drought, followed by a locust invasion that destroyed much of the remaining harvest. In November 2005 experts noted a 220,000 ton shortage in the harvest of grains, such as millet, due to these conditions. A famine of critical proportions swept the country approximately half a year later. Response to the crisis, both by Niger’s government and the international community was slow, and aid only began relieving some of the malnutrition in the region around July and August of 2005. The organization Doctors Without Borders attributed the weight of the blame on neoliberal policies, especially of organizations like the International Monetary Fund. This paper explores the question: to what extend did economic structural adjustment policies contribute to the inadequate response of the Nigerian government and of the international community following news of the approaching famine? Was Niger’s leadership negatively compromised by economic agreements? And how heavily should we weigh the allegations of Doctors Without Borders? Through the exploration of documents such as Niger’s Poverty Reduction Strategy Papers, this research attempts to answer these questions, ultimately concluding that the Nigerian famine was the result of far more complex issues.

Statistical Analysis of Search Engine Log Files: Session Segmentation
Sam Hendricks, Senior, Informatics
Mentor: Efthimis N. Efthimiadis, Information School

Analysis of search logs is an ongoing undertaking by the Information School to better understand user search behavior and improve the design of information retrieval systems. The current research investigates search behavior through the analysis of web search logs from the AltaVista search engine. Searches that originated from Greece for the period of two months, January and February 2004, are being analyzed. The log data include cookie, date, time, query, query expansion using AltaVista’s PRISMA module, and the number of result pages seen. The data allow for a longitudinal study of search behavior based on cookie information. The research involves the development of PERL scripts that process the logs and provide data for further statistical analysis using SPSS and R. The results report on a new method of session segmentation that incorporates cookie, time and query term overlap. The analysis looks at the data both as individual instances as well as sessions. Statistics include frequencies of queries, term distributions, languages used including mixed
language queries, search features used, query length, query formulation, query expansion and query modification patterns. The results of this web segmentation study will be compared to those of previous web search log studies and highlight on the differences of such studies.

**Satellite Calibration with LED Detectors at Mud Lake**

*Jonathan Hiller, Senior; Mechanical Engineering*  
**Mentor:** Carol Bruegge, Earth Observation Department, NASA's Jet Propulsion Laboratory, Pasadena, CA

Earth-monitoring instruments in orbit must be routinely calibrated in order to accurately analyze the data obtained. Calibration curves for an orbiting instrument are derived by comparing radiometric measurements taken on the ground in conjunction with a satellite overpass. A permanent, automated facility is planned at Mud Lake, Nevada (A large, homogeneous dry lakebed) to routinely perform calibration measurements. Some orbiting instruments have low resolutions on the order of 250 meters per pixel. This necessitates data collection with many widespread, permanently installed radiometers at Mud Lake to minimize error. Because the cost and durability of commercial radiometers is prohibitive for use in a wide desert network, research was conducted to develop a robust, inexpensive radiometer using LEDs as sensors. A prototype was created, characterized, and tested at Mud Lake over the summer. Colored LEDs were found to have a suitably narrow sensing bandwidth to obtain good qualitative radiometric measurements, and will therefore yield good quantitative measurements when coupled with one calibrated radiometer. In addition, both the LEDs and the circuitry involved in each instrument are simple, inexpensive, and very robust. Therefore, it was concluded that installing a widespread array of the LED radiometers at Mud Lake would be practical to reduce satellite calibration errors and observe long-term surface changes of the earth.

**Self Assembly Properties of Marine Polymers**

*Jon Holloway, Senior; Cell, Molecular, and Developmental Biology*  
**Mentor:** Pedro Verdugo, Bioengineering

Phaeocystis globosa is among the most important of photosynthetic agents in the world’s oceans. Approximately half of all photosynthetic carbon fixation occurs in the ocean, making phaeocystis a major player in the global carbon cycle. Carbon fixed by phaeocystis is released to seawater in the form of exo-polymers or EPS (Wei Chun et al). Immunological studies have shown phaeocystis EPS to be a ubiquitous component of every major marine environment (Orellana et al). EPS like other polymers in the Dissolved Organic Matter (DOM) continuum, is not readily available for bacterial consumption (Orellana et al ocean sciences). However, if EPS polymers assemble to form micro gels, they can be colonized and available to bacteria degradation. Bacterial degradation of gels causes a release of CO2 on an order that would change our current estimates of the oceans CO2 buffer capacity. However, the demonstration that phaeocystis EPS can self assemble has not yet been shown. In this study we used Dynamic Laser Spectroscopy to investigate the assembly process of phaeocystis EPS. Samples of artificial seawater containing phaeocystis EPS were observed over a 108 hour period. Our results show that EPS spontaneously assembles to sizes typical of micro gels in seawater observed by (Chin et al. 1998). (Orellana and Verdugo 2003) predicted up to 7*10^16 g of organic carbon could occur in the oceanic gel phase. That amount out weights all other marine biomass combined by a factor of 50, and has important implications for the biogeochemical cycle of the earth. From our results, we conclude that given the ubiquitous nature of phaeocystis and the self assembly properties of the EPS it releases; phaeocystis globosa is a major contributor of gel forming DOM to the global carbon cycle.

**Ionic Wind Lifter**

*Ananda Horike, Senior, Aeronautics and Astronautics*  
**Mentor:** Dana Dabiri, Aeronautics and Astronautics

The Ionic Wind Lifter project is focused on the potential for ionized air particles to be accelerated through an electric field in order to provide thrust. The general concept of this research is to hold two electrodes of appropriate form in a fixed relation to each other. When the two electrodes are oppositely charged to the correct degree, the air around the emitter will ionize and the ions will accelerate towards the positive collector. As the ions accelerate towards the collector, they will collide with neutral air particles and pass on their momentum. This will create a cascade effect which will result in a large number of air molecules, ionized and neutral, accelerating towards the collector. This apparatus which will ionize the air and then provide the thrust is deemed the Ionic Wind Lifter. The current apparatus is a triangular shape with three aluminum, flat collectors and three thin wires as the emitters. Some research has been preformed on investigating the different effects of emitter/collector spacing, levels of voltages for the collector and emitter, different lifter shapes and switching the sign of charge on the emitter and collector. However, further research is needed in all of these areas. The area that I have been further researching is the computer modeling of the project. The Ionic Wind Lifter has been modeled in a computer program, ANSYS, capable of applying different electric potentials to the apparatus. The electric field and electric field strength can then be analyzed and thrust values and ideal configurations could be predicted. This research allows the prediction of certain behaviors without constructing multiple different versions of the lifter in order to optimize the performance of a model. Hopefully, this research will be able to help us create an optimized design of the lifter.

**Effects of hypertonic solutions on neuronal activation**
inside and outside the blood-brain barrier
Jacqueline Ho, Senior, Psychology
Mentor: Douglas Fitts, Psychology

The regulation of fluid and electrolyte balance is crucial to maintaining functional physiology, and osmoreceptors are known to monitor such homeostatic disruptions. In previous studies using intravenous (iv) hypertonic infusions, sodium chloride (NaCl) and sucrose elicited drinking and arginine vasopressin (AVP) secretion; urea and glucose did not. NaCl and sucrose are excluded from cells, and hypertonic solutions of these solutes osmotically dehydrate cells and thus activate osmoreceptors. Glucose and urea are permeable to cells and do not have this effect. However, all of these solutes are slow to cross the blood-brain barrier (BBB) and all of them osmotically dehydrated the brain and raised cerebrospinal fluid sodium concentration. Osmoreceptors inside the BBB should have been stimulated by all solutes, and for this reason the researchers concluded that the critical osmoreceptors controlling thirst and AVP secretion must reside outside the BBB in the sensory circumventricular organs (CVOs). From these studies we predict that all of the solutes will activate osmoreceptors inside the BBB, but only NaCl or sucrose will activate osmoreceptors in CVOs. To test this prediction we infused hypertonic NaCl, glucose, or urea iv into rats for 20 min and perfused them at 90 min for assay of Fos expression in the brain as a sign of neuronal activation. All hypertonic solutions stimulated Fos expression in target hypothalamic nuclei inside the BBB whereas isotonic NaCl did not. Hypertonic NaCl was the only solute to elicit a strong response in the CVOs outside the BBB. Interestingly, hypertonic urea and glucose elicited an intermediate response in the area postrema, a CVO that is outside the BBB. The results strongly suggest that AVP secretion and drinking are induced primarily by osmoreceptors in CVOs outside the BBB.

The Relationship Between Sediment Characteristics and Alexandrium Cyst Distributions in Puget Sound
Jeff Hubert, Senior, Environmental Science, UW Tacoma
Mentor: Sian Davies-Vollum, Interdisciplinary Arts & Sciences, UW Tacoma

Although harmful algal blooms are intensively monitored in Puget Sound, the mechanisms that distribute them throughout the estuary are poorly understood. Distribution may occur when *Alexandrium* cysts are incorporated into sediments and transported by bottom currents. Correlating cyst germination to sediment grain size, carbon content, and bioturbation intensities may help predict areas likely to experience future harmful algal blooms. Here, I present the results of a study of sediment cores taken from five areas of Puget Sound with a history of harmful algal blooms. This study analyzes particle size, total organic carbon content (TOC), and bioturbation intensity and compares these parameters to counts of *Alexandrium* cysts in the sediments. Preliminary results show that silt and sand are the dominant sediment materials, and that there is no strong correlation to cyst abundance. Quantitative TOC analysis and a qualitative assessment of sediment bioturbation are on-going, and will be presented in the final poster. I hypothesize that the results of the TOC and bioturbation analysis will not show a positive correlation with cyst abundance.

Automated Classification of Protein Crystallization Images Using Ensemble Machine Learning
Diane Hu, Senior, Computer Science
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Linda Shapiro, Computer Science & Engineering

We aim to develop software using machine learning that can automatically detect the presence of successfully grown protein crystals in two-dimensional images taken of crystallography experiments. This is a crucial step that will support a much larger crystallography technique that seeks to determine three-dimensional protein structure on a high-throughput scale using X-ray diffraction. We utilize a grid system that divides each image into smaller block-shaped regions. A support vector machine (SVM) is then trained on numerical features computed for each block, and the final classification for an image is obtained by ORing together the predictions of all blocks within that image. To increase the accuracy of results, we are exploring different ensemble learning methods. A hierarchical approach was first adopted in which an ensemble of first-level SVMs was trained on a specific kind of successful or unsuccessful crystal growth. A second-level SVM was then trained on the confidence probabilities emitted from all first-level SVMs and was responsible for delivering the final binary classification of the image. We also experimented with the effects of bagging and boosting, both of which manipulate the dataset to produce multiple classifiers that can ultimately participate in a “majority wins” voting scheme. Finally, other classifiers such as decision trees and neural networks were explored in order to implement stacking.

Spectroscopic Properties of Synthetically Prepared Porphyrins
Sayed Intiaz, Sophomore, Biochemistry
Mentor: Gamal Khalil, Chemistry

The main focus of my research is on porphyrins, which are naturally occurring planar molecules that are found in chlorophyll and in hemoglobin (the oxygen carrier in red blood cells) just to name a few. The nature of porphyrins is that they have conjugated pi electron systems that allow for excitation and emission under various wavelengths of light. The idea was to identify the different vibrational properties of several synthetically prepared porphyrins by Infrared Spectroscopy. Through Infrared Spectroscopy (IR) data we can identify very important functional groups within the
porphyrin, and the focus was to identify Carbonyl groups. Different methods of preparing samples for IR readings include: making a KBr Pellet, using Solid porphyrin, using Sodium Chloride IR card, using Teflon IR card, and using Polyethylene IR card. Another big focus included the nature of porphyrins that include a lactone group. Through current data, the lactone shows vibration in the carbonyl range of 1700-1800 cm⁻¹, but the idea was to evaluate the acid/base properties of the lactone containing porphyrin by applying a base. The results show a chemical change with the application of 1,8-Diazabicyclo[5,4,0]-undec-7-ene (DBU), a well known base. Current theory suggests that either protons are extracted from the porphyrin ring or that the lactone group breaks apart to make a fundamentally different product. More on this research on lactones will be the basis for development of pH sensor. The pH sensor will function to identify basicity of concrete so we may obtain valuable structural information and prevent damage.

CAM Rural Information Services
Paul Javid, Senior, Computer Science
Mentor: Ed Lazowska, Computer Science and Engineering

Interest has been growing recently in bridging the digital divide - the division between people who use modern digital tools and information services and those who don’t. This growing interest has sparked an effort within the computer science community, termed Information and Communication Technologies for Development, whose focus is to provide information systems and services in a useful, sustainable, and understandable way to digitally disenfranchised users. For the past few years I have been working with various NGO’s and governmental organizations in rural India to determine how to overcome some of the barriers to information technology usage in rural or infrastructure-poor environments. Working with graduate student Tapan Parikh, I have developed CAM, a document-based architecture for providing remote rural information services. CAM is designed to tackle some of the inherent problems with information aggregation, analysis, and usage in developing countries. In our system, a camera-equipped mobile phone is used to process forms. This allows paper forms to be programmed, thereby linking physical information on paper to on-line information services. We have found many potential applications for CAM including micro-finance group lending, rural supply chain management, primary health data collection, and other services. CAM provides a promising approach to making a wide variety of services available in an affordable, accessible way. There are almost unimaginable potential benefits to be realized, and almost unimaginable new markets to be created.

Renal Fibrosis
Johanna Christa Isidro Javier, Sophomore, Biology
Mentor: Jesus Lopez-Guisa, Pediatrics, Children’s Hospital & Regional Medical Center’s Department of Nephrology Research

The Polymerase Chain Reaction (PCR) is used for the amplification of a specified DNA sequence. For the past school year, students from the IMSD undergraduate research programs at the University of Washington have collaborated with Children’s Hospital & Regional Medical Center’s Department of Nephrology Research to genotype genetically altered mice used for research. In this laboratory mice are used that have several variants in their specific genotypes in order for their phenotypes to be analyzed. Transgenic mice which were genotyped either had sequences which were knocked out, or sequences manipulated through the Flox or other methods, or sequences added in through the Cre plasmid. DNA sequences used in this analysis were uPAR, gp130, LRP, floxgp130, F4/80, floxLRP, and LIFR. These strains all code for genes that either suppress or promote renal fibrosis, whether it is directly or indirectly. Eventually, the mice genotyped in this project or their offspring will be used for a better understanding of the progression of Renal Fibrosis.

Evaluation of Spiral Stiffness in Reinforced Concrete Columns
Amanda Jellin, Senior, Civil Engineering
Mentor: John Stanton, Civil Engineering

The response of structures under earthquake loading is a major concern for public welfare, especially on the West Coast. Because earthquake loading is cyclic and lateral, structures that are designed sufficiently for normal loading can still fail in response to seismic activity. One particular type of failure that occurs due to earthquake loading is bar buckling. Bar buckling is when the longitudinal reinforcing steel bar in a concrete column bulges out due to combined lateral cyclic and axial loading. One of the many factors affecting bar buckling is the transverse reinforcement, which acts to confine the longitudinal reinforcing bars. The purpose of this project is to study the stiffness of transverse reinforcing, while varying transverse bar size, concrete cover length and bond. This was accomplished using a 1/3 scale column test specimen, consisting of 9 longitudinal reinforcing bars, seven transverse reinforcing hoops, and a single channel down the height of the column, to allow access to the hoops. A hook and hydraulic pump were then used to apply a load perpendicular to the transverse reinforcement, which models a bar buckling outward. A potentiometer and a load cell were then used to measure load vs. displacement. This data was then compared to two simple predictive models, one accounting for elastic behavior and the other for plastic behavior. The simple models sufficiently predicted...
and bound the transverse spiral behavior; however, due to additional questions left unanswered additional research on the subject is currently being conducted.

The Isotopic Composition of Hydrogen Released During Nitrogen Fixation
Ilan Jen-La Plante, Junior; Chemistry
Mentor: Andrew Rice, Joint Institute for the Study of the Atmosphere and Ocean
Mentor: Paul Quay, Oceanography

Multiple studies have been conducted to study both the sources and sinks for atmospheric hydrogen (H₂). Many of the main contributors, including the combustion of fossil fuels, biomass burning, and photochemical oxidation of methane and other hydrocarbons, have been examined both for their relative contributions to the atmospheric H₂ budget and their isotopic compositions. However, some of the sources, such as ocean production or the H₂ released during bacterial nitrogen fixation have yet to be fully understood. Although soils are seen globally as a major hydrogen sink, under certain conditions nitrogen fixation by legumes can result in a net release of H₂ to the atmosphere. The H₂ released from this process is estimated to account for approximately three percent of global H₂ production. The purpose of this research project is to measure the isotopic composition of H₂ released as a byproduct of bacterial nitrogen fixation. Air samples were collected in vivo using a rigid static flux chamber method and the isotopic composition of these samples was then measured in the laboratory by mass spectroscopy. Our results support a model which includes microbial hydrogen production associated with nitrogen fixation and indicate that this hydrogen source has a lower ratio of deuterium to hydrogen as compared to the atmospheric average isotopic composition.

Authority, Indigenous Identity and Religious Revival
Frances Rose Johnson, Senior; Anthropology
Mentor: James Green, Anthropology

Two hours north of the Ecuadorian capital of Quito, high in the Andes lays the town of Otavalo. The indigenous people of this city call themselves Otavaleños or Otavalos. These people share the Latin American colonial legacy of forced labor and racism imposed by the dominant mestizo culture. The Otavalans have created a niche for themselves by marketing and selling woven goods; thereby beginning the process of establishing their political, social and economic independence. As these societal changes take place, religion changes as well. The religious history of the Otavalen people has been a colonial one in which traditional religious practices have mixed with or been limited by Catholicism and other missionary religious organizations. Presently, there is a political movement that strives to create a resurgence of traditional religion and a rejection of western missionary religious beliefs. The phenomenon of religious revivalism has been a topic of study in the United States, Middle East and other regions that are politically volatile, yet the study in Latin America has been limited. Religious revivalism in Otavalo is tied to politics of identity, ethnicity and globalization. As modernization spreads, traditional social structures often perceive a threat to their continuation. Religious resurgence serves as a mechanism to meet the challenges of modernization by creating and maintaining the culture and identity of distinct groups. (Levine 1986) I explore the revival of traditional religion as observed in interviews with activists and observation of community rituals during the summer solstice of 2005. The objective is to establish a theoretical basis for understanding these particular events and how they serve to promote cultural identity and vitality.

An Exploration of Paternal Perinatal Depression and its Relationship to Maternal Depression
D. Ian Jordan, Senior; Nursing
Mentor: Nia Johnson-Crowley, Nursing
Mentor: Pamela Jordan, Nursing

The transition to parenthood is a major life change involving renegotiation of roles and responsibilities and often accompanied by increases in stress and anxiety. Recent media attention has focused on postpartum depression in women, e.g., Brooke Shields, Andrea Yates. There has been minimal investigation of depression in men over the transition to parenthood and the few existing studies have many limitations. The purpose of this study is to assess the incidence of depression in men over the transition to fatherhood and to explore the relationship between maternal and paternal depression over the perinatal period. This is a secondary analysis of data from the Becoming Parents Program grant, a randomized controlled clinical trial of a couple-focused educational program with 470 married couples making the transition to parenthood. Demographic and depression (Center for Epidemiological Studies Depression Scale (CES-D)) data gathered during pregnancy, at 6 months, and one year postbirth were analyzed. Preliminary analyses reveal that 15% of the fathers scored 16 or above on the CES-D, indicative of depression, with rates remaining stable from pregnancy through one year postbirth. In comparison, 25% of the mothers scored 16 or above on the CES-D during pregnancy, 19% at 6 months postbirth, and 24% at one year postbirth. Strengths of this study include use of a large and diverse sample with simultaneous longitudinal data collection from both partners of subject couples. These factors make this study unique and the findings will be a significant contribution to the understanding of perinatal depression in both men and women.

Thin Gold Film Growth on Fused Silica Substrates
with Application to a Gravitational Torsion Balance Pendulum

Alan Kalet, Senior, Physics
Mentor: Paul Boynton, Physics
Mentor: Fumio Ohuchi, Materials Science and Engineering

Techniques for plating metallic thin films on silica based surfaces using silane adhesion promoters are of particular interest in a variety of applications to sensing devices. Their use, however, has not been viably developed as a general plating technique on larger scales. Our intent was to design a method of gold thin-film growth on a specific device, i.e. a fused silica torsion balance pendulum capable of sensing very small deviations from Newtonian gravity, although the procedure can easily be utilized more generally. The pendulum itself is rather large (~730 cm²), has a complicated shape, and requires a complete conductive coating to assure that any electrostatic charge does not accumulate on the surface. To avoid perturbing the mass moments of the pendulum, the film needs to retain the morphological properties of the underlying substrate. Both these requirements must be met to prevent the creation of unwanted torques on the pendulum. We also require the film to have mirror-quality optical properties, since the pendulum itself will be reflecting a laser beam as part of a high precision positioning system. Through systematic experimentation, we found that modifications of a three-stage method consisting of surface activation, colloidal gold nucleation, and electroless gold plating results in continuous, uniform, thin gold films that exhibit good adhesion. The presence of self assembled monolayers (SAM) of (3-mercaptoethyl)methyl-dimethoxyxilane (MPDMS), and colloidal gold nanoparticles were verified on substrates by X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM). Atomic force microscopy (AFM) studies show rms surface roughness on the films is 70-100 nm, well within tolerance, and an average film resistance of 2-4 Ohms. Films prepared using this method also display optical properties comparable to films prepared by evaporating gold.

Effects of Strain Rate and Moisture on the Mechanical Behavior of Euplectella aspergillum Spicules

Paul Kanikkeberg, Senior, Materials Science and Engineering
Mentor: George Mayer, Materials Science and Engineering

The fibrous spicules of the sea sponge Euplectella aspergillum consist of alternating concentric layers of silica and protein, in addition to a silica core. Due to this unique structure, E. aspergillum spicules possess mechanical properties superior to that of similar man-made materials, such as monolithic silica. Strain rate and moisture were the two variables used in the continued investigation of the spicules' mechanical properties. The effects of these variables were observed using a three-point bend test on a DMA (Dynamic Mechanical Analyzer) in static mode, as well as imaging of the fracture surfaces with a scanning electron microscope. The bend test was performed using different loading rates to test the strain rate effects. The presence of moisture was altered by soaking the samples in both deionized water and sea water at different time intervals to reach a saturation point. Samples that had reached this saturation point were tested and compared with dry samples in order to investigate a possible change in toughness. For comparison purposes, E-glass fibers were also tested. The mechanical property data and SEM analyses are presented. E. aspergillum spicules also demonstrated a noticeable decrease in elastic modulus in the presence of both sources of moisture. The observed moisture effects were consistent enough to conclude a definite increase in plasticization, but additional testing is required in order to confirm a dependence of the spicules’ mechanical behavior on strain rate.

Drug Inhibition of Human Herpes Virus 8 Infection

Paige Kasai, Senior, Molecular, Cellular and Developmental Biology
Mary Gates Scholar
Mentor: Michael Lagunoff, Microbiology

Kaposi’s Sarcoma (KS) is the most common tumor of AIDS patients world-wide. The etiologic agent of KS is Kaposi’s Sarcoma-associated Herpesvirus (KSHV or Human Herpes Virus 8). The goal of my research is to identify drugs that inhibit KSHV. Computational analysis by our collaborator, Dr. Samudrala, predicted small molecules that should bind to the active site of the KSHV protease and thereby inhibit KSHV maturation. The KSHV protease cleaves and activates the KSHV assembly protein. The assembly protein allows proper viral maturation by forming the essential viral capsid. I screened three drugs for inhibition of KSHV infection in our cell culture model. I induced lytic replication of the virus in infected cells in the presence or absence of drugs and measured the amount of infectious virus produced by infecting susceptible cells and then measuring infection rates by immunofluorescence. I found one drug, T, which greatly inhibits KSHV production. When drug T was compared to known treatments for KSHV in the same assay, drug T has outperformed them in every experiment. Through immunofluorescence experiments we have shown that the virus does not lose its ability to make all classes of genes. This supports our hypothesis that the protease is created, but is blocked by drug T. To further support our proposed mechanism I am currently cloning the KSHV assembly protein to show that the assembly protein is cleaved in normal viral production, but is not cleaved after drug treatment due to protease inactivation. The results from these experiments are exciting because they may provide a new treatment for Kaposi’s Sarcoma.

Characterization of HIV gp120 Envelope Expression

E. Aspergillum
Envelope (Env) glycoprotein of human immunodeficiency virus (HIV) binds CD4 and a coreceptor to mediate target cell entry. It is hypothesized that locations of carbohydrates on Env undergo change and can affect both CD4 binding and escape from neutralizing antibodies (nAbs). To identify fitness advantages of specific carbohydrate patterns, envelope (env) gp120 DNA sequences were obtained from 11 Macaca nemestrina over one year of infection with simian-human immunodeficiency virus (SHIV). Ten unique clones of env DNA from each animal were obtained from weeks 12, 20, and 32 post-infection. These sequences were subjected to phylogenetic analysis. Although 19 of 23 potential N-linked glycosylation (PNG) sites (amino acid sequence Asn-X-Ser/Thr) were highly conserved, we observed a steady accumulation of 6 PNG changes over time. These changes occurred in multiple Macaca nemestrina and were proximal to the CD4 binding site, based on molecular modeling of the Env structure. Twenty-one functional Env expression plasmids were created from representative week 32 variants. These env variants were assayed for differences in expression level, stability, and infectivity. Each variant was transfected into 293T cells and expression of Env gp120 was quantified with an enzyme-linked immunosorbent assay (ELISA) using binding to CD4 as a capture step. Levels of gp120 present in cell lysates versus supernatants provided an estimate of Env stability. Expression plasmids were also used to create pseudovirions, which were lysed and assayed via ELISA for p24 (viral capsid) and gp120. This allowed for comparison of approximate gp120 levels per viron for each variant. Further studies are underway to determine how well each Env variant binds to CD4.

Determination of the Abundance, Distribution, and Composition of Spider Communities in a Small Tropical Subsistence Farming Village
Levi Keesecker, Senior, Environmental Science, UW Tacoma
Mentor: John Banks, Interdisciplinary Arts & Sciences, UW Tacoma

It is recognized that spatial scale and arrangement in agroecosystems can significantly alter the community structure of some arthropods. This study examines the extent to which spatial factors, specifically the proximity of farms to forest fragments, affect spider (Araneae) communities in small tropical subsistence farms. Spider specimens were collected by pitfall traps in the farming village of Mastatal, Costa Rica (50 km southwest of San Jose) and subsequently identified to family level. The distribution, abundance, and composition of spider communities are compared among 3 habitat types (forest fragments, crop land, and pasture) and implications for forest management are discussed.

Single Nucleotide Polymorphism Analysis in the Brown Alga’s Chloroplast-Encoded cfxQ Gene
David Keith, Senior, Biology
Amanda Hoyt, Recent Graduate, Biochemistry
Kun Lin Lee, Senior, Biochemistry, Economics
Mentor: Rose Ann Cattolico, Biology

Heterosigma akashiwo is an obligate autotrophic alga that uses the Calvin-Benson cycle to convert atmospheric CO₂ into simple sugars. It is estimated that 50% of CO₂ is fixed by algae. Because of increases in atmospheric CO₂ and the contribution of CO₂ to global warming, it is important to understand how these organisms process this greenhouse gas. Ribulose 1,5-Bisphosphate Carboxylase/Oxygenase (RuBisCO) is the most abundant enzyme on earth. This protein complex is required for the Calvin Cycle function because it utilizes CO₂ as a substrate. In terrestrial plants and green algae, RuBisCO requires the companion protein rubisco activase. The gene cfxQ in Heterosigma akashiwo is a putative RuBisCO activase. The cfxQ gene of nineteen geographically-distinct Heterosigma akashiwo strains have been sequenced and analyzed for single nucleotide polymorphisms (SNPs). cfxQ was sequenced directly from PCR products with Big Dye v. 3.1. Sequence analysis was performed with Sequencher and Vector NTI software programs. Five variants have been discovered. Both synonymous mutations, which have no effect on the amino acid sequence, and non-synonymous mutations, which cause amino acid alterations, have been observed. Preliminary modeling, based on amino acid sequence, has shown that there is non-random clustering of these mutations, which suggests that non-synonymous mutations may have a functional impact on CfxQ activity. Because of codon usage in Heterosigma akashiwo, synonymous mutations may affect the level of cfxQ transcription. Future projects will include the sequencing of cfxQ in additional geographically-distinct strains of Heterosigma akashiwo to increase our data set and sequencing of the large subunit of RuBisCO (rbcL). It is possible that SNPs in rbcL and cfxQ may have coevolved, and this data will assist our analysis of the impact of these SNPs on protein function.

Retention and Mobility of Washington State’s Teacher Workforce
Rena S.H. Kido, Senior, Sociology
Brook Sattler, Junior, Technical Communication
Mentor: Marge Plecki, Educational Leadership & Policy Studies
Mentor: Mike Knapp, Educational Leadership & Policy Studies

The retention and mobility of Washington State’s Teacher Workforce is an ongoing project of the Center for the
Study of Teaching and Policy (CTP) in the College of Education. This research examines the retention and mobility of Washington’s teachers at the state, district, and school levels during three different five year periods (1998-99 and 2002-03, 1999-00 and 2003-04, 2000-01 and 2004-05). In the attempt to analyze Washington’s teacher workforce, we are analyzing how schools and districts in Washington differ in their retention rates. Data was examined in relation to student demographics, measures of student learning, and poverty level of the school, with special attention given to novice teachers and teachers of color. The retention patterns across the state provide a baseline for comparison and 20 districts were selected for in-depth examination. Findings from the statewide analyses suggest that both experience and age impacts teacher mobility. Novice teachers leave at higher rates than experienced teachers, while teachers with a considerable amount of experience are also more likely to exit the system (often due to retirement). Current work in progress includes analyses for 9 additional districts in order to help them better understand their workforce and support novice teachers.

Girls’ Estradiol Levels and Family Relations
Cindy Meerim Kim, Senior, Psychology
Mentor: Sybil Carrere, Family and Child Nursing

Early pubertal timing for girls is associated with a variety of negative psychological and health outcomes. In particular, early pubertal timing is often associated with problematic family relations. Previous research indicates that girls who experience high-for-age level of estradiol, a female sex hormone, show increased rate of pubertal development and greater family discord. The present study examined the association between the girls’ estradiol levels and family conflict. Sixty-two intact, two-parent families with girls, ages nine to eleven, from the greater Puget Sound area in Washington State participated in the study. The rate of pubertal development for the girls was assessed by estradiol level. Family conflict was measured using the Family Global Behavioral Coding system during a ten-minute problem discussion between the girls and their two parents. We hypothesized that families of girls with higher levels of estradiol would exhibit greater family conflict during the ten-minute discussion, compared to girls with lower levels of estradiol. There was partial support for the hypothesis. In general, when girls had higher levels of estradiol, their parents exhibited significantly lower levels of parental cohesion during the problem-solving task \( r = .42, p = .01 \), fathers exhibited less parenting behaviors \( r = .40, p = .01 \), and mothers’ engagement decreased during the problem-solving task \( r = .37, p = .02 \). The present study found no association between girls’ levels of estradiol and their behavior during the ten-minute problem solving discussion. The results suggest that pubertal transition in girls may be associated with poor parental behaviors and cohesion.

Cadmium-induced Apoptosis during Neural Tube Development
Nayeon Kim, Senior, Biology
Mentor: Elaine Faustman, Environmental and Occupational Health Sciences
Mentor: Joshua Robinson, Environmental and Occupational Health Sciences

Neural Tube Defects (NTDs) are common congenital malformations caused by abnormal neurulation. Both genetic and environmental factors seem to play a role in the development of NTDs. The ubiquitous heavy metal, cadmium (Cd) is a developmental toxicant in rodents, able to induce NTDs. Studies suggest Cd may induce apoptosis in the neuroepithelium of the cranial neural folds, resulting in improper neural tube formation. SWV and C57BL/6 mice show differences in sensitivity to Cd. The SWV strain shows high resistance to Cd-induced NTDs compared to the sensitive C57BL/6. We hypothesize that Cd induces apoptosis during neurulation, compromising neural tube formation resulting in incomplete development (NTD) in the C57BL/6 but not in the SWV. The purpose of this project was two-fold: 1) to develop a protocol enabling us to extract both RNA and protein from a small amount of initial material and 2) to address our hypothesis Protein Assay. Our initial results show that this method is sufficient in acquiring enough protein to complete WB analysis, allowing us to limit the quantity of animals used in this study. In addition, WB analysis was completed for cleaved casp3, casp7, casp8, casp9, and B-actin. Initial results show an increase in c-casp3 in C57BL/6 embryos after 12hr whereas in the SWV, we observe a smaller increase in activation. Preliminary findings support our hypothesis that Cd induces more apoptosis in the C57BL/6 than the SWV during neural tube development. Supported by NIH Grants ES10613-1; ES07033; ES07032.

Degradation of TNT and RDX by Transgenic Aspen Plants
Leonid Kisselev, Senior, Biology and History
Mentor: Sharon Doty, Forest Resources

TNT (2,4,6 – trinitrotoluene) and RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) are energetic explosives that are part of the military munitions, and have greatly accumulated at military ranges. These explosives are capable of entering soil and groundwater, and carry a danger to both environment and humans, having a possible carcinogenic effect. Phytoremediation, the use of plants to degrade pollutants, is a promising way to deal with this problem. The goal of this project is to create transgenic plants that express a high amount of the enzymes responsible for TNT and RDX degradation (Nitroreductase and RDX P450), that would be capable of increased rates of phytoremediation. To achieve this, two strains of Agrobacteria (R1601)
containing the plasmids (circular DNA molecules) with the genes for the enzymes of interest and for antibiotic (kanamycin) resistance are grown, mixed together, and co-inoculated into aspen wound sites. This allows the genes of interest to be inserted into the plants. The leaves are put on co-cultivation plates, and 2 days later on plates with antibiotics to kill the Agrobacteria and to select for the co-transmitted selectable gene encoding kanamycin resistance. Only the transgenic roots from the wound sites are capable of growing in the presence of antibiotics. The presence of the genes of interest is verified by extracting DNA from the transgenic roots, amplifying the genes of interest by using Polymerase Chain Reaction (PCR), and gel electrophoresis to visualize the gene presence. So far, one transgenic line has been created that tested positive for the presence of Nitroreductase gene and that is able to grow on media containing TNT better than the control plants.

Investigations of Photodegradation Under Applied Stress of a Polyurethane Film in the Presence of Oxygen
Kathryn Klug, Senior, Chemistry, Seattle Pacific University
Mentor: Peter Lyle, Chemistry, Seattle Pacific University

In this work, investigations of the degradation (measured in quantum yield) of polymers with molybdenum-molybdenum backbones were conducted. Parameters that inhibit or promote degradation were studied, such as applying stress or increasing the concentration of radicals within the structure, with the goal of designing a polymer which degrades on a controlled time scale. Previous data has produced quantum yield versus stress data of two different polymers in an oxygen-sensitive environment. This work focused specifically on the inclusion of oxygen (an increased radical concentration) into the system as another parameter to be considered in the degradation process. Stress dependence data was inconclusive as one polymer appeared to confirm and the second showed no increase or decrease in quantum yield with varied levels of applied stress. However, it was found that allowing samples to diffuse with O₂ does indeed increase the radical trap concentration and may help increase the quantum yield, if the polymer is able to fully permeate. Overall, the data suggests a need to replicate this work and further investigate the effects of the glass transition, temperature control, and error within the system.

Neuregulin expression in the injured brain and spinal cord: potential effects of growth-factor expression on remyelination
Jennifer Knox, Senior, Neurobiology
Mary Gates Scholar
Mentor: Philip Horner, Neurological Surgery

Spinal cord injury is a significant cause of disability that currently affects 200,000 people in the United States, with 10,000 new cases annually. Partial or total paralysis results from neuron cell death and loss of axons. At the site of injury, some axons are spared but later undergo demyelination, which also contributes significantly to motor and sensory deficits by interfering with proper transmission of impulses. Remyelination, or the process whereby axons are re-wrapped with myelin, occurs in the mammalian central nervous system, although new myelin is much thinner and restoration of normal conduction remains impaired. Discovering such mechanisms is crucial to the development of effective treatments for spinal cord injury. Recently, much attention has been directed to a class of growth factor-like molecules known as neuregulins, which have been found to increase myelin thickness. All previous work on neuregulin has utilized an in-vitro approach, and my research focuses on how one type of neuregulin, NRG1 Type III, impacts myelination in an animal model of spinal cord injury. Reverse transcriptase polymerase chain reaction (RT-PCR) has been used to assess which forms of NRG1Type III are expressed in the injured and healthy spinal cord. Tissue was isolated from specimens using Laser Capture Microdissection, and it is apparent that expression differs between normal and injured cord, as well as in the brain structures that project to the spinal cord. The next step will be to assess the significance of this downregulation and engineer a virus to deliver neuregulin genes to the spinal cord with the goal of increasing neuregulin expression at the site of injury.

Environmental Policy: Analysis of regulations of air and water quality standards in the United States
Laura Knudsen, Junior, International Studies, Environmental Studies
Mentor: Peter Guttorp, Statistics

Air and water are generally considered global commodities, which do not belong to any particular individual. However in light of increased pollution and consumption patterns, many nations have crafted regulations to address water and air quality issues. Thus far, my quality research focuses on these regulations in the United States that is best demonstrated through the Clean Air Act and the Clean Water Act. Interestingly, the process of creating these standards and the ability to enforce these regulatory measures are generally unknown to the public because of their complex nature. As a result, I first analyze the lengthy process of setting the clean air and water standards by the Environmental Protection Agency and the corresponding advisory panels and committees. Then I examine the application of these standards with regard to enforcement by agencies, such as the Clean Air Agencies, and the role of Congress and the executive branch in maintaining these standards. Finally, I examine if these measures are truly successful in effectuating cleaner air and water. Through the use of library, web
sources as well as interviews with individuals involved and setting and enforcing these regulations, I am able to come to an understanding of the complexity of these measures that I wish to explain and share with the public.

The Washington Large Area Time Coincidence Array
Andrew Larkoski, Senior, Physics, Mathematics
Mentor: R. Jeffrey Wilkes, Physics

The Washington Large Area Time Coincidence Array (WALTA) project is a collaboration of the University of Washington Department of Physics with high schools and colleges in the Seattle area investigating the highest energy cosmic rays. Cosmic rays are subatomic particles or nuclei created in stars, supernovae, and other galactic and extragalactic sources which, upon reaching the Earth, strike the upper atmosphere, producing a shower of detectable particle, such as muons. At each participating location, an array of muon detectors is maintained and data collected which is made available to the “command center” here at UW. From the data, the energy and direction of the muons (and hence the cosmic rays) can be determined. This could lead to as of yet undiscovered astrophysical sources near our galaxy or illuminate some physics that does not fit the current Standard Model. Also, most importantly, the WALTA project brings together students and teachers who would otherwise not interact with the research community with the scientists who contribute to the forefront of their field. Here at UW, I helped set up and am responsible for maintaining two arrays on campus, on the rooftops of the Applied Physics Lab and the Atmospheric Sciences Building. These serve as models for high school groups, and benchmarks for our data collection system. I will present results from my own analysis of cosmic ray air showers detected by these arrays and show how these data are related to potential new discoveries in astrophysics.

Circadian Rhythmicity in Crustaceans
Tracy Larson, Senior, Neurobiology; Cell, Molecular, and Developmental Biology
Mentor: Horacio de la Iglesia, Biology

Circadian rhythms are biological oscillations with a period close to 24 hours that are synchronized to the solar day. The neural structures and molecular pathways underlying circadian rhythmity have been studied in several species including Drosophila. The basic molecular clock mechanism relies on feedback loops of transcription and translation of the so-called clock genes, which result in the circa-24 hour oscillation of these genes’ products. Intertidal crustaceans exhibit both circadian and circatidal rhythms, specifically biological oscillations with a period close to the tidal cycle and synchronized to tides. However, the neural structures and molecular pathways underlying these rhythms in crustaceans are poorly understood. The main goal of my research project is to unravel the molecular and neural basis of circadian and circatidal rhythmity in intertidal crustaceans. Using reverse transcription-PCR with degenerate primers based on the sequence of clock genes of Drosophila and other invertebrate species, I was able to clone a 2800 bp fragment of a homolog of the clock gene timeless (tim) in the crab species Cancer productus. Using a polyclonal antibody against the Drosophila gene’s peptidergic product, TIM, I have been able to identify a cluster of two to five neurons within the crab brain that show TIM-like immunoreactivity. I am currently studying tim expression within the brain using whole mount in situ hybridization targeted to the mRNA. Our long-term goal is to study the spatial and temporal patterns of expression of these genes’ products in the central nervous system of the crab. The characterization of the components of the circadian system of intertidal crustaceans will provide new tools for the study of biological timing, and will represent the first step toward the understanding to the biological basis of circatidal rhythmity.

Analysis of Cell Proliferation in Dystroglycan Mutant Cerebral Cortex
Charmaine Lau, Senior, Neurobiology
Mentor: Robert Hevner, Pathobiology

Dystroglycan (DG) is an important molecule for cerebral cortex development. DG mutants have a mouse form of cobbledstone lissencephaly with the inability of neurons to organize themselves within the cortical plate. It has also been shown that there is an increase in brain size of nearly 20% from gross observation as well as brain mass comparison in this type of mutant. The main focus of this project is to study two types of progenitors in the cerebral cortex of the DG null mice, namely radial glia (Pax6+) and intermediate progenitor cells, or IPC (Tbr2+). We hypothesize that the increase of brain mass in DG knock out is due to the increase of proliferation of these progenitors. The methods used are double labeling of Pax6 or Tbr2 with proliferation markers BrdU and pHH3, and cortical surface area comparison between wild type and null mice. If this hypothesis is in fact supported, DG might play a role in regulating proliferation of progenitor cells in the neocortex.

Interactions of RNA-Processing Factors During RNA Transcription
Jonathan Leano, Sophomore, Biochemistry
Mary Gates Scholar
Mentor: Neil Dobson, Chemistry
Mentor: Gabriele Varani, Chemistry

In living organism, the process of making proteins involves first copying the genome (DNA) into another form of nucleic acid (messenger RNA) by means of an enzymatic reaction carried out by RNA polymerases in a process called transcription. The messenger RNA then provides the template for protein synthesis (translation). During transcription, the messenger RNA is modified
in a variety of ways to generate a form competent for protein synthesis and exportable to the cytoplasm of the cell. Errors in messenger RNA processing or in its cellular fate lead to many genetic diseases. By identifying the interactions between the proteins involved in these processes in a more easily tractable model organism (i.e. budding yeast), a better understanding of RNA processing in humans will be possible. My study focuses on the last process at end of a gene (3’-end processing) and control transcription termination. It is executed by a complex set of proteins (as many as 100) that are only partially characterized in molecular detail. My study focuses on two essential subunits of the protein complex called CFIA that executes 3’-end processing. Rna15p recognizes the site where processing takes place and interacts with Pcf11 to signal the termination of the copying of the gene into the messenger RNA. I am using protein biochemistry methods (e.g. pull down assays and others) to determine how these two protein subunits interact with each other. By executing this study, we will understand at atomic detail how transcription and RNA processing are connected and co-regulated.

**Analysis of Genetic Markers at the AHI1 Locus in Consanguineous Families with Joubert Syndrome**

**Eugene H. Lee, Senior; Neurobiology**  
Mary Gates Scholar  
**Mentor:** Melissa Parisi, Pediatrics

Joubert syndrome (JS) is a rare autosomal recessive condition characterized by hypotonia, ataxia, mental retardation, disordered respiratory control, abnormal eye movements, and a distinctive hindbrain malformation. Four chromosomal regions have been identified in association with Joubert syndrome. My project focuses on identifying families with JS who are genetically linked to one of these regions by molecular methods. In order to find linkage, I am conducting haplotype analysis of consanguineous families using microsatellite markers located near the AHI1 gene on chromosome 6q23. AHI1 is a 28-exon gene known to be causative in approximately 10% of families with JS, and our group has previously identified a variety of different disease-associated mutations in this gene. We will analyze those families that do show evidence for linkage by sequencing the AHI1 gene to look for disease-causing mutations. Any AHI1 mutations identified will be confirmed by analyzing their segregation pattern in other family members. For this project I am using polymerase chain reaction (PCR), microsatellite genotype preparation, genotype analysis software, and DNA sequencing methodologies. By means of pedigree analysis, I can look for identity-by-descent (IBD) and evidence for linkage to ascertain which families will be included in sequencing efforts. Families that do not show linkage to AHI1 will be analyzed by looking at random genetic variations in their DNA known as single nucleotide polymorphisms (SNPs) to create a unique genetic map for each individual. By evaluating common regions of IBD among affected individuals, we hope to identify additional genetic regions harboring novel JS genes.

**Identification of Prostate Cancer Biomarkers**

**Melanie Leong, Senior; Developmental, Cellular and Molecular Biology**  
**Mentor:** Alvin Liu, Urology  
**Mentor:** Asa Oudes, Urology

The second most common cancer in American men is prostate cancer. The American Cancer Society estimates that there will be 234,460 new cases of prostate cancer, and 27,350 men will die from the disease in the year 2006. The methods available to diagnose prostate cancer are not always accurate. Misdiagnoses can lead to unnecessary medical procedures; or in the worst case, leave the cancer undiscovered. Biomarkers are needed to diagnose cancer early and to inform which cancer will recur. In this project, the gene expression profile of normal and cancerous prostate cells was assessed with DNA microarrays in which expression of nearly all genes was scored. Potential cancer biomarkers were identified and their expression was verified with quantitative PCR; and where possible, by measuring their protein level through immunoassays. For example, the genes DLX1 and DLX2 were shown to have elevated expression in cancer with little or none in normal.

**Development of Cerebellar Neurotransmitter Systems in Primates**

**David Stern Levitt, Senior; Neurobiology**  
Mary Gates Scholar  
**Mentor:** Farrel Robinson, Biological Structure

The cerebellum influences every movement that we make. Damage to the cerebellum impairs the speed, accuracy, and consistency of movements. To produce its contribution to movements, the cerebellum processes sensory and motor signals through a very well-described network of neurons. This network contains a variety of distinct cell types. Currently we know little about how several of these cell types develop and communicate with each other. To clarify this, we study the development of the monkey cerebellum using fetal brains of five different ages. We use immunohistochemistry to identify cells of different types and the distribution of several different molecules including neurotransmitters and receptors. By comparing labeling at different stages we can work out how the cerebellum’s distinctive structure develops. The results of this project will characterize the development of particular cerebellar signaling pathways and cell groups.
Human Sense
Xiangyu Li, Junior, Arts and Sciences
Mentor: Beliz Brother, Art, Art History, Design

The Art of Creating Spaces and Its Influence on Human Sense project is an exploration to the space design in public areas. It is a combination of art proposal and architectural study to evaluate and develop the space impact in our living environment. Space has a big influence on humans. Whether it is the magic entrance opening of the City Hall or the staggering interior of the Experience Music Project, each public space has created a unique reflection to people’s emotion. We find that space is a key element in defining and stimulating human sensibility. The study focuses on how space creates a sense of dimension; how the designers approach a special artistry by creating interesting transition of spaces; how the space relates to the environment in terms of scale, closeness, hue, and tone; what positive/negative impact a space can bring to its users and its neighborhood; how the inner space related to its outside. This project will study several public spaces and art projects to explore the art of space and the relationship between different spaces. 3D modeling design and study will also be used to better understand designer’s ideas in creating a sense of art in understanding human’s feelings. The goal of this project is to create an in-depth exploration to our built-up environment to see how a space is created to evoke people’s emotions and how artists and architects express a sense of dimension for the viewers and users of the specific spaces.

GFOGER-mediated Adhesion of Epithelial Cells to a Biomaterial Surface
Katharine Liang, Senior, Neurobiology
Howard Hughes Scholar, Mary Gates Scholar
Mentor: Cecilia Giachelli, Bioengineering

Biomaterial performance is often impeded by poor implant integration with the host tissue. Modification of a biomaterial scaffold surface with adhesion proteins to facilitate integrin interactions is one approach to increase cellular integration. However, use of full-length, multidomain adhesion proteins presents specificity issues, since many of these interact with more than one integrin. To alleviate this problem, protein-derived peptide sequences have been identified that interact solely with a unique integrin. Our lab has been focused on epithelial tissue engineering. In a wound healing environment, the αβ integrin of epithelial cells interacts with the GFOGER (glycine-phenylalanine-hydroxyproline-glycine-glutamate-arginine) amino acid sequence of collagen I. The goal of the present study was to modify the surface of a biomaterial with the GFOGER peptide to enhance epithelial adhesion and improve construct performance. Serial dilutions of GFOGER, along with its inactive analog GFOGDR, were precoated (0-50µg/mL in PBS) onto TCPS and left overnight. Epithelial cells (neonatal human epithelial keratinocytes, HEKαβ) were plated onto the surface for a one hour incubation period, after which adhesion was quantified. GFOGER peptide adsorbed onto TCPS showed dose-dependent HEKαβ cell adhesion and significantly higher cell adhesion compared to GFOGDR (precoat>3.13µg/mL). The adhesion assay was repeated in an immobilization scheme to poly (2-hydroxyethyl methacrylate) with similar results. Additional blocking experiments employing an anti-αβ antibody resulted in a significant decrease in cell adhesion, confirming cell interaction with the GFOGER peptide through the αβ integrin. Future studies will include immobilization to poly (2-hydroxyethyl methacrylate) and analysis of epithelial phenotype when plated on the surface. (Funded by the Howard Hughes Medical Institute Research Program for Undergraduates, the Singapore-University of Washington Alliance and University of Washington Engineered Biomaterials EEC-9529161.)

Highly efficient TiO₂ system for degradation of organic pollutant under UV or visible light
Wenke Liang, Junior, Materials Science & Engineering,
Sichuan University - UW Exchange Program
Mentor: Rajendra K. Bordia, Materials Science Engineering
Mentor: Greg Korshin, Civil and Environmental Engineering

Titanium dioxide (TiO₂), also called titanium (IV) oxide or titania, is the naturally occurring oxide of titanium. When it is exposed to ultraviolet (UV) light, the intrinsic electron (e⁻)-hole (h⁺) pairs are generated by the radiation energy, which is known as the photocatalytic effect. These electrons and holes can react with adsorbed pollutants on the TiO₂ particle surface and result in the degradation of the pollutants. Without suitable electron and hole scavengers in the TiO₂ system, the dissipated electrons and holes can only exist a few nanoseconds before they recombine together, which drastically reduces the degradation efficiency. The goal of our project is to produce a highly efficient TiO₂ system under UV or visible light radiation for the degradation of organic pollutants such as ethynyl estradiol (EE2), a hormone contained in birth control pills. We will attain this objective in following ways: first increasing the photocatalytic activity of TiO₂ powders via metal doping, second modifying the band gap of TiO₂ so that it is photocatalytically active under visible light by non-metallic doping and finally modifying the surface of the doped TiO₂ particles so that they can anchor the organic molecules and enhance the degradation reaction rate. This research is expected to lead to a much more efficient system for the degradation of trace and persistent organic pollutants in water supply.

Chemiluminescent Assays of Nitric Oxide Carriers
Ken Lindsay, Senior Biochemistry
Within the past 20 years, much has been learned of the role of the nitric oxide (NO) as a vasodilator in the circulatory system. In the late 1980s it was identified as the Endothelial Derived Relaxing Factor. Generally known as a short ranged signal molecule formed from L-Arginine via endothelial nitric oxide synthase (eNOS), NO can also be transported in the circulation through reactions with hemoglobin forming S-nitrosohemoglobin (SNO-Hb) and iron nitrosyl heme hemoglobin. It can also be formed from nitrite. To date, our research on NO has focused on perfecting the chemiluminescent assays for measuring nitrite (NO\textsubscript{2}), SNO-Hb, nitrosyl-heme hemoglobin and nitrate (NO\textsubscript{3}) in rat blood. This is different from current medical practice, in which these distinct NO carriers are treated as a sum, NO\textsubscript{3}. This value NO\textsubscript{3} can be useful in general study, however, due to the varied biological reactions concerned with the transport of NO within the vascular system, our research focuses on the measurement of these smaller sources of NO. It is the goal of this research to aid in identifying trends within these more distinctive carriers. Assays of the levels of these NO carriers in healthy rat blood have given consistent values. The refinement of these assays will allow measurement of NO production in human blood and allow future research efforts in the understanding of NO in physiology.

**Holocene Forest-Fire History around Ridley Lake, Washington**
Kyle Linebarger, Senior, Earth and Space Sciences
Mentor: Jody Bourgeois, Earth and Space Sciences
Mentor: Alecia Spooner, Earth and Space Sciences

This research project examines change in forest-fire frequency around Ridley Lake in the North Cascade Mountains in Washington State over the last 15,000 years. Concentrations of macroscopic charcoal particles in lake sediment will be compared to published forest-fire history records from tree-ring data for the last 400 years. If there is a correlation between the charcoal record and the tree-ring records, it will provide insight for interpretation of charcoal concentrations throughout the core. Changes in charcoal accumulation rates and concentration will indicate how forest-fire regimes have changed over the 15,000 years. Such changes can be linked to shifts in climate or changes in forest population. The sediment core is 4 m. deep and potentially represents a complete record of post-glacial forest-fire events and vegetation changes. Identified tephra deposits and 14C dates on pollen are used to estimate sample ages. Preliminary results indicate a charcoal peak at a depth of ~1 m., which corresponds to ~2,240 cal yrs. BP. For analysis, charcoal particles are separated into two size classes, >150 microns and >500 microns, which provide information about the relative size of fire events and their proximity to Ridley Lake. Results of this study will be included in a larger project to reconstruct the post-glacial paleocology of the North Cascades.

**Durability of expression of adenovirus and adeno-associated virus (AAV) vectors in the inner ear in-vivo**
Hsin-Pin Lin, Senior, Neurobiology, Biochemistry, Chemistry
Mary Gates Scholar
Mentor: Clifford Hume, Otolaryngology-HNS

Hearing loss is a very common sensory problem. Unfortunately, the current treatment of hearing aids does not work well for many people. Therefore, the main goal of our lab is to develop a biological therapy for hearing loss by correcting the underlying pathology in the ear. In previous studies, it has been shown that transcription factor atoh-1 may be able to trigger the regeneration of functional hair cells following damage or loss. Thus, we would like to find an appropriate gene vector to deliver atoh-1 into appropriate cells. For the therapeutic purpose, the appropriate gene vector needs to be capable of targeting the appropriate cell types in the cochlea in a manner that is minimally destructive and expressing in the cells for a certain time interval. My research is to determine the durability of expression of adeno-associated virus (AAV) vectors in the inner ear in-vivo. I will utilize AAV expressing a GFP-cre fusion protein in conjunction with ROSA26 cre reporter mice to answer this question. Cells in reporter mice express beta-galactosidase, after infection and cre-mediated recombination even if viral gene expression (GFP) is subsequently extinguished. Promising AAV serotypes of AAV-GFP-cre will be injected into the scalae of the inner ear of ROSA26 mice. At different time points following infection (days to months), ears will be analyzed for beta-galactosidase and GFP expression to assess targets of infection, persistence of viral gene expression, clearance or attrition of infected cells and the effect of the procedure and viral infection of hearing. The greater the durability of AAV expression is, the longer the cells will be double labeled with beta-galactosidase and GFP. Single labeled beta-galactosidase positive cells indicate the viral promoter has been silenced, but the cells remain. Loss of cells due to immune clearance or other mechanisms will lead to no labeling.

**Analysis of Radar Data from the West Antarctic Ice Sheet**
Katie Liu, Senior, Neurobiology, Biochemistry
Mentor: Kenichi Matsuoka, Earth and Space Sciences

This project constitutes part of a three-year program designed to investigate characteristics of more than 3000-meter-thick ice around a future full-depth ice coring site near the central West Antarctic Ice Sheet (WAIS). Using available ice-penetrating radar data gathered by airborne surveys we will investigate spatial variation of internal structures and bed conditions of the ice sheet, with a focus on the effect of ice temperature anomalies on the internal structure. To accomplish this we will determine the vertical
Experimental conditions will be determined such as what the microfluidic channels. Through this process, the best particle orientations experienced from the fluid used in micro/nano-particles with different shapes at diverse theoretically modeling the effects of friction forces on sorting by integrating opto-plasmonic tweezers (a new concept is that cells with various shapes will experience different friction forces (i.e. drag) from the flowing fluid by us) with microfluidic channels which operates at lower photodamage to biological cells. In addition, sorting is currently there are two main techniques used, but each has its own disadvantages. The first method is fluorescence activated cell sorting, which is limited to single-file cell sorting and initial preparation is required for fluorescent labeling. The second method is optical tweezers with the disadvantage of requiring high optical intensity to trap and move small particles, which can cause photodamage to biological cells. In addition, sorting is generally achieved based on the differences in cell sizes. Our research group is proposing a new approach for cell sorting by integrating opto-plasmonic tweezers (a new optical manipulation method currently being developed by us) with microfluidic channels which operates at lower optical intensities to prevent cellular harm. The underlying concept is that cells with various shapes will experience different friction forces (i.e. drag) from the flowing fluid when trapped by the tweezers. Because the drag depends on the orientation of the cells, this effect can be utilized to separate biological cells with different shapes. I am theoretically modeling the effects of friction forces on micro/nano-particles with different shapes at diverse particle orientations experienced from the fluid used in the microfluidic channels. Through this process, the best experimental conditions will be determined such as what range of light intensities will prevent photodamage while maximizing the high-resolution sorting ability of the opto-plasmonic tweezers, what flow rates should be used, and determine the dependence of sorting on cell orientation. The results obtained from modeling will then guide the actual implementation of cell sorting using opto-plasmonic tweezers with microfluidic channels.

A Comparative Study Between Engineering Experts and Students: What Is the Design Process as They See It?
Mei Liu, Senior, Electrical Engineering
Diana Baral, Junior, Materials Science and Engineering
Athena Epilepsia, Junior, Technical Communication
Michelle Hirawady, Senior, Chemical Engineering,
French Studies
Adrienne Oda, Junior, Bioengineering
Shannon Westphal, Junior, Computer Science
Mentor: Susan Mosborg, Center for Engineering Learning and Teaching
Mentor: Jason Saleem, Center for Engineering Learning and Teaching

How do engineering professionals and students conceptualize design? To better inform engineering education, in this study we compare the underlying ideas that expert engineers and pre-engineering college freshmen have about design. Understanding these conceptions is important for preparing high caliber engineers. This investigation is part of the Design Expertise Project at UW’s Center for Engineering Learning and Teaching. Our research team asked 6 pre-engineering college freshmen and 19 professional engineers to solve a “real-world” engineering problem: designing a playground in a 3-hour laboratory session. Participants thought aloud as they worked on the problem. In addition, to directly elicit their conceptions of the design process, we asked participants to complete four other tasks. They 1) sketched their idea of the design process; 2) read and commented on a typical textbook description of the design process; 3) chose 6 most and 6 least important design activities from a list of 23; and 4) rated (on a scale of 1-5) their level of agreement with each of 27 statements about design. Using this information, we will be carrying out three specific analyses. We will compare and contrast participants’ sketches in conjunction with their comments on the engineering design process. We will also tabulate results of the 2 questionnaire tasks (i.e. tasks 3 and 4 above) and analyze comments participants made while designing their playgrounds. For each of these analyses, we will be comparing results between groups. In addition to presenting descriptive statistics, we will identify themes in participants’ responses. Gaining insights into how experts versus students see the design process is crucial to enhancing engineering education and enabling future strides in engineering skill and innovation.
Electrospun Nanofibrous Structure of Silk Fibroin
Carolyn Lovano, Junior, Biology
Mentor: Narayan Bhattarai, Materials Science and Engineering

In nature, silk spiders and silk worms spin highly engineered continuous fibers by passing aqueous protein (fibroin) solution through their spinnerette. Once the fibroin solution is released to air, it hardens into an oriented semicrystalline fiber that is stronger than any other spun polymer fiber. Among various synthetic routes investigated, nanofiber fabrication using electrospinning has been an efficient means of generating high surface-to-volume ratio materials that may be used as scaffolds in tissue engineering and other engineering applications. We have successfully prepared the pure silk and nanofibers by electrospinning the purified silk or silk and polyethylene oxide (PEO) blend solution in aqueous formic acid. Raw silk was repeatedly degummed, dissolved, dialyzed, filtered and then lyophilized to achieve the silk-fibroin powder. Purified silk-fibroin solution and PEO were mixed in different weight ratios and electrospun. Light microscopy (LM) and Scanning Electron Microscopy (SEM) techniques were employed for morphological study of the fibers. The continuous fibers can be easily converted into nonwoven fabrics which may be useful in designing a mechanically strong silk-based nanofibrous scaffold.

Creation of a Non-technical User Interface for Automation of a Microfluidic Valve and Pump System
Kendra Loven, Sophomore, Electrical Engineering
Mentor: Mark Holl, Electrical Engineering

Control of the delivery of reagents to real-time experiments on living cells to examine their response to external stimuli is a common need. When the timing of stimuli along with the collection of data is required, the technology can bottleneck the design and implementation of desired biologically driven experiments. Spreadsheets are a simple and almost universally understood tool; and can be used to define control protocols for complicated processes. I have developed a program, written in Visual Basic, to read in a spreadsheet and manage a Universal Imaging PC-16 valve controller in MetaMorph. The ones and zeros of the different cells in the spreadsheet are converted to serial output for the PC-16. The program can run as a standalone, or sequenced inside MetaMorph. The sequencing allows the valve cycles to occur between other events. The spreadsheet is timed to the millisecond, giving the program maximum accuracy. After normal design revision cycles, the program runs robustly within the MetaMorph microscope control and image analysis software package as an executable dynamically linked library (dll). MetaMorph protocols that define the timing and settings for collection of cellular response are used in tandem with the reagent control programs that apply the stimulating reagents and create the measured response. Currently, the PC-16 and developed program have the capability to control up to sixteen valves; however, in the future, different pumps and vacuums will be controlled in this program in addition to the valves from the PC-16 device. Overall, the emphasis of the project was to engineer a tool that the practicing cell biologist could use for fluidic control, therefore allowing the biologist to maintain focus on the critical biology and use simple spreadsheets to define complicated fluidic control protocols.

Survivin Phosphorylation Determines Cell Fate Following Chemotherapy
Belinda Luk, Junior, Cell, Molecular, and Developmental Biology
Mentor: Daniel Y. Wu, Medicine, Division of Oncology (VAPSHCS, FHCRC, UWMC)

Survivin is a member of the human inhibitor of apoptosis family shown to inhibit programmed cell death (apoptosis). Known to over-express in 80% of cancer cells, survivin has been postulated to enable cancer cell survival following therapy. Survivin is phosphorylated in mitosis by the cyclin-dependent mitotic kinase Cdc2 (also known as Cdk1). This regulatory event has been shown to be pivotal for the stability of the survivin protein and its anti-apoptotic function. We have shown that both Cdc2 and survivin are acutely induced by chemotherapy in p53-null human lung carcinoma H1299 cells. In this setting, we postulate that the Cdc2-induced survivin expression enables damaged cells to bypass cell death by apoptosis and enter a state of prolonged cell cycle arrest known as accelerated cellular senescence (ACS). Furthermore, the phosphorylation of survivin by Cdc2/Cdk1 kinase is necessary for the survival of cells immediately following chemotherapy. To examine this hypothesis we have used an antisense oligonucleotide approach to specifically knockdown survivin expression and a conditionally expressed survivin mutant (T34A) to interfere with endogenous survivin phosphorylation. We show here that knock down of survivin in this period of time immediately following chemotherapy results in rapid cell death by apoptosis. However, the over-expression of T34A survivin in this time did not affect cell viability to the subsequent ACS state. We conclude that the induction of survivin in H1299 cells by chemotherapy is essential for cell survival and therefore the establishment of the senescent state. However, the phosphorylation event appears to be dispensable to this choice of cell fate.

Napping or Chillin’: Congruence Between Diary and Actigraphy Reporting
Erin Lum, Senior, Nursing
Mentor: Carol Landis, Biobehavioral Nursing & Health Systems
The prevalence of chronic arthritis in children is 10/10,000. Children with juvenile rheumatoid arthritis (JRA) report poor sleep quality and excessive daytime sleepiness. Parents are concerned with the child’s disturbed sleep and its negative impact. Sleep researchers use an actigraphy watch to record sleep by monitoring motion or a diary report of sleep patterns. It’s not known how accurate the actigraphy watch is to detect sleep versus quiet rest (such as watching TV). Therefore, the aim of this study is to compare napping behavior with actigraphy data and the sleep diary record in children during periods of arthritic flare and disease remission. Forty-six children (ages 6-11) diagnosed with JRA were enrolled during periods of arthritic flare and disease remission. The child wore an actigraphy watch and maintained a sleep diary for seven days, including 2 days in the UW School of Nursing sleep laboratory. Daytime actigraphy data was blocked and scored for sleep and the actigraphy watch data is currently being entered into SPSS. The study is currently in progress and comparisons are being made between reported nap times (diary) and actigraphy pattern. If the results show that the actigraphy and diary data are comparable, the actigraphy watch can be used as an accurate way to measure napping in these children.

Diversity and Distribution of Denitrifying Bacteria
Alexandra MacKenzie, Sophomore, Biochemistry  
Mentor: James Staley, Microbiology  
Mentor: Brian Oakley, Microbiology

Denitrification is crucial to biogeochemical cycling as it is an important loss pathway which releases dinitrogen gas to the atmosphere. Denitrifying bacteria contribute a significant portion of the reduced dinitrogen gas to the atmosphere and thus are critical to the nitrogen cycle. Fully understanding nutrient cycling, especially denitrification, is important to continued life on Earth, because fixed forms of nitrogen are limiting nutrients in many environmental processes and are recycled only through specific nutrient cycles. Bacteria located in the anoxic region of the Black Sea were found to exhibit nitrate reducing activity. Upon closer examination many bacteria contained the nitrite reductase gene (nirS) which carries out the first step in the denitrification process. However at present, the diversity, abundance, and extent of ecological interactions of denitrifiers in the Black Sea is unknown. My research focuses on the distribution of genetic diversity of bacteria with the nirS sequences as a means to create a profile of denitrifiers in the Black Sea. I am approaching this question by comparing the nirS gene sequences from bacteria obtained from environmental samples taken at varying depths in the water column. To isolate and amplify each individual nirS gene from the original sample, I used the polymerase chain reaction (PCR), ligated the PCR products into a cloning vector, and transformed competent E.coli which then grew on a selective medium. Gel electrophoresis was employed to determine the predicted length of the nirS clones which indicated a successful uptake of the vector before sequencing. After the sequencing I verified that the sequence was indeed a nirS gene sequence using an online data base. These sequences were compared with known bacterial nirS genes from similar anoxic environments using a phylogenetic tree. The results of this research will further our knowledge of the genetic diversity of this activity in the Black Sea.

Brain AChE Inhibition in Juvenile Rainbow Trout Exposed to Pesticide Mixtures Within Urban Streams in Western Washington: Non-Additive Effects
Windy Madden, Senior, Program on the Environment  
Richard Battin, Jr., Junior, Aquatic and Fishery Sciences  
Jaechul Kim, Senior, Aquatic and Fishery Sciences  
Mathew McDaniel, Senior, Aquatic and Fishery Sciences  
Vija Pelekis, Senior, Aquatic and Fishery Sciences  
Mentor: Christian Grue, Aquatic and Fishery Sciences

Recent efforts have documented pesticide concentrations within surface waters of urban streams in western Washington. Although levels reported are low (most <1.0 ppb), the presence of these chemicals has generated concerns, particularly their potential effects on salmonids. We exposed juvenile (ca. 10 g) rainbow trout (Oncorhynchus mykiss) to a chemical cocktail representative of urban streams in western Washington. Nominal concentrations (ppb active ingredient) of 9 herbicides, 3 insecticides (ChE-inhibitors), an insecticide breakdown product, and a fungicide were the maximum reported during peak storm flow events (hereafter 1X). With the exception of the fungicide and the breakdown product, formulated products (FP, single AI) were used and if possible were selected from those available at retail outlets. Four experiments were conducted: (1) 1X cocktail or clean dechlorinated water for 96-h under static conditions at 12 C, (2) 1X, 3.3X or 10X cocktail or negative control, (3) 10X cocktail, and 10X mixtures of the 3 ChE inhibitors, the ChE inhibitors + 3 triazine herbicides, the triazines together, and a negative control, and (4) 10X mixtures of the 3 ChE inhibitors as active ingredients (AI) and formulated products (FP, single AI) were used and if possible were selected from those available at retail outlets. Four experiments were conducted: (1) 1X cocktail or clean dechlorinated water for 96-h under static conditions at 12 C, (2) 1X, 3.3X or 10X cocktail or negative control, (3) 10X cocktail, and 10X mixtures of the 3 ChE inhibitors, the ChE inhibitors + 3 triazine herbicides, the triazines together, and a negative control, and (4) 10X mixtures of the 3 ChE inhibitors as active ingredients (AI) and formulated products (FP), each AIs and FPs alone, and a negative control. Brain AChE activity was not inhibited in fish exposed to the 1X cocktail, but was in the 3.3X (23%) and 10X (84%) cocktails. Inhibition was not potentiated by the triazine herbicides. Enzyme activity was not affected by the 10X concentrations of the individual AIs or FPs, but was inhibited 59 and 78 percent in fish exposed to the mixtures, respectively. The implications of these results to urban streams, the regulation of pesticide mixtures, and the use of AIs in assessing hazards pesticides pose to non-targets will be discussed.
Changes in chloroplast DNA during development in tobacco and other Nicotiana species
Marianne Madsen, Sophomore, Biochemistry
Mentor: Arnold Bendich, Biology

The amount of chloroplast DNA (cpDNA) in maize, Arabidopsis, and tobacco has been shown to decline during leaf development, although there are varying degrees of decline in each plant. For maize and Arabidopsis, most of the chloroplasts from fully expanded leaves have undetectable levels of cpDNA, whereas nearly all Nicotiana tabacum (tobacco) chloroplasts retain their cpDNA. The goal of my work is to determine cpDNA abundance for several Nicotiana species, including tobacco, during various stages of development. In addition, I plan to analyze the structure and integrity of cpDNA molecules at these developmental stages to determine when the cpDNA begins to change from large, complex (Class I and II) structures to degraded forms (Class III). Differences in cpDNA abundance and structure may correlate with variations in the regenerability (the ability of plants to develop from excised leaf tissue) of different species of Nicotiana, such as the highly regenerable tobacco and the non-regenerable N. paniculata. The method used to measure the cpDNA abundance is fluorescence microscopy after DAPI staining. Imaging of individual ethidium-stained DNA molecules reveals the structure of the cpDNA.

Coexpression of Tyrosine Hydroxylase and KiSS-1 mRNA in Hypothalamic Nuclei of the Female Mouse
Ilan Maizlin, Senior, Biochemistry
Mary Gates Scholar
Mentor: Robert Steiner, Physiology, Biophysics

Kisspeptins and their receptor, GPR54, play a crucial role in the neuroendocrine regulation of GnRH secretion. The Kiss1 gene, which encodes kisspeptides, is expressed in neurons in the arcuate nucleus (Arc) and anteroventral periventricular nucleus (AVPV) of the hypothalamus. In the AVPV, the expression of KiSS-1 mRNA is sexually differentiated, with higher expression in the females, whereas in the Arc, KiSS-1 is not sexually differentiated. In earlier studies we demonstrated that KiSS-1 neurons in both the Arc and AVPV express estrogen (E) receptor alpha (ERα); however, E inhibits the expression of KiSS-1 in the Arc but stimulates its expression in the AVPV. Based on these observations, we postulated that the physiological function of KiSS-1 neurons in the AVPV is different from those in the Arc. To identify distinguishing markers for KiSS-1 neurons in the AVPV and Arc, we focused on tyrosine hydroxylase (TH), the rate-limiting enzyme in the synthesis of dopamine. Like KiSS-1, TH is present in ERα-expressing neurons in the AVPV, and the expression of TH is sexually differentiated in the AVPV. Thus, it seemed plausible that KiSS-1 neurons in the AVPV might coexpress TH. To test this hypothesis, we used double-label in situ hybridization to detect TH mRNA in KiSS-1 neurons of female mice. We found that more than 99% of KiSS-1-expressing neurons in the AVPV coexpressed TH, whereas less than 5% of the KiSS-1 neurons in the Arc coexpressed TH. These results indicate that the coexpression of TH differentiates KiSS-1 neurons in the AVPV from those in the Arc, bolstering the argument that these two anatomically distinct populations of KiSS-1 neurons perform different physiological functions.

‘Weapons of Targeted Destruction’: Designing an Efficient System for the Rapid Identification of Effective shRNA’s
Frances J. Mao, Junior, Biochemistry, Molecular, Cellular and Developmental Biology
Howard Hughes Scholar
Mentor: Raymond J. Monnat, Jr., Pathology, Genome Sciences

RNA Interference (RNAi) is a remarkably potent technology that is used for targeted gene silencing in biological systems. In studying diseases that result from the loss of a single protein, RNAi becomes an especially powerful tool in that a direct causative relationship between disease phenotype and protein deficiency can be established. One of these diseases, Werner Syndrome (WS), as the concentrated focus of my lab’s investigative efforts, provides the ideal context for RNAi application. As an autosomal recessive premature aging disorder, Werner Syndrome is caused by mutations that result in loss of the Werner protein (WRN). In order to study the acute effects of losing WRN in vivo, short hairpin interfering RNA’s (shRNA’s) are designed and introduced into cultured WRN+/+ human cells that result in elimination of WRN protein. Ideally, multiple shRNAs that target the same protein are optimal to reduce the likelihood of confounding, off-target effects. However, to date, only one successful shRNA against WRN has been found, despite a market that is saturated with commercially-available shRNAs that falsely claim to knock down WRN protein. In order to identify additional shRNAs that effectively deplete WRN, we have developed a high throughput screen that relies on the shRNA-dependent loss of a WRN-EGFP (enhanced green fluorescent protein) fusion protein, and thus EGFP fluorescence, from a human fibroblast cell line. My research has focused on the generation and validation of a WRN-EGFP cell line as a screening tool for WRN-specific shRNA identification. In conjunction with analysis of protein loss by Western blot, I am also using flow cytometry to characterize WRN-EGFP depletion on a temporal and quantitative scale. Coupled with the construction of a lentiviral shRNA library, this approach should provide a way to rapidly identify effective shRNA’s to any protein of interest that can be engineered as a stable EGFP fusion.
Body Politics: Women, “Vice”, and Social Policy

Shantel Martinez, Senior, History
McNair Scholar
Mentor: George Behlmner, History

During the mid-Victorian years, Parliament became more involved with politics of the body. As the British Empire expanded, the further the state sought control over the bodies of its citizens, especially those of the urban poor. As a result, Parliament frequently introduced legislation that discriminated against the poor and operated as if their bodies were state property. In 1864, a legislation entitled “The Contagious Diseases Prevention Act” was quietly introduced at the end of the session with little publicity. The Act seemed to be just another legislation that corresponded to a series of Contagious Diseases (Animal) Acts. However, the Act of 1864 was the first of three Contagious Diseases Acts that dealt with women, not animals. Originally, the Contagious Diseases Act of 1864 was introduced as national security legislation. The purpose of the Act was to reduce venereal disease in the British armed forces. However, the Contagious Disease Act was not aimed directly at the sailors and soldiers, but rather on the prostitutes whom they visited. Initially, the Act was implemented in only a few number of garrison districts, but it was extended to more garrison districts in 1866 and 1869. At first, opposition to the Contagious Disease Acts was small and ineffective. However, not until the passage of the Act of 1869, did repealers instigate a serious threat to extension. Like other contemporary, social reform movements, the rhetoric employed to fight the legislation was based on moral and religious foundations as well in the language of English citizenship. Repealers argued the Acts did not promote the health and safety of the general public but actually demoted it by creating a double standard in society. Moreover, repealers saw their campaign as saving English civil liberties, which in their eyes were quickly being eroded. They used English history to substantiate their cause by using expressions from certain documents, such as the Magna Carta, to emphasize the genealogy of the notion of citizenship. The rhetoric based on morals and the rights of English citizenship helped repeal campaigners gain attention, increase public agitation against the Acts, and finally retract the legislation.

Habitat relationships of Fritillaria camschatcensis: a locally-rare species of cultural concern to Northwest Native Peoples

Carie McCoy, Senior, Environmental Science, UW Bothell
Mentor: Warren Gold, Interdisciplinary Arts and Sciences, UW Bothell

Fritillaria camschatcensis (black lily) is a culturally significant food plant for native peoples of Washington, British Columbia, and Alaska and is listed as a sensitive plant in Washington State. This species is found from Japan through the coastlines of Russia and northwestern North America down to Washington State. Presently in Washington it has an unusual distribution, growing in coastal estuaries and in sub-alpine wetlands. My research goal is to characterize the vegetative communities proximate to F. camschatcensis in a coastal estuary near Everett, WA and at a sub-alpine wetland (a Sphagnum fen at 880 m). These two sites are less than 50 km apart but differ markedly in climatic and ecological characteristics. An understanding of the plant communities and soil environment where this species occurs is critical to developing management and restoration strategies. It is particularly important at this southernmost extent of its range with a changing climate.

I evaluated species abundance and composition of plant communities with and without F. camschatcensis at both sites using visual estimates of foliage cover for each species. I also examined selected chemical properties of soils within some of these communities to better understand the habitat requirements of F. camschatcensis. The soil environment of both sites is clearly stressful for plant growth, yet in different ways. The sub-alpine wetland soils are cold, very acidic, and comparatively low in organic matter and inorganic nitrogen while the estuary site is saline and drier. Estuary soils with F. camschatcensis differed chemically from adjacent communities lacking F. camschatcensis. However, soil chemistry at the sub-alpine wetland did not differ between communities with and without F. camschatcensis. These soils results will be combined with analyses of the vegetation to develop an understanding of the basic biological and chemical environments where F. camschatcensis exists at this edge of its global distribution.

The Quest for Variable Objects

Rosalie McGurk, Sophomore, Astronomy, Physics
Carl Cutler, Freshman, Music
Mentor: Anjum Mukadam, Astronomy
Mentor: Paula Szkody, Astronomy

Our goal is to discover new variable objects in archived data acquired using the 2.1 meter telescope at McDonald Observatory in Texas. Celestial objects, such as stars, are considered to be variable when their brightness changes with time. The brightness of variable objects changes due to many possible causes, including eclipses in a planetary system, material flow between two nearby stars, or stellar pulsation. Monitoring the brightness of variable objects allows us to calculate the period of variability, which is the length of time between repeating patterns of brightness. The technique of imaging with continuous, short exposures (time series photometry) gives us high time resolution and allows for an accurate measurement of the period of variability. We use these series of optical images to plot the change in brightness over time of potentially variable objects. Then we use a mathematical tool known as the Fourier Transform to find the periodic signals within the data. Our data span a few hours with short exposures.
of vent organisms. They form at spreading centers where crests, temperature and water circulation, and the ecology movement and formation, sediment deposits at ridge concentration of elements in seawater, plate tectonic areas of much research and debate in relation to the plate tectonic since the late 1970's, hydrothermal vents have been an area of much research and debate in relation to the concentration of elements in seawater, plate tectonic movement and formation, sediment deposits at ridge crests, temperature and water circulation, and the ecology of vent organisms. They form at spreading centers where new oceanic crust is created by volcanic processes. These vents release hot fluids with numerous elements and compounds from the solid ocean crust to seawater and mix with cold seawater, thus dramatically influencing ocean chemistry. My project was established to determine how hydrothermal vent systems change over time and how they respond to disruption by volcanic activity. To investigate how hydrothermal fluid composition changes over time, scientists at the Pacific Marine Environmental Laboratory have installed time-series samplers which can collect hot fluid once each week or on demand through a satellite/acoustic link. The latest set of samples was recovered in May, 2005. I began my work with analyzing the chemistry of the water collected between September, 2004 and May, 2005 from a hydrothermal vent at Axial Volcano on the Juan de Fuca ridge. The chemical analysis included measuring pH, alkalinity, and concentrations of major elements. Following the chemical analysis, I interpreted the patterns of changes which occurred that year. Through the course of this year’s study, no major volcanic events were detected and it did not appear that there were significant changes in vent fluid chemistry at the completion of my summer project. Also, I was briefly shown this project’s data from previous year’s indicating that volcanoes would not cause long term changes in vent areas. Therefore, I have yet to ascertain any new insights of hydrothermal vent systems.

Assessment of the Burke Museum’s Cretaceous fossils
Rex McLachlin, Junior, Earth and Space Sciences
Mentor: Christian Sidor, Biology

I am doing a survey of the Burke Museum’s Cretaceous vertebrate fossil collection. Completing this survey will create a summary of the date of collection, geographic location and geologic formation the specimens in the Burke’s inventory originated from. A comparison of the museum’s database with the locality cards kept with the fossils themselves permits the compilation of most of the requisite data. Approximately 3,200 of the Burke’s 45,000 vertebrate fossils date from the Cretaceous period. The vast majority of fossils, 73%, come from the Hell Creek formation in Montana. The Lance Creek formation, which outcrops mostly in Wyoming, is the source of 23% of the collection. The rest of the fossils are from various other formations which comprise between 2 and <1% of the total. These formations are from Kansas, New Jersey, South Dakota and Utah and the Province of Alberta. Almost all the fossils (99%) come from the United States with the remainder from China, Mongolia, Canada and France. Reptiles are the most abundant class in the collection, comprising 68% of the fossils. Also significant are mammals (19%) and fish (13%). There are a handful of bird and amphibian fossils making up less than 1% of the total. The most common reptiles are the dinosaurs which make up 43% of the collection. Crocodilians (17%) and turtles (6%) are also well represented. The majority of the dinosaurs (73%) are ornithischians, mostly represented by Hadrosaurs from the Two Medicine Formation and Triceratops from the Hell Creek formation. The saurischians present are all theropods and are represented almost exclusively as teeth fragments. Notable fossils in the Burke’s collection include dinosaur eggs, most of a Triceratops skull, a complete Anatotitan foot, and a portion of a Tyrannosaurus jaw.

The Effects of Volcanoes, Earthquakes, and Time on Hydrothermal Vents
Toby Mcleod, Freshman, Oceanography
Mentor: David Butterfield, Joint Institute for the Study of the Atmosphere and Oceans

Since the late 1970’s, hydrothermal vents have been an area of much research and debate in relation to the concentration of elements in seawater, plate tectonic movement and formation, sediment deposits at ridge crests, temperature and water circulation, and the ecology of vent organisms. They form at spreading centers where fresh-water body weather phenomenon.

Effect of employee sense of efficacy on community interventions for HIV prevention
Michalina Montano, Junior, Biology
Krycia Cowling, Junior, Public Health  
Michaela Dorres, Junior, International Studies  
Sarah Goldenkranz, Junior, Neurobiology  
Mentor: Damuta Kasprzyk, Honors Program, Senior  
Research Scientist, Battelle Seattle Research Center

Issues: In Zimbabwe, a country with high HIV prevalence, it is not easy for NGO staff to remain optimistic about the value of behavioral interventions for HIV prevention. Paradoxically, the high prevalence increases the potential impact of optimism. It is imperative that researchers foster a sense of staff efficacy, keeping employees motivated and ensuring their optimism has the greatest impact. Description: Four University of Washington undergraduates interned for the Zimbabwe Community Health Intervention Research Project (ZiCHiRe), implementing the CPOL prevention intervention. Interviews with 42 staff, and 6 stakeholders involved in HIV prevention were conducted. Since this intervention model’s effectiveness has not been proven in Zimbabwe, employees’ opinions about their efficacy are unbiased by previous results. Interviews explored factors contributing to a strong sense of efficacy at individual and institutional levels. Staff members were asked about their understanding of the intervention model and how they perceived their role in it. Individuals were also queried about their opinions on the future of HIV in Zimbabwe. Lessons learned: Two primary reasons emerged for ZiCHiRe staff’s high sense of efficacy and optimism: 1) A direct association between employees’ proximity to the target communities and their opinions regarding the success of the intervention; 2) Interaction between project teams and awareness of how individual jobs fit into the intervention as a whole. Staff and stakeholders not directly connected to target communities perceive HIV prevention efforts to be less successful. Recommendations: All staff should receive training regarding all components of the HIV intervention to emphasize the importance of their roles, regardless of direct contact with target communities. If staff of a community-based intervention have a high sense of efficacy, their optimism will filter through to the target community, facilitating change. Contact with target communities and between teams fosters a high sense of efficacy.

Xenon Adsorption on Carbon Nanotube Bundles  
Jeremy Morales, Junior, Physics  
Kevin Dillon, Senior, Physics  
Dario Machleidt, Senior, Physics  
Lucas Miller, Senior, Physics  
Mentor: Oscar Vilches, Physics  
Mentor: Subramanian Ramachandran, Physics

The goal of our project is to determine the thermodynamic properties of xenon adsorbed to a carbon nanotube bundle substrate. We are specifically interested in determining xenon’s behavior once adsorbed (e.g. if it behaves as a solid or liquid in one, two, or three dimensions), as well as finding critical points or phase transitions that xenon may exhibit. We have performed one nitrogen and one xenon isotherm at respectively 77.4 and 130K, calibrated the temperature sensors, written and fine tuned a LabView program to acquire data, run an empty cell background heat capacity measurement between 80K and 130K, and are in the process of removing sources of scatter from our first xenon film heat capacity data over the same temperature range. One of us (S.R.) has done a similar experiment in a different setup at much lower temperatures (1.8 to 20K) for neon adsorbed on similar carbon nanotube bundles. The data we are collecting now on the xenon experiment seems to parallel what was found for neon: a perennally smooth set of heat capacity data points all the way up to the highest temperature measured. Despite the scatter in our data, it is most likely that no critical point is observed for xenon in our temperature range, since any such point would be registered as a prominent, delta function like spike in the heat capacity. Evidence for any less obvious characteristics of xenon’s behavior as a film on the nanotube bundles remains an object of our research. Our work is supported by the National Science Foundation, DMR 0245423.

Gene Flow Amongst the Wild Capsicums of Bolivia  
Haley M.A.K. Morris, Senior, Biology - Ecology and Evolution  
Mentor: Joshua J. Tewksbury, Biology

One of the most popular spices in the world are chilies (genus Capsicum), and like all spices, their popularity is due to the presence of secondary chemicals - in the case of chilies, these are capsaicinoids, responsible for the “heat” or “pungency” of chilies. While capsicums are the only species producing capsaicinoids, there are non-pungent, ancestral Capsicums. The origin of pungent capsicums is thought to be in Southern Bolivia, and recently, our lab has discovered that two ancestral species (Capsicum chacoense and C. baccatum) that co-occur, and in some populations are polymorphic for capsaicinoid production - some plants will produce pungent fruit (containing capsaicin) and other plants will produce non-pungent fruits (fruits without capsaicin). These species may be the first pungent chilies, yet to date non-pungent C. baccatum has only been found in populations sympatric with non-pungent C. chacoense. We thus test the possibility that pungency polymorphism in C. baccatum could have occurred through interspecific hybridization. Specifically, we performed greenhouse crosses between: 1) the two species of chilies, and compared flower-to-fruit ratios between these interspecific crosses and 2) intraspecific crosses and 3) selfed fruits, all on the same plants, in both species. Results will be discussed.

Low Dose Radiation Exposures to Transiently Increase Resistance to High Dose Effects  
Audrey Moruzzi, Junior, Neurobiology
Comparing Coping Strategies of Homeless and Non-Homeless Youth in Seattle, Washington

Alexis Mugele, Senior, Nursing
Mentor: Janet Cady, Family and Child Nursing
Mentor: Betty Gallucci, Biobehavioral Nursing and Health Systems

According to the Seattle Human Services Department, on any given night in Seattle an estimated 800 young people, ages 12 to 24, are without a safe place to sleep. Previous research conducted on homeless and non-homeless adolescent males in Canada found an increase use of disengagement coping styles among homeless youth, and that such a coping style is a factor in the prevalence of psychological maladjustment impacting homeless youth. Building upon these findings, the purpose of this project is to compare the coping strategies in homeless youth to those of non-homeless youth. This is a descriptive study of the coping strategies of homeless youth and non-homeless youth. The coping scores of these two groups of youth will be compared to each other to identify similarities and differences. This convenience sample will consist of 40-80 youth. Questionnaires will be distributed to 20-40 youth receiving services for ROOTS Young Adult Shelter and 20-40 youth in the University of Washington commons area near the Student Union Building. The instruments being used are the COPE Inventory and an investigator designed questionnaire. COPE Inventory is a standardized tool consisting of 60 questions. It measures the psychological coping strategies used by persons when confronted with difficult or stressful events in their lives. The coping styles assessed in this instrument include responses that are considered adaptive or maladaptive in controllable situations. The investigator designed questionnaires contain demographic questions, questions regarding previous experiences with different U-district populations and questions asking their opinion of needs and resources of homeless youth. The study is currently in progress and results will be reported in May. It is my hope that understanding the coping differences between these two populations may help in designing services that better meet the needs of homeless youth.

Effects of Model Organic Species on the Stability of Solids that Control Lead Release in Drinking Water

Jonathan Murray, Sophomore, Pre-Engineering
Mary Gates Scholar
Mentor: Gregory Korshin, Civil and Environmental Engineering

Safe drinking water is one of the cornerstones of public health. A considerable threat to this safety is the release of lead in drinking water. This study has focused on examining the mechanisms that cause lead release. Old lead pipes are one of the primary sources of lead in drinking water. They corrode to form both lead-containing solids and soluble species that are carried into people’s bodies. An important compound is lead dioxide, or PbO₂, which is almost insoluble and therefore suppresses lead release. One of the factors that affects the formation and stability of PbO₂ is natural organic matter or NOM that is generated in water sources because of the breakdown of vegetation and biological activity in the ecosystem. This study was centered on the exploration of links between this NOM and the behavior of PbO₂. The goal was to show that organic compounds can act as reducing agents and cause the reduction of Pb IV species into more mobile Pb II species. The difficulty of working with NOM is that it is a complex mix of compounds. To simplify the experiments, model organic compounds were employed to examine reactions between PbO₂ and NOM. Resorcinol, a phenolic compound with properties somewhat similar to those of NOM, was used initially, but then tannic acid, a compound generated by many plants that is structurally closer to NOM, was selected. Spectrophotometric and inductively coupled plasma analyses were carried out to measure the oxidation of tannic acid and soluble lead release. The morphology of PbO₂ was studied with scanning electron microscopy. Results obtained so far have shown that the model compounds do react with PbO₂ and that reaction leads to an increase in soluble lead. Still left to determine
is the mechanism of this reaction and to changes that the lead dioxide undergoes.

**Dynein Depletion changes the Organization of Microtubules in the Cell Cycle**  
*Jennifer Mytton, Junior, Biology*  
*Mentor: Merrill Hille, Biology*  
*Mentor: Edwin Munro, Friday Harbor Labs*

Microtubules play a dynamical role throughout the cell cycle in order to accomplish jobs needed for mitosis and cleavage furrow positioning. Two of these jobs include positioning the male and female pronuclei at the middle of the cell before the formation of the mitotic spindle, as well as communicating the position of that spindle to the cortex of the cell in order to transmit a signal. In turn, this signal will cue the formation of the contractile ring to assemble. Dynein is a major motor protein that engages with the cortex in *C. elegans* embryos. Dynein is localized at the cortex and nuclear membrane, and engages with microtubules by running toward the minus ends of microtubules (concentrated at the centrosomes). Literature states that in a cell heavily depleted of dynein, pronuclear migration doesn’t occur, and pronuclei positioning never transpires. We noted that dynein and microtubule have an interaction at the cortex and note that dynein exerts some type of force on microtubules. Without Dynein microtubules do not experience a catastrophe (shrinking) when encountering the cortex. Microtubule residency became longer when using RNAi to knock down the dynein heavy chain. Pronuclei positioning, centration, mitosis, and also cleavage furrow positioning also were affected by Dynein depletion. Microtubules don’t reach out to the female pronucleus, the female and male pronuclei break down separate of each other, and we see the male form a pseudo-mitotic spindle, lacking female chromosomes. The centrosomes slump along the posterior of the embryo. Long astral microtubules reach across the egg as a result of no dynein interaction. The lack of force-generation between microtubules and dynein results in astral microtubules having no pulling mechanisms for centration and we see two misplaced furrows. We see that one cleavage furrow is placed in the anterior and one in the posterior.

**Face and Object Habitation in Toddlers with Autism Spectrum Disorder**  
*Jessica Namkung, Senior, Psychology*  
*Mentor: Sara Webb, Psychiatry, Behavioral Sciences*

The most prominent deficit that individuals with autism display is difficulties in social interactions, potentially due to inability to attend to and process faces. Such difficulties in face processing play a critical role in understanding impaired social cognition since early face processing abilities serve as a fundamental building block in later development of social skills. To examine early impairments, 3 groups of toddlers aged between 18 to 27 months are tested: Toddlers with Autism Spectrum Disorder (ASD), Toddlers with developmental delay (DD), and Toddlers with typical development (TYP). Toddlers are compared on their face and object processing and memory, measured by a habituation paradigm. Toddlers participated in 4 habituation experiments, each consisting of an object and a face with a five second delay and five minute delay. Preliminary evidence suggests that the ASD group took longer to habituate to faces compared to other groups. This finding provides evidence for delayed information processing and greater deficits when processing faces in toddlers with ASD.

**Mapping Msx1 Expression in Human Fetal Digits**  
*Abby Navratil, Senior, Bioengineering*  
*Mentor: Chris Allan, Orthopaedics and Sports Medicine, Bioengineering*

Regeneration, as an alternative to the use of prosthetic devices, is an ultimate goal to improve the quality of life for limb amputees. Msx1, a gene encoding for a transcription repressor, has been shown to play a key role in regeneration. In digit tip regeneration studies in mice, the regenerative region has been shown to express Msx1. Msx1 has also been found within the region of the nail bed in human fetal digits. Clinically it has been observed that children 11 years or younger are capable of regenerating digit tips if the amputation occurs in the nail bed. Our study focuses on the expression pattern of Msx1 in developing human fetal digits. Additionally, we have begun to study the expression in an in vitro digit tip regeneration organ culture model. For this study, fetal digits of an estimated gestational age between 45 and 90 days are obtained from the University of Washington Center for Human Embryology with University of Washington Institutional Review Board approval. Tissue is sectioned and stained for Msx1 using standard immunoperoxidase immunohistochemistry. For digits used in organ culture, the tips are amputated within the region of the distal phalangeal bone and cultured for 2, 4, or 7 days before immunohistochemical processing. We have determined that Msx1 is expressed in the distal region of the developing digits beneath the nail bed and becomes progressively distally and dorsally restricted with age. These results are potentially significant because reports of regeneration in both mice and humans suggest that digit regeneration only occurs in the region of Msx1 expression. Organ culture of regenerating digit tips may help determine whether Msx1 expression is upregulated in cells at the digit tip post-amputation, or if cells expressing Msx1 migrate to the site of injury.

**“Are you sure?”: The role of confidence in Perceived Norms and College Student Drinking**  
*Teryl Neil, Senior, Psychology, Sociology*
It has been established that perceived norms are associated with drinking. Surprisingly, no one has looked at the role of confidence in this association. The role of confidence in relation to perceived norms and drinking is salient in regards to social norm interventions aimed at capitalizing on discrepancies. In such interventions, students are asked what they perceive as the drinking norms for college students and, afterward, are presented with actual norms which may be lower than thought. Correcting misperceived norms is thought to lower students drinking in accordance with actual drinking norms. The present study evaluates how confidence in the perception of typical student drinking relates to perceived norms and drinking. Participants include 2095 (42.2% male) college freshmen from a large west coast university who completed a larger intervention study using a web based survey about alcohol use and related consequences. Students were asked about their own and typical student drinking (e.g., # drinks per week, # drinks per occasion and frequency). Regression analysis was used to evaluate the relationship between confidence, perceived norms and drinking. Results indicate that higher confidence was associated with more accurate perceptions of peer drinking. Confidence was also associated with consuming more drinks per week, per occasion and greater frequency. Furthermore, greater confidence was associated with a stronger relationship between the perceived typical number of drinks consumed on a given occasion by other students and the number of drinks typically consumed by the individual. Confidence did not moderate perceived drinks per week or frequency and drinking. Regarding drinks per occasion, greater confidence in estimates of students’ drinking is associated with heavier drinking. In sum, students that report higher confidence in their estimates of other students’ drinking are more accurate in their perceptions, are themselves heavier drinkers, and more influenced by their perceptions of other students’ drinking.

Does Therapist Style Make a Difference in Predicting Alcohol Treatment Outcomes?
Franchesca (Thach) Nguyen, Senior, Psychology
Mentor: G. Alan Marlatt, Psychology
Mentor: Karen K. Chan, Psychology

Brief interventions utilizing Motivational interviewing (MI) have been shown to be efficacious for reducing alcohol consumption and associated consequences in a variety of settings. Motivational interviewing is a non-confrontational, non-judgmental, and directive style of therapy to address clients with alcohol problems. Research suggests that these types of interventions help to better engage and retain clients in treatment, as well as significantly reduce problem behaviors (Dunn et al., 2001). While many research studies measure treatment outcome from these interventions more generally, the present study specifically looks at MI as the vehicle for client change. Using the Motivational Interviewing Treatment Integrity (MITI) Codes, this study examines the relationship between higher MI competency in therapists and client alcohol consumption and problems at follow-up. Participants were 100 clients 18 and over from the employee assistance program (EAP) seeking mental health services. EAPs are part of an employee’s benefits package and most EAPs offer three to eight sessions with a mental health professional. All EAP clients completed a brief alcohol screen (Audit-C) embedded in a standardized general health screen administered prior to the first session. Clients meeting screening criteria were assigned to either a brief motivational feedback intervention or services-as-usual therapist. Follow-up assessments were conducted two-weeks and three-month post-baseline. Second sessions of the brief interventions were audio taped and coded by trained undergraduate students using the MITI. Repeated measures ANOVA will be used to examine alcohol consumption and related consequences at baseline and 3-month follow-up by MITI scores.

Mutant PKCγ in the Pathogenesis of Spinocerebellar Ataxia-14
Jeannie K. Nguyen, Junior, Neurobiology, Biochemistry
Howard Hughes Scholar
Mentor: Dong-Hui Chen, Neurology
Mentor: Wendy Raskind, Medicine

Spinocerebellar Ataxia 14 (SCA14) is an inherited neurodegenerative disorder. Symptoms of SCA14 include an unsteady gait, dystarthis, abnormal eye movement, sensory loss, myoclonus, cognitive impairment, and cerebellar atrophy. This disease is caused by mutations in the protein kinase C gamma gene (PRKCG). The PRKCG gene encodes the protein PKCγ, a member of a family of serine/threonine kinases. PKCγ plays a role in signal transduction, cell proliferation and differentiation, synaptic transmission, and tumor promotion. In vertebrates, there is high expression in the brain and spinal cord, especially in Purkinje cells of the cerebellar cortex. The goal of the Raskind lab is to understand the pathogenesis of SCA14 and how mutant PKCγ causes this disease. Current studies include in vivo studies with transgenic mice and in vitro studies investigating phosphorylation activity, cell death, and the target of the protein. Protein aggregates have been observed in COS-7 cells transfected with wild-type (WT) and mutant PKCγ tagged with green fluorescent protein (GFP). These aggregates are classified as either dot-like aggregates or mass aggregates. In comparison to WT, many PKCγ mutants show an overall high percentage of cells portraying protein aggregates. In particular, we want to discover the exact subcellular location of these protein aggregates by visualizing PKCγ-expressing cells by electron microscopy (EM). To study cell death, flow cytometry is being utilized to quantify levels of apoptosis.
in mutant PKCγ cells. Hydrogen peroxide (H$_2$O$_2$) is used to induce apoptosis while annexin V-PE is used to measure apoptosis in PKCγ-expressing cells. With H$_2$O$_2$-induced apoptosis, WT PKCγ cells display higher levels of apoptosis in comparison to mutant PKCγ cells. These studies are ongoing and we are in the process of optimizing the protocols and repeating experiments in order to confirm the results.

The Effects of HIV-1 Envelope Transmembrane Amino Acid Changes on Neutralization Sensitivity

Minh-An Nguyen, Junior, Biochemistry, Chemistry
Howard Hughes Scholar
Mentor: Catherine Blish, Division of Human Biology, Fred Hutchinson Cancer Research Center
Mentor: Julie Overbaugh, Division of Human Biology, Fred Hutchinson Cancer Research Center

Every six seconds, someone is infected with Human Immunodeficiency Virus-1 (HIV-1) and over 40.3 million people are presently infected. A major focus of efforts to halt this epidemic is the development of a vaccine that will generate neutralizing antibodies to HIV-1. Such antibodies, which recognize the viral envelope protein and prevent the virus from entering cells, have been found to be protective from infection in animal models. Unfortunately, generating neutralizing antibodies that are broadly reactive has proven quite challenging. Our aim is to characterize viral features that make HIV-1 more susceptible to antibodies. Previous studies showed that among the viral isolates from one subject, two amino acid changes in the transmembrane region were critical to convert a neutralization-resistant envelope to a neutralization-sensitive envelope. In order to explore whether these changes in the transmembrane sequences had a broad effect on neutralization of various HIV-1 strains, we have been engineering similar amino changes into other viruses and examining neutralization sensitivity. We used site-directed mutagenesis to make these amino acid changes on various neutralization-resistant viruses. In order to generate these mutants, we created primers with the desired nucleotide sequence changes and used these to amplify modified viruses using Polymerase Chain Reaction (PCR). We then evaluated neutralization sensitivity to various monoclonal antibodies and antibodies in plasma. We found that the specific residue changes individually caused an increased sensitivity to neutralization in diverse viral backgrounds. This suggests that small changes near the transmembrane region may have an important global role in neutralization sensitivity. In the future, we plan to make double mutants containing both of the transmembrane amino acid changes, in order to evaluate whether this effect is enhanced. These data may offer insights for future vaccine design, as viral envelopes with these sequences that are more readily neutralized by antibodies may be better immunogens.

Investigating Cyclic Nucleotide Analogs Used As Tools

Cedric Ng, Senior, Biology (Physiology)
Mentor: Joe Beavo, Pharmacology
Mentor: Thomas Hinds, Pharmacology

Many hormones, neurotransmitters, and drugs work by altering physiological levels of cyclic adenosine monophosphate (cAMP) and cyclic guanosine monophosphate (cGMP). The levels of cyclic nucleotides in cells are regulated by phosphodiesterases (PDEs), which degrade cyclic nucleotides and by various signal transduction pathways such as G-protein mediated adenylate cyclase pathways. Within these pathways, the secondary messenger cyclic nucleotides have their own receptors and function to activate or suppress various protein kinases, nucleotide gated channels, and guanine nucleotide exchange factors among others. Synthetic cyclic nucleotide analogs have been developed as tools to probe the mechanism of cyclic nucleotide actions in signal transduction pathways because of their ability to activate or suppress cAMP or cGMP activated enzymes. However, none of these tools have been systematically tested for their ability to act as substrates or inhibitors for the various PDEs. This project establishes reference data for these cyclic nucleotide analog tools by testing their effects on various PDEs using a novel method. Microcalorimetry does not require the use of radioactivity and can measure the amount of heat given off when the phosphodiester bond is hydrolyzed. The hydrolytic reaction rates between PDEs and various cyclic nucleotide analogs are determined (Km, Kcat, and Vmax) through this method. Some analogs were not metabolized, but were found to inhibit some of the PDEs, allowing Ki to be determined as well. Microcalorimetry is a very promising method because it is able to test cyclic nucleotide analogs that are not testable by other methods. Preliminary results show that some cyclic nucleotide analogs have differential effects on various PDEs. For example, the enzyme kinetics determined for PDE1B on a number of cyclic nucleotide analogs have shown that several cyclic nucleotides act as high-affinity inhibitors that are not hydrolyzed. These findings may in turn require reinterpretation of a lot of the data in the current literature.

Field Population Patterns in *Synechococcus* Phylogenetic Trees for Three Genes

Katherine Nickel, Senior, Cell, Molecular and Developmental Biology
Mentor: Gabrielle Rocap, Oceanography

Marine *Synechococcus* is a genus of cyanobacteria that live throughout the world’s oceans, and they play an important role as primary producers in marine habitats. It has been established that *Synechococcus* can be organized into clusters that contain similar genetic sequences, but the mechanism that causes these clusters to occur remains unknown. It is hypothesized that these clusters are formed by periodic selective sweeps, but currently we do not...
have enough sequence data to test this hypothesis. By examining phylogenetic patterns of multiple genes we hope to identify mechanisms causing genetic clusters and gain a larger picture of the evolutionary history within this genus. We sampled a surface (5m) *Synechococcus* community from the Sargasso Sea, during spring when they reach their annual peak in abundance. From these samples, we constructed clone libraries with the PCR amplified products using primers specific for marine cyanobacteria for the following three loci: the 16s-23s rDNA internal transcribed spacer (ITS); *ntrC*, an nitrogen transcription regulator; and *narB*, a nitrate reductase. We will construct phylogenetic trees of the cloned environmental sequences and compare the branching orders of clusters to see if these patterns are consistent with periodic selective sweeps.

**Gene Targets of Sonic Hedgehog in the Neural Tube**
Yoko Inès Nozawa, Senior, Cell, Molecular and Developmental Biology  
Mentor: Henk Roelink, Biological Structure

Sonic Hedgehog (Shh) is an inductive signaling molecule, which is essential for dorsoventral patterning in the vertebrate neural tube. Shh is secreted from the notochord and later from the floor plate and forms a gradient across the ventral to dorsal axis. The varying concentrations of Shh induce different cell types such as motorneurons to develop at specific locations. Activation of the Shh response pathway is initiated by Shh binding to Patched, part of the receptor complex on the cell surface which activates a pathway that will eventually induce or repress the expression of genes via the action of the transcription factors Gli1, Gli2 and Gli3. Dr. Néva Meyer, a former graduate student in the Roelink lab, has created a subtractive screen in order to identify genes that are transcriptionally regulated by Shh. My project is to analyze the gene targets identified from this screen. Using *in situ* hybridization, I have determined the expression patterns of several genes, including ILF-1, CoupTF2, ZnF482, ActRIIB, PTx1, ZnF489 and Tsh1. In order to determine whether the target gene is up or downregulated by Shh, I will perform double *in situ* hybridizations (with a known transcriptional target) on chick embryos in which Shh has been misexpressed in the neural tube. Understanding how these genes participate in neural tube patterning will provide a better understanding of the mechanisms underlying Sonic Hedgehog dependent neurogenesis during early development.

**Researching Foxa’s role in liver gene regulation**
Mari Obara, Senior, Biology  
Mary Gates Scholar  
Mentor: Alison Crowe, Biology

Transcription factors are proteins that promote gene activation. In this project, we focus on the transcription factor Foxa and its ability to activate genes crucial to liver formation during embryonic development. We use the α-fetoprotein (AFP) gene, which is activated in the fetal liver but silenced in the mature liver, to study how Foxa regulates the expression of liver-specific genes. DNA in the nucleus is usually found in a tightly coiled state called chromatin. This tight packing hinders gene-activating enzymes from accessing the DNA. Foxa has been suggested to promote liver gene expression by loosening the coil and allowing proteins that make up the gene transcription machinery to assemble near the liver gene in an area called a promoter region. Past studies have also shown that Foxa is somehow able to stabilize the machinery complex (called a preinitiation complex, or PIC) once it has assembled, but the mechanism by which Foxa does this has yet to be elucidated. We hypothesize that Foxa does this by directly interacting with the proteins making up the complex. In our previous experiments, we tested Foxa’s capability to bind PIC proteins by co-incubation and found Foxa to directly associate with one of the proteins. In our more recent experiments, we looked for an increased level of PIC proteins binding to the AFP promoter region in the presence of Foxa by constructing a PIC onto the AFP promoter region *in vitro*, or in a test tube environment, in the presence and absence of Foxa. We then used Western blot analysis to compare the level of PIC protein binding to the promoter region under the different conditions. Our preliminary data shows an enhanced level of binding in some of the PIC proteins in the presence of Foxa, suggesting Foxa plays a direct role in stabilizing PIC formation.

**Instinctual or Learned?: A Comparative study of Predator Recognition between Laboratory-Reared Infant Macaques and Wild Infant Macaques**
Misa Odagiri, Senior, Biology, Psychology  
Mentor: Randall Kyes, Psychology

Predator recognition is a crucial cognitive ability for any organism’s survival in the wild. The purpose of this study was to examine whether this ability has a genetic predisposition through studying primate species. The research question was: are monkeys innately aware of potential predators, or do they need to learn from experience to be able to perceive predators as threatening entities. This study took place both in a laboratory setting with captive-born infant pig-tailed macaque monkeys (*Macaca nemestrina*) and in the field with wild infant long-tailed macaque monkeys (*Macaca fascicularis*). Monkeys in both conditions were presented with stimuli including models of a python, which are known to be a predator of macaque monkeys, and control objects in a proximal distance. Behavioral responses to each stimulus were recorded for both captive and wild monkeys. I hypothesized that monkeys could not differentiate their predators from harmless organisms/objects without previous threatening experiences associated with predators. Thus, the ability of predator recognition would not have a strong genetic
predisposition. Assuming there is no genetic basis, it was predicted that laboratory-reared infants would not display fear responses specific to the python, and would respond to any novel stimulus in the same way. Wild infants were assumed to have had experience recognizing potential predators among other stimuli through their own life experiences or mimicking adults’ cautious behavior. Having conducted the experiments both in the field and in the laboratory, results indicate that there were fewer significant differences between responses to different types of predatory stimuli in the captive monkeys compared to those of wild monkeys. The wild monkeys displayed more distinct responses toward the stimuli, showing a greater numbers of threat responses to the python model over other stimuli.

Mars Surface Feature Analysis
Travis Orloff, Senior, Earth and Space Sciences
Mentor: Alan Gillespie, Earth and Space Sciences

I plan on taking images from several satellites (especially moderate-resolution day/night multichannel thermal-infrared Themis data) to look at two geographic features on the surface of Mars. The first is a volcano named Arsia Mons which is compositionally simple, consisting of basalt flows and windblown dust. This area acts as control to the second, more complex one, which is in Candor Chasma. In this second area layered sulfate deposits (Montgomery and Gillespie, 2005) crop out from the walls, but the chasm appears to be floored with black rock and ripples or dunes. The goal of the research is to try to determine the composition of the black floor of Candor Chasma: is it particulate or bedrock? Is it silicate, and if so, what kind? The first research question may be addressed by thermal inertia, calculated from registered day/night Themis images. Bedrock has high inertia, and low day/night temperature differences, whereas sand has low inertia, and high differences. The second research question can be addressed from the multichannel nature of the Themis data and thermal emissivities calculated from them. Basalt has a spectrum distinct from gypsum, for example. Other spectral work has suggested the presence of olivine, a silicate mineral common in basalt, at the edges of some chasmata, but the fundamental question for Candor is not yet answered.

Iron Availability and Reactive Oxygen Species
Production in Heterosigma akashiwo
Richard Overman, Senior, Biology
Mentor: Rose Ann Cattolico, Biology

Heterosigma akashiwo is a marine alga which forms harmful blooms that cause fish kills in coastal waters around the world. A proposed mechanism for the toxic effect of Heterosigma is that the organism produces reactive oxygen species (ROS) that attack the gill tissue of fishes. The production of ROS may be an adaptive solution for increasing the availability of organically trapped iron in Heterosigma’s environment. It has been hypothesized that organically chelated Iron(III) may be...
reduced by ROS into Iron(II) increasing it’s solubility, freeing it from the chelate, and making it available for uptake by a *Heterosigma* cell. Previous research in our laboratory has produced low iron tolerant mutants selected through prolonged iron limitation. These mutants provide a good system for investigating the relationship between ROS production and iron availability. Our experiment involved eight individual cultures consisting of four low iron selected mutants and four controls grown in low iron and replete media, respectively. The concentrations of hydrogen peroxide and superoxide, two types of ROS, were measured in the cultures using high-throughput, plate based, fluorescent Amplex Red and luminescent MCLA assays respectively. Low iron selected cultures had a reduced hydrogen peroxide concentration, but a higher superoxide concentration that wildtype cultures. Under certain conditions, ROS concentrations in cell cultures were less than sterile media, suggesting active degradation of ROS. By spiking cell cultures with hydrogen peroxide, we have confirmed that *Heterosigma* is capable of reducing the concentration of this reactive molecule in its environment. In addition, the concentration of hydrogen peroxide remains constant irrespective of cell density in an actively growing culture. Further results will be helpful in revealing the intricacies of ROS production and degradation by *Heterosigma* cells and by abiotic processes within the environment, as well as the role of ROS in iron acquisition.

**Carbon cryogels with tunable nanostructures for supercapacitors**  
*Yangyang Pan, Junior, Materials Science and Engineering  
Mentor: Guozhong Cao, Materials Science and Engineering*

Supercapacitor offers high specific power with moderate specific energy, and thus attracts lots of attention in research community and industry. Supercapacitors can find a wide range of applications such as hybrid cars and high performance space crafts and airplanes. Most supercapacitors are based on activated carbon. Although activated carbon possesses a huge surface area and large porosity and can store energy by adsorbing charged electrolyte molecules on to the internal surface, there’s no control in chemical composition that have been found to have significant impacts on the performance of supercapacitors. In our research, porous carbon cryogel with micropores in the size of several nanometers was synthesized using resorcinol and formaldehyde as precursors and sodium carbonate as catalyst by sol-gel processing. After gelation, solvent exchange with t-butanol was carried out prior to freeze drying which was to prevent the RF gel network from collapse by eliminating capillary force during the removal of solvent. The resulting RF cryogels are pyrolyzed at 1050ºC in nitrogen, and activated at 900ºC using CO₂ to produce carbon cryogels with desired microporous structure. It has been found that the content of catalyst and water have significant influences on and can be used to tune the porous structure. The typical carbon cryogels have a porosity of 1.2~1.6 cm³/g, a BET surface area exceeding 2000 m²/g, and a mean pore size of 2~4 nm. The capacitance of our carbon cryogel is of 105 F/g, with a figure of Merit (FOM) value around 7.8 W/g for operation voltage at 2V, compared with the maximum FOM value of 3.6 W/g reported in literature. Future work includes the understanding of the relationship between the chemical composition of the sol, processing conditions, microstructure and the electrochemical properties. More specifically, I will focus on the study of the relationship between the impedance and microstructure of the carbon cryogels.

**Electrochemical Deposition of Cuprous Oxide onto Silicon**  
*Jason Parker, Senior, Electrical Engineering  
Mentor: Daniel Gamelin, Chemistry*

This project focuses on developing spin-based electronics (spintronics) materials and devices. Unlike traditional electronics devices, which use the charge in a material for signal transmission or data storage, spintronics devices seek to use the spins of electrons as well. By harnessing the spins of electrons, spintronics devices could revolutionize electronics by further miniaturizing electronics devices and even adding new functionality to them. To make spintronics technologies practical, spintronics materials must be interfaced with silicon. The deposition of one potential spintronics material, transition metal-doped cuprous oxide (TM²⁺:Cu₂O), onto silicon has been conducted using electrochemical deposition. The characterization of TM²⁺:Cu₂O films and this material’s interface with silicon has been done with conducting atomic force microscopy, electron paramagnetic resonance spectroscopy, and x-ray diffraction. Layers of Cu₂O have been shown to Indeed have an interface with the silicon, and an electrical signal can be transmitted through the Cu₂O. Studies to show that the transition metal dopants are successfully incorporated into the Cu₂O during the electrochemical deposition are still under way.

**Phytoremediation of Pollutants**  
*Jin Young Park, Senior, Biochemistry, Chemistry  
Mentor: Sharon Doty, College of Forest Resources*

Phytoremediation is the remediation of pollutants from the environment by plants. These plants can be used to clean up the environment by removing various chemicals and toxins through uptake and metabolism. The ability for plants to be able to remediate is significant, because there are various toxins that are polluting the environment. These toxins can be a health hazard because some may be carcinogenic. My research focuses on the degradation of carcinogenic toxins such as carbon tetrachloride,
Determining the Estrous Cycle of a Captive Lowland Anoa (Bubalus depressicornis) Through Behavioral Observations and Endocrine Analysis
Barbara Parsons, Senior, Environmental Science, UW Tacoma
Mentor: Scottie Henderson, Interdisciplinary Arts & Sciences, UW Tacoma

The Lowland Anoa is a solitary bovid that inhabits dense swampy forests; it is endemic to the small Indonesian Island of Sulawesi. The Anoa is an endangered species with an estimated population from 3,000 to 5,000 and is declining due to habitat encroachment and poaching. Very little is known about the physiology and behavior of the endangered Lowland Anoa. This lack of knowledge makes conservation and breeding efforts difficult. Point Defiance Zoo and Aquarium in Tacoma, Washington has a breeding pair of Lowland Anoas that have been unsuccessful at breeding to date. This is due to the aggressive and solitary nature of the species and because it is not clear when the female is receptive to the male. The goal of this study is to determine the estrous cycle of the Anoa through behavioral observations and fecal analysis of progesterone metabolites. This method is a non-invasive approach that should yield a clear correlation between behavioral estrus and progesterin levels. Behavioral observations indicate the female’s estrous cycle to be between 16 and 22 days. This time period will be narrowed and the day of receptivity pinpointed once fecal analysis is compared. A better understanding of the reproductive physiology of this individual should facilitate successful breeding.

Development of an ATP Assay for Determining the Presence of Living Organisms in Ballast Water
Alison Paulson, Junior, Biochemistry, Biology (Ecology and Evolution)
Mentor: David J. Lawrence, Aquatic and Fishery Sciences

Ballast water is used for ship stability as vessels travel between seaports throughout the world. Ballast water, and any organisms contained in that water, is taken up in one port and released into another upon arrival to the ship’s destination. Accordingly, ballast water serves as a transport mechanism for aquatic species, including phytoplankton, zooplankton, and pathogenic strains of bacteria and viruses. Non-indigenous species may have dramatic ecological effects on recipient ecosystems if they survive a voyage. In an attempt to prevent the introduction of invasive species, treatments are being developed to significantly reduce the abundance of organisms in ballast water. Currently, I am developing an assay to determine the number of living organisms present in ballast water after it has been treated. Because all organisms use adenosine triphosphate (ATP) as a source of energy, the presence of ATP in a sample of water is indicative of the presence of a living organism. The quantity of ATP in a given sample can be determined using a firefly bioluminescence screen in which the amount of light emitted in a reaction between the firefly protein luciferin and ATP is proportional to the amount of ATP present. A baseline concentration of ATP expected for a given number of organisms will be established by measuring the ATP content of a variety of cultured phytoplankton and zooplankton species. With this information, the number of organisms remaining in a treated ballast water sample can be quantified based on the amount of ATP present. This will allow the efficacy of a given ballast water treatment to be determined. In the future, this assay could serve as a rapid and sensitive test to verify that a ship is in compliance with ballast water discharge standards.

Interpreting Serial Magnetic Resonance Imaging of Untreated Gliomas: Quantifying Diffuse Glioma Cell Distribution
Danielle Peacock, Senior, Biochemistry
Jeff Jacobs, Sophomore, Biology
Mentor: Kristin Swanson, Pathology, Applied Mathematics

Gliomas, one of the most common primary brain tumors, are extremely aggressive, and due to ineffective treatment are uniformly fatal. The diffuse invasion of glioma cells extends well beyond what is visible on current imaging modalities, and these tumors consistently reoccur after treatment with resection and therapy. The main goal of our research is to better understand the growth of these tumors through a mathematical model based on the proliferation (ρ) and migration (D) of glioma cells. We have collected a database of patients with two serial magnetic resonance imaging (MRI) prior to any treatment or surgery. By measuring the volume of the tumor and assuming a spherical shape we can calculate a mean tumor radius for
each distinct imaging date. We are able to use these two radii measurements to find the growth rate of the tumor. According to the mathematical model, the untreated glioma should grow at a linear rate. The measurements collected from our database of patients agree with the model prediction of linear growth. Using this calculated growth rate along with the imaging volumes, we are also able to define values for the two model parameters: migration rate (D) and net proliferation rate (p). These parameters are specific to each patient and aid in quantifying the individual tumor cell dynamics. It is our hopes that using this model to describe and quantify the diffuse glioma cell distribution, unobservable on MR imaging, will lead to more efficient treatment and improved diagnosis. The next step in our research is to determine what other biological factors play a part in the growth of gliomas and how these factors affect the model.

**Gaining a Full Visibility Spectrum of the Night Exhibit at Woodland Park Zoo**

*Smita Pednekar, Senior, Psychology*

*Mentor: Renee Ha, Psychology*

When walking into the Nocturnal House, also know as the “Night Exhibit” at the Woodland Park Zoo, visitors are often struck by how dark the exhibit is. It takes a few minutes for your eyes to adjust. Perhaps this is why visitors have often complained that the animals don’t seem to be present. The Nocturnal House first opened to the public in November of 1970, and since then a number of changes have been made to suit the needs of both the public who visit the site and the animals housed inside. There is a fine balance made by zookeepers, between designing a specific environment that is both enriching, natural and quiet enough for the particular animals, yet also open and bright enough for the visitors to view them. Through the implementation of an imposed reversed light-dark cycle, along with the use of incandescent spotlights to enable night viewing, Woodland Park Zoo was able to keep the animals active during the hours when visitors will be attempting to see them. A few years afterward, after strong indication that the enclosures were too dimly lighted to be able to see the animals easily, resulted in increasing the “nighttime” light levels. However, even with these changes, visitors still complain that the animals in the Nocturnal House are not readily visible. My study investigates the percentage of actual visibility of these twelve species to everyday visitors in the night exhibit. The sampling procedure used in this study will be a time based system of scan sampling. With nine exhibits, data will be taken from one point in front of each exhibit, at the point in which there is the widest visual field.

**Kinetics of DNA-Modified Gold Nanoparticle Aggregation**

*June Peng, Sophomore, Chemistry, Biochemistry*

*Mentor: Eric Klavins, Electrical Engineering*

Self-organizing systems contain components that are easily manipulated to induce a desired global state. These systems are of great interest because of their applications to a variety of disciplines, ranging from electronics to medicine. The system I am studying currently involves the aggregation of DNA-modified gold particles. Two non-complementary DNA oligos are attached to 15 nm gold particles to make two sets of modified gold colloids. A solution containing both types of colloids can be made to aggregate by the addition of a DNA `linker` that is complementary to both types of DNA `tails`. The chemistry of this system has been studied in great detail by other labs, who have demonstrated controlled assembly and disassembly of aggregates, as well as utilization of the system as a probe for various metal ions. However, the mathematics of the system has not been studied, and my project is to model the system by using molecular statistical calculations. The goal is to determine from initial conditions what the ending state will be in terms of the number and size of aggregates, as well as the path that will be taken to arrive at equilibrium. Experimental data collected will help cross-check the mathematical model as well as provide information about rates of the reaction and aggregate size distribution. Spectroscopy and microscopy will be used to gather relevant data. Other parameters that affect assembly rate and pattern will be studied as well, and include factors like concentration of the linking DNA, the number of DNA `tails` attached to each bead, and gold size. Ultimately, the goal is to learn how to exert exact control over this and other self-organizing systems by use of mathematical models that elucidate the connections between the local interactions and the global behavior of the systems.

**Synthesis and Characterization of Cobalt Nanodisks and Surfactant Exchange**

*Christopher Petz, Junior, Materials Science and Engineering*

*Mentor: Kannan M. Krishnan, Materials Science and Engineering*

There has been increasing demand in the development of nanoscale patterning for the use in electronic and spin-electronic devices. Magnetic nanoparticles with narrow size distribution have drawn much attention due to the possibility of their self-assembly into nano-patterns useful for applications. Preparation of nanoparticles with various size, shape and morphologies can be manipulated by varying the characteristics of the surfactants during synthesis. In this proposal, controlled synthesis and variable coating techniques for disk-shaped cobalt nanoparticles will be explored for the application in spintronics using their anisotropic magnetic properties and the large, conducting, contact surface. After synthesis, conducting polymer or monomer unit, such as polyaniline (PAN) or Pyrrole, respectively, will be
Pathways to Multinucleoside Analog Resistance in HIV

Crystal Pyrak, Junior, Biochemistry
Mary Gates Scholar
Mentor: Robert A. Smith, Pathology

Two distinct types of human immunodeficiency virus (HIV) are known to cause AIDS in humans: HIV-1 and HIV-2. Both viruses are susceptible to nucleoside analog inhibitors of reverse transcriptase (RT). Although these drugs provide substantial clinical benefits, they can often result in the emergence of drug resistant strains of virus that limit their effectiveness. In both HIV-1 and HIV-2, a Q151M mutation in RT confers resistance to AZT, d4T and ddI. This replacement requires two nucleotide substitutions at codon 151 (CAG→ATG) and therefore may arise through two possible intermediate mutations: CAG→AAG (Q151K) or CAG→CTG (Q151L). To examine the role of these intermediates in the development of Q151M-mediated multinucleoside resistance, we engineered the Q151K and Q151L substitutions into full-length molecular clones of HIV-1 and HIV-2. We then analyzed the viability and drug sensitivity of the resulting mutant viruses in culture. In HIV-2, both the Q151K and Q151L intermediates had no detectable replication capacity. However, the Q151L HIV-1 variant retained 10% of the wild-type infectivity and showed increased sensitivity to AZT and 3TC. These data suggest that the intermediate mutations are strongly deleterious to viral replication and that there are intrinsic architectural differences in the nucleotide-binding pockets of HIV-1 and HIV-2 RT. The Q151M resistance mutation may arise via two simultaneous nucleotide changes at codon 151. Alternatively, other mutations may provide a favorable genetic background for the intermediate pathways to Q151M. Additional studies are required to resolve these possibilities.

Analysis of Cerebral Cortex Overgrowth in a Mouse Model of Thanatophoric Dysplasia

Syeda Arshya Quadri, Senior, Neurobiology, Biochemistry
Mentor: Robert F. Hevner, Pathology

Thanatophoric dysplasia (TD) is a severe developmental disease characterized by cortical malformation and disorganized hippocampus. TD is caused by a gain of function mutation in the fibroblast growth factor receptor 3 (Fgfr3) gene that constitutively activates tyrosine kinase. In humans with TD, as well as in a mouse model of TD (EIIa:Fgfr3<sup>-/-K644E</sup> mice), the cerebral cortex is enlarged in both cortical area and thickness. The developing neocortex contains two types of progenitor cells for pyramidal projection neurons. The first type, radial glia, produce neurons and glia, and express Pax6, a homeodomain transcription factor. The second type, intermediate progenitor cells (IPCs), produce only neurons, and express Tbr2, a T-domain transcription factor. We hypothesize that there is an increase of Tbr2+ and Pax6+ cells in the neocortex that leads to increased cortical area and thickness. Employing immunostaining and cell counting techniques, we are studying the number of progenitor cells in the cortex of TD mice. Preliminary results suggest that cortical neurogenesis is prolonged in TD mutant cortex beyond the normal period.

High Powered Helicon: Thrust Stand and Prototype Space Propulsion System

Gregory R. Quetin, Senior, Aeronautics & Astronautics, Engineering
NASA Space Grant Scholar
Robert Winglee, Earth and Space Sciences

Wires wrapped in a helicon create the High Powered Helicon effect (HPH). By driving current in the wires at high frequencies it creates an electromagnetic field in a ‘screw’ down the axis. The HPH is hung in a vacuum chamber combined with electromagnets to contain the plasma along the axis. Argon gas is injected through a high voltage grid to create the seed plasma that is then accelerated down the axis by the HPH. The HPH has possible applications as a space thruster because of the ejection of matter and its efficient energy use. In the hopes of developing HPH into a space thruster, a second HPH2 has been made to help in finding the best parameters for operation. Following further characterization of HPH2, a third HPH will be fabricated and then taken to a NASA center for thrust characterization. A definitive thrust measurement is essential in proving the HPH as a viable space propulsion device. The short duration of thrust and the small amount of thrust created by the HPH make measuring its output very difficult as the thrust stand has to be very precise and sensitive for success. I have been working on the design and manufacture of a thrust stand capable of measuring the short duration thrust of the HPH. Design work consisted of literature research and CAD modeling in VectorWorks. Manufacturing has consisted of machining the structure of the thrust stand, researching and purchasing displacement sensors and researching methods for vibration dampening and leveling.
Narrow-Band Noise vs. Pure Tone Thresholds in listeners with high-frequency sensorineural hearing loss

Caitlin Rawn, Senior, Speech and Hearing Sciences
Mentor: Pamela Souza, Speech and Hearing Sciences

Amongst the different types of hearing losses that exist in audiology, functional hearing loss (FHL) continues to be an issue because of the effects it can have on obtaining accurate threshold measurements. While there is no organic explanation for the displayed hearing loss, there are many different motivations behind exhibiting a FHL. Without accurate thresholds, assessment and recommendations are negatively affected. Numerous techniques have been created for testing suspected FHL patients in order to obtain more accurate threshold results. However, little research has been done comparing stimulus type to resulting thresholds. In this study, right ear thresholds found using a pure tone stimulus were compared to those thresholds found using narrow-band noise. All subjects had a symmetrical, bilateral sensorineural hearing loss ranging from mild to moderately severe. Typical audiometric exams were given with the addition determining the right ear’s thresholds at each frequency when a narrow-band noise stimulus was presented. Results to date show that thresholds found using narrow-band noise are better than those found using pure tones, especially in the higher.

Mapping of zebrafish genes conferring resistance to hair cell death

Katherine Reinhart, Senior, Molecular, Cellular and Developmental Biology
Mentor: David W. Raible, Biological Structure
Mentor: Edwin W. Rubel, Otolaryngology, Head and Neck Surgery, Physiology and Biophysics

Aminoglycosides are a class of antibiotic with broad clinical applications. However, certain aminoglycosides such as neomycin have limited usefulness in human patients because they can cause hearing and balance disorders. This has been shown to be due to the death of mechanosensory hair cells in the inner ear. The underlying mechanism behind this death is the subject of our research. The zebrafish, Danio rerio, is a promising model organism for the study of ototoxicity, owing to high similarity between inner ear hair cells in all vertebrates and those found externally on the body of fish and other aquatic vertebrates. We have conducted a standard forward genetics screen and identified several mutant lines with resistance to aminoglycoside-induced ototoxicity, as indicated by hair cell survival after large doses of neomycin. The goal of this project is to identify the location of each of three mutations in the zebrafish genome. In order to do this, I am testing the phenotype of 5-day-old embryos from each mutant line and collecting those exhibiting resistance, as well as their wild-type siblings, for DNA extraction. I am using microsatellite markers with known genomic locations to evaluate chromosomal linkage with the mutant gene in question. Each microsatellite locus is assessed using a polymerase chain reaction (PCR) and agarose gel electrophoresis assay to determine whether specific alleles are coinherited with the mutation. After linking each mutation to a specific chromosome, we will further narrow it to a specific gene. This knowledge could be instrumental in elucidating the pathway through which aminoglycosides cause hair cell death, eventually leading to a clinical treatment to protect these cells from aminoglycoside insult.

The effects of thought suppression on subsequent alcohol use

Jessica Rieken, Senior, Psychology
Mentor: Alan Marlatt, Psychology
Mentor Seema Clifasefi, Psychology

Thought suppression (TS) is a cognitive process during which an individual attempts to force oneself to stop thinking about a certain unwanted thought. Ironically, TS has been found to lead to an increase in the unwanted thought itself, known as a rebound effect (Wegner, Schneider, Carter, & White, 1987). Despite these findings, many people still attempt to use this type of mental control strategy. Although we know that TS has cognitive repercussions, we do not know to what extent TS affects behavior. There is some evidence to suggest that TS has behavioral consequences. For example, one study showed that smokers who used TS to attempt to quit smoking were significantly more unsuccessful at quitting than those who did not use this strategy (Toll, Sobell, Wagner, & Sobell, 2001). Another study showed that dieters who used TS were more likely to exhibit binging behaviors than those not suppressing food related thoughts (Herman and Mack, 1975). Taken together, these studies suggest that TS does play a role in behavioral outcomes. The focus of our research was to investigate whether suppressing thoughts about alcohol would lead, not only to a traditional cognitive rebound effect (thinking about alcohol more), but also to a behavioral rebound effect (drinking more). Problem and social drinkers were instructed to either “suppress thoughts about alcohol” or “think anything” for a period of 5-minutes. Shortly afterwards, they were given a lexical-decision task measuring response time in identifying alcohol-related words vs. non-words. Finally, they took part in an ostensible alcohol taste-rating task where the dependent measure was amount of alcohol consumed. Our results stand to inform treatment providers about the pros and cons of mental control strategies related to behavioral consequences, and also have implications for individuals who use TS as a means of keeping unwanted behaviors under control.
Establishment of Sustainable Gardens for Natural Product Science: Mint Analysis
Jessica Ritland, Junior, Liberal Arts, The Evergreen State College
Erin Dowling, Senior, Liberal Arts, The Evergreen State College
Forest N. Thompson-Edgel, Senior, Liberal Arts, The Evergreen State College
Mentor: Peter J. Pessiki, Evening and Weekend Studies, The Evergreen State College

Over the past five years our group has set out to establish an organic garden capable of supplying a variety of plants suited for natural product chemistry. The goal is to establish a sustainable source of starting material for course related lab work or advanced independent student research projects. Three crops have been cultivated successfully, hops, mints and alliums (mostly garlic). This chemical garden covers an area of 2500 square feet and is located on the Organic Farm, which is part of our campus. Our poster will include a general introduction to the garden and an analysis of the three types of mints. The mints include spearmint, peppermint and a chocolate mint. The volatile oils were isolated by steam distillation using a Dean-Stark apparatus and analyzed by GC-MS. These results will be discussed as well as general strategies for the establishment of a sustainable chemical garden.

Exhaled Nitric Oxide as an Effective, Non-Invasive Marker of Respiratory Health in Elementary School Children
Jana N. Rone, Junior, Environmental Health
Mentor: Sally Liu, Department of Environmental and Occupational Health Sciences

Each weekday, 24 million American children commute to and from school by bus, where they may be exposed to elevated levels of diesel exhaust. Diesel exhaust can affect children’s respiratory health, resulting in inflammation of the lung’s airways and worsening of asthma symptoms. However, there have been no studies that relate diesel exhaust levels on school buses to the health impacts in student passengers. This five-year longitudinal study quantifies the levels of on-bus diesel exhaust exposure and respiratory health for 200 healthy and 200 asthmatic children over a three-year monitoring period. Three exposure groups of first to fifth graders were recruited from the Seattle and Tahoma school districts: 50 children ride cars, 150 children ride old buses that later become retrofitted, and 200 children ride buses that undergo several retrofitting processes. In the clinical setting, measurements of exhaled nitric oxide (eNO) are suggested as a sensitive biomarker measurement of lung inflammation (Kharitonov and Barnes 2000; Slutsky et al 1999). Therefore, eNO may be an effective, noninvasive tool for epidemiologic studies of air pollution as a potentially important indicator of lung inflammation and asthma aggravation in subjects with asthma. Utilizing this tool, monthly measurements of pulmonary inflammation through eNO are obtained on all children during the school year. The non-invasive measurement of eNO in all study participants is conducted through offline collection of exhaled breaths into a Mylar balloon at the elementary school. Following collection, NO content (ppb) within balloon samples is measured using a nitric oxide analyzer. An evaluation of the best collection strategy and the analysis timeline in regards to eNO measurements, including eNO measurements from a subset of the study subjects will be completed. Comparisons of pulmonary health conditions across various modes of buses and commutes, and thus various exposure levels to diesel exhaust, will also be established.

The Chicano Movement in the State of Washington: Political Activism in the Puget Sound and Yakima Valley Regions from the late 1960’s to the early 1980’s
Oscar Rosales, Senior, American Ethnic Studies, History McNair Scholar
Mentor: Jim Gregory, History

This research is being done in collaboration with a larger project on Seattle Civil Rights and Labor History here at the University of Washington, which is being conducted through the History Department, and the Harry Bridges Center for Labor Studies, to name a few. The project focuses on documenting the history of Mexican American Activism in the Puget Sound and Yakima Valley areas in the state of Washington as well as its unique development as a social movement that has left an indelible mark in the activist history of the Pacific Northwest. In approaching this project, the research mainly consisted of two main methods of collection of information. One was the use of original documents organizational notes, newsletters, articles from the Daily and other such printed material that has original information about students and community activism. The other came about through the use of oral history interviews. Through this project I wish to further document the conditions present in the state of Washington during this period in the late 60’s and early 70’s and how the movement had similarities as well as differences as it relates to activity in the southwest. Additionally, the project intends to give an overview of this period to examine the effect the movement had both in institutions of higher education as well as in the Mexican American community in the state of Washington.

Sloan Digital Sky Survey Supernova Search
Amy Rose, Freshman, Astronomy
Amber Almy, Freshman, Astronomy
Mentor: Andrew Becker, Astronomy

The Sloan Digital Sky Survey (SDSS) is an ongoing, large-angle survey that has been described as “the most...
in a closed chamber. Current work is analyzing P/O ratios muscle oxygen consumption via rate of oxygen depletion muscle PCr concentration while Polarography measures of mitochondrial ATP production by measuring declining as the number of atoms of ATP produced by the respiratory isolated mammalian muscle P/O ratios, formally defined spectroscopy and Polarography measurements to calculate have developed a novel technique combining 31P NMR mentioned here. To study mitochondrial efficiency, we preventing various diseases including and beyond those medical devices for use in diagnosing, predicting, and underlying concepts needed for future development of various tissues and organs throughout the body. Monitoring and quantifying mitochondrial function could provide the underlying concepts needed for future development of medical devices for use in diagnosing, predicting, and preventing various diseases including and beyond those mentioned here. To study mitochondrial efficiency, we have developed a novel technique combining 31P NMR spectroscopy and Polarography measurements to calculate isolated mammalian muscle P/O ratios, formally defined as the number of atoms of ATP produced by the respiratory chain per oxygen atom utilized. NMR determines the rate of mitochondrial ATP production by measuring declining muscle PCr concentration while Polarography measures muscle oxygen consumption via rate of oxygen depletion in a closed chamber. Current work is analyzing P/O ratios in two different types of mammalian hind leg muscle, EDL (extensor digitorum longus) and soleus. Results have shown significantly similar P/O ratios between the two muscle types, demonstrating the viability of this technique and paving the way for future work using the same experimental approach to analyze effects of age and disease on mitochondrial efficiency. Decreased P/O ratios are hypothesized in diseased muscle with mitochondrial electron transport chain complex deficiencies, and decreased mitochondrial efficiency is expected in aged muscle due to both the free radical theory of reactive oxygen species (ROS) exposure and the mitochondrial theory of aging due to random somatic cell mtDNA alterations.

The Role of the Hippocampus in Contextual Memory Retrieval
Melanie Sabado, Senior, Biology, Psychology
Mentor: Sheri Mizumori, Psychology, Neuroscience and Behavior
Mentor: David Smith, Psychology, Neuroscience and Behavior

My lab has initial evidence to support our hypothesis that rats learn to discriminate contexts, which is shown by highly differentiated neuronal response patterns in a brain region called the hippocampus. We continue to investigate neuronal responses to contextual information processing by the hippocampus, especially in regard to its impact on various motor behaviors and other parts of the brain, such as the thalamus and retrosplenial cortex. In this experiment, we evaluated the effects of temporarily inactivating the hippocampus on contextual processing, with a drug called muscimol. One group of rats was given muscimol infusion early to test the affects of muscimol on learning. Another group of rats was given muscimol infusion after learning to test the affects of muscimol on performance of the well-learned behavior. Each of these groups was compared to a control group that was given saline infusion at the same time. If the contextual retrieval hypothesis is correct, we expect that muscimol will block the rats’ ability to distinguish the contexts and remember where the reward is located. We recorded hippocampal neuronal activity while rats learned to identify two different contexts with different reward locations. They perform their responses on a plus shaped maze within an enclosed circular area, with objects around the perimeter serving as external visual cues. The rats were forced to rely on internal context information to remember where chocolate milk rewards were located. For analysis, neuronal activity was recorded along with digitized video footage. Spatial and reward related firing patterns of the neurons are examined by comparing the frequency of firing to the position of the rat and the time when the reward was obtained.

Diversity of Nitrogen Reducing Bacteria in the Black
SOCS-3 Involvement in Kaposi’s Sarcoma Herpesvirus Infection
Melaine K. Sarreal, Senior, Microbiology
Mary Gates Scholar
Mentor: Michael Lagunoff, Microbiology

Kaposi’s sarcoma (KS) was first classified in Mediterranean men in 1872. Since this discovery, four forms of KS have been identified: Classic KS, Endemic KS, Iatrogenic KS, and AIDS-associated KS, which is the fiercest form. The causative agent of KS is Kaposi’s sarcoma herpesvirus (KSHV), a member of the Gamma2-herpesviridae. The KS tumor is made up predominantly of KSHV infected endothelial cells. KSHV infection of endothelial cells in culture activates the Signal Transduction and Activator of Transcription-3 (STAT-3) pathway for signaling. Activation of STAT-3 causes the protein to enter the nucleus to activate transcription of the gene, Suppressor of Cytokine Signaling (SOCS-3). SOCS-3 participates in a negative feedback loop to shut off the Jak/STAT pathway. In studies performed in the Lagunoff lab, it has been shown that STAT-3 is activated by KSHV infection. The goal of my research is to determine if SOCS-3 is up-regulated with KSHV infection and if so, if its activation is important for KSHV infection. Using Real-Time PCR, I have determined that SOCS-3 is up-regulated with KSHV infection. I am currently working on Western Blotting to determine if the SOCS-3 protein is actually expressed at different time points. Current studies have shown that STAT-3 is down-regulated between 2 – 20 hours, which is expected because the role of SOCS-3 is to inhibit the Jak/STAT pathway. An interesting find is that at about 24 hours STAT-3 expression is again up-regulated. Through further research, we would like to discover how KSHV infection overcomes the inhibition of SOCS-3 on the Jak/STAT pathway. In the future I will also infect cells with RNAi probes that degrade SOCS-3 mRNA to examine the infection and document any differences in infection compared to cells infected with normal virus.

The Search for Gravitationally Lensed Quasars using the Space Telescope Imaging Spectrograph (STIS) Aboard the Hubble Space Telescope (HST).
Shannon Schmoll, Junior, Physics, Astronomy
Mentor: Scott Anderson, Astronomy

Within the Universe there are many objects that are difficult or impossible to detect using light gathering telescopes and so other methods must be employed. The search for gravitational lenses is one method that is very useful for finding high-mass objects that may not otherwise be detected such as dark matter. According to Einstein’s general theory of relativity, these objects create a gravitational pull large enough that it will bend the light of a distant luminous object as it travels towards Earth. This project uses images taken aboard the Hubble Space Telescope (HST) with the space Space Telescope Imaging Spectrograph (STIS) to find signs of bent light from quasars. These objects are used because they are extremely luminous and are some of the farthest objects we have detected resulting in a higher probability of being lensed. However, despite their usefulness, only 0.01% of all quasars are lensed. Images were looked at to find signs of this phenomena which includes multiple images of the same object, or something known as a halo effect, where there is a ring of light around the quasar image. All the known images of specific quasars from the HST archive have been analyzed which resulted in one strong candidate. A ground-based telescope will be used in image the quasar to confirm its candidacy. If multiple objects appear in the new image, spectra will be taken to determine if the two objects are really light from the same object. This will hopefully be coupled in the future with a search in the wide-field images in which quasars serendipitously are imaged with HST. This part of the study will be based on the influx of confirmed quasars coming out the Sloan Digital Sky Survey.

Explosives Detection Using an Ion Counter
Julia Schwarz, Sophomore, Physics
Mentor: Antao Chen, Applied Physics
Would the tendency for explosive materials to carry electronegative nitro or peroxide groups decrease the negative ion count in the air surrounding them? In other words, is it possible to detect hidden explosive chemicals using an ion counter? My research investigates this very question. I am studying the effect of explosives (using chemical stimulants) on the negative ions in the air. This study is important because it is an unexplored topic and would provide insight into a non-hazardous method for broad-area surveillance of explosives. To accomplish this, my mentor and I have designed an experiment which compares the normal negative ion count in the atmosphere (around 200 negative ions per cubic centimeter) to the ion count in the atmosphere around an explosive chemical stimulant. From this data, we measure the sensitivity and accuracy of potential explosives detection by measuring the ion count in the atmosphere. Preliminary data indicates that the chemicals we are using do not create a noticeable change in the ion count, however we will continue to test different chemicals with more accurate measurement techniques to get more conclusive results.

Prostate-Specific Differentiation of the Pluripotent Stem Cell NCCIT
Christina Shadle, Senior, Cellular, Molecular, Developmental Biology,
Gates Millennium Scholar
Mentor: Laura Pascal, Urology
Mentor: Alvin Liu, Urology

Prostate cancer is the second leading cause of cancer death in men in the US. Recent studies have shown that cancer and stem cells have in common the capacity for self-renewal. Thus, the study of normal prostate development is important in understanding carcinogenesis. Adult stem cells are present within the prostate, and these stem cells are induced to differentiate or mature into functional epithelial cells by stromal mesenchyme cells. The pluripotent, nonseminomatous germ cell-derived embryocarcinomal cell line, NCCIT, was used as a stem cell substitute to characterize prostate epithelial differentiation. Diffusible factors (in stromal conditioned media) as well as direct contact with prostate stromal cells induce prostate-specific differentiation of NCCIT cells. Undifferentiated stem cells (such as NCCIT) have a high expression of alkaline phosphatase, and this is lost in the differentiated progeny of NCCIT. At the same time, these progeny cells show a different morphology. When assayed by gene array analysis, in which expression of many genes is scored, these cells showed gene expression signature of prostate luminal epithelial cells. In the presence of stromal cells, prostate secretory products like PSA were detected. These results indicate that prostate-specific differentiation can be induced by diffusible factors and cell-to-cell contact. This model can be used to determine the molecular mechanism of prostate development and the defects in cancer.

Dynamics of the Interaction Between Fibronectin and Group B Streptococci
Jared Shannon, Senior, Bioengineering
Mentor: Dave Castner, Bioengineering, Chemical Engineering

Group B Streptococci (GBS) are a leading cause of meningitis, sepsis and pneumonia in newborns. GBS adherence to the extracellular matrix protein Fibronectin (Fn) has been indicated as the initial step in GBS colonization and infection. The goal of my project is to quantitatively measure the binding strength of the interaction between GBS and Fn. My research focuses on three different GBS-Fn binding interactions: GBS to adsorbed Fn (the form to which GBS actually binds), GBS to soluble Fn (which has been shown to not bind GBS), and adsorbed Fn to a mutant strain of GBS which has been shown to not bind Fn. Measurements will be made via atomic force microscopy, where Fn will be attached to a tip and allowed to bind with GBS before the tip is pulled away and the bond broken. This process will be applied thousands of times to each of the three binding interactions followed by statistical analysis to yield the binding strength of each of the interactions. I hypothesize that my results will correlate well with what is already known about the three interactions. That is, I expect the binding strengths of both the GBS-soluble Fn and mutant GBS-adsorbed Fn interactions to be much lower than that of GBS to adsorbed Fn.

Differential Family Interaction Patterns: An Observational Study of Children With and Without Autism
Emily Silverstein, Senior, Psychology
Mary Buslon, Sophomore, Pre-Nursing
Mentor: Christopher Jones, Psychology

Autism is a neurobehavioral disorder currently affecting 1 in 166 Americans. Despite the dramatic increase in prevalence rates over recent years, research on the social-communication patterns of these children and their families remains scarce. Past studies that have examined the differences in communication patterns between families of children with autism and families of typically developing children suggest that autism families are distinctly less responsive in their interactions. The purpose of the present study is to provide a comparative analysis of differential interaction styles that occur in families of children with and without autism. To date this is the first observational study in which interactions between families and children with autism were examined in an unstructured activity within the home environment. This research environment provided a context in which families were able to engage in naturally occurring interactions due to the routine nature of the activity (i.e., dinner) and the absence of researchers during tapings. We predicted fewer initiations from children with autism and shorter overall interaction lengths for autism families. Preliminary data analyses from this
study also support previous research that children with autism possess a deficit in reciprocal social interactions. We are interested in how family members compensate for this deficit, specifically by the type (i.e. question, directive, etc.) and frequency of communication observed.

**Rudolf: An Autonomous Ground Vehicle**  
*Alicia Skilton, Freshman, Mechanical Engineering  
Mentor: Andy Crick, Electrical Engineering*

The Defense Advanced Research Projects Agency created the Grand Challenge in 2003 as a competition to promote the research and development of autonomous ground vehicles for the use on the battlefield. When the first grand challenge failed to produce a successful vehicle, the Autonomous Robotics and Control Systems (ARCS) lab at the UW decided to design and build a vehicle for the 2005 competition. Because we wanted people to be able to drive Rudolf like an ordinary car, we attempted to make the modifications inconspicuous. Our autonomous vehicle uses stereo vision (the use of two cameras to triangulate the distance to an object) and global positioning satellites (GPS) to find the best route on a path. It used computer controlled hydraulic systems to follow that path. My contribution to the project mainly involved testing of the vehicle and the fabrication of parts for improvements to the vehicle. While testing, my team mates and I discovered that the computer program would often need to start turns earlier because the relatively large turning radius and the significant response times were not adequately accounted for. I also worked on the fabrication of an installation of housing for a user interface for the interior of the vehicle and a camera mounting that could hold the newer cameras in a variety of configurations. From working on this project and from other teams in the 2005 Grand Challenge it is apparent that the knowledge and resources now exist to make successful autonomous ground vehicles both for military and civilian use.

**Changes in Marine Molluscan Fauna from the Olympic Peninsula at the Eocene-Oligocene Boundary**  
*Tara Smiley, Senior, Earth and Space Sciences, Biology  
Mary Gates Scholar  
Mentor: Elizabeth A. Nesbitt, Curator, Burke Museum, Paleontology Division*

The drastic global cooling event that took place around the Eocene-Oligocene era boundary, 33.7 million years ago, and the subsequent biological changes in species distribution and abundance are recorded in the fossil record. Turnover in the shallow-marine molluscan fauna of the Pacific Northwest across this boundary reflects the global shift from greenhouse to icehouse conditions. At the same time there was a significant regional change in tectonic regime that resulted in a narrow continental shelf and steep forearc slope due to the first uplift of the Cascadian volcanic arc. My research focuses on shallow-marine molluscan fauna from the Quimper Formation that spans the Eocene-Oligocene transition. The aims of this research are to reconstruct the depositional environment and paleoecology of this region and to identify the change in fauna that marks the era boundary. At present, identification of index fossils has restricted the age of deposition to the two adjacent molluscan biostratigraphic zones, the *Echinophoria dalli* and *Echinophoria rex* Zones. A stratigraphic column of exposed outcrop along the western edge of the Quimper Peninsula will provide relative ages and a temporal sequence of the identified fossils and thus a timeline of deposition. The recorded changes in the dominant faunal assemblages are plotted against the column. The location of the Eocene-Oligocene boundary in the Quimper Formation should be recognized by a shift in species abundances from warm to cool water species. Studying the response of the molluscan fauna to changes in climate and local geology across the Eocene-Oligocene boundary in the Quimper Formation will contribute to our understanding of the conditions during this time and the impact of change on the biology of the Olympic Peninsula and the greater Pacific Northwest margin.

**Cardiovascular risk factors and severity of Coronary Arterial Disease among Emergency Cardiology patients**  
*Jason Soh, Senior, Microbiology  
Mentor: Michelle Williams, Epidemiology  
Mentor: Daniel Enquobahrie, Epidemiology*

The association between potential risk factors and severity of coronary arterial disease among a sample of emergency cardiology patients seen at a secondary prevention clinic was investigated. Participants were randomly selected among patients who visited the Emergency Cardiology Center in Tbilisi, Republic of Georgia from January through December of 2004. A total of 99 patients were enrolled in the study. Medical records were used to collect information on risk factors and disease severity. Analysis was conducted using SPSS version 13.1 software. A majority of study participants (78.8%) had multi-vessel disease. Patients with multi-vessel disease had higher congestive heart failure and acute myocardial infarction rates when compared to patients with single-vessel disease (32.0% vs. 23.8% and 20.5% vs. 14.3% respectively). In this study population, higher rates of obesity (body mass index ≥30kg/m²), type II diabetes mellitus, dyslipidemia and metabolic syndrome were observed among patients with multi-vessel disease as compared to patients with single-vessel disease, although the differences were not statistically significant. Current smoking was prevalent among patients with single-vessel disease, while patients with multi-vessel disease had a higher rate of past smoking. The discrepancy between smoking and the severity of illness may be a reflection of prevention efforts. Patients with multi-vessel disease had higher concentrations of total cholesterol, low density lipoprotein, triglycerides and
lower concentrations of high density lipoprotein. Though, only the association between high density lipoproteins and severity of arterial disease reached statistical significance. 

A trend in associations between increased risk of having severe arterial disease and traditional cardiovascular risk factors; obesity, type II diabetes, dyslipidemia and metabolic syndrome were demonstrated. These results are similar to reports of studies conducted among other populations. The relative importance of each risk factor in this population should be further investigated in larger studies.

### Understanding the Structure of the Milky Way

**Harkirat Sohi, Sophomore, Biology**  
**James Bushong, Freshman, Arts and Sciences Pre-Major**  
**Mentor: Daryl Haggard, Astronomy**  
**Mentor: Zeljko Ivezic, Astronomy**

Was the formation of the Milky Way Galaxy a smooth process that led to a uniform distribution of stars, or an episodic process during which the Galaxy swallowed smaller groups of stars? Astronomers are still uncertain, but new data from the Sloan Digital Sky Survey (SDSS) reveals that the Milky Way has lots of irregular substructure, i.e., regions of the Galaxy where the distribution of stars is not smooth at all, as well as clusters of stars that are moving differently than the rest of the stars in the Galaxy. It appears that our Galaxy is, in fact, constantly eating smaller galaxies that stray too close, a process that continues even today. We used SuperMongo, a powerful plotting and analysis package, to select subsets of the SDSS data and to compute the distances to and velocities for each of about 230,000 Milky Way stars in the SDSS spectroscopic database. We then used SuperMongo to generate plots of distance vs. velocity in order to detect irregular structures, represented by clumps or large variations in these plots.

### Traditional Chinese Medicine in America: How to Adapt American Society

**Liyun Song, Junior, Anthropology**  
**Mentor: Stevan Harrell, Anthropology**

With Chinese immigration in the United States from 19th Century, as one aspect of Chinese culture, Traditional Chinese Medicine was also brought here by Chinese immigrants. So my project attempts to trace the development of Traditional Chinese Medicine in America during this more than one century from some historical literatures and tell some Chinese doctors’ life stories. Accordingly, uncover how Traditional Chinese Medicine adapted the mainstream culture in American society, as a marginal culture. At the same time, use some ethnographic methods to interview some local Chinese Medicine doctors in Seattle to illustrate how the Chinese medicine adapt American culture and what its role in American society. I think my project can to be a contribution for the study of Chinese immigration in America, at the same time our Chinese culture will be understand by more people in the world.

### Protein-Protein Interactions That Control Yeast Vacuole Assembly

**Debra Sprague, Senior, Biology**  
**Howard Hughes Scholar**  
**Mentor: Rachael Plemel, Biochemistry**  
**Mentor: Alex Merz, Biochemistry**

Yeast vacuoles, like mammalian lysosomes, are the final organelle in the endocytic pathway, whose culminating event is fusion. A six-protein complex called HOPS (homotypic fusion and vacuole protein sorting) is an integral member of the fusion machinery. Using the genetics-based yeast two-hybrid method, we are investigating three HOPS-related questions: 1) Which domains (determined through evolutionarily conserved homology among model organisms) of the six HOPS proteins interact? 2) What is the nature of HOPS interactions with other proteins known to be involved in fusion? 3) What is the nature of HOPS interactions with other as-yet-unknown proteins? We have prepared 144 bait and prey constructs, which are in the process of being tested for interactions among each other and, in the case of a subset of six beta-propeller domain constructs, against the entire collection of 6000+ yeast genes. Preliminary results include both interactions expected from previous work and novel interactions. When the two-hybrid tests are completed, we will employ biochemical assays to confirm all discovered positive interactions. Ultimately, confirmed protein-protein interactions will be used to further define a physical model of the HOPS complex and its molecular partners in the endocytic pathway.

### Capping versus connecting arterial sheaths to a heparinized pressure flush device in patients undergoing percutaneous coronary intervention (PCI).

**Susanne Steffes, Senior, Nursing, UW Bothell**  
**Mentor: Heidi Petry, Nursing, UW Bothell**

**Background:** Percutaneous angioplasty and stenting has become an increasingly common treatment in patients with coronary artery disease with over 500,000 performed in 2002. On cardiac care units, routine nursing care of this patient population requires nurses to monitor and assess the arterial and venous puncture sites for complications. The major complications are bleeding, hematoma, infection and clot formation. Anecdotal information obtained from several hospitals through an inquiry indicates varying nursing practices related to the care of arterial sheaths. In the past, arterial sheaths were often left in place for greater than 24 hours, thus, a heparinized pressure flush devise is necessary. Today sheaths are often removed within 4-8 hours post PCI. Therefore, questioning the necessity of
current nursing practice which requires additional nursing time and costs of equipment. **Purpose:** To determine the rate of complications and patency in post PCI patients with arterial sheaths connected to a heparinized pressure flush device compared to capping the arterial lines. **Methods:** Quality improvement study to provide baseline data over a three-month period evaluating complications associated with clot formation and bleeding associated with our current practice of connecting arterial sheaths to a heparinized pressure flush device. **Outcomes:** Based on the results, it may be possible to cap arterial sheaths and evaluate the safety of this nursing practice by another quality improvement study, similar to the first study measuring the same outcomes over a three-month period.

**Comparisons between Self-Harming and Typical Adolescents during a Parent-Child Discussion Task**  
Adrienne L. Stevens, Graduated: Bachelor of Science  
August 2005, Psychology  
Mary Gates Scholar  
Mentor: Theodore P. Beauchaine, Psychology  
Mentor: Sheila E. Crowell, Psychology

Adolescents who intentionally harm themselves are an enigmatic psychiatric population. Though many agree that self-harm behavior is indicative of severe psychological distress, little is understood about the emotional, psychological, and interpersonal factors that contribute to intentional self-injury in adolescence. Some believe that self-harm serves to modulate intense negative affect in emotionally dysregulated adolescents. It has been suggested that emotional dysregulation and impaired coping may be modeled and/or reinforced within the adolescent’s family system, contributing to the development of self-injurious behavior. The present study was designed to explore this theory. To test the hypothesis that self-harming adolescents and their parents would exhibit greater conflict during an emotionally evocative interaction, adolescents and their parents were asked to engage in a discussion task. The task consisted of a ten-minute videotaped discussion centered on an area of everyday conflict (e.g. dating, chores, phone privileges). Videotaped data were subsequently coded using the System for Coding Interactions and Family Functioning (SCIFF). Data analyses indicated that parent-child interactions in the self-harming group were characterized by conflict. Self-harming dyads displayed less positive affect, more negative affect, and lower cohesiveness than control dyads. However, further analyses revealed that it was primarily the adolescent’s behavior that contributed to group differences in family functioning. Specifically, self-harming adolescents displayed more opposition/defiance and less positive affect than typical adolescents. Though the results seem to suggest that the adolescents’ behavior was responsible for adverse interactions, further investigation and analysis of parental and adolescent contributions to discordant family functioning is warranted.

**Cholesterol Solubility in Giant Unilamellar Vesicles (GUV’s) Containing the Ternary Lipid Mixture DPPC: DOPC: Cholesterol**  
Mark Stevens, Sophomore, Physics  
Mentor: Sarah L. Keller, Chemistry

In the laboratory, giant unilamellar vesicles (GUV’s) offer a similar system to a basic cell membrane for studying miscibility of cholesterol and phospholipids in a lipid bilayer. The “raft hypothesis” of Simons and Van Meer postulates that separation of lipids into liquid ordered and liquid disordered regions helps to facilitate many important cell processes. Our laboratory produces vesicles through various methods, but this study will focus on electroformation. We believe that the electroformation process creates vesicles with the same lipid composition originally put into the cell, up to an ultimate cholesterol solubility limit. It is important for us to test our assumption and also to determine the solubility limit in order to understand and properly present the results of other GUV studies from our laboratory. Studies of lipid compositions of vesicles containing DPPC:DOPC:Chol will be conducted by cholesterol and phosphorus assays on extruded GUVs, specifically the Invitrogen Amplex Red Cholesterol Assay Kit and a previously developed Phosphorus Assay.

**7x4=24, A Video-geographical Humument of Seattle, WA**  
Kent Straub-Jones, Senior, Landscape Architecture  
Mentor: Ellen Garvens, School of Art: Photography

In this video project the city of Seattle serves as the text for reinterpretation. The video project was influenced by the works of John Cage and his resampling of text. Tom Phillips and his palimpsestuous reinterpretation of found objects. In this case certain parts of the city are shown while others are omitted. Also referenced in the film is the work of Ron Fricke and his beauty of the ‘everyday’ or ‘common’ landscape. The video was created over a three week period. It began by taking a city map of Seattle which had a predetermined 7x4 grid of 28 squares. Three of the squares were omitted primarily due to their inaccessibility, with the U-District being omitted because of its familiarity. The remaining 24 squares were broken up into a 01:00-24:00 time system in the 24hr clock. Each hour of ‘real time’ it then cut into 30 seconds of time on the film. Filming required driving around the entire city of Seattle and rushing from one part to another to get the footage from the correct time segment. If math could resample a city and turn it into a video this is one possible outcome.

**Development of a Novel and Specific Diagnostic Test**
for Syphilis
Amanda Suchanek, Senior, Biology
Mentor: Wesley Van Voorhis, Pathobiology
Mentor: Caroline E. Cameron, Medicine

Syphilis is a sexually transmitted disease caused by the spirochete bacterium Treponema pallidum. The disease is diagnosed primarily by serodiagnosis, but current tests lack sensitivity and specificity to T. pallidum. My research focuses on a protein thought to reside in the outer membrane of the bacterium, identified as Tp0453. Antibodies to Tp0453 are detected in early syphilis and high titers of antibodies to Tp0453 are found in all stages of syphilis. Thus, Tp0453 shows promise as a sensitive serodiagnostic reagent for syphilis. However, it has been difficult to produce sufficient quantities of full-length Tp0453 for this purpose. For my project, I have been subdividing the Tp0453 protein by recombinant expression of fragments and testing the fragments for antibody reactivity. My goal is to identify the immunodominant epitope(s) of Tp0453. The hypothesis is that a small immunodominant fragment can be more easily manufactured to develop an effective serodiagnostic test for syphilis.

Mutations in Plasmodium vivax dihydropteroate synthase gene, drug resistance, and mutations in the dihydrofolate reductase gene
Stephanie Suzuki, Senior, Microbiology, Biology
Mentor: Carol Sibley: Genome Sciences

Plasmodium vivax is a single-celled parasite that causes one form of malaria. Although vivax is the most widespread type of malaria, research has concentrated on a related parasite, Plasmodium falciparum. The drug combination sulfadoxine-pyrimethamine (S/P), while effective against many strains of Plasmodium falciparum, is not used for treatment of vivax malaria because it was believed that P. vivax was innately resistant. S/P targets two components of the folate pathway, the dihydrofolate reductase (dhfr) and dihydropteroate synthase (dhps) genes. In one recent study, patients with P. vivax were identified who had received S/P treatments either due to mixed infections with P. falciparum or misdiagnoses. Mutations in dhfr of P. vivax were found to correlate with resistance to the drug combination. I am studying mutations in the dhps gene to determine whether a correlation also exists between changes in the gene and treatment results. Also, I will look for correlations between mutations in the dhps gene and mutations in dhfr. Samples used to determine this relationship come from a separate study, where dhfr sequence was determined and tested in a yeast assay for resistance to pyrimethamine. To examine these correlations, two fragments in the dhps gene were amplified using the polymerase chain reaction (PCR) and the DNA sequence determined. Each region contained amino acids homologous to regions that carried mutations in the P. falciparum dhps gene. I will identify single nucleotide polymorphisms in dhps genes derived from patient isolates that did or did not respond to S/P treatment. This will allow us to examine the correlation between drug resistance and dhps mutations. Other genomic DNA samples for which the dhfr sequence and in vitro resistance to pyrimethamine are known will also be examined. These samples will be used to determine whether mutations in dhps occur simultaneously with mutations in the dhfr gene.

Lysophosphatidic acid and sphingosine-1-phosphate as lipid mediators of microglia
Sarah Swarts, Senior, Neurobiology, Biochemistry
Mentor: Thomas Moeller, Neurology

Microglia are the resident immune cells of the Central Nervous System. Under normal conditions, they remain in a resting state, but when activated, they proliferate, migrate, and produce cytokines, as well as upregulate specific surface proteins, including cell adhesion molecules and Major histocompatibility complex (MHC) class I and II proteins. Neuronal cell death can trigger microglia to transform into phagocytic cells and ingest cellular debris. Microglia have long been known to play an active role in neurological diseases such as alzheimer’s disease, HIV-associated dementia, and multiple sclerosis as well as acute ailments such as trauma, seizure, or stroke. As such, the knowledge of what factors lead to microglial activation is of utmost importance. My research focuses on whether two lysophospholipids, lysophosphatidic acid (LPA) and sphingosine-1-phosphate (S1P), lead to microglia activation. Microglia express both LPA and S1P receptors. LPA and S1P are serum factors, found in the blood in physiologically relevant concentrations. When the blood brain barrier (BBB) is compromised (during acute trauma or chronic diseases), these serum factors may seep into the brain and cause microglia activation. My lab has shown that both LPA and S1P elicit Ca2+ signals in cultured microglial cells. In order to classify microglial response to S1P and LPA, I will be using WST-1 to test for changes in metabolic activity, the nitric oxide assay to assess nitric oxide production, the LDH assay to measure cell death, and ELISA to test for changes in cytokine production.

An UrbanSim Service Manager
Jason Tan, Senior, Computer Engineering
Mentor: Alan Borning, Computer Science & Engineering

The UrbanSim project explores software-based methods of forecasting regional growth, development, land use, and transit over 20-30 years using models that simulate different actors and processes in the urban environment. At the core of UrbanSim services are simulations that run on large input datasets representing a region, and outputting datasets recalculated via stastical equations that model an agent/process. In the past, other services (i.e. UBuildIt indicators, OpenEV maps) have run simulations through code, which makes it difficult for technical modelers and
One goal in the geosciences is gaining a better understanding of Earth’s deep structure and composition. A principal tool for such studies is seismology. Interpretation of seismic elastic wave velocity models in terms of composition requires laboratory determinations of velocities in rocks and minerals. Several common minerals remain inadequately calibrated. In this project I will seek to improve our understanding of the properties of one such important rock-forming mineral. Feldspar minerals are estimated to constitute 60% of Earth’s crust and hence are found in almost all rocks. Feldspar velocities are anisotropic, they vary greatly with direction of propagation. Twenty-one elastic constants are required to define their elasticity. Prior to recent work at the University of Washington, the only study of feldspar elasticity was undertaken more than 40 years ago. It was determined that the earlier data for the sodium containing feldsars, albite, are in significant error. I will continue this research program by investigating the calcic end member, anorthite. To determine elastic constants I will use the Impulsive Stimulated Scattering (ISS) technique. A pulsed laser creates surface waves on polished surfaces of oriented single crystals. The surface wave velocities are measured as a function of direction and these velocities are inverted to determine the 21 constants. With this improved elastic tensor it will be possible to better interpret seismic data, and it will assist seismologists in evaluation of crustal anisotropy.

Searching for Coexisting Liquid Domains in Giant Unilamellar Vesicles (GUVs) Composed of a Saturated Lipid, an Unsaturated Lipid, and a Biologically Relevant Sterol

Emily E. Terrell, Senior, Biochemistry, Neurobiology, Music
Mentor: Sarah L. Keller, Chemistry

Cholesterol is found in the plasma membrane of all vertebrate cells where it has both biochemical and biophysical roles. Biochemically, cholesterol is active in many metabolic pathways and serves as a precursor of sex hormones and bile acids. Biophysically, cholesterol is traditionally valued because of its ability to decrease the melting temperature of lipids, thereby retaining the fluidity of membranes throughout the cellular environment. However, much more cholesterol is present in the plasma membrane than is needed to fulfill its biochemical roles. Furthermore, recent research suggests that cholesterol plays an important biophysical role in the formation of membrane “raft” domains. These are areas of the membrane that are rich in cholesterol and saturated lipids and are thought to be important for biochemical processes such as membrane transport and cellular signaling. However, raft domains are smaller than 1 micron in diameter, making them impossible to visualize and difficult to study. In order to overcome this difficulty, we use GUVs (giant unilamellar vesicles) composed of a saturated lipid, an unsaturated lipid, and a sterol to observe coexisting liquid domains, which serve as a very simple model system for biological raft domains. Currently, an important question in the field of biophysical chemistry asks what structural features of cholesterol allow it to interact with membrane lipids to form these raft domains. To address this question, I use GUVs composed of 1,2-Dioleoyl-sn-glycero-3-phosphocholine (DOPC), dipalmitoylphosphatidylcholine (DPPC), and a sterol similar to cholesterol in equimolar ratios. I explore sterols that are present in the cholesterol synthetic pathway or are plant analogs of cholesterol in an effort to understand which structural components of cholesterol are necessary to allow the formation of coexisting liquid domains. Because many
of these sterols are associated with human pathologies, a deeper understanding of their membrane properties may lead to improved treatments of these diseases.

**Characterizing the Progressive Disordering of Polymer Blend Spherulites to Dizzy Dendrites**
*Jillian Thayer, Junior, ACS Chemistry*
*Mentor: Bart Kahr, Chemistry*

Spherulites are polycrystalline solids formed under conditions far from equilibrium, and are commonly observed in a variety of ordered morphologies with a generally spherical shape. The addition of polymeric additives or particulate impurities perturbs crystal growth, and the resulting dendrites exhibit high levels of orientational disorder, referred to henceforth as dizzy dendrites. The goal of this study is to characterize the mechanisms controlling the progressive disordering of polyethylene oxide (PEO)/polymethylmethacrylate (PMMA) blend spherulites to dizzy dendrites upon addition of organically modified montmorillonite clay. Spin coated thin film samples and evaporated films of PEO/PMMA blends have been observed and measured using polarized light microscopy to yield maps of orientation and birefringence (a direct indicator of order). Insight into the mechanisms controlling spherulitic disorder is necessary in controlling materials synthesis and advancing the study of diseases such as Alzheimer’s, which may be affected by the crystallization of spherulites in vivo.

**Establishment of a functional genomics platform in Agrobacterium tumefaciens**
*Alison Thompson, Biology, Seattle Pacific University*
*Katherine Houmiel, Biology, Seattle Pacific University*
*Mentor: Derek Wood, Biology, Seattle Pacific University*
*Microbiology, University of Washington*

Three reference genomes have been sequenced to date within the genus *Agrobacterium*. These genomes represent a large dataset that has been extensively evaluated using current bioinformatics methodologies. The current approach seeks to develop a functional genomics platform in one of the three reference genomes, *A. tumefaciens* C58. This organism serves as a model for both tumorigenesis and genetic engineering. This resource is designed to provide the *Agrobacterium* research community with access to a suite of genetics tools that will facilitate the functional characterization of any selected gene product within the genome. This approach is modeled on a system designed by the Kahn laboratory at Washington State University in *Sinorhizobium meliloti* that utilizes modified Gateway in vivo recombination cloning technology. In this system, intact open reading frames are cloned into a single vector that can then be used to generate a variety of genetics tools including protein fusions, epitope tags and deletion constructs. We have successfully adapted this system for use in *Agrobacterium* and are now developing a high throughput cloning system. We are using this system to generate deletions in genes that constitute new members of the VirG regulon, the master virulence regulatory system in *Agrobacterium*. We hope in the long term to provide a complete Gateway set for this model organism that can be used by the larger research community to facilitate functional analysis of targeted gene products.

**Comparative Analysis of Essential Oil Composition in Picea Stichensis**
*Forest N. Thompson-Edgeel, Senior, Chemistry, Interdisciplinary Arts and Sciences, The Evergreen State College*
*Mentor: Peter J. Pessiki, Chemistry, The Evergreen State College*

Essential oils in conifers are hypothesized to be a natural defense to parasitic insects. This research focused on a comparative analysis of the essential oils isolated from *Picea Stichensis* (Sitka Spruce) as a function of location. These samples were collected from coastal sites in Washington and Oregon. The essential oils were isolated from the needles using steam distillation. Analyses of the oils were performed using Gas Chromatography Mass-Spectroscopy (GC-MS) and preparation variations included both dried and fresh samples. This poster reports on our protocol for oil isolation and our preliminary findings, that trees of the Washington Coast show different essential oil composition from those of coastal Oregon.

**Killing tuberculosis one thymidine at a time**
*Chris Thouvenel, Senior, Cellular, Molecular and Developmental Biology*
*Mentor: Carol Sibley, Genome Sciences*

*Mycobacterium tuberculosis* causes tuberculosis, an infectious respiratory disease that is prevalent worldwide. This bacterium has a novel thymidylate synthase, ThyX, that is very different from the enzyme that synthesizes thymidine in humans. This makes ThyX an excellent drug target because its inhibition would prevent *M. tuberculosis* from replicating without affecting thymidine synthesis in the human host. The crystal structure of the ThyX protein has been solved, but it is only the first step in understanding the key amino acids required to inhibit the enzyme. For example, amino acids required for the each step of the required reaction have not been defined. My goal is to locate the specific residues on the ThyX enzyme that are involved in the binding and activity for each of the steps. I am performing random mutagenesis on the *M. tuberculosis* ThyX gene and testing for functionality in a yeast strain that is unable to produce its own thymidine. Mutated ThyX genes that fail to complement suggest possible residues in the protein structure that are essential for enzyme function. This information will contribute to
design of a drug that could inhibit the thymidylate synthesis pathway of the ThyX enzyme in M. tuberculosis, but leave the thymidylate synthase enzyme in humans unaffected.

Correlations between HCV structural and nonstructural proteins and RNA markers of viral infection and replication in human liver specimens in situ
Igor Tikhonov, Senior, Biochemistry
Daisy Ko, Senior, Biology
Mentor: David R. Gretch, Laboratory Medicine
Mentor: Sampa Pal, Laboratory Medicine
Mentor: Margaret C. Shuhart, Medicine

Background: Hepatitis C virus (HCV), a plus-strand RNA virus within the Flaviviridae family, is an important cause of chronic liver disease in man. The replication biology of HCV has not been delineated. Hypothesis: Intrahepatic HCV replication is linked with the expression of nonstructural (NS) but not structural (virion-associated) viral proteins. Methods: Liver specimens from 52 patients with chronic hepatitis C were studied. HCV core, a viral structural protein, and NS3, a nonstructural protein were assayed by immunocytochemistry utilizing commercially available monoclonal antibodies. The percentage of liver cells harboring HCV genomes and replicative intermediate RNAs were evaluated by in situ hybridization using sense and antisense dig-labeled riboprobes (Pal et al, J Virol 2006; 80:2280-90). Huh-7 cells containing an HCV replicon and HeLa cells expressing HCV RNA subgenomes of either plus or minus strand polarity were used as controls. Statistical comparisons were made by chi-square, t-tests, linear regression and Spearman test. Results: HCV core and NS3 antigens were detected in 74% and 64% of biopsies, respectively. Detection of HCV core was associated with detection of HCV genomes (p=0.0008) and the NS3 protein (p=0.0034), but not detection of RI RNA, the marker of HCV replication (p=0.35). In contrast, detection of NS3 was equally associated with both genomic and RI RNAs (p=0.02 and p=0.01, respectively). Conclusions: These results demonstrate that while both HCV core and NS3 proteins are expressed during HCV infection, the NS3 nonstructural protein but not core structural protein was significantly associated with intrahepatic HCV replication. The data imply a close linkage between NS protein expression and viral replication.

Biochemical Characterization of RGS5 Isoforms
Bradley K. Tom, Senior, Molecular, Cellular, and Developmental Biology
Mentor: William M. Mahoney, Pathology
Mentor: Stephen M. Schwartz, Pathology

G-Protein coupled receptors (GPCRs) are important biological molecules, because they are major components of signaling pathways, which regulate virtually every process within the body. GPCRs are bound to heterotrimeric G-proteins, located inside the cellular membrane, allowing for the transmission of extracellular signals to downstream pathways. We in the Schwartz lab are interested in studying the role that Regulator of G-Protein Signaling 5 (RGS5) has on these signaling pathways. We hope to determine the connection between the regulation of GPCR-mediated signaling pathways and the effect of these pathways within different branches of the vascular system by studying the function of the RGS5 protein. RGS5 proteins act as a Guanosine Triphosphatase (GTPase), returning the activated Gα subunit to its inactive state by exchanging the Guanosine Triphosphate (GTP) for a Guanosine Diphosphate (GDP). Previous assays have demonstrated that there is a significantly larger amount of RGS5 transcript in arterial smooth muscle cells (SMCs) when compared to venous SMCs. We have isolated multiple RGS5 isoforms, which have different amino- and carboxy-terminal sequences relative to endogenous RGS5. These isoforms will be cloned into bacterial expression plasmids. E. coli expressing the cloned plasmid will be induced to produce protein, which will then be purified using the Glutathione S-transferase (GST) purification technique. When the RGS5 protein catalyzes the exchange of GDP for GTP, an inorganic phosphate (P) is released. By using 32P-labeled GTP, we hope to quantify the relative rate of GTP hydrolysis exhibited by the different RGS5 isoforms.

Cerebellar signal propagation for eye movements in monkeys
Ana Torvie, Senior, Neurobiology, Psychology, Spanish
Mentor: Farrel R. Robinson, Biological Structure

The cerebellum makes our movement fast, accurate, and consistent. Our lab studies the cerebellum’s role in voluntary rapid eye movements, called saccades, as a model of its role in all movements. Saccade-related cerebellar output comes from the CFN, the caudal part of the cerebellar fastigial nucleus. Activity in the right CFN drives the eyes to the left and that in the left CFN drives the eyes to the right. Both left and right CFNs are active during every saccade. During a rightward saccade the left CFN is active first, accelerating the movement rightward. Later, the right CFN is active to decelerate the saccade. Although we do not know how the cerebellum produces it, this late decelerating burst is what makes saccades accurate. Our theory is that a saccade command enters the cerebellum on one side and initiates the early accelerating activity in the CFN on that side. The signal then crosses to the other side of the cerebellum via axons called parallel fibers, producing the late decelerating command in the other CFN. To test this theory, we surgically cut the parallel fibers between the left and right sides of the cerebellum to prevent signals from reaching the opposite CFN and causing the late burst. We predicted that this cut would abolish late decelerating CFN bursts, making saccades overshoot their targets. The data collected confirms both
predictions. After the surgery there was no decelerating burst in any of the 8 CFN neurons that we studied. Also, the first post-cut horizontal saccades analyzed were ~20% larger than normal. These results support our theory that the parallel fibers are crucial in propagating the decelerating accuracy component of saccades. Ultimately, increased awareness of this newly discovered cerebellar mechanism may lead to clinical treatments for cerebellar damage.

Quantitative Analysis of Holocene Shoreline Retreat in Unconsolidated Sediment in the Puget Lowland, WA

Jeff Tracy, Senior, Earth and Space Sciences
Mentor: Terry Swanson, Earth and Space Sciences

The long-term retreat rate of the shoreline lying adjacent to the Puget Sound is difficult to quantify because the geomorphic evidence used to establish previous shoreline positions (i.e., wave-cut platforms) is itself, subsequently eroded by submarine processes. Qualitative assessment of recent shoreline retreat can be made by comparing the width of wave-cut platforms lying adjacent to shorelines experiencing variable retreat rates. Simply stated, shorelines comprised of unconsolidated sediment that are retreating rapidly, have wider wave-cut platforms than shorelines experiencing low retreat rates. Two new methods are proposed to quantitatively assess the long-term shoreline retreat of unconsolidated bluffs on southern Whidbey Island, WA: 1) Numerous outwash channels formed immediately following deglaciation and incised to the post-glacial marine high-stand (i.e., baselevel). Because the incision event was short-lived for many of these channels, they did not incise lower than the marine high-stand. Where shoreline retreat has been rapid, the post-glacial marine terrace has been eroded, but the up-

Energy Efficient Paper Manufacturing

Kimberly Tran, Junior, Electrical Engineering
Mentor: Alexander Mamishev, Electrical Engineering

Industries currently spend about 32% of the total consumed energy per year. A significant amount of this energy is invested in the paper industry, making it one of the largest energy consumers in the world, spending up to 2.7 quadrillion joules of energy per year. The energy consumed is mainly used in the de-watering process, which reduces pulp moisture content from approximately 98% to 6%. It is vital that moisture content be measured at the wet end in order to facilitate the outcome of paper quality. Paper pulp enters the machine in the wet end and dewatering, suction and press rolls remove the majority of water, in order to obtain a paper web that can be fed through a drying section. Existing sensors follow a feed
back process that measures moisture content after the dewatering section and feeds back the information to the wet end so alterations can be made. FEF (Fringing electric field) sensors follow a feed forward process that measures moisture content at the wet end and then feeds the information forward to the de-watering and later sections. Alterations of energy output can be eliminated by decreasing the amount of energy wasted during the feed back process. The ability of FEF sensors to make non-contact and non-invasive measurements at high speed gives it a great advantage over existing methods such as microwave, infrared scanning, and electromagnetic field perturbation. Simulations with FEF sensors have demonstrated the ability to measure high moisture content with quality reproducibility and repeatability results. Future works include developing a measurement system and FEF sensors to integrate into a paper machine in the production line. The ultimate objective of this project is energy efficiency and preservation, which will be beneficial to both the industries and the environment.

**Multivariate Correlational Analysis of Dynamic PET Images to Characterize New Gene/Drug Delivery Pharmacokinetics in Small Animals**

Linh Tran, Senior, Bioengineering and Mathematics  
Mary Gates Scholar, Travel Award Recipient.  
Mentor: Satoshi Minoshima, Radiology  
Mentor: Jennifer A. Flexman, Bioengineering  
Mentor: Donna Cross, Primate Lab

Small animals are often used for investigating biodistribution of new gene/drug treatments; concurrently, there is growing interest in using imaging to study pharmacokinetics. We have applied principal components analysis (PCA) as a way to explore independent physiologic components for the in vivo application of new gene/drug delivery vehicles. We used the hemagglutinating virus of Japan envelope (HVJ-E) as a model delivery vehicle to test in vivo characterization of physiologic components. Dynamic 2D PET images of each rat from four control groups: 1) [F-18]fluoride alone with intramuscular injection, IM (n=4); 2) [F-18]fluoride alone with intravenous injection, IV (n=4); 3) [F-18]fluoride-poly-L-lysine (PLL) complexes (n =3); 4) [F-18]fluoride-PLL-Feridex complexes (n = 2); and the treatment group, HVJ-E encapsulating [F-18]fluoride-PLL-Feridex complexes (n = 5), underwent PCA. The first two principal components were analyzed. 2D coronal projection images of pixel correlations were reduced to the sum of pixel blocks. ANOVA was used to establish significance between block sums between groups for each component. Components of all IV-injected control groups showed bone uptake of [F-18]fluoride and clearance of free tracers with average variance of 23.9±3.9%. IM-injected subjects lacked an initial vascular component compared to IV-injected subjects. The average percentage variance of IM-injected [F-18]fluoride subjects’ bone component was 50.4±5.3% compared to 24.1±3.5% for IV-injected [F-18]fluoride subjects (p <0.0001) and all components were significantly different from all controls (p<0.01 for ANOVA). The HVJ-E group had an additional physiological component with increased activity over time corresponding to liver uptake of HVJ-Es unveiling a unique biodistribution for this group. This study demonstrates that image-based, multivariate correlational analysis is effective for investigating the variance of dynamic data and detecting independent physiologic components without a prior, regional hypothesis. This imaging method is useful for the early characterization of new gene/drug biodistributions in small animals.

**The role of nucleus accumbens medium spiny neuron in locomotor activation, anxiety and reward**

Phuong Tran, Graduated, Neurobiology  
Mentor: Valerie Olson, Biochemistry  
Mentor: Richard Palmiter, Biochemistry

The nucleus accumbens (NAc) is a brain region that is part of the limbic system and has been implicated in addition, reward, locomotor activation, and anxiety. The majority of neurons in this region are called medium spiny neurons and they make and release GABA as their primary neurotransmitter. GABA is the primary inhibitory neurotransmitter in the brain and is thought to be present in 25% of all central synapses. It is produced by an enzyme called glutamic acid decarboxylase (GAD). Because of the ubiquitousness of GABA, systemic or local administration of GABAergic drugs affects the functioning of many different kinds of neurons and affects both local GABA release and GABAergic inputs from other brain regions. Thus, it has been difficult to ascertain the exact role of medium spiny neurons in the mentioned limbic functions. We sought to selectively block GABA release by NAc medium spiny neurons by deleting the GAD67 gene (the most common isoform of GAD which is known to make 95% of all GABA) in adult mice by using a combination of a transgenically modified mouse line and viral mediated gene transfer. We then assessed the extent to which locomotor activation, anxiety, and drug and natural reward is affected. Here we report that mice lacking the GAD67 gene in their medium spiny neurons showed a deficit in reward, but no change in locomotor activation or anxiety.

**Culture Differences and Norm of Reciprocity Influences on Response to Setbacks**

Thuy Doan N. Tran, Senior, Psychology  
Mentor: Jason Plaks, Psychology

Students’ lives are full of setbacks, whether it’s in academics, relationships, or career choices. Some are able to pull through and get back on their feet, determining to try harder, or to find other ways of reaching their
goals. However, there are some who withdraw from the race completely. The purpose of this experiment was to address the question: What makes one person persist while another withdraws? In particular, this research examines how culture and the norm of reciprocity influence the determination of whether one tries again or quits. Participants were presented with a variety of achievement setback scenarios and were asked to rate their emotional, behavioral, and motivational responses. Comparing Caucasians and Vietnamese individuals, it was hypothesized that individuals who are raised with collectivistic values will score higher on the norm of reciprocity scale than individuals raised with individualistic values. This is presumed to be because a collectivistic perspective encourages individuals to reciprocate toward those who have helped them significantly (e.g. parents). It was also predicted that individuals who score higher on the norm of reciprocity scale would be more determined to try again after facing setbacks. That is, the desire to honor those who have helped them will increase the motivation to achieve on difficult tasks.

Sediment Mobility in the Antarctic Dry valleys

Nathan Turpen, Senior, Earth and Space Sciences
Mentor: Jaakko Putkonen, Earth and Space Sciences

Previous estimates of sediment transport rates in the Antarctic Dry Valleys suggest a minimal mobility of sediments. Here we present new evidence of rock fragments (0.5 - 15.0 cm in diameter) that have broken off of larger boulders and subsequently traveled downhill. These fragments are transported down slope creating trails of debris that can reach tens of meters in length. Learning how these features, called boulder trails, form and evolve will give us a better understanding of the past and present sediment mobility in the Antarctic Dry Valleys. Boulder trails were mapped and studied within our Antarctic field locations in Arena, Koenig, Beacon, and Upper Wright valleys. We determined and recorded the lithology, size, and spatial distribution of the fragments, the source boulder characteristics, soil surface characteristics, and slope angle. The abundance of boulder trails that are found on almost all of the various surface types in the Dry Valleys, strongly contradicts the prevailing understanding of near total preservation of the landscape. Preliminary analysis of our dataset suggests that the distance an individual fragment travels, and the total size and length of the debris trail down slope from its source boulder, are both dependent upon the fragment size, lithology, and hill slope angle. We expect the continuing analysis of our datasets from the last two field seasons to provide definite evidence of considerable sediment mobility in an environment that may be much more dynamic than previously thought.

Possession Glaciation in the Northern Puget Lowland:

A Detailed Assessment of the Geologic Evidence

Greg Van Etten, Senior, Earth and Space Sciences SURP
Mentor: Terry Swanson, Earth and Space Sciences

The Possession glaciation has been mapped and identified in the sediment record in both the northern and southern Puget lowland. It is described as a glacial advance of the Cordilleran Ice Sheet coincident with Marine Oxygen Isotope Stage 4 (65-80ka). The type location of the Possession drift is found at Possession Point on Whidbey Island, Washington. There are several other important type locations on Whidbey Island where the Possession glaciation has been identified, which include Double Bluff, Strawberry Point, and Blower’s Bluff. The presence of the Possession drift in the Puget Lowland represents the terminal limit of the Cordilleran Ice Sheet. It is not consistent with the marine oxygen isotope record in that the magnitude of global ice volume during MIS 4 is less than both MIS 2 (last glaciation) and MIS 6. Consequently, it is imperative that the type locations of the Possession glaciation be revisited and studied with greater detail. My research will consist of creating detailed stratigraphic sections at the given type locations to critically assess the genetic origin of the units mapped as glacial drift. I will also be sampling fine-grained sediment for future TL (thermo-luminescence) dating to provide chronology to these sections. The ultimate goal of this research is to provide enough information and evidence so our work can be published in scientific journals.

Neural Responses to Species-Specific Calls in the Inferior Colliculus of the Big Brown Bat

Angela Vandenberg, Senior, English, Neurobiology
Mary Gates Scholar
Mentor: Jenna Monroy, Biology, Northern Arizona University
Mentor: Ellen Covey, Psychology

Many neurons in the inferior colliculus (IC), a midbrain auditory center, act as feature detectors that respond to specific properties of sound. The IC of the big brown bat contains neurons that respond selectively to frequency sweeps, sinusoidally frequency-modulated tones (SFM), and sound duration. Although these features represent some key characteristics of biologically important sounds, it is not known how they, or other types of IC neurons, respond to natural sounds. We presented 6 species-specific communication calls to each neuron. We also presented single syllables of each call and synthetic sounds that mimicked the characteristics of each call. To determine which features were necessary to evoke a response we measured the excitatory frequency response area of the neuron, that is, the range of frequencies and intensities to which the neuron responded when presented with pure tones. We also created a spike-triggered

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average of the stimulus waveform to determine whether a specific sound pattern consistently preceded the neuron’s response. We found that the frequency response area of a neuron did not reliably predict the neuron’s response to natural calls. Although the spectral components of many natural calls were within the neuron’s frequency response area, even unselective neurons (those that responded to pure tones) were highly discriminatory in their response to natural calls. Furthermore, a neuron’s response to a single call syllable did not reliably predict its response to an entire call with multiple repeated syllables, and rarely did a neuron’s response to a natural call match its response to its synthetic counterpart. This complex response pattern may be the result of temporal summation that occurs across syllables or the result of forward and backward masking due to inhibition.

Developing a Data Recording System for Radar Survey of Antarctic Ice
Pavan Vaswani, Freshman, Electrical Engineering
Mentor: Kenichi Matsuoka, Earth and Space Sciences
Mentor: Howard Conway, Earth and Space Sciences

This project is a part of ongoing research conducting radar measurements of the interior of the Antarctic ice sheet. A new radar system was developed to measure several properties of the ice sheet, including ice crystal alignment, ice temperature, internal and bedrock topography, and basal conditions. The use of radar provides a wealth of data across the ice sheet, an improvement upon the isolated data typical of ice cores where data is available only at drilling locations. The present system for data collection consumes a large amount of power, operating on a generator that creates significant noise in the data. Renovations will create a lighter system with more rapid data collection that can operate on a battery, providing more useful data due to reduced noise. In addition, three more major functions were added to the system to allow for more effective data collection. First, radar data requires the context of location and time collected to be of use to the researcher; therefore functionality to collect and stamp data with time and location coordinates from a GPS receiver through the data acquisition board was added. Second, the system also requires an error detection mechanism to prevent erroneous data collection. For this purpose, an external alarm was set up for the system. Currently, missing triggers for a second initiate this alarming process. However, more criteria will be for generating an alarm can be defined. Third, in order to allow researchers to view data being collected to further check for potential errors or malfunction, functionality to allow viewing of data on an external handheld display will be added to the system. The system implemented was used to collect data from the air near the Bering Glacier in Alaska and in ground-based radar data collection in the Antarctic this austral summer.

Carbon Dioxide Evasion in Puget Sound Wetlands:

Implications For Balancing the Carbon Budget
Stanley Vegors, Biochemistry, North Seattle Community College
Kristen Murdoch, Sophomore, Biology, North Seattle Community College
Cate Overstreet, Sophomore, Biochemistry, North Seattle Community College
Jeremy Thornton, Sophomore, Environmental Science, North Seattle Community College
Jordan Vajda, Senior, Philosophy, North Seattle Community College
Donald Warren, Sophomore, Biology, North Seattle Community College
Heidi Arden Wilken, Sophomore, Biology, Computer Science, North Seattle Community College
Mentor: Ann Murkowski, Biology, North Seattle Community College

In this century, increasing concentrations of carbon dioxide (CO₂) and other greenhouse gases in the Earth’s atmosphere are expected to cause warmer surface temperatures and changes in precipitation patterns. Gaining a better understanding of CO₂ sources and sinks on a global scale is therefore essential to managing potential human and ecosystem impact. Importantly, recent research in the tropics has indicated that out-gassing of CO₂ from rivers and wetlands of the central Amazon basin constitutes a significant carbon loss that was previously unidentified through traditional ground-based measurement. In this study, we measure and quantify CO₂ out-gassing from a local wetland environment using an infrared gas analyzer (IRGA). In order to gain a better understanding of how the Puget Sound wetlands in Western Washington contribute to the carbon budget, GIS mapping technology was then used to extrapolate across the regional wetland system. Results suggest that atmospheric CO₂ exchange rates increase with water depth, indicating that estimates should involve depth measurements as well as correct for seasonal variance in precipitation. This work supports the suggestion that significant evasion of CO₂ occurs in freshwater ecosystems and should continue to be measured and included in global carbon cycle models.

Interaction of PUB 30 and PUB 31 genes with the ERECTA pathway in Arabidopsis
Jessica Waite, Senior, Plant Biology, Spanish
Mary Gates Scholar
Mentor: Keiko U. Torii, Biology

The degradation of proteins is a crucial process to all living organisms. Without it, essential biological pathways would not be allowed to continue. The ubiquitin-26S-proteasome system is one method for degrading undesirable proteins in eukaryotes. In this system, a target protein is tagged by ubiquitin, a small peptide, by means of a series of three
ubiquitination factors: E1, E2, and E3. The tagging of the protein is followed by its subsequent degradation by the 26S proteasome. My focus is on E3 ubiquitination factors, which determine the specificity of the proteins to be tagged. **PUB 30 and PUB 31**, two closely related genes encoding E3 factors in Arabidopsis, are my genes of interest. My research project is to understand how these two PUB genes interact with three ERECTA genes, which code for receptor kinases required for cell proliferation and organ elongation. The double mutant plants lacking both PUB30 and PUB31 genes have a dramatic phenotype exhibiting elongated stems and pedicels, while the triple mutant plants lacking ERECTA-family genes (**EREcta, ERL1, and ERL2**) exhibit a severely dwarfed and infertile phenotype. My goal is to analyze the genetic interaction between these two PUB genes and three ERECTA-family genes through methods of generating important mutant combinations by genetic crosses, genotyping with PCR, as well as histochemical analysis of tissues. Our hypothesis is that these PUB proteins down-regulate the ERECTA pathway by selectively targeting the receptors or downstream signaling components for destruction. Consistent with this hypothesis, I have found that **EREcta** is epistatic to PUB 30 and PUB 31.

**Effects of Common Household Products in Closed Ecological Systems**

*Mary Sue Walker, Post-Baccalaureate, Biology*
*Mentor: Frieda B. Taub, College of Ocean and Fishery Sciences*

Freshwater Closed Ecological Systems consisting of an animal grazer, *Daphnia magna*, and three microscopic photosynthesizers, *Ankistrodesmus, Scenedesmus*, and *Selenastrum*, were established to determine the effect of commonly employed household products on aquatic communities. Closed Ecological Systems (CESs) are closed to atmospheric exchange. As such, they are completely dependent on the chemicals present at initiation for nutrients. The algae in the research systems provide food and oxygen, while the *Daphnia* consume the algae and recycle C as CO2 and other nutrients. A fertilizer (Miracle Grow©), insecticide (Ace© Ant, Roach & Spider Killer), and an herbicide (Ace© Ready-To-Use Weed & Grass Killer2) were included in separate treatment sets, and the effects on the *Daphnia* and algae were observed and recorded. Two sets of treatments, (algae only and algae plus grazer), sealed in 120 mL glass bottles, for each of four sets (control, fertilizer, insecticide, and herbicide), were established. Ten replicates of each set were employed, for a total of forty systems. The tested substances were diluted to over a billion parts. *Daphnia* survival and greenness of the bottles was observed and recorded throughout the experiment. In the CESs containing the grazer *Daphnia*, control populations ranged from 2 to 23 animals. The insecticide proved powerfully fatal, wiping out the entire population of *Daphnia* within 24 hours. The fertilizer established populations ranging from 0 to 30, while the herbicide supported populations from 4 to 11. In the algae-only CESs, the control systems proved to have the highest level of greenness, followed by the fertilizer, pesticide, and then herbicide. Observations will continue for at least two more weeks. Results to date demonstrate that very dilute solutions of commonly used household chemicals can have marked impacts on aquatic communities.

**Culture and Self-Evaluation: An Idiographic Approach**

*Jennifer Wang, Senior, Psychology*
*Mentor: Yuichi Shoda, Psychology*
*Mentor: Jenna Jung-Youn Lee, Psychology*

Past research has concluded that individuals from Japan report more critical self-evaluations compared to European Americans. However, self-evaluation responses may be dependent on the situation one experiences. For example, if a situation involves shared success, then a Japanese person may evaluate herself positively. If a situation involves succeeding over one’s peers, then she may not evaluate herself positively. Previous studies tended to average self-evaluation responses across situations for each individual, and then average the responses across individuals to arrive at fixed dispositions for members within a cultural group (i.e. European Americans versus East Asians). In these studies, variability in responses between situations and between individuals of the same culture is considered “noise.” In my project, I am interested in the intra-individual variability in self-evaluation responses. Participants of various ethnicities evaluated several situations by rating how positively and how negatively they would feel about themselves. Study 1 aims to demonstrate that individuals have a unique and stable self-evaluation response to different situations. Study 2 aims to demonstrate an individual’s unique and stable relationship between psychological features embedded in situations and the self-evaluation response to these features. This relationship in turn should predict how the individual will respond to novel situations containing the same features.

**Shifting Outlooks: The Presidency and National Education Reform**

*Ashley Watson, Senior, Psychology, Political Science*
*Mary Gates Scholar*
*Mentor: Bryan Jones, Political Science*

Beginning with the passage of the No Child Left Behind Through a combination of participatory and empirical research, I identified medicinal plants and recorded their applicability. In addition, I translated a book describing the preparation and use of various Costa Rican medicinal plants found throughout the country. I conclude that while deforestation may be problematic in certain areas of Costa
Rica, it is negatively impacting the abundance of medicinal plants in Mastatal. At least for the time being, the people of Mastatal can safely depend on TEK for disease treatment.

Mega Churches and Religiosity
Daniel Wei, Senior, Sociology and International Studies
Mentor: Steven J. Pfaff, Sociology

This undergraduate research looks at the field of the Sociology of Religions in the area of mega churches. The purpose is to discover research on the formation of the mega churches and how they are structured. In Rodney Stark’s theory on religious group size we would expect that mega church members would have lower commitment to the church’s core values and teaching in comparison of those churches that have a lower numbers of the members. However, given evidence that mega churches are successful, how do they secure higher commitment to the churches’ core teaching and how do the churches enforce it? If it is through the small groups, then how do the small group leaders handle the “free rider” issue within the small group setting? Stark’s Theory of asserts that mega churches that offer outer worldly reward instead of social rewards will have more committed members. Do the mega churches present themselves and their message this way? Do they rely on the socially rewarding message or the other worldly message to draw members into the mega churches community? Do they rely the social programs as a reward system to keep the members more committed to the church or another program? Stark’s theory states that the stricter of church’s core belief, the more committed the members. Thus, we would need to look at the church’s teaching to see if mega churches do indeed have a stricter teaching of Biblical principles.

HIFU Reflection Lesion Characterization
Kathy Wei, Freshman, Pre-Engineering
Mentor: Shahram Vaezy, Bioengineering

High Intensity Focused Ultrasound (HIFU) is a recently-developed medical therapy modality for non-invasive, extracorporeal treatment of internal bleeding and tumors. The energy delivered by a HIFU transducer can be amplified by reflecting the ultrasound beam from post focal regions back towards the focus. We studied the volume of the lesions produced in turkey breast, by HIFU, with and without an ultrasound reflector in order to more fully understand how to utilize the reflections. Lesions were produced for 5, 10, 20, 30, 40, 50 and 60 seconds and at 100 W, 200 W, 300 W or 400 W electrical power. The lesion volumes were estimated by two methods. One method, developed by Jonathan Yuen, used cross-sectional outline rotation of the lesions. The other method summed the volumes of lesions slices small enough to be considered cylinders. From the preliminary results, durations of less than 30 seconds showed little volume differences between treatments with and without a reflector, but longer durations showed that lesions with reflector were noticeably larger. Shape-wise, the lesions were observed to grow length-wise before girth-wise with increasing duration and power. The volumes ranged from 0.07 cm$^3$ to 16.23 cm$^3$. The difference in lesions produced with reflector or absorber were greater at higher powers. For example, at 100 W and 30 s, lesion produced with an absorber was 0.69 cm$^3$ while those produced with a reflector averaged at 1.66 cm$^2$ with a standard deviation of .34 cm$^2$. Meanwhile, at 400 W and 30 s, lesions produced with an absorber averaged at 7.16 cm$^2$ with a standard deviation of 0.25 cm$^2$, while the lesion produced with a reflector was 14.48 cm$^2$. In conclusion, post-focal backward reflection appears to provide an effective method to increase the HIFU energy delivery to a focal region, for enhanced tissue therapy.

Deforestation in Costa Rica and its Impact on Traditional Ecological Knowledge
Melanie Welch, Senior, Program on the Environment, Environmental Science & Resource Management
Mentor: John Withey, Program on the Environment

The Costa Rican government’s progressive biodiversity protection program has set aside 25% of the country’s total land area in national parks, yet deforestation still occurs in many parts of the country. Costa Ricans living in rural areas depend on traditional ecological knowledge (TEK) of medicinal plants for remedies to illnesses, as traveling to a medical facility is often not an option. I was interested in whether or not the current rate of deforestation was impacting the abundance of medicinal plants available to a rural population. I spent one month documenting the variety of medicinal plants in the rural Costa Rican town of Mastatal. I did this under the direction of the town’s eldest resident, Doña Maria. Through a combination of participatory and empirical research, I identified medicinal plants and recorded their applicability. In addition, I translated a book describing the preparation and use of various Costa Rican medicinal plants found throughout the country. I conclude that while deforestation may be problematic in certain areas of Costa Rica, it is not negatively impacting the abundance of medicinal plants in Mastatal. At least for the time being, the people of Mastatal can safely depend on TEK for disease treatment.

Newspaper Items Regarding Substance Abuse in Selected U.S. and Eastern European Newspapers
Nadezhda Welter, Senior, Computing and Software Systems, UW Bothell
Florin Bucur, Senior, Business, UW Bothell
Mentor: Andrea Kovalesky, Nursing, UW Bothell

Although substance abuse is a major health concern for many communities and countries, limited resources can prevent the use of some evidence-based interventions. The overall purposes of this research project are: to (1) compile a database of interventions related to the prevention or
treatment of substance abuse being used in communities with a variety of economic and personnel resources; (2) note which interventions are evidence-based; and (3) assist other communities in developing interventions that fit their economic and staffing profiles. To assist in this process, selected newspapers from the United States and Eastern Europe have been perused for items related to substance abuse. Two students from UW, Bothell, have collected articles in their respective native languages from three distinct regions in northwest Russia and two different regions in Romania. Over a four month period (October 2005 – January 2006), the students accessed the online versions of the newspapers and identified the articles of interest by visually scanning through the entire contents of each newspaper. The students then summarized the identified articles in English or translated them completely. Concurrently, the faculty mentor searched hard copies of newspapers from two U.S. communities (one in Washington and one in Pennsylvania). Word searches were avoided because so many different words are used to describe substances of abuse. The faculty mentor is reviewing a variety of intervention models to develop a comprehensive classification system for the interventions described in the identified newspaper articles. The students will assist with locating evidence-based literature about these interventions. Although preliminary data analysis reveals a strong focus on law enforcement aspects of substance abuse, all three researchers have noted a number of articles that provide important information about policy development, pertinent programs, and health and educational issues related to various types of substance abuse.

**Automating Braille Text Label Placement in Scientific Diagrams**

*Dana Wen, Junior, Computer Science, Music  
Mentor: Richard Ladner, Computer Science & Engineering*

Although the Braille system has served for a hundred and fifty years as a quick and effective way to make written materials widely available to the blind community, there is currently no efficient method in existence for converting images found in math, science, and engineering textbooks to a tactile format that can be utilized by the blind. Diagrams, graphs, and charts must be converted by hand though one of many painstaking and time-consuming methods. As a result, blind students, researchers, and professionals lack access to valuable visual resources. The Tactile Graphics Project was created to assess the problems surrounding this issue and develop a viable solution. In collaboration between the Department of Computer Science and the Access Technology Laboratory, the Project has developed software to automate the translation of images to a tactile format. Currently, my role with the Project centers on building a software component to efficiently handle text label placement in graphs, charts, and diagrams. When labels are converted from English to Braille, the text often becomes longer and interferes with graphical elements and other text labels in the image. In addition, some text labels are placed at an angle in the image, and must be rotated to the horizontal in order to be properly displayed as Braille. My software component will correct these problems by automatically creating an optimal layout for the text labels in a given image. In the ideal layout, text labels will remain close to their original locations, but no intersection will exist between any two text labels or a text label and a graphical element. The current algorithm for creating this layout involves assigning each label a rating according to the severity of its placement problems and adjusting label location based on each label’s status in a priority queue.

**Effects of populated towns on water quality in neighboring Galapagos bays.**  
Joni L. Werdeman, Senior, Chemistry, Oceanography  
Mentor: Roy Carpenter, Oceanography

Dissolved nutrient levels were measured in three Galapagos Island bays adjacent to the largest population centers (Puerto Ayora, Puerto Baquerizo Moreno, and Puerto Villamil) and in one bay with no adjacent inhabitants (Cartago Bay), to characterize water quality within each bay. Water column and sediment pore-water samples were collected on the R/V Thomas G. Thompson 20-28 January, 2006. Macronutrient analyses were performed to determine anthropogenic contributions to nitrate, ammonium, and phosphate concentrations. Salinity, oxygen, and temperature measurements were also made and nutrient concentrations were normalized to salinity, to account for regional differences. If anthropogenic effects are present, salinity-normalized concentrations of nitrate, ammonium, and phosphate would be expected to be greater in bays associated with human population and/or tourism. All populated bays have an increase in at least one of the three nutrients compared with the control, supporting this assumption. Wreck Bay (adjacent to Puerto Baquerizo Moreno) exhibits some of the largest nutrient increases in comparison to Cartago Bay; it also has a greater decrease in oxygen % saturation then all other bays. These data support the thought that anthropogenic contributions are already present. These observations can further aid estimates of future effects of nutrient contributions from growing population and tourist activities within the Galapagos Islands.

**Convenient Provenience Tool: Presenting Archeology Data to the General Public**

*Thomas Wiese, Senior, Informatics  
Peter Griffen, Senior, Informatics  
Brian McNally, Senior, Informatics  
Gordy French, Senior, Informatics  
Mentor: David Hendry, Information School  
Mentor: Laura Phillips, Burke Museum*
Mentor: Peter Lape, Burke Museum

Current methods used for visualizing large sets of archaeological data primarily include charts and graphs. These tools attempt to show simple relationships in the dataset, such as how many artifacts exist within each layer of each pit dug by the archaeologists. Such visualizations are useful to a certain extent, but are not ideal when the absolute three dimensional location or provenience of a particular artifact needs to be seen. This location information can be particularly important when attempting to reconstruct a dig site in three dimensions, as the dig sites are essentially destroyed when they are excavated. To solve this problem, we worked with the Burke Museum to create the Convenient Provenience Tool. Our project aims to make archeological data available to a larger audience than just archeologists by providing a simple interface and vivid visuals to guide potential users through the system. Pits dug in an archaeological site, also known as units, are represented as squares. When a unit is clicked on, a vertical cross-sectional view shows the natural layers within that pit. Finally, when a layer is clicked, a horizontal cross-section shows where inside that layer artifacts can be found. Additional information about each artifact is provided when the mouse pointer is moved over a particular artifact. To ease the process of finding a particular artifact, controls can be used to highlight certain types of artifacts. Formative usability evaluations showed that most people were capable of understanding and using the system within under five minutes. To reach the largest possible audience, this tool is implemented in a web-based application using widely adopted standards. This project can inform the development of information systems that allow the general public to experience the scientific and cultural insights of archeology at the Burke Museum.

Building Relationships/Building Knowledge
Heidi Arden Wilken, Sophomore, Biology, Computer Science, North Seattle Community College
Sam Bellomio, Sophomore, Structural Engineering, North Seattle Community College
Koby Allard, Sophomore, Applied Mathematics, North Seattle Community College
Haley Gronbeck, Sophomore, Women’s Studies, North Seattle Community College
Mentor: James Harnish, History and Interdisciplinary Studies, North Seattle Community College

A recent study conducted at Penn State University found that students involved in student activities, study groups, and who interact frequently with faculty and advisors outside of class are less likely to drop out. The goal of our research project is to find out if we can successfully create a circumstance where such interactions will occur, hence our research question: Will having opportunity for informal conversation with faculty about issues of teaching and learning positively affect students’ understanding of themselves as learners? We are surveying a group of first and second quarter students to gain a baseline of their understanding of themselves as learners while they are still adjusting to college. A number of these students will have lunch/coffee with a faculty member of their choice and talk about issues of teaching and learning. A quarter later all the students will be surveyed again and the results will be compared to see if the student – faculty interactions had any effect. The expected outcome is that the students will experience positive changes from interacting with faculty in this informal setting, which would support this as a continued method for helping first and second quarter students during their adjustment phase.

Ascertainment of the Role of P58IPK in the Chemokine and Cytokine Response to Influenza Virus Infection
Kevin Wilmot, Sophomore, Microbiology
Mentor: Michael G. Katze

Influenza affects lives all around world. In the United States alone it accounts for approximately 40,000 deaths each year. Considering this staggering statistic, it is imperative to understand how influenza subverts the host response to the virus. One way in which the virus may do this is through the cellular protein P58IPK (inhibitor of protein kinase). During infection, influenza recruits the host cell protein P58IPK which inhibits the activation of the interferon-induced, dsRNA-activated protein kinase R (PKR). This series of events affects the host cell shut-off of viral protein synthesis. Recently, our laboratory has generated a mouse strain lacking expression of P58IPK. To better understand the role of P58IPK during influenza infection, P58IPK-/- mice and P58IPK+/+ controls were infected with a mouse-adapted strain of influenza. P58IPK-/- mice exhibit an upregulation of immune responsive and antiviral genes at an earlier timepoint post-infection compared to P58IPK+/+ controls. These data suggest that P58IPK may play a role in delaying the host response to the virus. Key mediators of the host response against the virus are chemokines and cytokines. We are interested in determining the role of P58IPK in chemokine and cytokine expression during influenza infection. Chemokine and cytokine mRNA levels in the lungs of uninfected and influenza infected P58IPK-/- mice and P58IPK+/+ controls will be ascertained by quantitative Real Time PCR. ELISA analysis will be used to determine chemokine and cytokine secretion in the serum of uninfected and influenza infected P58IPK-/- mice and P58IPK+/+ controls. These data will be compared to data from preliminary microarray experiments using lungs from influenza-infected P58IPK-/- mice. This work will define a role for P58IPK in the immune response to influenza virus and allow us to determine a correlation between chemokine and cytokine mRNA levels and protein secretion in P58IPK-/- mice.
Analysis of the contribution of BRCA1 to epigenetic change in ovarian tumor cells
Martha Wilson, Senior, Molecular, Cellular and Developmental Biology
Mentor: Piri Welsh, Medical Genetics

Ovarian cancer has the highest mortality among gynecologic cancers. In 2005, 22,220 women were diagnosed with ovarian cancer, and 16,210 women died of the disease. Little is known about the progression of ovarian cancer and most women (>80% of cases) are diagnosed with advanced metastatic disease. Pathways to malignancy include changes in the primary DNA sequence and epigenetic modifications which consist of chromatin-based heritable changes in DNA regulatory elements. Epigenetic changes do not alter the corresponding DNA sequence. BRCA1 is a well-known tumor suppressor gene. Approximately 10% of ovarian cancer occurs in women who inherit a mutation in BRCA1. In addition, most of sporadic ovarian tumors (50%-70%) have lost an allele of BRCA1 and consequently have decreased BRCA1 protein expression. My research focuses on identifying epigenetic modifications, specifically those associated with changes that occur in proteins associated with DNA, which alter transcription of genes. I am investigating the epigenetic consequence of loss of BRCA1 in an ovarian tumor cell line obtained from a patient with an inherited BRCA1 mutation. I have performed immunoprecipitation assays on the ovarian tumor cell line, as well as on the same line which has been transfected with wild-type BRCA1 with antibodies specific to acetylated histone H3 and RNA Polymerase II. Precipitated DNA fragments have been hybridized to DNA chips which allow us to determine the epigenetic differences between these two ovarian cell lines. Understanding the epigenetic effects of the loss of BRCA1 is important in the deciphering of its role in maintaining chromatin structure, and its influence on the transcription of other genes involved in ovarian cancer tumorigenesis.

A Microfluidic Device for LATE-PCR
Kathryn Winglee, Sophomore, Biochemistry
NASA Space Grant Scholar
Mentor: Mark Holl, Electrical Engineering
Mentor: Deidre Meldrum, Electrical Engineering

Polymerase chain reaction (PCR), a now commonplace process that amplifies DNA from as few as one copy to detectable levels, is a tool used by many scientists in genetic research. A new and powerful technique derived from PCR for quantitative analysis of DNA is Linear-After-the-Exponential Polymerase Chain Reaction (LATE-PCR) in which single-stranded DNA, rather than double-stranded DNA, is produced, enabling increased allele discrimination compared to traditional PCR methods. The research objective is to design, fabricate and test a microfluidic device that will perform LATE-PCR on single cells. The device design features the following process steps: 1) trap a single cell, 2) lyse the cell, 3) mix DNA with PCR reagents, 4) thermocycle DNA and reagents, and 5) detect alleles to test for loss of heterozygosity (a symptom of cancer and old age in which one allele is lost from a heterozygote, an organism with two different alleles). This device will enable LATE-PCR to be performed at lower cost and reduced risk of contamination while requiring a smaller amount of DNA than the present method using test tubes. Current research progress includes a design for a microfluidic device and thermal cycler heater. The microfluidic device has been fabricated using a polymer called polydimethylsiloxane (PDMS) and tested using dye. The thermal cycler design comprises indium tin oxide (ITO) resistive film patch heaters on glass slides. The heaters are now being microfabricated.

Specific Pathogen-Free Transgenic Mice Carrier for Molecular MR Imaging
Cory Wyatt, Senior, Bioengineering
Mary Gates Scholar
Mentor: Satoshi Minoshima, Radiology

Since transgenic mice are important in many systems, they are stored in barrier specific pathogen-free (SPF) facilities. These facilities have the highest level of pathogen protection available and are essential to the integrity of transgenic research. If a transgenic mouse is removed from the barrier SPF facility and exposed to any potential external pathogens, it cannot be returned to the barrier SPF environment, putting the animal at risk during future housing. This dilemma is particularly acute for longitudinal imaging studies, where the same subject is used for repeated imaging sessions over months. In addition, the cost of transgenic subjects makes longitudinal imaging studies more attractive. In this study, we developed a case that will maintain a SPF environment internally while allowing for the longitudinal MR scanning of transgenic mice. The device consists of an air-tight mouse cage with a special cradle attachment to hold the transgenic mouse within a custom-built MRI coil. It allows for prolonged anesthesia through filtered gas lines as well as the injection of MRI contrast agents inside the cage, which can be done using gloveports to manipulate the animal. To allow for reentry of transgenic mice to barrier SPF facilities, all materials used to build the device are autoclavable. To demonstrate the capability of our design, a 16 month old mouse was anesthetized (ketamine/xylazine) and placed in the cradle attachment within the custom-built coil. A T1-weighted MR scan (3D SPGR, TE=6.8 ms,TR=15 ms, FA=14°) was then performed (8 min) on a 1.5T scanner (Signa, GE, Milwaukee, WI). Images of the entire body were obtained and of excellent quality, demonstrating the potential effectiveness of the device. This device will reduce the number of expensive transgenic subjects required for an imaging study and perhaps allow previously impractical studies to be performed.
Virtual Reality Visualization of Robotic Exoskeleton
Tian Xia, Senior, Electrical Engineering
Mary Gates Scholar
Mentor: Jacob Rosen, Electrical Engineering

The robotic Exoskeleton being developed at the BioRobotics Laboratory (BRL) is an orthotic device worn by the human operator. It can enhance the operator’s muscular strength and control and perform automatic physiotherapy through mechanical actuation. As a part of the Exoskeleton project, my project focuses on the virtual reality visualization of the robot. The visualization project involves the creation of the hierarchical model of the Exoskeleton, joint-to-model calibration, real-time joint data collection and display. The virtual reality model has been developed using the Virtual Reality Modeling Language (VRML), and the joint data collection module using Matlab’s Virtual Reality Toolbox. The joint-to-model calibration and integration are underway. Additional capabilities such as the visualization of the velocity and torque vectors are also being developed.

Alzheimer’s Disease and the Guamanian Parkinson’s Disease Complex: Comparative Proteomics
Wan Jou Yang, Senior, Neurobiology, Biochemistry
Mentor: Thomas J. Montine, Pathology

Parkinson’s Dementia Complex (PDC) is a neurological disease unique to the indigenous inhabitants of Guam, the “Chamarros”. Because PDC patients have symptoms of Parkinson’s disease as well as Alzheimer’s-like dementia, many researchers have extolled the disease as “the neurological Rosetta Stone.” There have been many proposals for its cause, but so far no genetic and environmental factors have been consistently supported. Interestingly, the prevalence of dementia among patients has increased, which may provide some insight into the characteristics of Alzheimer’s disease (AD). This project takes a broader, biochemical look at PDC in comparison to Alzheimer’s disease by extracting detergent-insoluble proteins from the temporal and frontal lobes of four populations: (1) Seattle AD patients, (2) Seattle controls, (3) Guam PDC patients, and (4) Chamorro controls. Using a technique called “ITRAQ”, the proteins from the each group will be uniquely labeled, enabling a 4-way comparison of protein abundance by mass-spectroscopy. The results of the ITRAQ will also be confirmed by ELISA and Western Blot. We expect that there will be increased amounts of insoluble proteins in PDC and AD brains relative to controls, and that the Seattle and Guam controls will be different from each other. The extent of similarity in the proteomics of AD and PDC may implicate the amount of overlap in disease etiology. We will focus especially on well-characterized proteins associated with neurodegenerative diseases, including Tau, aβ, and a-synuclein. We also hope to discover new targets for study by identifying insoluble proteins that correlate strongly with PDC. Future research may involve an examination of the more soluble proteins of PDC and similar proteomic comparisons between PDC and Parkinson’s disease.

Functional Ceramic Coatings
Zablo Yang, Senior, Materials Science and Engineering
Linh Nguyen, Senior, Materials Science and Engineering
Mentor: Rajendra K. Bordia, Materials Science and Engineering
Mentor: Srinivasa Rao Boddapati, Materials Science and Engineering
Mentor: Nik Hrabe, Materials Science and Engineering

Ceramic coatings are highly desirable for many applications in the biomedical and electrochemical fields. Hydroxyapatite, a calcium phosphate mineral \( [\text{HA}: \text{Ca}_10(\text{PO}_4)_{6}(\text{OH})_2] \) is chemically similar to bone and is used as a coating on implants to generate osteoconductivity. In the electrochemical field, solid-state electrochemical devices are becoming increasingly significant for a range of energy conversion applications. These devices are usually based on electrochemical cells with ceramic electrolytes and metallic electrodes. In this research, we are developing ceramic coatings on metals for applications in the area of materials for biomedical and energy conversion applications. The first part of this research consists of finding a non-line-of-sight coating method for porous titanium that will provide an interconnected porous network for bone ingrowths after implantation. We are exploring sol-gel approaches to produce the coatings. In this process, the porous metal substrate is dip-coated with a chemical precursor of HA which is converted to HA via a thermal treatment. SEM and XRD are used to characterize the morphology and the constituent phases of the coatings. The second part of the research focuses on preparation of yttria-stabilized zirconia coatings on steel substrates. Nanosized zirconia particles were used to prepare slurry with different dispersants. slurries of differing \( \text{ZrO}_2 \) content were prepared and their viscosity measured as a function of vol% of \( \text{ZrO}_2 \) in order to optimize the process. The substrates were dip coated, dried, sintered at a variety of temperatures and characterized using XRD and SEM.

Condition Based Maintenance of Electric Power Networks
Daniel Yeager, Junior, Electrical Engineering
Mentor: Alexander Mamishev, Electrical Engineering

An autonomous robotic platform has been developed to carry diagnostics sensors for the purpose of inspecting underground power distribution cables. In this project the feasibility of an autonomous inspection robot has been demonstrated as a means of replacing or supplementing conventional power cable aging status sensing methods. A mobile platform contains a control system capable of autonomous navigation, integrated with sensor and signal processing technology developed for the application. A combination of thermal, vision, dielectrometry, and
acoustic sensors is used to effectively determine the aging status of power cable networks. Control and signal processing algorithms operating within a distributed processing architecture provide a flexible approach to control of autonomous inspection systems. The key advantage of this inspection method is the ability to sense distribution cable failure status with increased accuracy at a fraction of the cost of typical monitoring technologies.

Medicinal Properties of *Ganoderma lucidum*
Evan Yoo, Senior, Biology
Mentor: Joe Ammirati, Biology

*Ganoderma lucidum*, a polypore mushroom, is widely used for its health and medicinal properties, especially in Asian countries such as China, Japan, and Korea. Its common names are “Reishi” (Japan), “Ling Zhi” (China) and “Young-chi” or “Bool-lo-cho” (Korea), all roughly meaning “herb of eternal youth”. The use of this fungus by humans has a long history. In 2838 BCE, Shen Nong, the father of Chinese agriculture and medicine, mentions *Ganoderma lucidum* as the most valuable herb in *The Four Canons*. Due to its rarity in ancient times, mainly emperors and royal families who could afford to find *Ganoderma lucidum* had a chance to consume it. Several studies have shown that *Ganoderma lucidum* affects main organs of the human body; for example, it is effective in both lowering hypertension and treating diabetes by reducing the blood glucose level. The applications of such findings are very important, since *Ganoderma lucidum* can regulate mechanism and metabolism that ensure all organs function properly. My research focuses on the effects of temperature on spore germination of this fungus as a means of obtaining isolates in pure culture that can be used for genetic based studies, such as an evaluation of its mating systems and identification of different strains that could be used in medical research. If maximum spore germination can be achieved (it typically is less than 15%), then it would make it possible to cultivate this fungus from natural population for use in future studies.

The Mechanism of Membrane Fouling by Natural Organic Matter
Yeping Yuan, Junior, Civil and Environmental Engineering
Mentor: Mark M. Benjamin, Civil and Environmental Engineering

Over the past two decades, the most important development in drinking water treatment technology has been the production of membranes that allow a high throughput of water while rejecting most contaminants very efficiently. The major impediment to the successful application of these membranes has been fouling by natural organic matter (NOM), which is generated by the decomposition of living materials in the watershed. However, the exact mechanism by which the fouling occurs is still unclear.

One of the more puzzling observations about fouling relates to the behavior of systems in which water is passed through several membranes in sequence. Intuitively, one expects the material that causes fouling to be trapped by the first membrane, so that the fouling of subsequent membranes would be much less. However, when such experiments are carried out, the fouling of downstream membranes occurs almost as rapidly as that of the first membrane. We have hypothesized that the explanation is that the very act of passing through the membrane causes a small portion of the NOM to coagulate and form a gel, which is the true cause of the fouling. Most NOM does not coagulate and is able to pass through the membrane, until an additional, small portion coagulates as the water passes through the next membrane in the sequence. The current research is designed to test this hypothesis, using Lake Washington water as the source water. Influuent and effluent concentrations of NOM are being measured, and scanning electron microscope imaging is being used to provide information on the nature of the material deposited on the membrane surface. The result of this study will provide a better understanding of the relationship between NOM molecules and their coagulation and membrane fouling formation, ultimately improving the ability to purify drinking water more effectively and efficiently.

Relationship between light and solute-exclusion zone
Chung Jong Yu, Junior, Molecular Biology
Mentor: Gerald H. Pollack, Bioengineering

Previous work in our laboratory has shown that microspheres were excluded from the region adjacent to Nafion TT-110 tubing in a microsphere-water solution. The cause of the exclusion zone is not yet fully understood. We made inquiries into relationship between light and the exclusion zone in order to understand the mechanism of how the exclusion zone forms. To investigate the relationship between the light effect and exclusion zone, we used various intensities of light, two different types of illumination (dark/bright field) and different types of tubing (Tygon R-3603 and Nafion TT-110). Tubing was immersed in Carboxylate 2.0 µm microsphere-water solution. Under the microscope, using the microscope’s light, direct incident light on the specific region of the tube and observe the result. In the solution, Tygon tubing did not form an exclusion zone, but Nafion tubing did. When additional light on the two types of tubing was applied respectively, only Nafion tubing forms the expanded peak of the exclusion zone in addition to the exclusion zone. Furthermore, the expanded peak is made only under the dark field illumination, and above a certain intensity. Our results suggest that the exclusion zone must already have formed to build the peak. Furthermore, we concluded that the expanded peak forming process is more related to the characteristic of exclusion zone directly. Future studies will investigate how this expanded zone is made. They will examine effect of wavelength on the exclusion zone
and will test the heat factor of light using heat filters and electricity. Understanding the exclusion-zone system may help to elucidate how to separate the salt from water or pathogens from water.

**Analysis of the airway proteome during early pneumonia caused by *Staphylococcus aureus***

Rong Zeng, Senior, Microbiology  
**Mentor**: Christy L. Ventura, Infectious Disease  
**Mentor**: Craig E. Rubens, Infectious Disease

*Staphylococcus aureus* is a pathogen that causes significant nosocomial and community-acquired pneumonia. The interactions between *S. aureus* and the host during the early stages of pneumonia are poorly understood. In particular, the proteome of the host is not well-defined during acute pneumonia; thus, our goal is to define the host airway proteome during pneumonia and to characterize protein-protein interactions at the molecular level. Bronchoalveolar lavage fluid (BALF) from mice infected intranasally with *S. aureus* was analyzed by LC-MS/MS. A significant increase in pro-inflammatory cytokines (IL-6 and TNF-α), complement C3, immunoglobulins, and lactoferrin was observed. We hypothesized that the influx of such proteins can be verified, via SDS-PAGE and Western Blots, and thus predict that the LC-MS/MS data is significant. Because 70-80% of the host BALF proteins are represented by just three overabundant proteins (IgG, transferrin, and albumin), a Mouse Multiple Affinity Removal System (MARS) was used to deplete these proteins. SDS-PAGE and Western Blotting were used to assess the efficiency of depletion. SDS-PAGE analysis indicated that the amount of protein in the BALF does increase during the first 12 hours of infection. Western Blotting of native and depleted samples showed that depletion is specific for the overabundant proteins, while less abundant proteins, including lactoferrin, are retained in the sample. We conclude that the amount of protein in the lungs of infected mice increases over time and that MARS represents an efficient and reproducible methodology for depletion of overabundant proteins.

**Carangiform Locomotion Project**

Jennifer Zhang, Senior, Electrical Engineering, Computer Engineering  
**NASA Space Grant Scholar**  
Timothy La Fond, Junior, Electrical Engineering, Computer Engineering  
**NASA Space Grant Scholar**  
**Mentor**: Kristi Morgansen, Astronautics and Aeronautics

Coordination between groups of autonomous vehicles is made difficult by the imperfect nature of sensors which prevent precisely locating each vehicle. Belief spaces representing the probability of the automaton being at any given location along with mathematical control functions incorporating the different vehicles govern the motion of the vehicles are used to control the group. To test different three-dimensional control functions in a realistic environment, multiple robotic fish were constructed to act as vehicles for the functions. These vehicles will eventually maneuver as a group using knowledge of their probable location and the locations of fellow fish. Another goal is to increase the mobility of the robots to make them more responsive. To increase the mobility of the robots, diagrams of real carangiform fish performing maneuvers were analyzed and the motions duplicated with the robots. New rapid-turn and rapid-start maneuvers were added to the standard forward swim and turn. Currently the fish are also being used as examples in the Engineering 100 class this quarter. Students learn the difficulties in using the different components of the robots including the depth sensors, the compass, and control functions governing depth and heading. At the end of the class the students will define instructions for the fish in order to guide it through a obstacle course.

**Meiotic recombination near telomeres in yeast**

Liang Zhang, Junior, Biology  
**Mentor**: Breck Byers, Genome Sciences

Meiotic recombination near the ends of eukaryotic chromosomes (telomeres) is poorly understood, but it may contribute significantly to the diversity of telomere-proximal genes, such as the olfactory receptors in humans and the major antigenic determinants of the malarial pathogen. Telomere-dependent silencing of transcription limits our ability to monitor crossing over and other modes of recombination reliably in most species, but these processes are accessible to analysis in the budding yeast, *Saccharomyces cerevisiae*. Preliminary tetrad dissection experiments in our lab suggest that the URA3 gene, when inserted into a site immediately adjacent to the telomere, recombines with a linked marker more frequently when telomeric silencing is partially blocked by selecting for expression of the URA3 gene or by altering histone modification. Because tetrad dissection is cumbersome, it has not yet been feasible to test various modifications on the sporulation protocol to learn how to maximize the effects on recombination. We are developing new strains that will enable us to get larger numbers of colonies that represent a random selection of spores. These methods depend on the use of two recessive drug resistance markers (can1 and cyh2) that are heterozygous in the diploid being sporulated. Plating the products of meiotic sporulation on the relevant drugs (canavanine and cyclohexamide, respectively) allows selection of can1 cyh2 cells, providing a convenient sample of the haploid spores. When the same strain is also heterozygous for telomere markers, we can thereby assay the extent of telomere-proximal recombination without having to perform tedious tetrad dissection. This will permit us to test many varied conditions for their effects on the rate of recombination and help clarify the relationship between telomere silencing and crossing over.
The vertebrate thymus is a primary lymphoid organ that acts as the site of T-lymphocyte differentiation and proliferation. The thymus is comprised of subsets of epithelial cells populating either the medullary or cortical regions. An example of the importance of the thymus is the nude mouse that has a minimally functioning immune system due to its improperly developed thymus that cannot support T-cell differentiation. This extreme phenotype is caused by the absence of the gene coding for the transcription factor foxn1. Although it seems to have great importance in determining the developmental fate of the thymus, not much else is known about foxn1. It has been the focus of my research to address the key issues of when and where foxn1 is expressed during thymic development to gain a better understanding of how it contributes to thymic epithelial cell differentiation. Foxn1 expression can be visualized with the use of the reporter construct β-galactosidase in mice. Results from histochemical detection of β-galactosidase activity have shown that the spatial expression of foxn1 is restricted to a subset of medullary thymic epithelial cells (mTECs) in the thymus of the adult mouse. The identification of this subset is crucial in identifying the direct interactions between foxn1 and the thymic epithelium. To do so, two-color immunofluorescence using anti-β-galactosidase and anti-medullary thymic epithelial marker antibodies is being used to colocalize foxn1 with its specified regional expression. The question of when foxn1 is expressed is equally as important as where, because it helps define whether foxn1 is necessary for maintaining a developed epithelial population after differentiation. In characterizing the temporal expression of foxn1, similar immunohistochemical techniques are being employed to identify the patterning of foxn1 expression during pre and post-natal thymic development. These studies will also hopefully decide whether foxn1 is an adequate marker for thymic progenitor cell populations.

The focus of my project is to characterize the signal transduction mechanisms of thrombin-induced microglial activation. The central nervous system inflammatory response has been strongly implicated in a variety of neuropathologic diseases, including stroke. The primary mediators of neuroinflammation are activated microglia. Microglial activation involves cell migration, proliferation, changes in antigenic profile, and release of cytokines. A variety of blood-borne serum factors such as the coagulation proteinase thrombin, have recently been reported to rapidly induce microglial activation. We focused on characterizing the specific signal transduction pathways that mediate thrombin-induced microglial activation. We demonstrated that thrombin up-regulates the microglial cell surface expression of CD95 (Fas) and CD40. Fas is a molecule involved in the signaling cascade leading to programmed cell death (apoptosis), and increases in Fas are seen frequently in microglia activation. CD40 is an integral membrane protein found on the surface of microglia and a key surface antigen in cellular differentiation. We hypothesized that intracellular signaling protein called mitogen-activated protein kinases (MAP kinase) are intermediaries of thrombin-mediated microglial activation. MAP kinases, such as ERK1/2, p38 and JNK are a group of kinases that mediate signal transduction from surface receptors to the nucleus. Using inhibitors of ERK1/2, p38 and JNK pathways we found that U0126, an inhibitor of the ERK pathway, attenuated the thrombin-induced up-regulation of CD95 (Fas) and CD40, whereas the other inhibitors showed no reduction. ERK kinase plays a significant role in thrombin-mediated expression of CD95 (Fas) and CD40. Recently revealed molecular mechanisms underlying thrombin’s effects involve proteolytic activation of two different thrombin-responsive, protease-activated receptors (PARs), PAR1 and PAR4 in microglia. Our studies showed that activation of PAR mediates surface antigen expression on a microglia cell line. Synthetic PAR 1& 4 agonist mimicked these effects and microglia respond to these peptide-agonists in near identical fashion to microglia exposed to thrombin in vitro.

Characterization of foxn1 expression in the mouse thymus

Tong Zhang, Senior, Biochemistry
Mary Gates Scholar
Mentor: Andrew Farr; Biological Structure, Immunology

The vertebrate thymus is a primary lymphoid organ...
flexible system design and integration with urban locations. We explore an integrated energy solution for urban areas, which harnesses the wind energy on top of skyscrapers and uses it to generate both clean electricity and cleanly produced hydrogen with a minimal real-estate footprint.

The system is designed to manage the stochastic nature of wind energy by utilizing both short-term and long-term energy storage options. This stabilizes electrical output and creates a reliable source of energy to draw on for hydrogen production. Being located closer to areas of high energy consumption allows for higher efficiency in distribution. The power park provides benefits to the area in the form of reduced load stress for the electrical grid, reduced greenhouse gas and air pollutant emissions, and a fueling point for future hydrogen-based fleets. The entire system is scaleable to demand, and can fuel between 10 and 50 hydrogen cars a day, while providing a consistent source of wind generated electricity to its host building.

Circumventing Erythropoietin-Induced Tumor Progression using a Chemical Inducer of Dimerization

Songmao Zheng, Junior, Biology, Sichuan University-University of Washington Exchange Program, UW Honors Program

Mentor: C Anthony Blau, Medicine, Hematology

Recombinant erythropoietin used for cancer related anemia treatment increases by 10% annually, but mounting evidence suggests that erythropoietin may stimulate cancer progression. The project our group undertakes involves the identification of the off-target effects of Epo and provides a method for regulating red cell production by administrating a chemical inducer of dimerization (CID), which binds to the modified ligand-binding site of engineered fusion proteins contained within hematopoietic stem cells. We are now adapting and refining an established in vivo model of erythropoietin-induced leukemia by employing the use of a human erythroleukemia cell line, AS-E2. We have shown its exclusive dependency on EPO with proliferation tests and have detected LDH isoenzymes which enable the unambiguous monitoring of human cell engraftment in mice by flow cytometry. Then sublethally irradiated beta2 microglobulin knockout mice will be transplanted with unfractionated isogenic bone marrow cells from fluorouracil treated donors that are transduced using a lentiviral MSCV-based vector encoding the CID responsive and erythropoiesis promoting fusion protein (MSCVGFPiresF36VMpl). Following transplantation, mice will immediately receive tail vein injections of AS-E2 cells and begin treatment with CID combining EpoR neutralizing antibodies, neutralizing antibodies alone, erythropoietin alone or vehicle (PBS). It is expected that the longevity of mice that get CID with antibodies should be improved while mice that get Epo alone should die fastest. Also, we are now comparing our newly developed single chain Fragment variable antibodies with previously published antibodies for EpoR detection by immunohistochemistry (IHC), using pseudotissues with predefined levels of EpoR expression to correlate EpoR expression with actual heterogeneous patient samples. EpoR transcript levels quantified by quantitative rtPCR will be compared with EpoR expression by IHC. Moreover, a cohort study is underway to test whether erythropoietin increases the risk of disease recurrence in women with EpoR+ breast cancers. This CID therapy holds the potential to treat all EpoR+ cancers.

Neurodegeneration of CA1 and CA2 neurons in Alzheimer’s disease

David Zhu, Senior, Neurobiology, Economics

Mentor: Jing Zhang, Pathology

One of the intriguing observations in human diseases of the central nervous system is that most diseases are regional specific. For example, neurons in the cornu ammonis 1 (CA1) region of the hippocampus are vulnerable to neurodegeneration in Alzheimer’s disease (AD), epilepsy, and brain ischemia, whereas the neighboring CA2 region remains relatively resistant in these diseases. The molecular mechanisms underlying this regional vulnerability are largely unknown. This project aims to study the protein profiles of the neurons in the CA1 as compared to the CA2 regions, hoping to identify proteins unique to each region that may confer its sensitivity or resistance to neurodegeneration in various human diseases. To perform this study, human hippocampal tissue was dissected and stained, and neurons from the CA1 and CA2 regions were captured separately via laser capture microdissection. The captured neurons were subjected to trypsin digestion followed by liquid chromatography-tandem mass spectrometry for protein identification. Using proteomic software and subsequent analysis, a difference is expected in the protein composition of the CA1 and CA2 regions of the human hippocampus; a comparison of the proteins identified will likely help to explain either the vulnerability of CA1 neurons or the resistance of CA2 neurons to neurodegeneration in various human diseases.

Site-Selective Growth of Organic Semiconductor Crystal on Patterned Self-Assembly Monolayer Template

Jinyu Zou, Junior, Materials Science & Engineering

Mentor: Alex K-Y. Jen, Materials Science & Engineering

π-conjugated organic semiconductors are regarded as a promising class of materials that finds application in a wide range of electronic and optoelectronic devices including light emitting diodes, photovoltaics and transistors not only due to their intriguing advanced electronic and optical properties, but also the possibility for low cost solution processing in large area applications and on flexible substrates. Since the performance of the organic semiconductors is strongly dependent on their
intermolecular organization, one main challenge in the field is to create monodomain crystalline structures for achieving high charge mobility through coherent charge transport. The study of single organic crystals, in which grain boundaries are eliminated and concentration of charge traps is minimized, is important for the fundamental understanding of the intrinsic electrical property the semiconductor. In our research, we study the nucleation and growth mechanism of an n-type π-conjugated semiconductor in solution. Furthermore, we utilize a micro-patterned self-assembled monolayer as a nucleation template to selectively growth the crystal on the surface. Our ultimate goal is to selectively grow the organic crystal on the electrodes to study its electrical property.

Effects of dTrpA1 on Thermoregulation of Adult
*Drosophila melanogaster.*

Jessica Zvaleuskas, Senior, Biology
Mentor: Raymond B. Huey, Biology

The ability to regulate body temperature is crucial for most living organisms because body temperature affects physiological reaction rates, activity, and ultimately fitness. Those organisms that cannot regulate temperature endogenously (ectotherms) rely primarily on their behavior to thermoregulate. To do so, they must be able to sense and respond to temperatures in their environment. Recent work suggests that the ability to sense temperature is in partly dependent on the function of certain families of Transient Receptor Potential (Trp) channels. In particular, when the dTrpA1 channel is knocked down in fruit fly larvae (*Drosophila melanogaster*), the larvae fail to avoid high temperatures (>27°C) that will harm or kill them. Whether this channel is critical for thermoregulation in adults is still unknown. Therefore, I am investigating whether loss of function dTrpA1 compromises thermoregulatory behavior of adults. I use genetic techniques to create dTrpA1 knockdowns. I then place flies in a chamber, half of which rests on a hot plate (40 °C) and compare the thermoregulatory behavior of knockdown and wild-type flies. I am also using a linear temperature gradient to determine the effect of dTrpA1 on thermal preference of adult *Drosophila melanogaster*. I hypothesize that adults lacking dTrpA1 channel will, like larvae, fail to avoid high temperatures. Furthermore, I predict dTrpA1 knockdowns thermal preference will be skewed towards the hot end of the gradient. This work is one of the first studies to link the molecular mechanisms of temperature sensation to organism behavior.
Students Honor Their Mentors

Participants in the 2006 Undergraduate Research Symposium were invited to submit a haiku poem honoring their research mentors. Included in this volume is a selection of the wonderful poems that we received. Posters and slide shows of all the submissions are on view throughout Mary Gates Hall. A complete list may also be viewed on the Undergraduate Research Program website, www.washington.edu/research/urp

Student: Kelly Hills - Comparative History of Ideas
Mentor: Phillip Thurtle - Comparative History of Ideas

papers, books, advice;
laughter mixes with critique -
cherry blossoms fade

Student: Ilan Jen-La Plante - Chemistry
Mentor: Andrew Rice - Ocean & Fishery Sciences

Ask me a question
Perhaps you will discover
You knew the answer

Student: Yris Lance - International Studies
Mentor: Peter Bacho - Interdisciplinary Arts and Sciences

Peter Bacho drops
the waters of his knowledge
and helps bloom new lives.

Student: Julia Mattson - Neurobiology
Mentor: Judy and John Clark - Biological Structure

Seventeen words is
Not enough to describe how
Great Dr. Clark is.

Student: Christine Shannon – Humanities, English
Mentor: Ellen Garvens - Art

She taught me to cut
Stick with the impressive stuff
Less is more she said
PRESENTATION SESSIONS

PLEASE NOTE
Abstracts are listed alphabetically by the presenter’s last name, unless otherwise noted.
SESSION 1A

*Note: Titles and Abstracts in order of presentation.

INTERNATIONAL RESEARCH IN THE SOCIAL SCIENCES
Session Moderator: Steven Harrell
Mary Gates Hall Room 228

A Narrow Spiritualism: Health Care-Seeking on the Margins of Southwest China
Lauren Brown, Senior, Anthropology and Public Health
Mary Gates Scholar
Mentor: Stevan Harrell, Anthropology

Scholars in the medical anthropological discourse debate the strength of quantitative analysis on health care-seeking behavior. Relationships found through decision-theoretic models among socioeconomic status, belief, and choice remain unclear. Treatment-seeking for chronic conditions is an especial confounder and the role of culture in the “logic of health” demands address. My research surrounds the health care-seeking rationales provided by Yi ethnic minority (emic: Nuosu) residents of Yangjuan Village, Liangshan Yi Autonomous Prefecture, Sichuan Province, People’s Republic of China. I took twenty-six narrative-style interviews on four separate visits in 2004 and 2005. Participant-observation and interviews with five key informants who act in health care-providing roles supplement the narrative analysis. In post-reform China, one sees distinct behavior that creates rational places on the periphery of the Yi body to seek ethnomedicine. This place compensates and resists social, economic, health systems change - summarily political reforms that stigmatize ethnomedicine as religion or “doing superstition.” I will propose an explanatory model of these rationales to demonstrate the persistence of ethnomedicine’s efficacy to treat the Yi body.

Yi Minority Embroidery of Southwest China
Sara Celms, Senior, Anthropology
Mentor: Steve Harrell, Anthropology

There are many government designated minority groups living in the People’s Republic of China. Social characteristics are used to differentiate minority ethnicity people from Han people, the ruling majority in modern China. One classified minority is the Yi people who live in the Southwestern region of the country. Within the broad government classification of Yi, there are other smaller groups with their own language and social characteristics. One of these smaller subgroups is the Nuosu people who live in Sichuan Province. For this project, I focused on the embroidery done by Nuosu women living in the rural village of Yangjuan. After meeting with accomplished embroiderers, watching their techniques, and practicing with their kind guidance, I was able to learn some of the stitches and patterns that are commonly used to decorate their traditional garments. I now have a good understanding of when and how traditional clothes are worn in modern-day Yangjuan. The increasing impact of other cultures coming from outside the small mountain village is interesting to notice and can be seen when the prevalence of modern and traditional styles of dress are compared. The video-taped footage I shot while visiting and working with the women of the village will be made into a short film.

China’s Rural Education in Transition: A Case Study of Yanyuan County, Sichuan Province
Christina Chan, Senior, Economics
Mentor: Stevan Harrell, Anthropology

During the Reform Period, China’s Central government embarked on widespread fiscal and political decentralization in order to combat fiscal inefficiencies. With reforms, lower levels of government have had to become more self-sufficient in providing public goods, which has had a large effect on regional inequalities. This research project looks at the provision of public education in a rural county of Sichuan province and whether the education situation is correlated with the budgetary state of the local government. This presentation focuses on the fieldwork section of the project: an urban to rural gradient comparison of primary schools in Yanyuan County, a mountainous area largely inhabited by minority groups. The local government, due to a lack of resources, no longer pursues the Maoist ideal in which every village has its own elementary school. Instead, the new strategy is to concentrate on building larger, higher quality schools in township areas. In essence, exchanging accessibility to education for quality. We examine five schools from different villages, each representing a facet of the change in local education funding policies: One school is an example of a failing rural school; two are “magnet” schools in more developed areas; two schools are exceptions, maintained by outside funding despite decreased government resources. In the works is also a time series analysis based on documentary research from Yanyuan County’s budget and education reports from 1978 to 2003. This second section looks to determine through regression analysis whether the fiscal policy changes are correlated with the state of education. In the end, the combination of time-series and cross-section data from Yanyuan County will provide a detailed description of the provision of primary education in one of the poorest areas of China.
With 1.2 billion people without access to potable water and 2.4 billion people without proper sanitation services, the expansion of clean water resources in the developing world is of grave concern. Yet, as countries around the world have attempted to tackle the problem, improving access to water has proven to be a great challenge. My research project is an investigation into the attempted privatization of the city of Cochabamba, Bolivia’s water supply and the subsequent social uprising that eventually led to the cancellation of the concession. In particular, I am attempting to understand why the citizens of a city with inadequate water services would fight a reform that was intended to bring significant improvements to access and availability of clean water and sanitation. Among most major development agencies and organizations, private participation in the water sector is considered the contemporary answer to many developing nation’s problems with water scarcity. However, from the outset the majority of Cochabambinos, rich and poor, rejected the concept of water privatization. My research project is thus an investigation as to why privatization was incompatible with the socio-cultural and economic dynamics of Cochabamba. Specifically, I am analyzing the political and social institutions of Bolivia to understand how issues of weak governance effectively undermined the reform. Moreover, I am examining the process of privatization in its entirety and the details of the contract to determine why privatization was met with such powerful resistance.

Exploring the Limits of Global Market Integration and Cross-Continental Arbitrage: The Case of American Depository Receipts Issued by Russian Firms
Ilian Draganov, Senior, Business Administration, UW Bothell
Mentor: Ufuk Ince, Business Program, UW Bothell

In this study we contribute to the literature on global financial market efficiency. We examine statistical and time-series properties of the American Depository Receipts (ADRs) issued by a pool of Russian firms on the New York Stock Exchange (NYSE) in relation to the characteristics of the corresponding securities in their native economic environment in Russia. We focus on forty Russian ADRs that are trading on the NYSE and are therefore subject to extensive regulatory filing requirements with the Securities and Exchange Commission. Using daily stock market and exchange rate data, we identify possible arbitrage opportunities in trading the twin securities across the American and Russian financial markets after taking into account the transaction costs in the stock and currency exchange markets. We examine the degree of price and return divergence using time series regressions with varying lags. In addition, we provide possible explanations for the discrepancy in security price processes in the two markets: market sentiment, microeconomic conditions, regulatory ownership restrictions, and trading hour overlap. The findings enable us to answer the question of how correlated, and therefore efficient, the pricing of Russian ADRs trading on NYSE is. The conclusions of this study have implications for analyzing market efficiency and integration in other emerging financial markets.

Sichuan Peppercorn: The Changing Roles of a Spice in the Culture and Political Economy of Sichuan Province
J. Alexander Kyllo, Senior, International Studies and Chinese
Mentor: Stevan Harrell, Anthropology

Sichuan peppercorn (Zanthoxylum piperitum, in Chinese) grows on prickly ash trees, found in the cool highland regions of Sichuan Province. Ground into a powder or tossed whole into a dish, it combines with the fiery chili pepper to create the mouth-watering, tongue-numbing flavor that defines Sichuan cuisine. My research project investigates the economic and cultural forces that drive the demand for this peculiar spice, and the emerging commodity chain through which the agricultural market meets this consumer demand. The bulk of the production occurs in the minority Yi populated peripheral areas of Sichuan, but the main consumers are the majority Han Chinese, many of whom live in major urban centers such as Chengdu. My analysis thus focuses on how the growth of an urban consumer class and changes in its dietary patterns promote markets for non-essential culinary goods like Sichuan peppercorn, and how consumer demand affects the agricultural activities of minority communities in the rural periphery. The primary product of my research, a Jackson School of International Studies honors thesis, will include a theoretical background on commodity chains and a history of the political economy of Sichuan, supplemented by personal interviews with people in different roles along the Sichuan peppercorn commodity chain, such as farmers, wholesalers, government officials, chefs, and consumers.

Venezuela and Human Rights
Yris Lance, Senior, Global Studies, UW Tacoma
Mentor: Peter Bacho, Interdisciplinary Arts & Sciences, UW Tacoma

Venezuela is a country with countless natural and human resources, such as oil, minerals, and a large professional middle class population. Over its history, Venezuela’s social, political, and economic structures have continually been changing; these changes have increased the struggle to expand and defend human rights. Human rights conquest
and violations throughout the history of Venezuela—the Spanish conquest, colonization, latifundism, caudillismo, and also during democracy have evolved. Many human rights, such as the abolition of slavery, the abolition of the death penalty, free public education, the right to vote, and freedom of expression, have been achieved. Although some of them have been violated, the large number of existent NGOs and organizations supportive of Human Rights continue to keep supervision and control over any intended or perpetrated violations. The evolution of human rights will be studied through the different stages of Venezuela’s history, specifying the social, economic and political achievements and also the improvements and failures to comply with the human rights of the population. The intent is to demonstrate that over Venezuela’s history many human rights have been established, but many of them have also been violated independently of its governmental periods. However, the creation and installation of human rights organizations have made it easier to control these violations by providing support to hold the perpetrators accountable for their crimes. Venezuelans’ search for equality, dignity, and freedom has always been a struggle surrounded by violent changes. The country’s stability has constantly been at risk because of the increased corruption, the favoritism in public decisions, and the unfair distribution of oil profits among the population. Poverty and social inequality, the depletion of the public patrimony, the enrichment of the elite, and impoverishment of the poor have increased the popular discontent, created popular violence and established the need for social, political, and economical changes in the hands of new political leadership.

SESSION 1B

GEOLGY AND MARINE BIOLOGY OF THE GALAPAGOS ISLANDS
Session Moderator: E. Virginia Armbrust
Mary Gates Hall Room 238

Formation of Roca Redonda Island due to development of an extensional transform zone, northern Galápagos Archipelago
Heidi Berkenbosch, Senior, Oceanography
Mentor: Mark Holmes, Oceanography

Although much of the complex geology of the Galápagos Islands and their relationship to the Galápagos spreading center (GSC) 100-200 km to the north remains unresolved, it is thought that the Wolf-Darwin lineament, lying between the archipelago and the GSC, is a result of stresses produced by the transform fault at 91°W. The lineament formed when an oblique extensional transform zone (ETZ), not normally observable at midocean ridge transform faults, filled with magma from the adjacent GSC and from the mantle hot spot plume beneath the western edge if the Galápagos platform. Previously collected low-resolution bathymetry suggested that an incipient ETZ might be present south of the GSC, and that magma leakage along this ETZ might have formed Roca Redonda Island, a small but active volcanic edifice at the northern edge of the Galápagos platform. A 1580 km² area northwest of Roca Redonda was mapped to confirm the existence of features that would be consistent with an ETZ. High-resolution bathymetry and backscatter data were collected along 300 km of track using a Simrad EM300 multibeam mapping system. A 3.5 kHz subbottom profiler collected single-beam bathymetry and reflectivity data simultaneously. EM300 data were edited and processed using Caris® and Fledermaus® software suites. The mapped region contains one segmented 12-km-long ridge, some rough areas of relatively fresh volcanic terrain, and some smooth areas of uplifted (?) sediments blocks that are all oriented in the same direction (278°) as the GSC. A region of small seamounts was also mapped in the southern portion of the study area. Although the volcanic features found during the survey are not oriented in the direction that would be expected for an incipient ETZ, they do indicate that some volcanic process is occurring in the region other than what would be expected from usual hotspot processes.

Is Juana Ridge, the northwestern submarine rift zone of Fernandina Island, Galápagos Archipelago, volcanically active?
Jennifer Glass, Senior, Oceanography
Wesley Thompson, Senior, Oceanography
Mentor: Mark Holmes, Oceanography
Mentor: Daniel Fornari, Woods Hole Oceanographic Institution

A ~20-km-long submarine volcanic ridge extending northwest from Fernandina Island, western Galápagos Archipelago, was studied in January 2006 aboard R/V Thomas G. Thompson. The ridge, hereafter referred to as Juana Ridge, is presumed to have formed by repeated episodes of lateral diking from the magma chamber underlying Fernandina Island, similar to formation processes of the well-studied Puna submarine rift zone east of the Island of Hawaii. Research methods included Simrad EM300 multibeam mapping, sea-surface magnetic measurements, sub-bottom profiling, a towed CTD (Conductivity-Temperature-Depth) survey, and water sample chemical analysis. A search for along-axis and ridge-flank hydrothermal plumes was conducted because active submarine rift zones are often characterized by hydrothermal activity, which is manifested in high silica and low phosphate fluid concentrations as well as temperature and optical transmission anomalies. Whereas no evidence of hydrothermal venting was found,
preliminary inspection of high-resolution multibeam swath data suggests that Juana Ridge is in a juvenile developmental stage characterized by growth of an intrusive core complex at the near-shore (proximal) end, accompanied by abundant surface eruptions. This hypothesis is supported by the well-developed cross-sectional profiles of the proximal axis of Juana Ridge, in contrast to irregular and asymmetric distal cross-sectional profiles. Abundant constructional volcanic morphologies (cones and craters with deep pits) representing sites of primary eruptive venting were identified in multibeam bathymetry maps. Magnetic anomaly data suggest that a magnetic low exists over the proximal portion of Juana Ridge, although topographic correction is required for verification. A pit-crater field (~3000 m water depth) on the northern tip of Juana Ridge correlates with regions of high reflectivity in EM300 backscatter data and is presumed to represent unsedimented, relatively fresh lava flows.

Determining the volume of materials transported by the collapse of Volcan Ecuador on Isabela Island, Galápagos Archipelago, using ArcGIS

Hillary Hall, Senior, Oceanography
Mentor: Mark Holmes, Oceanography

Shield volcanoes such as Hawaii, the Galápagos, and the Canary islands are known to decay rapidly once they become extinct. The decay can result in huge landslides that involve large subaerial and submarine portions of the island. Volcanoes in general are prone to laterally directed eruptions, sometimes associated with landslides, such as occurred with Mount St Helens in 1980. Volcan Ecuador, located on the westernmost tip of Isabela Island in the Galápagos Archipelago, was apparently subjected to a massive collapse approximately 100,000 yBP. The goal of this study was to determine the volume of the material that was transported during this collapse, to further characterize the type of sector collapse that occurred, and to assess the probability that the collapse triggered a tsunami. Using a high-resolution multi-beam mapping system on board the R/V Thomas G. Thompson in January 2006, data were collected which were then used to create a digital bathymetric model (DBM). The volume of the inferred landslide was determined by reconstructing the submarine flank prior to collapse and subtracting it from the DBM. In similar fashion, the volume missing from the volcano was estimated by subtracting the volume of the current volcano from the volume of the digitally reconstructed volcano. Comparison of the missing volume from the volcano to the inferred volume of the landslide suggests that only 24% of the missing volume can be accounted for. The ‘missing’ material could have been ejected into the atmosphere (in the case of an eruption) or have been carried away by the strong currents (in the case of a subaerial/submarine landslide). Alternatively, the pre-collapse model of the volcano could have been substantially in error. The most likely explanation is that the ‘collapse’ involved both a lateral eruption and a massive landslide.

A Characterization of the Equatorial Undercurrent Between 92°00’W and 91°20’W

Kevin Odle, Senior, Oceanography and Earth & Space Sciences
Mentor: Martin Seelye, Ocean & Fishery Sciences

The Equatorial Undercurrent (EUC), also known as the Cromwell current, flows from the western Pacific Ocean to the eastern Pacific Ocean within about one latitudinal degree of the equator. The Galapagos Islands exist on and near the equator in the eastern Pacific and thus represent an obstruction to the flow of the EUC. This study examines how the EUC was disrupted by the western portion of the Galapagos Islands between the 13th and 23rd of January 2006. The specific region of investigation lies between 92° 00’W and 91° 20’W and between 1°30’S and 0°82’N. The majority of the EUC was found to circumnavigate the archipelago around the north side of Isabela Island. Visual aids include Matlab graphics depicting flow at different depths, satellite imagery of surface-water chlorophyll and sea surface temperature, TAO/TRITON data from 95°00’W and 110°00’W, ARGOs and Iridium drifter profiles, CTD profiles, and bathymetry.

Bacterial abundances in and around the Galapagos Islands

Pamela Maynard, Senior, Oceanography
Mentor: Gabrielle Rocap, Oceanography

The highly productive waters around the Galapagos Islands are an anomaly in the eastern equatorial Pacific, a High-Nitrate-Low-Chlorophyll (HNLC) region characterized by relatively low phytoplankton productivity when compared to expected values determined by the amount of nutrients available. The presence of the islands in this region may be one of the reasons for this anomaly, influencing seawater iron concentrations. Studies have shown that phytoplankton growth and productivity are limited when iron is deficient. Bacteria are also influenced by the presence of iron and show an increase in number corresponding to an increase in phytoplankton growth when iron is added to HNLC waters. During 13-22 Jan 2006, bacterial concentrations at seven stations distributed spatially amongst the Galapagos Islands were enumerated aboard the R/V Thomas Thompson to investigate the relationship of bacterial concentration to proximity to potential iron-sources. Samples were taken at the surface, chlorophyll maximum, 250m, 500m, and 1000m and counted using epifluorescence microscopy and DAPI DNA counter-stain. Bacterial concentrations decreased with depth, varying spatially at the surface and in the subsurface (10-20m). Values at the surface ranged between 0.64x10^6 - 3.13x10^6 bacteria mL^-1 while subsurface concentrations were lower (0.58x10^6 and 2.14x10^6 bacteria mL^-1). No recognizable pattern or relationship to water properties or distance to the islands was noted to explain these variations. In addition, an incubation
experiment was conducted from water collected at the chlorophyll maximum from a relatively low chlorophyll standing stock site and incubated for 72 hours with FeCl₃ and an iron chelator (DFOM) amendments to determine the bacteria’s response to iron addition and removal. No statistically significant difference between amendments was observed after 72 hours suggesting that the bacteria were not iron-limited. Thus, bacterial numbers may not be directly influenced by iron in this region but rather by nutrient concentrations or biological interactions.

**Primary Production around the Galapagos Islands and the effects of cloud cover and differing light regimes**

*Benjamin Gilmore, Senior, Oceanography*

*Mentor: Gabrielle Rocap, Oceanography*

The spatial distribution and effect of light intensity on primary production around the Galapagos Islands were studied in late January 2006 using measurements of dissolved oxygen concentration, surface photosynthetically active radiation (PAR) and satellite imagery. Measured primary production values in incubations of differing light intensities were found to be statistically indistinguishable; measurements of daylight PAR also did not correlate with primary production values. Primary production values averaged across treatments displayed much spatial variability. On the west side of Isabela Island, surface waters produced the highest values of production (~ 35 μmol L⁻¹ d⁻¹) with nearly undetectable values produced from sub-surface waters. In contrast, on the east side of Isabela Island sub-surface waters produced the highest values (~ 20 μmol L⁻¹ d⁻¹) with lowest values (~ 7 μmol L⁻¹ d⁻¹) produced from surface waters. The vertical distribution of chlorophyll a in the water column showed a similar pattern, with the maximum at the surface to the west and below the surface to the east. Chlorophyll a size fractions, measured by collaborating scientists, showed a dominance of larger size fractions (mostly diatoms) on the west side and a dominance of small size fractions on the east side. Thus, differences in primary production from the east side of Isabela Island versus the west side of Isabela Island may be due to phytoplankton community composition rather than differing light intensities.

**Carbon remineralization rates in marine sediments beneath areas of high and low primary productivity in the Galapágos Archipelago**

*Jacquelyn Neibauer, Senior, Oceanography*

*Mentor: Mark Holmes, Research Professor, Oceanography*

Predictions of future levels of atmospheric CO₂ rely on the ability to quantify the flux of carbon from ocean waters to the sea floor. Although a portion of the carbon sequestered to the deep sea is effectively isolated from the atmosphere through sedimentary burial, some is remineralized and has the potential to be released back to the atmosphere. To assess the significance and magnitude of this process and its relationship to primary production around the Galápagos Islands, box cores were obtained at five stations near Isla Isabela (three to the west and two to the east) in January 2006 during a cruise aboard R/V Thomas G. Thompson. Four sub-cores were taken from each core to permit replicate analyses. A CTD (conductivity-temperature-depth) sensor package measured oxygen concentrations in the bottom water at each station. Primary production rates were determined at each station; chlorophyll concentrations in the surface waters (0-200 m) were determined using a fluorometer calibrated to extracted chlorophyll values measured at nearby stations. Oxygen consumption rates were calculated by comparing sedimentary oxygen profiles (measured using an oxygen microelectrode) to the profile expected from oxygen diffusion alone. The Redfield ratio (C₁₇₆ O₁₃₈) was used to convert oxygen consumption rates to carbon remineralization rates. The three stations west of Isabela showed little variation in carbon remineralization rates and oxygen penetration depths, with averages of 1.4 x 10⁻⁴ mol cm⁻² s⁻¹ and 7.2 mm, respectively. Primary production rates averaged 13.6 mol C L⁻¹ d⁻¹. The two stations east of Isabela showed oxygen penetration depths of 9.8-12.1 mm and carbon remineralization rates of 6.2-7.7 x 10⁻⁷ mol cm⁻² s⁻¹. Primary production rates ranged from 6.5-9.4 μmol C L⁻¹ d⁻¹. Overall, greater carbon remineralization rates and shallower oxygen penetration depths were found underlying regions of high productivity compared to areas of low productivity.

**Phytoplankton distribution, growth and grazing dynamics around the Galapagos Archipelago**

*Wendy Guo, Senior, Oceanography*

*Tasha Snow, Junior, Oceanography*

*Mentor: Gabrielle Rocap, Oceanography*

Phytoplankton are unicellular photosynthetic organisms that are the foundation of the marine food web. Around the Galapagos islands, the marine ecosystem is characterized by regionally high primary production and chlorophyll concentrations that are uncharacteristic of the surrounding high-nitrate low-chlorophyll waters of the Eastern Equatorial Pacific. In general, satellite images displaying surface chlorophyll concentrations show much higher concentrations west of the island of Isabela, also referred to as the “Galapagos plume”. To better understand this distribution, phytoplankton community composition, distribution, as well as growth and grazing rates were determined at stations east and west of Isabela. Samples were collected with a CTD and net tows from the R/V Thomas G Thompson from the 19th -28th of January, 2006 and analyzed via size fractionated chlorophyll and microscopic analyses. At three of seven stations, intrinsic growth and grazing rate estimates were measured using a seawater dilution technique with the same size fractions in chlorophyll measurements. Additionally, half of the dilution bottles during this experiment were enriched
with a final concentration of 2.0 nM FeCl$_3$. It was found that stations west of Isabela Island had higher total chlorophyll concentrations and chlorophyll maximums at the surface with a dominance of phytoplankton larger than 20μm. The stations east of Isabela had sub-surface chlorophyll maximums that coincided with the bottom of the mixed layer and phytoplankton less than 2μm in size dominating throughout the water column. Overall, the three experiments displayed statistically insignificant intrinsic phytoplankton growth and grazing except for the >20μm size fraction with the addition of iron at a station west and a station east of Isabela. Thus, with differing size composition and standing stock of phytoplankton, our data suggests that iron is limiting on both sides of Isabela.

**SESSION 1C**

**SOCIAL AND PSYCHOLOGICAL FACTORS ACROSS THE LIFESPAN**

Session Moderator: Lisa Kopp, Psychology  
Mary Gates Hall Room 234

**Relationship Between Neighborhood Characteristics and Parental Involvement on Violent Behavioral outcomes among Cambodian and Vietnamese Adolescents**  
Ariana Cantu, Senior, Social Welfare  
Mentor: Tracy Harachi, School of Social Work

Studies have shown that neighborhood characteristics predict adverse outcomes among children and youth, e.g., neighborhood disorganization, lack of prosocial opportunities, and criminal activity in the community (Brook, Noruma, & Cohen, 1989; Griffin et. al., 1999; Hawkins et al., 1992; Leventhal & Brooks-Gunn, 2000). Prior research has also linked adolescent exposure to violence with reports of frequent use of violence (Proctor, L.J., 2005; Sams & Truscott, 2004). Leventhal and Brooks-Gunn (2000) concluded from their review that family factors tend to be more strongly associated with individual outcomes than neighborhood factors, for example, emotional support from parents influence youth more strongly than youth’s perception of support from neighborhoods (Bowen & Chapman, 1996). Cross-Cultural Families (CCF) is a longitudinal study which recruited 327 Cambodian and Vietnamese first generation immigrant parents and their children who originally resided in the Seattle area. This study used CCF data to investigate the perceptions of neighborhood safety, frequency of violence exposure in neighborhoods, and whether neighborhood risk factors were associated with self-reported violent behaviors among Cambodian and Vietnamese youth. The study also examined the relationship between parent involvement in their child’s life as a protective factor for Cambodian and Vietnamese youth against violent outcomes and negative lifestyles, i.e. high rates of parental involvement in the child’s life buffering the effects of neighborhood risk factors for exposure to violence. Data when the youth were an average of 16 years old (s.d. 1.13 years) were used in these multivariate analyses. Additionally using GIS technology and census tract data in Seattle of neighborhood rates of violence, the study maps youth reports of violent behavior and perceptions of neighborhood safety by zip code. This research increases the available information on Cambodian and Vietnamese youth in the field of adolescent social research.

**Parental Perfectionism, Suicidal Ideation, and Emotion Regulation: The Relationship**  
Blair Kleiber, Senior, Psychology  
Mentor: Mary Larimer, Psychiatry & Behavioral Science

High levels of perfectionistic behavior (a.k.a., clinical perfectionism) have been linked to numerous psychological problems, including depression and suicidal ideation, self-harm and plans. Studies have shown that adolescents and young adults exhibiting high levels of perfectionistic behavior are also likely to have parents who do so. In addition, these “young clinical perfectionists” are more likely to attempt or complete suicide than their non-clinically perfectionistic counterparts. The ability to cope effectively with negative emotions (i.e., emotion regulation skills) has been found to buffer people from high intensity negative emotions that increase the likelihood suicidal ideation and suicidal behaviors. Therefore, it would make sense that the greater access to “emotion regulation skills” an individual has, the less vulnerable they would be to the influences of a highly perfectionistic parent or parents. We found that there is a link between perceived perfectionistic parents and suicidal ideation and hopelessness (a predictor of suicidal behaviors). Level of access to emotion regulation skills was also found to have a moderating effect on the relationship between parental perfectionism and suicidal ideation and hopelessness.

**Sex Differences in Autonomic Correlates of Conduct Disorder and Oppositional Defiant Disorder in Middle Childhood**  
James Hong, Senior, Psychology and Sociology  
Mary Gates Scholar  
Mentor: Theodore P. Beauchaine, Psychology

Conduct disorder (CD) and oppositional defiant disorder (ODD) are more prevalent in males than females. Unfortunately, most studies exploring the autonomic correlates of CD and ODD have not included female samples. This study examined potential sex differences in psychophysiological response patterns to reward, extinction, and negative mood induction among children.
Homeless Youth: A Comparative Study
Jacqueline Mishawn Echols, Senior, Psychology
Mentor: Ana Mari Cauce, Clinical Psychology
Mentor: Richard Nobles, Clinical Psychology

Research in the area of homeless youth mental health has increased over the last 20 years, with many studies examining the severe behavioral problems occurring both prior to and during their homelessness. Research in the aforementioned area has not focused on the behavioral problems in the substantial subset of homeless youth who have also had experiences in the foster care system. Research has also neglected to explain the overpopulation of African Americans as well as other minorities in the homeless youth population. A separate examination is indicated, as research has demonstrated that foster care youth often have severe behavioral problems. This study seeks to explore the behavioral problems in minorities and homeless youth who have had experiences in the foster care system and to determine if these youth have more severe problems than their non-foster care counterparts.

Premenstrual Symptomatology in Women with Physical and Sexual Abuse History
Linda de Laveaga, Senior, Psychology, Seattle Pacific University
Mentor: Kathy Lustyk, Psychology, Seattle Pacific University

Comparative studies have shown that women who have been physically and/or sexually abused have more gastrointestinal, gynecological and psychological problems than non-abused women (e.g., Golding, 1999, Bohn & Holz, 1996). Furthermore, women with a history of physical and/or sexual abuse show more severe premenstrual symptomatology (PMS) than non-abused women (Runz, 2002). Our study was conducted to assess the potential mediating effect of perceived stress (i.e., stress) on the relationship between abuse history and PMS in 91 college female students ranging from 18-25 years old. By completing the Cohen Perceived Stress Scale (Cohen, Kamarck & Mermelstein, 1983), Drossman History of Abuse Questionnaire and Shortened Premenstrual Assessment Form (Allen, McBride & Pirie, 1991) we were able to assess individual reports of stress, abuse and PMS respectively. Our results indicate that abused women diagnosed with CD and/or ODD compared with controls. Boys (n=89) and girls (n=46) between the ages of 8 and 12 played a game with conditions of reward and frustrative non-reward, then watched a video designed to elicit feelings of sadness. Respiratory sinus arrhythmia (RSA), cardiac pre-ejection period (PEP), and electrodermal responding (EDR) were recorded. We hypothesize that males and females with CD/ODD will show no differences in physiological responses, whereas normative samples of males and females will.

Medical ethics is a liminal field existing in the space between the sciences and humanities. This middle ground between the bastions of academia creates a fertile ground for utilizing interdisciplinary studies to examine issues that arise with the field. This paper intends to problematize the heavy emphasis medicine places on the principle of
autonomy, and suggest that a solution can be found in the concept of affect. The focus on autonomy has placed medical ethics on an inevitable path of conflict between individuals. As new technologies allow us to extend and suspend life and death, we find ourselves stuck in a battle between individuals: whose autonomy do we respect? By focusing on the individual, we perpetuate the notion that people are islands to themselves, resulting in an isolation and alienation of patient, provider, friend and family, when in reality we are intimately connected not only to our families, friends and even medical providers, but our environment as a whole. I contend that our focus on the liberal human subject has overemphasized the principles of autonomy, and that the solution to this conflict can be found in idea of affect, capacity to touch and be touched. Our current model for understanding and implementing medical ethical decisions is an antagonistic one that sets personal autonomy against personal autonomy, generating animosity and conflict. The argument for moving towards an affect-centered ethics is an attempt to alleviate the conflicts of autonomous medical ethics by resituating ourselves to a position that both questions and acknowledges how we are all connected to one another. This paper places an emphasis on affect offering a more complicated and comprehensive view of the medical humanities, and our process of ethical decision-making.

SESSION 1D

AQUATIC ENVIRONMENTS: FROM MICROBES TO MEGAFORA
Session Moderator: Jennifer Ruesink, Biology
Mary Gates Hall Room 288

Isolation and characterization of viruses of the toxic bloom-forming diatom Pseudo-nitzschia
Benjamin P. Johnson, Senior, Oceanography
Mentor: Gabrielle Rocap, Oceanography

Marine diatoms of the genus Pseudo-nitzschia (Bacillariophyceae) are significant globally-distributed bloom-forming algae. Several Pseudo-nitzschia species are known to cause amnesiac shellfish poisoning events. These diatoms generate domoic acid (DA), a potent neurotoxin. During bloom conditions, large amounts of the toxin can be bioaccumulated in the flesh of organisms feeding on the diatoms. Sufficiently high DA levels lead to commercial and recreational shellfishery closures. In late September of 2005, shellfisheries in Sequim Bay, Washington, were closed due to high DA levels caused by a large Pseudo-nitzschia bloom. Phytoplankton blooms such as this have been shown to be modulated by marine virus populations by preferential infection and/or growth inhibition of the dominant species. However, no viruses infecting Pseudo-nitzschia have yet been described. In an effort to obtain a virus of Pseudo-nitzschia, water samples were taken at six locations in Sequim Bay on 20 September 2005. 0.22µm filtrates of the samples were screened for the presence of a viral pathogen of three Pseudo-nitzschia species: P. pungens, P. multiseries, and P. sp233 (species-unknown) by most-probable number (MPN) and extinction-dilution assays. The data presented here includes the initial infections of Pseudo-nitzschia spp., isolation of viral clones, and preliminary characterization of the clonal isolates.

Characterization of the Methylotrophic Bacterial Community in Lake Washington
Sarah Bowerman, Senior, Biology
Advanced Undergraduate Research Fellow
Mentor: Mary Lidstrom, Chemical Engineering and Microbiology
Mentor: Marina Kalyuzhnaya, Chemical Engineering

Methylotrophy is the ability to utilize C1 compounds, such as methanol, methylamine and methane as a single source of energy and carbon. The methylotrophic bacteria play an important role in environmental carbon and nitrogen cycling. Methylotrophic bacteria are also important for possible use in bioremediation, the use of living organisms to safely dispose of hazardous waste. While the methane-utilizing community of Lake Washington is very well described, so far knowledge of non-methanotrophic C1 utilazers is limited to a small group of “specialists” such as Methylophila and Methylbacterium that can be easily enriched at methanol-selective conditions. However, these species represent only a minor part of the natural population and do not reflect the complete metabolic potential of the natural environment. To assess the methylotrophic bacterial community in Lake Washington I followed two lines of research, one culture-independent (flow cytometry-based cell separation) and one culture-based (enrichment and taxonomical description). To determine the diversity within the lake Dr. Kalyuzhnaya and I used the Fluorescence-Activated Cell Sorting (FACS) method to collect cells possessing methylotrophy function from the bacterial community. We then conducted Polymerase Chain Reaction (PCR)-based analysis of these cells, identifying a new group of methylotrophic bacteria carrying novel divergent methylotrophic genes. Several of the bacteria were successfully isolated from sediment after enrichment on formaldehyde, the toxic compound that accumulates in lake sediment as a side product of the decomposition of organic material. My research was focused on further characterization of these important members of the lake sediment microbial community. I conducted several genetic, phenotypic and metabolic assays. We found that the isolates were closely related to beta-proteobacteria, detected in several environmental niches across the world,
such as soil, deep sea, and groundwater. Characterization of the isolates resulted in formal description of the two novel bacterial genera from beta-proteobacterial phyla: *Methylotenera* and *Methyloversatalis*.

**Stable Isotope Fractionation during Copper Limitation by Denitrifying Bacteria**
*Greg Horn, Senior, Earth & Space Sciences, Microbiology*
*Mentor: Roger Buick, Earth & Space Sciences*

Denitrification, the reduction of oxidized nitrogen compounds to nitrogen gas, is an important process in the biogeochemical cycling of nitrogen. This process is mediated by bacteria under anaerobic conditions, and can be monitored by the fractionation of stable isotopes that occurs in biological systems as one isotope of a given element is favored due to a lower mass. My research focuses on the fractionation of stable isotopes of carbon and nitrogen by three species of denitrifying bacteria: *Pseudomonas stutzeri*, *Pseudomonas chlororaphis*, and *Paracoccus denitrificans*. Denitrification in these bacteria relies upon a series of reductions of nitrogen oxide species catalyzed by enzymes, one of which, nitrous oxide reductase, contains 8 copper atoms. As these bacteria grow, copper in the growth medium becomes depleted and unavailable for use. We hypothesize that copper limitation will inhibit the progress of denitrification and change its products. Concentrations of two nutrients, nitrate and nitrite, are determined using spectrophotometric analysis to infer the growth stages of the bacterial cultures. Bacteria and media samples are then analyzed by mass spectrometry to determine if fractionation of carbon and nitrogen has occurred, and if it varies by growth stage. Variable fractionation of stable isotopes during denitrification may serve as a basis for further stable isotope studies of Proterozoic sediments between 1.0 and 1.8 billion years old for possible perturbations in the nitrogen cycle. A current model of ocean chemistry (Canfield, 1998) holds that the oceans during this time were euxinic (sulfide enriched and anoxic). High sulfide concentrations would have scavenged much of the copper making it unavailable for biological use allowing only partial denitrification, increasing the concentration of nitrous oxide in the atmosphere. This has implications for greenhouse warming under a faint young Sun and for more recent times as nitrous oxide is a very powerful greenhouse gas.

**Spatial Variation in Stable Isotope Signature of Benthos in Puget Sound, Washington**
*Alex Lowe, Senior, Aquatic and Fisheries Sciences*
*Mentor: Tim Essington, Aquatic and Fisheries Sciences*

Nitrogen isotopes are a robust measure of trophic level and are very useful in food web studies. Nitrogenous wastes addition through sewage outfalls has been observed to cause $^{15}$N enrichment of the organisms in a system. This enrichment effect can confound the meaning of the isotopic signature as it applies to the food chain. Puget Sound is an estuarine system with a high rate of input of anthropogenic nitrogenous waste through deep-water sewage outfalls. This study analyzed the Nitrogen isotope signature of the benthos to determine the effects of the sewage outfalls. Sediment samples were collected from 17 stations in the main basin of Puget Sound. Benthic organisms found in the samples were identified and prepared for LC/MS analysis for stable isotopes. It is expected that the organisms from sites near the sewage outfalls will be $^{15}$N enriched, while sites farther from the outfalls are expected to have lower $^{15}$N; though the long residence time of the deep water in Puget Sound could lead to a more uniform, enriched $^{15}$N signal. This study will also provide important community composition and a baseline benthic isotope signature to a concurrent, large-scale study of the Puget Sound food web.

**Demographic similarities and differences between Zostera japonica in its native (Korea) and introduced (Willapa Bay) habitats**
*Stacey L. DeAmicis, Senior, Botany*
*Mentor: Jennifer L. Ruesink, Biology*

Biological invasions are understudied in marine systems, despite the fact that coastal ecosystems are heavily invaded. The small eelgrass species *Zostera japonica* arrived in western North America around 1957, probably with oyster imports. To understand *Z. japonica*’s invasion process, we studied its demography and morphology in Willapa Bay, WA. Sampling occurred at near monthly intervals at two tidal elevations at each of three sites in 2004-2005. We found that i) *Z. japonica* is perennial but its shoot density declines by 50-80% over winter; ii) sexual reproduction is substantial (at least 30% of shoots flower) and successful (new recruits contribute 10-65% of all shoots in the spring); and iii) growth is rapid (1 cm/d), with total annual production estimated at 4.79 x 10$^6$ kg DW/yr, or 14% of native eelgrass production. A recent publication from Korea allowed us to compare *Z. japonica* in its native and introduced ranges. Some seasonal patterns were similar, in particular, peak germination in April, peak growth rate in mid-late summer, and reproduction from June to September. In contrast, the Korean population showed little seasonal variation in shoot density, and plants there tended to be larger, with lower proportions of flowering shoots. We suspect that *Z. japonica*’s successful invasion stems in part from high reproductive ability that enables it to overcome stressful overwinter conditions.

**Genetic Species Identification of Juvenile Rockfish**
*Rose Okamoto, Senior, Aquatic and Fishery Sciences*
*Mentor: Danielle Mitchell, Aquatic and Fishery Sciences*

Rockfishes, (*Sebastes spp.*), are a speciose and widely
distributed group of marine fishes in the Pacific Ocean, consisting of 102 described species worldwide. Several species of rockfish have been exploited commercially and recreationally, resulting in population declines. Conservation efforts directed towards rockfishes have been hindered due to the lack of effective methods in identifying species. Specifically, different species of juvenile rockfish may share the same niche at some point in their development, and are often morphologically indistinguishable from one another. The ability to identify them to species would provide further insight into their various life histories and would thus aid conservation and management. The goal of our study was to identify juveniles of two species (redbanded (*Sebastes babcocki*) and tiger (*Sebastes nigrocinctus*) rockfish) by PCR amplification of the mitochondrial DNA ND 3/4 region and restriction fragment length polymorphism (RFLP). Juvenile rockfish samples, the majority of which were assumed to be tiger and redbanded rockfish, were collected from the Olympic Coast National Marine Sanctuary in 2002. We received a total of 104 fin clippings for genetic analysis; we were able to successfully differentiate between the two species. Our genetic analyses of the 104 samples show the majority of them to be tiger rockfish. Genetic identification of juveniles of these two species will have further implications into conservation and will aid in a collaborative study focusing on the trophic ecology of redbanded and tiger rockfish at this early life history stage.

**Abundance Estimates of Sixgill Shark (*Hexanchus griseus*) in Puget Sound**

Brian Langseth, Senior, Aquatic & Fishery Sciences, Applied & Computational Mathematical Sciences

Mentor: Vincent Gallucci, Aquatic & Fishery Sciences

Estimating abundance is crucial in determining the role a species has in its environment. Longline surveys were conducted from 2003-2005 to estimate abundance and other demographic parameters of sixgill shark (*Hexanchus griseus*) populations in Puget Sound and the San Juans. Sixgill sharks are large, benthic predators and thus have the potential to heavily impact their environment. Increases in their population have been observed over the last decades but, because they have not been adequately studied, their impact is unknown. Multiple measures of abundance exist, the most common of which relates catch per unit effort (c.p.u.e.) to abundance through a catchability coefficient. This coefficient is typically linear, but can also be nonlinear. Another measure of abundance involves line transect theory, which relates abundance to both the number of sixgills caught on the longline, and the estimated number of sixgills missed. Preliminary estimates of abundance using line transect theory resulted in a density (± 95% CI) of up to 12.6 ± 2.9 sixgills/km². This estimate seemed high and many uncertainties exist. Therefore other methods of measuring abundance are currently underway.

**Session 1E**

**Of Mice and Men (and Flies, Worms, and Bacteria): Studies of Function via Biochemistry, Genetics, Neurobiology, and More**

*Session Moderator: Rachel Klevit, Biochemistry*

Mary Gates Hall Room 271

**Structure and function of two vital human stress proteins: αB-crystallin and HSP27**

Erik Miller, Senior, Microbiology

Mary Gates Scholar

Mentor: Ponni Rajagopal, Biochemistry

Mentor: Rachel Klevit, Biochemistry

Two human proteins, αB-crystallin and HSP27, members of the small heat shock protein (sHSP) family, are known to be important for human cells to deal with stresses such as extreme heat or pH. Defects in these two proteins are linked to numerous diseases, namely cataracts of the eye, Alzheimer’s Disease, and certain neural and muscular diseases. It is believed that sHSPs act primarily as chaperones; they prevent misfolded proteins from aggregation, which can cause havoc in the cell. Unfortunately, conclusive data on the structure, mechanism, or specific roles of αB-crystallin and HSP27 in healthy or diseased individuals is sparse. My project aims to shed more light on the mode of action of these two proteins by pursuing four goals: to study the chaperoning activity of αB-crystallin, to examine interaction between αB-crystallin and HSP27, to obtain information about the three-dimensional structure of HSP27, and to study the oligomerization of αB-crystallin. I will use chaperone assays using light scattering to investigate how αB-crystallin functions. With regards to the interaction, there is *in vivo* evidence that αB-crystallin and HSP27 interact in certain cell types, and this interaction may yield an important function. I have and will conduct experiments, primarily using Nuclear Magnetic Resonance Spectroscopy (NMR), to look for, and subsequently characterize, an *in vitro* interaction between the core domains of the two proteins. To elucidate structural data on the core domain of HSP27, which will help illuminate its function and mechanism, I have and will also use NMR. Finally, I have made a chimeric protein, a hybrid between a bacterial protein of known structure and αB-crystallin, to inform how αB-crystallin forms homo-oligomers. All of these studies will provide insights into the nature of these two sHSPs.
Identify the interaction between αB crystallin and growth factor ligands and cell death modulator ligands.

Ananth Shenoy, Senior, Biochemistry
Mentor: John I. Clark, Biological Structure

αB crystallin is a member of the small heat shock protein family and is a molecular chaperone involved in protecting and refolding unfolded proteins. αB crystallin interacts with a broad range of proteins including extracellular signaling molecules like growth factors and molecules involved in modulating cell death like proteases. Our goal was to determine whether the growth factors EGF, FGF, IGF, NGF-β, TGF-β, and VEGF and the cell death modulators β-catenin, Bel-2, Bel-2, caspase-3, caspase-8, and TNF-α directly interacted with αB crystallin and to identify sites on αB crystallin that mediated these interactions. The interactions between αB crystallin and the target proteins were assessed via a peptide scanning method known as protein pin array which measured binding between sequential fragments of αB crystallin and the growth factor and cell death modulator proteins. The growth factors FGF, NGF-β, and VEGF and the cell death modulator β-catenin did interact with αB crystallin while the growth factors EGF, IGF-1, and TGF-β and the cell death modulators Bel-2, Bel-2, caspase-3, caspase-8, and TNF-α did not significantly interact with αB crystallin. The sites on αB crystallin that mediated these interactions were identified and corresponded to regions on αB crystallin responsible for chaperoning unfolded proteins, suggesting that the interactions identified by the protein pin array were chaperone interactions.

Insights into the Signal-Sensing Mechanism of Salmonella PhoQ

Anna Schneider, Senior, Biochemistry and Mathematics
Mentor: Rachel Klevit, Biochemistry
Mentor: Sam Miller, Microbiology

Two-component systems are a class of very common regulatory systems used by many Gram-negative bacteria to control essential cell functions related to pathogenesis. Each two-component system is composed of a sensor kinase protein that, when activated by a signal, phosphorylates a specific partner protein that regulates gene expression. One such sensor kinase is PhoQ, an integral membrane protein in Salmonella. PhoQ contains a transmembrane domain, an extracytosolic sensor domain, a second transmembrane domain, and a cytosolic histidine kinase domain. We are seeking to determine the biochemical mechanism by which the sensor domain of PhoQ senses the environmental signals Mg$^{2+}$ and pH. Specifically, we are investigating changes in the protein’s three-dimensional conformation that result from the sensing event. Our primary technique is multidimensional nuclear magnetic resonance spectroscopy (NMR), which detects the chemical environment of each amino acid residue within the protein and allows one to track dynamic changes in protein conformation in solution. Each peak in a NMR spectrum corresponds to a specific residue in the protein. We used two types of three-dimensional NMR spectra to assign most of the peaks to their corresponding amino acids in the sensor domain of PhoQ. The first type of experiment provides information about through-bond interactions along the protein backbone, while the second type provides information about through-space interactions indicative of both primary and secondary structures. These peak assignments have allowed us to pinpoint several clusters of residues in the PhoQ sensor domain that are strongly affected by changes in concentrations of Mg$^{2+}$, H+, or both.

Engineering yeast Phenylalanyl-tRNA Synthetase to allow incorporation of a Diverse Set of Non-natural Amino Acids

Wafa Hassouneh, Junior, Bioengineering
Mentor: Rupert Davies, Bioengineering
Mentor: Richard To, Bioengineering
Mentor: Patrick Stayton, Bioengineering

Proteins are essential for most processes occurring within living organisms. Therefore, engineering and manipulating proteins allows us to implement them in the drug delivery systems and microfluidics/diagnostic applications. One method developed recently to control protein activity is attaching a polymer near the catalytic site. These polymers are generally attached to the protein’s native amino acids. My project aims to facilitate polymer attachment by the addition of non-natural amino acids (nnAA) to the target protein. The addition of an atom transfer radical polymerization (ATRP) initiator based non-natural amino acid will eliminate the reliance on native amino acids and should allow for greater conjugation efficiency. To incorporate a nnAA into the amino acid sequence of a protein, the nnAA must first be bounded to a specific tRNA. This coupling between tRNAs and amino acids is catalyzed by a family of enzymes known as Aminoacyl-tRNA synthetases (aaRS). Our aim is to create mutants of phenylalanyl-tRNA synthetase (PheRS) using site-directed mutagenesis. The mutated PheRS will allow the binding of bulkier non-natural amino acids that are chemically similar to phenylalanine. We have designed mutations of the PheRS which we hypothesize will open up the binding site to allow bulky nnAA to bind. The aim of the mutations is to displace an amino acid loop within this site. The mutated amino acids either interact with the substrate or interact with neighboring amino acids that anchor the loop in place. The displacement of the loop should decrease steric hindrance felt by bulkier substrates.

Contractile Ring Assembly in the C. elegans Embryo

Mai Truong, Junior, Environment Health
Mentor: Ed Munro, Biology
Mentor: George von Dassow, Biology

Mentor: Patrick Stayton, Bioengineering
To test if the HPA axis has been altered by ablation of chronically increase levels of CRF and alter the HPA axis. Thus, loss of NPY/AgRP neurons removes neurons excite neurons in the paraventricular nucleus (PVN) which release corticotropin releasing factor (CRF) into portal circulation to the anterior pituitary. NPY/AgRP neurons excite neurons and decrease CRF release. Thus, loss of NPY/AgRP neurons removes inhibitory tone on POMC neurons and is predicted to chronically increase levels of CRF and alter the HPA axis. To test if the HPA axis has been altered by ablation of NPY/AgRP neurons, we will assay plasma corticosterone levels in the mice under basal conditions and after fasting. We will also measure corticosterone before and after introduction of liquid diet.

**Session 1F**

**ROBOTS AND VISION**

Session Moderator: Dieter Fox, Computer Science and Engineering

Mary Gates Hall Room 389

Infection Imaging using Paramagnetic Nanoparticle-Labeled Leukocytes

Jamie Bishop, Senior, Bioengineering

Mentor: Satoshi Minoshima, Radiology and Bioengineering

The goal of my research is to develop and optimize a technique for imaging internal infections with magnetic resonance (MR) imaging. My research employs leukocytes (white blood cells) as vehicles to transport MR contrast agents (paramagnetic nanoparticles) to a potential site of inflammation or infection. The ability of the leukocytes to circulate through the blood to the site of infection makes them an attractive candidate as an efficient and reliable transport for MR contrast agents to the site of infection. Leukocytes in blood are able to recognize the contrast agents as foreign, ingest them, and then travel through the circulatory system until they are attracted to an inflamed tissue site. MR tracers are ferried to the site of interest so that they may be imaged using MR imaging. A previous work [1] indicated feasibility of this approach, but recent developments of new paramagnetic nanoparticles and MR imaging capability allow us to investigate further leukocyte labeling technology that is applicable to human subjects. In this study, MR contrast agent concentrations in labeled leukocytes and leukocyte viability after labeling were examined in vitro and in vivo to determine the amount of contrast agent that can 1) be carried without inhibiting cell movement or viability and 2) induce a visible signal during MR imaging. The techniques used to perform infection imaging are widely relevant to the clinical setting. Knowing the precise size and location of an infection would be helpful in diagnosis and treatment. This technique will also be useful for the evaluation of pathologic processes in which leukocytes play a major role, such as atherosclerotic plaques. In addition, the technique of labeling leukocytes with paramagnetic nanoparticles can also be applied to label leukocytes with pharmaceuticals for the purpose of drug delivery to a site of inflammation or infection.

Spatially-adaptive Dither
Jayson Bowen, Senior, Electrical Engineering
Mentor: Maya R. Gupta, Electrical Engineering

A spatially-adaptive dither algorithm aims to increase image quality on printing devices that use dither for digital halftoning. Halftoning is a very important aspect of signal processing which affects everyone who uses any printed media today. It exists because most print devices only have a limited number of pigments, but have to represent a large number of color tones to make up the image. Digital halftoning is used to increase tonal resolution in exchange for spatial resolution. Dither, one halftoning technique, is used in devices such as laser jets and magazine presses because it is fast and robust to printing variations. However, dither softens edges. Spatially-adaptive dither aims to retain most of the speed and robustness of dither, while also increasing the edge sharpness lost by standard dither methods. This is done by segmenting the image using small sliding windows for each color plane and deciding how much spatial activity there is within each window. If sufficient activity is detected, then that window is halftoned with another technique that preserves sharpness, otherwise standard dither is used for that window. Currently, we are investigating three techniques that spatially-adaptive dither can use to enhance edges. They are: cluster dither, which groups similar values together and dithers those groups independently; small dither, which simply uses a smaller dither screen, thus increasing sharpness by trading off tone levels in active regions, where the tone difference is not seen; and error diffusion, which is best at preserving edges but worst at reproducing smooth regions. Our results have shown that edge sharpness does increase using these new techniques, but continued work in stabilizing the quality and simulating other printing conditions is needed.

Computer-Controlled Mixing for a Self-Assembly Robotics Testbed
Sam Burden, Sophomore, Electrical Engineering
Mentor: Eric Klavins, Electrical Engineering

Self-assembly is a process whereby numerous simple components interact locally to produce a macroscopic effect. It pervades the natural world, driving everything from chemical reactions to protein synthesis. The goal of the current research is to investigate self-assembly as a paradigm for controlling the assembly of robotic devices. We previously built a set of robotic tiles which can assemble into predictable structures if they are mixed randomly on an air table testbed. Effectively mixing the tiles is critical to the research conducted with these robots. Consequently, I have been building a mixing system that uses computer-controlled solenoid valves to release bursts pressurized air that force the tiles around the air table; this design imitates a mixing algorithm used in a computer simulation of the testbed. My current goal is to investigate the role mixing plays in determining assembly yield in our system. I intend to characterize the kind of mixing that helps the robots assemble and implement several forms of feedback-controlled mixing. As an example, I should be able to control the average kinetic energy of the robots using velocity data taken from images of the tabletop. These results will be useful when investigating the current testbed and may be applicable in other contexts like MEMS-scale assembly.

Semi Autonomous Powered Reciprocating Gait Orthosis AKA Robot Suit
Monty Reed, Junior, Pre-Major
Mary Gates Scholar
Mentor: Steve A. Stiens, Rehabilitation Medicine

Development of a Semi Autonomous Powered Reciprocating Gait Orthosis (SAPRGO Robot Suit), a new passive physical therapy device that can also be used for mobility needed for Rehabilitation Medicine. They Shall Walk is a project to develop such a device. The current version under development is known as the LIFESUIT Prototype Fourteen (LS14). Future versions will be known as the Access Suit. Is it possible to develop a light weight passive physical therapy device that can hold a patient upright while assisting with balance and facilitation human gait? Investigation from 2001 to present has studied human gait, physical therapy and mobility issues. Development and construction of thirteen prototypes has determined the feasibility of such a device. March 13, 2005 a field trial was conducted with LS12 over a 3.1 mile race known as the St Patrick’s Day Dash. Official recorded time was one hour and thirty five minutes. Currently LS14 is under construction with the expected outcome of a SAPRGO that can balance and walk while a paraplegic is wearing it. It is further expected the SAPRGO will offer therapists a device patients can wear to walk the halls of a hospital ward for exercise. The SAPRGO should benefit persons with any limited mobility to attain exercise.

The Mimic of Insect Flight: Flapping Robotics
Tao Tao, Junior, Mechanical Engineering
Mentor: Minoru Taya, Mechanical Engineering
Mentor: Yuan Chang Liang, Mechanical Engineering

The first appearance of winged insects is shrouded in the past, but they probably took to the air almost 350 million years ago. Recently, interest has developed in small autonomous flying vehicles, largely motivated by the need for aerial reconnaissance robots inside buildings and confined spaces. Industry, commerce and the military have all identified potential roles for such micro-air vehicles. The Defence Ministry plans to develop sophisticated unmanned fighter jets equipped with a radar-evading stealth function by 2020. C.I.M.S. is one of five research
inhospitable who have been engaging in a specific area. CIMS is responsible for designing and simulating the wing of the flapping robotics. The aim of CIMS Flapping Robotics is to design a Bumble bee analogous flapping robot, which is able to be aloft in air with the greatest wing flapping angle approximate 120 degree at 100Hz. Most of initial creative designs are based upon mimicking insects’ wings. In order to ascertain the inherent characteristics of the flapping robotics, a great deal of empirical, theoretical and computational simulation approaches are implemented throughout the whole research. A rig with a high speed camera could enable researchers to observe the characteristics of modal and vibration dynamics. Also a rig with hot wire high sensitive sensor could assist us to find out some crucial data about the air flows adjacent the wing, which determines whether a flapping robot manages to take off vertically. Researchers apply dynamics, structures, and fluids mechanics etc. to maintain results consistency. In addition, Computational simulations (Ansys, CAE) play a paramount role for researchers to establish a virtual model (CAD) in an engineering work station and, then there is a circulation which comprises of simulation, analysis and modification during the design process.

**Fostering Human-Robotic Interactions Through Vision-Based Activity Recognition**

Jean Yanni Wu, Junior, Computer Science, Bioengineering  
Boeing/OMA Scholar  
Mentor: Rajesh Rao, Computer Science & Engineering  
Mentor: Aaron Shon, Computer Science & Engineering

The goal of this project is to develop a model of social interaction between humans and humanoid robots. A robot has to be able to detect a human in order to interact with her or him. We implement an autonomous system for recognizing human poses and other objects in our humanoid robot, a Fujitsu HOAP-2. The robot displays a set of different behaviors based on what it observes through its built-in video camera. We use Principal Component Analysis (PCA) and color segmentation to identify human poses or the object in question. Although a human-controlled robot can perform similar tasks, input latency poses a problem. Because an autonomous robot can react faster, it can interact more naturally with humans. This application can be employed in research in other fields such as work in cognitive psychology, where autonomous robot is used to study development in infants.

**Feature-Based Classification for Mouse Eye Image Recognition**

Jenny Yuen, Senior, Computer Engineering  
Mentor: Linda G. Shapiro, Computer Science & Engineering

Cataracts are a common illness and there are hypotheses associating them to other illnesses such as Alzheimer’s disease and diabetes. Because of the different effects of each type of cataract, the classification of cataracts is important in the medical field. In order to prove or disprove the previous hypotheses, current studies are performed in mice eyes with the intention of testing it in humans in future studies. Given a set of images of known categories, we want to create an automated classifier that can tell, given another image whose category we do not know, the category to which it corresponds. Using information from the image such as color and texture, we can extract the eye-ring formation pattern and the appearance of certain regions of the eye. With this information from each image, we can create a model for each category. However, an image contains not only the information we are interested in, but also noise due to illumination problems; the size and form of the eyes can vary depending on the particular mouse, and the characterization of each type is not obvious in some cases even to the experts. Our initial model used the ring pattern of the eye together with the intensity distribution of a horizontal line through its center to determine the class of an image. The initial results showed that we have been able to characterize some of the categories very well, while others can still be confused. The latest research methods that we have developed involve adding two more features considering the distribution of intensities in specific areas of the eye and the patterns of these local intensities. The current model has been created for 4 classes of cataracts and has generated more accurate results compared to its predecessor.

**SESSION 1G**

**AFFAIRS OF THE HEART AND GUT:**  
**PROBING CLINICAL ANSWERS TO DISEASE**

*Session Moderator: Lindus Conlan, Biochemistry*  
*Mary Gates Hall Room 231*

**EMD 57033 and its Effects on Force Production and Kinetics of Cardiac Muscle**

Kristina Bezold, Senior, Bioengineering  
Mentor: Michael Regnier, Bioengineering

EMD 57033, a positive ionotropic agent, is being studied as a means to increase the pumping capacity of a heart which has experienced heart failure. The research of my laboratory and others has determined three possible mechanisms of contractile effects: increased Ca\(^{2+}\)-binding to Troponin C, a subunit of an actin regulatory protein, increased actomyosin interaction, or altered kinetics of force generation. My research focuses on the last of the three possible mechanisms. It has been determined that EMD 57033 can increase the force output at maximal...
Ca\textsuperscript{2+} concentrations (pCa 4.0) by 38±8\% (n=10) in rat cardiac muscle (trabeculae). To try to account for this drastic increase in force, many aspects of the kinetics of force production were tested. We found that there was no significant differences in the rate of force redevelopment (k\textsubscript{f}), stiffness (high frequency sinusoidal, HFS), unloaded shortening velocity (slack testing, SLT), and chord stiffness (CHS). The first three experiments have been completed (sarcomere length 2.3µm) and analyzed, with t-tests showing conclusively that there is indeed no difference. The chord stiffness experiments will be done at sarcomere length of 2.0µm to minimize passive force production and stress on the muscle fiber. Preliminary studies indicate no significant differences in this kinetic measurement either. This data implicates that the large increase in force production is not a result of changes in the kinetics. Additional studies examining the other two mechanisms above lead us to believe the increase in force is primarily due to an increase in actomyosin interactions. Further studies hope to confirm this proposition.

The Role of Cardiomyocyte Apoptosis in the Development of Cardiac Fibrosis
Téja Dyamenahalli, Senior, Molecular, Cell and Developmental Biology
Mentor: April Stempfien-Otero, School of Medicine, Division of Cardiology

Cardiomyocyte (CM) apoptosis is elevated in many cases of end stage heart failure. Cardiac fibrosis is a common phenotype of heart failure. In previous studies we have shown that in SR-uPA transgenic (TG) mice there is an increase in plasmin-dependent cardiac fibrosis (CF). We hypothesize that in these mice, plasmin causes the pericellular proteolysis of laminin, an extracellular adhesive glycoprotein that acts as a bridge between the cell membrane and the basal lamina. Consequently, due to the loss of cell-matrix contact, apoptosis is induced. Apoptosis of CM then leads to replacement fibrosis. To test this hypothesis, we will be measuring CM apoptosis in the hearts of SR-uPA transgenic and non-transgenic (NTG) mice using TUNEL staining of apoptotic nuclei in situ. In addition, since caspases are known mediators in the apoptotic pathway, we will perform immunostaining for cleaved caspase-3 (CC3), a downstream effector caspase, in TG and NTG heart sections. Mouse thymus sections will serve as a positive control. We will also perform western blot analysis for CC3 on TG and NTG heart lysates. Lysates of camptothecin treated and non-treated 293 cells will be positive and negative controls respectively. To test the hypothesis that cleavage of a specific matrix component is associated with apoptosis, we will perform immunostaining for laminin on TG and NTG mice heart sections. We expect to find increased apoptosis in SR-uPA TG versus NTG hearts as indicated by a greater number of TUNEL staining and CC3 positive cells in TG hearts than in NTG hearts. As well as a stronger CC3 signal on the western blot of TG heart lysates. Additionally, we expect to see a decrease in total laminin staining in TG versus NTG heart sections. Elucidating the mechanisms that lead to CF has major implications for the treatment of the disease in humans.

Imaging the Esophagus: Balloon Catheter
Henry Fu, Senior, Bioengineering
Mentor: Xingde Li, Bioengineering

Barrett’s Esophagus is an acquired condition which occurs in a patient’s lower esophagus. The condition occurs when the tissue cells in the lower esophagus sustain damage from stomach acid. Rather than the normal cells regenerating, cell types similar to the stomach lining grow instead, which has a stark visual contrast than the normal esophagus. The importance of Barrett’s Esophagus lies in the fact that patients with it have a higher chance of developing adenocarcinoma, cancer in the lower esophagus. Once patients are diagnosed with Barrett’s Esophagus, they undergo an endoscopic screening program plus biopsy to monitor any progression of the disease and identify adenocarcinoma in its early stage. The current screening method is takes excessive amount of time, with a limited amount of effectiveness in identifying adenocarcinoma. This research project aims to develop a new technique to screen patients at risk for adenocarcinoma. Optical coherence tomography (OCT) is an imaging modality which uses low coherent light to generate high resolution cross sectional images. OCT would be an ideal imaging technique to screen for adenocarcinoma. In order to use OCT to survey the entire esophagus, a special type of imaging catheter must be designed and constructed. We have completed the catheter design which overcomes the challenging of offering a high-resolution while keeping the optics small. Currently I am in the process of prototyping and testing an imaging catheter. Future works involve conducting OCT imaging of a phantom and biological tissues ex vivo to characterize the performance of the catheter. Using the images obtained in the animal tests, we could determine if the image quality is high enough for clinical imaging. Design optimization will be carried out if needed. The goal of this project is to eventually usher in a new imaging technology to combat a deadly clinical disease.

The effect of EMD 57033 on regulatory protein interactions in muscle
Megan Ham, Senior, Bioengineering
Mentor: Michael Regnier, Bioengineering

Hypertension, defined as a disease of high blood pressure, has been diagnosed in over 50 million Americans. Many drugs have been proposed to solve muscular deficiencies like hypertension, but these drugs can also hinder the function of other muscles in the process. For instance, the drug EMD 57033 (EMD) was originally designed to
increase the muscle force produced in the heart. EMD never made it through FDA testing; it is known to enhance cardiac muscle, but the drug has no specificity towards cardiac muscle over the other muscle tissues in the body. My research focuses on the mechanism by which EMD is affecting cardiac, fast skeletal (psoas) and slow skeletal (soleus) muscle. Each muscle type contains different isoforms of the proteins that regulate force production. EMD is believed to change the interaction between these regulatory proteins resulting in an increased force production. A side-by-side comparison of force produced by these muscle types will probe the differences in these isoforms and allow the mechanism by which EMD operates to be analyzed. I have analyzed psoas and soleus fibers by mounting a single muscle fiber on a force transducer and bathing the fiber in calcium (Ca\(^{2+}\)) solutions in the presence and absence of EMD. Soleus fibers showed a significantly larger response in force production than psoas fibers. Other work with cardiac muscle shows an even higher force production under the influence of EMD. From the completion of this work we hope to determine the mechanism of EMD and differences in regulatory proteins between different muscle types.

**Protein profiling of neonatal cardiomyocyte grafts and adult rat cardiac tissue after myocardial infarction**

*Elizabeth A. Miller, Senior, Bioengineering*

*Alicia Moreno-Gonzalez, Bioengineering*

*Mentor: Michael Regnier, Bioengineering*

Cardiomyocyte cell transplantation is being investigated as a treatment to repair the damaged heart after a myocardial infarction (MI). This procedure has been shown to improve cardiac performance on a whole-heart scale, including decreasing cavity dilation, increasing ejection fraction, and decreasing the expansion of the infarcted region. The goal of this study is to examine the underlying molecular mechanisms of this improvement in cardiac function by investigating the protein isoforms expressed in the grafted tissue and the surrounding myocardium. Neonatal rat cardiomyocytes isolated from 1-3 day old rats were fluorescently labeled (CM-Dil) and injected into one week old infarcted regions of adult rat hearts. Control tissues including normal adult rat myocardium have been analyzed using isoform-specific antibodies for troponin I (TnI), a muscle regulatory protein. Preliminary mechanical data from grafted tissue shows active force with greater Ca\(^{2+}\) sensitivity, which is characteristic of neonatal rat cardiomyocytes expressing the slow skeletal isoform of troponin I (ssTnI). Ongoing experiments include identifying the isoform of TnI expressed in the grafted cells by immunohistochemistry using a ssTnI antibody. It is speculated that neonatal rat cardiomyocytes maintain their neonatal proteins, and do not differentiate into adult-like cells expressing adult-type cardiac proteins.

**A High Throughput Anti-Death Assay for Cell-Based Cardiac Repair**

*Mark K. Saiget, Senior, Bioengineering*

*Mentor: Thomas E. Robey, Bioengineering*

*Mentor: Charles E. Murry, Pathology*

Cellular cardiomyoplasty, the transplantation of cells into myocardial tissue, is a promising technique for myocardial infarct repair. Problems such as physical loss of the injected cells and, more importantly, cell death after transplantation contribute to graft sizes less than 10% of the original cell number injected. Although numerous potential solutions to decrease graft cell death exist, traditional reliance on histology makes screening these strategies slow and costly. We wished to develop an efficient, high throughput assay to permit rapid screening *in vivo* of anti-death strategies. Grafts of C2C12 skeletal myoblasts transfected with β-galactosidase (β-gal), a prokaryotic gene, can be measured using a β-gal chemiluminescent assay. With this technique, the number of β-gal-expressing C2C12 cells linearly correlate to β-gal activity, both *in vitro* and *in vivo* after transplantation into the heart. We validated this system using heat shock, an intervention previously demonstrated to increase graft size by histology, and showed that the β-gal assay gave results comparable to histology in only a fraction of the time. Our next test of the system will be to explore the effects of constitutively active hypoxia-inducible factor 1 alpha (HIF-1α). HIF-1α in its activated form is found in hypoxic conditions and, similar to heat shock, activates transcription for the production of proteins that increase oxygen delivery. It also alters cellular metabolism and increases cell survival *in vitro*. Existing DNA for this constitutively active HIF-1α will be inserted into a lentiviral vector and used to transfet β-gal-expressing C2C12 cells. After verifying expression of HIF-1α protein and its transcriptional targets, these cells will be tested for death reduction using our high throughput anti-death assay. If found beneficial, HIF1-α treatment will be incorporated into future cardiomyoplasty strategies using human embryonic stem cell-derived cardiomyocytes.

**Cell Transplantation for Myocardial Infarction: Passive stiffness measurements**

*Mark Schrader, Senior, Bioengineering and Biochemistry*

*Mentor: Michael Regnier, Bioengineering*

Ischemic heart disease (caused by myocardial infarction) is the number one killer in developed Western countries at 12% of total deaths. Massive cardiomyocyte death induces ventricular remodeling, in which invading macrophages swallow necrotic tissue, and fibroblasts secrete collagen and other ECM proteins which form a dense, stiff matrix. The non-compliant matrix not only fails to contribute to active tension during contraction (systole), but its high passive stiffness significantly alters heart function during relaxation (diastole) and systole. Here, a method for improving heart function following myocardial infarction,
cell transplantation, is examined. Cell transplantation of neonatal and fetal cardiomyocytes has been shown to improve global heart function of infarcted hearts in studies which show increased developed systolic pressure and decreased infarct expansion and cavity dilation. However, the mechanism by which cell transplantation improves heart function is not completely understood. Mechanical measurements are performed on cell-grafted tissue, infarct tissue and others, in which the preparation is stretched above its slack position and held until tension reaches steady state, and is then released for one minute before it is further stretched. Preliminary data has shown that the stress-strain relationship for cell-transplanted tissue correlates much more with the control (non-infarction) than infarcted tissue. This suggests that one mechanism by which cell transplantation can improve global heart function is by returning the passive-elastic properties of the infarcted heart to conditions more similar to normal myocardium.

**SESSION 1H**

**ONE MOMENT OUT OF TIME: ARTISTS MAKING THE ORDINARY EXTRAORDINARY**

*Session Moderator: Brian Reed, English*

*Mary Gates Hall Room 287*

“The Martyr Shrine”

_Elizabeth Cardarelli, Post-Baccalaureate, Studio Art, Western Washington University_

Mentor: Julia Sapin, Art History, Western Washington University

The art piece highlighted is “The Martyr Shrine” from a current Independent Study, “Self-Portrait Shrines of Handmade Paper.” My colleague Douglas H. Smith stimulated my interest in martyrs with his work in labor organizing, e.g. those who died for the eight-hour work day. Roxanne Dunbar-Ortiz drew my attention through her book _Blood on the Border_. I also explored martyrdom in relation to my childhood, ancestry and suffering in the Catholic faith. My self-portrait martyr shrine embodies this creative process. *Nature of the Research: The heart of this piece studies the nature of the connection between social and personal martyr archetypes. Symbols and concealed symbols in the “Martyr Shrine” examine a hidden aspect and meaning of society, specifically how our martyrs are shamed because we made mistakes by creating them. Methodology: Self Portrait Shrines of Handmade Paper* is a self-guided series utilizing handmade paper and emphasizing the importance of fiber arts in education and the history of civilization. Paper holds a self-actualizing role in personal history, and is particularly relevant to self-exploration through journaling etc. Laminating, collaging, tying, tearing and lashing paper with other mediums made the structure. In addition I used the techniques of burning and dyeing as personally transformative experiences. A poem I wrote accompanies the piece. *Results:* My understanding of paper and its uses is inherent in its manipulation and seen in the sculpture. Honoring the martyrs, the role of martyrdom in my family, and how it connects me with the societal creation of martyrs, brought me to a conclusion about why our martyrs are not sung about, but are shamed. “The Martyr Shrine” as art educates, and heals bringing pride and justice socially and personally.

**Cause=Time: T.S. Eliot and the Importance of Tradition in Poetry**

_Elizabeth Cardarelli, Post-Baccalaureate, Studio Art, Western Washington University_

Mentor: Julia Sapin, Art History, Western Washington University

T.S. Eliot, a poet at the forefront of the modernist movement, was once quoted saying, “Poetry is not a turning loose of emotion, but an escape from emotion; it is not the expression on personality, but an escape from personality. But, of course, only those that have personality and emotions know what it means to want to escape from these things.” Eliot was an advocate for the notion that emotion in poetry should not exist, and that it is the job of the poet to evoke images that have nothing to do with feelings or their personal life. Eliot argues that a poet must surrender himself to something more valuable than he is, and that it is the progress of an artist that is a continual self-sacrifice, a continual extinction of personality. In his essay titled, “Tradition and the Individual Talent”, Eliot furthers his ideas when he claims that a poet is only considered original when compared to works of the past; and if he is not compared to previous works, how are we to know, and how can we decipher if what he has created is of any artistic merit or not? Moreover, my research mainly focuses on Eliot’s views of traditional poetry, and how modern poets are more influenced by the past then maybe they care to admit. Furthermore, I argue that tradition exists because poets cannot know what direction they are moving in unless they acknowledge that the past truly dictates where they are going in the future.

**The Horrors of Nature: The Dark Side of Victorian Fairy Painting**

_Erin Corrales-Diaz, Senior, Art History_

Mentor: Susan Casteras, Art History

The Victorians, like the generations before them, were equally interested in the unknowable Other and fantastic creatures, particularly malicious ones. This obsession in literature and art with the darker realms of Faerieland can in part be explained by the influence of German 19th-century culture, above all in such sources as the fairy tales by the Brothers Grimm. Although the Germanic influence was
considerable, the Victorians created their own version of Faerieland, which resulted in an explosion of fairy-themed art in the 1850’s. Fairy painting provided a passage into the fears and desires of the Victorian through unusual means; and indeed, fairy painting is an ideal source for Victorian cultural studies. The introduction of Darwin’s theories to the Victorian world altered the previous conceptions about man’s place in nature by proposing a connection between animal and man. The fears of suddenly having primitive emotions and actions based upon primal connections and losing the previously secure position in nature were reflected in art and books in the forms of scary monsters, goblins, darkness, and the grotesque. Late eighteenth-century artist, Henry Fuseli, Victorian fairy painter, John Anster Fitzgerald, and fairy illustrator Arthur Rackham all include elements of the gothic and the grotesque in their art. As nineteenth-century British society changed, fairyland adapted and projected the contemporary fears of the era through grotesque beings of various sorts. Fuseli’s The Nightmare dwells on the incubus figure enticing primitive sexual dreams. The Artist’s Dream by Fitzgerald depicts horrific goblins as symbols of a concern over hidden primitive urges released by dreams. Finally, Rackham reveals the influence of Darwin in his anthropomorphic trees in scenes from Rip Van Winkle. Ultimately, the dark side creates a cultural phenomenon resulting in a society concerned about their place in nature and their eagerness to reassert that order in their art.

Elegant Forms in the Everyday
Derrick Jefferies, Senior, Photography
Ellen Garvens, Photography

The theme of the 2005 Summer Institute was “Becoming Strangers: Travel, Trust, and Collaboration”. During the Institute, I became increasingly aware of small objects used in daily life and desired probe their structures to reveal an elegant and complex microcosm that is hidden from the naked eye. My research explored the power of photography to reveal the strangeness in the everyday using the transformative power of light, scale and perspective in providing alternate visual realities. By isolating and photographing banal objects such as soap, banana peels and sugar (objects we encounter in our everyday lives), I hoped to explore the objects’ intricate sculptural qualities. Using a 4x5 bellowed camera, simple studio set-ups and minimal lighting, I was able to transcribe these miniature forms into large and descriptive photographs. The result is a series of photographs that belie our conventions of scale and reveal a world of beauty and form that is often overlooked.

Entries
Eunsong (Angela) Kim, Senior, English, Comparative History of Ideas
Mary Gates Scholar
Mentor: Brian Reed, English
Mentor: Ellen Garvens, Photography

The title of this video art piece is Entries. I saw the story as pieces of journal entries, written by the same person during different times of one’s life. The film follows two young girls in and out of their private and public moments. They enter into rooms, parks, theaters, bathrooms and other ordinary places almost friends (because they are with each other throughout the film) but obviously distant. Each entrance into a new space represents a violation of public and private areas. The girls take systematic and linear turns to each entrance. The film, like most of my other works is quite abstract, without a definitive plot, but with its own structure. The film is brought together not by its plot, or the silence of, but by its transforming yet repetitious actions. Like almost all post-modernist art these actions are open to individual interpretation. But if needed, my quest was to examine communication, or the lack of, in memories and their travels.

68°S, 144°E at 47°N, 122°W
Adam Satushek, Senior, Photography
Mary Gates Scholar
Mentor: Ellen Garvens, Photography

During the 2005 Summer Institute in the Arts and Humanities, I created a piece of installation art that investigated the creation of strangeness through notions of space. These ideas included the abundance of space present within every object as well as the folding of space and time. My goal was to arrange spatial planes within a room in such a manner that they would imply the existence of a space beyond the walls. I began by thinking about our notions of horizontal and vertical, and how these planes exist on a spherical surface, such as the Earth. Realizing that these planes are relative to each particular point, I decided I could transport the orientation of horizontal and vertical from one location to another to accomplish my goal. The locations I chose were Seattle (47°N, 122°W) and the Zelee subglacial trench, in Antarctica (68°S, 144°E). I used my living room couch, a common place object, and then constructed a life sized replica of the couch from wire mesh and tie wire. The wire as a material served to exaggerate and illustrate the relatively expansive space (between the nucleus and electron field) that is present within every object. The wire couch was then suspended from the ceiling in the orientation it would achieve if located at the Zelee trench. The wire couch acted as an animation of the fabric couch and connected it to a third couch that through the animation was manifested in Antarctica. The experience of these two places within one space creates a fold in space and time, urging the viewer...
to imagine something that is beyond what they can readily perceive, and calling for more attentive involvement with the everyday.

Doppler
Christine Shannon, Senior, Humanities and English
Mentor: Ellen Garvens, Photography

Becoming Strangers: Travel, Trust and Collaboration was the theme of the 2005 Summer Institute of Humanities and Art. In preparing for my presentation at the SIHA symposium, I kept the theme in mind, as I traveled outside of my comfort zone, and worked with materials and ideas new to me. My goal was to combine the new ideas I was being exposed to with my own mundane experience. I trusted my instincts and professors as I undertook the job of making the everyday strange. One idea that was stressed during the summer was the idea of phenomenology, or the intimate study of an occurrence that is perceived by the mind or senses. I found this concept very interesting, and decided to work my project around the phenomenology of a moment. With a video camera I visited a metal shop and began taping some workers and their environment. I went into the editing process with twenty seven minutes of tape that eventually would become just over three minutes that were looped in the video Doppler. The end result of the editing process was a very refined and delicate view of the ordinary. Time and light collaborate in a precious scene that I had not noticed in the metal shop. By slowing down the tape and applying a critical eye, I editing towards the simple. With the help of my mentor, photographer Ellen Garvens, I found that the narrative of the video was stronger with fewer images. I learned how powerfully simple a moment could be. Today I work with my newly formed critical eye in all research and artistic endeavors. Doppler works because of the careful editing process, using only the essential images. The moments expressed in the video are new and unusual, the everyday made strange.

SESSION II

CELL AND MOLECULAR MECHANISMS OF GROWTH AND DEVELOPMENT
Session Moderator: Billie Swalla, Biology
Mary Gates Hall Room 295

Exploring a pH gradient in the central vacuole of Acetabularia acetabulum and its role(s) in development
Nikki Dejobd, Senior, Neurobiology
Mentor: Dina F. Mandoli, Biology

Acetabularia acetabulum, a giant unicellular marine green alga, is a classic model for development. It contains a large central vacuole that spans the length of the cell (Ngo et al., 2005). Crude extracts of flash frozen segments suggest that this vacuole maintains a pH gradient ranging from 3.5 in the apex to 8.3 in rhizoid, signifying this central vacuole is a polar organelle. Currently, I am directly measuring the pH of the central vacuole in Acetabularia using an Oregon Green diacetate probe (Molecular Probes, OR); when acetate groups are removed by intracellular esterases, this probe becomes highly fluorescent and demarcates acidic regions in the cell. Defining when in development this gradient forms and when it dissipates will provide insight into how it is formed and why it exists. The longitudinal pH gradient dissipates in gametangia bearing cells, suggesting that the charge separation is temporally coupled to the movement of daughter nuclei up the stalk. It is plausible then that the longitudinal charge separation provides an energy source for cytoplasmic streaming, the movement of macromolecules such as RNA, and nuclear transport. We hypothesized that if the pH gradient depended on proton pump density, then a longitudinal asymmetrical distribution of the pumps could establish this gradient. A particular transmembrane proton pump involved in the movements of protons is vacular H^+-ATPase (V-H^+-ATPase) (Brauer et al., 1997). However, Northern analysis indicated that expression levels of V-H^+-ATPase are uniform. Understanding why this gradient is necessary is of interest not only because Acetabularia must devote significant resources to establish and maintain the polarity of this central vacuole, but because other plant vacuoles may also make and maintain pH gradients.

Identification of Novel Peroxins in Saccharomyces cerevisiae
Rula Green Gladden, Senior, Biochemistry
Mentor: John Aitchison, Biochemistry

Peroxisomes are organelles found in eukaryotic organisms—from yeast to humans—that metabolize fatty acids. In humans, peroxisomes are necessary for healthy development; babies born with mutations in genes necessary for peroxisome biogenesis develop Zellweger Syndrome and usually live only a few months. Despite the peroxisome’s importance, the complex process by which it develops and proliferates throughout the cell is not well understood. There are twenty-six genes (called PEX genes) known to encode peroxins (proteins involved in peroxisome biogenesis), but previous research tentatively identifies over 200. Here we use a large-scale visual screen to independently identify peroxins in Saccharomyces cerevisiae. Peroxins are not visible while cells are only in the presence of glucose. However, upon addition of fatty acids (such as oleic acid), peroxisomes proliferate and grow. To enable a visual screen, a library of 4,800 haploid, viable strains containing both a one gene-deletion and a green fluorescence protein tagged thiolase (POT1-GFP) was constructed. When
induced by the presence of oleic acid, POT1-GFP is synthesized and localized to developing peroxisomes, visualizing them. Any phenotypic change, such as in peroxisome number or size, must be caused by the gene-deletion in that strain. Thus far, the amount of fatty acid induction necessary for optimal detection of peroxisomal abnormalities has been determined. Approximately 1000 strains have been screened though, and many strains with diminished peroxisome number and size and one strain with abnormally large peroxisomes have been identified. Strains with previously known PEX deletions have also been identified, indicating the successful progress of the screen. Quantitative methods, such as the computational determination of average peroxisome size and number, will be used to confirm the abnormality of candidate strains. Ultimately, this data will be used to determine how those proteins identified interact with known peroxins and with each other in a dynamic network.

Putative RuBisCO Activase CfxQ in the Toxic Alga Heterosigma akashiwo

Kun-Lin Lee, Senior, Biochemistry
Amanda Hoyt, Recent Graduate, Biochemistry
Mentor: Rose Ann Cattolico, Biology

CO₂ entry in the Calvin Cycle of many autotrophic organisms is driven by the enzyme Ribulose 1,5-Bisphosphate Carboxylase/Oxygenase (RuBisCO). The activity of RuBisCO is catalyzed by an ATP dependent enzyme, RuBisCO Activase. Analysis of the chloroplast-encoded cfxQ in the Raphidophyte Heterosigma akashiwo shows sequence homology to bacterial RuBisCO activases. In addition, previous studies revealed that CfxQ enhances the performance of RuBisCO in bacterial systems. We hypothesize that Heterosigma CfxQ is a RuBisCO Activase. The cfxQ gene is being studied at three different levels: genomic, transcriptional, and proteomic. At the genomic level, though present in almost 2,500 copies per cell, the presence of single nucleotide polymorphisms (SNPs) has been documented to occur when geographically distinct algal populations were analyzed. Five variants of the cfxQ gene have been identified among nineteen Heterosigma strains that have been sequenced. The nucleotide changes that have been observed cause both synonymous and non-synonymous amino acid alterations in the resulting proteins. At the transcriptional level, RNA isolation and quantitative PCR techniques are being developed to probe the relationship between the expression of cfxQ and the RuBisCO operon over the synchronized growth cycle of Heterosigma. At the proteomic level, we wish to analyze the biochemistry of CfxQ (e.g. ATPase activity; RuBisCO Activase activity.) To achieve this goal, we are presently over-expressing the cfxQ gene in Topo T7 bacterial vector.

Arsenicals cause a misplacement of reproductive structures in Acetabularia

Vidhi Tyagi, Senior, Biology
Mentor: Dina Mandoli, Biology

Arsenic is a toxic metalloid that occurs in many natural environments. Exposure to arsenicals causes deleterious effects in plants and can lead to a failure of nuclear migration in algae such as Macrocystis. We are using Acetabularia acetabulum, a single-celled green alga, as a model organism to study mechanisms of arsenic toxicity. This alga responds to externally applied doses of arsenic in a concentration dependent manner. Exposure to high doses of an arsenical results in death, while chronic low doses of the same arsenical induces misplacement of the spherical gametangia during reproduction: gametangia that normally would form in the cap at the apex form instead in the base of the stalk. Induction of this phenotype, “basal babies”, was found to be dependent on both developmental age and duration of exposure. To determine when in development Acetabularia is sensitive to arsenic, we exposed populations to 10-day intervals of arsenate throughout the life cycle. Surprisingly, populations exposed to longer durations of arsenate did not develop the phenotype. Juveniles with 3±1 whorls of hairs were more sensitive to chronic low doses of arsenic than cells with ≥6 whorls of hairs. Juveniles responded to chronic exposure to 10⁻⁷M of arsenate but adults did not. Our future aim is to create a phenocopy of the basal babies phenotype by inducing point mutations in gametangial DNA using ethyl methanesulfonate. Prior to performing an EMS mutagenesis Kevin Wherry of the Mandoli Lab will have developed and refined a reliable method of cryopreserving the gametangial phase of A. acetabulum. In conjunction with this project it is imperative to understand the mechanism of gamete release. Currently we are studying the effects of duration of light/dark exposure, wavelength of light, temperature, and nutrients on gamete release.

Ferlin Expression and Evolution in Ascidians

Lauren May, Senior, Cell, Molecular, & Developmental Biology, Biochemistry
Mary Gates Scholar

Hee Sun Kim, Junior, Cell, Molecular, & Developmental Biology
Mary Gates Scholar
Mentor: Billie J. Swalla, Biology

We are studying the expression of ferlins during development in the sea squirts, Ciona intestinalis and Ciona savignyi. Ferlins are a family of highly conserved C2 domain proteins found in protozoans and, in metazoans, bind calcium and function in vesicle fusion and membrane repair. Mutations in these proteins can cause muscular dystrophy in humans and mice, nonsyndromic autosomal deafness in humans, and infertility in fruit flies and nematodes. Although ferlins have been well studied in...
many organisms, they have not been examined in ascidians. We therefore set out to identify spatial and temporal ferlin expression in C. intestinalis and C. savignyi. Expressed Sequence Tags (ESTs) for three ferlins, dysferlin, otoferlin and Fer1L3, were obtained from the C. intestinalis genome website and their amino acid sequences were analyzed to locate the C2 Calcium-binding domains within the ferlin proteins. Using the ESTs for these ferlins, we created RNA probes and performed in situ hybridizations in C. intestinalis and C. savignyi to determine the temporal and spatial expression of ferlins in larvae and adults. We observed ferlin expression in larval stages and several adult tissues of both ascidian species and we are currently confirming our results. A second focus of our research is analyzing and comparing ferlin proteins of protozoans and metazoans. By performing protein alignments and constructing gene trees with the assistance of computer programs we identified an evolutionary scenario for how the ferlin family has developed from its initial presence in protozoans to its presence in complex metazoans. We also confirmed the exceptionally high rate of conservation of the ferlins, particularly within their C2 domains. We are currently working with Barbara Wakimoto and Michelle Fisher to publish a paper in Molecular Biology and Evolution that will present our data on the evolution of the ferlin family.

The Function of RPAs in Drosophila Cell Cycle Control

Ryan Smolinsky, Senior, Biochemistry
Mentor: Gerold Schubiger, Biology

The focus of our lab is to identify genes that are involved in the coordination of nuclear and cytoskeletal cycle using Drosophila embryo as a model system. It is known that amount of Cdk1-Cyclin B is responsible for the transition into mitosis. Increasing the gene copy number of Cyclin B in the mother increased the amount of Cdk1 activity in the embryo. This increase changes microtubule morphology and delays the onset of anaphase producing a viable easy to screen phenotype. We conducted a genome wide dominant loss of function screen and selected mutations that modified the 6 Cyclin B phenotype. One mutant, Rpa2, suppressed the 6 Cyclin B phenotype and appeared like a wild-type embryo. Thus Rpa2 was identified as a suppressor of the 6 Cyclin B phenotype. The genetics indicate Rpa2 and Cdk1-Cyclin B are functionally connected in regulating the onset of anaphase and microtubule dynamics. What is Rpa2 and what is its function in normal development? Rpa2 is a member a trimeric protein complex (Rpa1, Rpa2 and Rpa3), which in yeast is known to bind single stranded DNA during replication to stabilize the strands. For proper function, all three units are necessary. To test whether in Drosophila all three are involved in the same manner and interact with Cdk1-Cyclin B, we need to have mutations of the other two genes (Rpa1 and Rpa3). None are available. Therefore we will make mutations in Rpa1 and Rpa3. For this we generate a mutant form of the gene and replace the wild-type copy with the mutant in the genome of the fly.

Facilitating genetics in Acetabularia acetabulum: efficient cryopreservation and induction of gamete release

Kevin Wherry, Senior, Biochemistry
Mentor: Dina F. Mandoli, Biology

Reliable long-term storage of germplasm is important for any model system. At present, lineages of A. acetabulum must be continuously cultured which is labor-intensive and requires space in controlled growth chambers. This precludes maintenance of more than a handful of genetically distinct lineages of Acetabularia acetabulum. Zygotes of A. acetabulum can be stored at 15°C for 2-4 years (S Berger & MJ Kaever, 1992 Dasycladales, An illustrated monograph of a fascinating algal order, Georg Thieme Verlag Stuttgart, NY). However, zygotes stored at 15°C are subject to die-off and contamination by bacteria and yeasts. In addition, these diploid zygotes cannot be crossed immediately, but have to be grown through the life cycle, approximately three months, in order to obtain gametes for a cross. Cryopreservation of the haplophase would reduce the cost and labor inherent in continuous cell culture and facilitate genetics and large-scale mutagenesis by permitting accumulation of hundreds of cell lines and by providing a ready source of gametes for mating. A. acetabulum can be transformed with Agrobacterium tumefaciens (K Hollis, D Capps, A McMahon, RG Ivey, & DF Mandoli in preparation). Some transformed cells will have insertions into a coding region, i.e. will “tag” a gene, generating a mutant phenotype. Surprisingly, freezing gametangia in seawater alone resulted in 92% viability. Adding 7% of one of the classic algal cryoprotectants (glycerol, DMSO, and MeOH) to the seawater resulted in 92-105% gametangial viability. We are optimizing cryopreservation, and will present out data that test variables during the freezing (developmental age when frozen, rates of freezing) and during recovery from freezing (rates of thaw, volume of the recovery medium, and light conditions).
**SESSION 1J**

**MOVING BEYOND MICE AND FLIES: SKY-DIVING STICK INSECTS AND OTHER WILD TALES FROM THE ANIMAL KINGDOM**  
*Session Moderator: Elizabeth Marin, Biology*  
*Mary Gates Hall Room 284*

**Crawling Behavior Influenced by a Proposed Multifunctional Motor Network in *Tritonia diomedea***  
*Anne Darby, Junior, Biology and Physiology*  
*Mentor: Shaun D. Cain, Friday Harbor Labs*

Understanding how the nervous system controls behavior is the primary focus of neuroscience and neuroethology. Often, researchers reduce the complexity of this puzzle by studying the neural networks that underlie individual behaviors. Recently however, it has become apparent that some neural networks are multifunctional. A multifunctional neuronal network is an interconnected group of neurons that participates in the generation of multiple behaviors. In this study, we used the marine mollusc *Tritonia diomedea* to investigate the function of a locomotor circuit during two distinct types of locomotion: escape swimming and ciliary crawling. We chose to use *Tritonia* because it has large, identifiable neurons and a central nervous system readily accessible to electrophysiology (Chase, 2002). The Dorsal Swim Interneurons (DSI) in *Tritonia diomedea* are thought to serve as components of a multifunctional neuronal network that influences both swimming and crawling behaviors (Popescu and Frost, 2002). The role of the DSIs as an integral part of the escape swim behavior has been known for over three decades. Recent evidence suggests that the DSIs might play a role in ciliary locomotion. This study investigated the synaptic connections between the DSIs and the two ciliary neurons pedal 5 and 6. An isolated brain preparation was used for electrophysiology experiments to investigate and identify the types of monosynaptic and polysynaptic input from the DSIs to Pd5 and Pd6. Our experiments show that the primary connection between the DSIs and the ciliary motor neurons are monosynaptic and that the rate of firing in the DSIs can change the post-synaptic potential in Pd5 and Pd6 from a simple single excitatory potential to a complex multi-component potential exhibiting both excitatory and inhibitory components.

**Molecular and Limb Bud Development of the Pycnogonid *Anoplodactylus viridintestialis***  
*Lisa Kvalheim, Senior, General Biology*  
*Mary Gates Scholar, Friday Harbor Research Apprenticeship*  
*Mentor: Lynn Riddiford, Biology*

Pycnogonida is a basal Arthropod classified within the major group of Chelicerata. Although their morphological development has been well studied, nothing is known about its molecular aspects. Broad is a BTB domain-containing transcription factor that is necessary for pupal specification in higher insects and for anisometric growth of wing pads in lower insects. Using PCR primers to the BTB domain of Broad, I found no *broad* gene in the basal pycnogonid *Anoplodactylus viridintestinalis* but instead another BTB domain transcription factor *bric-a-brac*. This transcription factor is known in other arthropods to cause segmentation of the tarsal segments of the limbs. Limb development in this species is unusual in that the 4 pairs of legs of the adult are added sequentially during a series of premetamorphic molts. Limb bud formation during these molts was imaged using phalloidin to visualize actin and propidium iodide as a nuclear stain. Further studies are necessary to determine where and when *bric-a-brac* is expressed during this limb development.

**Control of the Ventral Lateral Preoptic Area by the Suprachiasmatic Nucleus Circadian Clock***  
*Rebecca Reh, Junior, Neurobiology*  
*Mentor: Horacio de la Iglesia, Biology*

The ventrolateral preoptic nucleus (VLPO) through its release of galanin has been pinpointed as a key center controlling sleep. The hypothalamic suprachiasmatic nucleus (SCN) contains a master circadian pacemaker that governs physiological and behavioral rhythms, among which is the sleep-wake cycle. The timing of sleep by the SCN is presumably controlled through direct and indirect input to the VLPO and other sleep centers, but the role of these neural pathways has not been tested functionally in neurologically intact animals. The goal of this project is to exploit an unusual property of the hamster circadian system to determine whether neural outputs of the SCN are involved in the circadian activation of the VLPO. When hamsters are kept under constant light conditions, their circadian rhythm of locomotor activity splits, showing two bouts of activity. This bimodal pattern of activity reflects the antiphase oscillation of the bilaterally paired left and right SCN. This offers a unique model in which daytime and nighttime genes are simultaneously expressed in one animal. Given that most of the SCN projections to the rest of the hypothalamus and preoptic area are ipsilateral, the split hamster brain represents an ideal neurologically intact model to study the output pathways by which the SCN controls specific rhythms. In order to test the hypothesis that SCN efferents to the VLPO control the timing of the
Directed Aerial Descent in Tropical Stick Insect
(Phasmatidae: Extatosoma)
Yu Zeng, Visiting Junior, Biology
Mentor: Thomas Daniel, Biology

The study of controlled descent during a jump or fall (either parachuting or gliding) in animals is thought to be important for understanding how flight evolved. Indeed, the evolution of animal flight and wings is argued to be rooted in the ability to sustain gliding paths in arboreal environments. Although much is known regarding gliding behavior in vertebrates, less is known about such activity in insects. Because insects evolved flight separately from vertebrates, it is important to examine insect gliding if we wish to gain a larger picture of the evolution of flight in these two groups. Recent work by S.P. Yanoviak et al. (Nature 2005) suggests that ants falling from trees can direct their path to return to the tree trunk. Whether this behavior is restricted to ants and what mechanisms underlie it remains unclear. Here I study how the instars of Australian stick insect (Extatosoma sp.) use the directed descent to return to the tree trunk in our simulated wild conditions in the UW greenhouse. I also explore how visual cues and ontogeny (size) affect descent behavior. I addressed this issue by examining in detail the gliding performance of walking stick insects. I use a combination of video tracking and experimental manipulation of Extatosoma sp. instars. I used a combination of mathematical modeling along with experimental approaches to quantify the bias in descent paths. Preliminary results suggest that there is a significant bias of the vertical descent path and that the bias is size (life stage) dependent. This has broad implications to the origins of flight in insects.

**SESSION 1K**

**BIOENGINEERING: MATERIALS AND MOVEMENT**

**Design and Testing of an Antibiotic Releasing Hydrogel for use with Intraocular Lenses**
Erin Anderson, Senior, Bioengineering
Mentor: Buddy Ratner, Bioengineering and Chemical Engineering
Mentor: Tueng Shen, Ophthalmology

Approximately 10 million Intraocular Lenses (IOLs) are successfully implanted annually following cataract surgery. However, surgery entails a risk of infection – endophthalmitis, which is the inflammation of the intraocular cavities, and may result in severe vision loss or blindness. Patients are given antibiotics to reduce and prevent infection, but improper use of the prescribed treatment results in a substantial number of endophthalmitis cases each year. We have developed a prototype insert that...
releases antibiotic at a controlled rate for one week, and can be attached to a variety of medical devices, including IOL’s. Norfloxacin, the chosen antibiotic for this study, was loaded into poly-hydroxyethyl methacrylate (pHEMA) hydrogels. The hydroxyl groups of the pHEMA are subsequently reacted with octadecyl isocyanate to form a self-assembled monolayer-like, controlled release coating of methylene chains. Electron spectroscopy for chemical analysis is used to analyze the atomic composition of the surface. The amount of norfloxacin released in distilled water is determined by UV/VIS spectroscopy at a wavelength of 280 nm. Results show that with longer coating reaction times, the amount of norfloxacin released is reduced. The hydrogels are also tested in vitro for their ability to prevent bacterial adhesion and biofilm formation on intraocular lenses. This study provides evidence that our prototype has the potential to prevent bacterial infections following cataract surgery. Further work needs to be done to create a gel with the correct dimensions to be clinically applicable, and to study the efficacy in vivo.

Ex-vivo Generation of Corneal Epithelial Cell Layers on Temperature Responsive Polymer Surfaces for Use in an Artificial Cornea
Sariah Khormaei, Senior, Neurobiology and Biochemistry
Mentor: Tueng T. Shen, Ophthalmology
Mentor: Buddy Ratner, Chemical Engineering, Bioengineering

As the most anterior portion of the eye, the cornea possesses protective and refractory characteristics crucial for sight. Damage to the cornea, often due to disease or injury, may result in corneal blindness, the second most common form of treatable blindness worldwide. Currently, corneal blindness affects more than six million people, and another 150 million people are at risk. Although full thickness corneal transplant surgery is a viable treatment for some, the success of this procedure is limited by the availability of human donor tissue. In recent years, in order to circumvent the scarcity of donor tissues, new types of artificial cornea constructs that are easily implanted and that require limited amounts of donor tissue are being explored. The objective of this project is to construct a corneal epithelial layer that may be incorporated into an artificial cornea construct. To accomplish this goal, primary human corneal limbal stem cells were isolated from donor human corneas, seeded with a mouse fibroblast feeder layer and expanded on a temperature responsive surface of Plasma Polymerized N-isopropylacrylamide or ppNIPAM covering Tissue Culture Polystyrene. These surfaces promote normal epithelial cell sheet growth and adhesion in standard 37 degree Celsius culture conditions. However, lowering the temperature to 20 degrees Celsius changes the properties of the ppNIPAM surface, allowing adhered cells to spontaneously detach. This results in an intact corneal epithelial layer that may be incorporated with a transparent polymer and/or other materials to form an artificial cornea construct. To better characterize these spontaneously detached corneal epithelial sheets, immunofluorescence detection of extracellular matrix proteins retained by the detached sheet will be performed.

Improving the microstructure and mechanical properties of chitosan-alginate composite scaffolds
James Kuo, Junior, Bioengineering and Political Science Gates Millennium Scholar, NASA Space Grant Scholar, Mary Gates Scholar
Mentor: Narayan Bhattarai, Materials Science & Engineering
Mentor: Zhensheng Li, Materials Science & Engineering
Mentor: Miqin Zhang, Materials Science & Engineering

Tissue loss due to injury or degenerative diseases afflicts millions of people every year. Current treatments focus on alleviating symptoms of tissue loss. Tissue engineering presents a promising alternative with the potential to regenerate lost tissue, in which a biodegradable scaffold serves as a temporary medium to promote tissue growth. In this process, scaffolds are seeded with cells and growth factors. After implantation, the scaffold degrades slowly while the cells continue to grow and form new tissue. Chitosan and alginate, both naturally occurring polymers, have been studied for use as scaffolds. Both materials are biocompatible, biodegradable, and non-toxic. When combined, the resultant chitosan-alginate composite exhibits high mechanical strength, but not enough for most tissue engineering purposes. Optimizing the current scaffold fabrication process to improve the mechanical strength and uniformity of the microstructure with desired pore size and interconnectivity was attempted through changing ratios of reagents, chemical cross-linking agents, and the addition of silk fibroin. The compressive strength of the scaffolds was characterized with an Instron mechanical tester and the microstructure and porosity were evaluated with a scanning electron microscope and ethanol displacement test. The incorporation of silk fibroin does not add mechanical strength. Scaffolds with a 1:1 chitosan-alginate ratio by mass and those crosslinked with glutaraldehyde exhibited the highest Young’s modulus. Higher mechanical strength may lead to better scaffold durability in vivo while still maintaining biopolymer advantages of high cell attachment, growth, and proliferation.

Effects of oscillatory flow on FimH binding
Kaoru Kusuma, Senior, Bioengineering
Mentor: Wendy Thomas, Bioengineering

Bacteria colonize body surfaces by binding and detaching from receptors on cell surfaces. Often, bacterial adhesion is affected by fluid flow or shear rates. Unlike most bacteria which are washed off surfaces as fluid flow increases, Escherichia coli expressing the protein FimH on its
fimbria binds more firmly to mannose residues on cell surfaces as the flow increases within a certain physiologic range. However, increased shear rate reduces the rate at which E. coli forms initial attachment with the mannose residues. This trade-off causes the biphasic effect of shear. Thus far, experiments studying the binding property of FimH involved only uniform flow but physiologic fluid often show oscillating flow patterns. Thus, the goal of my project is to study the effects of oscillatory flow on FimH binding. Firstly, the wall shear rate in the system does not directly reflect the pumping velocity, but is also affected by the resistance and compliance of the fluidic system. Therefore, the wall shear rate was first measured by injecting oscillating flow rates into a channel filled with polystyrene beads and tracking the velocities of the beads. Next, I will be injecting E. coli into the system and comparing E. coli attachment to mannose coated surfaces in oscillating flow to that in uniform flow. It has been hypothesized that oscillatory flow may enhance FimH binding. This is because unlike uniform flow, oscillating flow shows alternating shear rates whereby FimH can initiate attachment to mannose residues at lower shear rates and bind more strongly to the residues as the shear rates increases. Thus, I expect to observe a greater number of bound FimH-expressing E. coli on the mannose coated surface in oscillating flow than in uniform flow. Measuring bacterial adhesion with oscillations in shear rate is crucial in understanding how FimH adhesion responds to physiologic conditions.

“Smart” polymer micelles for targeted drug delivery
Christopher Pirie, Senior, Bioengineering
Mentor: Scott Henry, Bioengineering
Mentor: Allan Hoffman, Bioengineering
Mentor: Patrick Stayton, Bioengineering

One major limitation of chemotherapeutic treatment of solid growth tumors is acquired drug resistance. As treatment proceeds there is a natural selection for malignant cells that possess membrane bound p-glycoprotein (PGP) efflux pumps. The PGP pumps allow cells to resist chemotherapeutic cytotoxicity by actively transporting these drugs out of the cell. To overcome this resistance, we propose a “smart” polymeric micelle system to deliver chemotherapeutics directly to the cytoplasm of target cells, bypassing the action of membrane bound efflux pumps. It is known that micelles can be loaded with hydrophobic drugs and that micelles of a particular size will passively accumulate in vivo at solid growth tumors via the enhanced permeability and retention effect. Previously we have shown the utility of alkyl-amine modified poly (styrene-alt-maleic anhydride) (SMA) for pH-sensitive membrane lysis. Here we incorporate SMA in a diblock copolymer with butylacrylate (BA) as a hydrophobic block, synthesized by a two step reversible addition fragmentation chain transfer polymerization. SMA was polymerized first using benzyl dithiobenzoate as chain transfer agent. After isolating the polymer product, it was used as a macro-chain transfer agent for a second polymerization to add the BA block. This technique was capable of producing diblock copolymers with a hydrophilic: hydrophobic block ratio of approximately 1:1. Above a critical concentration, these diblock copolymers will spontaneously form micelles. Based on their size we anticipate that these micelles will accumulate in tumors in vivo and subsequently be taken up by endocytosis. Further, following endocytosis the modified SMA will respond to the reduced pH of the endosome and lyse the endosomal membrane, freeing both micelle and drug into the cytoplasm, thus bypassing membrane bound efflux pumps. We believe these “smart” micelles will have particular utility for the treatment of drug resistant tumors.

Characterization of Osteoprotegerin-loaded hyaluronic acid hydrogels for bone regeneration
Ruth Siew, Senior, Biochemistry
Mentor: Patrick Stayton, Bioengineering

Hydrogels composed of the naturally occurring polymer, hyaluronic acid (HA), were developed as scaffolds for bone regeneration. This process may be best achieved when the rate of scaffold degradation is proportional to the rate of tissue formation. HA hydrogel degradation rates can be influenced by manipulating the formulation parameters of the hydrogel, such as the molecular weight and concentration of HA. Additionally, controlled release of growth factors from the scaffolds should enhance the healing. A particular growth factor, osteoprotegerin (OPG), has been found to be an endothelial cell survival factor and to inhibit the activation of osteoclasts. Thus, we hypothesize that OPG delivered from HA hydrogels can be used to repair bone. In this study, degradation mechanisms were examined and the amount of HA that degraded from the gel was determined by a carbazole assay. OPG protein release by the gel was quantified using an ELISA. Hydrogels were prepared using 20mg/mL of 220kDa HA or 30mg/mL of 110kDa HA. The high molecular weight gels degraded quickly (5 days) while the low molecular weight gels did not degrade even for several months. Using ratios of the two molecular weights, intermediate degradation rates were obtained. OPG had a more prolonged protein release compared to BSA, which can be explained by electrostatic interactions between OPG and HA. In the slow degrading gels, OPG was released for over eight weeks. Hydrogels with OPG were implanted in a rat calvarial defect model to investigate in vivo effects.

Protein Incorporation into Poly(Vinyl Alcohol) / Amino Acid (PVA/AA) Hydrogels
Zuotian Tatum, Junior, Bioengineering
Mentor: Buddy D. Ratner, Bioengineering

Biomaterials have been used widely in our daily lives to improve our life quality, from contact lenses to tissue...
engineering scaffolds. Hydrogels are hydrophilic polymer networks which have the ability to absorb vast amounts of water, and many have been found to be suitable biomaterials due to their high water content, potential for in vivo degradation and biocompatibility. The study described here characterizes a new hydrogel system based on poly(vinyl alcohol) and amino acid (PVA/AA), and evaluates their suitability for use as a biomaterial. PVA/AA hydrogels were discovered by Dr. Praful Nair in 2001 when mixing PVA with various amino acids (AA) in aqueous solution. The PVA/AA hydrogel has great potential as a biomaterial due to its natural degradation, biocompatibility, and tunable mechanical properties. However, early tissue culture studies showed low cell adhesion to all PVA/AA materials. In this study we evaluated tailoring cell adhesion through incorporation of proteins: collagen type I, an Extra Cellular Matrix (ECM) protein, and laminin, which is specialized for cell adhesion in cardiovascular tissue. Two protein incorporation methods were compared: (1) non-covalent (direct) protein incorporation and (2) covalent protein incorporation. Results from non-covalent protein incorporation showed a great improvement in cell adhesion on PVA/AA hydrogels. Moreover, the covalent protein incorporation via covalently linking type I collagen using 1,1-carbonyl diimidazole (CDI) was shown to increase the cell spreading on PVA/AA hydrogels.

**Session 1L**

**Adaptation and Ecology: Global Perspectives**  
*Session Moderator: John Banks, Biology, Interdisciplinary Arts & Sciences, UW Tacoma*  
*Mary Gates Hall Room 251*

**Molt-Migration in Western Kingbird**  
*Jessie H. Barry, Junior, Ecology and Evolutionary Biology*  
*Mentor: Sievert Rohwer, Biology*

Through the use of museum specimens and field observations, I describe the timing and location of late summer feather replacement in adult and juvenile Western Kingbirds. The Western Kingbird (*Tyrannus verticalis*) is an insectivore that breeds in the arid lowlands of western North America. In the late summer, adult kingbirds depart their breeding grounds and move to the southwestern United States and northern Mexico, where they replace all of their body and flight feathers in about 70 days. In contrast, juveniles replace body but not flight feathers in their late summer molt, and do not move south before molting. The breeding grounds of Western Kingbirds become exceedingly dry in late summer, while the region, where adults go to molt, becomes very productive in late summer because the Mexican Monsoon delivers most of the annual rainfall to this region in July, August and September. The primary productivity generated by these rains supports an abundance of insects, which allows adult kingbirds to forage efficiently and meet the energetic demands of feather replacement. This study adds Western Kingbird to the growing list of western passerines that undergo a molt-migration to the region of the Mexican Monsoon. The presence of juveniles in collections after the departure of adults confirms that the decrease in adults in not an artifact of inactive collectors. The early departure of adults can also be demonstrated by using museum databases to plot the number of adult kingbirds as a fraction of all passerines collected from the same area through time. This validates the use of total passerines in collections as an index of collecting effort, which should be useful methodology for species in which both adults and juveniles move to the Mexican Monsoon to molt.

**Enhancement of Abiotic Stress Tolerance in Poplar Trees through the Functional Analysis of a Stress-Responsive Chaperone Protein**  
*Gregory Osborn, Senior, Cellular, Molecular and Developmental Biology*  
*Mentor: Sharon Doty, College of Forest Resources*

Abiotic stresses, such as drought, salinity, extreme temperatures and chemical toxicity of soil, are all factors that limit the growth of plants, resulting in reduced crop yields and inefficient use of resources. Adaptive mechanisms of plants are complex- a better understanding of stress tolerance machinery will allow us to increase agricultural productivity. The goal of my project is to investigate the ability of the aspen protein Stable Protein 1 (SP1), and its homologs in cottonwood, to increase the stress tolerance of Poplar trees and tobacco. SP1 seems to function as a molecular chaperone to protect or repair critical enzymes during stress conditions. I want to determine if the overexpression of SP1 in plants will increase tolerance to stress conditions, such as heat, cold, salinity, drought and various environmental pollutants. Furthermore, I will investigate if tobacco, a plant that has not been found to express sp1, can benefit from sp1 transgenic expression. To overexpress SP1 in *P. trichocarpa* and *P. deltoides*, the sp1 gene with the viral 35s promoter has been subcloned into the vector pART27. The vector constructs will under undergo agrobacterium-mediated transformation into target plants. Successful transgenic plants will be tested for stress tolerance. Transgenic sp1 tobacco plants are awaiting verification and will be tested in similar experimental conditions. I hypothesize that the transgenic cottonwood species and tobacco will be more tolerant to stress due to increased expression of the SP1 protein. If this is correct, I would expect to see transgenic plants healthy in conditions that trouble control plants. Understanding if this protein
can allow plants to adapt to unfavorable conditions is key to ascertaining the overall importance of SP1 in the establishment of outstandingly stress tolerant agriculture.

**Does Pore Density Differ Among Magellanic Penguin (Spheniscus magellanicus) Eggs?**

*Sharmila Pal, Junior; Chemistry, Chemical Oceanography*

*Mentor: P. Dee Boersma, Biology*

Hipfner et al (2001) hypothesized that late-laid avian eggs have high porosity that allow embryos to develop more rapidly through higher gas exchange. Massaro et al (2004) found that second laid eggs of Yellow-eyed penguins (Megadyptes antipodes) had significantly more pores and thinner eggshells than first laid eggs. They also found that older females laid eggs with significantly greater eggshell thickness but more porosity. We tested Hipfner et al (2001) hypothesis with Magellanic Penguins (Spheniscus magellanicus). Magellanic penguins lay two eggs four days apart, but the eggs hatch within two days of each other. We expected that second eggs to have more pores than first eggs. We further predicted that Magellanic penguins that were older or females that nested in high humidity environments (burrows rather than bushes) to have more egg pores which would speed the development and reduce the incubation period. Further, we expected that if there was a difference in eggshell thickness, first eggs would be thicker and have fewer pores as they require a longer time to hatch (42 days compared to 40 days). Contrary to the predictions, we found: (a) egg pore density was similar regardless of laying order (t = 1.06; p = 0.81; n=47); (b) egg shell thickness did not differ between first and second eggs (t = 1.77; p = 0.26; n=47); (c) female age and egg pore density were poorly related (r = 0.03; p = 0.54; n=18); and (d) pore density was not significantly different between bush nests and burrow nests (t = 0.26; p = 0.79; n_bush = 26; n_burrow = 14). Therefore, egg pore density does not account for the two days shorter incubation time of second eggs in Magellanic penguins.

**Plant Exploration and Collection in Sichuan, China**

*Rizanino H. Reyes, Senior, Environmental Horticulture & Urban Forestry*

*Mentor: Sarah Reichard, University of Washington Botanic Garden*

Sichuan Province, located in Southwest China, holds what is thought to be the most diverse flora in the northern temperate zone. It has served as the source of many of the plants found in urban landscapes throughout Europe and North America. From fall 2004 through the summer of 2005, a team of renowned horticulturists, field guides, assistants and I embarked on several plant expeditions in the mountainous regions of the province in search of wild species with potential garden merit. Even with several thousand species already in cultivation, there is much more that is yet to be discovered. Meanwhile, regulations by the Chinese government are making plant collecting for foreign researchers much more difficult. Through the UW-Sichuan Exchange Program, I coordinated trips into the mountains and deep forests of Sichuan to collect samples. With the aid of my classmates, several contacts and colleagues, we managed to collect several hundred samples of plant material for herbarium specimens along with collections of seed and live plant material that were shipped back to the United States. With the dried herbarium specimens awaiting proper export documentation, the seeds and plants collected have already arrived and are currently growing as part of the collections at University of Washington Botanic Gardens. This material will be evaluated for its adaptability to the Pacific Northwest, as well as its invasive potential. Following this evaluation, plants worthy of distribution to gardeners and collectors will be identified and described. When the herbarium specimens arrive, they will be incorporated into the collections of the Otis Hyde Herbarium for identification and display.

**Ecology and the Evolution of Molt Scheduling in Neotropical Migrants**

*Vanya Rohwer, Junior; Ecology and Evolutionary Biology*

*Mentor: Toby Bradshaw, Biology*

*Mentor: Sievert Rohwer, Biology*

In migratory birds, the replacement of worn feathers (molt) is crucial for breeding, migrating, and surviving the winter. My research focuses on ecological forces that affect the scheduling of molt and migration. Prior studies of the scheduling of molt and migration in North American songbirds that winter in the Neotropics have revealed important east-west contrasts. Most eastern breeders molt on the breeding grounds before migrating. In contrast, about half of western breeders migrate to northwestern Mexico before molting, while other western breeders complete the molt on the breeding range. Western species that migrate before molting are thought to be pushed away from their breeding grounds by late summer drought and to be pulled to the region of the Mexican monsoon where food to support the molt is abundant in late summer. Here I seek to understand why nearly half of western Neotropical migrants molt on their breeding grounds. By comparing the breeding habitats of western Neotropical migrants, I show that most species that molt on their breeding grounds breed in Douglas-fir, while most species that migrate south before molting breed in low elevation, broad leaf or open habitats. Species that use Douglas-fir for breeding should be able to move up slope to molt in mountain Douglas-fir forests, where conditions remain wet in late summer. As a case study I censused Cassin’s Vireo during its breeding and molting season in Washington. Auditory surveys showed that vireos breeding in low elevation pine or Douglas-fir forests moved at least 300 m up-slope in late summer, where they molted in wetter, high elevation Douglas-fir forests.
Is interference with the internal affairs of foreign nations ever warranted? Is the United States justified in keeping such activities from the American people? At what point do the interests of our own country take precedence over the sovereignty of another? We examine these and other pressing questions concerning U.S. covert interventions with a multifaceted, integrated approach. Incorporating in-depth analysis of the overthrow of the Allende regime in Chile as a specific case and the pervasive effects of the Office of Public Safety as a more indirect example, we analyze the moral and ethical ramifications as well as the ultimate validity of these policies. The duplicitous nature of American “political altruism” abroad lies at the heart of our crisis of national identity.

**US Foreign Policy Toward South Asia**

Spencer Allen, Senior, International Studies
Tsering Dhongthog, Senior, International Studies and Political Science
Galen Erickson, Senior, International Studies
Jon Frost, Junior, International Studies and Economics
Richard Hooban, Senior, International Studies
Aurora Jones, Senior, International Studies and Spanish
Richard Knoeber Jensen, Senior, International Studies
Sonia Luthra, Senior, International Studies
Tom Stocks, Senior, International Studies
Jed Tsai, Senior, International Studies
Kayanna Warren, Senior, International Studies and Biology
Andrew Watkins, Senior, International Studies

**Mentor:** Anand Yang, Jackson School of International Studies

The US has a rapidly growing interest in the region of South Asia for many reasons of strategic importance: international security, geopolitical balance, and economic growth foremost among them. Analyzing policy, history, academic and scientific works, this Task Force’s findings detail the direction that US foreign policy should take regarding the region as a whole and toward each country within it: India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan, and the Maldives. On issues ranging from nuclear nonproliferation and terrorism to cultural exchange and multilateral agreements, from technology FDI and energy to HIV and poverty, this Task Force concludes that there is much the US will gain from investing in increased communication and collaboration with the region, from President Bush’s first visit there in March of 2006 and beyond.

**Use of Presidential Proclamations as political fodder for religious constituency groups**

Mary Higdon, Senior, Communication

**Mentor:** David Domke, Communication

The interplay between politics and religion is of considerable interest these days, with research being conducted by scholars in political science, communication,
history, theologists, and other disciplines. The rise of what might be called “religious politics” is apparent in tensions among Christians, Muslims, and Jews, as well as terrorism generally. It is therefore important to understand how religious groups and government interact. One way is to examine the ways that U.S. presidents encourage religious constituency groups through their official public communications. Using the electronic archives of official presidential documents maintained by the University of California, Santa Barbara, I retrieved presidential proclamations beginning with Franklin D. Roosevelt. Such proclamations are largely symbolic in nature, having little real effect; as a result, these communications are ideal opportunities for presidents to send what political scientists call “signals” to religious groups, without necessarily alerting the wider public.

Over 3,000 proclamations have been issued since the Roosevelt presidency began in 1933. Unfortunately, the distinction between Executive Orders and Proclamations has been blurred historically, with distinct separation occurring beginning in 1972. Since Gerald Ford produced only a few proclamations before Jimmy Carter took office, this research focuses on proclamations issued from the Carter administration through George W. Bush, Jr. Preliminary identification of proclamations for potential “religious signals” is complete; those that appear to function in this way will be counted and then will undergo textual analysis as the next stages of this research. This study is expected to increase understanding of how U.S. presidents use public signals to religious constituency groups to indicate their alignment with these groups’ goals.

**Japanese Textbook Controversy**

*Casey Parks, Junior, International Studies (Asia), Japan option*

*Daniel Foe, Senior, International Studies (General Track)*

*Grace Carroll, Senior, International Studies (Asia), Japan option; Political Science*

*Howard Chan, Junior, International Studies (General Track)*

*Niki Iglesias, Senior, International Studies (General Track)*

*Masami Kobayashi, Senior, International Studies (Asia), Japan option*

*Sujin Lyu, International Studies (Asia), Japan option*

*Lucien Speidel, Senior, International Studies (General Track)*

*Mentor: Robert Pekkanen, International Studies (Asia)*

The textbook controversy over Japanese history textbooks first arose in 1982 over a change of wording in the description of Japan’s colonial role in WWII. Since then, the controversy has flared up repeatedly, drawing huge protests from both China and South Korea. In 2005, the controversy once again reared its head, this time drawing the largest protests yet from their East Asian neighbors. In order to best address what official U.S. policy should be in regards to this issue, we examined: the history of the conflict; the content of the textbooks in question; what exactly U.S. interests in the region are; and the relations between and policies of the three involved nations. With this body of knowledge behind us, it became readily apparent that neither intra-region relations, nor U.S. – East Asian relations were at a reasonable point to allow any direct U.S. intervention. Due to ongoing multilateral talks within the region, and an expected improvement in U.S. – East Asian relations in the near future due to a recent reorganization of the U.S. department of State, we found it highly probable that both of these conditions will improve in the coming years. It was therefore concluded that the U.S. should hold direct interaction in this controversy until a time when such action is likely to have a positive benefit for U.S. interests in the region.

**Children as American Citizens: The Fundamental Rights of Students in U.S. Law and Pedagogical Tradition**

*Riobin Brown, Senior, Political Science, Seattle University*

*Mentor: Erik Olsen, Political Science, Seattle University*

The fundamental rights of elementary and secondary students are not clearly delineated in U.S. law and tradition. Though minors enjoy some rights, they are limited, and greatly dependent on whether or not they are exercised in their capacity as students. The landmark Supreme Court cases Tinker v. Des Moines School District, Hazelwood School District v. Kuhlmeier, Bethel School District v. Fraser, and West Virginia v. Barnette define the context in which student’s rights are discussed. While Tinker established that students do not “shed their constitutional rights at the schoolhouse gate,” the Court decided in Hazelwood and Fraser that the responsibility of schools to provide an ordered educational atmosphere and foster academic achievement outweighed students’ rights to freedom of expression. The reasoning of the Court and the conservative education policy of the 1980s that underlies it contrast strongly with the philosophy of the pioneer of American progressive education, John Dewey. Dewey’s theory emphasizes education for citizenship in a democracy, which rests on the idea that public inquiry and discussion are conditions necessary for learning how to be an effective member of a democratic society. This paper explores the traditions surrounding the pedagogy of public discourse and education for citizenship, court decisions that have blurred the lines between “student” and “citizen” in American constitutional law, and the politics inherent in the American educational system that necessitates that public schools not be designated as public forums.
SESSION 1N

NARRATIVES ABOUT POWER AND CULTURE
Session Moderator: Gerald Baldasty, Communication
Mary Gates Hall Room 248

Jewish-Arab Coexistence Narratives in Haifa, Israel
Jacob Brown, Senior, International Studies
Mentor: Joel S. Migdal, The Henry M. Jackson School of International Studies

The Israeli-Palestinian Conflict is a source of great tension between Jewish and Arab (or Palestinian) citizens of Israel, the Jewish State. Relations between these two ethno-national identities are often characterized by suspicion, resentment, and mistrust. However, in the northern port city of Haifa, Jews and Arabs are often said to enjoy a rare form of integrative harmony and peaceful coexistence. A closer investigation of life in Haifa, however, reveals two competing narratives that both seek to define Jewish-Arab relations: 1) an official narrative, perpetuated by the municipality and media, that claims peaceful integration and cooperative coexistence, and 2) an unofficial narrative, perpetuated by mostly private Arab institutions and radical, left-wing Jewish activist groups, that claims institutional discrimination and segregation. Through participant observation conducted in Haifa throughout the summer of 2005 and interviews with prominent Israeli politicians, businesspeople, academics, and activists, my research seeks to show the reality of Jewish-Arab relations in Haifa, the existence of these competing narratives, and the ways in which these narratives are perpetuated and compete in the social space of Haifa.

The Dilemma of Collective Action in the Spanish Basque Region
Stacey Fernandez, Senior, Jackson School of International Studies; Community and Environmental Planning
Mentor: Gad Barzilai, Jackson School of International Studies

The Basque separatist group Euskadi Ta Askatasuna, or ETA, began using violence as a form of social mobilization in its attempts to bring about an autonomous Basque state during the Franco regime of the mid-20th century. Since then, the group has dominated the international news media while groups promoting the use of alternate forms of collective action in the movement have grown in number. My project will determine levels of support for violence as a form of collective action throughout the Basque separatist movement; it will examine the movement, and focus on perspectives within the Basque minority, Spanish civil society, and the Spanish state. Research will also consider ways in which the Spanish state has facilitated or hindered the use of violence within the separatist movement, and how recent outbreaks of violence from terrorist groups such as al-Qaeda have affected public perceptions. Research will examine current views on the Basque separatist movement by analyzing Spanish media representations of both peaceful and violent demonstrations promoting Basque autonomy, the literature of Spanish political organizations and the missions and writings of a variety of Basque region political groups including Gesto por la Paz and Elkarr; historical perspectives will be determined by using Spanish newspaper archives, governmental documents and other publications. I expect this research to demonstrate that governments can reduce the propensity for violence as a form of collective action through increasing political participation. I expect this research to demonstrate that governments can reduce the propensity for violence as a form of collective action through increasing political participation.

Racing Jewels: A Feminist Commodity Chain Analysis of Diamonds
Brendan Stewart, Senior, Women Studies
Mentor: Priti Ramamurthy, Women Studies

Historically, black South Africans mined diamonds for colonial and corporate interests, unlikely to ever own the diamonds they produced. However, in the post-Apartheid era, many South African elites are now consumers of diamond jewelry, in addition to other traditionally “white” status symbols. This project uses feminist commodity chain analysis to study whether socially constructed meanings surrounding diamond jewelry consumption in South Africa have shifted to accommodate black South African consumer sensibilities, and to help understand what the basis for those changes might be. Feminist commodity chain analysis is a methodology which links economic and social relationships between consumers and producers of a commodity and traces the manners in which ideologies of race, gender and class maintain these positions. Exploitative, racially segregated social policies connected to diamond production have had profoundly oppressive consequences for black South Africans, with lingering social inequalities persisting even after the fall of Apartheid. Likewise, the marketing imagery used to sell diamonds and “white weddings” to Western consumers is deeply intertwined with diamonds’ colonial origins—diamond engagement and wedding rings are primarily Victorian inventions—and supports a particular, narrow ideal of virtuous, white, middle-class femininity, an ideal which is frequently overtly hostile to black women. Through readings of diamond jewelry advertisements in black-targeted South African women’s magazines and South African jeweler’s websites, and the analysis of statistical and historical data relating to diamond production and consumption, this project examines popular cultural
trends and novel jewelry marketing strategies that may explain the appeal of diamonds for black South African consumers.

Framing the Middle East: An Examination and Analysis of the Photographic Portrayal of Twenty-three Countries in the Middle East appearing in Time, Newsweek and U.S. News and World Report, 2002 to 2004
Charles Whitter, Recent Graduate, Interdisciplinary Arts & Sciences, Global Studies, UW Bothell
Mentor: Ron Krabill, Interdisciplinary Arts & Sciences, UW Bothell

The average reader of any one of the three major weekly newsmagazines in the United States is generally better educated, more affluent and more politically sophisticated than average. To this influential audience, how is a region that few have any personal experience in, but is a region of great strategic importance to the United States, portrayed and represented? What is shown? Who is shown? What is the suggested “meaning” of these images? How is this region, and those who live there, to be understood? Nearly 1000 images from 23 countries in the Middle East (defined for the purposes of this study as the Department of Defense’s Central Command/CENTCOM “area of responsibility” plus Israel, but excluding Afghanistan and Iraq as countries involved in U.S. military action greatly increasing the number of photographic portrayals and skewing the totals towards a higher number of violent images) have been scanned and archived. Upon examination, the vast majority of images portray violence, the aftermath of violence, or armed individuals or groups. Using the work of Todd Gitlin, John Berger, Roland Barthes, Stuart Hall, Edward Said, David Levi-Strauss and others, an argument is made that the consistent and repeated images of violence that appear in these magazines “frame” the region as inherently violent and further that this state is normal, natural and unaffected by the rest of the world.

The Hispanization of Wapato, WA (1907-Present)
Gonzalo Guzman, Senior, History, American Ethnic Studies
Mary Gates Scholar, Zesbaugh Scholar, McNair Scholar, NASA Space Grant Scholar, Gates Millennium Scholar
Mentor: Erasmo Gamboa, American Ethnic Studies and History

The Hispanization of Wapato is a research project on Latino history in the Pacific Northwest in collaboration with the American Ethnic Studies Department’s Chicana/o Studies Division. The research studies the history of the Latino, mostly Mexican, community in the small rural town of Wapato, Washington. Although the Latino community has a minor presence since the city was founded in 1908, the Latino community begins to develop appreciably in the 1940s. This project explores the early years but focuses mainly on World War II to the present to determine how the Latino community has changed overtime. More importantly the research attempts to explain how Wapato transformed from an Anglo-Asian-Chicano town to a near exclusive Chicano-Mexican immigrant town. Another focal point is identity change in Wapato against changing racialization of its residents, social sphere, and landscape. The pivotal economic changes including the transformation of Wapato’s downtown sector to its current dilapidated form, and the effects of “White and Middle Class Flight” are analyzed in the project. Documents being examined in this research include federal census data, Wapato church membership and history, Wapato’s school enrollment records, oral histories of longtime residents, and Wapato’s newspaper, the “Wapato Independent.” The research will argue that the Mexican community’s influence extends back over to the early 1900s and the current white citizen out-migration has been masked by Latino immigration. Furthermore, this research intends to reveal that the history of racism and discrimination, as much as economic structural change of agriculture, in the Wapato community has shaped the development of the majority and later dominance of the Latino community.

Neoliberal Globalization: United States Hegemony or Imperialism?
Joan Lee, Senior, International Studies, Seattle University
Mentor: Connie Anthony, Political Science, Seattle University

Globalization as a phenomenon of interconnectedness creates extremely economically interdependent relationships between states, necessitating an examination of the connection between globalization and political power within the international system. This paper argues that globalization, from its inception, has unequally benefited powerful states. Although it is arguable that in the present system of global politics there exist many powerful states; i.e.: G8 countries, it is certain that after the fall of the Soviet Union, the United States has enjoyed a position of seemingly uncontested military, economic and political power. This paper establishes a link between globalization and the global hegemon, namely the United States, a country that has undoubtedly created the shape and face of today’s interconnectedness in the form of neoliberal globalization, which emphasizes the reduced role of government in regulating a state’s economy, as well as liberalization of trade and financial markets, and privatization. The key players in this system of neoliberal interconnectedness are argued to be international financial institutions; i.e.: the IMF and World Bank, whose agendas are uncannily parallel with the United States’ economic and political interests, and whose aid packages affect a state’s sovereignty by necessitating a specific domestic policy, beginning with a state’s economy, and strongly intimating American-style capitalism and democracy.
The experience of British colonialism in India is cited in order to establish similarities, as well as difference between traditional empire and neoliberal globalization. The presented argument establishes that globalization is not inherently empire, but because neoliberal globalization has been shaped by the United States to mirror its own economic and political interests, and is also a very intrusive form of interdependence, the similarities between the two necessitate a serious discussion of the U.S.’ role and influence in the global political system.

Battle Lines Drawn: The Culture War in Moscow, Idaho
Shay Colson, Senior, Comparative History of Ideas
Mentor: James Wellman, Jackson School of International Studies

Moscow is a sleepy college town in Northern Idaho, home to roughly 10,000 year-round residents. This traditionally liberal community has played witness to the rise of a Reformed Christian church, Christ Church. Led by Pastor Douglas Wilson, Christ Church has been the center of controversy in the community, much stemming from the Church’s stance on homosexuality, education, and other important issues. Pastor Wilson, author of more than 30 books, calls for the abolition of the public school system, and advocates the death penalty for homosexuals, and has written a book which biblically justifies Southern slavery.

With a growing congregation already numbering 1,100 (nearly 10% of the town’s population) Christ Church is making significant social, economic, and cultural impact. In addition to founding Christ Church, Pastor Wilson has founded a K-12 school (Logos), New St. Andrew’s College, a Christian publishing company (Canon Press), and an educational accreditation agency (Association of Classical and Christian Schools), all located in Moscow.

For the residents of Moscow, many of whom hold diametrically opposing viewpoints, there is a very real and very difficult struggle playing out. On one hand, many disagree with the views and holdings of Christ Church at a core level. On the other, they advocate for tolerance, free speech, and respect for the views of others. Reconciling these feelings is proving to be extremely difficult, and is only exacerbated by the continued growth and influence of the church. For my research, I have interviewed Moscow residents, including Christ Church leadership and membership, long time community residents, vocal church opponents, and Pastor Wilson himself. By offering a neutral, academic setting and gathering multiple first-hand accounts in addition to my research, I explore the personal, cultural, and societal interactions taking place in one community’s fundamental struggle over the vision and shape of its future.

SESSION 2A

*Note: Titles and Abstracts in order of presentation.

THEORY AND PRAXIS IN CULTURAL INNOVATION AND PRODUCTION
Session Moderator: Clarke Speed, Honors Program
Mary Gates Hall Room 284

Seahomes: Manufacturing Pre-existence
Sean Day, Recent Graduate, Comparative History of Ideas
Mary Gates Scholar
Mentor: Phillip Thurtle, History

This year, I will be presenting a hybrid of the presentation given at the Summer Institute for the Arts and Humanities in 2005. It is an examination of the research process, the similarities between the arts and sciences are often manifest. Still, the uses, meanings, and values that are derived from the contributions from either area are largely polarized. While it may seem obvious to many, it is worth examining the implications of a nearly universal tenet in popular western thought: that if something is of the arts, it is interpreted and consumed differently than something constructed within the societies of science. Can creativity exist as something other than art or science? Seahomes addresses that question as the exploration and construction of a method to jump outside of categorically enforced routines by creating a setting that promotes interaction and imagination. From the arena of Seahomes, practitioners of various established disciplines, both scientific and artistic, might borrow, research, or even develop projects and objects that would not otherwise have been facilitated through a conventionally polarized artistic or scientific process. Seahomes is created largely with 3-D software. Visualizations, along with a list of feasible technological and ethnographic descriptions, are the tools that will be used to populate the Seahomes world. It is through these physical signs that the person who is interacting with the Seahomes environment will be able to bridge their own lives and experience, thereby ultimately facilitating the emergence that the project should engender. The expected result is transportation itself: a change of viewpoint. And, hopefully, new ways of handling our most precious tool: our imagination.
Networking through Networking: The Intimate Connections of Mail, Artists, and the Web
Marya Dominik, Senior, Interdisciplinary Arts and Sciences, UW Bothell
Mentor: Gray Kochhar-Lindgren, Interdisciplinary Arts and Sciences, UW Bothell

Getting a handwritten letter in the mail still gives us a thrill. The handwriting, and carefully chosen words link us to the sender. Each letter is a piece of art, from the stamp, and paper, to the color of the ink that scribed each word. Today the handwritten letter is a relic, an artifact. Email is the correspondence of choice, and the telephone follows close behind. Bills and marketing materials are what dominate the post these days. What have we lost by turning to the technology of the internet? The delight of receiving a package in the mail is still there. The desire to communicate with paper and pen and other ephemera still remains. It is from this context that we see the resurgence of mail art. What was once a reaction to the traditional forms of art and an offshoot of Dadaism has taken on life of its own. Today these artists, both serious and crafty, are networking through the internet. They create their connections online, through emails, blogs, and websites. It is pixels and bytes that have salvaged the art of the letter. Mail, strangely enough, has been brought back to the fore by technology. My research will focus on how Mail Art’s popularity and dispersal has been facilitated by technology.

Eros, Logos and Wikipedia: Postmodern Knowledge & Lyotard’s Paralogy
Erik Echols, Senior, Interdisciplinary Arts & Sciences, UW Bothell
Mentor: Gray Kochhar-Lindgren, Interdisciplinary Arts & Sciences, UW Bothell

Postmodernity, according to Jean-Francois Lyotard, breaks up the grand narratives that he argues have governed knowledge up to this point. Contributions to the state of knowledge, however, are no longer from a select few. Open-source knowledge bases on the internet form a virtual agora for both the production and distribution of knowledge. In this presentation, I will argue that Wikipedia combines a vast number of contributors from all around the world, with open-source technology. This combination provides a newly designed electronic agora where many smaller narratives take place simultaneously. Each of these narratives contributes to a more fluid, and dynamic state of knowledge.

ArcheoVis: Archaeology visualization in 3D
Darien Hager, Senior, Informatics
Mentor: David Hendry, Information School
Mentor: Ben Fitzhugh, Anthropology

The ArcheoVis project is a software application for exploring archaeological data as a three-dimensional rendering. The visualization is not intended to be photorealistic, but instead to focus on helping archaeologists to familiarize themselves with the area of interest, discovering patterns and anomalies through visual (gestalt) perception. Using the Java™ language and the Java3D rendering library, I have written a prototype that generates an on-screen representation of an excavation which can be navigated and examined on a common laptop or desktop computer, making it possible to be used in the field. The source data used in its development consists of laser-measurements from an excavation in Alaska’s Kodiak archipelago, courtesy of the UW Anthropology department. Ideally this will serve as a starting point that can be adapted for use with other excavations or institutions, giving archaeologists a practical and inexpensive means to visually model their work. Although the prototype is still being developed, I plan to demonstrate a functional version and detail the various ways in which it can serve as a useful archaeological tool.

Paradox and Progress: Exploring Urban Culture in Amsterdam through Interdisciplinary e-Research
Belinda Luk, Senior, Cellular, Molecular, and Developmental Biology
Demi Anzoulatos, Freshman, International Studies
Christopher Blair, Junior, International Studies
Lacy Cooper, Senior, Sociology, Comparative History of Ideas
Shilpa Coorg, Sophomore, Biology
Lisa Mahlum, Junior, History
Mentor: Clifford Tatum, Honors Program

There are approximately 174 ethnic groups in the city of Amsterdam. Like many urban centers in Europe, Amsterdam is undergoing an identity shift as migration trends continue to change the ethnic make-up of the city. This summer, the University of Washington is participating in an international collaboration with the Virtual Knowledge Studio (Royal Netherlands Academy of Arts and Sciences), and the International School for the Humanities and Social Sciences (University of Amsterdam). Prior to conducting field research in Amsterdam, the UW students will develop social science and humanities interdisciplinary research designs that employ digital data-gathering devices and e-research techniques. The conceptual framework utilized in this study is based on the assumption that technologically mediated research influences not only the method of data collection and analysis but also the character and process of knowledge production. For the symposium, students will present their interdisciplinary research designs prepared for the field research component to take place in Amsterdam during August 2006. Specific research topics include immigration policy, Islamic communities, electronic music, urban youth culture, human rights, and programmatic tolerance. Small-group research teams will begin their research in Seattle and gain knowledge and
resources from European Studies, CEP, Anthropology, English, Communication, Architecture and Informatics faculty. Students will also conduct online research related to their research topics. Each student researcher will develop an individual blog to use as a lab notebook documenting their research plan and progress as well as for sharing data resources. Planning elements include places to see, institutions to visit, and people to observe and/or interview. Accomplishment of the small-group research projects will result in a collection of digital content that is used to create multimedia presentations that are produced as video pod-casts. Additionally, the collective data repository and individual project findings will be the basis for a multimedia aggregation that reflects a meta-level synopsis of the overall program.

SESSION 2B

NEUROBIOLOGY: CELLULAR, STRUCTURAL, AND BEHAVIORAL STUDIES
Session Moderator: Wendy Raskind, Medicine
Mary Gates Hall Room 271

Stem Cell Regeneration in Normal Adult Human Cortex and Chemotherapy-Treated Tumor
Megan Hoane, Senior, Biology (Physiology)
Mentor: Philip Horner, Neurosurgery

The prognosis for various forms of malignant brain cancer has remained relatively unchanged despite improvements in treatment techniques over the past several decades. Were the molecular mechanisms of this disease to be deduced, an entirely new (and hopefully more effective) field of therapy could be applied. Recent research has directed its attention to the potential causative relationship between gliomas and progenitor cells, which demonstrate remarkable similarities in morphological and behavior characteristics. A progenitor cell that continues to proliferate despite loss of standard regulation controls is a widely hypothesized source for gliomagenesis. The mechanisms and pathways utilized by both healthy and unstable progenitor cells in the adult human brain, however, remain relatively unknown. Numerous studies have been conducted using the rodent as a model organism, but the significance of such results relative to the biology of the human brain is uncertain. Thus, this investigation aims to elucidate the regenerative pathway utilized within pseudonormal adult human cortex and then compare this profile to that displayed by adult human tumor samples under both normal and antimitotic conditions. All tissue samples have been kept alive in tissue culture and treated with ARAC (an antimitotic drug) and/or BrdU (a label that tracks cell division). The goal is to assess the molecular phenotype of the stem cell which regenerates after the chemotherapy agent is applied. The response of each sample will be assessed by staining for progenitor and stem cells within small tissue slices via immunohistochemistry. The identity, location, and regenerative capacity of these cells will be of particular interest and the results may aid in understanding how the adult human brain operates under normal homeostatic and uncontrolled tumor conditions.

Adult Neurogenesis: Tbr2 is Expressed in Neuronal Fate Determined Progenitors of the Hippocampus
Tom Kowalczyk, Senior, Neurobiology
Mentor: Robert Hevner, Pathology

The dentate gyrus of the hippocampus is one of two regions where new neurons are generated in the adult nervous system. Progenitor cells in the dentate gyrus divide and differentiate into a class of neurons called granule cells. It has been found that these cells express a sequence of molecular markers as they transition from neural progenitor cell to differentiated neuron. In this sequence, early progenitors express nestin and Pax6, fate determined neural progenitors express PSA-NCAM, Doublecortin, and NeuroD, while differentiated non-dividing granule cells express Calretinin, Calbindin and NeuN. The T-box transcription factor, Tbr2, has been found to be important in the cortex and cerebellum of the developing mammalian brain. Using immunohistochemistry we stained the adult mouse hippocampus with antibodies against Tbr2 and various other markers characteristic of the progenitor cells in the dentate. Analyzing the stained tissues with laser scanning confocal microscopy we found Tbr2 to be highly co-localized with markers of dividing cells (PCNA, BrdU) and fate determined neural progenitors (PSA-NCAM, Doublecortin, NeuroD) in the dentate gyrus. Lower incidences of co-localization were observed in early progenitors (Pax6) and little to none in differentiated neurons (Calretinin, NeuN). These findings indicate transient expression of Tbr2 in neuronal fate determined dividing progenitors of the adult dentate gyrus. Studies of these developing cells have the potential for bringing us closer to developing effective methods for regenerating nervous tissue.

Investigation of the interaction between NPC1 and human APP
Lauren Surface, Senior, Neurobiology
Mary Gates Scholar
Mentor: Leo Pallanck, Genome Sciences

Niemann Pick Type C disease (NPC) is a fatal autosomal recessive neurodegenerative disorder, with amyloid plaques and neurofibrillary tangles, both features of Alzheimer’s disease, observed. It is characterized by faulty lipid and cholesterol trafficking in the lysosomal/ late endosomal system and is caused by mutations in the NPC1 gene.
The *Drosophila* genome has two homologs of this gene, NPC1a and NPC1b. These genes have been found to recapitulate the vertebrate protein function. The goal of this project is to assess in *Drosophila* the outcome of expressing human genes that, when mutated, may be toxic in a NPC1a mutant background. The first of these genes encodes for the amyloid precursor protein (APP). APP, when cleaved, forms β-amylloid peptides that are found in plaque deposits of Alzheimer’s disease patients, with cholesterol being an important regulator of this process. Since disrupted cholesterol trafficking and amyloid plaques also are associated with Niemann-Pick Type C disease, we can look at the consequences of APP expression within the NPC1a mutant background. A system has been developed to assess the toxicity of normally lethal genes in a clear and effective manner. This remarkable system creates eye tissue that is mutant for an essential gene, while the rest of the body is heterozygous for this gene. By using this system, we can compare flies with mutant homozygous NPC1a / NPC1a eyes to flies with eyes lacking NPC1a and are expressing APP. We hypothesize that there may be a disrupted eye with the combination of APP and mutant NPC1a, indicating an interaction between these proteins. In addition to this use, we are studying homozygous NPC1a mutant animals that have been rescued into adulthood by the addition of cholesterol to their diet. Neurodegeneration and impaired cholesterol trafficking are being examined in these animals through whole-mount staining and confocal microscopy.

**Sexual Dimorphism in Brain Structure; Possible Relationships to Autism**

*James Wang, Senior, Bioengineering*

*Mentor: Stephen R. Dager, Radiology*

*Mentor: Veronica Smith, Radiology*

Studies on human cerebral cortex have suggested sex-related anatomical differences. Research has shown that the male brain volume is on average 9% larger than the female brain volume. Cortical volume differences have also been observed in certain disease processes, such as autism. Autistic brain volume, on average, is 10% larger than normal brain volume. Preliminary findings further suggest that cerebral volumes in 3-year-old boys and girls with autism are proportionally enlarged compared to age and sex-matched typically developing children. We want to better understand autistic disorder by comparing existing brain magnetic resonance images (MRI) across typically-developing as well as autistic boys and girls. We will use surface-based morphometry to compare cortical shape differences across groups. Sex-matched comparison will be used to investigate enlargement of the autistic brain. For example, recent publication of the Excessive Male Brain Theory postulates that individuals with autistic disorder tend to exhibit extreme male cognitive and behavioral characteristics possibly related to larger brain volumes. Cross-sex comparison, specifically comparing autistic girls to typically developing boys, will be used to better understand the structural similarities and differences between these two groups. This research project is a useful step toward understanding the relationship between brain structure differences related to autism and sex and aberrant behavioral and cognitive function in autism.

**Surface-based morphometric analysis of ethnic differences in three-year-old brains**

*John Lee, Senior, Biochemistry and Biology (Molecular, Cellular & Developmental)*

*Mentor: Stephen Dager, Radiology*

*Mentor: Veronica Smith, Radiology*

Surface-based morphometry (SBM) is a quantitative approach used to analyze structural MRI data by measuring the sulcal contours along the external surface of the cerebrum. The SBM method is robust and objective for detecting subtle differences in brain surface anatomy. This analytic approach is currently being used to characterize brain cortical differences in a group of young children with autism involved in a longitudinal study of brain development. The intent of the current study is to use SBM to compare brain surface structure between three-year-old typically developing (TD) Caucasian children to age- and sex-matched TD Asian children. Comparison between average surface cortical maps generated from each ethnic group will be evaluated for systematic cortical anatomical differences. A more general goal of this work is to help establish core neuronal anatomical features of autism consistent across different ethnic groups. Thus, an understanding of the interrelationship of demographic factors such as ethnicity, age, and sex on brain development will help us to more specifically identify pathophysiological processes underlying abnormal brain development in autism.

**A Transmission Disequilibrium Test of DCDC2 Markers in Dyslexia**

*Lani Chun, Senior, Biology*

*Mentor: Wendy Raskind, Medical Genetics*

Dyslexia is a common neurobehavioral learning disability that affects 5-10% of school-aged children. It is characterized by severe difficulties in reading and spelling that cannot be explained by low levels of intelligence or inadequate schooling. Although the exact cause of dyslexia is unknown, a large number of studies strongly suggest that it has a complex genetic component. Linkage analyses have identified multiple regions that might contain genes that contribute to the phenotype. Recently, several candidate genes for dyslexia have been proposed. Two studies support involvement of the *DCDC2* gene—located on chromosome 6—to dyslexia. *DCDC2* is believed to be involved in cortical neuron migration, and genetic changes in this gene may cause an incomplete or abnormal formation of brain circuits that are involved with
reading and spelling skills. Meng and colleagues (2005) did transmission disequilibrium tests (TDTs) on several markers. They found a 2,445 base-pair deletion and two single-nucleotide polymorphisms (SNPs)—rs1087266 A/G and rs807724 C/T—within the DCDC2 gene that showed a significant difference in transmission between parents and affected children. In a separate study, Schumacher and colleagues (2006) performed TDTs on 22 SNPs in the DCDC2 gene. The SNP rs793862 A/G was found to have significant transmission disequilibrium. A second SNP, rs807701 C/T, was not found to have significant transmission disequilibrium when assayed alone, but rs793862 A and rs807701 C together showed a very strong pattern of linked over-transmission. We sought to replicate the results found by Schumacher et al. and Meng et al. in a set of multigenerational families with dyslexia. Our data suggests that the deletion and four SNPs do not have any significant transmission disequilibrium in our subject sample.

Ocular Motor Memory: The Speed of Sequence Learning
Tess Lang, Senior, Neurobiology
McNair Scholar; Howard Hughes Scholar; OMA-Boeing Scholar
Mentor: Thomas Eggert, Neurobiology
Mentor: Ric Robinson, Biological Structure

Motor learning is the improvement of spatial and temporal accuracy of movements with practice. With repetition, an implicit motor action is able to become automatic with its tempo and movements in space coupled. The goal of this study is to investigate the relationship between spatial and temporal qualities of sequence learning by finding out if spatial and temporal aspects of non-continuous sequence learning act independently or not of one another. A serial reaction time task (SRTT) is a learning sequence that begins with acquisition of a task followed by motor actions being stored in memory, and resulting with the execution of a goal. Past studies have shown ways of analyzing sequential learning through the use of latency measurements and percentage of correct responses. In spite of a considerable amount of research, the relationship in which spatial and temporal information become coupled in the process of learning sequential movements has been narrow in analysis and limiting in the nature of errors allowed to occur. By allowing healthy subjects to reproduce a visual sequential pattern with and without temporal variation using memory guided motor movements, a measurement of the total cost of errors made in the sequential reproduction could be obtained using a novel array of error analysis methods toward the eye-movement SRTT in order to study implicit spatial and timing learning interdependencies. If temporal and spatial aspects of sequence learning act coupled, then changing the temporal aspect would most likely change the nature of learning. Ultimately these studies could provide better understanding of the organization and mechanism of sequential learning and a means of early-onset diagnosis tests for symptoms in Parkinson’s and Huntington’s disease patients, which have shown to affect regions of the brain responsible for the capability of performing implicit learning tasks such as SRTT.

SESSION 2C

MOLECULAR MANIPULATIONS: TRANSITIONS FROM RESEARCH TO APPLICATION
Session Moderator: Ethan Allen, Nanotechnology
Mary Gates Hall Room 242

The Syntheses of Tethered Aminoalkenes as Substrates for Intramolecular Hydroamination
Thomas Weisey Chung, Junior, Chemistry (ACS Certified)
Mary Gates Scholar
Mentor: Brian M. Cochran, Chemistry
Mentor: Forrest E. Michael, Chemistry

Synthetic organic chemistry is an effective means of building intricate molecular compounds for use in pharmaceutical industries, materials science, and molecular biology. Furthermore, the effectiveness and specific capabilities of these approaches are demonstrated by efficient syntheses of appealing organic molecules. The pharmaceutical industry has an interest in complex nitrogen-containing molecules since a vast number of today’s top-selling drugs, like Ritalin, are nitrogen-containing compounds. The purpose of this research is to synthesize amine-tethered olefins that are activated by neighboring functional groups in order for hydroamination to be favored. We report here the syntheses of tethered aminoalkenes and the attempted catalytic addition of nitrogen substituents across a carbon-carbon double bond. Tert-butyl [(4E)-2,2-dimethyl-5-phenylpent-4-en-1-yl]carbamate and benzyl[(4E)-2,2-dimethyl-5-phenylpent-4-en-1-yl]carbamate were synthesized in three steps with 48% and 31% yield, respectively, and characterized by NMR spectroscopy. These amino-olefins may effectively serve as substrates for formation of nitrogen heterocycles by catalytic intramolecular hydroamination reactions. Future work will be directed toward testing these substrates in hydroamination. This may also include cyclizations of other aminoalkenes for the assembly of naturally occurring alkaloids.
Inter-laminar Resistance Heating: A Search for an Alternative Heating Technique for Carbon Fiber Fabrication in Industry Applications
Ben Creelman, Junior, Mechanical Engineering, Seattle Pacific University
Mentor: Lane Seeley, Physics, Seattle Pacific University

The question I have attempted to answer with my honors research project is: Are there advantageous alternatives to the current engineering process of fabricating carbon fiber composites? Specifically, in this process there is a stage where the composite needs to be heated (cured); but in some situations with large pieces, large industrial ovens are not practical. Thus I have searched for (and I believe found) a process that will answer this dilemma. Ultimately I have come to title my honors project: “Inter-laminar Resistance Heating: A Search for an Alternative Heating Technique for Carbon Fiber Fabrication in Industry Applications.” Over winter break I have made considerable progress in answering these questions with the aid of a local engineering company (Janicki Industries). As a result of theoretical calculations and thermal modeling, I came up with a design for an alternative heating technique using resistance wiring, constructed the needed test materials, and successfully implemented the experimental process of “Inter-laminar Resistance Heating” in the form of a small test piece of carbon fiber. With the guidance of my advisors, Dr. Lane Seeley and John Janicki (vice-president of Janicki Industries), I am currently attempting to forecast the potential properties of this process in a full scale industry setting. For the first part of my presentation, I plan on outlining the various theoretical aspects that had to be taken into account during the infancy stages of my project (during which heat transfer calculations, production considerations, and materials research will all be explained). For the second part, the focus will be on the financial and practical implications of this experimental process which will be examined by theoretically projecting the results from my test example into a full-scale industry setting and comparing these projections with the current processes.

Thermal Stability of Carbon Nano-Tube Reinforced Ceramic Foams
John Morris, Senior, Materials Science & Engineering
Mentor: Rajendra Bordia, Materials Science & Engineering
Mentor: Michael Scheffler, Bavarian Center for Applied Energy Research, ZAE Bayern, Erlangen, Germany

Carbon nanotube reinforced ceramic foams are an attractive material for high temperature thermo-mechanical applications like the heat shields for spacecraft. Our lab has developed an attractive process to make ceramic foams from polymer derived ceramics (PDC) with in-situ growth of carbon nanotubes. The goal of this research on the CNT reinforced Si-O-C polymer-derived ceramic foam is to characterize the thermal stability of the material system. The strategy for obtaining the thermal stability was to compare the degradation and oxidation performance of the foams in bulk and powder forms processed at different temperatures. Using the TG/DTA, a number of annealing experiments were conducted on the samples. The hypothesis was that the powder samples would loose carbon mass faster due to an increased surface area. The data shows an opposite effect. These samples were also examined in the SEM and showed complete removal of CNTs from annealed samples. We are exploring various possible explanations for this phenomenon and conducting additional tests to investigate this unusual behavior.

Robust bioassay for genotoxic agents
Vanessa R. Palmer, Sophomore, Chemistry and Biochemistry
Mentor: Norman J. Dovichi, Chemistry
Mentor: Emily H. Turner, Chemistry

A handful of species of bacteria and yeast have been successfully engineered as biosensors for the presence of genotoxic agents. While the methods of detection may differ, all of these assays share a common drawback: low dose thresholds for DNA damage. Our group has created a Deinococcus radiodurans construct containing a translational fusion of the DNA repair protein RecA and green fluorescent protein (GFP). When the organism produces RecA to initiate the SOS pathway in response to DNA damage, the detectable GFP fluorescence has intensity proportional to DNA damage. The key advantage of our biosensor is the extremely wide scope of tolerance of D. radiodurans to genetic damage via alkylation, double strand breaks, and oxidative stress; it is, in fact, the most radioresistant organism known. Several genotoxic compounds, including formaldehyde and mitomycin C, were tested. Survival curves and plates were then generated after exposure to determine maximum and optimal dosages to induce RecA production. Fluorimetry was used to determine the linear dynamic range of response; the kinetics of the RecA response were also analyzed. To determine stochastic variability in RecA expression between individual cells, fluorescence microscopy was performed. Using these methods, DNA damage in D. radiodurans relative to control cells with baseline RecA levels is quantifiable, making the RecA: GFP fusion strain potentially viable as a sensitive detector for dangerous contaminants in environments too hostile for other organisms.

Crosslinked Lipid Bilayers for Cell Surface Studies
Galen Sather, Senior, Biochemistry
Mentor: Roger Michel, Bioengineering
Mentor: Esmaeel Naemi, Bioengineering
Mentor: Michael Halter, Chemistry

Although supported lipid bilayers are increasingly used
as model systems for biological coatings and have led to new insights about protein-surface and cell-surface interactions, they lack the high stability desired for use in ambient or high-vacuum environments and have not revealed the secrets of how to engineer surfaces that properly heal. The question arises whether controlling the surface chemistry is sufficient to control cellular responses, and whether current model surfaces are too simplistic in their molecular architecture if compared to biological interfaces. The membrane of the red blood cell, a truly biocompatible entity, consists of a fluid phospholipid bilayer that is mechanically stabilized on the intracellular side by a dense protein network. The membrane surface is decorated by a variety of transmembrane and surface-anchored proteins. We are adopting this design principle to engineer a lipid membrane-based surface coating. For supported lipid bilayers to serve as useful models in cell culture and implantation experiments, enhanced mechanical stability is crucial while maintaining membrane structure or fluidity. We can covalently crosslink leaflet lipid molecules to pHEMA [poly (hydroxyethyl methacrylate)] substrates via 1.1’ carbonyldiimidazole (CDI) activation of the pHEMA surface and attachment of the polar head group. Additionally, it is possible to mechanically stabilize lipid bilayers by partial covalent cross-linking of the inner leaflets to the support and cross-linking the inner and outer leaflets (by their hydrophobic tails) themselves to increase stability in air and ultra high vacuum environments.

**Porous Titanium Fabricated Via the Protein Forming Method**

*Ka C Wong, Senior, Materials Science & Engineering and Economics*

*Mentor: Raj Bordia, Materials Science and Engineering*

*Mentor: Almuth Berthold, Institut für Nichtmetallische Werkstoffe, Technical University of Berlin*

*Mentor: Hulmet Schubert, Institut für Nichtmetallische Werkstoffe, Technical University of Berlin*

Porous Ti6Al4V was attempted to be produced by using the protein forming method. This study characterizes slurry compositions and processing parameters aimed to obtain porous Ti6Al4V with interconnected porous networks and highly controllable porosity and pore size. Laboratory egg white powder was used as a binding and a foaming agent. A porous Ti6Al4V green body was produced through a gelling and drying process at 80°C and 120°C. A good strength porous Ti6Al4V specimen is available after a protein burnout process in an air atmosphere and a sintering process in a vacuum environment. Optical microscopy was performed on the porous Ti6Al4V specimens after each processing step to inspect their porous structure. Carbon and oxygen contents were also analyzed in the specimens during intermediate processing steps. Optimal temperature for protein burnout process is identified to be between 400°C to 450°C for an egg white concentration in the range of 6vol% - 24vol%. Pore sizes approximately 200–700 μm were observed after the sintering process. These experimental results demonstrate prospects on fabricating porous titanium and other metals using the protein forming method.

**Development of Cu incorporated V$_2$O$_5$ thin films and the measurement of electrical conductivities and Seebeck coefficients**

*Xiaohao Zheng, Junior, Materials Science & Engineering*

*Mentor: Fumio Ohuchi, Materials Science & Engineering*

Thermoelectrics have a long history of development and industrial use. The reason it fascinates scientists is that heat energy is a clean and infinite resource which can be utilized conveniently. Quality of the thermoelectric property is assessed by the figure of merit, $ZT=S^2\sigma T/\kappa$, where $S$ is the Seebeck coefficient, $\sigma$ is the electrical conductivity, and $\kappa$ is the thermal conductivity at given temperature $T$. Materials having high figure of merits have better capability of converting heat energy into electrical energy; however, a power factor $S^2\sigma$ is a convenient parameter to be looked at for designing new materials. V$_2$O$_5$ is an intriguing material, which crystallizes into a layered structure possessing a high Seebeck coefficient, however, low electrical conductivity prevents achieving high power factor. My project is aimed at developing a method to improve the electrical conductivity of V$_2$O$_5$ without changing the Seebeck coefficient. Theoretically, incorporation of Cu into V$_2$O$_5$ can result in the increase of Cu-V-O bond and the V$_{5+}$ concentration. Enhanced exchange of electrons between V$^{5+}$ and V$^{4+}$ can facilitate polaron hopping, resulting in the increase of the electrical conductivity. To achieve this, we have developed a new inorganic sol-gel method to incorporate Cu into V$_2$O$_5$ host materials by making Cu$_x$V$_{2-x}$O$_5$ gels. Experimentally, molten V$_2$O$_5$ is poured into Cu$^+$ or Cu$_{5+}$ containing solutions and stirred for several hours to obtain Cu$_x$V$_{2-x}$O$_5$. Gels are formed when the Cu/V ratio is low; however, Cu$_x$V$_{2-x}$O$_5$ precipitates in solutions with high copper-ion concentration. The gel was deposited on a glass substrate followed by annealing at 400°C, whereas the precipitates are sintered and made into a pellet form. The structure of the sample was determined by x-ray diffraction. By controlling the thickness, the Seebeck coefficient and electrical conductivity were measured.
**SESSION 2D**

**BODIES AND MEDIA: THE REMIX**

*Session Moderator: Philip Thurtle, Comparative History*

*Session Assistant:*

*Mary Gates Hall Room 251*

**Why Birds Sing: The Science and Poetry of Birdsong**

*Steven Araujo, Senior, Comparative History of Ideas*

*Mentor: Phillip Thurtle, Comparative History of Ideas*

Birdsong is one of the fastest growing topics in behavioral biology today; it has also inspired many poems throughout the ages. The aim of this project is to navigate the uncharted space in between these two forms of research at this pivotal moment in time. Instead of trying to choose between a scientific or poetic explanation, the project suggests ways in which science and poetry could build off of each other, for example, poets using concepts that they learned from scientists such as “song matching.” As for birdsong itself, the project aims to show the diverse amount of functions that it can be used for such as: communicating aggressive or flirtatious messages, communicating some aspect of a bird’s personality, speaking to people, questioning reality and existence, and expressing feelings of astonishment. Ultimately, the project tackles the question of morality, and how birdsong, as well as all the life that surrounds us, as directives and as emergent phenomena, must be studied.

**Film History Remixed: DJ Spooky’s *Rebirth of a Nation***

*Maggie Bardacke, Recent Graduate, English*

*Mentor: Brian Reed, English*

D.W. Griffith’s 1915 film *Birth of a Nation* is known as a groundbreaking work of technological innovation, while the film’s social message has a legacy of its own. The unmistakable glorification of the Ku Klux Klan during Reconstruction in the film has made the film an object of censorship and a springboard for arguments surrounding race and American politics. In an extraordinary piece of contemporary art, DJ Spooky, a conceptual artist, author, and musician, takes Griffith’s film and applies the dj technique of sampling to the visual medium. My research paper explores DJ Spooky’s *Rebirth of a Nation* by looking at Spooky’s historical influences and the precursors of today’s ‘remix culture’ while also taking into account the critical reception and audience reaction to *Rebirth of a Nation*. My research includes my first readings of film history and theory; the discovery of the Situationists, the French artistic and political movement of late 1950s, and in particular their tactic *detournement*, the reuse of preexisting artistic elements in a new ensemble; and an in-depth look at the NAACP’s historical and contemporary stance on the original film. Through my research I have come to believe that DJ Spooky’s work deserves attention from a broad audience for his ability to show that our current exceedingly technological culture makes possible new opportunities for transformations and demands a dialogue in which you can not speak of the present without combing it with knowledge, experience, or artifacts of the past. I argue that DJ Spooky’s film does much to draw desperately needed attention to the observation that the spectacular pace of film’s evolution, of which Griffith played a crucial role, is incongruous with the slow crawl of progress in civil rights.

**Documentary Film *Fellini Ungrateful Celebration***

*Eric Burritt, Senior, Cinema Studies*

*Mary Gates Scholar and Undergraduate Travel Award Recipient*

*Mentor: Professor Willis Konick, Cinema Studies*

*Fellini Ungrateful Celebration* is a documentary on Felliniana, which was a conference hosted by the University of Washington and numerous external sponsors in the fall of 2003. This conference marked the 10th anniversary of the death of the famed Italian director, Federico Fellini. Directors, writers, scholars and actors who have been influenced by Fellini’s work traveled from all over the world to attend. Components of the conference consisted of an academic conference hosted by the UW, a film festival at the Experience Music Project and Seattle Art Museum, an opening night event at Meany Hall, an original drawing exhibit at the Henry Art Gallery, a photography exhibit at Suzzallo Library and more. Every event was filmed, including some interviews, resulting in approximately 70 hours of digital videotape, which were then reviewed, logged, and edited into an 88 ½ minute documentary. The documentary asks and answers the question: If Fellini were alive today, would he have been pleased about Felliniana, and if so would he have attended any of the events?

**“Tall Trees”: A Short Story Exploring Issues of Hope in the Capricious Modern World***

*Holly Johnson, Junior, Comparative History of Ideas*

*Mentor: Phillip Thurtle, Comparative History of Ideas*

As each adult generation emerges, the hope for a more accountable and interconnected world tends to depreciate. In a societal sense, for example, global warming threatens humans exponentially as each day passes, as do the horrid statistics of objet poverty, famine, and disease. These realities are debilitating to individuals everywhere. Often times an individual assuages this paralysis through modes of escapism such as foreign travel or through engaging in destructive behaviors like drug abuse. However, creative writing that embodies namely both intellectual and emotional struggles creates reflection on ways to negotiate the ramifications of hopelessness. Creative writing reveals
that experiences such as travel are not merely acts of escapism, rather they are different avenues to explore the self and create opportunity to nurture the internal optimist in every individual. In this paper I use creative writing as one of these tools for exploration when I discover hope in one of the most frustrating of experiences.

In Search of a Historical Anthropology: Cuban Filmmaking, 1990 to present.

Maiensy Sanchez, Senior, Anthropology
Ronald E. McNair Scholar; EIP Presidential Scholar
Mentor: Rachel R. Chapman, Anthropology

This work examines the images of Cuba, produced by its film industry during the Special Period, as a symbol of resistance. The Special Period is the official designation for the period of time following the collapse of the former Soviet Union and the drastic economic transformations affecting the island as a consequence. Using a theoretical framework that incorporates analysis of the role of visual anthropology by Marita Sturken and Lisa Cartwright, as well as the work of David MacDougall, I seek to explore Cuba's publicly distributed and consumed visual representations. My specific aim is to document anthropologically the history of Cuba’s official public image-making and image-makers, as well as its contested ‘realities’ through its filmic production. This study is based on in-depth thematic analysis of visual and written narratives from a sample of fifteen predominantly feature films, and ethnographic interviews of Cuban film professionals. I focus particularly on the discourse of the ‘magical’ (after the literary term “magic realism”) in three dimensions: 1) the production, reproduction and maintenance of the official myth; 2) the language and meanings conveyed by filmmakers/creators in their dialogue with Cuban society; and 3) the portrayal of religious expressions. The significance of this work lies in the exploration of the contradictions present in late socialist Cuba between the hegemonic construction of official claims of what Cuba is and what it is not, and the hybridity of daily, lived experience that its residents negotiate and its artists engage.

Singing the Body Imaginative: The Elemental Flesh in Alan Moore’s Promethea

Jennifer Kate Stuller, Graduate, Comparative History of Ideas
Mentor: Phillip Thurtle, Comparative History of Ideas

Word and image in the comic narrative combine to create a storytelling experience that resonates with the way we inhabit the world. By invoking visceral experience that connects inner and outer worlds, body and mind, reality and imagination, this form of narrative has a unique power to influence the ways we perceive ourselves, our environment, and our imagination. By using Alan Moore’s graphic novel, Promethea, in relation to Maurice Merleau-Ponty’s phenomenological concepts of the elemental Flesh and the Chiasm or “crossing,” this paper will illustrate how comic narratives can do more than entertain. They have the power to encourage us to see the world anew, and to experience it as profoundly magical. Promethea, as a comic narrative, and Promethea as a progressive superhero reminds us that there is something deeper in the world, something that connects us that we can not quite articulate, but that we have somehow gotten ourselves away from. Comic writers may call this something “Super.” Magicians call it “Magic.” Philosophers like Merleau-Ponty have named it “Flesh,” and Christians call it God.” But no matter the name It’s both larger and smaller than humanity. It’s intertwined throughout everything. How do we reconnect to that which is ethereal, yet elemental? What would the world look like if we opened up or expanded our perceptions of it? What would it feel like? Promethea can show us.

Male Ballet Dancers in America: Exploring the Stigma of Effeminacy

Laura Umetsu, Junior Pre-Business
Mentor: Elizabeth Cooper, Dance

My research attempts to deconstruct the reasons behind the relative scarcity of the male ballet dancer in America (despite the numerous potential benefits that ballet offers to its male participants) by exploring the reasons behind its stigma of effeminacy, using historical and contemporary texts, as well as personal interviews with local professional and amateur ballet dancers from the Pacific Northwest. My research continues by comparing ballet to other popular American athletic activities as well as providing insight regarding ways to introduce and immerse American men into the world of ballet.

SESSION 2E

HORMONAL AND ENVIRONMENTAL MODULATION OF THE NERVOUS SYSTEM
Session Moderator: Martha Bosma, Biology
Mary Gates Hall Room 238

Glutamate’s Role in Antinociceptive Processing within the Ventrolateral Periaqueductal Gray Matter of the Mesencephalon of the Rat

Timothy Harris, Freshman, Neurobiology and Psychology
Mentor: Michael Morgan, Psychology, Washington State University, Vancouver

The sensation of pain seems to be a common experience throughout one’s life. Currently, doctors use anesthetics
and analgesics in order to alleviate high levels of pain. However, many of these anesthetics used in contemporary medicine have not been successful in producing a continuous inhibition of pain, without negative side effects. The ventrolateral periaqueductal gray matter (vPAG) plays a significant role in inhibiting pain, commonly referred to as antinociception. Within the vPAG, GABA\textsubscript{A} neurons inhibit the activation of PAG output neurons, thus inhibiting the activation of analgesia. While extensive research has investigated GABA\textsubscript{A}’s role in preventing antinociception, little research has been devoted to investigating the excitation of antinociception. Thus, the researcher wanted to determine if glutamate as an excitatory amino acid, triggers pain inhibition in the vPAG. The researcher believed that only with the inhibition of GABA alone would antinociception be produced. The researcher injected either glutamate or GABA\textsubscript{A} antagonists kynurenate and bicuculline, respectively, into the vPAG, and tested for levels of pain tolerance. Overall, there was a significant increase in antinociception with the simultaneous administration of both kynurenate and bicuculline, inhibiting both GABA and glutamate neurons, thus rejecting the researcher’s hypothesis. Therefore, glutamate does not activate the analgesic response of the vPAG. Rather, inhibiting glutamate, alongside with GABA, may be used as an effective anesthetic. It may also be inferred that the PAG output neurons have an intrinsic ability to produce analgesia, and that glutamate may also inhibit the production of analgesia; however, this theory requires further investigation.

VIP Signaling From the SCN May Activate Kisspeptin Neurons
Sonya Jakawich, Senior, Biology (Physiology)
Mentor: Robert Steiner, Physiology and Biophysics

In the female rodent, ovulation is driven by a surge of gonadotropin releasing hormone (GnRH) and luteinizing hormone (LH). The surge only occurs at a certain time of day indicating that it is tightly coupled to the circadian oscillator located in the suprachiasmatic nucleus (SCN) of the hypothalamus. A role for the SCN is further indicated in that disruption of the signaling from the SCN blocks the ability of an animal to produce a GnRH/LH surge and the GnRH/LH surge can be shifted in a predictable manner by environmental light. A circadian output signal, vasoactive intestinal polypeptide (VIP), has been implicated in the generation of the surge. The type 2 VIP receptor (Vipr2) is expressed in areas of the brain known to regulate reproduction, including the anteroventral periventricular nucleus (AVPV) of the hypothalamus. Additionally, VIP projections from the SCN project to E-responsive neurons in the AVPV; although the identity of the target neurons is unknown. Kisspeptin-expressing cells, co-expressing estrogen (E) receptor (ER), are located in the AVPV. Kisspeptins, products of the Kiss1 gene, are potent activators of GnRH neurons and are essential for normal reproductive function. I postulated that kisspeptin neurons in the AVPV are the targets for the action of VIP. To test this hypothesis, I have conducted experiments to first, see whether Kiss1 neurons in the AVPV express Vipr2 mRNA and second, if so, to assess whether Vipr2 mRNA in kisspeptin neurons is regulated by E. Finding evidence for coexpression of Vipr2 and Kiss1 mRNAs would lend support to the idea that VIP signaling from the SCN activates kisspeptin neurons in the AVPV, which in turn drive the preovulatory GnRH/LH surge.

Synchronous, Spontaneous Calcium Transients in Embryonic Chick Hindbrain: Characteristics and Function
Sean Hughes, Senior, Neurobiology, Danish, and Biochemistry
Mary Gates Scholar
Mentor: Martha Bosma, Biology

The hindbrain is an important structure in vertebrate neural development, ultimately giving rise to cranial nerves IV-XII, many of the related nuclei, and the brainstem itself. These structures play important roles in autonomic body control, in brain arousal, and in controlling the head’s musculature and sensation. Our lab has shown that synchronous, spontaneous, and calcium-dependent electrical transients occur in fetal mouse hindbrain (that is, calcium enters the neurons as a reflection of electrical activity that occurs throughout the hindbrain simultaneously and without any external stimulation). This type of activity appears commonly in neural development; while not well understood, it is likely to play a role in mediating synapse formation, axonal path finding, and cell positioning. Our laboratory has extensively characterized this activity as it appears in the hindbrains of mouse embryos and has shown that the activity depends on midline serotonergic neurons that ultimately develop into the raphe nuclei. In order to investigate the cross-species significance of this activity, I have begun to characterize it in chick embryos by imaging the population events in the hindbrain with a calcium-indicator dye while simultaneously examining electrical characteristics in individual neurons. Chicks express synchronous, spontaneous transients that resemble but are not identical to the murine activity. For instance, the chick head’s musculature and sensation. Our lab has shown that the hindbrain is an important structure in vertebrate neural development, ultimately giving rise to cranial nerves IV-XII, many of the related nuclei, and the brainstem itself. These structures play important roles in autonomic body control, in brain arousal, and in controlling the head’s musculature and sensation. Our lab has shown that synchronous, spontaneous, and calcium-dependent electrical transients occur in fetal mouse hindbrain (that is, calcium enters the neurons as a reflection of electrical activity that occurs throughout the hindbrain simultaneously and without any external stimulation). This type of activity appears commonly in neural development; while not well understood, it is likely to play a role in mediating synapse formation, axonal path finding, and cell positioning. Our laboratory has extensively characterized this activity as it appears in the hindbrains of mouse embryos and has shown that the activity depends on midline serotonergic neurons that ultimately develop into the raphe nuclei. In order to investigate the cross-species significance of this activity, I have begun to characterize it in chick embryos by imaging the population events in the hindbrain with a calcium-indicator dye while simultaneously examining electrical characteristics in individual neurons. Chicks express synchronous, spontaneous transients that resemble but are not identical to the murine activity. For instance, the chick events do not appear to originate in the midline raphe-precursor population. That the activity appears to operate by a wholly new and as of yet not elucidated mechanism offers tantalizing questions about the significance of the activity. This talk will focus on giving an overview of the properties of the activity in chick and offering hypotheses about its mechanism of origin and functional role in neural development while highlighting the fact that the activity is so crucial that the two different species developed different mechanisms to drive it.
Identification and characterization of the anterior cardiac plexus – anterior commissural neuron 1/2 neuroendocrine system in *Cancer productus*

Erin E. Savage, Senior, Biology
Mentor: Andrew Christie, Biology

Recently, my lab identified the anterior cardiac plexus (ACP) as a neuroendocrine organ intrinsic to the stomatogastric nervous system (STNS) of the crab *Cancer productus* (Christie et al. [2004] *J. Exp. Biol.* 207, 1163-1182). In the present study, we have used Neurobiotin (NB) backfilling of the anterior cardiac nerve (on which the ACP is located) to identify two neurons in each commissural ganglion (CoG) that are the sole sources of innervation to this structure. In addition to producing the ACP, these neurons (named anterior commissural neurons 1 and 2 or ACN1/2) also arborize in the synaptic neuropil of the CoG. Synapsin labeling suggests that the CoG arbors of ACN1/2 are post-synaptic, receiving information from other portions of the nervous system and therein affecting the output of this system via the control of hormone release from the ACP. Previously, immunohistochemistry identified FLRFamide- and mandibular organ-inhibiting hormone (MOIH)-like peptides as putative hormones in this system. Interestingly, both the FLRFamide- and MOIH-like peptides appear to be trafficked exclusively to the ACP, with little or none in the CoG arbors of ACN1/2, again indicating that the peptidergic signaling from this system occurs only from its endocrine arbor. Exogenous application of TNRNFLRFamide, a native *C. productus* FLRFamide, increased both excitatory junction potential and contraction amplitude of several cardiac sac muscles located in the general vicinity of the ACP, suggesting that one function of the *C. productus* ACN1/2-ACP system is to modulate the behavior of the foregut musculature.

Thermoregulatory Behaviors in *Drosophila* Larvae as Hybridization Barriers

Grace Kim, Senior, Biology (Physiology) and Psychology
Mary Gates Scholar, Howard Hughes Scholar
Mentor: Raymond Huey, Biology

*Drosophila santomea* is a recently discovered sister species of *Drosophila yakuba* found on the island of Sao Tome. The two species are found at different altitudes, with *D. santomea* occurring higher than *D. yakuba* and overlapping slightly at a mid-altitudinal range. Hybridization is minimal between the two species with hybrids making up only 1% of all flies in the overlapping zone. Past studies have explored mechanisms of reproductive isolation, but no ecological explanation has been suggested. Based on the altitudinal distribution and fact that temperature is strongly correlated with altitude, we propose that heritable thermoregulatory behaviors act as barriers to hybridization. We tested larval temperature preferences and maximum tolerances of *D. santomea, D. yakuba,* and their hybrids. Pure population and hybrid larvae embedded in media were heated slowly, and the temperatures of emergence and lifting off the media (i.e. “waving”) were considered maximum temperature setpoints. To determine thermal preferences larvae of both species (but not hybrids) were left on a thermal gradient. The temperature of the final location was noted as the preferred temperature. *D. santomea* showed significantly lower wave, emerge, and preferred temperatures than *D. yakuba*. Hybrids showed either intermediate behavior with a maternal species pattern bias or were indistinguishable from *D. yakuba*. The data support our hypothesis that thermoregulatory behaviors prevent hybridization in these species. Further gradient and larval survivorship experiments are necessary to fully demonstrate the effect of thermoregulatory behaviors.

The Influence of Extracorporeal Shock Wave Therapy on the Rat Nervous System: a Histological and Immunohistochemical Study

Kevin Seals, Sophomore, Bioengineering
Morgan Wise, Sophomore, Biology (Physiology)
Mentor: Michael Chang, Rehabilitation Medicine

Extracorporeal Shock Wave Therapy (ESWT) is a versatile treatment modality used over the past 25 years to disintegrate nephrolithiasis, and has recently been shown to heal tissue damage. In some studies, ESWT has displayed a clinically useful analgesic effect. In other studies, ESWT has yielded no analgesia. We believe these contradictory results stem from a poor understanding of the relationship between the physical shock waves of ESWT, and the biological effects they induce in tissue. Physical shock wave (SW) effects include the production of micro-jets by shock wave-cavitation bubble interaction, and direct effects, such as shear forces. While the biological effects of ESWT have been studied extensively, the results are highly varied, due perhaps to high variability in parameters (pulse number, energy density, and machine type, among others). SWs also interact with tissues through the creation of free radicals, which can induce cellular chemical change. Release of substance P (sP), a neurotransmitter involved in certain analgesia mechanisms, may explain shock wave induced analgesia. Despite that some articles suggest ESWT produces no change in sP concentration, other studies show an sP increase and subsequent decrease that closely parallels clinical ESWT analgesia. As the parameters used in these studies differ widely, we hypothesize that sP release may influence the ESWT analgesia mechanism, and that this is dependent upon specific SW parameters. To test this, we will first apply SWs of varying energy level (0.12-0.40mJ/mm²) and frequency (0.5-4.0Hz) to an in vivo rat model and test their influence on the electrophysiology of the neuromuscular system. We will then sacrifice the rats and analyze histo-morphology and histo-chemistry, including sP concentration. Through an analysis of sP concentration using a parameter spectrum that encompasses values that did and did not produce analgesia in previous studies, we
will gain a better understanding of the displayed analgesia variability.

**SESSION 2F**

**SOCIAL CONSTRUCTION OF THE URBAN**

*Session Moderator: Dennis Ryan, Urban Design & Planning*

Mary Gates Hall Room 234

**Fixing the City by Hosting a Party: North American International Mega-Events in the Post-World War II Era**  
*Kevin Kirkpatrick, Senior, History*  
*Mentor: John Findlay, History*

My research focuses on the changing historical roles that two related but different international mega-events—world’s fairs and the modern Olympic games—played in urban improvement projects in North American cities since about 1960. It is no secret that today hosting the modern Olympics is a highly desirable way for cities to simultaneously publicize themselves, bolster economic activity and undertake major improvement projects. London, New York, Paris and about fifteen other cities all bid vigorously last July for the 2012 summer event, in large part because they wanted to foster urban renewal projects. Athens, similarly, fended off intense international competition to win the 2004 hosting rights and subsequently spent billions to both ready the city for its time in the global limelight and provide lasting facilities for Greek citizens. Yet as little as fifty years ago, the idea of pursuing the Olympics as a tool of urban renewal was a relatively novel concept. In the early 1960s, cities worldwide were only beginning to standardize the practice of hosting international mega-events as a way to set aside internal political differences and improve infrastructure. Cities in the United States and Canada explored the practice by experimenting with world’s fairs in the 1960s-70s, transforming them from the largely temporary and often massive extravaganzas held before World War II into little but glorified urban renewal schemes by the mid-1980s. Because of both the decline of the cultural relevance of expos and the successful financing model pioneered by the 1984 Los Angeles Summer Games 1984, North American cities by the early 1990s also completely rejected the world’s fair as a means of urban improvement and set their sights instead on the usually elusive and often expensive Olympics. How that happened is what I have tried to document using a combination of primary and secondary sources.

**Lessons from The Jungle**  
*Andrew Overton, Senior, Political Science*  
*Mentor: Roger Morris, Honors Program Visiting Faculty*

The beginning of the twentieth century was a period of laissez faire market economy in the United States, when ruthless businessmen and corrupt politicians were lining their pockets by exploiting workers and fooling consumers with inferior products. Such practices were most evident in the meatpacking industry controlled by a cohort of capitalists called the Beef Trust, which deliberately bought off politicians, paid low wages, and profited from the lax meat inspection. In 1906, Upton Sinclair, a young socialist author revealed these injustices to the public in his famous exposé, *The Jungle* and subsequently played an active role in a publicity campaign against the Beef Trust. The publicity campaign was met with strong resistance. The battle between Sinclair and the Beef Trust culminated in the Meat Inspection Act of 1906. Though the legislation fell short of Sinclair’s high expectations, it was a major starting point to the long path of consumer reform in the meatpacking industry. Nowadays, the meatpacking debate still continues as the lack of adequate consumer protection against unsafe meatpacking practices in the United States persists. In order to help solve today’s meatpacking issues, it is useful to look back to the lessons left us by Sinclair’s earlier success for meatpacking reform. In my thesis, I identify the reasons behind *The Jungle*’s success and evaluate its impact on meatpacking legislation. Next, I analyze subsequent meatpacking related legislation from the Food, Drug, and Cosmetic Act of 1938 to the most recent FDA policies directed at preventing mad-cow and e coli infections. As a result of the analysis, I argue that efforts for meatpacking reform are just as needed today as they were 100 years ago.

**Household Registration System in Viet Nam: A comparative study with China**  
*Aimee Nguyen, Senior, International Studies*  
*Mentor: Kam Wing Chan, Geography*

In 1964, the Socialist Republic of Viet Nam introduced a system called *hộ khẩu* (household registration); this system required each person to register his/her permanent residential place either it was urban or rural settlements and was generally a tool for administrative purposes. Eight years earlier bordering north of Vietnam, the People’s of Republic of China implemented a nationwide system called *hukou* (household registration) system. It worked as a device to maintain the dual economy; which separated the rural Chinese from urban residents and controlled the mobility of the population. Today, not only do these systems still work as mechanism to obstruct mobility, it has also served to discriminate against the rural residents, the majority of the population of the two countries. There is little doubt this kind of system is a major violation of basic human rights of hundreds of millions of people in Viet
Nam and China. Indeed, the Viet Nam’s system invites an obvious comparison with its Chinese predecessor. This paper examines the similarities of the Vietnamese hukou system and the Chinese hukou system, and, for that matter, the degree to which the Vietnamese one is an emulation. This is the central focus of the paper, which seeks to elucidate why, and how Viet Nam uses this system to administer its people. This paper examines and compares the cases of Viet Nam and China in five aspects based on the use of original materials published in Chinese and Vietnamese, in addition to the English materials: 1) the historical aspect of internal migration control which led to the establishment of the household registration system today by drawing on the three major periods of history: pre-reform era, reform era and thereafter, 2) the general nature, purposes and functions of the system to explore their similarities, 3) assessing the control mechanisms of Viet Nam and China to examine how Viet Nam implements its policies, 4) comparisons of both countries’ migrations trends of rural dwellers to urban center, and 5) detailed examination of Chinese and Vietnamese laws and regulation of the systems. The conclusion points to the insights generated from studying these two systems together in understanding control and industrialization strategy in the communist system.

Graffiti and Public Space in Seattle
Emily Fischer, Senior, Communications and Philosophy
Sarah Rosenfeld, Junior, Communications
Mentor: David Silver, Communications

Graffiti research has traditionally been snubbed by academia. While some scholarly literature does exist on this topic, there is abundant need for further investigation into graffiti’s history, why it exists, its communicative purposes, the impact it has on communities, whether it has aesthetic value, and its relationship to the mass media. I am in the process of researching these issues. My methodology currently includes taking photographs of Seattle graffiti, and performing visual and textual analyses of these photographs. I am also currently submerging myself in the available academic literature about graffiti. I intend to eventually conduct interviews with graffiti artists, city policy makers, law enforcement officials, members of the general public, business owners, and perhaps legislators. I hypothesize that there is a vast difference of opinion between what graffiti artists believe and what the American cultural majority believe about the essential nature of graffiti and whether it has value for society. My research will be dedicated to finding answers to tough questions about graffiti’s implications for society as a whole. The overarching research question I plan to pursue is: How Does Graffiti Transform Public Space? I will first become versed in as much scholarly writing about graffiti as I can, and from there I will begin postulating a new communicative theory of graffiti (or building on/ modifying an existing theory that I find support for). I will interview individuals from all different sides of the issue in order to include a human perspective, continuing to perform visual analyses of Seattle graffiti, and eventually making recommendations about what can and should be done about graffiti.

Refugee Landlord Relations in the Puget Sound Region
Kimberly Logan, Senior, Political Science, Geography
Mentor: Suzanne Withers, Geography

One of the frequently overlooked areas in the provision of social services is housing for the refugee population within the first year after arrival. When a refugee family’s lease expires for the apartment that they were initially placed in by their resettlement organization, they must make a decision about whether to remain in their current apartment or leave. As we see increasing numbers of refugees living in and moving to South King County, this becomes an area of social service provision for non-profit and government agencies alike. The question that needs to be asked is: are people going to continue to live in the apartments that they are initially placed in or are they going to leave? This study conducted focus groups and administered surveys among several different refugee ethnic groups living within the South King County area, resettlement agencies, and landlords to determine what motivations for location decisions are and the reactions that various entities are having to these movement decisions and outcomes. Refugees responding have indicated that they find family and friends to be the most vital component when deciding where to live, far above potential job opportunities or even apartment quality and appropriateness. While indicating that an increase in government subsidies would encourage them to move, proximity and involvement with family and friends (location) has a dramatic impact on their decisions. The results of this study suggest that a different approach must be taken by resettlement agencies to ensure that they are placing their refugee clients in the most appropriate sustainable housing as possible. This would require a completely different approach than what many agencies are currently doing, as the present focus is on placing their clients in an apartment as quickly as possible working within the very limited financial allowances that they are given.

Integrating Regional Identity and Tourism Amenities
Michael McMasters, Senior, Landscape Architecture
Mentor: Marc L. Miller, School of Marine Affairs

Tourism, as an industry, is highly influential on urban form in cities. That influence often leads to a level of standardization thereby erasing the unique character that is pursued by tourists and held as sacred by locals. A considerable amount of research has already been done regarding the attraction of tourists. Less plentiful are writings on the physical planning to accommodate the
increasing numbers of tourists or to acknowledge to the importance of regional identity for the experiential benefit of tourists, the economic benefit of tourism brokers, and for the cultural acknowledgement of the residents of tourist destinations who are often left out of considerations within the industry. I am identifying a list of vernacular forms in the city of Bellingham, Washington, and discovering if those elements could be used in a waterfront park marina to maintain Bellingham’s character while enhancing the function of the marina and its surrounding amenities. I am identifying regionally specific or sacred elements, both urban and environmental. Through the use of case study analysis of similar built environments, I am trying to determine whether the marina’s success might be enhanced or hindered with the incorporation of those elements. The results of the research should be a list of regional icons that residents of Bellingham hold as sacred or special, a list of opportunities and constraints in the use of any design forms within this project for the Port of Bellingham or for any future projects that they may undertake, and examples of similar successful “place making” projects.

SESSION 2G

EPIDEMIOLOGY AND IMMUNITY
Session Moderator: Tuofu Zhu
Mary Gates Hall Room 389

Assessing the Impact of Male Circumcision as an HIV Intervention Strategy
Jeff Eaton, Senior, Sociology and Mathematics
Mary Gates Scholar
Mentor: Samuel J. Clark, Sociology

Several observational studies over the last 15 years in southern and eastern African countries have identified lack of male circumcision as a risk factor for female-to-male HIV-1 transmission. More recently, laboratory studies have demonstrated that the inner surface of human male foreskin is highly susceptible to HIV-1 infection, having four times as many CD4+ target cells as the female cervix and a controlled clinical trial found that circumcised males are 60% less likely to contract HIV compared to uncircumcised males. However such an individual level effect does not guarantee the efficacy of male circumcision as an intervention method at the population level. As interventions often have a large upfront cost but only expect returns several years in the future, the target and scale of the program must be carefully chosen. Only through population level modeling can the impact of various intervention programs be accurately assessed. We use the Structured Population Event History Simulator (SPEHS), a stochastic simulation model of an HIV epidemic in

a sub-Saharan African population, to investigate the impact of circumcision-based interventions on population HIV prevalence. In particular we seek to (i) define the subpopulation of males in which a circumcision-based intervention is most effective, (ii) identify the threshold number of circumcisions in order produce a substantial decrease in HIV prevalence, and (iii) assess the indirect effect of a male circumcision intervention on HIV incidence and prevalence in women and children.

Immunological Evidence of HIV-1 CTL Escapes in Monocytes and T Cells
Leah Michelle Hampson, Senior, Microbiology
Mentor: Tuofu Zhu, Laboratory Medicine

Cytotoxic lymphocytes are an immunological pressure that may result in increased viral evolution and escape in viral epitopes of Human Immunodeficiency Virus sequences. Previous studies have shown that as CTL activity increases in patients with HIV, genetic pressure for escape mutants also increases. Further, HIV-1 sequences in a newly infected individual are largely homogenous, even though the transmitter may show heterogeneous genotype. The Zhu lab has shown that HIV-1 evolves in monocyte-macrophages as a separate compartment from CD4+ T cells during the course of HIV-1 infection with or without ART. Also, HIV-1 compartmentalization between monocytes and CD4+ T cells increases by time, correlating with evolution rate between these compartments. In the present study, we determined whether the independent evolution of HIV-1 in monocytes and CD4+ T cells is associated with CTL immune escapes. Virus sequences were analyzed at sequential time points from a patient with untreated, primary infection, specifically comparing monocytes and T-cells for compartmentalization. Sequences were also compared from early and late time points with the already known sequences epitopes to look for escape mutations in specific compartments. We observed more frequently HIV-1 variants with CTL escapes in monocytes as compared to CD4+ T cells in multiple HIV-1 genes. Identifying viral escapes is vital in understanding HIV-1 mutation and evolution, eventually leading to the design of better therapies and vaccines. By examining early time points and late time points, insight is gained as to where the virus is being harbored and the mechanism by which it is mutating. What is learned in this study could eventually lead to more efficient therapies that eradicate rather than simply reducing the virus.

Investigation of Dual and Low HIV-1 Infection
Blythe McLoughlin, Senior, Microbiology
Mentor: Tuofu Zhu, Laboratory Medicine

Studies of individuals who appear immune to HIV-1, or retain low levels of virus, may provide insight into the mechanisms by which HIV-1 can be prevented and controlled. Genetic analysis of breakthrough HIV infection
Protein phosphorylation and aggressiveness in prostate cancer

Prostate cancer is the second most common form of cancer and the second largest cause of cancer death in American men. The objective of my project in the Knudsen lab is to analyze the protein phosphorylation patterns of prostate cancer tissues with the aim of identifying markers for aggressive tumor behavior. Initial experiments are conducted with prostate cancer xenografts, which are prostate cancer cells from human patients that are transplanted into immune-compromised mice. Our collaborators generated pairs of xenografts that are either dependent or independent of androgen for their growth. These represent two different stages of prostate cancer: the androgen-sensitive being the less aggressive and treatment-responsive cancer type, and the androgen insensitive are the more aggressive, treatment-refractory cancers. We questioned whether the two cancer types could be distinguished based on their protein phosphorylation levels and patterns. The Western blot method of protein analysis was used to separate proteins from the cancer tissues and to probe them for the presence of phosphorylation with a broad-spectrum antibody. Additionally, we measured the numbers of dividing cells in the same tissues by immunohistochemistry to examine a potential link between protein phosphorylation and cell division. Our results showed that androgen-insensitive cancers had more protein phosphorylation relative to their androgen-sensitive counterparts. Immunohistochemical analysis revealed that more aggressive tumors had a significantly lower proportion of dividing cells compared to less aggressive tumors; thus unexpectedly, cell proliferation was negatively correlated with protein phosphorylation and tumor aggressiveness. Currently we are extending our analysis to ovarian cancers with the hope of identifying patterns of protein phosphorylation that correlate with different cancer sub-types and clinical behaviors. In conclusion, our results show that protein phosphorylation correlates with the biological behavior of prostate cancer cells, and thus can be used as a marker for tumor aggressiveness.

Hepatitis C: An Epidemiological Profile

Bethany Samuelson, Senior, Biology, Seattle Pacific University
Mentor: Derek Wood, Biology, Seattle Pacific University

Currently, hepatitis C is the most common chronic blood-borne viral infection in the US. As of 1998, 3.9 million Americans are known to have been infected with the hepatitis C virus (HCV). Long-term infection causes inflammation of the liver, potentially leading to fibrosis, cirrhosis, and even death. On April 27, 2003, a bill was passed by the Washington State legislature mandating the design and implementation of a state plan for the prevention and management of hepatitis C, incorporating education, testing and counseling, and guidelines for health-care professionals to prevent further transmission of HCV and the onset of chronic liver disease. It is the purpose of this study to analyze the hepatitis C positive patients of Benton and Franklin counties in southeastern Washington State in an attempt to better understand, address, and educate the population. Data was collected retrospectively from the records of HCV positive patients treated by local infectious diseases physicians (prevalence) and actively from the mandatory reporting system of the Benton Franklin Health Department (incidence). Demographic factors, diagnostic and staging tests, and treatment rates were analyzed for the purpose of creating a useful epidemiological profile. Results revealed that 370 patients (0.2% population) in Benton-Franklin County are currently under the care of an infectious diseases specialist for treatment or surveillance of acute or chronic hepatitis C, and that 200 patients (0.1% population) were diagnosed with HCV between January of 2003 and June of 2005. Most of these recently diagnosed patients are not currently receiving treatment. Both the sheer number of patients represented by this study and the incomplete records generated by current methods of disease tracking indicate that action must be taken to further educate the at-risk populations and health care professionals, promote earlier detection, advise, refer and treat appropriately, and prevent further transmission of this disease.
Simple and Accurate Thyroglobulin Measurements for All Patients: Overcoming the Limitations of Thyroglobulin Autoantibodies

Lianna Wood, Senior, Chemistry and History
Mentor: Andy Hooftnagle, Laboratory Medicine
Mentor: Mark Wener, Laboratory Medicine

Thyroglobulin detection in the serum of patients with differentiated thyroid carcinoma assists physicians in identifying residual, metastatic and recurrent disease. Although immunometric assays have been the preferred method for thyroglobulin measurement, they are hindered by the presence of thyroglobulin autoantibodies in the serum of many patients, producing unpredictably increased or decreased readings. Following the success of simple biochemical treatments in dissociating hindering antibody-antigen complexes in other assays, we assessed a variety of in vitro methods to dissociate thyroglobulin and thyroglobulin-autoantibody complexes, including dilution with phosphate buffered saline, sodium dodecyl sulfate treatment, acid treatment, base treatment, concentrated chaotropic salt treatment, and combinations of the above treatments. Each treatment was followed by either dilution or neutralization to allow the thyroglobulin to bind to the antibodies in our assay. A commercially available sandwich enzyme-linked immunosorbent assay (ELISA) was used to assess the effectiveness of each of our methods. During the initial assessment, synthesized samples made from thyroglobulin and thyroglobulin autoantibody negative serum, purified thyroglobulin and concentrated rabbit monoclonal anti-human thyroglobulin antibodies were tested on each method before evaluating patient samples. Particularly harsh treatments, such as very low temperature and high temperature, significantly reduced our thyroglobulin measurements in samples both with and without antibodies, likely indicating denaturation of thyroglobulin. Many of the more mild treatments, such as SDS at room temperature, failed to increase the concentration of thyroglobulin detected in samples with antibody relative to no treatment. A balance between dissociation of the complexes and the denaturation of thyroglobulin was found with concentrated chaotropic salt treatment, which showed approximately 100% recovery both in synthesized and patient samples. 3M NaBr provided better recovery than NaCl, MgCl₂, and NaSCN. Treatment of serum with a concentrated NaBr solution prior to thyroglobulin measurement provides more sensitive thyroglobulin detection in patients with antithyroglobulin autoantibodies.

Breakthrough HIV-1 in Late Seroconverters

Amanda Woodward, Junior, Cellular, Molecular and Developmental Biology
Mentor: Tuofu Zhu, Laboratory Medicine

Human Immunodeficiency Virus Type 1 (HIV-1) is most commonly transmitted via unprotected sexual contact in the United States. However, some individuals remain uninfected after repeated exposure to the virus through sexual contact with multiple infected partners. These individuals are designated exposed seronegatives (ES). We have also identified another cohort of individuals who were part of the ES cohort for a long period of time, but (for an unknown reason) seroconverted and became HIV positive later, termed as later seroconverter (LSC). LSC is a unique acute (early) infection population because of their extensive exposure to HIV-1 resulting in selected protection from previously exposed strains. It is therefore critical for vaccine development to understand why a breakthrough infection occurred. Our goal in this study was to PCR amplify and sequence a highly variable region of the HIV genome, gp120. We then compared the sequences from the LSC breakthrough viruses with other acute infection samples and chronic infection samples against the ancestor virus (generated from a database to produce an ‘original’ HIV sequence). Our preliminary results showed that the HIV-1 gp120 region of the acute infection samples was less divergent from the ancestor virus than the chronic infection samples and that the LSC breakthrough virus was more divergent from the ancestor virus than the regular acute infection samples. However, after recently obtaining more patient sequences to add to the analysis, we found that although these trends still existed, the results were no longer statistically significant. However, the LSC virus was more divergent from the exposed virus in their long-term partner, indicating that the LSC virus divergence from the ancestor was related to immunological pressure from exposures.

Session 2H

Computing for the Benefit of Humankind

Session Moderator: Richard Ladner, Computer Science and Engineering
Session Assistant:
Mary Gates Hall Room 287

TEASE (Tree EASE) Algorithm Implementation in TIGR MeV 3.1

Annie Liu, Junior, Computer Engineering
Mary Gates Scholar
Mentor: Roger Bumgarner, Microbiology

Microarray is a powerful tool in biological research that allows scientists to analyze the expression levels of a large number of genes at one time. Microarray data is typically processed for biological interpretation in the context of Gene Ontology (GO) terms. A common way to do this is...
through clustering analysis, which group genes with similar patterns, and post-hoc manual GO-term search on each cluster. This process can be extremely tedious. We have implemented a new algorithm called TEASE (Tree-EASE) that automates this process by integrating hierarchical clustering with GO-term exploration tool, EASE. The analysis result is displayed on a user-friendly interface that allows intuitive navigation. TEASE is implemented in the programming language Java and is incorporated into the open-source microarray data analysis software, MeV 3.1 (MultiExperiment Viewer).

A Model for Assessing the Quality of Online Medical and Health Information
Grace Preyapongpisam, Senior, Informatics
Amelia Lacenski, Senior, Informatics
Mentor: Wanda Pratt, Biomedical and Health Informatics and The Information School

Eight out of ten Internet users search for medical and health information online; however, no standard exists for assessing the quality of such information. Prior work by Civan and Pratt (2004) proposes a model for assessing the quality of online medical and health information based on four dimensions: content, reference, authorship, and publisher. In addition to these four indicators, we hypothesize that a fifth dimension, reader accessibility, has a significant impact on readers’ assessment of quality. As it relates to medical and health information online, “content” refers to indicators of scientific rigor found in phrases such as “randomized controlled trial” and peer review; “reference” describes the popularity, citation rate, and usage context of the material; “authorship” relates to the credentials and affiliations of the author; “publisher” refers to the authority, popularity, domain, and format of the publisher; and “reader accessibility” refers to reader comprehension and site usability. In order to test our hypothesis and determine whether user perceptions and behavior correspond to the four- or five-dimensional model, we conducted a focus group and task observation. We found that all five dimensions affect user quality assessment to varying degrees depending upon the context of the search. The qualitative insights that we obtained informed the design of a medical and health information search engine prototype that presents feedback on the quality assessment of documents and allows users to scale the five quality dimensions according to their information priorities.

Real Time Conversation Detection in Dynamic Social Networks
Veneta Tashev, Senior, Computer Science
Mentor: Henry Kautz, Computer Science & Engineering

The structure and dynamics of social networks are of critical importance to many social phenomena, ranging from organizational efficiency to the spread of knowledge and disease. My group has taken the approach to learning the structure and dynamics of social networks using sensing and communications tools together with artificial intelligence techniques to unobtrusively study large populations of interacting humans over extended periods of time. Currently the subjects wear a device, such as a pocket PC, and statistics about any audio present are collected on the device and then transmitted to a common storage from where they are processed. Hidden Markov Model, a variant of finite state machine, is used in detecting the presence of human voice. Data between different subjects is compared and conversations are identified. The goal of my project is to allow real-time conversation detection. The devices worn by the subjects have Bluetooth technology on them. When a change in the statistics tracking the present sound is detected, then the program sends out a call to any other Bluetooth devices the proximity and exchanges voicing data with them. Then the devise runs, online, the conversation detection algorithm and decides whether there is a conversation between two or more of the subjects. The research challenges include: transmitting information between the devices; running the conversation detection algorithms in real time without a full data set but with only information up to that point in time; and the limited space and power provided by the device.

Predicting Information Flow through Blogsphere
Jack Hebert, Junior, Computer Science and Engineering
Mentor: Dan Weld, Computer Science and Engineering

Users of web-log (or “blog”) communities create social networks by posting opinions and links that they find interesting, sharing them with other users who read the posts. Each user has limited influence over other users, but when one user posts an opinion or a link that another user finds novel, the other user may post concerning that opinion or link. Influences on this user-to-user level form the basis of viral-marketing, a marketing tactic of growing importance. The ability to predict when users will repost or, in the terminology of viral marketing, become ‘infected’, would allow a marketer to determine the optimal subset of users to receive advertising such that the largest influence is gained for the minimal cost. This work considers two methods put forth in the literature to model these infections and analyzes their predictive ability. The ‘Linear Threshold Model’ and the ‘Independent Cascade Model’ have previously been used to identify which users are most influential and from which source users are becoming infected. This work analyzes their predictive ability over a corpus of blog posts and shows that the ‘Linear Threshold Model’ can predict future infections with 85% accuracy while the ‘Independent Cascade Model’ can predict with 65% accuracy. These accuracies show that influence and information flow can be modeled and suggest that viral marketing is a viable technique.
A Structure Editor for Diagnostic Educational Assessment
Cy Khormaee, Senior, Computer Science
Mentor: Steven Tanimoto, Computer Science & Engineering

The Structure Editor for Diagnostic Educational Assessment Project (SEFDEA) is a part of the ongoing research by the Online Learning Environments Laboratory which is currently investigating methods for diagnostic assessment on the basis of online learning artifacts and log files. More specifically, SEFDEA is concerned with developing an application in C# to facilitate the process of constraining and assessing student’s rhetorical responses for diagnostic analysis by the instructor. The structure editor will constrain student input to a set of syntactically correct responses. This will permit the diagnostic analysis mechanism to readily infer semantic content of the writing and subsequently infer facets of student understanding. In order to avoid having only a narrow field of applicability, the editor will accept template files from an instructor or educational technologist that define classes of permissible documents. The goal of the project is to provide instructors with a versatile tool to streamline and enhance the diagnostic assessment process.

SESSION 21

The Science of Love and the Politics of Nationalism: Explorations in Modernism, Buddhism, Medievalism, Feminism, and Nationalism
Session Moderator: Shawn Wong, English
Mary Gates Hall Room 295

Joyce’s Ulysses: Newton, Nationalism, and the New Science of Love
Jean Bessette, Senior, English, Seattle University
Mentor: Edwin Weihe, English, Seattle University

For this research project, I argue that James Joyce’s Ulysses uses science as a metaphor for both the confinement and liberation of hybrid identity in colonial Ireland. For Joyce and his characters, this hybrid identity is created by external British colonialism and the subsequent internal national conflict. The effect of this hybridity on the artist figure is a marginalization by both the British-favored, Protestant upper-class and his own nationalistic Catholic upbringing. I argue that Isaac Newton, a prominent British scientist and official, can be used to connect science and identity because he claims that the world is mechanized, that time and space are absolutes, and that all objects follow the same laws. What are the implications of a deterministic universe for the outcast artist who fits neither within nor without Ireland? To emancipate his characters from Newtonian confinement, Joyce turns to the work of a Jewish, non-Anglo-Irish scientist: Einstein, whose theories of relativity break from Newton in regard to light. In my paper, I explore how Einstein’s theories manifest in Ulysses in the relationship between Leopold and Molly Bloom, specifically in Leopold’s frequent references to his wife’s weight and light. However, Bloom’s liberation from Newtonian law is threatened by Molly’s partner in adultery, Blazes Boyan, who imperils her subjectivity by objectifying her body. Einstein proves that, as a star ages, it loses nuclear fuel and concedes to the force of gravity attempting to condense it into a smaller and smaller package. In other words, its surface moves closer to its core and, when Blazes regards Molly as merely a sexual object, she actually becomes her surface. Ultimately, however, Bloom restores her significance, through the metaphor of $e=mc^2$ and his insightful, emotionally scientific eye.

Reproducing and Resisting Racial and Gendered Nationalism in Comfort Woman
Anne Kim, Senior, English and International Studies
Mentor: Alys Weinbaum, English

During the past decade, the story of Korean “comfort women” has attracted much media and academic attention, particularly within feminist scholarship. This issue of Korean “comfort women,” or sex slaves for the Japanese imperial military during World War II, is taken up by Nora Okja Keller’s novel, Comfort Woman. The novel tells the story of Akiko Bradley, a former Korean “comfort woman” who later marries an American missionary and moves to the U.S. where she raises her daughter, Beccah. In Hawaii where she later moves, Akiko falls into trances and practices shamanism. Within the broken, nonlinear form of this novel, the story of Akiko’s daughter also emerges. An increasing body of critical work on this novel has examined issues including historical trauma, the intersection of sexual and colonial violence and the silencing of women. In my project, I argue that Keller’s novel also offers a rich ground on which to interrogate questions about racial and gendered nationalism and its intersection with reproduction. In analyzing this novel, I thus theorize the intersection of race, gender, nation and reproduction, arguing that Comfort Woman is a meditation on the exclusions of nationalism – as racialized and gendered formations – in Korea, Japan and the U.S. I conclude that Comfort Woman critiques gendered nationalism, through an examination of masculine Korean nationalism, and racial nationalism, which is represented by the Japanese military, and shows that U.S. nationalism is quite similar
to both. In revealing such forms of nationalisms, the
text theorizes the possibility of reproducing a new
nation based on a genealogy of women. Yet, in doing
so, Keller’s text reinforces problematic notions of
nationalism as a “blood” identity reproduced by women.

**Calypso: Chronicling Afro-Caribbean Culture from
Engagement to Emergence**

*Koreen McLeod, Senior, Social Welfare*

*Mary Gates Scholar*

*Mentor: Brian Reed, English Department*

I became interested in this project as a participant in
the 2005 Summer Institute in the Arts and Humanities
where as part of an interdisciplinary group, I explored
the theme, Becoming Strangers: Travel, trust and
Collaboration. In my attempt to understand how one
builds trust in the face of strangeness, I directed my
attention to African descendants in the Caribbean region
who survived travel in the African slave trade, slavery
and later colonialism. Calypso music is a social construct,
resulting from an intricate mixture of these experiences as
the group settled into their new environment. However,
it is frequently recognized for only its entertainment
value. Yet, since its beginning, this music has been used
at times as a voice of clever social commentary and at
others, outright resistance to the oppression. With the
abolition of slavery in the 1830s, a large number of East
Indians settled in the region as indentured servants.
Again, calypso’s ability to foster interchange in the face
cross-cultural interactions can be explored in relation
to its influence on and from East Indian settlers in the
region. Finally, as a large number of Afro-Caribbeans
traveled to and resettled in large cities like New York,
Toronto and London, calypso reports on their experiences
while providing another venue for cultural interchange.
This study will explore the growth and changes of
calypso music as it parallels the Afro-Caribbean
experience. Various texts, video and audio recordings
will be analyzed in this project. The findings will show
how the Afro-Caribbean not only survived difficult
times but created a music which fostered resistance,
cross-cultural interchange and a strong connection to
an ancestral land. These finding will further show how
trust and collaboration can be built, even in the face of
strangeness and struggle.

**Buddhist Abhidharma and the Soteriological
Implications of Jñāna**

*Robert Mullen, Senior, International Studies and Asian
Languages & Literature*

*Mentor: Collett Cox, Asian Languages & Literature*

This study investigates the later developments
of Buddhist literature, specifically Abhidharma
scholasticism, and its intimate concern with the
techniques and results of meditative practice. This
study will illustrate that spiritual practice should not
be understood as involving a single, unified method, or
even a bifurcated model of spiritual practice, but rather a
plurality of techniques. Beginning with the general issue
of authorship, as it concerns the historical development of
these texts, this study will introduce a myriad of problems
involved with the study of early Buddhist scholastic
literature. From the canonical works with their orthodox
commentaries, to their divergent textual permutations,
these texts embody an enduring concern with the nature
of spiritual practice. By examining the divergent textual
developments of the later Abhidharma ‘authors’ this study
will expose certain limitations of modern scholarship
and provide an analysis of the literary framework within
which early Buddhist spiritual practices were situated.
Modern scholarship, which delimits two conflicting
groups of meditative techniques, can hinder a full
view of the plurality of spiritual practices and their
interdependence upon one another. In contrast, this study
will illustrate that the Buddhist conception of knowledge
implies the whole of spiritual practice, which although
viewed as a plurality eventually leads to the singular goal
of Buddhist sainthood.

**War Horses in Medieval Rajput Poetry**

*Elizabeth Thelen, Senior, Asian Languages & Literature
and Comparative History of Ideas*

*Mary Gates Scholar*

*Mentor: Michael Shapiro, Asian Languages & Literature*

This research concerns the representations of horses in a
body of epic poetry originating in western India during
the sixteenth century. The representations of horses play
an under-recognized role in this literature, as its symbolic
use of the horse has informed both the cultural identity
of the elite warrior caste group known as Rajputs as well
as Indian nationalist struggles. This poetry is written in a
dialect of Hindi known as Dingal and portrays historical
battles. One such battle was the Battle of Haldighati,
which was one of the more significant battles fought
between independent Hindu rulers and the Mughal
Empire. This battle was fought in 1576 between the
armies of the Hindu ruler Maharana Pratap and the
Mughal emperor Akbar in the western part of India now
called Rajasthan. In its early forms, poetry about this
battle, which was composed by court bards employed
by Hindu kings, told varying narratives of the battle.
The presence of horses in the earlier poetry is assumed,
incidental, and not unusual. As a Rajput warrior ethic
developed in the context of the Mughal Empire and later
British colonization, there was a gradual shift in narration
which emphasized the role of the horse. Popular belief
today holds that the horse was a central part of the Rajput
warrior culture and several horses, including Maharana
Pratap’s horse Cetak, are portrayed as martyrs who
saved their riders in battle. By translating and analyzing
selected verses of two poems, my research examines the
progressively embellished symbolic role of the horse. This research is based upon two editions of the poem Khuman Raso, both manuscripts dating to the early eighteen hundreds and thought to be composed in the mid-seventeen hundreds, and the poem Vamsh Bhaskar, which dates from the mid to late eighteen hundreds.

**The Language of Fiction: Meaning without Essence**
*David Tracy, Senior, English*
*Mentor: Brian Reed, English*

David Markson wrote his famous postmodernist novel “Wittgenstein’s Mistress” in 1988. It is the first person story of Kate, apparently the last person on earth. Over the course of the novel, Kate describes, among other things, her travels around the world, her knowledge of classical and art history, and what she does and how she feels from day to day. The particular interest of this essay, however, is what Kate’s story has to do with a title that makes it so apparently involved with the work of the German philosopher Ludwig Wittgenstein. It turns out that “Wittgenstein’s Mistress” is largely concerned with a problem in Wittgenstein’s description of language. The problem is how language can have meaning without an essence of community. “Wittgenstein’s Mistress” treats the problem by revealing the nature of language as fiction. For the purpose of understanding the argument, the essay has been systematically broken into four parts. Part one is an overview of Wittgenstein’s philosophy. It covers his description of language and concludes with the unresolved problem of how language makes meaning. It is a spring board for the following sections. From there, part two launches into “Wittgenstein’s Mistress,” and shows how the novel reveals the non-essence of community through pronoun mix-up, historical fiction, and the writer character, to name a few of the literary devices. Part three considers a significant consequence of the non-essence of community, that is, the potential loss of all meaning. It does so by looking at how Kate responds to the loss of community around her. And finally, the fourth part shows that due to the nature of language as fiction, there need not be an essence of community in order for language to make meaning.

**The Government “Die wie ein Alp auf meine Seele lag”: Imperial Politics and Feminist Discourse in German Southwest Africa in Ada Cramer’s Weiß oder Schwarz**
*Julia Voss, Senior, English, History, Seattle University*
*Mentor: Hazel Hahn, History, Seattle University*

Situated at the crossroads of colonialism, racism and feminism in the early twentieth century, Ada Cramer’s 1913 memoir, Weiß oder Schwarz: Lehr- und Leidensjahre eines Farmers im Südwest im Lichte des Rassenhasses, brings many of the major issues of modern history and society into dialogue with one another. Cramer narrates the experience she and her husband Otto, had farming in the German colony of Southwest Africa following the Herero Rebellion of 1904. Although Cramer concerns herself explicitly with defending Otto against charges of vicious brutality against their African indentured laborers, her memoir discusses metropolitan and peripheral German politics and the early German feminist movement. Over the course of the memoir, Cramer describes how she and Otto became increasingly critical of the government which thwarts their attempts to recreate traditional, rural German life in Southwest Africa. On the other hand, her descriptions of her own challenges and development as a female colonist link Cramer to the discourse of colonial feminism emerging in German fiction and autobiography, seen in authors like Frieda von Bülow. Cramer’s memoir argues that traditional German values were perpetuated in the colonies by German women from the Fatherland, even if this required opposing the metropolitan and colonial government. Both the political and the feminist development her memoir recounts demonstrate Cramer’s turn toward reactionary modernism. By capturing the complicated intersection of race, gender, and imperial politics in the early twentieth century, Cramer’s Weiß oder Schwarz demonstrates how these forces combined to radicalize conservative settlers as government became more liberal.

**SESSION 2J**

**NEXT GENERATION OF BIOMEDICAL DEVICES AND THERAPIES**
*Session Moderator: Rajendra Bordia, Materials Science and Engineering*
*Mary Gates Hall Room 231*

**Listeria monocytogenes Mediated Polyplex Delivery**
*Jingyang Chen, Senior, Bioengineering*
*Mentor: Suzie Pun, Bioengineering*
*Mentor: James Bryers, Bioengineering*

The development of safe and effective gene delivery vehicles remains a hurdle in gene therapy. The properties of synthetic vehicles such as polymer nanoparticles can be tightly controlled, but their transfection (gene delivery and expression) efficiencies and tissue penetration depths leave much to be desired. We propose a novel method of increasing the transfection efficiency and tissue penetration depth of DNA bound to synthetic polymer nanoparticles (polyplexes) by co-incubating polyplexes with *Listeria monocytogenes*, a gram positive, intracellular bacterium. The first goal of our project is to determine whether co-
incubation of *Listeria monocytogenes* with polyplexes results in higher transfection efficiencies in cultured human cells when compared to transfection by polyplexes alone. Our second goal is to elucidate the mechanism for any observed increase in transfection efficiency. Flow cytometry analyses and protein expression assays we conducted indicated an increase in transfection efficiency in a human cervical cancer cell line (HeLa) when poly-L-lysine (PLL) and polyethylenimine (PEI) polyplexes were co-incubated with *Listeria monocytogenes*. To determine the mechanism of the increased transfection efficiency, we will conduct real-time tracking of fluorescently labeled polyplex and bacteria using fluorescence microscopy during the transfection of HeLa cells. We hypothesize that polyplexes bind non-covalently to the outside of bacteria, and that transfection efficiency is increased by *Listeria monocytogenes* mediated cellular uptake and endosomal release. The elucidation of the mechanism of *Listeria monocytogenes* mediated polyplex delivery would allow mathematical modeling of the transfection process, provide clues to the development of polyplexes co-delivered with *Listeria monocytogenes*.

**Synthesis and Characterization of Chitosan-Methotrexate/Folic Acid Nanoparticles for Targeted Drug Delivery**

*Benjamin S. Davis, Junior, Biology (Physiology)*  
*Mentor: Miqin Zhang, Material Science and Engineering*

Chitosan-based particulate drug delivery systems have been examined extensively over the past several years. Advantages such as biocompatibility and chemical functionality make chitosan extremely useful in pharmaceutical applications. In this study, we synthesized various chitosan conjugates and subsequent nanoparticle systems for use as a targeted drug delivery system. The targeting agent folic acid was attached to chitosan via 1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide reaction. The resulting chitosan conjugates were characterized by Fourier transform infrared spectroscopy (FTIR) and UV spectroscopy. Nanoparticles were then synthesized via an ionic gelation process with tripolyphosphate (TPP). Transmission electron microscopy (TEM) and dynamic light scattering (DLS) were then used to determine the size and morphology of the nanoparticles. Experimental variables such as different values of pH, chitosan molecular weight, and reagent ratios were optimized to increase ligand loading and reduce nanoparticle size. The development this targeted drug carrier would provide a powerful tool for the delivery of many pharmaceuticals.

**Increasing the Efficiency of Chemotherapy for Brain Tumors**

*Nathan Chin, Senior, Biochemistry*  
*Rachel Sparks, Senior, Bioengineering*  
*Mentor: Pierre Mourad, Neurosurgery and Applied Physics Lab*

To combat brain tumors with drugs, sufficient dosages of the drug need to be delivered to the brain. Getting a sufficient dosage to the brain is particularly difficult because of the blood brain barrier, the blood vessel lining in the brain. The blood brain barrier transports what is needed from the blood to the brain and keeps what is harmful for the brain away. Unfortunately, the blood brain barrier does not recognize cancer fighting drugs and prevents the drug’s entry into the brain. To get a therapeutic amount of drug into the brain, the blood brain barrier must be bombarded with high levels of drug causing many unwanted side effects to the patient including hair loss, severe nausea and extreme fatigue. Current, researchers are studying ways of disrupting the blood brain barrier. My laboratory uses a high intensity focused ultrasound device to temporarily disrupt the blood brain barrier. Previous experiments with this device have shown movement of a protein into the brain, which the blood brain barrier usually does not let into the brain. Permeation of this protein has fueled further investigation into ultrasound induced blood brain barrier disruption. I am studying the flux of a number of current cancer fighting drugs. The goal of my research is to find a more efficient pathway for delivering cancer fighting drugs. Increasing the efficiency will allow doctors to lower dosages given to patients and ideally minimize the negative side effects that occur with chemotherapy.

**High Intensity Focused Ultrasound Mediate Blood Brain Barrier Opening**

*Rachel Sparks, Senior, Bioengineering*  
*Mentor: Pierre Mourad, Neurosurgery and Applied Physics Lab*

The Blood Brain Barrier (BBB) consists of a system of endothelial cells that line the blood vessels of the brain. Its defenses include mechanical barriers- tight junctions that form a physical barrier between cells. Another important defense, cellular pumps actively remove substances from the cells. These mechanisms work to keep harmful substances out but they also prevent most pharmaceuticals from entering. Pharmaceuticals inability to penetrate the BBB greatly reduces their efficacy. Currently few methods exist to get around the BBB but they results in pathological changes or infection. In my project I use high intensity focused ultrasound (HIFU) to temporarily open the BBB. The design of HIFU allows it to elicit biological changes in tissue within a small area, called the focus. HIFU elicits responses including tissue heating, bubble formation, or in the case of my work BBB disruption. My project explores the HIFU’s effect on the BBB using a rat model. My experiments try to show that Vinblastine, Gentamicin, Gabapentin and Temadilor exhibit increased drug flux when using HIFU to open the BBB. The procedure carried out involved applying HIFU to one brain lobe of the animal. Next the animals received injections of radiolabeled drugs. Sacrifice of the animals occurred 1 hour after the injection. After a perfusion harvest of appropriate tissues followed
In the past, surgical removal was the only treatment for many solid tumors, but now image-guided High Intensity Focused Ultrasound (HIFU) therapy has the ability to ablate tumors completely non-invasively. HIFU can heat specific internal tissue sites to necrosis levels in a matter of seconds while leaving the surrounding tissue unharmed. In our research, we are designing a transvaginal ultrasound-guided HIFU system for the treatment of uterine fibroids. Fibroids, also known as leiomyoma or fibromyoma, are a form of non-cancerous or benign tumor that grows within the uterine wall. They are the most common type of pelvic tumor, diagnosed in half of all women. Our system is unique among proposed uterine fibroid HIFU devices in its design because of its use of annular phased-array technology. It utilizes a 3.0 MHz 16-element piezo-composite transducer with a natural focus of 8cm. The phased-array technology allows for the focus of the HIFU beam to be steered to different depths, ranging from 3 to 10 cm, during treatment by the introduction of phase delays into the ultrasound signals. Our system also employs integrated B-mode imaging ultrasound that allows for concurrent real-time imaging of the treatment. I have altered LabView software from a prototype version of this system that acts as the interface of user, imager and treatment transducer. To test the system at the different foci, lesions were formed in tissue mimicking gel, ultrasound field maps were made, and Schlieren images were taken. Ex vivo tissue lesions will be formed to analyze the magnitude of necrosis at varying foci and treatment parameters. A clinical study will also be performed to test the ergonomics of the device. The goal of this research is to bring the technology to clinical trials and eventually into clinical use.

**Close Approach Noise Analysis for MRFM Design and Targeting**

*Christian K. Kikuchi, Senior, Bioengineering*
*Mentor: John Sidles, Orthopaedics and Sports Medicine*

In the next five years, MRFM will transition from fundamental research to in-the-lab imaging technology. This rapid development will require concurrent engineering -- critical systems developed in parallel. Among the many systems in MRFM are a closed-loop 3D MRFM scanner, advanced cantilever fabrication, digital control and emulation, end to end quantum simulation, signal processing and analysis, and sample preparation. My contribution will seek early answers to these two key questions: A. What specific utility would atomic-resolution imaging have in drug development? More broadly, can we be assured that atomic-resolution imaging would be of substantial utility to the pharmaceutical industry? B. Are there any technological “show-stoppers”? More broadly, are there any technical reasons why single-spin microscopy might prove infeasible? The goal of my project therefore, is to develop sample preparation methods for introducing nevirapine to the (cryogenic, in-vacuum) MRFM imaging environment, and measuring the force noise created by nevirapine, upon close approach. This project will be responsible for the following two goals of quantum microscopy development: (1) Quantum microscopy with single-atom resolution will be broadly useful in drug development. (2) Close-approach force noise, originating in samples, is not a “show stopper.” Goal 1 therefore is to author a design article that analyzes why nevirapine is the preferred candidate for MRFM development and how analysis of nevirapine will benefit the pharmaceutical community. This article analyzes how drug development could have been changed assuming that MRFM was available with nevirapine as the comparative development model. Nevirapine is a HIV-1 Reverse Transcriptase inhibitor. Goal 2 therefore deals with the sample preparation and noise analysis aspect of my project, and will focus on developing a method of making nevirapine suitable for MRFM analysis.
the nature of the debris found. This project is evaluating the debris found on the shores of beaches along the Washington coast. It is determining what materials are most abundant, as well as where on the beach most debris is found. I am also looking at which region of Washington receives the most debris, and what factors lead to the differences in distribution. Once this is complete, I hope to develop the data and organization into a marine debris monitoring program for COASST, a citizen science organization. This program will then be continued in the future in order to create a comprehensive log of data over different seasons and years.

**Shipbreaking at Alang, India**  
*Julie McElroy-Brown, Senior, Interdisciplinary Arts & Sciences, UW Tacoma*  
*Mentor: Michael Kucher, Environmental Studies, Interdisciplinary Arts & Sciences, UW Tacoma*

Shipbreaking has traditionally been a poorly regulated industry with minimal regard for the health and safety of workers or the impact on the environment. Historically, ships were broken at regulated European dry dock facilities by skilled workers. After the 1970's, the high cost of environmental controls and employee safety standards drove this work onto the cheaper shores of developing countries that needed the raw materials. Where do worn out bulk carriers, outdated cruise ships, and aging oil tankers go when they have outlived their economic usefulness, or are no longer safe? The end of life for many of the world’s vessels is the shipbreaking yard on the beach of Alang, India. With seven miles of sandy shoreline and a tidal range of up to 42 feet, Alang has the ideal physical characteristics to beach ships at high tide. It became the largest shipbreaking yard in the world, processing 3,600 ships from February 1982 to March 2002. Here, thousands of workers cut apart massive ships with little more than hand tools and brute strength. The release of hazardous wastes during this process, such as asbestos, polychlorinated biphenyls (PCB’s), and tributyltin (TBT), has contaminated local air, soil, and water. Shipbreaking benefits from the disconnect which exists between the economic needs of Alang’s people, the financial objectives of the shipping business, and the policy limitations of international law. Paper based on evidence collected by the International Labour Office, the International Maritime Organization, the Basel Convention, and the U.S. Environmental Protection Agency.

**Improving Harmful Algae Monitoring to Reduce Health Risks and Economic Impacts in Puget Sound, Washington.**  
*Joseph Nelson, Junior, Environmental Health*  
*Mentor: Elaine Faustman, Environmental and Occupational Health Sciences*

Amnesiac Shellfish Poisoning caused by the neurotoxin Domoic Acid (DA) was first documented in eastern Canada in 1987. The diatom *Pseudo-nitzschia* sp. produces the toxin, and is found in coastal and inland Washington waters, where it is concentrated by filter feeding shellfish. Since 1991 the presence of DA in shellfish tissue has been monitored in Washington, and twice in the last three years outbreaks have occurred in Puget Sound, which resulted in toxin concentrations of shellfish above the action level of 20 µg DA / g tissue. A literature review was conducted to understand how international shellfish sanitation programs protect the food supply while minimizing economic impacts to aquaculture. Monitoring programs from countries with oceanographic features and shellfish resources similar to those found in the Puget Sound region were evaluated based on their ability to manage the dual concerns of economic and public health interests. All monitoring programs reviewed were founded on the understanding that shellfish contaminations were highly variable events in both temporal and spatial scales and as such utilized shellfish tissue monitoring. The relative economic importance of local shellfish resources and aquaculture sites was a good predictor of the funding priorities (cooperation between government and industry), early warning abilities, and adaptability to changing conditions. In areas where managers couldn’t monitor widely distributed resources, such as the west coast of North America partnerships with stakeholders provided additional support in monitoring. To protect public health and a growing shellfish industry in Puget Sound, managers will be need to apply the monitoring practices of other jurisdictions with the help of local stakeholders and volunteers.

**Consumer Perspectives on the Web of Causality within the Marine Aquarium Fish Trade**  
*Breck A. McCollum, Junior, Aquatic and Fishery Science*  
*Mentor: Patrick Christie, Ocean and Fishery Science*

Collection, handling and transportation issues surrounding the marine aquarium fish trade have resulted in the degradation of many fishing communities and the supplying coral reefs worldwide. Currently a number of conservation agencies are working in source countries to improve industry sustainability. Our analysis suggests that additional attention to informing consumers and hobbyists is fundamental in creating the demand for sustainably caught organisms. In addition, such educational campaigns should link human health impacts for collectors with environmental ones in a manner that is appropriately honest, yet not antagonistic to this important industry. Content analysis of various relevant sources and interviews suggest that the public discourse surrounding the negative environmental and human health issues of the aquarium fish trade is not well developed. Very little information on the processes involved in collection is readily available to the concerned aquarist or general public. Not surprisingly, all forms of hobbyist media generally avoid these challenging topics. As might be expected, trade books and magazines generally
stress that the aquarium industry inspires its hobbyists to be conservationists. Websites occasionally offer “hand-caught” livestock with no definition of what “hand-caught” actually means. Awareness is growing, however. A recent survey by the University of Florida indicated that 50% of hobbyists are aware of the conservation issues involved and associated collection practices. The linkages between various actors associated with the aquarium fish trade will be summarized in a “web of causality”. This analysis, that highlights the connection between local actors and conditions in exporter countries and international actors and conditions in importer countries, suggests that a holistic strategy addressing various unsustainable processes is fundamental to success. Our research has raised the question that once more consumers are aware of the consequences of their choices; will the demand for inexpensive organisms continue to outweigh the demand for sustainably caught organisms?

**Fate of EE2 in drinking water disinfection**

*Zhang Yaofu, Junior, Environmental Engineering*

*Junhe Lu, Recent Graduate, Civil and Environmental Engineering*

*Mentor: Gregory V. Korshin, Civil and Environmental Engineering*

The fate and transport of Endocrine Disruptive Chemicals (EDCs) in the environment have been extensively investigated due to their importance to public health. EDCs are chemicals that are structurally similar to natural hormones produced either by animal or human endocrine systems and may interfere with endocrine systems of wildlife, causing problems such as gender mutation of fishes, and are also potential health threats to exposed human populations. Birth control pills and many other human pharmaceuticals are important sources of EDCs in wastewater and surface water. Large amount of EDCs cannot be absorbed or broken down via normal metabolism; as such, they are eventually excreted. Due to the limited efficiency of EDC degradation in conventional wastewater treatment plants, EDCs are then released and become part of the water cycle in the environment. This research project investigates the fate of EDCs in drinking water disinfection, when EDCs are presumably oxidized, and carcinogenic products are formed. By looking into the mechanism of reaction between EDCs and chlorine, the goal is to decompose EDCs without forming carcinogenic products. The 17 alpha-ethynylestradiol (EE2) is a typical EDC used in this research project. Methods such as Gas Chromatography (GC), UV/VIS Spectrophotometry and Fluorescence Spectroscopy were employed to explore the mechanism and kinetics of this reaction. Among the identified products, a number of carcinogenic chemicals, notably chloroform and Haloacetic acid were detected. Further research is being conducted to determine how intermediate products are formed in the reaction between EE2 and chlorine.

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**SESSION 2L**

**FERTILITY, FLIES, FLUORESCENCE, AND MORE!**

*Session Moderator: Erica Smith, Biochemistry*

*Mary Gates Hall Room 288*

**Star-Net: Student-Scientist-Researcher Network**

**Investigating the Effects of Genes and the Environment on Smoking Behavior**

*Ce’Nendra Martin, Junior, Microbiology*

*Mentor: Maureen Munn, Genome Sciences*

The StarNet Project, an Educational Outreach Program in the Department of Genome Sciences, is developing a curriculum that will involve the students in designing and implementing a case-control study that investigates how environmental and genetic factors affect smoking behavior. However, current genotyping assays are not accessible to high schools and community colleges due to prohibitive equipment cost and reagent toxicity. I am working with Dr. Maureen Munn to develop a genotyping assay that alleviates both problems. This assay identifies Single Nucleotide Polymorphisms (SNPs) found in the Dopamine D2 Receptor (DRD2) gene (Gen Bank Accession Number AF050737), which encodes for a variation, the Taq1 A RFLP site. Recently DRD2 has been associated with addictive disorders including nicotine and cocaine dependence, and obesity. It is hypothesized that DRD2 is a reinforcement or reward gene. We have chosen to use DRD2 to test and modify a reverse dot blot protocol. In the reverse dot blotting technique, allele-specific oligonucleotide probes are bound to a nylon membrane. Both alleles of DRD2 from an anonymous subject are amplified to include a biotin molecule, hybridized to the appropriate probes, and visualized via a colorimetric detection process. In correctly fitting the reverse dot blot technique to the high school and community college classroom, my goal is to show that the protocol gives accurate results and is accessible to students. Throughout the four years of the project, successive high school and community college students will carry out different aspects of the research investigation including designing the questionnaire that probes environmental factors related to smoking behavior, developing an informed consent document, genotyping subjects at loci that may be implicated in smoking behavior, and analyzing data. This project will help students understand the complexity of clinical research, provide them with the tools to critically assess research studies, and it may encourage some students to pursue careers in this field.
Speciation and Human Infertility: Filling the Gap in the Fertilization Cascade
Margo Haney, Junior, Molecular, Cellular, and Developmental Biology
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Willie Swanson, Genome Sciences

Rapid evolutionary divergence has been observed in several species as a result of reproductive isolation. One hypothesis is that human infertility could similarly be caused by rapidly evolving reproductive genes. Therefore, understanding adaptive evolution in model organisms may provide insight into human infertility. The goal of my research is to shed light on the fertilization event in a much simpler organism: Haliotis rufescens, commonly known as the red abalone. Over the years, much focus has been granted to identifying and characterizing the reproductive proteins involved with the dissolution of the egg vitelline envelope of H. rufescens. However, remaining steps in the fertilization cascade are not well understood and require further study. To characterize additional steps in the fertilization process, first the proteins involved must be identified. To accomplish this, I constructed a complimentary DNA (cDNA) library from the mRNA of H. rufescens testis and sequenced one thousand inserts. A large number of expressed proteins were identified through comparison with a database of known proteins. From these proteins, I have selected a glycosyl hydrolase, an exocellulase precursor, and several proteases as candidates for further investigation. The next phase of my project entitles sequencing homologs in multiple species of abalone for use in comparative genomic analysis. This analysis will compute the ratio of nonsynonymous to silent point mutations and will identify proteins under positive selection. The proteins of these adaptively evolving reproductive genes will require further investigation through functional characterization. Overall, in adding to our knowledge of the H. rufescens fertilization cascade, I hope to achieve a deeper understanding of speciation and how this is related to the problem of human infertility.

Integrin in Tubulogenesis
Janice Chen, Senior, Biochemistry and Biology (Cellular and Molecular)
Mentor: Celeste A. Berg, Genome Sciences

Tubes are an essential part of our lives, from the pipes that bring water to our house to vessels that bring oxygen to our brains. Errors in tube formation in human development cause common birth defects such as spina bifida. To understand how biological tubes become malformed, we first need to understand how a tube forms from a flat sheet of cells. By studying dorsal appendage formation during oogenesis in the fruit fly Drosophila melanogaster we are able to focus on tube formation using powerful genetic tools. Cells fated to make the dorsal appendages reorganize and move over other cells to form and extend the tube beyond the tip of the egg. Preliminary results show thicker dorsal appendages in cells that lack an adhesion protein called integrin. Integrin is a cell-surface protein that links the actin cytoskeleton to the extra-cellular matrix and is active in the projections of moving cells. My hypothesis is that without integrin, the elongating tube collapses when stretched as there are no anchors between the cell and external structure. Alternatively, cell projections cannot recognize their surrounding context and fail to extend at all. Both hypotheses could cause shorter and wider dorsal appendages. To distinguish between the two models, I will image cells lacking integrin using fluorescent markers for cell shape. These studies will yield insight into more complex biological processes such as organ formation and the spread of cancer cells.

Cell Scaffold: Effects of SPARC on Cell-Matrix Interactions in Lens and Retina
Julia Mattson, Senior, Neurobiology
Mary Gates Scholar
Mentor: John I. Clark, Biological Structure

The structures of mice and human lenses and retinas are very similar, making transgenic mice excellent models to study lens and retina development. SPARC (Secreted Protein Acidic and Rich in Cysteine) is an extracellular matrix-associated protein that has been shown to have a wide variety of roles, including regulation of tumor cell growth, wound healing, and maintaining normal lens transparency. The extracellular matrix (ECM) is a complex structure made up of structural proteins, proteoglycans, growth factors, and matrix-cellular proteins that surrounds and supports cells by essentially serving as “cell scaffolding.” In the absence of SPARC, mice display early cataract formation involving disruption of the lens capsule, the basement membrane of the lens. SPARC-null mice also exhibit a later onset of abnormal retinal development, as can be observed by the prominent retinal folds that develop in older mice. Immunohistochemistry protocols have been used to identify key extracellular matrix proteins that are absent or over-expressed in the SPARC-null mouse genotype. In preliminary experiments, the expression of several basement membrane and matrix-associated proteins including Paxillin, Focal Adhesion Kinase (FAK), Laminin, Connexins 43 and 46, Actin, and beta-catenin has been different in the wild-type and SPARC-null mouse genotypes. This research intends to investigate and define correlations in affected cell-matrix interactions in both retina and lens. Understanding disrupted processes on a cellular level can afford us a better understanding of how to maintain normal lens and retinal development, which has many clinical applications.
**Protein Fingerprint for Breast Cancer Cells Using SDS PAGE and Capillary Electrophoresis**  
*Joan Bleecker, Junior, Chemistry and Biochemistry*  
*Mentor: Norman Dovichi, Chemistry*

I am working in Dr. Norman Dovichi’s laboratories, studying protein expression “fingerprints” of MCF7 breast cancer cells. Protein expression differs from case to case, and cancer cells undergo major changes through different cancer stages. I have been working on finding more specific protein fingerprints using two-dimensional gels and capillary electrophoresis (CE). The ultimate goal of this research is to improve cancer prognoses and to develop better patient-specific treatment regimens. Capillary electrophoresis is a technology which separates proteins having detection sensitivity almost a million-fold stronger than earlier methods. Proteins are separated in the capillary by properties such as weight to charge ratio, size, and hydrophobicity. A laser beam at the end of the capillary excites the labeled proteins to fluoresce. Photons from fluorescence are then detected and translated to a computer as peaks over time. These peaks represent separated proteins that can be mapped to protein expression in breast cancer cells. For gels, I used 1D and 2D SDS-PAGE (sodium dodecyl sulfate polyacrylamide gel electrophoresis) to separate proteins. 1-D gels separate proteins based on molecular mass, and actual masses of separations are determined from co-migrating protein standards. 2D gels proteins are first separated by isoelectric point on an isoelectric focusing strip (IEF) and further isolated by molecular weight (SDS-PAGE). I have also worked on lysis methods and ethanol fixation for CE and gels. The samples we inject into CE are lysed cancer cells grown in culture. I have been studying the effects of ethanol fixation, which stops proteins degradation during lysis, on the solubility of proteins in lysis buffer mostly through the resolution of samples in 1D gels.

**Folding Specificity of Homologous Nucleotide Binding Domains**  
*Jessica Marie Smith, Sophomore, Chemistry and Biochemistry*  
*Mentor: Beth Traxler, Microbiology*

In order to transport most molecules across membranes, cells utilize a variety of different membrane transport proteins. ATP-Binding Cassette (ABC) transporters comprise one important family of these proteins, with representatives found in all organisms. For instance, malfunction of these transporters causes cystic fibrosis in humans; in bacteria, ABC transporters can provide multi-drug resistance. These transporters consist of transmembrane domains and cytoplasmic domains that bind and hydrolyze ATP during transport. Together, these proteins form complexes capable of transporting molecules such as sugars, vitamins, and amino acids. The ABC transporters of interest in this project are involved in the transport of maltose (MalFGK) and glycerol phosphate (UgpAEC) into E. coli. Of specific interest are the homologous ATP-hydrolyzing domains of MalK and UgpC, which share 48% amino acid identity. Previous studies have shown that UgpC can act inefficiently with MalF and MalG in absence of MalK to transport maltose. We seek to identify critical contacts between the ATP-hydrolyzing domains and membrane spanning domains. To do so, we isolated UgpC mutants that better complement MalFG for growth on maltose media. Candidates were sequenced to identify regions of UgpC (and by extension, MalK) that are important for specificity of transport and for proper assembly into a functional oligomeric complex. We hope to continue to identify mutants as different methods of mutagenesis are employed. Current data indicates that subtle changes can significantly impact the way these proteins interact. This and future research will shed light on how homologous genes evolve for divergent functions and what protein-protein contacts are important for functionality and specificity of protein folding.

**A Fluorescent, Non-Radioactive Approach to Visualization of ds-DNA and Protein Interactions**  
*Jun Amora, Junior, Neurobiology and Biochemistry*  
*Mentor: James Bassuk, Department of Biological Structure and School of Medicine - Urology*

The sequence specific binding of proteins to DNA is a significant episode that regulates DNA transcription leading to differential gene expression. (1) One technique employed by biochemists to study protein-nucleic acid interactions is the gel shift assay. This assay is a quick detection method that is capable of resolving small amounts of sequence specific interactions even in crude cell and tissue extracts. The central foundation behind the gel shift is the differential electrophoretic mobility of protein-DNA complexes and uncomplexed nucleic acids in a nondenaturing gel (2). Customarily, 32P radio-labeled oligonucleotides have been used to detect shifts. While isotopic detection offers great sensitivity, it also entails environmental and safety issues. Other detection techniques require biotinylation and subsequent addition of probe molecules such as fluorescein onto the oligonucleotide (3). However, not only do these techniques require prelabeling the DNA, they also introduce the risk of non-native protein-DNA interactions that may influence binding efficiency. This project therefore aims to study a protocol that provides a quick detection method using fluorescent DNA and protein stains. This procedure shortens preparation time and also retains entirely native interactions between DNA and protein. SYBR Green DNA stain detected as little as 0.28 picomoles of AP-2, a twenty-six base pair oligonucleotide(4). Furthermore, the relative intensity of the fluorescent band was dependent on the amount of DNA present. This feature allows for more extensive data analysis that could be applied to show the exact stoichiometry of specific DNA and protein interactions in the future. In
addition, a SYPRO protein stain- SYBR stain overlay was used to point out the exact spot on the gel where the DNA and protein complex had migrated. NFkB p50 protein and NFkB consensus oligonucleotide were used to show the detection of a Rel Homology Region Binding (5) using SYBR and SYPRO fluorescent stains. With the use of this protocol, it is easier to study clinically important protein interactions in a shorter amount of time.

**SESSION 2M**

**APPLICATIONS AND ALGORITHMS FOR MODERN METHODS OF MATHEMATICS**

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

*Mary Gates Hall Room 278*

**Slow scale parameter evolution of soliton solutions to the perturbed Nonlinear Schrödinger Equation**

*Norris Hawk Berry, Senior, Applied & Computational Mathematical Sciences and Physics*

*Mentor: J. Nathan Kutz, Applied Mathematics*

Theoretically predicted by Satyendra Nath Bose and Albert Einstein in the 1920’s, Bose-Einstein condensation has since become a new experimentally-tangible state of matter. In 1995 the first Bose-Einstein condensate was created by Eric A. Cornell and Carl E. Wieman of the University of Colorado at Boulder, and Wolfgang Ketterle of the Massachusetts Institute of Technology, for which they were awarded the Nobel prize in physics in 2001. However, the condensates that have so far been produced in the laboratory, generally only exist for several seconds to a few minutes before evaporating. Not only does this make it difficult to study this new form of matter in its own right, but it also makes it impossible to utilized its amazing and unique properties in other experimental settings. The primary focus of our research is describing the slow evolution of soliton solutions to the Nonlinear Schrödinger Equation (NLS) when a small forcing is applied. The principal application of our work is the behavior of quasi-one dimensional Bose-Einstein condensation in an external electromagnetic potential. In particular our research is concerned with the behavior of Bose-Einstein condensation in the presence of very small sinusoidal and/or parabolic potentials. These potentials correspond to the small forcing with which we perturb parameters of the well-known stable solitary wave solutions to the NLS. This perturbation allows us to describe the slow scale time evolution of these soliton solutions given the strength of the small external potential. In addition, we numerically simulate the evolution of these condensates to confirm our results.

**Averaged models for passive mode-locking using nonlinear mode-coupling**

*Joshua Proctor, Senior, Aeronautics & Astronautics and English*

*Mentor: J. Nathan Kutz, Applied Mathematics*

A novel laser configuration has been proposed using the nonlinear mode-coupling behavior in devices such as a waveguide array in order to achieve mode-locking in a laser. The two element model (the fiber model and the mode-coupling model) has been shown to be robust and stable. Yet, a difficulty arises in analyzing the two element model in a rigorous fashion because there are two separate equations modeling the devices. Therefore, to better analyze the laser configuration an averaged model is proposed that will allow for a single solution. An averaged mode-locking model is presented in which the nonlinear mode-coupling behavior in a waveguide array, dual-core fiber, and/or fiber array is used to achieve stable and robust passive mode-locking. By using the discrete, nearest-neighbor spatial coupling of these nonlinear mode-coupling devices, low intensity light can be transferred to the neighboring waveguides and attenuated. In contrast, higher intensity light is self-focused and remains largely unaffected. This nonlinear effect, which is described by linearly coupled nonlinear Schrödinger equations, leads to the temporal intensity discrimination required in the laser cavity for mode-locking. Computations of this pulse shaping mechanism show that stable and robust mode-locked soliton pulses can be produced. The averaged model has the same asymptotic characteristics as the two element model.

**Nonlinear Mode Coupling in Dual Core Fibers and Waveguide Arrays: Theory and Applications**

*Kimberlee Shish, Senior, Aeronautics & Astronautics*

*Mentor: J. Nathan Kutz, Applied Mathematics*

We consider the intensity-dependent pulse propagation in a dual core fiber grating. When a grating is written on one of the cores at the correct frequency, there is a periodic transfer of energy between the two modes, which can be detuned by increasing the intensity. With this dual core configuration, low intensity light can be coupled to the other core, while high intensities stay in the original core, allowing for the development a theoretical basis for a mode-locking device (by creating narrow, high intensity pulses). We consider how varying the grating strength and the size and spacing of the cores, and adding a nonlinearity term affect coupling. To develop the laser, the propagation through a fiber with a nonlinear coupling element was modeled. More recently, the dynamics of waveguide arrays (another coupling element) have been considered in the presence of dispersion. When coupled with a laser cavity, loss is experienced, and only a limited parameter space could be found where mode-locking would occur. This has
lead to the development of a model for a waveguide array chip laser.

**SpectrUW: a laboratory for the numerical exploration of spectra of linear operators.**

*Firat Kiyak, Junior, Computer Engineering*

*Mentor: Bernard Deconinck, Applied Mathematics*

Spectra of linear operators play an important role in various aspects of applied mathematics. For all but the simplest operators, the spectrum cannot be determined analytically and as such it is difficult to build up any intuition about the spectrum. One way to obtain such intuition is to consider many examples numerically and observe emerging patterns. This is feasible using an efficient black-box numerical method, i.e., a method that requires no conceptual changes for different examples. Hill’s method satisfies these requirements. It is the mathematical foundation of SpectrUW (pronounced “spectrum”), mathematical black-box software that serves as a laboratory for the numerical approximation of spectra of one-dimensional linear operators.

**Geometry optimization with a modified downhill simplex method**

*Robert Snoeberger, Senior, Chemistry, Mathematics*

*Mentor: Xiaosong Li, Department of Chemistry*

The combination of quantum mechanics and computers has enabled theoretical information of molecular systems to be quickly extracted. The energy of a molecular system is a function of the spatial arrangement of the atoms allowing numerical optimization methods to search for the lowest energy geometry. The two types of optimization methods commonly used are energy based or directed gradient based methods. Energy based optimization methods are slow to converge so directed methods using first derivate and possibly second derivatives are generally preferred. However, the calculation of second derivatives and, to a lesser extent, first derivatives become computationally expensive as the number of atoms in the system grows. The size dependence makes the optimization of large molecular systems infeasible and energy based optimization schemes become more favorable. The objective of the current work is to construct an efficient energy based optimization scheme based on the downhill simplex method. The downhill simplex method was implemented in the Gaussian suite of computational chemistry software and modifications were subsequently added. Trial optimizations were preformed on select molecules from the Baker test set.

**Connections and Critical Edges**

*Kyotaro Hemmi, Junior, Mathematics*

*Mentor: Hong Qian, Applied Mathematics*

In studies of networks, examination of the critical edges conveys the degree of stability that a system holds. This paper will introduce readers to the interdependence between the definition of critical edges and the choices that an observer may make in deciding what parameters to keep fixed and varied. For special types of graphs, an algorithm to test for critical edges will be provided.

**Exploring Homological Algebra: Applications of Quillen’s Structure Theorem**

*Eliana Hecter, Senior, Mathematics*

*Mentor: John Palmieri, Mathematics*

I will give an exposition of Quillen’s famous structure theorem for mod p cohomology, followed by illustrative examples. The goal of the talk is to give a sense of how homological algebra is useful as an abstract tool.

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**SESSION 2N**

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**FROM EARTH TO UNIVERSE: MODELING, MATTER, AND INTERACTIONS**

*Session Moderator: Gerald Seidler, Physics*

*Mary Gates Hall Room 248*

**Sedimentary Structures in the Upper Kingston Peak Formation: Implications for Snowball Earth Environments**

*Jesse Einhorn, Senior, Earth & Space Sciences*

*Mentor: Darrel Cowan, Earth & Space Sciences*

The Kingston Peak Formation of Death Valley, California, is a sequence of conglomerate diamictite and sandstone, unconformably overlain by the Noonday Dolomite. The diamictite texture is characteristic of sediments deposited by glacial processes, and the presence of low-latitude glacial features has been used to infer the occurrence of ancient ice-age events that were globally extensive. In contrast, the Noonday Dolomite is composed of biogenic carbonate layers that typically form in warm, shallow, marine basins. Since both the Kingston Peak and Noonday are poorly dated, the hiatus represented by the unconformity between them is of unknown duration, and the nature of the transition from one formation to the other remains obscure. In addition, the contact between the two units shows considerable spatial variation, and in some areas the lithology, structure, and provenance of the upper-most members of the Kingston Peak are unknown. By investigating undocumented exposures of the Kingston Peak and their contact with the Noonday Dolomite, this project aims to clarify the transition between two very different depositional environments. In the field, we will identify and document the sedimentary features on both sides of the contact, and take clast samples for correlation.
to paleogeographic interpretations of the area. By examination of sedimentary structures within the uppermost member of the Kingston Peak, we hope to ascertain the likelihood of a glacial origin for this unit, and to determine whether these formations are compatible with the “Snowball Earth” hypothesis.

**Modeling Martian Lee Wave Clouds**

*Christopher Glein, Senior, Chemistry*

**Mentor:** Stephen Wood, Atmospheric Sciences

**Mentor:** David Catling, Atmospheric Sciences

**Mentor:** David Montgomery, Earth and Space Sciences

Lee waves form when stable air is deflected upward by a topographic obstacle and experiences buoyant oscillations on the downstream side of the obstacle. Clouds materialize when condensation occurs at the cooled crests of the waves, which usually leaves a train of clouds that are aligned orthogonal to the prevailing wind. The existence of lee wave clouds on Mars has been known since the Mariner 9 mission (1972). Craters varying in size from a few to hundreds of kilometers in diameter commonly generate Martian lee wave clouds. Understanding lee wave clouds on Mars is important because they are a rich source of information on its atmosphere. Their wavelength is determined by the temperature and wind profiles of the atmosphere, and their occurrence is tied to the general climactic state of the atmosphere. We have developed a numerical model that calculates wavelengths of lee waves using data from the NASA Ames Mars General Circulation Model (MGCM) to investigate the seasonality of lee wave clouds on Mars. We have been comparing model predictions with images from the Mars Orbiter Camera (MOC) and water vapor abundances from the Thermal Emission Spectrometer (TES) to establish whether Martian lee wave clouds are generally water-limited or dynamics-limited. In addition, we have been using our model, along with wavelengths from MOC images and temperature profiles from MGS Radio Science (RS) measurements, to constrain wind profiles. These results are significant because wind speed is a fundamental dynamical quantity for which few measurements exist. A more detailed understanding of wind on Mars will allow others to model the transport of water, dust, and heat in the Martian atmosphere.

**Torsion Pendulum Axion Search: Addressing the Strong CP Problem**

*Daniel Schultheis, Junior, Physics, Mathematics*

**Mentor:** Eric Adelberger, Physics

**Mentor:** Seth Hoedl, Physics

Since 1978, the Strong CP (charge-parity) Problem has been the subject of much speculation in the physics community. The source of this debate arises from the surprising degree to which the strong force obeys CP symmetry, despite the inclusion of an explicitly CP violating term. By far, the most elegant solution to this inconsistency calls for the inclusion of a new elementary particle, the axion. Since an exchange of virtual axions between unpolarized nucleons and polarized electrons creates a small force, we plan to exploit the effects of this force by using a torsion pendulum to experimentally verify the existence of the axion. The core of our experimental design consists of a torsion pendulum suspended by a tungsten fiber between the narrowly separated pole faces of an electromagnet. By periodically changing the polarity of the magnet, we can scan for periodic oscillations in the motion of the pendulum. My research on the axion search has been largely devoted to constructing, troubleshooting, and calibrating the autocollimator, a device which uses the reflection of a laser beam from the pendulum and onto a photodiode to measure the angular deflection of the pendulum. Current estimates predict that our experiment will improve by up to eighteen orders of magnitude on the present limit on axions in the 100-1000 μeV mass range.

**Extended Calibration of Photometric Metallicities in SDSS**

*Adam Kobelski, Senior, Astronomy, Physics*

*Caleb Matthiesen, Senior, Astronomy, Physics*

*Michael Schmieding, Senior, Astronomy, Physics*

**Mentor:** Chris Laws, Astronomy

**Mentor:** Suzanne Hawley, Astronomy

Understanding the galactic distribution of metal-rich stars is important for studying the chemical evolution of our galaxy, tracing the history of our galaxy’s physical evolution, and possibly determining the distribution of extrasolar planets. Stellar metallicities – in particular, the ratio of iron to hydrogen compared to the sun ([Fe/H]) – can be obtained from spectroscopic data or new methods based on specific colors established by the five separate wavelength bands from the Sloan Digital Sky Survey (SDSS). Our research is focused on using both photometric and spectroscopic data to extend the current calibrations done for low metallicity stars to [Fe/H] ratios greater than solar. We are currently analyzing both photometric data from UW’s 0.8m Manastash Ridge Observatory telescope and spectrographic data from the ARC Echelle Spectrograph at the 3.5m Apache Point Observatory in New Mexico. Using Sloan colors calculated from the photometric data and the metallicities of stars obtained from spectroscopy, we are formalizing the expected theoretical relationship between Sloan magnitudes and stellar metallicities. Although spectroscopic data is more accurate in determining chemical compositions, it is more time-consuming and expensive to acquire than photometric data. By defining the relationship between [Fe/H] and photometric colors, we will be able to make direct estimates of a star’s chemical properties from photometric data alone. Additionally, our estimates can be applied to the large “all sky surveys” that have already obtained photometric colors for millions of
stars, most notably the SDSS. These results will bring a better understanding of structure in our galaxy and allow us to predict where extrasolar planets may be found more confidently.

**Indium Abundances in Solar Neighborhood Stars**  
*Suzanne Hayward, Junior, Physics and Astronomy  
Mentor: Chris Laws, Astronomy  
Mentor: Suzanne Hawley, Astronomy*

Nucleosynthesis is the process in which stars generate the elements that make up the majority of the periodic table. As time passes, the amount of heavier elements in the universe increases, so younger stars will have more of these elements than older stars. Thus studying the abundances of elements within stars teaches us about the evolution of the chemical composition within our galaxy. The objective of my research has been to analyze the spectra from the Spectroscopic Survey of Stars in the Solar Neighborhood (S4N) study (C. Allende Prieto, et al, 2004), and measure the Indium to Iron abundance ratios ([In/Fe]). In order to accomplish this I first had to select the relevant portion of the spectra for the stars that was around in the major Indium lines located near 4511 Angstroms. Then using a spectrum-synthesizing program and observations from the S4N, I adjusted parameters such as velocity shift and abundances until the model for a star matched the observed spectra as well as possible. With these fit abundances, I was then able to calculate the [In/Fe] ratios for 95 of the 118 stars in the study. My results indicate that [In/Fe] decreases significantly at higher [Fe/H] values, a trend that is markedly similar to that seen in the element Europium, an element with which Indium shares many characteristics. This connection suggests that these two elements may share a primary source in our galaxy – violent supernovae of very high-mass stars.

**Modeling KH 15D: A Pre-Main-Sequence Binary**  
*Devin Silvia, Junior, Astronomy and Physics  
NASA Space Grant Scholar  
Mentor: Eric Agol, Astronomy*

KH 15D is a spectroscopic binary that appears to be surrounded by a circumstellar disk of gas and dust. Due to the orientation of the system, this T-Tauri star undergoes periodic eclipses that last for a substantial portion of the binary orbit. Currently, one of the stars of KH 15D is completely blocked from view and the visible star is undergoing increasingly longer eclipses as the disk precesses around the stellar objects. The goal of our research is to develop a model for KH 15D that will accurately predict the motion of the stars as well as the motion of the disk. In order to create a model for the stars, we are writing a minimization routine that simultaneously fits both the recorded radial velocity data and the recorded light intensity data as a function of time. By fitting both sets of data at the same time, we hope to achieve a fit that is more accurate than those that fit only one set of data. Once we are confident in our model for the motion of the stars we will move on to the model for the disk. In the end, our model for KH 15D should allow us to determine if there is a planetary body forming within the circumstellar disk. This would provide further knowledge of the process of planet formation and could serve as an insight into planet formation that is happening elsewhere.

**LISA Small Forces Investigation**  
*Michael Nickerson, Senior, Physics  
Mary Gates Scholar  
Mentor: Jens Gundlach, Physics*

The LISA Small Forces Investigation is an experiment designed to measure and understand fempto-Newton forces between closely spaced metallic surfaces. It is being conducted by the University of Washington’s Eöt-Wash group, and has been ongoing for several years. The results of this investigation will be used in the modeling, design, and construction of a reference sensor for the Laser Interferometer Space Antenna (LISA). The LISA mission is designed to study gravitational waves from astronomical sources, and is scheduled for launch in 2015. Small, short-range forces between metallic surfaces are poorly understood on long timescales, and must be compensated for in order to achieve the low noise levels required by LISA. To better understand these forces, the LISA Small Forces Investigation has constructed a freely oscillating torsion pendulum, suspended by a high precision, low-noise fiber. Measurements are made of the small forces acting between the pendulum and a mounted, movable plate. To achieve the required sensitivity levels, the forces are exaggerated by measuring at very small separations. We have determined the sensitivity limit of the apparatus, and the dependence of noise on plate-pendulum separation and ambient variables such as pressure and temperature.
Students Honor Their Mentors

Participants in the 2006 Undergraduate Research Symposium were invited to submit a haiku poem honoring their research mentors. Included in this volume is a selection of the wonderful poems that we received. Posters and slide shows of all the submissions are on view throughout Mary Gates Hall. A complete list may also be viewed on the Undergraduate Research Program website, www.washington.edu/research/urp

Student: Jason Soh - Microbiology
Mentor: Daniel Enquobahrie - Epidemiology

    teacher leader friend
    revealing the possible
    in impossible

Student: Wan Yang - Neurobiology, Biochemistry
Mentor: Randall Woltjer and Thomas Montine - Pathology

    It's all right, he says-
    The best lessons lie in
    mistakes and failures

Student: Ce’Nedra Martin - Microbiology
Mentor: Maureen Munn - Genome Sciences

    The cat’s out the bag
    She’s fabulous and glad
    and excited for me

Student: Mari Obara - Biology
Mentor: Alison Crowe - Biology

    Teaching me to think
    I grow as a scientist
    Under her broad wings

Student: Smita Pednekar - Psychology
Mentor: Renee Ha - Psychology

    We went to the zoo,
    Renee and I, and inside
    I found why we learn.
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Students Honor Their Mentors

Participants in the 2006 Undergraduate Research Symposium were invited to submit a haiku poem honoring their research mentors. Included in this volume is a selection of the wonderful poems that we received. Posters and slide shows of all the submissions are on view throughout Mary Gates Hall. A complete list may also be viewed on the Undergraduate Research Program website, www.washington.edu/research/urp

Student: Emily Fischer - Communication, Philosophy
Mentor: David Silver - Communication

David is the best
He encourages and helps
Us sort out our thoughts.

∞

Student: James Hong - Psychology, Sociology
Mentor: Theodore Beauchaine - Psychology

Learning from gurus
of psychology and life,
i’m forever changed.

∞

Student: Adrianne Stevens - Psychology
Mentor: Sheila Crowell - Psychology

Sheila Crowell taught
me to believe in myself
and now here I am!

∞

Student: Chris Thouvenel - Biology
Mentor: Carol Sibley - Genome Sciences

Opportunity
To learn and try for myself
Thanks Dr. Sibley

∞

Student: Jingyu Zou - Materials Science and Engineering
Mentor: Alex K-Y Jen - Material Science and Engineering

Thanks for my mentor
He guides me to the research
World full of wonder
ACKNOWLEDGEMENTS

The Undergraduate Research Program wishes to recognize all of the faculty members, postdocs, staff, and graduate students who have contributed to the education of the undergraduate researchers featured in this symposium.

None of this would have been possible without you.

We wish to thank all of the volunteers who helped to organize and run this event; Session Moderators: Ethan Allen, Ginger Armbrust, Gerald Baldasty, John Banks, Rajendra Bordia, Martha Bosma, Lindus Conlan, David Domke, Dieter Fox, Stevan Harrell, Rachel Klevit, Lisa Kopp, Michael Kucher, J. Nathan Kutz, Richard Ladner, Elizabeth Marin, Gerald Pollack, Wendy Raskind, Brian Reed, Jennifer Ruesink, Dennis Ryan, Gerald Seidler, Billie Swalla, Erica Smith, Clarke Speed, Phillip Thurtle, Shawn Wong, and Tuofu Zhu; Planning Assistance: Joanna Crook, Jeff Eaton, Jessica Eggen, Noah Giansiracusa, Kelly Hills, James Hong, Sonya Jakawich, Katharine Liang, Mei Liu, Breck McCollum, and Jenny Yuen; Event Support Staff: Center for Experiential Learning Staff, David Aldrich, Monica Banks, Patience Browne, Amanda Burrows, Jodene Davis, Rod Davis, Neil Dobson, Wendy Durant, Tom Gething, Joshua Gibbs, Lindsey Grad, Harry Hayward, Roberta Hopkins, Sandra Kay Johnson, Michaelann Jundt, Kyla Lackie, Tim Lennon, Jon Linse, Virginia Lupori, Tracy Maschman-Morrissey, Mona Pitre-Collins, Judy Robertson, Bob Roseth, Nancy Ruzycki, Joel Schwartz, Linda Sellers, Jo-Ann Sire, Erica Smith, Christine Stickler, Vega Subramaniam, Megha Sundara, Irene Svete, Susan Terry, UW Postdoctoral Association, Ally VanderStoep, Matt Winslow, Rachel Woods, Pat Wrobel, Donald Zongker; Special Guests: Provost Phyllis Wise, Vice-Provost Mary Lidstrom, Acting Dean and Vice-Provost Christine Ingebritsen, and everyone who has contributed to this event.

We express appreciation for sponsorship of this event to the Office of Research, the Mary Gates Endowment for Students, and the Office of Undergraduate Education.

Thanks to the Mary Gates Endowment for Students, the Office of Research, and the Washington Research Foundation for their support and encouragement of undergraduates in research.

A special note of thanks to the faculty who released their classrooms in Mary Gates Hall for this event.