UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 18, 2012 Mary Gates Hall

Online Proceedings

SESSION 1D

AN EXAMINATION OF THE EFFECTIVENESS OF PROGRAMS AIMED AT IMPROVING SOCIAL OUTCOMES

Session Moderator: Michael Verchot, Consulting and Business Development Center
Mary Gates Hall 238
1:00 PM to 2:30 PM

* Note: Titles in order of presentation.

Can Autistics Redefine Autism? The Cultural Politics of Autistic Activism
Ronnie Thibault, Junior, Interdisciplinary Studies (SEB)
Mary Gates Scholar
Mentor: Benjamin Gardner, Interdisciplinary Arts & Sciences

This study focuses on how the global efforts of a politically active and increasingly visible movement of adult autistic activists are challenging the common framing of autism and shifting the contemporary autism debate. Common representations throughout the autism field contextualize the autistic experience through diagnostic categories of difference, constructed primarily by psychologists, neurologists, educators, and service providers. These characterizations are determined through observational criteria such as delayed communication, repetitive physical behaviors, and marked deficits in social skills. While the deficit mindset dominates the media and the public perception of autism, there is a lack of attention and research on how the social impact of these 'perspectives from the outside' influence the lived experience of autistic adults. This work counters the hegemonic deficit interpretation by investigating the multiple meanings of autism, and studying whether politicized tensions over autistic representations—and misrepresentations— influence public conversations surrounding service delivery, treatment design, and provisions of care. Drawing on qualitative cultural research methods including narrative, textual and image analysis, as well as ethnographic field notes, this study critically analyzes the lived experience of adult autistics and their efforts to re-humanize public assumptions about autism while living in a society, they suggest, that stigmatizes their experience as emotionally isolated, socially deficient, and mentally diseased. I analyze the socio-political discourse of autism and the conflicting representations put forth by medical professionals, mainstream media, institutions, scholars, and—autistics. These contradictory interpretations produce a cultural system of difference engaged in debate over autistic autonomy, self-determination, and justice. To critically engage this 'culture war' this inquiry considers who has the right to speak for the autistic community? Whose values are characterized as authentic by the public? Finally, this investigation asks, can autistics redefine autism and how will this definition reframe their position in political discussions about them?

SESSION 1Q

ADVENTURES IN ASTRONOMY

Session Moderator: Suzanne Hawley, Astronomy
Johnson Hall 022
1:00 PM to 2:30 PM

* Note: Titles in order of presentation.

Supernova Remnant Progenitor Masses in M31 and M33
Zach Jennings, Senior, Physics, Astronomy
Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Julianne Dalcanton, Astronomy
Mentor: Benjamin Williams, Astronomy

When massive stars reach the end of their lives, they erupt in enormous explosions known as supernovae, leaving behind clouds of shocked gas and dust known as supernova remnants (SNR). The primary technique to measure the mass of the progenitor star requires waiting for the star to explode and examining pre-explosion Hubble Space Telescope archival images of the site, which may or may not exist. This technique is constrained by rarity of supernovae, and as such only ˜25 progenitors have any mass constraint whatsoever in the literature. We employ an alternative technique in which we examine color-magnitude diagrams of the regions surrounding known supernovae to measure their star formation history. We then use this star formation history to assign an age to the progenitor star. By employing stellar evolution models, we convert this age to a mass. Because we do not rely on identification of the specific progenitor star in the images, we are free to apply our technique to cataloged SNR, drastically increasing the

number of available targets. We apply our method to ˜135 cataloged remnants in the nearby spiral galaxies M31 and M33, representing a dramatic increase in the number of currently known masses. We examine the distribution of these derived masses and comment on implications for supernova physics.

POSTER SESSION 2

Balcony, Easel 95

2:00 PM to 3:30 PM

Organizing "The S.P.O.T.": Negotiating and Intervening in the Production of Student Space

Erich Christopher (Erich) Freywald, Senior, Society, Ethics, & Human Behavior (Bthl)
Mentor: Benjamin Gardner, Interdisciplinary Arts & Sciences

"The S.P.O.T.", which stands for Students in Partnership for Organizing Transformation, began constructing a physical space on the University of Washington Bothell (UWB) campus in the fall of 2011. This space is meant to serve as a multipurpose room for recognized student organizations (RSO) to collaborate in creating a campus culture inclusive of diversity, representation and open dialogue. The purpose of this study is to critically analyze how The S.P.O.T. exists as a site of struggle, produce by the complex interplay of passionate and influential social actors including The Office of Student Life, RSO leaders, and dedicated faculty. I also document how RSO leaders negotiate public space on campus in an effort to mobilize the wants and needs of their organization. I have conducted a series of in-depth interviews with RSO leaders, participated in several UWB Club and Innovation Forums, and spent months directly observing how students attempt to understand public space on campus. Through this research I argue that The S.P.O.T., designed with the purpose of igniting social change, has itself become a powerful social actor in shaping students understanding of UWB initiatives and policies. RSO leaders must continually employ a series of strategies to maintain visibility and legitimacy in a constantly shifing sociopolitical landscape. By unraveling the unseen forces behind the creation of student spaces, such as The S.P.O.T., and exposing the limitation, as well as the potential, we can better understand how students make sense of complex social issues. This research is necessary if students, RSO leaders, and faculty are committed to increasing awareness, respect, and understanding by transforming physical space on campus.

POSTER SESSION 2

MGH 241, Easel 169

2:00 PM to 3:30 PM

Membrane Filtration with Heated Aluminum Oxide Particles

Francesca Theresa (Francesca) Liburdy, Sophomore, Pre Engineering
NASA Space Grant Scholar
Mentor: Mark Benjamin, Civil And Environmental Engineering

Membranes are used frequently in water filtration to remove bacteria and contaminants from fresh water. Natural organic matter (NOM) collects inside the permeable membrane, and causes resistance against the water flow. As NOM collects, more force is required to move water through the membrane, and the energy required to continue the process increases. When the pressure required to move water through the membrane has increased, the membrane has fouled. This project examines the filtration and adsorption of NOM in fresh water obtained from Lake Washington. Heated aluminum oxide particles (HAOPs) act as an adsorbent layer, trapping NOM and protecting the membrane from fouling. The HAOPs protect the membrane by collecting and removing NOM through deposition and backwash cycles. During deposition, twenty grams per meters squared (g/m^2) of HAOPs are pumped inside a plastic, tubular membrane with a pore size of 2-3 microns. Lake water is then pumped through the membrane at a flux rate of 200 liters per meters squared per hour (lmh), and trans-membrane pressures are measured within the system. Trans-membrane pressure is measured to calculate the amount of pressure necessary to move water through the membrane. Samples are collected periodically throughout a 20 hour run time and analyzed for UV absorbance. UV absorbance measures the amount of light able to transmit through a sample of lake water; the amount of light that travels through the water correlates with the amount of contaminants or NOM that remain in the water. HAOPs successfully remove NOM molecules and protect the membrane, preventing it from fouling quickly.

SESSION 2B

HOST AND PATHOGENS

Session Moderator: Geoffrey Gottlieb, School of Medicine

Mary Gates Hall 231

3:30 PM to 5:00 PM

* Note: Titles in order of presentation.

Antibiotic Sensitivity Testing of Pseudomonas Isolates from Cystic Fibrosis Airways Indicate a Lack of Correlation Between Experimental Resistance and Actual Resistance During Clinical Therapy

Lisa Kathleen (Lisa) Andersen, Senior, Microbiology
Mentor: Pradeep Singh, Microbiology
Mentor: Benjamin Staudinger, Medicine/Pulmonary and Critical Care

Chronic infections with Pseudomonas aeruginosa are a significant cause of deterioration of lung function in patients with cystic fibrosis (CF), and have substantial clinical importance due to their marked resistance to treatment with antibiotics. Furthermore, existing laboratory methods for testing bacterial susceptibility to antibiotics are poor indicators of clinical response to therapy, which further increase the difficulty associated with treating these infections. Current research shows that phenotypically diverse P. aeruginosa subpopulations evolve within a single patient during prolonged infection, and that clinical antibiotic therapy causes some of these subpopulations to change significantly in relative abundance. Observed changes in abundance following antibiotic treatment signify varying degrees of antibiotic susceptibility within each patient's P. aeruginosa population as a whole, with an increase in a particular subpopulation abundance indicating resistance, and a decrease in a particular subpopulation abundance indicating sensitivity. As previous studies have only evaluated P. aeruginosa antibiotic sensitivity prior to antibiotic treatment, we attempted to demonstrate the correlation between an increase subpopulation abundance following clinical treatment and the degree of resistance to antibiotics in laboratory testing. This was done by evaluating the antibiotic minimum inhibitory concentration (MIC) of a range of isolates collected from CF patients who had undergone antibiotic therapy, using antibiotics which had been given to each patient in clinical treatment. Our results demonstrate a marked lack of correlation between relative subpopulation abundance and antibiotic MIC, with clinically resistant subpopulations showing the same or lower MIC than subpopulations which were clinically sensitive treatment. We conclude that isolates resisting treatment do not have a different MIC than isolates responding to treatment, suggesting that mechanisms other than classic antibiotic resistance are responsible for treatment resistance in the CF lung. Further studies to evaluate these mechanisms, such as biofilm formation and formation of persister cells, are currently under way.

SESSION 2S

COMPLEXITY AND EVOLUTION OF BIOLOGICAL SYSTEMS

Session Moderator: Billie J. Swalla, Biology
Johnson Hall 111
3:30 PM to 5:00 PM

* Note: Titles in order of presentation.

Mutational Changes in an RLINE Retrotransposon Accompanying Evolution
Shambhavi Gautam, Senior, Biology (General)
Mentor: Benjamin Hall, Biology
Mentor: Dale Lindsley
Mentor: Michelle Stitzer, Biology

Retrotransposons exist as genetic elements within chromosomal DNA that can replicate themselves and move to new locations within a genome, using a process involving an RNA intermediate. They are a widespread class of transposable elements, abundant in plants, fungi, mammals and yeast. One type of retrotransposon is a Long Interspersed Nuclear Element (LINE). Unlike most retrotransposons, LINEs have no long terminal repeats (LTR) and they possess a poly A tail which defines the 3' terminus of the element. They are several kilobases long and contain two open reading frames (ORFs) encoding a gag protein (ORF1) and endonuclease and reverse transcriptase domains (ORF 2) conferring the element's ability for retrotransposition. Due to incomplete insertion attempts, many 5' truncated copies of LINE elements are present in the Rhododendron genome. A family of LINE elements called RLINE and several related 5' truncation fragments have been discovered in *Rhododendron williamsianum*. I used PCR primers to amplify the regions of the genome in *R. williamsianum* where truncated RLINE insertions were found. The amplified DNA was then sequenced by Sanger sequencing. I am analyzing ten 5' truncation fragments ranging from 692- 2918 base pairs. By phylogenetic analysis of aligned sequences common to the various full-length and deleted RLINES, I will endeavor to determine the evolutionary relationships of the truncated fragments to the full length RLINE and to one another. So far, I have sequenced and compared 8 different RLINE fragments of *Rhododendron williamsianum*, and will continue characterizing RLINE insertions.

SESSION 2S

COMPLEXITY AND EVOLUTION OF BIOLOGICAL SYSTEMS

Session Moderator: Billie J. Swalla, Biology
Johnson Hall 111
3:30 PM to 5:00 PM

* Note: Titles in order of presentation.

Cooperation and Communication in *Pseudomonas aeruginosa*
Sarah Peterson (Sarah) Hammarlund, Senior, Swedish, Biology (General)
Mary Gates Scholar
Mentor: Benjamin Kerr, Biology

Cooperation is a fascinating paradox of evolution. Why would an organism incur a cost to itself in order to benefit another individual? The Achilles' heel of cooperation is that it can be exploited by cheaters. Cheaters reap the benefits of cooperation, but do not incur the same costs as the cooperators. Cheating is therefore considered a major problem in the evolution of cooperation. One possible way of reducing the

vulnerability of cooperating organisms to cheating is through communication. Communication allows individuals to cooperate only when the conditions are favorable. My research involves a form of bacterial communication called quorum sensing, which allows bacteria to accomplish cooperative tasks that require a collective action. Pseudomonas aeruginosa, an opportunistic pathogen that causes severe infections in immuno-compromised individuals and patients with cystic fibrosis, uses quorum sensing to regulate the production of toxins and enzymes. We used a wild-type cooperating strain of P. aeruginosa and several non-cooperating cheater strains to investigate the relationship between cooperators and cheaters. We predicted that the cheater strains would benefit when grown together with cooperators in a well-mixed environment, but suffer in a structured environment. We tested this prediction through competition assays in both a shaken liquid environment (unstructured) and a soft-agar environment (structured). Combined with further research, our results may suggest that communication helps a cooperating population avoid collapse when faced with cheaters.

POSTER SESSION 3

MGH 241, Easel 137

4:00 PM to 5:30 PM

Rugged Landscapes

Brittany Noelle Harding, Senior, Biology (Molecular, Cellular & Developmental)
Mary Gates Scholar
Mentor: Benjamin Kerr, Biology
Mentor: Joshua Nahum, Biology

Evolutionary biology studies how populations change over time. For evolution to occur, there must be genetic variation, ultimately from mutation. Any mutation in a given environment may have a positive, negative, or neutral effect on fitness. Evolving populations tend to increase in fitness. A metaphoric "fitness landscape" is useful for visualizing this, with genotypes linked by mutations and elevation being their fitness. Fitness "peaks" denote genotypes from which all mutations are deleterious (downhill). If the landscape is smooth (possessing only one peak) then populations will always converge there by natural selection. However, if the landscape is rugged (multi-peaked), populations might get stuck on a low-fitness peak. This population must cross the "valley" between peaks to reach the higher peak. We are studying how migration patterns between subpopulations of *Escherichia coli* influence adaptation. Structured populations only allowed migration between nearby subpopulations of bacteria, while unstructured migrations occurred between any of the 95 other subpopulations of bacteria. We found that structured populations reached a higher fitness than unstructured ones. My project is investigating the genetic mechanisms behind these results. Using Illumina technology, I have completed whole genome sequencing and targeted sequencing on these populations. I am using these results to determine the type and frequency of mutations acquired in structured vs. unstructured populations. We have two hypotheses explaining structure's effect on adaptation: the Mutational Distance Hypothesis and the Diversity Hypothesis. The Mutational Distance Hypothesis predicts that there will be more mutations accumulated in the structured populations than the unstructured, whereas the Diversity Hypothesis predicts that structured populations will have greater genetic diversity than unstructured populations. This work will lead to a greater understanding of adaptation and may have medical implications concerning the understanding bacterial evolution.

POSTER SESSION 3

Balcony, Easel 119

4:00 PM to 5:30 PM

Development of a Split Protein Assay to Detect Ubiquitination in *E. coli*

Anupam Kumar (Anupam) Garg, Senior, Bioengineering
Mary Gates Scholar
Mentor: Richard Gardner, Pharmacology
Mentor: Michelle Oeser, Pharmacology/Molecular & Cellular Biology

Ubiquitin is a protein modifier that is essential for many eukaryotic cellular processes. Attachment of ubiquitin to substrate proteins (ubiquitination) occurs in a three-step cascade that involves a ubiquitin activase, ubiquitin conjugase, and ubiquitin ligase; it is the ligase that targets substrate proteins. One challenge for the ubiquitin field is identification of substrate cohorts for ubiquitin ligases. Although ubiquitination only occurs naturally in eukaryotic organisms, we have previously reconstituted the ubiqutination cascade in *E. coli*. Isolation of the ubiquitin pathway within a prokaryotic cell, such as *E. coli*, allows for the investigation and modification of individual components of the pathway and the measurement of immediate effects of these changes upon the overall process of ubiquitination. This project, which consists of the construction of a split protein assay, aims to address the abovementioned challenge by building on our previous work reconstituting ubiquitination in *E. coli*. The assay uses two fragments of the protein dihydrofolate reductase (DHFR) to detect the ubiquitination of proteins in *E. coli*, outside of the natural eukaryotic environment of ubiquitin. All of the essential components of the ubiquitination pathway, including individual fragments of DHFR fused to ubiquitin and a substrate protein of interest, are transformed into the bacterial cell. The assay tests for the covalent attachment of ubiquitin to the substrate protein through growth on selective medium, which is possible only through the combination of the separated fragments of DHFR. This reporter system allows for experimentation regarding the interaction and selectivity of the

ubiquitin ligase with the substrate protein of interest. Thus, a functional reporter system will allow for the streamlined analysis and determination of the substrate cohort for a given ubiquitin ligase. Changes to the components of the system may include using different ubiquitin ligases and substrate proteins.

POSTER SESSION 3

MGH 241, Easel 134

4:00 PM to 5:30 PM

Evolutionary Pattern of Cassandra Element Transposition

David Dong Uk (David) Shin, Senior, Biology (Molecular, Cellular & Developmental)
Mentor: Benjamin Hall, Biology
Mentor: Michelle Stitzer, Biology

Genus *Rhododendron* consists of over 1000 species of woody plants. While the overall phylogeny of the genus is known, the relationships between species are not. My research focuses on a small and unusual retrotransposon, *Cassandra*, and its possible use for evolutionary studies. Retrotransposons are sequences that are able to move to new DNA chromosomal locations via mechanisms simlar to retroviral DNA replication. Transposition involves transcription of an integrated DNA copy through an RNA product that acts as a template for reverse transcription, and finally integration of the resulting DNA at new sites in the plant genome. Like other retrotransposons, *Cassandra* has no mechanism for complete excision from a site it has occupied. Thus, once the element is inserted into a genomic site, all or part of it is retained at this position as a stable marker. Consequently, a *Cassandra* insertion at a given site is a shared derived trait, suitable for evolutionary tree-building. Ultimately, knowing these sequences of transposition may shed light on the pattern of evolutionary divergence of *Rhododendron* and *Ericaceae* plants. Based on one insertion site, my data suggests that thus far, only a solo LTR version of the *Cassandra* element is found in most species of the subgenus *Hymenanthes* (primarily in East Asia), with an empty site found in the subsection *Pontica* (more geographically diverse). Interestingly, for a few species within *Hymenanthes* that lack the element, another conserved insertion (approx. 450 bp) is found in the DNA instead. Moving forward, I will look at additional insertion sites, to gain further information on *Rhododendron* phylogeny.