

Undergraduate Research Symposium May 18, 2018 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons East, Easel 79

11:00 AM to 1:00 PM

Orbital Solutions for a Variety of Eclipsing Binaries

Aleezah Ali, Junior, Physics: Comprehensive Physics, Astronomy

Mentor: Diana Windemuth, Astronomy

Mentor: Meredith Rawls, Astronomy

Mentor: Eric Agol, Astronomy

Eclipsing binaries (EBs) are systems in which two stars orbit and pass in front of each other as observed from Earth. They are important astrophysical tools utilized in this project to directly measure the fundamental properties of stars, such as their masses and radii. We create a sample of 35 bright, detached EB targets from the Villanova Catalogue, based on high-quality photometry from the Kepler Satellite and spectroscopy from the Apache Point Observatory Galactic Evolution Experiment (APOGEE). Here, we present mass, radius, and orbital solutions for a subset of these EBs. For each system, we extract radial velocities (RVs), the speed at which each star in the system is moving away from the observer, from the APOGEE spectra. Then, we combine the RV with Kepler light curve (LC) information to simultaneously model the system light and line-of-sight speed as a function of time. Because our model has high dimensions with 18 free parameters, we first solve for the LC and RV solutions separately, and then simultaneously solve them. We use a nonlinear least-squares optimization method to determine the best fit solution and quantify the uncertainties in model parameters running Monte Carlo Markov Chain (MCMC) simulations. The model parameters that we find will further our understanding of fundamental stellar properties and binary star orbital parameters.

POSTER SESSION 1

MGH 241, Easel 141

11:00 AM to 1:00 PM

Variation in Hind Limb Morphology in Relation to Hunting Behavior in Carnivora

Aleina Catherine Cudnofskey, Senior, Biology (Physiology)

Dustin Kramer, Senior, Biology (Physiology)

Mentor: Sharlene Santana, Biology

Functional morphologists examine the anatomy of organisms to elucidate how they are adapted to various habitats and behaviors. These type of studies have also led to intense research and speculation about the specific behaviors associated with the morphologies of now extinct species. Can we predict the hunting behavior of a predator from its skeletal morphology? In this study, we examined both femur morphology and the calcaneus to femur length ratios in extant members of Carnivora, with the goal of finding a link between these traits and a species' hunting strategy. We categorized hunting strategies from videos and previous accounts by taking note of the presence and timing of each species' attacks of live prey. To quantify hind limb bone morphology across species with different hunting strategies, we measured the length of the calcaneus and femur, and the minimum bone diameter of the femur. Our sample included 12 extant species from several hunting strategies. We expect to find femurs with a greater minimum diameter in species that have strategies that require greater muscle force during the prey capture period. This type of anatomy would provide the support necessary for attachments of larger running muscles. For femur to calcaneus ratio, we expect to find a lower value in species with longer chase periods in their hunting strategy. This would be due to a greater need for longer strides and contact time to reach the speeds necessary to catch their prey. This study will allow scientists to more accurately predict the hunting behaviors of extinct animals based on measurements that can be easily obtained from an intact fossil.

POSTER SESSION 1

Commons West, Easel 38

11:00 AM to 1:00 PM

Are People Living with Dementia Vulnerable for Potentially Inappropriate Medications?

Xintong (Erra) Li, Senior, Nursing

UW Honors Program

Mentor: Tatiana Sadak, PCH

The use of Potentially Inappropriate Medications (PIM) in elderly is common and can lead to increasing risks for adverse drug events, morbidity, and increased utilization of health care resources. Early identification of PIM can improve the quality of care in elders and reduce hospitalizations. This study aims to identify PIM in a sample of N=60 people living with dementia who recently experienced a hospitaliza-

tion and to evaluate what PIM are most common. We also aim to evaluate correlations between PIM and the number of patient's chronic conditions and the total number of medications. Our hypothesis is that patients with higher burden of illness (more conditions and medications) can have higher number of PIM. We identified PIMs by evaluating medical records using the STOPP/START criteria. The STOPP/START criteria classify inappropriate medications that should be stopped as well as the appropriate medications that should be started instead. Descriptive statistics was used to describe the sample and the prevalence of PMI, chronic conditions and medications. Correlation analyses was used to explore relationships between the variables. Study findings will inform healthcare providers about the prevalence of PIM and help identify patients who are at higher risk of PIM.

POSTER SESSION 1

MGH 241, Easel 162

11:00 AM to 1:00 PM

Identifying the Role of RHY-1 in the *C. elegans* Response to H₂S

Colette Anne Felton, Senior, Biochemistry

Mary Gates Scholar, UW Honors Program

Mentor: Dana Miller, Biochemistry

Mentor: Frazer Heinis, Biochemistry

Hydrogen Sulfide (H₂S) has potent physiological effects. In large doses, it is a deadly toxin, but in small doses, it acts as a signalling molecule with a wide range of physiological effects. The worm *C. elegans* is a good model organism for the study of H₂S because of its short lifespan, ease of genetic manipulation, and ease of maintenance. In *C. elegans*, H₂S induces a stress response pathway, coordinated by the HIF-1 and SKN-1 transcription factors, that plays a role in extending lifespan and improves resistance to various stresses. A previous screen in our lab identified several mutations that suppress the requirement of hif-1 for survival in H₂S by increasing SKN-1 activity. One SKN-1-upregulated transcript, rhy-1, was sufficient to rescue hif-1 lethality in H₂S. RHY-1 is an integral membrane protein that is localized in the hypodermis, intestine, and some head neurons of *C. elegans*. It has predicted acyl transferase activity, but its specific molecular function is unknown. The role of RHY-1 as a hif-1 lethality suppressor indicates that it acts in a hif-1 independent H₂S response pathway. The goal of this study is to better understand the role of RHY-1 in this hif-1 independent response pathway. In order to identify its binding partners and elucidate its role in cellular signalling, we performed immunoprecipitation of RHY-1 for use in tandem mass spectrometry. This approach allows for the identification of its binding partners under baseline and H₂S stress conditions, which may further define the role of RHY-1 in the stress response to H₂S. Defining the role of RHY-1 will enhance our understanding of how

the H₂S stress response leads to increased lifespan in *C. elegans*. Since several members of this pathway are well conserved in humans, this work may provide a mechanism for the therapeutic use of H₂S in human medicine.

SESSION 1D

MARINE ECOLOGY AND FOOD WEBS

Session Moderator: Bonnie Becker, Academic Affairs

(Tacoma)

MGH 228

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Predicting Diet through Quantification of Biomechanical Differences in Cranial Morphology in Odontoceti

Grace X. Sun, Senior, Biology (General)

Austin Fletcher Sears, Senior, Biology (Physiology)

Mentor: Sharlene Santana, Biology

Among the most robust determinants of fitness within the animal kingdom are successful feeding techniques that enable adequate energy acquisition. The need to maintain a steady food supply is especially crucial in mammals who have high metabolic demands in order to maintain a homeostatic internal body temperature. Within the Class Mammalia, the Order Cetacea consists of whales, dolphins, and porpoises, and includes some of the most derived and specialized aquatic carnivores. Of the three Cetacean suborders, Odontoceti retains the ancestral condition of having teeth rather than baleen for filter-feeding as in Mysticeti whales. This allows odontocetes to consume many prey types, ranging from cephalopods to large vertebrates. The aim of this study is to investigate if interspecific differences in bite force and gape size evolved in tandem with the consumption of specific prey types in odontocetes. To achieve this goal, we used skull specimens from the Burke Mammalogy Collection at the University of Washington to take a variety of linear measurements of the cranium and mandible. We used these measurements to estimate gape size and bite force by applying mathematical equations, and then contrasted these values across species that differ in diet. We expect to find that odontocetes evolved cranial adaptations to 1) increase bite force as a means to consume harder prey and 2) increase gape size as a means to consume larger prey. Developing a better understanding of how species maximize energy gain is imperative to determining the factors that drive evolution and species adaptation. This knowledge can also help inform future conservation efforts, improve the general understanding of Odontoceti evolution, and serve as a reference for future studies of mammalian cranial morphology and biomechanics.

POSTER SESSION 2

Commons West, Easel 21

1:00 PM to 2:30 PM

Using Linguistic Knowledge to Resolve Ambiguity in Speech Perception When Hearing is Degraded

Siuho Gong, Senior, Speech and Hearing Sci (Com Disorders)

Mentor: Matthew Winn, Speech & Hearing Sciences

Mentor: Steven Gianakas

Sometimes speech sounds (phonemes) can be ambiguous, and people have a tendency to interpret the ambiguous phoneme differently in different contexts so that they perceive a real word, as opposed to a non-word. This effect is called "lexical bias." For example, when there is ambiguity between whether /m/ or /n/ is heard, /m/ is more likely to be perceived if it is followed by "uch," because "much" is a word, but "nuch" is not (and vice versa if the context is "udge"). We hypothesized that for people who have hearing loss or use a cochlear implant, there will be additional ambiguity in hearing speech, and that the lexical bias effect would be stronger. We simulated degraded hearing using vocoded speech played to listeners with normal hearing. Participants heard speech continua that gradually morphed from /m/ to /n/ in the "uch" and "udge" contexts, and either had a clear spectral quality or a degraded spectral quality. Results suggest that the lexical bias is stronger when the speech signal quality is less clear, which is consistent with the hypothesis because of the increased phonemic ambiguity in these conditions. By understanding how signal degradation impacts the perception of phonemes, audiological tests for speech reception can be improved to separately acknowledge the effects of hearing from the adjustments that the listener makes to maintain lexical biases in speech perception.

POSTER SESSION 2

MGH 241, Easel 149

1:00 PM to 2:30 PM

Application of Rationally Modified Self-Assembled Two-Dimensional Protein Array

Karl Benjamin Gilmore, Sophomore, Chemical Engineering

Mentor: Francois Baneyx, Chemical Engineering

Mentor: Alexander Thomas

Although crystalline two-dimensional (2D) protein arrays are often found on the surface of archaea and bacteria where they form a protective S-layer, their potential in bionanotechnology applications remains unfulfilled. Progress in computation has recently allowed the (re)design of proteins for self-assembly into arbitrary structures. We are working with a rationally modified protein from *S. typhimurium* that can self-assemble into large ($> 100 \mu\text{m}$) and thin ($\sim 5 \text{ nm}$) hexagonal

2D arrays pierced by $\sim 3 \text{ nm}$ pores upon addition of divalent cations (e.g., Ca^{2+}). The goal of our research is to test the ability of these arrays to organize gold nanoparticles (AuNPs) with desirable plasmonic characteristics. To this end, we stain protein arrays with the lipophilic fluorescent dye Nile Red, and analyze fluorescence microscopy images to quantify how the decoration of arrays with various concentrations of AuNPs affects the rate of photobleaching of the Nile Red fluorophore. Understanding how AuNPs bind to protein arrays could lead to further applications, such as templated growth of inorganic materials or co-assembly of enzymes and inorganic catalysts.

POSTER SESSION 2

Commons East, Easel 65

1:00 PM to 2:30 PM

Forming Identity through Memory, History, and Place

Maisha Barnett, Senior, Community, Environment, & Planning

Mary Gates Scholar

Mentor: Manish Chalana, Urban Design and Planning

Mentor: Keith Harris, Built Environments

This research explores the questions: How is identity shaped by our built environment? Can storytelling along with physical movement alleviate place attachment? This research also seeks to preserve the historic identity of Seattle's central district neighborhood through the memories of its residents. It is my hope that by understanding the relationship between the built environment and human consciousness, I will learn how to design spaces that nourish the human soul while honoring its physical history. To examine these questions, I conducted an extensive literature review on theories about place and identity, and the human experience of place. I also published an online survey and conducted ten oral interviews of central district residents. A composite walking tour was then created from the physical places in their stories to highlight the overlap in their experiences, values, and identities. Through storytelling, archival research, observation, field research, map making and physical movement in these spaces, I have demonstrated a connection between memory, history, and place. My final product, a narrated walking tour, serves as a mechanism to bring people together, to educate the public about the central district and to highlight the interplay between spatial geography and social identity. The tour conjures lost places and memories into the physical world and diminishes feelings of place attachment. The tour also serves as an urban planning tool to heal displaced communities. As Seattle continues to grow and change, experiences such as this walking tour provide a living, breathing example of our shared history to anchor old residents while inspiring new citizens to honor our natural and built environment.

POSTER SESSION 2

MGH 241, Easel 155

1:00 PM to 2:30 PM

Towards Biomimetic Treatment of Gum Disease: Repair of PDL via Peptide-guided Remineralization

Keertana Krishnan, Senior, Materials Science & Engineering

UW Honors Program

Yousef Mohammed Baioumy, Junior, Chemical Engineering

Mentor: Mehmet Sarikaya, Materials Science & Engineering

Mentor: Deniz Tanil Yucesoy, Materials Science and Engineering

Mentor: Sanaz Saadat, Oral Health Sciences

Mentor: Sami Dogan, Restorative Dentistry

Periodontal disease (PDL) results from a serious infection in the gingival tissue (gum) that can eventually lead to tooth loss and jawbone damage. The disease is common with more than 3 million cases in the US per annum. Bacteria build up in plaque lead to gingivitis and periodontitis under improper oral hygiene. If left untreated, the supporting tissues of the teeth e.g., cementum and periodontal ligaments will be lost, therefore making the teeth and supporting tissues vulnerable to bacterial attack, leading to serious infections and, even, to death. Current approaches in regenerating periodontal ligaments include the use of bioactive molecules and barrier membranes for guided tissue regeneration using human stem cells. Although the utilization of such materials enhances the cell proliferation and differentiation to a degree, the absence of cementum-like tissue prevents the complete regeneration of periodontal ligaments on the tooth surface. The aim of this project is to develop a biomimetic strategy to restore cementum tissue and regenerate the periodontal ligaments using human periodontal ligament (hPDL) cells in vitro. Using peptide-guided remineralization, we created a new cementum-like mineral layer on exposed dentin. The hPDL cells are then cultured and seeded on the novel cemento-mimetic layer and induced to differentiate. The proliferation and differentiation of the hPDL cells are monitored in detail using 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) and alkaline phosphatase (ALP) assays, respectively. Our results show that the newly formed cemento-mimetic mineral layer facilitates the hPDL growth and differentiation. The method described herein offers a unique biomimetic solution to regenerate periodontal ligaments and thereby ultimately prevent tooth loss and eliminate periodontal disease. This work is supported by WA-State Life Sciences Discovery Funds, UW-School of Dentistry Spencer Funds, and Amazon-UW/CoMotion Catalyst Program.

POSTER SESSION 3

Commons East, Easel 68

2:30 PM to 4:00 PM

STAT1 Activation Following Interferon Sensing Bifurcates Antiviral and Inflammatory Responses

Chia Heng Lee, Recent Graduate,

Mentor: Ram Savan, Immunology

Mentor: Adriana Forero

Type I and type III interferons (IFNs) are the key modulators in innate immunity that mediate antiviral responses to clear infections. It is known that the two families of IFNs signal through the same JAK/STAT signaling pathway to induce a similar antiviral response despite engaging different receptors. By utilizing the same signaling pathway, the two IFN systems converge upon a common transcription activation complex known as Interferon Stimulated Gene Factor (ISGF3), which induces gene expression once it is fully assembled. Intriguingly, their downstream responses differ greatly. While type I IFN induces a robust but pro-inflammatory response, type III IFN induces a more delayed but sustained response without triggering inflammation. The molecular mechanism governing this differential outcome remains poorly understood. We proposed that such outcome is due to a differential ISGF3 recruitment, which in turn governs the induction of pro-inflammatory chemokines. Since ISGF3 complex consists of STAT1, STAT2 and IRF9 subunits, and its gene transactivation ability is dependent on STAT1 and STAT2 activation, it is possible that differential phosphorylation of these transcription factors accounts for the initiation of the inflammatory responses. To investigate the functional implication of STAT1 and STAT2 activation, we stimulated STAT1-deficient U3A and STAT2-deficient U6A cells with type I IFN, and measured the expression of downstream genes that are known to be pro-inflammatory. Our results show that STAT1 is the crucial factor that accounts for the different outcome between the two IFN systems. Considering that type I IFN are used extensively to treat chronic viral infections, but its pro-inflammatory nature results in poor clinical outcomes, such understanding may elucidate a new therapeutic target that can be manipulated to minimize inflammation associated with IFN treatment.

POSTER SESSION 3

Balcony, Easel 111

2:30 PM to 4:00 PM

Attributes of Resilience: A Look at the Lives of Immigrants

Rim Salomon, Sophomore, Psychology, Sociology, Shoreline Community College

Mentor: Diana E Knauf-Levidow, Social Sciences, Shoreline Community College

Immigrants experience many challenges prior to arriving in the United States and face ongoing challenges associated with migration and the assimilation process. Despite the multiple challenges and difficulties, immigrant people show enormous strength, courage, and self-determination. Resilience is defined as the process of moving forward from adversity, developing new skills and creative ways of coping and becoming stronger. I conducted a systematic literature review, using key terms such as immigrant, asylum seekers, coping mechanisms, and resilience. I incorporated multidisciplinary lenses including psychology and sociology to identify and understand the major contributors to immigrants' resilience as well as major factors that hinder resilience. Research suggests factors such as family strength, cultural and community support; religiosity and spirituality help to build resilience. In contrast, factors such as language barriers, discrimination, punitive policies and the labeling of trauma by experts are known to hinder resilience. The research implies that the experts lack awareness of their labeling and understanding of trauma stories. Additionally, studies suggest that contrary to popular beliefs, immigrant people are resilient and motivated, and value education and hard work. Further research in methods of developing policy systems that support and facilitate resilience is desperately needed.

POSTER SESSION 3

MGH 258, Easel 191

2:30 PM to 4:00 PM

How Much is the Columbia River's Snow Reservoir Shrinking?

Kateryna Gomozyova, Fifth Year, Civil Engineering

Mentor: Oriana Chegwiddden, Civil and Environmental Engineering

Mentor: Bart Nijssen, Civil and Environmental Engineering

Anthropogenic climate change is gradually reducing snowpack and shifting the timing and volume of streamflow in the Columbia River Basin. Mountain snowpack plays a key role in the water cycle by storing water in the winter and releasing it as snowmelt runoff in spring and summer. Snowmelt and the resulting streamflow are critical for a variety of sectors: irrigation, hydropower, flood risk management, and ecosystem services, particularly regarding salmon. There is a large network of reservoirs along the Columbia River and its tributaries that water managers use to store water from snowmelt to satisfy the needs of industries and communities. Snow can also be thought of as a reservoir, as it delays the streamflow response to a precipitation event. With anticipated increases in temperature due to a changing climate, the size of that snowpack reservoir is expected to decrease. We will analyze projections of changes in the amount of water contained within the snowpack and determine the volumetric size of the snow reservoir that will be "lost" due to a warming cli-

mate. We will compare it to existing reservoirs in the western United States. As the basis for these analyses we will use an ensemble of 160 different hydrologic projections included in the Columbia River Climate Change dataset. We will relate these changes in snowpack to changes in streamflow timing. The results of this study may help inform discussions about the need for changes to reservoir operations on the Columbia River.

POSTER SESSION 4

Commons East, Easel 48

4:00 PM to 6:00 PM

Collaboration and Communication between Second-Language Learners and Heritage Language Students in Mixed-Language Classes

Ellen Rachel Perleberg, Junior, Pre-Humanities

Mentor: Ana Fernandez Dobao, Spanish and Portuguese Studies

Mixed classes are foreign language classes in which second-language (L2) learners work alongside heritage language (HL) students, who have exposure to the language at home and are bilingual to some extent. Heritage language students, while typically having a greater vocabulary and a better sense of linguistic flow, often lack the metalinguistic and mechanical knowledge of their L2 peers. These differing strengths present a potential asset for the language classroom, but a challenge for teachers, too, who need to ensure all students' needs are being met. Therefore, mixed classes ought to be studied to address whether both heritage- and non-heritage-learners benefit, and in what ways, from working in mixed pairs. My study investigates the differences in classroom interaction between and among HL and L2 students by tracking the progress of two L2 learners across one quarter of Spanish class. I have transcribed audio data recorded in mixed-language Advanced Spanish classes which document collaborative writing tasks and include interactions between both L2-L2 and L2-HL pairs. I am analyzing these conversations for the use of English and its impact on learning, attention to language (grammar, vocabulary, or orthography) relative to natural conversational flow, self- and peer-correction, and for evidence of learning or change in students' interactions over the quarter. By analyzing and comparing these trends, I address whether second-language students benefited most working with heritage speakers or fellow second-language learners, and whether and in what cases heritage speakers benefited from working with these students. This information will help teachers make informed decisions about collaborative learning activities in mixed classes.

POSTER SESSION 4

Commons East, Easel 61

4:00 PM to 6:00 PM

Eliciting Human Factor Preferences in the Context of Digital Pedestrian Mapping - User Experience

Estelle Jiang, Senior, Informatics (Human-Computer Interaction), Informatics: Data Science

Alexandre Mooc, Senior, Human Ctr Des & Engr: Human-Computer Int

Ksenia Andreevna Ivanova, Senior, Design: Interaction Design

Mentor: Anat Caspi, Paul G. Allen School of CS&E

Mentor: Nick Bolten, Electrical Engineering

Digital mapping and routing has completely changed the way people interact with maps. However, a large percent of the population is, in general, not served well by most current popular digital mapping services due to two primary reasons. First, most maps do not focus services for pedestrian access. Second, unlike other areas of digital information delivery, mapping and routing has not gone through customization and personalization strategies to improve people's experience of and access to digital maps. There are many such human factors, ability characteristics, cognitive or emotional parameters, that are difficult for users to articulate numerically, but significantly impact the way in which urban environments are experienced and enjoyed by pedestrians, or the manner in which digital mapping information can be accessed. AccessMap is a map for those with disabilities, providing routes and information to wheelchair users, cane users, and others who may have difficulties getting around. Currently, users don't have too much freedom to control their preferences when they use AccessMap and they didn't have a profile to save the preferences they chose. Therefore, we tried to understand users' needs and modified existing interfaces to include more features. In our research, we are trying to design a better interface to address the diverse spectrum of user needs in a comprehensive and human-understandable way, as well as provide a platform to save and refine those preferences. We focus more on the user experience side of this project, we run varied research including scholar research and survey. We consolidated findings into personas and ideated scenarios and user flows to guide our design and envision how users would interact with the product. Our future goal is to run more usability tests with potential users for the purpose of improving application's user experiences and evaluation our design.

POSTER SESSION 4

Commons East, Easel 49

4:00 PM to 6:00 PM

Peer Interaction in the Spanish Language Classroom: Comparing Learner Interactions

Lori Baca, Junior, Pre-Humanities

Mentor: Ana Fernandez Dobao, Spanish and Portuguese Studies

A heritage language learner (HL) is a person who was raised in a home where a non-English language was spoken and who is to some degree bilingual, while a second language learner (L2) is someone who learned a non-English language after first acquiring English. The ways in which Spanish is acquired produces strengths and weaknesses among HLs and L2s. While L2s tend to have more knowledge with respect to Spanish grammar, metalanguage, and orthography, HLs have more fluidity and a larger vocabulary. This study aims to identify what educational environment that utilizes peer interaction between HLs and L2s would be the most effective for Spanish language acquisition. A prior research team recorded three types of peer interactions—HL-HL, HL-L2, and L2-L2—ranging from ten to fifteen minutes long. The participating students were all part of either the HL 300 level Spanish series, or the L2 equivalent. In addition to the recordings, linguistic background questionnaires conducted at the beginning and end of the quarter surveys were completed by all participants to establish their Spanish proficiency level and their attitudes with regard to Spanish as well as Spanish classes. I have been assigned four peer interaction recordings to transcribe using Conversation Analysis notation so that I can codify and analyze the participants' use of English within those interactions in addition to their reliance on it. I will be comparing their collaborative problem solving activities, how the students work together to solve vocabulary and grammar related challenges which will result in the acquiring of new language knowledge. Preliminary results propose that HL-L2 interaction does not produce as many instances for learning as in L2-L2 interactions. This analysis will help to create a more effective learning environment within mixed classrooms for both HL and L2 learners, which will ultimately increase professional marketability and social cohesion.