UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

Poster Session 1

MGH 241, Easel 160

11:00 AM to 1:00 PM

An Evaluation of Existing Self-Report Outcome Measures for People with Amputations Who Have Limited Community Ambulation

Kavya Magham, Senior, Psychology
CoMotion Mary Gates Innovation Scholar, Mary Gates Scholar
Mentor: Murray Maitland, Rehabilitation Medicine
Mentor: Katheryn Allyn, Bioengineering
Mentor: Donald Fogelberg, Rehabilitation Medicine

Lower extremity amputations (LEA) affect more than 1 million people in the US. A large proportion of these individuals, about 300,000, have poor levels of community ambulation, meaning they have limited mobility. They can usually walk less than 300 ft before stopping for rest. Despite this, current patient-centered outcome measures were largely developed and tested with people who exhibit unrestricted community ambulation, and not people who have significant mobility challenges. The purpose of the current study is to evaluate if current, standardized questionnaires for people with LEA are relevant and comprehensive for people with lower levels of mobility. I conducted a literature review and a consultation with experts which resulted in items from twenty questionnaires. Items were compiled from the four most appropriate questionnaires into themes including: transfers, ambulation, static postures and activities of daily life. To assess comprehensiveness, my team and I compared the number of items in each general category across the questionnaires and found that ”mobility on uneven ground” is needed for this population. Additionally, I designed an interview strategy so that people with LEA and lower levels of mobility could expand on their opinions of the questionnaires. The combination of the feedback on survey items and interview questions led me to the create the final questionnaire with a Likert scale so that subjects could respond with the relevance of each question. Results from my research will ultimately be used to improve measurement tools that are responsive to meaningful differences in quality of life and functional mobility for this population.

Session 1Q

History, Power, Memory

Session Moderator: Moon-Ho Jung, History

JHN 026

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Mademoiselle la Chevalière: Transgender History in the Age of Enlightenment

Mary Phalen, Senior, History
Mentor: Raymond Jonas, History

This project is an examination of the Chevalière d’Éon (1728-1810) and the body of academic work that has been written about her. While her life is well-documented, her remarkable gender transition in 1777 has largely been viewed as a mere curiosity or at best a political maneuver. The growing field of transgender history, however, provides a new analytical framework with which to examine her story. Drawing on a wealth of secondary sources for historiographical analysis as well as contemporary letters, memoirs, and articles, the paper looks at d’Éon’s feminism, her political career, and her personal life to put forward the argument that her gender was a matter of self-determination rather than external motivation, a notion that becomes clearer when her narrative is viewed as that of a transgender person navigating her gender nonconformity in a time when constructions of gender were quite different. The research presented shows that by branching out of modern narrow definitions of transsexuality and instead considering a broader range of experiences under the transgender umbrella, historians can use gender nonconformity in the past both to analyze contemporary constructions of gender and to help establish a historical transgender continuity rather than describing it as a modern movement without a presence in the past.

Poster Session 2

Commons West, Easel 35

1:00 PM to 2:30 PM

Ciliary-Driven Currents May Enhance Olfactory Sampling in Nudibranch Gastropods

Abigail Ames, Senior, Aquatic & Fishery Sciences, Oceanography

Mary Gates Scholar, Undergraduate Research Conference Travel Awardee

Mentor: James Murray, Biol Sci, Cal State East Bay

Chemosensation is a key component of navigation and communication for aquatic invertebrates. The posterior tentacles of nudibranchs are called rhinophores and are their primary olfactory organs. We videoed and measured active water currents driven by cilia around the clavus of rhinophores using dyes and neutrally-buoyant glass beads to observe speed and patterns of flow. The speed of particle flow toward the rhinophore averaged between 0.1 and 1.0 mm/s across five species, and particles were apparently pulled in viscous laminar flow toward the rhinophore from up to 3-5 mm away. For the lamellate rhinophores found in dorid species, fluid is split into medial and lateral lamellae at the midline of each rhinophore and moved anterior to posterior through the lamellae. These rhinophores can rotate around their vertical axis to pull in water from the left or right. In other dendronotid species, fluid is pulled downward into the cup-shaped clavus of the vertically-oriented rhinophore and released in all directions at the base of the clavus before the stalk. In a burrowing arminid fluid moves distally to proximally parallel to the ridges of the conical rhinophore. Scanning electron microscopy showed densely-ciliated areas on the unexposed surfaces of the rhinophores which facilitates fluid movement through the leaflets of the clavus. Exposed surfaces had small patches of presumably-sensory cilia as found on all skin. We hypothesize that these currents minimize the boundary layer thickness and thus decrease the response latency of olfactory receptors to changes in odor density, and also increase the volume of water sampled per time. Some species show little or no current flow and a comparative study will help us determine the adaptive function of sniffing.

POSTER SESSION 2

MGH 241, Easel 125

1:00 PM to 2:30 PM

Heterogeneous Coating of Reduced Graphene Oxide and Polydopamine on Nanostructured Substrates Using Dopamine Chemistry

Evan Jihong (Evan) Lam, Senior, Chemical Engineering

Mentor: Deok-Ho Kim, Bioengineering

Mentor: Kevin Gray, Bioengineering

The use of graphene in nanoscale systems serves many applications not only in solar cells but also in biomaterials because of the combined optical, electrical, and structural properties. Conventional methods including chemical vapor deposition and electrospraying to produce a layer of graphene on nanostructures is costly. Reduction of graphene oxide using chemical reagents presents an easier and cheaper alternative while maintaining the unique properties of graphene. But these methods are typically solution-based and further steps must be taken to coat reduced graphene oxide onto nanostructured surfaces. Dopamine chemistry was applied in a simple simultaneous approach of self-polymerization to reduce graphene oxide while creating an adhesive to incorporate a heterogeneous coating of polydopamine and reduced graphene oxide on a nanostructure. Use of various concentrations of graphene oxide demonstrated control over the sample's surface conductivity profile. Surface analysis characterizations confirmed the presence of the coating through X-ray photoelectron spectroscopy (XPS) while the electrical properties were determined using conductive atomic force microscopy (cAFM). The overall topographical morphology will be confirmed with atomic force microscopy (AFM). A potential application of the proposed device serves to provide functionally and structurally mature human pluripotent stem-cell derived cardiomyocytes (hPSC-CMs) for use in research and clinical drug trials.

POSTER SESSION 2

MGH 241, Easel 153

1:00 PM to 2:30 PM

Identifying and Validating Better Therapies for Glioblastoma Multiforme Using Synthetic Lethal Combinations

Amy Hong, Senior, Bioengineering

UW Honors Program

Mentor: Ray Monnat, Lab Medicine-Pathology and Genome Sciences

Glioblastoma multiforme (GBM) is the most common malignant adult primary brain tumor, accounting for 70% of malignant brain tumor diagnosis. However, regardless of therapy – surgery, radiation, and anticancer drug therapy – virtually all GBM patients eventually succumb to the progressive disease within 12 – 15 months of diagnosis. This is indicative of the proliferation and differentiation of neural stem cells into various cell types in the tumor which is thought to be a main contributing factor of malignant tumor resistance to standard treatments. This project aims to address this therapeutic challenge by identifying and testing potential new therapeutic regiments that leverage the underlying genetics of glioblastoma to improve treated response. We propose that certain genetic modifications (i.e. modifications in IDH1 or MGMT) can be made in glioma stem cells such that when a gene loses or gains a function, it will increase sensitivity of cells to a combination of therapies that is greater in magnitude than a single drug by itself. Towards this, we have generated whole exome sequencing data that will guide us in building a genetically-

defined glioblastoma cell line and allow us to identify potential new therapeutic combinations predicted to have high specificity for GBM cells. Implementation of these predicted synthetic lethal combinations in a co-culture system will determine if the predictions are tumor, genotype, and treatment-specific. Results of this project will help us better understand therapeutic vulnerability and its determinants, and test specific combination therapeutic regiments that could be applied to improve the treated outcome of patients with this deadly disease.

POSTER SESSION 2

MGH 241, Easel 154

1:00 PM to 2:30 PM

Quantification of FANCA Expression Required for the Suppression of Fanconi Anemia Induced Cellular Defects

Manjot Singh, Junior, Bioengineering
UW Honors Program
Mentor: Ray Monnat, Lab Medicine-Pathology and Genome Sciences

Many *in vitro* and *in vivo* approaches (e.g. overexpression or depletion) have established that proteins' expression levels can affect the cellular response to stresses and stimulus. Here, I describe an approach to examine the lowest protein amount necessary for a physiologic cellular response. My studies are focusing on Fanconi Anemia (FA), a heritable human genetic disease characterized by cellular and developmental abnormalities, including congenital abnormality, bone marrow failure, and an increased risk of malignancy. The FA pathway responds to inhibition of DNA replication due to DNA damage, particularly interstrand cross-links such as mitomycin-C (MMC). Mutations in the FANCA gene, however, can disrupt this pathway and cause cellular defects. The specific goal of this research is to investigate how much functional FANCA (wildtype FANCA) is required to suppress these cellular defects. To modulate FANCA protein amount, we are currently developing vectors with variable strength promoters that allow for graded expression (from 0-100%) of wildtype FANCA gene. These vectors will be integrated in a unique chromosomal location in corresponding FANCA-deficient isogenic cell line to generate a cellular library. The integrated transgene consists of two regions: a variable strength promoter and a common EGFP linked via a T2A self-cleaving sequence to the FANCA coding sequence. FANCA protein expression will, hence, be quantified using Western blot and using the co-translationally expressed fluorescent protein (EGFP). Lastly, the cellular library will be subjected to differing doses of MMC and promoter sequencing will be used to quantify promoter-specific survival (aka FANCA protein expression-specific survival) as a function of MMC dose. The findings from this study will enable FA-specific drug/therapeutic research by establishing the quantitative requirements for FANCA protein function in human cells.

POSTER SESSION 3

Balcony, Easel 109

2:30 PM to 4:00 PM

Characterizing Tbr1-Expressing Neurons in the Basal Forebrain

Jessica Taylor Lo, Junior, Biochemistry, Neurobiology
CoMotion Mary Gates Innovation Scholar, Mary Gates Scholar
Mentor: Robert Hevner, Neurological Surgery
Mentor: Ray Daza

Previous research has emphasized that the basal forebrain partially controls high-order neural processes such as memory. For this reason, it has often been studied in the context of Alzheimer's and Parkinson's disease, which both correspond to impaired cognitive function. In spite of the importance of this research, however, there stands much to learn and even revise about our understanding of the neurons which populate the basal forebrain. Neurons expressing the gene T-Box Brain 1 (TBR1) found in the Horizontal Limb Diagonal Band (HDB) and the Substantia Innominata (SI)—both regions within the basal forebrain—have been identified in the past as cholinergic neurons, meaning that they employ acetylcholine as their neurotransmitter. However, immunohistochemical stains of mouse brain sections in the Hevner lab have revealed counterevidence to this claim. We have hypothesized instead that the neurons which populate the HDB and SI are actually glutamatergic neurons, not cholinergic. In order to test this claim, we harvested mouse brains from different ages, ranging from embryonic, postnatal, to adult mice. These brains were embedded in Optimal Cutting Temperature Compound then sectioned these into 12 μm thick slices. These slices were then mounted on slides and stained via immunohistochemical techniques or via endogenous expression. High-magnification images were then collected using AxioVision software to confirm morphology and colocalization of neurons. Employing the above techniques, we have concluded that Tbr1-expressing neurons in the HBD and SI are not cholingeric. Rather, they are glutamatergic neurons. This distinction will be important as research into Alzheimer's and Parkinson's diseases develop. An understanding of the precise physical bases for complex, intangible processes is the necessary prerequisite to developing effective therapies.

POSTER SESSION 4

Commons West, Easel 24

4:00 PM to 6:00 PM

Replication of an Acoustic Tractor Beam

Judy Zhu Wu, Freshman, Pre-Sciences
Samira Hassan (Samira) Farah, Sophomore, Pre Engineering
Rahel Galato, Freshman, Pre-Sciences
Ulises Pina, Junior, Pre Engineering
Mentor: Ray Malfavon-Borja, OMAD, TRIO SSS

The ability to replicate results and data from a research project is important for validating published research and improving the transparency and trustworthiness of the scientific process. Still, reproducibility issues, like failure to reproduce experiments, are not uncommon. Towards this, we set out to replicate of a recent (2017) publication, "Realization of compact tractor beams using acoustic delay-lines". We selected this publication because the methods were explicitly written to be accessible and reproducible. During the reproduction, we evaluated the level of accessibility of materials required and ease of reproducing the published results. We also further explored the properties of the replicated system by assessing the limitations of the items that can be captured with an acoustic tractor beam. This work helps to bridge the translation of published research to non-experts, as well as evaluate the transparency and reproducibility of science.