Online Proceedings

SESSION 1I

MULTIDISCIPLINARY APPROACHES TO MEDICAL RESEARCH

Session Moderator: Gwenn Garden, Neurology

MGH 248

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Investigating Joubert Syndrome-Related ARMC9 Protein Localization in Primary Cilia during Ciliogenesis via Live-Cell Microscopy

Joseph (Joey) Smith, Senior, Biology (Molecular, Cellular & Developmental)

Mary Gates Scholar

Mentor: Dan Doherty, Pediatrics

Mentor: Julie Van De Weghe, Pediatrics Genetic Medicine

Joubert syndrome (JS) is a neurodevelopmental disorder characterized by developmental delay and a specific hindbrain malformation resulting in the "molar tooth sign" (MTS) as seen on MRI. Individuals with JS have variable intellectual disabilities, polydactyly, retinal dystrophy and cystic kidney disease. JS is classified as a ciliopathy—disorders with overlapping phenotypes affecting 1/1000 live births combined. Currently, 36 genes when mutated cause JS, and all their encoded products localize in and around the primary cilium—a cellular organelle important for signaling and human development. We recently identified the newest JS-associated gene *ARMC9* and its function, like the molecular mechanism(s) underlying JS, is unknown. Our preliminary data suggest that ARMC9 is required for cilium stability by promoting post-translational modifications (PTM) of ciliary microtubules. In stably ciliated, fixed (non-living) cells, ARMC9 localizes to the ciliary base, but to understand ARMC9's role in cilium stability, we must determine ARMC9 localization during ciliogenesis (ciliary growth). We hypothesize that ARMC9 redistributes to the ciliary tip to promote tubulin PTMs during ciliogenesis. To test this hypothesis, I am using GFP and BFP (green and blue fluorescent protein) tags to visualize ARMC9 and primary cilia respectively. I created $5HT_6$-BFP, a DNA vector encoding a BFP-tagged serotonin receptor fragment called $5HT_6$ which naturally localizes to cilia. Currently, I am optimizing the transfection of $5HT_6$-BFP and ARMC9-GFP into control cells for live imaging. As suggested by our data, I expect to see ARMC9 at the ciliary tip during growth, then redistribution to the base once the organelle is built. Determining where ARMC9 localizes during ciliogenesis will give us additional insight into its mechanism of action and role in JS. Ultimately, this work will allow us to identify therapeutic targets to mitigate the progressive features of JS and improve the quality of life of affected individuals.

POSTER SESSION 2

Balcony, Easel 93

1:00 PM to 2:30 PM

Dynamic Imine Bond Exchange for Self Healing in Organic Electronics

Stuart William Smith, Senior, Materials Science & Engineering

Mary Gates Scholar

Mentor: Christine Luscombe, Materials Science & Engineering

Mentor: Jonathan Onorato, Materials Science and Engineering

Organic materials show promise as alternative materials for many modern-day electronics applications, such as transistors, LEDs, and photovoltaics. They hold many advantages over their inorganic counterparts, such as being lighter weight, lower cost, and flexible. Self-healing polymers are a specific form of organic polymer that are particularly promising because of their potential use in flexible devices. Self-healing materials have the capacity to spontaneously reform damaged bonds, thereby returning the material to its original state and recovering its initial properties. Imine bonds are a type of self-healing bond. Imines have a highly dynamic nature, allowing for the reshuffling of bonds required to recover material properties. Much research has been done on the use of imine bonds in self-healing polymers; however, no work has been done utilizing imine bonds for self-healing in semiconducting polymers. To incorporate self-healing behavior into a semiconducting polymer, we have investigated the synthesis of a poly(azomethine), a semiconducting polymer with an imine bond along the backbone. Initially, as a proof-of-concept for the dynamic exchange of bonds in our specific system, we reacted aniline with 2-thiophenealdehyde to form an imine. Then, to determine if bond exchange occurred, the imine produced was reacted with another amine. The reaction showed that a significant amount of imine exchanged,

so we moved on to a polymer system. We synthesized 4,4'-dinitrotriphenylamine, which we then reduced to produce a diamine species. This diamine was then polymerized with a dialdehyde species, resulting in a fully conjugated polymer with multiple imine bonds along the backbone. The polymer will be made into thin films for testing. Mechanical properties will be investigated to determine initial film properties. Additionally, transistors will be produced to see if electrical properties can be recovered after the film has been damaged.

POSTER SESSION 3

Commons West, Easel 8

2:30 PM to 4:00 PM

When Do States Protect the Environment?: Conflicting Economic Motivations Behind State Funding Policy

Kassidy Jean Smith, Junior, Political Science
Mentor: John Wilkerson, Political Science
Mentor: Emma Rodman, Political Science, Center for American Politics and Public Policy

Environmentalism has often been considered a moral commitment. However, this paper investigates the hypothesis that environmentalism is not just a moral commitment, but a highly logical economic commitment. I argue that environmentalism is not contrary to economic motivations: instead, states fund their departments of ecology when they stand to gain economically from doing so. This paper compares the percentage of each state's budget that went towards funding their ecology department to the tax revenue generated by two types of state resources: the outdoor recreation economy in each state and each state's proven crude oil, shale gas, and natural gas reserves. When states receive more tax revenue from the outdoor recreation economy, they allocate a larger percentage of their budget to ecology departments. On the other hand, the presence of proven crude oil, shale gas, or natural gas reserves will decrease the amount of funding for state ecology departments because states generally gain more economically from the exploitation of those resources than from the outdoor recreation economy. Broader implications of this paper include the conclusion that the best way to ensure that states will be environmentally conscious is to make it economically advantageous to do so as states act primarily on economic incentives. This study uses data sets from Ballotpedia and American FactFinder and is supplemented with data from the National Conference of State Legislatures and the Outdoor Industry Association.

POSTER SESSION 4

MGH 241, Easel 126

4:00 PM to 6:00 PM

Effect of Chemical Fertilizers on Plant Growth-Promoting *Bacillus subtilis* Populations

Hillary Smith, Sophomore, Chemistry, North Seattle College
Kim Tran, Sophomore, Biochemistry, Mathematics, North Seattle College
Ying Xu, Sophomore, Biochemistry, North Seattle College
Sophia Herrmann, Sophomore, Soil Science, North Seattle College
Junfei Chen, Sophomore, Biochemistry, North Seattle College
Tristan Reni, Non-Matriculated, Finance, North Seattle College
Mentor: Ann Murkowski, Math and Science, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College

Conventional farming techniques involve large quantities of chemical fertilizers, which often leach into bodies of water causing eutrophication. The influx of excess nutrients from fertilizer results in rapid increase of aquatic algal populations followed by dissolved oxygen depletion. This process creates regions of low oxygen that negatively impact the water quality of many major lakes and coastal regions. To address this problem, the sensitivity of plant growth-promoting bacteria (PGPB) to excess fertilizer was investigated. We hypothesize that the addition of high amounts of fertilizer will result in smaller, less productive plants and diminished rhizosphere colonization of the PGPB, *Bacillus subtilis*. A modified Kirby-Bauer disk diffusion test was performed as an initial assessment of the effect of varied fertilizer concentrations on *B. subtilis*. Roots of romaine lettuce seedlings were then inoculated with *B. subtilis* and grown in soil treated with the same range of fertilizer concentrations. The effects of each treatment on plant growth were determined using total leaf area, quantification of the rhizosphere colonization by *B. subtilis*, and carbon assimilation measured with a LI-6800 Portable Photosynthesis System. These results are an important step towards establishing guidelines for appropriate application of agricultural fertilizer in order to mitigate the frequency and severity of eutrophication events in aquatic systems.

POSTER SESSION 4

Commons West, Easel 23

4:00 PM to 6:00 PM

An Early-Stage Pancreatic Cancer Diagnostic: Fabrication of a Graphene Field-Effect Transistor Utilizing a Modular Chimeric Probe Assembly for Biomarker Detection

Rebeka Khajehpour, Senior, Physics: Applied Physics
Zane Prior Smith, Senior, Physics: Biophysics, Gender, Women, and Sexuality Studies
UW Honors Program
Mentor: Richard Lee, Materials Science & Engineering
Mentor: Mehmet Sarikaya, Materials Science & Engineering
Mentor: David Starkebaum, MSE

The goal of our project is to create an electronic device capable of early detection of pancreatic cancer (PC) with high selectivity and sensitivity. PC projects a very low survival rate often due to late-stage cancer diagnosis. Recent research has established that there are PC biomarkers prevalent throughout the body for several years before symptoms emerge. The consequent wider time window presents an opportunity for these biomarkers to be detected at their initial low concentrations thus allowing for early diagnosis. Our device uses a modular sensing construct consisting of an immobilized probe molecularly bound to the surface of the sensor device. Detection occurs when a target biomarker specifically binds to the probe and changes the electrical properties of the sensing surface that is measured quantitatively. Validating the functionality of the sensing construct and its properties is accomplished through a variety of molecular adsorption and binding techniques that assess each step; from probe immobilization to target detection. Using this modular design, research is underway to develop an array of sensors, thus potentially revolutionizing rapid medical diagnostics to provide long-term health monitoring of PC and other cancers.