Online Proceedings

POSTER SESSION 2

MGH 206, Easel 166

1:00 PM to 2:30 PM

Dynamics of Environmentally Independent Decision-Making in Invertebrate Movement Patterns

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Mentor: Ann Murkowski, Biology, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College

The sensory mechanisms by which organisms orient towards potential food prior to initiating movement are well-researched. However, behavioral mechanisms in stimulus-poor environments which determine foraging through seemingly stochastic movement variability or random-walk models remain poorly understood. Existing literature describe analyses of a variety of single-organism emergent movement patterns but do not appear to offer comparative analysis between single- and multi-individual environments nor within degrees of resource availability. We introduce a new analysis of observed fluctuations in spontaneous movement by *Caenorhabditis elegans* exposed to diverse conditions of competition and resource abundance. We describe a sequence of experiments which quantify the movement patterns of *C. elegans* through video imaging pattern recognition codified by run-length-time and turn-angle-time in comparison to recursively updating algorithmic position estimation. We expect to observe movement patterned on optimized explore-exploit strategies—such as simple random walk or Lévy flight—with frequency of implementation influenced by both population and resource density.

POSTER SESSION 2

MGH 206, Easel 165

1:00 PM to 2:30 PM

Agrobacterium and Polyethylene Glycol-Mediated Transformation of *P. ostreatus* with the Human Insulin Gene

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In the US more than 100 million people are living with diabetes or pre-diabetes. The economic burden caused by these conditions, including medical costs, is approximately $327 billion annually. Conventionally, transgenic Escherichia coli has been the primary source of commercial insulin production, a process that requires extensive purification to ensure shelf stability and complete removal of contaminants. This study seeks to establish an alternative mode of insulin production using polyethelyne glycol (PEG) and agrobacterium to transform the oyster mushroom, *Pleurotus ostreatus*, with the human insulin gene. *P. ostreatus* is a valuable target for genetic transformation due to its lack of endotoxins, rapid growth, and fully sequenced genome. *P. ostreatus* was transformed using PEG and agrobacterium with a plasmid containing the human insulin gene and a carboxin resistance gene. Transformed cells were selected using carboxin, extracted, and regenerated on plates composed of yeast extract, malt extract, and glucose (YMG). Integration of the human insulin gene in to the mushroom genome was confirmed through PCR analysis of the transformants. Successful transformation of *P.ostreatus* offers a new avenue for insulin production, potentially diversifying the market and treatment options for diabetics.

POSTER SESSION 2

MGH 206, Easel 167

1:00 PM to 2:30 PM

Quorum-Sensing Inhibitors in Puget Sound Fungi

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Growing reliance on antibiotics in livestock production, commercial agriculture, and human healthcare has created evolutionary pressures on bacteria. These pressures have given rise to a new threat to public health, drug-resistant microbes. In addition, antibiotics eliminate all microbes, including the beneficial ones, and are not advisable for long-term use. Recent advances in the understanding of bacterial virulence via quorum-sensing (QS) has presented the scientific community with a promising new approach for alleviating the ongoing overuse of broad-spectrum antibiotics. Quorum-sensing is a form of coordinated gene expression mediated through detection of specific population density. Bacteria use QS as a way to regulate behaviors including biofilm formation, virulence, and motility. Quorum-sensing inhibition (QSI), is the ability to prevent QS and is used by organisms across kingdoms. This prevalence suggests that disrupting prokaryotic communication is either a common defense tactic against infection or acts as a competitive advantage in resource acquisition. Fungi, a kingdom in direct competition with prokaryotes are prime candidates for broadening our understanding of the mechanisms behind quorum-sensing. With its abundance of endemic fungi, the Puget Sound region provides a unique opportunity to screen species for QSI compounds. In this study, fungi representing diverse ecological niches were collected from local forests around the Puget Sound and isolated on potato dextrose agar plates. To screen fungal isolates we used *C. violaceum*, a bacterium that forms purple colonies when able to quorum-sense and changes to white when a QSI is present. Our results suggest fungi are an underexploited and unexplored source of novel bioactive molecules that could provide a method to inhibit virulent effects of bacteria without damaging an organism's microbiome.

POSTER SESSION 3

Balcony, Easel 91

2:30 PM to 4:00 PM

From Sulfate to Neurotoxin: the Presence of Sulfate-Reducing Bacteria as an Indicator for Methylmercury within the Duwamish/Green River Watershed

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Sarah Fenton

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Mercury (Hg) is widely known to be a neurotoxin. Mercury in our environment is found in many different forms, and the key difference between them is evident in the way they are absorbed by organisms. Hydrophobic methylmercury (Me-Hg) readily bioaccumulates in the tissues of all organisms, leading to Hg exposures involving higher doses. Recent research shows that sulfate-reducing bacteria (SRBs) play a role in methylating mercury only when they possess the hgcAB gene cluster. Gaining a more comprehensive understanding of the aqueous conditions required for SRBs to thrive and consequently methylate inorganic mercury is essential for addressing the ongoing problems associated with Hg toxicity. In the initial phase of this study, ion chromatography was used to quantify sulfate (SO42-) concentrations along an urban river in an industrial region of Seattle (the Duwamish/Green River Watershed). The measurements revealed that SO42- concentrations as high as 5300 ppm were present at several sites along the lower portion of the Duwamish River. A number of previous studies also showed significant amounts of mercury in this region's sediments and fish tissues. The secondary phase of this study involved an investigation determining whether the measured high sulfate concentrations were related to the production of Me-Hg and additionally examined if SRBs likewise played a role. River sediment was analyzed for the presence of the hgcAB gene cluster. Ongoing studies are focused on quantifying Me-Hg at sites where SRBs were found and on the identification of key indicators for mercury methylation conditions along a watershed. This study provides further insight into the relationship between mercury, sulfates, and SRBs when found in combination in an aqueous environment.

POSTER SESSION 3

Balcony, Easel 93

2:30 PM to 4:00 PM

Mycofiltration of Antibiotics Using White-Rot Fungi

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Mentor: Kalyn Owens, Chemistry, North Seattle College
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Antibiotics are an environmental contaminant increasingly found in aquatic ecosystems, adversely affecting wildlife and contributing to antibiotic drug resistance. Sources include untreated agricultural runoff entering rivers and estuaries, outdated or leaking septic systems in rural areas, and large urban populations excreting unmetabolized medications into sewage systems. Current wastewater treatment methods are unable to effectively mitigate the release of these environmental toxins, thus new approaches are needed. White-rot fungi produce lignin-modifying enzymes which can degrade persistent organic pollutants, including antibiotics. Previous studies have demonstrated that the mycelia of turkey tail (*Trametes versicolor*) and shiitake (*Lentinula edodes*) mushrooms can reduce concentrations of the common antibiotics erythromycin and cefuroxime, respectively. In this study, three species of fungus (turkey tail, shiitake, and oyster mushrooms/*Pleurotus ostreatus*) were combined to create a more dynamic and effective approach to removing antibiotics from wastewater, using commonly available equipment and low-maintenance growth conditions. The fungi were cultivated at room temperature in modular bins, connected in series with removable tubing. The mycelia of the fungi were exposed to antibiotic solutions (erythromycin and cefuroxime dissolved in water) and tested for rates of removal in two phases. The first phase established a baseline rate of removal for each single fungus/antibiotic pair; the second phase optimized the sequence of fungus species and method of exposure (continuous flow vs. batch mode) to improve filtration of a synthetic wastewater solution containing both antibiotics. Results suggest that combining fungal species may be a more efficient method of filtration compared to methods using a single species. This is a promising step towards advancing the practical technologies available for complex wastewater treatment in various settings.

POSTER SESSION 3

Balcony, Easel 94

2:30 PM to 4:00 PM

Improving Rocket Performance with a Modular Fuselage and Adjustable Ring Fin Design

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Space travel and exploration provides a new perspective of the universe and our place within it. Private companies are taking the leading role in driving the aerospace industry. Many of these companies are looking for new technologies that will lower the cost of spacecraft production and operation. This goal could be achieved through the development of a multi-use modular launch vehicle. This project created a scaled modular rocket utilizing an adjustable ring fin design. The adjustable ring fin allows the user to easily and quickly change the aerodynamics of the rocket to compensate for a variety of payloads. Four test models were created using Callisto rocketry kits. Three of the Callistos were modified with a variety of ring fin diameters, and one was kept as an unmodified control. The live test parameters were based on rail velocity, visual stability, and altitude. After the baseline performance of each ring fin was established, the lengths of the rockets were adjusted to simulate different payloads. This work demonstrates that adjusting the ring fin allows the same base rocket to fly a variety of payloads without needing to construct a new rocket. Successful flights of the test vehicles, with improved performance based on our alterations, provide a new avenue of research into incorporating small modifications to garner a wide array of uses without extensive and costly modification. Further research will involve scaling up to rockets with motors with an impulse up to 10,000 newton seconds, as well as testing other innovative concepts related to modularity and revisions to the ring fin design. The ultimate goal is the design of a single rocket with a changeable ring fin that can be used in a wide variety of applications, saving money on research and development of new launch systems.

POSTER SESSION 3

Balcony, Easel 92

2:30 PM to 4:00 PM

Effectiveness of Sterilization Methods in Virtual Reality Technologies

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Mentor: Ann Murkowski, Biology, North Seattle College

Virtual reality augmentation of therapy has advanced a long way since its beginnings. Virtual reality technologies have been found effective for treatment of post-traumatic stress disorder and phobias as well as a potential aid as an in-treatment distraction for burn patients undergoing dressing changes. The advent of increasingly advanced displays, tracking, and comfort have transformed virtual reality from a novelty into a highly beneficial clinical device. The increasing presence of virtual reality devices in clinical settings necessitates additional investigation into sterilization techniques. The diversity of materials in the devices makes a single method of sterilization difficult. The device's vulnerable surfaces can be separated into categories: lenses, casing, straps, and facial interface. The delicate electronics preclude the use of autoclave sterilization and the porous nature of the straps and cushioning preclude the use of surface wipes. Finally, the delicate lenses need special care to facilitate cleaning while retaining structure. In the present study UV, steam autoclave, and water-based benzalkonium chloride antibacterial foam were compared to standard procedures by Oculus, one of the leading commercial manufacturers of virtual reality devices. Oculus Go virtual reality headsets were disassembled for testing. After determining baseline presence of environmental bacteria, Staphylococcus Aureus was applied to the tested surfaces. The previously mentioned methods were applied to the newly contaminated surfaces and the surfaces were swabbed and cultured. Effectiveness of sterilization was determined through numerical analysis of colony forming units. While Oculus' standard procedures have adequately disinfected some of the diverse materials tested here, more rigorous methods are needed for complete sterilization. A hospital setting may benefit from a multifaceted and specialized approach that addresses the needs of different materials to prevent increases in resistant strains. Proper sterilization procedures for this rising technology will allow for safe widespread implementation as a medical device.