Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

Poster Session 1

Commons West, Easel 21

11:00 AM to 1:00 PM

Impact of Interdisciplinary and Investigative Thinking on Student Learning in General Chemistry

Seth Novak, Sophomore, Education, Communities & Organizations, North Seattle College
Robin Hills, Recent Graduate, Pre-med, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College
Mentor: Armin Seidl, Biology, North Seattle College

The Coalition for Reform of Undergraduate STEM (science, technology, engineering & math) Education and other prominent agencies have called for increased integration of STEM content, particularly in the first two years of a student's post-secondary education. Interdisciplinary learning in the humanities has been shown to foster a more complete understanding of core concepts and provide a method for incorporating complex thinking and heightened cognitive demands into daily classroom activities. Despite the compelling evidence for this approach, interdisciplinary curriculum is still rare in introductory STEM courses. Even more rare are studies that focus on identifying the impact interdisciplinary thinking activities have on student learning, student motivation and retention in STEM disciplines. In this study, a recently designed RISE (Research-based Interdisciplinary Science Education) curriculum was implemented in the general chemistry series at North Seattle College and student learning was investigated through a multi-modal approach. Student drawings and video of student working groups were analyzed and coded as a means to capture the thinking that occurs during an interdisciplinary investigation. Exam questions were collected from a traditional classroom and from an interdisciplinary classroom and assessed for understanding of hydrogen bonding (a threshold concept). Preliminary analysis of student pre- and post- challenge drawings indicates that there is an increasing trend in the ability to demonstrate integration of disciplines, in the overall complexity of the thinking that occurs, and in creativity. In addition, students in the interdisciplinary course scored higher on the hydrogen bonding exam question than the students in the traditional course. The results of this study demonstrate that students benefit from an interdisciplinary approach to learning chemistry and provide a pathway forward as more educators seek to transform how we teach introductory STEM courses.

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Optimizing Algae Growth and Oil Extraction in the Pacific Northwest

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Noor Z. (Noor) Ahmed, Senior, , University of Washington
Amgen Scholar
Mentor: Kalyn Owens, Chemistry, North Seattle College
Mentor: Armin Seidl, Biology, North Seattle College

Algae have been shown to be a promising renewable source of biofuel due to the ease of large scale growth, significant lipid content (30% by dry weight) and the low impact on global food supply. Current studies have provided foundational information to aid producing and extracting oil from a variety of algae species, yet there remains a need to establish species specific and local protocols. Here, an investigation focused on developing Pacific Northwest algal growing conditions and combining this with an optimal oil extraction technique is presented. *Chlorella vulgaris*, *Botrycoccus braunii*, and *Nitzschia sp.* were used as model organisms to establish growing, culturing and oil extraction parameters. Crucial for efficient extraction of the lipid content in algae cell walls was the use of silver nanoparticles (AgNP), which help break down cell walls and generally increase oil extraction yields. Based on preliminary experiments, it is anticipated that ideal conditions for growing algae will be around 5% moisture content and 55C incubation temperature. Oil extraction yields were highest when AgNP were utilized, and with a 6:1 solvent-to-solid ratio (1% diethyl-ether and 10% methylene chloride in n-hexane solvent). This study, in combination with other similar investigations, will contribute to the establishment of ideal growing conditions for algae biofuel production and ultimately provide a best practice for producing biofuel from algae in the Pacific Northwest.

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Identifying Quorum Sensing Inhibitors among Species of Pacific Northwest Algae

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Veronica Lenoski, Recent Graduate, Business and Leadership, Microbiology , University of Puget Sound
Jeffrey Lake, Sophomore, Biology, North Seattle College
Salima Hafurova, Sophomore, General Biology, Genetics, North Seattle College
Claudia Antonika, Sophomore, Biochemistry, Microbiology, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College
Mentor: Armin Seidl, Biology, North Seattle College

Traditional antibiotics are known to wipe out many species of bacteria, but often leave several resistant microbes to dominate. These resistant bacteria are a huge concern for human health. Medical researchers are on the hunt for new approaches to combat bacterial infections on a large scale. It has recently been discovered that bacteria communicate through Quorum Sensing (QS), which if inhibited, presents a promising strategy to control these pathogenic bacteria. Instead of eliminating the weakest strain of bacteria resulting in a proliferation of antibiotic resistance, inhibition of quorum sensing silences gene expression, virulence and pathogenicity. A variety of marine organisms have demonstrated quorum sensing inhibition (QSI) potential, however there are many marine organisms that have yet to be screened for QSI compounds. In this study, three species of marine algae native to the Pacific Northwest were investigated for quorum sensing inhibition (QSI) capabilities. *Ulva Lactuca*, *Chondracanthus exasperatus*, and *Iridaea Cordata* were subjected to QSI capability testing that involved use of the indicator strain *Chromobacterium violaceum* Bergonzini (ATC 12472). The indicator bacterium uses the QS signal N-acyl-homoserine lactone (AHL) to produce a purple pigment. Each species of algae was overlaid with agar inoculated with *Chromobacterium violaceum* and incubated overnight. Absence of pigment in the indicator strain suggested the presence of a QSI compound. Preliminary evidence indicated that two of the three species of algae tested demonstrated QSI activity. The next step of this research involves identification of the specific compounds involved in QSI, thereby contributing to the expanding catalogue of known QSI molecules from marine environments. Ultimately this work aims to make a contribution to the fight against antibiotic resistant pathogens.

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Force Myography Matrix for Prosthetic Devices

Matthew Runde, Sophomore, Biomedical Engineering, North Seattle College
Britta Swedin, Junior, Chemistry, Biomedical Engineering, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College
Mentor: Armin Seidl, Biology, North Seattle College

Advancements in the design of robotic prostheses have provided promising new prototypes as well as highlighted the need for continued development in myographic sensors essential for fine control of prosthetic limbs and other assistive devices. Force myography (FMG) sensor matrices have the potential to improve upon the granularity of motion control present in current non-invasive robotic prostheses. FMG utilizes pressure sensors to detect flexion and extension of muscle fibers, requires no complex signal processing, and has the potential for improved accuracy and robustness over other myographic interfaces, which have known issues of data clarity. In this study, FMG was investigated through sensor matrix design and data collection. A matrix of force sensors was constructed for use in human-computer interaction, using the open-source prototyping platform Arduino for data collection and mechanism control. The sensors were constructed from pressure-sensing material (Velostat) layered between conductive foil, arrayed in a grid, and housed in an adjustable sleeve. Data collection was focused on identifying force patterns which correspond to the eight classes of motion critical to a robust transradial prosthesis. Preliminary prototyping and data analysis indicate that simple, widely-available materials provide sufficient pressure sensitivity for prosthetic applications when compared to more common, prohibitively expensive sensors. The matrix returns pressure data regardless of radial position on a user's arm, such that pattern recognition algorithms will likely be sufficient to translate user intent into action. This approach will provide a framework for further development of low-cost prosthetic control alternatives, of particular interest for developing countries with limited funds for healthcare.

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The Effects of Hyperbaric Oxygen on Cellular Metabolism

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Mentor: Kalyn Owens, Chemistry, North Seattle College
Mentor: Armin Seidl, Biology, North Seattle College

Tissue engineering has provided medical researchers with the ability to grow transplantable tissues, simple organs, and complex organ tissues. Despite the tremendous progress in tissue engineering, there is an ongoing emphasis on opti-

mizing cell growth parameters. A lack of sufficient blood flow, vascularization, and the need for oxygen delivery prior to angiogenesis are central problems that need to be overcome when growing cells in vitro. Hyperbaric oxygen (HBO) treatment utilizes elevated pressure and elevated oxygen concentrations. Multiple studies have demonstrated that HBO contributes to increased proliferation and differentiation of cell growth, stimulation of growth factors, bacterial defense, and improved oxygen delivery to cells. In this study, *Saccharomyces cerevisiae* was used as a model organism for eukaryotic cell growth to gain a better understanding of the effects hyperbaric oxygen has on simple cellular metabolism. This was accomplished with the reduction of a resazurin-based reagent to track cellular metabolism. The samples were evaluated with a spectroscope and absorbance was used to calculate the amount of resazurin reduced by NADH, proving an indicator for metabolic activity. Preliminary evidence indicates that hyperbaric oxygen stimulus increases rate of metabolism. Future experiments will provide optimal pressures and oxygen concentrations for HBO growth protocols. This study indicates that HBO bioreactors provide a useful tool for controlling growth in cell cultures, and provides early evidence for the potential use of HBO for tissue engineering applications. This study will further the applicability of HBO as a tool for enhanced tissue engineering methods.

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Mycoremediation by Fungi Native to the Pacific Northwest

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Dani Bissonnette

Mentor: Kalyn Owens, Chemistry, North Seattle College
Mentor: Armin Seidl, Biology, North Seattle College

Urban watersheds are uniquely vulnerable to toxic runoff. Rain carries carcinogenic polycyclic aromatic hydrocarbons (PAH) from motor oil into stormwater control measures where they accumulate in the sediment and biosphere. Mushrooms have recently proven to be effective in remediating oil-contaminated sites by processes similar to extracellular digestion, whereby enzymes degrade large recalcitrant compounds into smaller, more bioavailable compounds. Identifying fungal species indigenous to the Pacific Northwest for use in stormwater mycoremediation systems is a critical first step in creating an ecologically responsible, reproducible installation. In this study, thirteen fungi species collected from local, contaminated sites were cultured on agar containing used motor oil to assess for PAH tolerance. Oil amount (% volume) was increased at each stage to select for higher motor-oil tolerance. To quantify PAH degradation of a given fungi species, an agar plate contaminated with oil was inoculated with mycelium, grown for fourteen days and analyzed by GC-MS to determine PAH concentrations. By comparing the original PAH concentrations in the motor oil to the PAHs present in the myceliated agar, each species' relative effectiveness at reducing large PAHs was determined. Initial results show that ligninolytic fungi such as *Hypsizygus ulmarius*, *Trametes versicolor*, and *Pleurotis pulmonarius* are the most successful at growing in increasing concentrations of oil. Using this method of concurrent fungal selection and testing, the mycoremediation potential of previously unexamined species (of which there are hundreds) can now be easily assessed and characterized. Identifying fungi effective at breaking down PAHs provides a natural and economical means of bioremediation. This research will contribute toward providing organisms and systems capable of bioremediation on larger scales.