Online Proceedings

Poster Session 1

Commons East, Easel 45

11:00 AM to 1:00 PM

Using Ion Chromatography to Quantify Organic Acids during Wine Production

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

Organic acids are crucial factors in creating the aromas and flavors in wine, each adding their own qualities and characteristics. Winemakers regularly use various forms of technology to quantitatively determine the contents of wine. Analytical tools such as enzymatic spectrophotometry, paper chromatography, and high-performance liquid chromatography offer methods to quantify chemical components including acetic, malic, lactic, tartaric, and citric acids, as well as sulfates and sulfites. Although ion chromatography (IC) has not been a widely studied method to analyze organic acid content in wine, it offers the potential to simultaneously analyze multiple ions with greater specificity and sensitivity than other approaches. This project examines the various ways that IC can be used to analyze the components of wine, allowing for further application within the wine industry. The malolactic fermentation process was tracked to measure the changes of malic and lactic acids within the wine. Sulfites and sulfates were measured as the wine was exposed to oxygen during the aeration process. The results show that IC provides greater accuracy than paper chromatography and enzymatic spectrophotometry, the most commonly used methods in wineries. This increased accuracy provides additional knowledge that allows winemakers to further understand and evaluate the chemical components in the wines that they create. This is a useful step towards making the characterization and marketing of the wines less subjective.

Poster Session 1

Commons East, Easel 48

11:00 AM to 1:00 PM

Construction and Analysis of DNA Origami Springs

Amy Swanson, Sophomore, Electrical Engineering, North Seattle College
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Amy Stegmann, Sophomore, Material Science, University of Washington
Mentor: Ann Murkowski, Biology, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College

DNA origami is the fabrication of biochemical structures using DNA as the building material. Using base pair design principles, DNA can be synthesized to self-assemble into dynamic objects such as a piston. The resulting creations have potential applications in nanotechnology including drug delivery, enzyme immobilization, photolithography, environmental restoration, and biocompatible devices. The goal of this project was to design a nanoscale mechanical spring and determine the parameters for spring constant and size. First, a spring comprised of multiple columns of double-stranded DNA was designed and fabricated. Size measurements were taken and morphology was verified using a transmission electron microscope. To measure the force constant of this structure, the 5' end of the first column was functionalized with a thiol group which was then bonded to a gold cantilever tip on an atomic force microscope (AFM). This construct was brought very close to a magnesium substrate and allowed to bond. Force measurements for the spring were taken via AFM by slowly retracting the cantilever from the substrate. The spring force constant was calculated from this data using Hooke's law in order to predict the amount of work that the DNA nanospring can perform when included in a complex nanostructure. The nanostructures created in this project can be used in conjunction with other DNA origami designs in order to create increasingly complex machines on the nanoscale.

Poster Session 1

Commons East, Easel 46

11:00 AM to 1:00 PM

A Comparison of the Antimicrobial Activity of Essential Oil from Three Orange Varieties

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Rolando Roxas, Sophomore, Microbiology, North Seattle College
Danielle Townsend, Sophomore, BioEngineering, North Seattle College
Mentor: Ann Murkowski, Biology, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College

As concern over antibiotic resistance continues to grow, there is a critical need to discover and develop new methods of controlling and preventing bacterial infections. Essential oils derived from the peels of oranges are known to possess antimicrobial properties. Previous research has established that limonene, the principle compound present in orange oil extract, is a particularly effective antimicrobial agent that both destroys bacteria and inhibits bacterial growth. To determine whether different varieties of oranges have varying antimicrobial potency, the efficacies of oil distilled from blood, navel, and valencia oranges were compared. Oils extracted through steam distillation were diluted with methanol to concentrations ranging from 1:20 to 1:1. Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli bacteria were exposed to the oils using the disc diffusion method on TSA plates. The minimum inhibitory concentration (MIC) for each oil was determined using the agar diffusion method. Gas Chromatography Mass Spectrometry (GC-MS) was used to compare the relative concentrations of limonene present in each essential oil. A better understanding of the potency of orange oil as an antimicrobial agent could lead to development of novel drugs and products to be used to combat infection and prevent the spread of bacterial pathogens.

POSTER SESSION 1

Commons East, Easel 47

11:00 AM to 1:00 PM

The Cognitive Effects of Bisphenol-A (BPA) on the Ramshorn Pond Snail, *Helisoma trivolvis*

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Mary Amstrup, Sophomore, Environmental Science, North Seattle College
Mentor: Ann Murkowski, Biology, North Seattle College
Mentor: Kalyn Owens, Chemistry, North Seattle College

This study explores the cognitive effects Bisphenol-A (BPA) has on the mature Helisoma trivolvis, a Ramshorn pond snail common in North America. BPA is a synthetic hormone used in plastics, making it ubiquitous around the world. BPA is easily leached into water and accumulates in many aquatic habitats, making this pond snail a prime candidate for research. BPA has been shown to interfere with the natural estrogen activity in the brain of pond snail embryos leading to developmental complications and premature death. This study focuses on the cognitive effects that BPA has on mature Ramshorn snails. Specifically the snail's ability to form short-term memories in response to a negative stimulus. An operant conditioning procedure was used to assess the memory capacity of the mature snails in a range of BPA-contaminated conditions (10-800 μg/L). We raise two consecutive generations of snails both separated into five populations. Each generation had a control group containing non BPA treated water and four other groups with BPA concentrations of 10, 200, 600 and 800 μg/L solutions. Memory deficits were correlated with BPA concentrations. The results from this study add to the growing understanding of both the potential cognitive impacts of BPA as well as potential ecological consequences of BPA contamination.

POSTER SESSION 1

Commons East, Easel 44

11:00 AM to 1:00 PM

Will Cyanobacteria Increase Carbon Fixation in Response to CO_2 Limitation?

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

Improving the efficiency of photosynthesis has the potential to help attain a net reduction of atmospheric carbon dioxide (CO_2). Cyanobacteria are an enticing target phylum as they contribute an estimated twenty five percent of global photosynthesis. Under ideal conditions, cyanobacteria grow and reproduce rapidly yielding numerous generations over a relatively short time span. Most research on cyanobacteria carbon fixation has been conducted under increased concentrations of CO_2. In contrast, this research investigated: 1) whether cyanobacteria subjected to CO_2-limited conditions will produce successive populations that have improved carbon fixation efficiency, 2) the viability of those adapted populations in present day atmospheric conditions, and 3) whether the survivors fix carbon at an increased rate compared to control cyanobacteria. To answer these questions, control cyanobacteria were maintained in ambient air conditions while an experimental population of cyanobacteria was developed under a range of CO_2-limited conditions. Half of the adapted populations were then returned to ambient air conditions. The rate of carbon fixation under both CO_2-limited and ambient air conditions was approximated by measuring biomass. This research could provide a laboratory-scale proof of concept for net reduction of atmospheric CO_2 by low energy biological means. This method could also eliminate the need for direct gene manipulation by capitalizing on an evolutionary process. Future experiments could replicate this study with different species of cyanobacteria to develop regionally compatible cyanobacteria with more efficient carbon fixation resulting in a net reduction of atmospheric CO_2 in an environmentally sustainable manner.

POSTER SESSION 4

Balcony, Easel 99

4:00 PM to 6:00 PM

Fingerprinting Volcanic Ash

Danielle Fay Aimee (Dani) Bissonnette, Senior,
Mentor: Kalyn Owens, Chemistry, North Seattle College

During the height of the last glaciation, the Puget Lowlands were covered by a large lake, Glacial Lake Russell, which catastrophically emptied sometime between 13,000 and 15,000 years ago through the straights of Juan de Fuca. Three icebergs once suspended in Glacial Lake Russell, became stranded in water-logged sediments in North Seattle. These icebergs deformed the landscape, forming three basins of varying depths that became bogs. The creation of these basins in this manner is a relatively rare geological occurrence. A volcanic ash layer was recovered from one of these peat bogs in North Seattle, Washington. The purpose of this research was to determine the age, volcano of origin, and chemical composition of a volcanic ash sample recovered from a peat bog in North Seattle, as a means to gain a better understanding of significant geologic events in this region. Chemical fingerprinting by Ion Chromatography (IC) provided concentrations of specific ions of interest, and carbon dating analysis allowed for the determination of an approximate age for the ash layer. Inductive Coupled Plasma Mass Spectrometry (ICP-MS), was used to determine metal distribution in the ash layer leading us closer to gaining a clearer understanding of when eruptions occurred and when the region was ice free. The ash layer is not present in the upland sediments, and is theorized to have eroded off seasonal snow-pack and settled in the bog. Large, stranded ice takes a few hundred years to melt out, and the mass of the ice can be approximated from the mass of the sediments displaced from the basin. This could help narrow down when exactly Glacial Lake Russell emptied. Understanding the mechanisms of how this rare form of deformation occurred would advance the geological understanding of the Puget Sound Region.