FLORIDA ATLANTIC UNIVERSITY
CHARLES E. SCHMIDT COLLEGE OF SCIENCE

SCIENCE FEST

Fri., April 12, 2024
10AM-2PM
Breezeway, FAU Boca Raton campus

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Abstract Book

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A Comparative Analysis of Materials and their Effects on Soil Water Purification

Danylo Fedkiv
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Rising Seawater and increasing acid rain rates can make it harder for plants and other biotic material in soil to grow. The study analyzes different powdered materials and their effects on purifying water pH and inorganic material composition (salts). This project was done using an apparatus that allowed water to pass through soil and collect in a small basin, providing easy access to the filtered sample. The researcher then gravity filtered it to remove any pieces of insoluble compounds and evaporated it to identify the total mass of the solutes in the solution. The original hypothesis was that, out of the three tested filter powders—charcoal, graphite, and bentonite clay—charcoal would be the most effective at improving pH and removing solutes from the solution. What the researcher actually found was that clay was the best at removing solutes due to its salt-absorbing nature and that charcoal was the best at improving pH. Graphite helped retain the most amount of water in the soil likely due to its hydrophobic nature and, therefore, the ability to prevent water from easily passing through it. So, while the researcher originally believed charcoal to be the one-size-fits-all material for water purification, he instead found that a mix of all three of these materials would work better rather than just using one. As for their absolute effects, each material only minimally improved pH and removed salts.

RUBES: Resonators Used in Building Emergency Sensors - Factoring in Quality

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Over the course of the prior project phases, research into the application of mechanical resonance for early-stage structural deterioration detection as well as the progression of damage until collapse has been founded in the reliability of clamped bar resonance. This current phase of the project involves proposing a new method of resonance, string resonance in particular. The most significant design setback of the bar resonator, which was examined in year 1 and 2 of this continuation project, is the poor quality factor, which refers to the decay in amplitude over time, being poor when the decay accelerates so fast that the ringing stops within seconds of the system being driven (Paschotta, Q Factor 2023). What would be ideal, however, is an even higher Q, as seen in the portion of the differential equation representing this relationship, which would yield a much shallower plot line and a longer period of time between the driving of the system and the eventual ringdown, which would ideally be

prompted by the system being shut off and otherwise always ringing. It is believed that this will be seen in a string-based resonator, with the decay of the amplitude being minimal, allowing for the continuous resonance of the entire system, creating a self-sustaining acoustic feedback loop in the process which will be demonstrated in future project phases.

Viral Voyage: Investigating the Flow of Bacteriophages into the Biscayne Aquifer

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The Biscayne Aquifer is located beneath Miami-Dade and Broward Counties, and is an extremely important freshwater source for a significant number of people living in South Florida. A majority of the hydrogeologic units of Biscayne Aquifer, also called aquifer filters, consist of porous soils, such as sand and limestone, allowing for high levels of permeability. However, due to this high level of permeability, contaminants, including harmful viruses, bacteria, and human caused contaminants, such as pesticides, micro-trash and chemicals, can easily enter the Biscayne Aquifer water supply. This project investigates the transport of bacteriophages through the aquifer filters of the Biscayne Aquifer, specifically the Fort Thompson, Tamiami, Miami Oolite, and Pamlico Sand formations, in order to represent the transport of viruses through the Biscayne Aquifer. The project will look to answer whether or not the geological conditions of these filters affect the transport of bacteriophages, and if so, then it should prove that filters with the least permeability will have the least bacteriophage transport, and those with the most permeability will have the most bacteriophage transport. To depict this phenomenon, diluted T4r+ coliphage was poured down models of the 4 filters previously mentioned and after the contaminated water drained through, it fell into a petri dish of E. Coli K12, then incubated. Finally, data from bacteriophage plaques formed on the petri dish was analyzed, supporting the hypothesis, since the most permeable filter, the Miami Oolite, had the most plaques, whereas the least permeable filter, the Pamlico Sand, had the least plaques.

Helping Hue: Investigating the Effects of Light Color on Productivity

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Light has made it into every corner of a human's lifestyle, yet how it affects them is not completely understood. The researcher's goal was to explore how light's color affects high

school students' productivity. The expected outcome of this study was that there would be a difference in the productivity of high school students when exposed to the different colors of light compared to the control group (white light). 27 participants (9 male, 18 female) were recruited. Each participant sat in one of the five study cubbies and took two surveys to assess their productivity. Due to the small sample size, there were no statistically significant differences in productivity; however, trends did exist. Based on gender, the females had their highest positive mood average in the blue light, while they had their highest negative mood average in the yellow light. On the other hand, the males had their highest positive mood average in the white light, while they had their highest negative mood average in the blue light. Overall, This has led to the conclusion that the white light was the best for productivity because it had one of the highest efficiency levels and positive mood averages out of all the colors. However, future research needs to be done in order to verify these results, both with a larger sample size and a greater variance in gender.

SOLAR SAILING: Effects of Photophoretic and Optical Propulsion on th+C7e Movement of Mylar-Based Compounds

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This experiment demonstrates the potential of aluminized mylar as a building material for solar sail using principles from optics, aerospace science, and materials science. Solar sails, which utilize the momentum of photons from light, require a vacuum to reduce friction from gas particles. The experiment focuses on two light forces: Photophoretic force, caused by temperature differences across a material, and optical force, resulting from the momentum of photons. In the experiment, a 100-watt LED serves as the source that generates the two light forces. The independent variable is the type of light force while the dependent variable is the type of mylar structure being affected by the light. To ensure the validity of this procedure, the mylar is placed inside a vacuum chamber to replicate the density of space. The vacuum chamber also makes the effects of the two light-generated forces more visible, which makes this an effective demonstration of photonic propulsion in action. During the controlled experiment, these forces are observed to move all three structures of aluminized mylar approximately one centimeter under partial vacuum conditions and thus indicate the effectiveness of both forces. The data collected, including parameters like brightness, wattage, and current of the light, is used to assess the effectiveness of light propulsion on the three distinct structures. These findings are analyzed with respect to conditions in outer space, which offer further insights into the potential application of photonic propulsion as a real-life application.

Bacteria Battle: Exploring the Impact of Hydrogen Peroxide Concentrations on Vibrio Fischeri for Bacterial Eradication in Florida Waterways

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South Florida Water Management District (SFWMD) is spraying hydrogen peroxide to remove toxic algal blooms, like blue-green algae. The algal blooms grow rapidly and have many negative health impacts on humans and animals. However, spraying hydrogen peroxide can affect other biota, like Vibrio fischeri, a bacterium that is beneficial to the aquatic ecosystem. The researcher will test how this specific bacterium reacts to the chemical combination that the SFWMD uses in Florida waterways. This research will test the effects of hydrogen peroxide on the growth of Vibrio fischeri. Different concentrations of this chemical could affect the bioluminescent bacteria and the researcher will test how the Vibrio fischeri reacts to the different concentrations of the hydrogen peroxide. The hypothesis for this experiment was that higher concentrations of hydrogen peroxide will reduce the survival rate of Vibrio fischeri. The hypothesis was supported.

Leveraging Self-supervised Contrastive Learning to Monitor Free-Body Movement Daily Activities of Parkinson's Disease Patients Using a Single Wrist Sensor

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In the emerging field of using wearable sensors to monitor human activities in Parkinson's disease (PD) patients, our study introduces a novel approach. Utilizing a self-supervised contrastive learning technique with a single wearable accelerometer wrist sensor, we address the limitations posed by conventional machine-learning models due to the complexity of patient data and practical sensor use. We first present the model's performance in recognizing seven daily activities among 15 PD patients, achieving a weighted F1-score of 68.00%. Subsequently, we evaluated the same model on PAMAP2, a public wrist sensor dataset from healthy, younger individuals, achieving an F1-score of 80.44%. In both scenarios, our self-supervised learning model surpassed the results of a fully-supervised method, which recorded F1-scores of 66.14% in PD patients and 80.36% in healthy subjects. These findings underscore the effectiveness of self-supervised learning methods. Our model's significance lies in its capability for reliable daily monitoring and offering critical insights with just one sensor, greatly aiding clinicians in managing PD and personalizing physical therapy for each patient.