Abstract: Science and Engineering Fair of Houston

3195

How does mantle convection strength affect plate motion and volcanic activity at an undersea ridge?

Precious Uzowuru, Roheemat Adetona

Fort Bend ISD /Hightower High School

Category:

Earth and Environmental Sciences

My project tests how the strength of mantle convection affects plate motion and undersea volcanic activity. We are building a model using a tank of water to represent Earth's mantle, foam pieces for tectonic plates, and a clay volcano at the center. By injecting hot water at different temperatures, we could see how heat made the plates move and cause eruptions using baking soda and vinegar. The results showed that hotter water made the plates move faster and the eruptions stronger. This shows that stronger convection in Earth's mantle can cause faster plate movement and more volcanic activity at mid-ocean ridges.

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Abstract: Science and Engineering Fair of Houston

3196

Relationship Between Water Quality and Air Pollution in Lake Biwa

Lingya Rangwalla, Emma Jiao

Home School/Homeschool

Category:

Earth and Environmental Sciences

This study investigates the relationship between air quality and water quality in Lake Biwa, with a specific focus on the influence of atmospheric particulate matter ($PM_{2.5}$), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) on turbidity, suspended sediment concentration, and chlorophyll-a levels. As Japan's largest freshwater lake, Lake Biwa is exposed to both local and regional atmospheric pollution sources, making it an important system for examining air–water interactions. Air quality data for $PM_{2.5}$, SO_2, and NO_2 were analyzed alongside water quality measurements collected across multiple monitoring locations and seasons within the Lake Biwa basin over a period of four years using google earth engine data. Turbidity and suspended sediment were used as indicators of particulate inputs and sediment dynamics, while chlorophyll-a served as a proxy for phytoplankton biomass and biological response. Statistical correlation and regression analyses were employed to assess the relationships between atmospheric pollutant concentrations and variations in lake water properties. The results indicate that higher atmospheric $PM_{2.5}$ concentrations are associated with increased turbidity and suspended sediment levels, suggesting a link between airborne particulate deposition and in-lake particulate matter. Elevated NO_2 levels show a positive relationship with chlorophyll-a concentrations, implying that atmospheric nitrogen inputs may contribute to enhanced phytoplankton growth. SO_2 concentrations exhibited weaker but noticeable associations with changes in turbidity, potentially reflecting indirect effects through acid deposition and particle formation. These findings highlight the role of atmospheric pollution in shaping lake water quality and emphasize the need for integrated air and water management strategies. Improved understanding of these linkages can support more effective environmental monitoring and policy development aimed at protecting Lake Biwa's ecosystem.

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Abstract: Science and Engineering Fair of Houston

3197

Oyster Power: Oyster Shell Powder and its Antibacterial Effects

Phoebe Pan, Simran Virdi

Friendswood ISD /Friendswood High School

Category:

Earth and Environmental Sciences

Large amounts of oyster shells are discarded each year, contributing to environmental waste. Oyster shells are primarily composed of calcium carbonate, a compound that has been suggested to have antibacterial properties. This project investigates whether ground oyster shell powder may inhibit bacterial growth and which factors influence its effectiveness. Heated and unheated oyster shell samples were compared to calcium carbonate, bleach, and distilled water controls. Both oyster shell solutions were alkaline, with pH values around 9, while the calcium carbonate solution had a pH of approximately 8. Flame tests indicated the presence of calcium in the oyster shell samples. Antibacterial testing was performed using Escherichia coli K-12 grown on agar plates with sterile filter discs soaked in each treatment. At this stage, no clear zones of inhibition have been observed for the oyster shell treatments. These results suggest that additional factors or processing methods may be required for ground oyster shells to exhibit antibacterial activity.

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Abstract: Science and Engineering Fair of Houston

3198

Disrupting the Dirt: The Impact of Microplastics on Soil Water Absorption

Olivia Foley

Conroe ISD /AST: Academy of Science and Technology

Category:

Earth and Environmental Sciences

This project investigates the impact of microplastics on soil water absorption and retention, addressing growing concerns about plastic pollution in terrestrial environments. The research question asks: How do varying concentrations of microplastics affect soil's ability to absorb and retain water? To answer this, soil samples were prepared in nine containers divided into three groups: a control with no microplastics, a 5% microplastic mixture, and a 10% mixture. Each container received 125 mL of water daily, and drainage was measured after 30 minutes and again after 24 hours over a seven-day period. Visual observations of soil texture and microplastic movement were also recorded. Results showed that water retention increased with higher microplastic concentrations, with the 10% microplastic soil retaining the most water and the control retaining the least. Statistical analysis using one-way ANOVA confirmed that these differences were significant ($F(2, 60) = 50.66$, $p < .001$). These findings indicate that microplastics alter soil structure in a way that reduces drainage and increases water retention, contrary to the original hypothesis. The study suggests that microplastic contamination can significantly impact soil behavior, potentially affecting plant growth by creating overly wet conditions that limit oxygen availability to roots. Understanding these effects is critical for maintaining soil health and developing strategies to reduce the environmental consequences of plastic pollution.

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Abstract: Science and Engineering Fair of Houston

3199

Carbon Boost: Optimizing Plant Metabolism for Increased CO_2 Fixation

Vallery Vasquez, Alyssa Wright, Eden Broussard

Conroe ISD /ASHP: Academy for Science and Health Prof

Category:

Earth and Environmental Sciences

This project investigates which nutrient used will increase the uptake of CO_2 gas in order to find an eco-friendly system to lower CO_2 in the local atmosphere, and supports the enhancement of plant growth. It is hypothesized that the uptake will not be equally distributed between the different nutrients and the control group; however, magnesium nitrate is highlighted to produce the quickest process of photosynthesis, which results in more CO_2 uptake. Using the CO_2 Gas Sensor from Vernier Science Education, the CO_2 uptake data was pulled into organized tables. The data collected from Phosphorus, Magnesium Nitrate, Manganese, and Generic 10g GA3 Water Soluble Gibberellic Acid would be analyzed in comparison with the control group and graphed. Chi-square tests were calculated using the individual plant measurements, with the control means used as expected values. In conclusion, the magnesium nitrate showed the most statistically significant difference from the control group when all the weeks are combined. Based on the chi-square calculations, the alternative hypothesis is accepted.

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Abstract: Science and Engineering Fair of Houston

3200

The Effect of Calcium Carbonate on Zinc Mobility and Soil Acidity

Alyssa Ackley, Mattias Erstad, Emmeline Courtier

Conroe ISD /ACES: Academy for Careers in Engineering and Scien

Category:

Earth and Environmental Sciences

Heavy metallic pollutants have become a major problem for the soils; thereby causing them to be so acidic, affecting our ecosystem and environmental systems negatively. It is the soil that is so acidic it permeates our crops, ground water, and food chain. It threatens farms and public health on a massive scale. This experiment puts Calcium Carbonate to the test to see if it can act as a pH buffer to offer as a rapid remediation tool for contaminated soil. It is an abundant and cheap mineral, making it vastly easy to get. To see how calcium carbonate is used, we used six cups- each packed with 1 cup soil, then spiked with 100mg zinc, ½ cups water, and advanced by ½ tbsp apple cider vinegar to simulate more acidic conditions. The cups were split and labeled into three groups, each with different amounts of Calcium Carbonate. After sitting and settling the contents leached through coffee filters, and revealed the distinct differences with the different pH levels due to the amount of content of $CaCO_3$. The high-dose cups erupted in strong fizzing, the CO_2 released from acid neutralization. Therefore yielding average leachate pH 7.5 with a low estimated zinc mobility. The medium treatment showed moderate fizzing at pH 6.5 and moderate mobility. The controls barely fizzed, while stuck at acidic pH 4.3 with high zinc leaching. From these findings, we are able to understand the efficacy of $CaCO_3$ on removing acidity and the binding of zinc ions on the soil particles. The revelation has provided a less costly approach for farmers and environmentally conscious individuals that would contribute towards amelioration, preservation, and the promotion of sustainable agriculture for many years to come

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Abstract: Science and Engineering Fair of Houston

3201

Potential Causes of Rising Methane Concentrations in Yukon Basin

Alvin Li

Katy ISD/Seven Lakes - HS

Category:

Earth and Environmental Sciences

Permafrost in high-latitude regions stores vast amounts of carbon that can be released as methane as environmental conditions shift. Satellite observation indicates increasing atmospheric methane concentrations over the Yukon Basin in recent years. This study investigates which factors are most strongly associated with these recent increases in methane concentration in an area filled with extensive permafrost, wetland, and thermokarst features. Atmospheric methane data collected from TROPOMI was compared with satellite-derived temperature, wetness, and surface water area data from MODIS LST, SENTINEL-5P, and ERA5-LAND. Annual and monthly time-series data were generated from analyzed satellite data for each variable, and correlation analysis was further conducted to assess relationships between atmospheric methane concentration and these factors. Results indicate that atmospheric methane concentrations have been consistently increasing for the past decade over the Yukon Basin. Annual mean temperature had a weak correlation with methane concentration, which can actually be expected from the complex environmental interactions influencing carbon release. However, minimum annual temperature showed a strong positive correlation with methane concentration (r= 0.889), potentially indicating that increasing minimum temperatures may be leading to thawing. Methane concentrations displayed very weak correlation with perennial subzero surface area, but displayed pronounced peaks during winter months when surface temperatures were lowest. Precipitation had a weak correlation with methane concentration, but surface water area from thermokarst development exhibited a strong correlation. These findings suggest that temperature is not the only factor driving the persistent increase in methane interaction, and hydrologic and subsurface processes form important dynamics in high-latitude methane emissions.

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Abstract: Science and Engineering Fair of Houston

3202

Bio-Intercept 3D: Predictive Kinetic Framework for Optimizing Subsurface Biofilm Barriers to Prevent IPM Metabolite Leaching

Aadi Deosthale, Guhan Gurubaran, Abhinav Sridharala

Cypress Fairbanks ISD/Bridgeland - HS

Category:

Earth and Environmental Sciences

Groundwater takes up 99% of the world's liquid freshwater, yet it is increasingly under threat by the unchecked infiltration of persistent agrochemical metabolites like aminomethylphosphonic acid(AMPA). This research and experiment address the critical remediation gap in the vadose zone by engineering a high fidelity reactive transport model to make optimal subsurface biofilm barriers. By integrating the ADR equation through a finite difference numerical solver, we simulated the transient leaching dynamics of a 240 hour storm event to transform bioremediation to a in-silico graph based result. The study also identifies a critical biophysical trade off between surface desiccation at shallow depths and a diffusion limited hypoxia at deeper levels. Quantified results showcase what we deemed a "Golden Zone", at 18cm where the intersection of atmospheric oxygen and hydraulic stability maximizes equality, where both are under fit conditions to provide ample leaching. While a deep barrier of 40cm fails with a 3.3% efficiency due to microbial suffocation, the optimal 18cm placement achieved a peak interception efficiency of 8.45%, highlighting a 2.5 fold increase in efficacy over deeper placements without needing additional biological or chemical variables. By identifying the specific "Golden Zone", we offer a scalable, electricity free strategy to safeguard global aquifers. This predictive model also empowers agricultural economies to implement these invisible biological filters which ensure long term drinking water security for rural populations which rely on contaminated groundwater sources.

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Abstract: Science and Engineering Fair of Houston

3203

Environmental Influences on the Demographics of Arapaima

Category:

Earth and Environmental Sciences

Gopal Susarla

Fort Bend ISD /Clements High School

Arapaima (Arapaima spp.) are large, air-breathing fishes of the Amazon floodplain that play a key ecological role and support important subsistence and commercial fisheries. Understanding how environmental conditions shape arapaima population structure is essential for effective and sustainable management. This study examined the influence of hydrological and habitat-related variables on the ratio of juveniles to adults in arapaima populations across floodplain lakes within the Mamirauá Sustainable Development Reserve. Long-term census data was combined (2005–2022) with hydrological records and lake-specific characteristics, including lake area, surrounding habitat composition, extent of adjacent water bodies, and management group designation. Using linear mixed-effects models with lake identity as a random intercept, the relative importance of these predictors was evaluated and model selection was conducted using Akaike's Information Criterion (AIC). The best-supported model identified surrounding chavascal habitat, management group, minimum annual water level, and the proportion of surrounding water bodies as key drivers of variation in population structure. Higher proportions of chavascal habitat, greater connectivity to surrounding water bodies, and lower dry-season water levels were associated with increased juvenile -to-adult ratios. These results suggest that both hydrological dynamics and landscape context contribute to shaping arapaima age structure, highlighting the importance of habitat configuration and floodplain water regimes in the management of Amazonian floodplain fisheries.

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Abstract: Science and Engineering Fair of Houston

3204

Fractal Recovery Dynamics in Plants Under Controlled Stress

Yenula Wickramasinghe

Cypress Fairbanks ISD/Bridgeland - HS

Category:

Earth and Environmental Sciences

Plant growth often faces stress from environmental factors, such as water and light, but the mechanisms of their recovery from this stress have been unclear. This study aimed to understand how the stresses impact growth recovery in plants by comparing growth affected by light stress and water stress. For this, a group of plants of the same type was used and grouped into two experimental groups, applying the water and light stress, and one control group. For each group, various parameters such as growth, leaf angle, leaf color, and soil water content were measured at regular intervals to observe various growth recovery responses over time. In the light-stressed group, there was a reduction in leaf angle and growth rate during stress, but a quick recovery after resumption of light. For the water-stressed plants, there was a greater and prolonged reduction in leaf angles and color, which showed slower recovery rates compared to light-stressed plants. In the control group, plants showed continued growth at a constant rate without much variation. Based on these experimental outcomes, it is clear that both factors trigger diverse growth recovery rates, where water stress has a greater effect compared to light stress.

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Abstract: Science and Engineering Fair of Houston

3205

Project Purify: A Hybrid Electro-Photocatalytic System for Targeted Degradation of Microplastics

Rhea Chidambaram

Private/The Village School

Category:

Earth and Environmental Sciences

Microplastic (MP) contamination is a persistent environmental and public health threat, with polyethylene terephthalate (PET) microplastics detected in drinking water, human blood, and placental tissue. Existing mitigation strategies rely almost exclusively on physical filtration, which concentrates (rather than neutralizes) plastic pollution and generates secondary waste streams. Project Purify combines physical capture, electrokinetic concentration, and photocatalytic degradation of PET microplastics in a single 3D-printed, automated reactor. I developed a three-phase experimental framework, which was optimized with over 400 quantitative measurements and triplicate aliquots per condition. Phase I evaluated microplastic capture using loofah, agar hydrogel, and a novel loofah-agar composite. The composite demonstrated the highest retention efficiency due to mechanical entrapment and hydrogel adhesion. Phase II tested electrophoretic concentration using carbon felt, graphite, and stainless steel mesh cathodes. A stainless steel mesh configuration (4.5 V at 2 cm spacing) yielded the highest particle interception. Phase III targeted PET degradation via immobilized TiO_2 photocatalysis. This approach achieved significantly greater apparent mass loss than slurry systems while preventing catalyst leaching. UV-on and UV-off controls confirmed degradation was photocatalytic, rather than mechanical. The optimized components were integrated into a 3D-printed vortex reactor designed for autonomous operation. The final prototype achieved a 96% reduction in recoverable PET microplastics, comparable to sequential testing (98%), and maintained high efficacy when tested with commercial bottled water. By neutralizing rather than relocating plastic waste, Project Purify establishes a realistic pathway toward mitigating one of the most pervasive pollutants of the modern era.

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Abstract: Science and Engineering Fair of Houston

3206

Category: Earth and Environmental Sciences

Design of a Novel Biodegradable Starch-Chitosan Composite Film as an LDPE Plastic Alternative for UV-Triggered Environmental Degradation Using Advanced Molecular Dynamics Simulation and Experimental Testing

Saketh Tammisetti, Veeraj Sirivolu, Aditya Puppala

Fort Bend ISD /Dulles High School

Conventional plastic films used for bags and flexible packaging are produced and discarded at enormous scales, with approximately one trillion low-density polyethylene (LDPE) bags used globally each year. These materials persist for years outdoors and fragment into micro-/nanoplastics that contaminate soil and water, leading to adverse effects on organisms. Current research on starch-chitosan biopolymer films shows promise as biodegradable replacements. However, these biopolymer matrices either lack sufficient mechanical performance or require industrial composting conditions, with degradation rates in outdoor environments remaining low. Additionally, contemporary approaches fail to cleverly utilize natural UVA/UVB light as an active photo-oxidative catalyst for degradation. This research combines experimental testing with molecular dynamics simulation using Sandia National Laboratory's LAMMPS software to design a biodegradable UV optimized film. To enable UV-degradation, inorganic additives in prior work were eliminated and replaced with an organic photosensitizer system consisting of riboflavin and plant-derived chromophores, including curcumin and anthocyanins from red cabbage powder dominated by cyanidin-3-diglucoside-5-glucoside. These compounds absorb light, including 395nm UVA, and promote photo-oxidative reactions that weaken polysaccharide chains through gradual chain scission, hydrogen-bond weakening, and loss of blend integrity. Macroscopically, the film remains intact during use but becomes brittle, like a leaf, after UV exposure, facilitating biodegradation. Six iterations were evaluated under a 395nm UVA exposure box and natural outdoor conditions, with the final optimized formulation exhibiting complete loss of integrity after ~37 hours of outdoor exposure. Matrix behavior was analyzed through molecular modeling using LAMMPS and complementary tools, with simulated trends closely matching experimental observations.

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Abstract: Science and Engineering Fair of Houston

3207

Comparing Biodiesels

Category:

Earth and Environmental Sciences

Sabira Sajan

Private/AL-HADI SCHOOL OF ACCELERATIVE LEARNING

The purpose of this science fair experiment is to compare two types of biodiesel made from waste vegetable oil using different catalysts to determine which one produces higher-quality fuel and has a lower environmental impact. A catalyst is a substance that speeds up a chemical reaction without being consumed or altered in the process, making it required in biodiesel production. Biodiesel is a renewable fuel for diesel engines made from biological sources like vegetable oils, animal fats, or recycled greases. A biocatalyst is a natural catalyst, typically an enzyme, which speeds up a biochemical reaction within a living system, while a chemical catalyst is an external, non-biological substance that accelerates any chemical reaction. In terms of quality, the chemical catalyst diesel was more visually clear and resembled real diesel more closely, but with more hazardous and quantity of waste. It also had a lower viscosity, which is better for diesel. The bio catalyst diesel was slightly more cloudier and denser signaling a little lower quality but with much lighter and less waste proving more eco-friendly. The results partially supported my hypothesis, as biocatalysts cause biodiesel to be significantly better for the environment but with slower reaction time and also causes slightly lower quality of biodiesel. In relation to future studies, researchers could experiment with other waste oils or fats to create biodiesel to see how the catalysts perform in turn. Also, future work could investigate properties of biodiesels like energy content and emissions in small engines for real world performance.

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Abstract: Science and Engineering Fair of Houston

3208

Geometric Plant Pot

Category:

Earth and Environmental Sciences

Natalie Okotie, Zainab Oyebamiji, khloe Quia

Harmony Public Schools - South District/Harmony School of Innovation Katy

Our experiment looked at whether a 3D-pirnted plat pot with drainage holes helped plants grow better than regular pots. We designed the pot using Fusion Autodesk and printed it with PLA plastic. We used two of the same plant, one in our pot and one in a regular pot from the store. For over four weeks, we measured how tall the plants grew and tested the soil moisture a few times a week. The plant in our pot had healthier roots and grew more steadily. The results showed us that a stable pot with drainage holes helps water flow better and stop the roots from rotting. This kind of pot is useful for indoor gardening and eco-friendly farming in places where natrual growth is scarce.

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Abstract: Science and Engineering Fair of Houston

3209

The Effects of Processing and Food Residue on Zophobas morio Biodegradation of Expanded Polystyrene

Luke Porterfield, Mikayla Porterfield

Clear Creek ISD /Clear Brook High School

Category:

Earth and Environmental Sciences

Expanded polystyrene (EPS) has detrimental effects and persists in environments for centuries. Zophobas morio larvae can biodegrade and subsist on EPS. We examine how EPS processing and food residue affect Z. morio EPS-consumption rates to support development of a household EPS-biodegradation system. We hypothesized that consumption would be highest with corn syrup and crushed EPS (easier to digest) and lowest with oil (larval preference for sugar and aversion to oils). Trial 1 had 18 groups: 9 Z. morio (n=5/group), 9 control (n=3/group). Trial 2 had 12 groups: 6 each Z. morio and control (n=5/group). EPS was weighed, treated (no coating, oil, corn syrup), reweighed, then processed (whole, sliced, crushed). Pre-weighed Z. morio (n=4) were added. After three weeks, larvae and EPS were re-weighed. Paired t-tests assessed pre- and post-mass differences. One- and two-way ANOVA evaluated differences among treatment groups. In trial 1, no-coating groups had higher EPS consumption for crushed (-553±89) than sliced (-320±142) or whole (-178±73, p=0.001). Coating data was skewed in trial 1, with trial 2 conducted with a modified procedure to address underlying causes. Trial 2 showed a significant difference between EPS consumption by coating type (F=16.7, p<0.001; corn syrup > no coating > oil). To set up household EPS-biodegradation systems, it is important to know whether EPS should be crushed and whether food residue affects degradation. We found that crushing and corn syrup increase EPS consumption and oil decreases it.

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Abstract: Science and Engineering Fair of Houston

3210

Corn Husk as Oil Absorbent

Category:

Earth and Environmental Sciences

Axel Garcia, Susana Razo, Janelle Grimaldo

Aldine ISD/Eisenhower HS

Corn Husk as oil absorbent Axel García, Janelle Grimaldo, Susana Razo Dwight Eisenhower High School, Houston, TX Oil spills result in long-term damage to aquatic ecosystems and wildlife, while many synthetic absorbents used are costly and non-biodegradable. The following experiment examined whether corn husk, an abundant agricultural waste product in the United States, is a more effective and selective natural oil absorbent than coconut husk. This question was posed: Does corn husk absorb more oil and less water compared to coconut husk under controlled conditions? Corn husk and coconut husk samples were dried, shredded into similarly-sized fibers, and weighed to approximately 5.00 grams per trial. Three trials were conducted for each material under water only, oil only, and mixed oil-water conditions. Each sample was submerged for a fixed time period, removed, drained uniformly, and reweighed. Oil absorption was calculated by subtracting the initial mass from the final mass. Results showed that corn husk absorbed significantly less water (0.32 g) than coconut husk (1.08 g), indicating lower hydrophilicity. In oil-only trials, corn husk absorbed an average of 4.88 g of oil compared to 4.12 g for coconut husk. In mixed oil–water trials, corn husk absorbed 4.74 g of oil, while coconut husk absorbed 4.35 g. These results demonstrate that corn husk is more hydrophobic and more selective for oil absorption. The findings support the hypothesis that corn husk is a more effective natural absorbent for oil spills due to its higher oil absorption capacity and lower water retention, suggesting potential for sustainable oil spill cleanup applications.

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Abstract: Science and Engineering Fair of Houston

3211

Algae correlation

Warren Qian

Katy ISD/Jordan - HS

Category:

Earth and Environmental Sciences

We explored which water bodies near the Mississippi River Delta are most prone to harmful algal blooms, comparing estuaries and bays with the open Gulf. By tracking chlorophyll-a (a bloom indicator) and particulate organic carbon (organic matter), we found clear differences. Our study reveals that bays and estuaries (like Atchafalaya Bay, Barataria, and Breton Sound) are significantly more vulnerable to algal blooms than the open Gulf. They consistently show higher chlorophyll-a levels and exceed bloom thresholds more often. This pattern holds true across seasons, though bloom frequency varies throughout the year. Interestingly, the source of organic matter changes drastically from offshore to inshore. In the open Gulf, organic carbon is mostly from algae. But as you move into bays and estuaries, other sources like river runoff, decaying plants, and stirred-up sediments become dominant. This shift means that while chlorophyll-a and organic carbon are closely linked offshore, they tell very different stories in the bustling, river-fed coastal waters. This helps us understand why blooms thrive more in these inland areas and what fuels their growth.

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Abstract: Science and Engineering Fair of Houston

3212

Plant-Derived Flocculants: A Natural Solution for Microplastic Pollution

Sathini Amaratunga

Conroe ISD /TWCP High School

Category:

Earth and Environmental Sciences

This project examines whether plant-derived mucilage from Fenugreek seeds, Basil seeds, and Asian Spinach can act as natural flocculants for removing microplastics from contaminated water. The hypothesis predicted that fenugreek mucilage would demonstrate the highest removal efficiency due to its high galactomannan content. Standardized microplastic fragments, each around (0.5-1.0mm), were counted and added to sixteen beakers of distilled water to replicate contamination on a measured level. Mucilage was extracted from each plant source and added to designated groups of beakers, while one group of beakers remained untreated as a control group. After a settling period, each solution was gravity-filtered. Microplastics remaining in the water were then counted using microscope fields of view. Data collected from the research concluded that Fenugreek seeds achieved the highest average removal efficiency, with 89% of microplastics being removed. Basil seeds and Asian Spinach mucilage were next, with 81% and 77% removal rates, respectively. This study aimed to detect an effective, biodegradable, and low-cost natural flocculant for microplastic removal, and ultimately found Fenugreek Mucilage as a practical and environmentally safe solution for reducing this pollution in water systems worldwide.

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Abstract: Science and Engineering Fair of Houston

3213

Testing Soil Additives to Speed Up the Breakdown of Compostable Plastics

Vaishnavi Gurik

Conroe ISD /AST: Academy of Science and Technology

Category:

Earth and Environmental Sciences

Compostable plastics were developed to reduce environmental impact compared to traditional plastics, yet their breakdown in soil can still be slow and incomplete. This study investigated how soil additives influence the degradation of compostable plastics over a span of four weeks. Polylactic acid (PLA) plastic samples were placed in boxes with loam soil containing one of five treatments: control group (no additive), compost, nitrogen-rich material, enzyme material, or commercial compost starter. Samples were weighed on December 1, December 22, and December 29, and visual observations of softness, cracking, color changes, and fragmentation were recorded. All samples increased in mass, likely due to water absorption and microbial growth. A one-way ANOVA comparing final masses showed no significant difference between treatments. However, qualitative observations indicated that plastics in the enzyme and compost treatments showed the greatest visible degradation, including increased softness and fragmentation, while the nitrogen-treated plastic showed moderate degradation. Samples in the control and commercial compost showed little to no visible degradation. These results indicate that visual degradation may be a more reliable indicator of compostable plastic degradation than mass measurements alone. This study highlights the importance of soil composition in compostable plastic breakdown and provides guidance for improving compostable plastic disposal in natural environments.

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Abstract: Science and Engineering Fair of Houston

3214

The Effect of Different Thermoplastics on the Acidification of Seawater

Kathleen Garcia

Aldine ISD/Blanson CTE HS

Category:

Earth and Environmental Sciences

The hypothesis was accepted: thermoplastics with more chemical additives, such as PVC and polystyrene, caused a greater decrease in seawater pH and a higher increase in dissolved CO_2 concentration than more chemically stable thermoplastics like PET. The first pattern I want to discuss is the one investigated in the article by Weiss (1971). The article presents research on the solubility of CO_2 in fresh water and seawater. They found that CO_2 solubility decreases as salinity increases, which means that CO_2 dissolves less in salt water than in pure water. This is consistent with the pattern observed in this experiment. Dissolved CO_2 increased by 0.2 ppm after 30 days; PVC increased by 0.18 ppm, PS by 0.07 ppm, and PET only by 0.06 ppm. According to the results, the concentration of dissolved CO_2 was higher in the controls, that is, in the plastics placed in distilled water. The pattern observed in this study supports Weiss (1971): higher salinity leads to lower dissolved CO_2. The findings of this experiment also support the results of Joseph et al. (2024), which indicate that under normal conditions (moderate temperature, water, or dilute solutions), PET is chemically inert. In this research, PET was the most stable plastic, showing the least significant changes in the data. However, PVC was the thermoplastic that showed the greatest changes, with the largest decrease in pH and the largest increase in dissolved CO_2 in seawater. Real-life implications: Although the experiment was conducted in a science laboratory, the water studied was from Galveston beach. Nothing was simulated; it was real seawater exposed to different plastics. The limitations of this experiment include the small amount of plastic studied and the small volume of water compared to the amount of plastic pollution affecting our coasts and the size of the ocean.

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Abstract: Science and Engineering Fair of Houston

3215

Electrochemical Descaling and the Removal of Microplastics from Drinking Water

Irvine Qian

Conroe ISD /AST: Academy of Science and Technology

Category:

Earth and Environmental Sciences

Water quality is increasingly threatened by the accumulation of microplastics and limescale, both of which pose significant environmental and industrial challenges. Furthermore, limescale buildup lowers water supply efficiency and increases energy consumption, while microplastics persist due to their non-biodegradable nature, endangering aquatic ecosystems and human health. This study investigates a novel, integrated water treatment approach combining electrocoagulation and electrochemical descaling within a single-cell system. It was hypothesized that this dual-purpose method would simultaneously precipitate dissolved calcium ions as calcium carbonate and remove microplastics through aggregation induced by coagulants generated from dissolving aluminum electrodes. To test this hypothesis, varying voltages were applied to a synthetic wastewater solution containing fluorescent microbeads, calcium ions, and bicarbonate ions using a coupled aluminum electrode setup over a 60-minute period. Microplastic removal was monitored visually, while limescale formation was assessed by examining calcium carbonate deposition on the cathode. Results showed effective accumulation of microplastics at the water surface and simultaneous cathodic deposition of calcium carbonate, verified using SEM/EDXS analytical techniques. A gradual increase in solution pH further supported hydroxide ion generation at the cathode, enhancing both coagulation and precipitation processes. These findings demonstrate the feasibility of a scalable, cost effective, and sustainable water treatment system capable of addressing multiple contaminants simultaneously, offering promising implications for industrial wastewater management and global access to clean water.

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Abstract: Science and Engineering Fair of Houston

3216

Category: Earth and Environmental Sciences

Impact of Collagen-Based Biodegradable Hydrogels on Water Retention and Growth Rates of Sugar Snap Peas over a Three-Week Time Period

Samiksha Dhar Roy

Clear Creek ISD /Clear Lake High School

This experiment sought to evaluate the efficiency of collagen-based biodegradable hydrogels on the water retention and growth rates of sugar snap peas in relation to agar-agar and carboxymethyl cellulose (CMC) powder based hydrogels. The hydrogels were created with identical ratios but differing primary ingredients (specifically, cellulose, agar-agar, and CMC powder) and were used to create test groups 1 (G1), 2 (G2), and 3 (G3). All test groups had the same composition of cups: one control, one agar-agar, one cellulose, and one CMC, each with a sugar snap pea seed. G1 received water every 3 days, G2 every 7 days, and G3 every 14 days. Data was collected for 21 days. The findings indicated that the hypothesis was partially correct. Collagen-based biodegradable hydrogels improved growth rate, but not necessarily water retention. Agar hydrogels remain the best at water retention, but the collagen hydrogels were able to improve growth rates the most in comparison to other hydrogels in groups with decreased watering frequencies. The results of this experiment suggest that implementing agar or collagen-based hydrogels in agriculture has the capacity to improve water retention and boost growth rates, contributing to a more sustainable future.

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Abstract: Science and Engineering Fair of Houston

3217

Creating Functional Diversity Index using GPP: Analyzing Quadratic Entropy and Pianka's Index for Ecosystem Optimization

Henil Parmar, Aryan Ayyanger, Ahdav Vijay

Katy ISD/Seven Lakes - HS

Category:

Earth and Environmental Sciences

The growing need to regulate environmental conditions and optimize ecosystems for sustainability has contributed to the increasing need for specialized measuring indexes that highlight important features of that ecosystem. The very relevant research regarding how ecosystems function in the changing nature of the world has raised the dilemma of creating accurate biodiversity indexes that can be used by scientists for appropriate practices. Most of the research by environmental scientists regarding biodiversity and its applications incorporate community-holistic measurements or sheer counting of species in the community: these methods, although relevant, are often impractical for more complex analysis. We propose a functional diversity approach that is based on measurable resource consumption from gross primary productivity. The index incorporates self-tested and developed components developed on the ideas of Rao's Quadratic Entropy and Pianka's Index. In the project, the index was the base for our analysis on specific ecosystems that would help us verify the indexes ability to optimize efficiency. Contrary to many other biodiversity indexes, this specific index has found high tested accuracy over multitrophic ecosystems because of its dual interspecies analysis allowing for multiple resource types, derived from the pair-comparison approach of Pianka's Index. The study verified the index's ability to provide useful functional diversity information over multiple ecosystem configurations. Such analysis allowed for exploration on the best ways to preserve biodiversity; however, many future avenues are yet to be developed.

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Abstract: Science and Engineering Fair of Houston

3218

How do Microplastics affect the growth of organisms?

Jonathan George

Fort Bend ISD /Hightower High School

Category:

Earth and Environmental Sciences

How do Microplastics affect the growth of organisms? I always heard people talking about the dangers of microplastics, but I never saw anyone see the actual dangers it can cause. In order to find the true dangers, I set 3 experiments to see how microplastics affect the growth of organisms. The first experiment I had to prepare microplastic liquid by boiling LDPE plastic t-shirt. I then create 3 different percentages plus a control of microplastic water. After creating all 4 liquids I will get a glass petri dish with a chlorine free paper towel and germinate the seeds with the different plastic water. After a week I measure the root size to see what petri dish grew the most. My next experiment is to put the seeds in soil to see which will sprout the highest. To prevent any variables in the soil it was baked to eradicate all insects. My next experiment is for algae, and I use algae and microplastic water solution and wait 5 days to let it grow. After the 5 days I use a spectrophotometer and check the growth every other day. I found that the microplastics did in fact affect the growth of both the plant and algae negatively. This proves that microplastics are dangerous and should be used sparingly because if it is able to affect the growth on plants imagine the dangers it can do on humans.

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Abstract: Science and Engineering Fair of Houston

3219

Field Identification of White Hydrogen with Witch Circles from Sentinel 2 Imagery

David Liu

Home school/SpiderSmart Learning Center - Katy

Category:

Earth and Environmental Sciences

White hydrogen (natural or geologic hydrogen) represents a promising, carbon-neutral energy resource formed through subsurface geological processes such as serpentinization. This study explores the use of Sentinel-2 multispectral imagery combined with Spectral Information Divergence (SID) and Spectral Angle Mapper (SAM) techniques to identify and characterize hydrogen-abundant geological environments. Data are obtained from the ArcGIS Global Natural Hydrogen Occurrence archive, preexisting fairy (witch) circle datasets, real-time Sentinel-2 imagery accessed via Google Earth Engine, and reference spectra from the USGS Spectral Library. Multispectral bands sensitive to alteration minerals associated with hydrogen-forming processes are analyzed and compared with control sites from surrounding non-hydrogen-associated terrains. Statistical and spatial analyses are conducted to evaluate correlations between spectral divergence metrics, inferred mineralogical composition, and hydrogen occurrence indicators. The study aims to identify reproducible spectral signatures linked to natural hydrogen systems and demonstrate a scalable, non-invasive remote-sensing framework to support exploration and assessment of white hydrogen resources for clean energy development.

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Abstract: Science and Engineering Fair of Houston

3220

A Comparative Study of Color-Based Feature Extraction and Deep Learning for Automated Coral Bleaching Detection

Miheer Parasnis, Siddhanth Relan

Houston ISD/Westside HS

Category:

Earth and Environmental Sciences

Coral bleaching is a visible indicator of reef stress caused primarily by rising ocean temperatures. Current monitoring methods rely on manual surveys, which are time-consuming, subjective, and difficult to scale. This project investigates whether a traditional color-based detection approach or a deep-learning model more accurately detects coral bleaching from underwater images. Two methods were developed and compared. The first approach used classical computer vision techniques, including color normalization and pixel-level color thresholding, to estimate bleaching severity based on loss of pigmentation. The second approach used a convolutional neural network (CNN) with transfer learning to predict coral bleaching severity from the same images. To address underwater imaging distortion, both methods were tested with and without underwater color correction. Coral segmentation was applied to isolate coral regions and reduce background interference. Model performance was evaluated using accuracy, mean squared error, and robustness to lighting variation. Explainable AI techniques (Grad-CAM) were applied to the CNN to visualize which coral regions influenced predictions, ensuring biologically meaningful reasoning. Results show that the deep-learning model consistently outperformed the color-based method, particularly in partially bleached corals and variable lighting conditions. Color correction and segmentation significantly improved performance for both approaches. This study demonstrates that while simple color-based methods can detect severe bleaching, deep learning provides greater accuracy, robustness, and interpretability. The results highlight the importance of combining image preprocessing with explainable AI for reliable coral reef monitoring and suggest a scalable approach for early detection of coral bleaching.

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Abstract: Science and Engineering Fair of Houston

3221

A Sustainable Low-Cost Biochar–Electro-Fenton System for Removing Pharmaceuticals from Contaminated Water

Katelyn Dang, Elizabeth Nguyen

Alief ISD/Alief Taylor HS

Category:

Earth and Environmental Sciences

Pharmaceutical contaminants such as caffeine and ibuprofen are increasingly detected in water sources and are not fully removed by conventional wastewater treatments. This study assessed a low-cost, energy-efficient water treatment system using biochar adsorption followed by Electro-Fenton oxidation to remove pharmaceuticals and regenerate biochar for reuse, making it practical and sustainable for low-resource and developing regions. Contaminated water samples were treated using biochar adsorption, Electro-Fenton oxidation, or a combined biochar–EF process. Pharmaceutical concentrations were measured using UV spectrophotometry and calibration curves, and treatment effectiveness was determined based on percent removal across multiple trials. Using these measurements, we found that biochar adsorption alone removed approximately 65–75% of ibuprofen and 60–70% removal of caffeine, while Electro-Fenton treatment alone removed around 60–65% of ibuprofen and 55–60% of caffeine. In contrast, the combined biochar–EF system increased removal to approximately 85–90% for ibuprofen and 80–90% for caffeine, demonstrating that the dual filtration system was more effective than either treatment alone. Electro-Fenton regeneration restored biochar adsorption capacity, allowing regenerated biochar to retain over 95% of fresh biochar effectiveness, while non-regenerated biochar showed lower retention. These results demonstrate that combining biochar adsorption with Electro-Fenton oxidation provides a practical, affordable, and environmentally friendly approach to cleaning water of pharmaceutical pollutants, for high possibility for real-world use.

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Abstract: Science and Engineering Fair of Houston

3222

Solar Powered Salt Removal

Toyosi Sodeke

Alief ISD/Alief Early College

Category:

Earth and Environmental Sciences

This project investigated how the amount of salt in water affects the amount of clean water collected through solar desalination. The purpose was to find an easy and renewable method that could help people in dry areas with limited access to fresh water. One solar powered desalination setup was used with two bowls of saltwater: one containing low salinity and one containing high salinity. Both bowls were placed in direct sunlight for eight hours each day over three days. The fresh water that condensed on the plastic cover and collected in the inner cup was measured daily in milliliters using a syringe. Across the three days, the low-salinity bowl produced 12.0 mL, 13.5 mL, and 11.5 mL of fresh water. The high-salinity bowl produced 8.0 mL, 8.5 mL, and 7.5 mL. The average collected was 12.0 mL for low salinity and 8.0 mL for high salinity, showing approximtely 33.3% percent difference in yield. This consistent pattern supports the hypothesis that higher salinity lowers the amount of water that evaporates and condenses in a solar still. The experiment proved that solar desalination can effectively turn saltwater into drinkable water using only sunlight. The results show that sunlight can power a simple and sustainable system to provide clean water in areas facing drought or water shortages. By reducing salt levels or improving design efficiency, this process could be expanded to help communities gain reliable access to safe drinking water without electricity or expensive technology.

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Abstract: Science and Engineering Fair of Houston

3223

Cast Away Effective

Mason Moreno

Pasadena ISD/Pasadena Memorial High School

Category:

Earth and Environmental Sciences

For my project I will be inventing diorama sewer system that can separate trash from inside the sewer pipes themselfs. If I create a mechinism to collect and prevent trash and wast then less wast will enter the ocean keeping it more clean. My idea is to have a pipe that switches to a new one everytime it gets filled with trash, then when that pipe gets switced the trash gets thrown in a dumpster where its recycaled or proporly disposed of. The way the trash will get collected in the pipes is nets and a barrier that stops bigger trash like bottled water, packaging, ect from reaching the ocean.

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Abstract: Science and Engineering Fair of Houston

3224

Spill Patrol: Absorbent vs Oil

Annam Busari

Alief ISD/Alief Early College

Category:

Earth and Environmental Sciences

Oil spills are a major environmental concern because they contaminate water, harm wildlife, and damage ecosystems. Many traditional cleanup methods are costly, slow, or can create new environmental problems. Because of this, there is growing interest in using simple and affordable absorbent materials to help remove oil from water. The purpose of this project was to test common household materials to see which one absorbs the most oil and could serve as an effective option in an oil spill situation. The materials tested in this experiment were paper, cotton balls, paper towels, and cloth napkins. To compare the effectiveness of each material, a controlled oil and water mixture was created in separate containers. Each material was placed in the mixture for five minutes and then removed so the remaining amount of oil could be observed. This process was repeated five times for each material to increase accuracy and reduce the chance of random errors. Throughout the trials, consistent results were recorded which made it possible to clearly identify the differences in absorption levels between the materials. The results showed that the cloth napkin absorbed the most oil in every trial and left noticeably less oil in the container. The paper towel was the second most effective, absorbing a steady amount but also taking in some water. The cotton balls absorbed a moderate amount but reached their limit quickly. The paper absorbed the least oil and was the least effective overall. These results suggest that materials with thicker and more textured fibers trap more oil and work better in cleaning oil from water. This experiment demonstrates that everyday materials can play a role in small scale oil spill cleanup and highlights the importance of finding simple, inexpensive, and environmentally friendly solutions.

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Abstract: Science and Engineering Fair of Houston

3225

Category: Earth and Environmental Sciences

Triple Threat: Leveraging Functionalized Hydrogels, Magnetic Amplification, and Electrostatic Filtration in a Multimodal System for Optimized Water Purification

Karishma Parghi, Rishabh Yadav

Conroe ISD /AST: Academy of Science and Technology

Over 2.2 billion people, approximately one in three worldwide, lack access to potable drinking water due to the prohibitive cost, high energy demands, and environmental inefficiencies of conventional purification infrastructure, particularly in developing regions. To address this gap, we developed the "Triple Threat," a portable, multimodal filtration device that synergistically combines hydrogel adsorption, magnetic amplification, and electrostatic separation to target distinct contaminant classes. Phase I synthesized alginate-biochar hydrogel beads via ionic polymer cross-linking process to enable adsorption of heavy metals and organic pollutants. Phase II involved custom-made, high power electromagnets integrated in a Halbach array for enhanced amplification to trap ferrous particulates. Phase III deployed an electrostatic precipitation stage, utilizing high-voltage fields (> 400 volts) to capture the invisible nanoplastics and biological contaminants that escape standard filtration. Filter flow rate, geometry and throughput were optimized to maximize contact time within a compact footprint in Phase IV, and in Phase V, all three filtration mechanisms were engineered into a low-cost, portable device in a closed-loop feedback system. Performance was evaluated using a synthetic challenge solution with N > 1000 per trial. Statistical analysis using two-sample t-tests and Kernel Density Estimation (KDE) demonstrated significantly greater contamination reduction compared to control systems ($p < 0.001$). Furthermore, a Cohen's d exceeding 10 indicated a transformative effect size. The system demonstrated filtration efficiencies computed through TDS (489 ppm reduction), surpassing the industry benchmarks at a fraction of the cost, presenting a scalable and energy-efficient solution to global water insecurity.

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Abstract: Science and Engineering Fair of Houston

3226

Environmental Health of Lake Conroe: A Microplastic investigation

Auriana Thomas, Jaimiyah Harrison, Jacob Woods

Conroe ISD /ASHP: Academy for Science and Health Prof

Category:

Earth and Environmental Sciences

This project investigated the prevalence of microplastics in Lake Conroe. Understanding this could help find the root of plastic problems in Lake Conroe. It is hypothesized that finding the prevalence of microplastics in Lake Conroe can help reduce the death rate of fish. Students will follow established procedures set by Texas Parks and Wildlife with whom they are partnered with. Students were first directed to cut all 30 fish from the anal vent to the beginning of the throat with metzenbaum scissors. Then searched the insides of the bass until they got ahold of the stomach. After getting a hold of the stomachs. Students set them in a beaker of hydrogen peroxide until the stomachs dissolve. After the hydrogen peroxide broke down the stomachs the students were guided to put a droplet under the microscope and search for helpful findings. Few microplastics were found in the samples. The prevalence of microplastics in Lake Conroe are not found repeatedly. The alternative hypothesis was not supported with this experiment. It was concluded that microplastics are commonly not found in Lake Conroe. Further research could explore finding ways to prevent microplastics coming into our water systems at all.

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Abstract: Science and Engineering Fair of Houston

3227

Power Drop

Diana Barrios, Leonardo Bedolla

Aldine ISD/Eisenhower HS

Category:

Earth and Environmental Sciences

The purpose of this project was to measure how rainwater pH affects the energy productivity of a solar panel. Neutral, acidic, and alkaline rainwater were simulated using household solutions. Distilled water represented neutral rainwater. A mixture of lemon juice and water represented acidic rainwater. A mixture of baking soda and water represented alkaline rainwater. The hypothesis stated that if the pH of the solution moved away from neutral, the solar panel's voltage output would decrease due to residue buildup or surface reactions that block light. Each solution was sprayed onto the solar panel separately. Voltage output was measured with a voltmeter every 30 seconds for five minutes. Two trials were conducted for each solution, for a total of six experiments. The solar panel was placed under a lamp to provide a stable light source. Testing was done in a dark room to prevent outside light interference. The results showed that the neutral solution produced the highest voltage output. Both acidic and alkaline solutions resulted in lower energy productivity. These results supported the hypothesis that non-neutral rainwater reduces solar panel efficiency.

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Abstract: Science and Engineering Fair of Houston

3228

Category:

Earth and Environmental Sciences

Optimizing Nanoplastic Filtration: Analyzing the Role of Valency-Dependent Electrostatic Compression in Coagulation for Membrane Systems

Japesh Banker, Bilal Sorathia

Conroe ISD /AST: Academy of Science and Technology

Membrane filters, which are commonly used for industrial water treatment and air purification, easily acquire a negative surface charge. In addition to the colloidal nature of nanoplastics, this poses a threat due to repulsion between the filter and plastics, which can reduce filtration efficiency, and previous research has not looked into the role of valency in membrane filtration. This project enhances nanoplastic filtration by utilizing multivalent cations to mitigate electrostatic repulsion, promoting coagulation, serving as an efficient pre-treatment. According to the Schultz-Hardy rule, at lower concentrations, stronger cations have higher coagulation efficiencies. PET solutions were prepared, then pre-filtered through a coffee filter to remove any particles greater than 5 micrometers, ensuring uniformity across the particles. Additionally, Tyndall scattering was used to confirm nanoplastics were present. Salts with varying valencies were then added at different concentrations, along with a control with no salt. The solutions were then filtered through the CME membrane to compare filtration efficiencies. The removal mass was calculated by weighing the filter before and after the solutions were passed through. Following the mass measurements, key data points were noted and placed in a line chart to compare efficiencies. It was noted that cations with a higher charge performed better at lower concentrations, with AlCl3 removing the most plastics at .01M, MgCl2 at .05M, and NaCl at .1M. This project applies to washing machines, municipal plants, and offers a low-cost solution for underdeveloped regions, allowing them to filter previously inaccessible nanoplastics with no water wasted.

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Abstract: Science and Engineering Fair of Houston

3229

Fighting Crop Fungus

Category:

Earth and Environmental Sciences

Liliana Garza

Clear Creek ISD /Clear Brook High School

This project is targeted to help farmers prevent crop loss caused by the fungus fusarium oxysporum, in a natural and cost-friendly way. Fusarium oxysporum is a harmful fungus that causes tumor-like cell growth on grain crops, making them unsuitable to sell. To start the project, I researched natural antifungals and found 5 main results, pomegranate peel powder, mustard powder, clove, cinnamon, and oregano. I hypothesized that the substances will significantly reduce the amount of fusarium oxysporum growth. To test my hypothesis, I covered 30 petri dishes with the fusarium oxysporum, and added 1 antifungal into the center of 5 dishes, repeating with all 5 antifungals, but making sure to leave 5 dishes with no antifungal to be my control group. To collect data, I measured the zone of inhibition from end to end over a period of 5 days. After 5 days, only 2 antifungals had a significant zone of inhibition. Ground cinnamon had the largest zone of inhibition, averaging 2.25 cm, while mustard powder had the second highest averaging 1.15 cm. The rest of the antifungals had little to no effect on the fusarium oxysporum. To take this project a step further, I would like to see results in more types of antifungals and find a way to combine the antifungals for a stronger result, then to apply it to crops without disturbing the environment. This way, farmers can keep the environment around their crops safe while preventing fusarium oxysporum from affecting the crops.

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Abstract: Science and Engineering Fair of Houston

3230

Hydroponics vs Regular soil

Brianna Santana

Pasadena ISD/Pasadena Memorial High School

Category:

Earth and Environmental Sciences

In my project, I wanted to see which system grew plants better. I had predicted that the soil system would work better, as it's not just the bottom of the plant getting wet; the entire plant in the soil is getting wet. I planted 3 different types of cucumbers all the same cucumber type spring burpees but one was pesticide-free, the other had pesticides, and one came from a cucumber bought in H-E-B and I would see which would grow better by the end of the project by, measuring the how tall the plant of that type had gotten, and averaging it out and I counted and averaged out how many leaves the seed type had. In the end, the Hydroponic system ended up growing better plants as not only were they way taller but their leaves were a lot healthier making them have more height and leaves than the potted soil cucumbers which in the end did not support my hypothesis. My findings are important as this is a better option for planting all types of seeds especially the ones that need more care and time that you don't have you can instead use a hydroponic system as the plant waters itself with the bubbles that are made with the airflow between the air compression and where the plants are hanging.

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Abstract: Science and Engineering Fair of Houston

3231

Understanding the vegetation in the Mississippi River area

Category:

Earth and Environmental Sciences

Johnny Zhao

Home School/Homeschool

Hurricane Ida made landfall in coastal Louisiana on August 29, 2021, causing major flooding and damaging vast areas of wetland vegetation in the Mississippi River Delta. The goal of this project was to use Google Earth Engine and satellite imagery from the Sentinel-2 mission to measure how vegetation changed before, during, and after Hurricane Ida. I focused on analyzing the Normalized Difference Vegetation Index (NDVI), a widely used indicator of plant health, to determine how severely the wetlands were impacted and how long they took to recover. To complete the analysis, I used cloud-free Sentinel-2 images to create NDVI maps for the month before Ida and the weeks following the storm. I then calculated an NDVI "change map" and built a time-series plot for the entire year 2021. The results showed a sharp drop in NDVI immediately after Ida, marking the period of greatest vegetation damage, followed by a steady rise as plants began to recover. Overall, the study demonstrates how freely available satellite data and simple coding tools can be used to monitor environmental change and better understand how major storms affect coastal ecosystems.

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Abstract: Science and Engineering Fair of Houston

3232

Soil Erosion and the Impact on the Environment

Anya Savani, Sarah Yagci

Fort Bend ISD /Clements High School

Category:

Earth and Environmental Sciences

Soil erosion is a problem that affects agriculture worldwide. The purpose of this project was to investigate the effectiveness of different types of ground cover in preventing soil erosion through wind. Our hypothesis was that the rooted plant would provide the most protection against soil loss, while the bare soil would experience the most. We prepared 3 pots with the same type of soil, and 9 cm each. One was left bare as a control group. Another had a layer of dead leaves placed on the surface, and the last pot contained a rooted plant. Each pot was placed on a slope was blown by the same source, a leaf blower, and the same distance, for the same amount of time. The amount of eroded soil was collected and measured for each pot. The results showed that the bare soil pot had much more erosion, while the soil with the dead leaf cover had less erosion, and the pot with the rooted plant had the least amount of soil loss. In conclusion, the data supported the hypothesis that a rooted plant cover reduced the "wind" erosion, with living plants offering the best protection due to their root systems binding the soil. These findings elaborate on the importance of maintaining vegetation to protect soil from wind.

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Abstract: Science and Engineering Fair of Houston

3233

Storm250-L2: A Storm-Centric 250m NEXRAD Level-II Dataset for High-Resolution ML Nowcasting

Andy Shi, Lucas Jiang

Private/The Kinkaid School - HS

Category:

Earth and Environmental Sciences

Machine learning based precipitation nowcasting relies on high-fidelity radar reflectivity sequences to model the short-term evolution of convective storms. However, the development of models capable of predicting extreme weather has been constrained by the coarse resolution (1–2 km) of existing public radar datasets, such as SEVIR, HKO -7, and GridRad-Severe, which smooth the fine-scale structures essential for accurate forecasting. To address this gap, we introduce Storm250-L2, a storm-centric radar dataset derived from NEXRAD Level-II and GridRad-Severe data. We algorithmically crop a fixed, high-resolution (250m) window around GridRad-Severe storm tracks, preserve the native polar geometry, and provide temporally consistent sequences of both per-tilt sweeps and a pseudo-composite reflectivity product. The dataset comprises thousands of storm events across the Continental U.S., packaged in HDF5 tensors, rich context metadata, and reproducible manifests.

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Abstract: Science and Engineering Fair of Houston

3234

Meta-Analysis of the Impact of Ambient Particulate Matter on Lung Function Across the Lifespan

Anirudh Mohan

Fort Bend ISD /Elkins High School

Category:

Earth and Environmental Sciences

The main aim of this meta-analysis was to gather information from studies regarding how air quality is correlated with lung function by measuring spirometry values (FEV1 and FVC), classified according to age. There have been no studies until now capable of quantitatively summarizing information from multiple sources, considering age. Some single studies have discovered, nevertheless, an association between lung health values and air quality. The object of this meta-analysis, therefore, has been to deeply investigate existing evidence pertaining to a connection relating lung health issues to exposure of particulate matter such as PM2.5 and PM10. Meta-analysis has been achieved through a separation of age groups and a calculation of averages, Z-scores, and P-values by attempting to establish how strong of a connection exists, if at all. Since all P values, having been estimated for each age group, have been <0.01, it has been possible to establish a negative relationship between lung health and air pollution from a very young age until older ages. A deficit of 2.19% among children, a deficit of 31.2 mL among adults, and a deficit of 1.08% among the elderly have been found for every 10 $\mu g/m^3$ of exposure, emphasizing how different age groups are affected by air pollution and the importance of public health intervention in this area.

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