Project ID: 261

Senior Division

Earth and Environmental Sciences

Joanna Amaro
Bonita Vista High School
Gr. 11

Leslie Sandoval
Bonita Vista High School
Gr. 11

To What Extent Does Sewage from Tijuana, Mexico Affect the Waters in San Diego

AWARDS:

Kaiser Permanente Blue Ribbon Award
National Oceanic and Atmospheric Administration (NOAA) Award

The purpose of the research is to identify the extent of how sewage water from Tijuana has affected the beaches in San Diego. The constant problem that has arised is with San Diego's citizens noticing the effects that their beaches are going through, looking for an answer to the rise of pollution in their beaches. In this procedure we tested four different beaches, Pacific Beach, Coronado Beach, Imperial Beach, and Playas de Tijuana, in each beach we tested the water four times, for a total of 16 different trials together. We tested the pH levels to determine the contamination levels of each one and compare them. The reason for this experiment is to find out how much the pollution coming from Tijuana sewage and how much it's really impacting the beaches in San Diego. Before our experiment, we predicted that the PH levels in the waters will have a decrease as they are closer to Tijuana, compared to the beaches farther away in which will still be contaminated but the pH level won't be as low. Once we went through the experiment the answer was clear, the four beaches we had tested, the ones further away tested with a high pH of an average of 7.7, comparing it to Tijuana's beach with a 6.3, we determined that the sewage were in fact affecting the beaches along with other factors. We concluded that along with other factors sewage is one of the reasons for contamination in San Diego Beaches.

Project ID: 262

Senior Division

Earth and Environmental Sciences

Nevaeh Elefante
Bonita Vista High School
Gr. 12

Sofia Sanchez
Bonita Vista High School
Gr. 12

To What Extent Does Urbanization and Urban Population Affect the Time We Have on Earth Due to Climate Change?

This project delved into the impact of urbanization on carbon emissions and its implications for the future of our planet. Our hypothesis proposed that as urbanization increases, so do carbon emissions, ultimately reducing the time humanity has left on Earth. To test this hypothesis, we analyzed data found online on urban populations and carbon emissions for each state in the United States. After gathering the data, we used Google Sheets to correlate these variables, seeking to find any relationships. Our findings revealed a significant correlation between urbanization and carbon emissions, with an R-value of 0.62 indicating a reasonably strong association. Furthermore, The Earth's capacity to absorb excess carbon is finite, with a maximum limit of 400,000,000,000 metric tons. The United States contributes 5233.518 carbon units in one year, which is merely 1.867% of the world's landmass. Considering this and projecting forward, the estimated time until this threshold is reached is approximately 76,430,424.0475 years, solely based on the United States carbon emissions. However, if current trends persist, the consequences could be dire. Continued urbanization-driven carbon emissions threaten to disrupt the delicate balance of the ecosystem. The greenhouse effect poses a significant threat to the health and well-being of countless species, potentially accelerating the depletion of our remaining time on Earth. Our research highlights the urgent need for action to mitigate carbon emissions associated with urbanization. Failure to address this issue risks irreversible environmental damage and a shortened time frame for human habitation on Earth.

Project ID: 263

Senior Division

Earth and Environmental Sciences

Samuel Estrada

Holtville High School

Gr. 10

The Levels of Formaldehyde in the Imperial Valley

My idea for the Science Fair Project was to check any signs of formaldehyde in the Imperial Valley. I checked here in Holtville and in El Centro to see if there would be a stark difference between the two. Formaldehyde is a colorless gas that when inhaled for too long can cause severe problems with the body. I wanted to find out if there were high levels of formaldehyde in the Valley. If there are high forms of formaldehyde in Holtville and El Centro, then it means it could be a danger to those that have respiratory problems. My hypothesis is if El Centro has a lesser amount of formaldehyde than Holtville, then that means El Centro has more plants that give out oxygen to regulate the concentration levels of the air. I first detected the air quality content of formaldehyde in Holtville then I detected it in El Centro. The first few days I detected it at the park in Holtville and then I detected it in Bucklin Park and near the El Centro Library. The results show that the air is healthy and does not have a lot of formaldehyde, however, on January 31st, near the El Centro Library and the Holtville park, it showed unhealthy amounts of formaldehyde. This could possibly mean that on that certain day the air must've been affected by fossil fuels or smoke.

Did Not Attend Judging

Project ID: 264

Senior Division

Earth and Environmental Sciences

Danica Fincher

Bonita Vista High School

Gr. 11

Charcoal Filter Efficiency at Filtering Heavy Metals in Water

Around the world and in more unfortunate places in the United States, much of the water supply is polluted or unhealthy to drink. However, because of low resources or income, many people cannot properly get access to clean water or a way to properly filter their water. In this experiment, I created three different types of filters, replacing the charcoal material with activated charcoal, horticultural charcoal, and grill charcoal. I did this to test the efficiency of different types of charcoal in homemade water filters. In the filters, it contained the same type of materials in each of them including: coffee filters, cotton balls, different sizes of rocks and gravel, and the plastic containers. From that, I am able to see what type is most effective.

I created a simulated polluted water by adding in different types of pollutants including food coloring, soil, grounded Miracle Gro Shake n' Feed, pepper, salt, and dishwasher soap. With that, I added the water to three of the filters five times to create five different trials. To test the prevalence of heavy metals, I used water strips and tested a few different categories including: Iron, copper, iron, nitrate, nitrite, and sodium chloride. As for results, filter A had an average percent change of 70.5%. Filter B had an average percent change of 75.55%. Filter C had an average percent change of 77.84%. The best design with the most efficiency is Filter C, because the majority of the trials had the cleanest results, and had a larger overall percent change compared to Filter A and B.

Project ID: 265

Senior Division

Earth and Environmental Sciences

Daniela Gallegos
Central Union High School
Gr. 12

Hedwig Moss (Hedwigia Ciliata) Ability to Filter Arsenic in Bodies of Water

AWARDS:

American Academy of Pediatrics Climate Change and Health Committee - Honorable Mention

This research was inspired by the book "Exploring AP Environmental Science" where there is a page that has diagrams of different plants and natural ways of filtration. In the diagrams you see sunflowers being used to filter radioactive water and willow trees being used to filter the soil. Due to the salton sea affecting the quality of life for Imperial County this lab was made to see if you can find solutions that affect communities in more environmentally friendly ways. Arsenic is one of the biggest polluters in the salton sea. The hypothesis is if the more moss in the body of water that contains arsenic less the arsenic level will be. With the addition of the null hypothesis being there is no difference in the level of arsenic level when more moss is added. To create this lab you test the level of water without filtration after that you insert the moss test/check the level in the time intervals of 30 min, 60 min, & 120 min. The results were the 15.24 cm x 15.24 cm on average filtered out 20 ppb of arsenic while the 33.02 x 33.02 cm slab moss on average filtered out the 35 ppb of arsenic in the water. In order to properly display results both chi-square and percent change were included as graphs/charts This continued to prove the hypothesis supported and null hypothesis rejected .

Project ID: 266

Senior Division

Earth and Environmental Sciences

Naina Gandevia
Holtville High School
Gr. 10

Effects of Air Quality on Asthma

AWARDS:

US Air Force Award Winner

Problem: We want to test how bad the air quality is in Imperial Valley and see how it affects the asthma of the people who live in the Valley.

Hypothesis: People with asthma in the Imperial Valley are more badly affected than people with asthma in other regions.

We have used an air quality monitor to collect data in multiple places in our high school, in Holtville, El Centro, San Diego, Riverside, and Mexicali. We have also asked people with allergies and asthma how the weather affects them and have been recording the state of the air quality using the Weather app on our phones.

From this data we have gathered that the air quality in the Imperial Valley is usually bad enough to affect those sensitive to the air quality, but not others. There have been many days where the air quality has been bad and the Weather app has issued an air quality alert and where the air quality was bad due to people burning things in the fields.

What we have concluded from our project is that there is a large amount of people in Imperial Valley with asthma who are often badly affected by the bad air quality.

Project ID: 267

Senior Division

Earth and Environmental Sciences

Sarah Gao

Canyon Crest Academy

Gr. 11

From Trash to Treasure: Fighting Desertification with Biodegradable Soil Amending Hydrogels Synthesized from Food Waste

AWARDS:

Grand Award Runner Up#1 – Senior Division Physical Sciences – ISEF FINALIST
The General Atomics Sciences Foundation Science Award - Senior Division
Professional Engineers in California Government (PECG) Award Senior Division
Association for Women in Science - Winner
NASA Earth System Science Award
Nature Needs SD - Winner
Society of American Military Engineers - San Diego Post - Senior Division 1st Place

Degrading four million square kilometers of fertile land annually, desertification threatens food security for billions of people. To mitigate desertification, soil-amending water-absorbing hydrogels can be added to vulnerable soil, bolstering water retention and minimizing loss to evaporation and runoff. However, these hydrogels are made from costly acrylic-based chemicals (SAPs) with toxic side effects. Previously, orange peel waste has been identified as a sustainable and affordable alternative thanks to high concentrations of hydrogel-forming pectin. However, oranges are not grown in many of the regions affected by desertification, so I sought to find alternative pectin-rich plants to make hydrogels from. I used bioinformatics tools to identify plants with enzymes that had high sequence and structural similarity to orange pectin biosynthesis enzymes. Based on the results, I obtained pectin from three plants (apple, mango, pomegranate), synthesized hydrogels, and monitored their ability to retain water in soil compared to a commercial SAP and orange peel hydrogels. Using a home-made Arduino moisture sensor, I observed that the pomegranate hydrogel and apple hydrogel respectively retained 75.3% and 73.0% of soil moisture over seven days with 24/7 exposure to heat and light, outperforming the commercial SAP and orange hydrogel. Fitting three mathematical models to the data revealed that moisture loss most closely follows exponential decay. Finally, to help stakeholders remotely monitor soil moisture over large swaths of land, I trained machine learning models to predict soil moisture from hyperspectral data (R2 value of 0.92). My research provides a novel, low-cost, and sustainable solution for land threatened by desertification. Future steps include refining the pectin extraction process for better yield.

Project ID: 268

Senior Division

Earth and Environmental Sciences

Briana Gutierrez
Bonita Vista High School
Gr. 11

Kendall Johnson
Bonita Vista High School
Gr. 11

To What Extent Does Thermal Pollution Affect the Growth and Development of Duckweed?

Thermal pollution is the rapid change in temperature in a natural body of water due to human impacts. Industrial machinery and power plants are main contributors to thermal pollution""industrial sites and power plants often take water from a natural source and when the water is returned, the temperature is altered. How will thermal pollution affect the duckweed? The hypothesis is that thermal pollution will cause the duckweed to die. Two trials were conducted: control=regular temperature, experimental= 27 degree celsius. 25 mL of water was poured into 10 petri dishes= total of 10 =5 trials. 5 trials were done. 1 gram of duckweed was placed into each petri dish. The duckweed was checked at 2:30 p.m. daily to determine how many were dying each day. A dead leaf of duckweed was fully brown. Not all the duckweed survived in each trial. The highest percentage of dead duckweed was 36%, followed by experimental 41%. Through our observations of the duckweed over the course of 14 days, the rapid decline of alive duckweed witnessed in our experimental group exemplifies the natural progression and effects of thermal pollution on organisms in a body of water. The results we observed aligned with what we had initially expected as we knew that a heated body of water, 27 degrees celsius to be exact, could not support the life of the duckweed for a long period of time.

Project ID: 269

Senior Division

Earth and Environmental Sciences

Natalie Hernandez
Bonita Vista High School
Gr. 11

Elijah Hutchins
Bonita Vista High School
Gr. 11

Testing pH Levels Along San Diego Beaches and Its Correlation to Acidification

AWARDS:

American Society of Civil Engineers - Senior Division 2nd Place

Ocean Acidification is a serious issue that has detrimental effects on ocean ecosystems. Ocean acidification has been known to eat away at the calcium carbonate of the shells of shellfish and alter the chemistry of the ocean making it increasingly more acidic, Leading to habitat loss, and coral bleaching just to name a few. Therefore this experiment aims to see if ocean acidification is occurring in the community of San Diego through pH sampling of 3 beaches. The hypothesis is that If pH testing is done at 3 different beaches in San Diego then the results will show acidic results in comparison to other studies done in years past.

Procedure: For the experiment, every beach was tested the same way, with the only difference being the location. At each beach, 5 sample points were taken. The sample sites are spaced out around 0.2 - 0.3 miles. This was done to cover each area of the coast similarly during the same time of day was crucial because any environmental factors around the sites (human factors such as traffic and other forms of pollution) could influence the results. Additionally, testing days were consecutive to minimize environmental factors that could affect the data. All beaches were local to keep the same range of conditions.

Results: From those results, it was determined that there is some ocean acidification occurring in San Diego. Coronado had the most basic pH out of all 3 beaches with an average of 8.086, and a standard deviation of 0.138, the lowest of the three beaches, making the pH data consistent for Coronado. Silver Strand had the lowest average of 7.798, but the highest standard deviation of 0.44. This implies that Silver Strand, out of the three beaches, is most likely to be experiencing ocean acidification due to there being the most inconsistent data, but the highest standard deviation of 0.44. Imperial Beach averaged right in the middle with a pH of 7.994, and the standard deviation was just higher than Coronado with 0.167 meaning it had consistent pH data. Conclusion: Despite Coronado having a pH average of 8.086 this is still lower than the average ocean pH of 8.1.

Project ID: 270

Senior Division

Earth and Environmental Sciences

Max Lau

Westview High School

Gr. 11

Using Reflectance Spectroscopy to Detect Plant Stress in Harmful Soil Salinity Levels

AWARDS:

CSEF Qualified

This project analyzed the relationship between the health of Sinapis alba plants and its reflectance measurements in counts (Î¼W/cm2 for 610, 680, 730, 760, 810, and 860 mn wavelengths) when under long term salt stress. It was hypothesized that there would be a noticeable relationship between Sinapis alba's health and its reflectance when subject to harmful salt concentrations, and that measurements at earlier time points could be used to point towards future plant health, and results supported this hypothesis. For 9 hours of exposure, plants treated with up to 16 g/L salt concentrations showed little change in counts and visible health, similar to results from control (0 g/L), higher concentrations however, had visible deterioration in health and a drop in counts, suggesting an internal concentration similar to soil soaked in 16 g/L salt water. When plants were exposed to harmful salt concentrations then immediately unharmful concentrations, plant health and counts returned to baseline, suggesting a positive correlation between plant health and measured counts. Results suggest that predicting future health using earlier measurements is viable, after 21 hours, plants were separated into "healthier" and "damaged" groups, and results indicate that there is a statistically significant difference in both raw counts and percent change at 6 hours. When exposed to stress, plants respond chemically in many ways. With salt stress, Sinapis alba appears to respond in a way such that its measured counts in the 6 selected wavelengths decrease, with these chemical changes preceding visible indicators.

Project ID: 271

Senior Division

Earth and Environmental Sciences

Tanvi Movva
Del Norte High School
Gr. 10

Eco-Friendliness of Mineral and Chemical UV Particles in Sunscreen Products

Sunscreen is essential for protecting skin from harmful UV radiation, but the ingredients that it contains can have detrimental effects on the earth and its marine ecosystems, like leading to coral reef bleaching. Around 14,000 tonnes of sunscreens get into waterways each year, which highly impacts the marine environment. The purpose of this experiment is to investigate how much of sunscreen's harmful UV absorbing chemicals get from the skin into the water at different intervals after sunscreen application. This is used as a proxy of how eco-friendly or reef-safe the sunscreen products are.

To start, a calibration curve was created using 9 different concentrations of sunscreens. The concentration was plotted against the absorbance calculated from the UV index measured using an UV meter. This is called the Beer-Lambert equation curve. Next, samples were created with different wait times of sunscreen application before getting in contact with water (1, 7, 15 and 30 minutes). After this, the absorbance would be calculated using the measured UV index and the previously created calibration curve, to determine the concentrations.

It was observed that the UV particle concentration decreases by 80% after application, waiting for 30 mins before interacting with water. Physical sunscreens containing ZnO particles are not soluble in water and stay on the skin. Physical sunscreens are preferred in comparison to chemical sunscreens. If chemical sunscreens need to be used, the sunscreen should be applied at least 30 mins before entering the water

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Continue on for Senior Division Earth and Environmental Science Projects # 273 – 278.

Project ID: 273

Senior Division

Earth and Environmental Sciences

Nathan Qiu
Canyon Crest Academy
Gr. 10

Remote Sensing for Disaster Response - Using Deep Learning Neural Networks to Classify Infrastructure Damage from Aerial and Satellite Imagery

AWARDS:

American Society of Civil Engineers - Senior Division 1st Place
BIA Cares - Senior Division 1st Place
CSEF Qualified

Disaster response is the series of actions taken by government officials, humanitarian organizations, and individuals before, during, or immediately after a natural disaster, to help the people affected. The goal of disaster response is not only to rescue and save lives, but also to ensure the health, safety, and basic needs of affected peoples. Disaster response includes many actions such as evacuation, search and rescue, emergency health care, food and water management, and re-establishment and maintaining of critical activities such as transportation and communication systems.

One significant problem within the scope of disaster response is logistics and classification, specifically, the classification of infrastructure, infrastructure damage type, and infrastructure damage severity. This includes the classification of buildings, roads, rubble, flooded areas, and more. Infrastructure and damage classification help coordinate search and rescue efforts, mitigate damage, prevent further incidents, and rebuild the community effectively and efficiently.

I intend to solve the problem of classification of infrastructure and damage through more efficient and effective automated means. Specifically, I will first construct two neural network algorithms. The first will classify the type of infrastructure present in an image, such as buildings, roads, or none. The second will classify the type of infrastructure damage present in the image such as flooding, rubble, miscellaneous, or none. Then, I will develop two more neural network algorithms specifically to categorize building footprints and flood damage. The first will create a heatmap of built land cover such as buildings and roads based on an image. The second will classify the severity of flood damage in an image.

Project ID: 274

Senior Division

Earth and Environmental Sciences

Srija Sengupta
Westview High School
Gr. 11

Effects of Temperature and Aeration on Dissolved Oxygen Levels in Lakes

Both land and aquatic organisms require oxygen to survive, but there is a much lower amount of available oxygen in water than air. If aquatic organisms do not get enough oxygen from the dissolved oxygen in the surrounding water, they can be put under immense stress and even die. Temperature and aeration tremendously affect dissolved oxygen content in water. Thus, I decided to test out 5 different temperatures, ranging from cold to hot, with 2 different aeration levels, both aerated and non-aerated. I hypothesized that the highest temperature of water with no aeration will contain the lowest amount of dissolved oxygen. The independent variable in this experiment was the temperature/aeration combinations chosen. The dependent variable was the parts per million of dissolved oxygen in each sample. The control variable were the cups of room temperature (25℃) water with no added aeration to simulate a real lake.

Procedure: I collected water from Lake Poway since many aquatic organisms reside in Lake Poway. Then, I split the water into 30 samples of different temperature/aeration combinations, ranging from cold to hot and aerated to non-aerated. I used dissolved oxygen test kits to find the dissolved oxygen content of each trial and recorded my data.

Results: The results showed that the highest temperature of water with no aeration contained the lowest amount of dissolved oxygen. There was a clear inverse relationship between temperature and dissolved oxygen content. Aeration increased dissolved oxygen content relative to the non-aerated samples of each temperature, but these aerated samples also followed an inverse relationship relative to temperature.

Conclusion: My hypothesis was supported with my data. The highest temperature of water with no aeration did indeed contain the lowest amount of dissolved oxygen. My results confirm an inverse relationship between dissolved oxygen and temperature, as well as that aeration increases DO content. Fish and aquatic organisms require 6-12 PPM of dissolved oxygen to live, which can only be achieved through lower temperatures and high aeration.

Project ID: 275

Senior Division

Earth and Environmental Sciences

Minghui Yao
The Bishop's School
Gr. 10

Sophie Zeng
The Bishop's School
Gr. 10

Today's Technology for Today's Environment - Using AI to Enhance Invasive Plant Removal

AWARDS:

Nature Needs SD - Winner
Torrey Pines Docent Society - Senior Division 1st Place
CSEF Qualified

Invasive species are the largest threat to global biodiversity, second only to habitat loss (Rosane). Removal and control expenditures of invasive plants cost billions of tax dollars yearly, exacerbated due to a lack of initiative and capability among regular citizens (Pinheira). The average person does not know what hundreds of different invasive plants look like or the proper procedure to remove them. This research project aims to develop an AI algorithm that identifies the most invasive plant species in local communities as a tool for volunteers, breaking down the knowledge barrier to invasive plant removal, starting with San Diego County. The algorithm uses a convolutional neural network, which was trained using several thousand expert-confirmed invasive plant images from the Calflora and Bugwood Image databases. Through dozens of tests and detailed tuning, it accumulated a top-2 and top-3 accuracy of 80-90%. We utilized data analyzation and visualization methods such as confusion matrices to gauge the model's performance and adjust accordingly. Invasive plant control experts from the SD River Park Foundation, California Invasive Plant Council, and SD Park and Recreation confirmed our conclusion that AI tools such as the one developed in this experiment will revolutionize and greatly streamline their work. Once implemented into a mobile app, this algorithm will equip volunteers with an accessible tool that allows for greater efficiency and scalability in removing invasive plants.

Project ID: 276

Senior Division

Earth and Environmental Sciences

Lilian Zeng
Del Norte High School
Gr. 10

Forever Chemicals? Maybe Not! Bioremediation of Perfluoroalkyl Substances in Waste-water Using Active Carbon and Plate-based White Rot Fungi

AWARDS:

American Academy of Pediatrics Climate Change and Health Committee – SR Div Honorable Mention
American Society of Civil Engineers - Senior Division 2nd Place
San Diego County Water Authority - Senior Division 1st Place
WateReuse Association - San Diego Society - Winner
CSEF Qualified

Per and Polyfluoroalkyl substances (PFAS) are a group of synthetic chemicals that have fluorine atoms connecting to alkyl chains, with 15000+ PFAS compounds registered at US EPA. Because of their stability and inertness to environmental changes, they are widely used in household and industrial applications. This leads to significant accumulation in the environment, being linked to adverse health effects in humans and wildlife. This project developed a sustainable method to enrich and bioremediate the PFAS in water systems by combining activated carbon (AC) and Laccase enzymes, an enzyme extracted from White Rot Fungi (WRF).

AC only and AC immobilized with Laccase (ACL) were mixed with solutions of two types of PFAS compounds (FS-35 and PFOA) respectively, at three different concentrations. At different intervals of mixing time, residual PFAS concentrations were analyzed by LC-MS. Both AC and ACL effectively absorbed all FS-35 and PFOA at low concentrations after day 5, and all FS-35 at high concentration after day 12. Laccase immobilized on AC improved PFAS removal efficiency by 30% at high-concentration level of FS-35. PFOA was more effectively absorbed than FS-35, due to its ionic carboxyl group. Analyses of methanol extracts from AC and ACL also showed Laccase on ACL did bioremediate FS-35 during absorption.

This is the first time combining activated carbon absorption and Laccase bioremediation for PFAS treatment. Current results demonstrate potential to remove and biodegrade PFAS in aqueous systems with long-term environmental sustainability. Further studies are ongoing for better mechanism understanding and process optimization.

Project ID: 277

Senior Division

Earth and Environmental Sciences

Emily Zhang
Canyon Crest Academy
Gr. 11

Plant Seed Mucilages: A Novel Adsorbent and Flocculant for Maximized Textile Dye Removal

AWARDS:

American Society of Civil Engineers - Senior Division 1st Place
Association for Women in Science - Winner
US Air Force Award Winner
CSEF Qualified

Global water scarcity is exacerbated by industrial pollutants like methylene blue. Traditional removal methods have limitations, prompting exploration of sustainable alternatives. This study investigates different plant species' mucilage in removing methylene blue. Mucilage was extracted at 35 °C using a hot water stirring method and manually separated using a cheesecloth. The mucilage was then dried in the oven into a powder. Compositional analysis was conducted using FTIR to analyze functional groups present in different mucilages. The dye removal experiment was performed with a synthetic wastewater solution with a concentration of 8 mg/L, at room temperature of 21°C, and a settling time of 30 minutes. A total of 15 trials were completed, repeating each adsorbent-flocculant 3 times. Based on the one-way ANOVA and regression model analysis, the type of plant mucilage greatly affects the effective percent dye removal, with certain plants more effective than others. The regression model confirmed that for each mucilage, there was a strong, positive correlation between mucilage dosage and percent dye removal. FTIR revealed the strong transmittance of functional groups, primarily in basil and chia seeds. The results show that the optimized parameters for the adsorption-flocculation were with basil seeds at a dosage of 35 g/L. The dye removal reached up to 97.35% under these parameters, outcompeting the synthetic flocculant aluminum sulfate. This approach offers a cost-effective and sustainable method for addressing water pollution, particularly in resource-constrained settings. Further exploration of large-scale applications and cost-effectiveness analysis is warranted to facilitate widespread adoption.

Project ID: 278

Senior Division

Earth and Environmental Sciences

Austin Zhang
Del Norte High School
Gr. 10

Investigating the Effects on Plant Growth and Disposal Methods for Various Types of Used Batteries

AWARDS:

CSEF Qualified

Batteries can exert a significant influence on soil health through the release of toxic chemicals and heavy metals, posing risks to human health and the environment. Investigating these impacts and exploring eco-friendly battery alternatives is crucial for mitigating environmental damage. This study focuses on comparing the chemical composition of commonly used batteries and assessing the effects of key metals""Lithium, Lead, Nickel, and Zinc""on plant growth and seed germination.

Our study reveals diverse impacts arising from various metal contaminations within a short timeframe. Among these, Lithium and Nickel demonstrate the most severe adverse effects, with Lithium leading to complete plant death and no growth, while Nickel induces grey, withering leaves and minimal growth, less than 10% of the control group. Lead inhibits plant growth by approximately 80%, with noticeable leaf drooping. Conversely, Zinc exhibits growth patterns similar to the control group, displaying a healthy and flourishing appearance. Similarly, in the seed germination experiment, Zinc significantly enhances the seed germination rate by over 50%, whereas Lithium, Nickel, and Lead completely impede seed development.

The study elucidates the harmful consequences of heavy metal contamination on both plant growth and seed germination, emphasizing the necessity for tailored disposal methods based on battery types and their contained chemicals. While alkaline and zinc-carbon batteries can be safely discarded in trash containers, Nickel metal hydride and Lithium batteries necessitate specialized recycling services, and Lead-Acid batteries should be returned to retailers or hazardous waste collection programs. Such practices are vital for mitigating environmental harm and ensuring sustainable soil health management.