CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Nicole M. Abudayeh

Project Number
J1101

Project Title
Photocatalytic Water Purification

Abstract

Objectives/Goals
My objective is to find the best substance to be used as a catalyst in the photocatalytic water purification.

Methods/Materials
I tested Titanium Dioxide, Zinc Oxide, Iron Sulfate, Sodium Fluoride, and Magnesium Malate, because they are good semiconductors, and they absorb light easily, which are the two main characteristics of photocatalysts. I added the different substances to 16OZ water bottles filled with river water, then I used agar petri dishes to grow bacteria from the original collected river water as well as the water treated by the 5 different catalysts after 3 different time lapses (10, 15, and 20 hours). I checked the bacteria growth of the original water and the water treated by the photocatalysts after each sun exposure period applying the Petroff-Hausser cell counter method, using a grid and a microscope to count the number of bacteria on each agar petri dish, and I compared the results.

Results
The data showed that Magnesium Malate, unlike the other photocatalysts, was able to eliminate all traces of bacteria in water within 20 hours. Magnesium Malate gave the best results for photocatalytic water purification. Magnesium has a vital role in plants' photosynthesis, it can absorb large amounts of light at a time, so it is a powerful photocatalyst to start the oxidation process of the microorganisms for photocatalysis.

Conclusions/Discussion
The performance of Magnesium Malate as a catalyst that harnesses the UV radiation from sunlight and uses the energy to break down a wide variety of organic materials, organic acids, pesticides, and microbes, was proven to be superior then other catalysts. Using Magnesium Malate as a photocatalyst and the sun UV light for water purification is an environmentally friendly, sustainable and inexpensive solution, especially for addressing drinking water quality issues in the developing countries, as well as disinfecting water after natural disasters.

Summary Statement
I found that Magnesium Malate is the best catalyst to be used in photocatalytic water purification

Help Received
None. I performed the experiment myself

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Sam L. Allen

Project Number
J1102

Project Title
Biodegradable Fog Harvesters

Abstract

Objectives/Goals
The objective of this project is to create or find the most effective biodegradable mesh out of burlap, cotton, linen and cotton/rayon to replace the nylon or polypropylene mesh used in the average fog harvester.

Methods/Materials
My materials were a Waterproof fan, Ultrasonic humidifier ("fog maker"), Stack-able plastic storage container with lid, Measuring cup
Fabrics to be tested, Something to mount fabrics on, Water. I timed the amount of time each fabric had fog blowing onto it, measured the amount of water each fabric collected and tested another fabric repeatedly 3 times for each fabric

Results
My test results showed that burlap was the most effective biodegradable fabric for collecting fog water, collecting on average 145 ml. of water. This result is very helpful in finding a potential alternative fabric to use in fog harvesting that is biodegradable because burlap is extremely biodegradable and can even improve the fertility of the ground that it breaks down in through the composting process. One clear drawback with using biodegradable fabrics appears to be that after being saturated, it is much less effective. The amount of water decreased as I reused the biodegradable fabrics, while the nylon or polypropylene showed no decrease in the rate of water collection. Another drawback that my project did not test for but which seems likely is that these biodegradable fabrics may not be as durable as the nylon or polypropylene fabric that is currently used, since they may degrade quickly when exposed to sun, water, and wind over the course of time. Lastly, this project did not analyze other relevant factors such as fabric cost.

Conclusions/Discussion
Based on my results I can conclude that among the fabrics tested, the most effective biodegradable fabric- burlap- was not as effective as the nylon or polypropylene fabric currently used in most fog harvesting set-ups. Although my objectives were met in my project, my hypothesis was incorrect. I thought that the cotton fabric would be the most effective of the biodegradable fabrics in harvesting fog, but really it was the burlap that was optimal.
If I were to continue my project, I would try to find a fabric that is biodegradable like burlap, but effective and durable like nylon and polypropylene, and is also comparable in cost to these non-biodegradable fabrics that are currently in use.

Summary Statement
I found a biodegradable material that was close to as effective as the one currently used in todays fog harvesters.

Help Received
I would like to thank my Dad for buying the materials and providing a printer for me. My grandparents for letting me use their house for testing, and my teacher for giving me support in the writing process and structuring my board.

Name(s)
Raven J. Alvarez

Project Number
J1103

Project Title
Project CO2: Simulating Roadside Fires and Their Production of Carbon Dioxide

Abstract

Objectives/Goals
The objective is to determine which plants, native to Northwestern California, are least likely to start roadside fires and will produce the least amount of carbon dioxide when burnt.

Methods/Materials
I used program R to conduct a bootstrap simulation to find which plants, specifically native to Northwestern California, produced the least amount of carbon dioxide, taking into consideration local fire ecology, the probability of each plant igniting, the biomass and the carbon content of the plant. The data used to define the parameters of the model came from my data synthesis. Data sources included the ECN Phyllis2 database of plant composition, the NOAA Storm Prediction Center, InciWeb, journal articles, and government reports.

Results
Lupine produce the least amount of carbon dioxide at 1.51 kg per kg burnt and Douglas fir produced the greatest amount of carbon dioxide at 2.03 kg per kg burnt. My analysis indicated that although trees burn less frequently than grasses, over multiple years, trees would produce a greater amount of carbon dioxide than grasses.

Conclusions/Discussion
When applying analysis results to the needs of roadside replanting, I would recommend a grass for a quick growing root system to hold the soil. Later, as a more permanent plant, Lupine would be the most advisable. These plants would produce the least amount of carbon dioxide if burnt and they are short enough not to be in contact with electrical lines. If humans take into consideration which plants are used when re-vegetating our public areas we can help prevent large amounts of carbon dioxide from being emitted into the atmosphere. These actions can do even more to fight global warming by sequestering large quantities of carbon dioxide from the atmosphere.

Summary Statement
My project investigates which plants would be best for re-vegetating roadsides to prevent fires and reduce carbon dioxide production.

Help Received
I was advised on where to find carbon content data by Mark Severy, a Research Engineer at the Schatz Energy Research Center, Humboldt State. Nick Nauslar a NOAA contractor in the Storm Prediction Center provided fire prediction information. I coded my simulation and my father reviewed my code.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Jillian E. Avila

Project Number
J1104

Project Title
The Removal of Microplastics in Ocean Water Using Homemade Filters

Abstract

Objectives/Goals
Create inexpensive filters from materials in your home to effectively filter out microplastics found in Ocean water.

Methods/Materials
Constructed a screen from a hardware store to dip into the first 6 inches of ocean water and collect surface samples. First filter materials were: plastic and glass water bottles, gravel, activated and crushed charcoal and clean sand. Second filter materials were: turkey baster, activated and crushed charcoal, and coffee filter. Using a microfiltration rig supplied by my advisor, I was able to compare the controlled sample to the two types of homemade filters.

Results
The result of using my filters demonstrated that they were effective in removing 97% of microplastics from the ocean water sampled. The average number of plastics counted in the control group was 86 particles. The filtered water average was 2 particles.

Conclusions/Discussion
The result of a homemade filter was effective in removing microplastics. Over 5 trillion pieces of plastic are currently polluting our oceans. 8 million tons of plastic is dumped into our oceans each year. Education and prevention would be the optimal solution. Knowing a simple filter can remove such a high percentage of plastics could be useful in industrial uses such as retrofitting ocean liners and fishing boats.

Summary Statement
I created homemade filters that effectively removed microplastics from ocean water.

Help Received
My advisor and mentor Dr. Craig Carlson gave me the use of his lab and advised me on how to compare a control group to my samples. I found samples of the filters online and cited the creators in my project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Carlos Ayala; Cristian Hernandez-Salazar; Damian Lopez

Project Number

J1105

Project Title

3D Printed Water Filter

Abstract

Objectives/Goals

Our goal was to design something that could help different parts of the world obtain clean water. Our problem that we were addressing was the lack of clean, drinkable water in many parts of the world. We wanted to design a solution that could be 3D printed that would help filter water.

Methods/Materials

Using Solidworks Computer Aided Drafting software at our school, we were able to design different prototypes that would filter the water. The filters were designed and 3D printed and then tested with filtration materials that are easily available. This was a layer of cotton, a layer of activated carbon, and a layer of sand. After each prototype was tested, the next prototype was designed, which improved on the last one. Each prototype was created based on the observations of the previous prototype's testing results.

Results

Based on the results of each prototype, a working filter was able to be designed and 3D printed that resulted in cleaner water and no leaking. This was based on 5 different rounds of prototypes, with each prototype being an improvement on the previous one based on the observations.

Conclusions/Discussion

This project resulted in an expansion on the use of 3D printing in the field of environmental engineering. What this project showed was that an effective and useful model for a water filter could be designed and engineered that can be used in all parts of the world to filter water.

Summary Statement

We were able to design and 3D print a water filter that effectively filters polluted water.

Help Received

We were able to do the design, 3D printing, and testing ourselves. Our STEM teacher assisted us by teaching us how to use Solidworks CAD software.

Name(s)
Danya Balagopal

Project Number
J1106

Project Title
Constructing a Sustainable, Low-Cost Herbal Biosorbents Filter to Remove Heavy Metals from Contaminated Groundwater

Abstract

Objectives/Goals
22% of California's community water systems rely on contaminated groundwater.Activated carbon filters are expensive and nonrenewable.The goal of my project is to construct a sustainable, low-cost filter by investigating the biosorptive effect of torrefied Oryza sativa hull pellets, Moringa oleifera seed kernels, Vetiveria zizanioides roots, Azidirachta indica leaves,and the adsorptive effect of Kaolinite, and Kaolinite-Carica papaya on the removal of iron and copper by 75% and reduce turbidity by 50%.

Methods/Materials
Torrefied O.sativa hulls, M.oleifera seed, V.zizanioides roots, A.indica leaves, kaolinite and kaolinite-c.papaya clay bowls were tested by soaking each of them in groundwater and varying:
Temperature (100,110,120C)
Adsorbent dose (5g,10g,15g)
Contact times (60,120,180 minutes)
with four trials each against the control of untreated groundwater. A Sper Scientific Turbidity meter was used to test turbidity. The removal efficiency was calculated and analyzed through ANOVA and supported by literature.

Results
My experiments supported the hypotheses proving that the biosorbents could remove iron and copper from groundwater by more than 75%. All tested biosorbents removed iron by 100%. V.zizanioides and the Kaolinite hybrid clay removed copper by 100%, while the others were at 80%. M.oleifera, V.zizanioides, and Kaolinite reduced turbidity by 50% and Kaolinite hybrid clays by 70%. However, O.sativa and A.indica did not support the hypothesis as they increased turbidity by 105% and 80% respectively.

Conclusions/Discussion
All the biosorbents adsorbed metals for different reasons. Torrefying O.sativa created a porous cell structure that increased the surface sites available for metal ion adsorption. The herbs adsorbed through complexation although they contain different compounds: both M.oleifera, V.zizanioides contain saponin, while A.indica contain salannin and azidiractin.Kaolinite clay possesses a high ion exchange capacity, while kaolinite-C.papaya has a high cation exchange capacity. M.oleifera, kaolinite and kaolinite-C.papaya possess strong flocculation and/or coagulative properties which reduced turbidity. My product which consists of a kaolinite- C. papaya hybrid bowl with V.zizanioides roots and a water-soluble capsule containing M.oleifera only costs $1.35 to produce.This provides a low-cost and sustainable alternative to carbon filters for rural communities dependent on groundwater.

Summary Statement
My project investigated the effect of six biosorbents on the removal of iron and copper and turbidity reduction in groundwater, to construct a sustainable, low-cost herbal filter as an alternative to activated carbon filters.

Help Received
I designed, experimented, and analyzed my results on my own. I thank my teacher, Dr. Wilmot, for his support; Mr. Dan Coltrin (Forensic Laboratories) for answering my questions; Clay Planet for firing my kaolinite bowls.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Mokshitaa Dhamotharan; Kaitlyn Venator

Project Number
J1107

Project Title
An Alternative Water Filtration System

Abstract

Objectives/Goals
The objective of this project is to provide clean drinking water to people in third world countries.

Methods/Materials
2 liter plastic bottles, 1 liter plastic bottle, various filtering materials, microscope and slides, water testing kit, bowels, cups, skewers, measuring spoons.

Results
A filter containing activated carbon, sand, and gravel can successfully filter turbidity out of water.

Conclusions/Discussion
Out of 4 different water filters the filter containing activated carbon, sand, and gravel was successful in filtering dirt particles in the water.

Summary Statement
We created an alternative filter that effectively remove turbidity out of water.

Help Received
None, my partner and I designed and built the project by our selves

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Allyson Diosdado; Savanna Strawn

Project Number

J1108

Project Title

Getting Microplastic Beads Out of Our Oceans

Abstract

Objectives/Goals

We are designing a submersible R.O.V that collects microplastic beads in the ocean. These are particles of plastic that are mostly found in hygienic products that are harmful to fish, birds, marine mammals and humans. Approximately 17.2 million microplastics beads are released into our oceans everyday. We designed a gate out of lego robotic parts and a filter as well, as for concentrating on the tiny microplastic beads. Overall, our R.O.V successfully worked using the gate, filter, and spandex cloth net.

Methods/Materials

We constructed the 3D "T-shaped" frame of the R.O.V out of PVC pipe. Then, we designed our net out of spandex cloth and wooden skewers. We have a layer of tulle in front of the net for extra filtration. We also constructed a movable gate and a filter out of Lego robotic parts. We added the steel washers and pool noodles for buoyancy. We then modified our original model to the one we have now, moving the filter into the net behind the tulle.

Results

After several test, we found the spandex material, out of the 4 materials we tested, works best for the net. The spandex allowed water to flow through and also trapped the microplastic beads.

Conclusions/Discussion

Overall, the submersible R.O.V we constructed to help collect oceanic pollution, which was focusing on the tiny little particles which are dangerous microplastic beads, successfully collected microplastic beads. We used the spandex cloth for the net. We placed the filter inside of the net with tulle in front of that. We also built a filtration system and a movable gate using the Lego robotics kit. This design of the net successfully collected microplastic beads filtering out the bigger trash. The R.O.V worked phenomenally at collecting microplastic beads.

Summary Statement

We are constructing a submersible R.O.V to collect oceanic pollution, focusing on microplastic beads, that are harmful to fish, birds and other marine mammals.

Help Received

Mira Loma MS STEAM Academy teacher Marry Ward supplied us with most of our recycled materials.

Name(s)
Ryann O. Flach

Project Number
J1109

Project Title
The Effectiveness of Hydrophobic Soil in Increasing Water Capacity in Reservoirs

Abstract

Objectives/Goals
The purpose of my science project is to determine if there is a beneficial way to use hydrophobic soil to increase water storage. This is important because farmers need water for irrigation and farming while the environment continues to experience drought conditions, declining supply of ground water and lack of good ways to store water.

Methods/Materials
I produced hydrophobic soil through a long, intensely hot burn process using soil collected from high elevation. In the lab test, I used hydrophobic and non-hydrophobic soils to perform soil measurement tests with 2" and 4" levels of soil for each type. I poured 125 ml. water into soil-filled test tubes and used a timer to record water level measurement as the water percolated through the soil and into the measuring cups below. I did 10 trials for each soil level and type. In the field test, I made 2 shallow holes in the ground and layered one with hydrophobic soil. I filled both with water and recorded percolation times.

Results
In both the lab and field testing, results showed that water percolation occurs faster in non-hydrophobic soil than it does in hydrophobic soil - water runs through non-hydrophobic at a faster rate. In the 2" soil test, avg ml. of water collected for non-hydrophobic soil was 86.9 ml vs. 69.1 for hydrophobic soil at 2 minutes. In the 4" soil test, avg ml. of water collected for non-hydrophobic soil was 77.9 ml. vs. 35.8 ml. for hydrophobic soil at 5 minutes. In the field test, at 30 minutes, there was little water remaining in the non-hydrophobic soil hole and the hydrophobic layered hole was still holding water.

Conclusions/Discussion
After completing my investigation, my results showed evidence that there could potentially be a beneficial way of using hydrophobic soil to layer reservoirs and pond basins to prevent percolation and increase water storage. I think its important to find ways to increase water for farming and irrigation purposes so we work together to keep livestock and grow crops that feed the world.

Summary Statement
The purpose of my science project is to determine if there is a beneficial way to use hydrophobic soil to increase water storage.

Help Received
Mr. Carl Gong was a resource for the project idea and direction. My dad served as the parent supervisor for the controlled burn.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Pascale C.H. Fung

Project Number

J1110

Project Title

Comparing Plant Populations in Restored vs. Disturbed Areas at San Elijo Lagoon

Abstract

Objectives/Goals

Many plants native to the Coastal Sage Scrub plant community are being crowded out by invasive plant species that compete for space, nutrients and water. In Encinitas, the San Elijo Lagoon Conservancy is working on restoration projects to reduce the growth of invasive plants and to restore disturbed lands by planting native species. The goal of my project was to document and compare the plant populations in the restored versus disturbed areas of the San Elijo Lagoon reserve. I believed that certain invasive species might still grow in restored areas and that certain native plants might still be able to thrive within disturbed lands.

Methods/Materials

I documented and analyzed over 150 plant samples. For my field tests, I visited the San Elijo Lagoon reserve multiple times over a three-month period from November 2017 through February 2018. I evaluated 23 quadrats and 21 transects at multiple locations near the Santa Carina Trail to document the plant species that were predominant throughout the restored versus disturbed areas. I used a meter tape to make transects of 15 meters and documented each plant in increments of 5 meters. I used a 0.5 m by 0.5 m quadrat that I divided into four sections to estimate plant percent coverage. I then computed and compared the average percentages of invasive versus native plant species that were present in the restoration area versus the disturbed lands.

Results

Surprisingly, but happily, my results revealed no invasive plants in the six-year restoration area of the San Elijo Lagoon reserve. The most predominant natives were the California Sagebrush and Black Sage, each representing more than 25% of the plants documented there. However, in the disturbed land, three-fourths of the plants were invasive species, about half Black Mustard and the rest mostly Slender Oat. Native species comprised only a fourth of the total plants found in the disturbed lands, including only three species, Lemonade Berry, White Sage, and most predominantly California Sagebrush, which represented over 75% of the native plants documented there.

Conclusions/Discussion

The results of my project suggest that the San Elijo Lagoon Conservancy is successful in its efforts to stop the growth of invasive plant species through rehabilitation, and indeed at least some native species, especially California Sagebrush, continue to thrive within disturbed areas of the San Elijo Lagoon reserve.

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Summary Statement

The goal of my project was to document and compare plant populations in restored versus restored areas of the San Elijo Lagoon reserve.

Help Received

My science teacher lent me some supplies. The San Elijo Lagon Conservancy showed me how to evaluate transects and quadrats. My parents drove me to the field site. I performed the field tests independently and analyzed the results myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Kian R. Ghasemi

Project Number
J1111

Project Title
Biogas Generation as an Alternative Energy Source and Study of Production Rates from Decomposed Waste Food Sources

Abstract

Objectives/Goals
To determine the highest amount of biogas generated from three waste food sources (mashed banana, chicken skin, potato peels) upon decomposition.

Methods/Materials
Fresh cow manure, 3 different types of waste food items, distilled water, latex balloons, soda bottles, and shipping tape.

Results
Over a period of 12 days, the mashed banana generated the most amount of biogas. On average, mashed banana generated 3.67 cm (31%) more biogas than the potato peels and 2.83 cm (22%) more than the chicken skin. The chicken skin generated the second most amount of biogas. On average, it generated 0.84 cm (7%) more than the potato peels. Finally, the potato peels generated the least amount of biogas.

Conclusions/Discussion
The mashed banana generated the most amount of biogas, then the chicken skin, and finally the potato peels. These results therefore refute the initial hypothesis and prove it incorrect. The conclusion of the experiment is that there are several different factors that affect the amount of biogas generated from a specific waste food source. By using this knowledge, biogas generation can be optimized to the full extent as an alternative energy source.

Summary Statement
I studied the decomposition of different waste food sources, and discovered that mashed banana had the highest biogas production rate.

Help Received
None. I performed this experiment independently.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Chaarvi Goel

Project Number
J1112

Project Title
Modifying Storm Drainage Grates to Keep Our Oceans Trash-Free

Abstract

Objectives/Goals
The objective is to discover how well storm drains keep out plastic of varying sizes and then design a more effective storm drain without causing an overflow.

Methods/Materials
Clay, various pieces of plastic, plastic sled, 3 gallons water, two buckets, measuring cup. Placed drain in a channel and measured the amount of plastic entering two different drains made of clay and the amount of water that overflowed.

Results
The new drain blocked 800% more plastic than the original. So, as a thin bar was put on the drain, less plastic went in and the overflow amount remained the same because the bar didn't stop any water from entering.

Conclusions/Discussion
The performance of the drain with the bar was more effective than the original drain. By stopping plastic from entering the oceans, plastic pollution can be stopped, which opens the path for efforts to clean the ocean. The new drain served its purpose by catching more plastic than the other drain without causing an overflow. It is concluded that the original drain is not adequate and a grate with a thin bar stops much more plastic from entering without causing water to overflow.

Summary Statement
By modifying the design of current storm drains with a simple bar across the original grate pattern, the amount of plastic entering oceans will be reduced significantly.

Help Received
None. I designed, built, and performed the experiments myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Hannah K. Hessler

Project Number
J1113

Project Title
Declining Bee Populations: How to Pollinate if They Disappear

Abstract

Objectives/Goals
Bee populations are declining rapidly. In the last year we had a bee loss of over 32%! Because bees pollinate every 1 in 3 bites we eat, I set out to find a method of efficient mass pollination without bees.

Methods/Materials
Pansies were pollinated three different ways: hand pollination, which is a form of pollination in which a small paintbrush is used to maneuver the pollen off the stigma and onto the stamen. Wind pollination, which is my own method of pollination where you take a blow dryer on low speed and temperature, and blow the flower at different angles, trying to get pollen off the stigma and onto the stamen. And finally, natural pollination, leaving the flower outside to pollinate naturally using insects, wind, and animals. Containers were used to prevent alternate variables from disrupting the project.

Results
My experimental results prove my hypothesis to be incorrect, as both, hand pollination and natural pollination, pollinated the pansies better than my experimental manually applied wind pollination.

Conclusions/Discussion
My results help me to further understand a bee's importance to the pollination process, because of how difficult it is to develop new ways to replace them. I have also discovered that my results may be inconclusive, because the plant used for wind pollination testing did not produce enough flowers to get accurate results. With further research, I believe an alternative mass pollination method could be developed.

Summary Statement
This project compares natural bee pollination on pansies to two alternative methods of flower pollination.

Help Received
I received help from plant scientist/Bakersfield College student Billy Reynolds of Robby's Nursery. He helped me to find a sexually reproducing winter flower, helped me to further understand how to hand pollinate, and showed me how to determine if a pansy was successfully pollinated.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Tanisha Jha; Vishnu Potharaju

Project Number

J1114

Project Title

Help Save the Planet: Sort Trash Right at the Source

Abstract

Objectives/Goals

Our project objective was to develop trash sorting habits in kids, inspire kids to contribute and help save the Planet. Waste, when properly sorted, will optimize recycling, reduce the waste sent to landfill, and protect the environment

The story of the city Curitiba, Brazil inspired us to do this project that would help reduce the amount of landfill. An iOS app was created where users could search for any item before disposing it if the item was Compostable, Recyclable or Landfill. Using this, waste was sorted into the right bin at the source. Effective recycling is based on effective waste sorting at its source. Waste sorting done correctly today will motivate future generations to learn and influence the environment positively.

Methods/Materials

Materials Used: MacBookPro, Swift 3.0 (App programming software), Trash-can, 3 garbage bags, hot glue gunn, cardboard, xacto knife, markers

Method: Using iOS Xcode and Swift programming language, an app named "SmartCan" was created. This app had scrollable list of items was created where each item has a title, image and waste category. When user searched for an item, details of that item were displayed defining if it is to be disposed as Compost, Recycle and Landfill. A survey was conducted on how waste was sorted into Compost, Recycle and Landfill with and without the app.

Results

A survey of usage of SmartCan app showed 100% improvement in sorting waste items. Without the app, most people scored between 50-70% wrong in waste sorting while they were all correct using SmartCan app.

Conclusions/Discussion

Proper disposal of waste can lead to a better environment and prevent future damage to renewable sources. Our app teaches kids how important it is to dispose trash properly, so it an empower them to make a difference on the environment. Waste sorting decisions taught to kids today can make a positive impact on the future eco system.

Summary Statement

Train kids to properly recycle and compost that will reduce landfill and save the planet for future generations.

Help Received

I got help in understanding the programming language, programmed the app myself after an internet search. My parent reviewed my programming.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Hemal B. Kurani

Project Number
J1115

Project Title
Smart Waste Management System

Abstract

Objectives/Goals
I created the Smart Waste Management system to optimize garbage collection by efficiently identifying and gathering solid waste and transporting it to landfills to prevent the dumping of waste at a low cost. In addition, I would like the Smart Waste Bin to be installed near public venues such as school and parks to make residents play enforcement roles that result in desirable social behaviors, also to eliminate littering.

Methods/Materials
First, I collected information about the trash bin's fill volume, temperature, and humidity. The attached camera takes pictures of the trash bin and its surroundings. Next, the effectiveness of the pedestrians is checked, and the data is accumulated in the Smart Waste Management software.

Some of the key materials I used include the Raspberry Pi 3, Arduino Uno, Arduino Uno Sensor, Ultrasonic Sensor, Port Hub, Phidget GPS, Light Sensor, and Camera. I also used Bracket and Python software.

For my project, I choose a location that consists of a lot of litter such as parks and schools. Next, I analyzed the routes of current waste management companies and created a Predictive Box Model based on the different fill quantities of simulated bins. Through this, I would like to improve the overall waste pickup by about 20% as the bins will trigger an alarm when they are 70% full.

Results
The extrapolated field test results showed that on the weekends, my trash bin reached the threshold fill volume of 70% and was collected. On a monthly average, each trash bin filled from about 45% to 60%. I learned that it is not feasible for garbage to be collected via dynamic routes. Garbage collectors should make less collection rounds, thus decreasing the overall cost.

Conclusions/Discussion
In conclusion, my Smart Waste Management system allows continuous monitoring of the waste bin to produce standard pick up routes, where only the waste for containers that require collection. Pictures of litter around my waste bin did result in pedestrians playing active roles to reduce the overall littering. The monitoring of the temperature and humidity allowed the faster pick up of garbage that was rotting and had a foul smell. According to my questionnaire, waste bins which are attractive helped reduce litter. Lastly, having the Fun Smart Waste Bin installed at public places will lead to young kids to become future inventors of eco-friendly products.

Summary Statement
My Smart Waste Management system allows for optimized garbage collection and sends pictures of litter around my waste bin for faster pick up.

Help Received
I designed and built the Smart Waste Management System myself. I got help in understanding circuits and software by my teacher.

Name(s)
Danielle E. Ligasan

Project Number
J1116

Project Title
Environmental Effects on the Biodegradability of the Plastic Bags, Paper Bags, and Newspapers

Abstract

Objectives/Goals
My project is to learn how fast things decompose in different environmental conditions. I did this project because grocery stores are now charging for plastic bags to encourage people to recycle and reuse. The materials I used are paper bags, plastic bags (biodegradable and non biodegradable) and newspapers. I left my materials under the sun, under the pile of mulch, pile of leaves, salt water and tap water for 1 year.

Methods/Materials
Materials:
10 biodegradable plastic bags (use two different brands)
10 non biodegradable plastic bags (use two different brands)
3 nets (plastic or cotton)
Wire or string
6 wooden post
5 brown bags
5 pages newspapers
Mulch Pile (consisting of grass clippings and leaves)
Tap Water
Leaf Pile
10 plastic container (2 liters each)
Saltwater (15% by volume)

Results
After one year, the paper bags I left under the sun almost completely decomposed followed by the newspaper. The newspaper and papers bags under the mulch pile and leave pile also showed different levels of decomposition. The newspaper and plastic bags became mushy but I did not observe a lot of decomposition either inside the tap water or sea water. The plastic bags even the biodegradable plastic bags did not decompose at all.

Conclusions/Discussion
Therefore, I conclude that after one year, the paper bags showed the most decomposition followed by the newspapers. The biodegradable and regular plastic bags did not decompose at all in different environment.

Summary Statement
I learned that all plastic will not decompose after 1 year in different environment and so it is important that we recycle and reuse to protect our environment.

Help Received
N/A

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Umair M. Mahmood

Project Number
J1117

Project Title
Investigating the Ingestion of Synthetic Polymers by Mealworms vs. Superworms

Abstract

Objectives/Goals
Approximately 50% of the plastic we use goes to waste after one use. The average American throws away 185 pounds of plastic each year. The solution: mealworms! The purpose of this project was to compare mealworms and superworms for their ability to consume plastic products. I tested styrofoam, high density polyethylene, polyester, and nylon to see whether beetle larvae are able to ingest these synthetic polymers. Would the worms be able to consume plastics other than styrofoam? Some research stated mealworms are more efficient than superworms at consuming styrofoam, so this project will also investigate whether mealworms and superworms differ significantly in their consumption of plastics.

Methods/Materials
I obtained 1,000 superworms and 1,000 mealworms. I set up ten plastic test boxes with 200 mealworms or superworms in each, along with one of the synthetic polymers or the control. I tested the amount of material consumed by the worms from two blocks of styrofoam, twenty pieces of high density polyethylene, two pieces of polyester, two pieces of nylon, a carrot and lettuce (the control). I monitored these boxes for five weeks, and weighed the test material every third day, using a scale with 0.001 gram accuracy.

Results
I tested 2,000 worms and evaluated over 100 data points. During the course of the experiment, the mealworms ingested 0.111g of styrofoam, and the superworms ingested 4.037g of styrofoam, more than 36 times the amount consumed by the mealworms. The mealworms also ingested 0.045g of high density polyethylene, and the superworms consumed 0.02 grams. The mealworms ingested of nylon, only 0.016 grams, while the superworms consumed 0.079g of nylon. The mealworms consumed none of the polyester, but the superworms ingested 0.041 grams of polyester.

Conclusions/Discussion
My results revealed that neither the mealworms nor the superworms ingested significant amounts of synthetic polymers except for styrofoam. Contrary to my hypothesis, the superworms consumed significantly more styrofoam than the mealworms. Superworms also consumed small amounts of nylon and polyester, and surprisingly, both worms consumed small amounts of high density polyethylene. My project suggests superworms, and to some extent mealworms, in a landfill setting might be an effective resource for eliminating styrofoam, although neither worm would make a significant reduction to other disposed plastics.

Summary Statement
I tested the mealworms and superworms in their ability to consume plastics, after the experiment I found that the styrofoam was consumed the most.

Help Received
None. I designed, built, and performed the experiments myself.

Name(s)
Divya B. Matta

Project Number
J1118

Project Title
Aerification: Sensors to Improve Indoor Air Quality with an Intelligent Ventilation Guidance System

Abstract

Objectives/Goals
Clean air is vital for a healthy body and a healthy mind. We spend much of our time indoors breathing poorly ventilated/polluted air. My goal was to create an intelligent ventilation guidance system, which took input from my indoor air quality sensors and integrated them with the nationwide, airnow.gov outdoor air quality data. I created a Raspberry Pi based sensor system, that measures particulate matter PM2.5 and Volatile Organic Compounds for indoor air. I also wrote a program to take the outdoor air quality measurement in real time from the www.airnow.gov. My program then compares these readings and provides real-time guidance on when to ventilate our indoors (homes, schools, offices.etc). For my project, we opened windows around the home to ventilate, and then validated the improvement in indoor air quality using my sensor data.

Methods/Materials
My project includes three primary components - A Raspberry Pi based indoor air quality sensor, A program for real-time API integration with airnow.gov data, and notification system, via text and email. The Raspberry pi sensor system includes a Raspberry Pi, with an Indoor Air Quality sensor, for detecting VOCs and PM2.5, an HCHO Sensor as a semiconductor VOC gas sensor, a temperature-humidity sensor, a dust sensor and a GPS sensor. The real-time integration with airnow.gov is via API calls from my python program, using my unique token for the project. The notification system is set up for continuous monitoring and alerts. When the air quality degrades indoors, the guidance on the current outdoor air quality helps to see if opening the window for ventilation will improve indoor air.

Results
At my home on average, we saw a 52.2% increase in air quality after opening the window for 30mins. The test was repeated, in multiple rooms at different times of day, at my home, school, and library, with results ranging from 47.8% - 58.9% improvement. The airnow.gov data is available as an hourly update. The email and text alerts have been reliable on the guidance for when to open windows.

Conclusions/Discussion
My conclusion is indoor air quality can truly be improved, by intelligent ventilation from outdoor air. A closed loop system such as my project here, that measures and compares indoor and outdoor air, is critical for every future building being built. Besides improving health, researchers have found that better air quality improves cognitive thinking.

Summary Statement
I built an indoor air quality sensor and implemented a real-time integration with airnow.gov nationwide sensor system, such that I could continuously compare indoor and outdoor air quality, and provide intelligent guidance on when ventilati

Help Received
My family helped significantly in procuring all the materials needed to build the sensor system. I used Online resources to learn python programming and how to program grove-pi sensors.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Kate E. Molinari

Project Number

J1119

Project Title

How the Conductivity and Salinity of Salt Water Affect Desalination: Discovering More Efficient Desalination Methods

Abstract

Objectives/Goals

The primary objective of my experiment is to discover more efficient desalination methods by desalinating water samples with varying salinity percentages and conductivity levels, and observing how these factors affect two different existing desalination methods.

Methods/Materials

First, I tested the conductivity of three 118 ml water samples with the salinity percentages 5%, 10%, and 20%, each three times, with a homemade conductivity meter. After I tested the samples I compared the conductivity levels yielded from the different salinity samples, and I found that the conductivity of the samples increased when the salinity percentage of the sample increased. Next, I desalinated 9, 118 ml water samples, (each 3 samples with one of the salinity percentages above) with a thermal, stove top desalination device I had constructed, testing their post-desalination salinity percentages with a salt water refractometer, noting how long it took for each salt water sample to desalinate. I desalinated all 9 samples in my thermal stove top desalination device over the course of one day. I repeated these procedures, except with my homemade solar desalination device, over the course of several weeks. I compared, again, how each salinity affected the time it took to desalinate the water, and its post-desalination salinity percentage.

Results

I found that the higher the salinity percentage, the longer the water samples would take to desalinate, and the higher the salinity percentage of the fresh water produced, would be. The 20% salinity water samples took the longest to desalinate, and produced the highest salinity percentage, post-desalination samples. Additionally, these results were consistent with my homemade solar-desalination device.

Conclusions/Discussion

Primarily, through my experiment I found that salt water can conduct electricity,and subsequently, harnessing the conductivity of salt water could potentially provide us with the energy we need to desalinate salt water, eradicating the desalination-energy and efficiency problems through this possible solution.

Summary Statement

After desalinating all the salt water samples for both methods of desalination, I found that the highest conductivity and salinity water samples took the longest to desalinate, and produced fresh water with the highest salinity percentages.

Help Received

I interviewed Nurit Katz, the Chief Sustainability Officer at U.C.L.A., to help me gain research about desalination factors, and recent improvements in the process.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Isabella M. Moore

Project Number
J1120

Project Title
Oil Spills and Nanotechnology

Abstract

Objectives/Goals
My project's purpose was to determine the effectiveness of cleaning up an oil spill with ferrofluid and a neodymium magnet.

Methods/Materials
Materials: 6 identical Petri dishes, colored water, mineral oil, motor oil, ferrofluid, and rectangular neodymium magnets.

Methods: 3 of the dishes were tested with mineral oil, the other 3 with motor oil. Each dish had 35 ML of water and either 1, 3, or 0 drops of ferrofluid on top of the 1 mL of oil. To remove the oil I dipped the magnet into the center of the "spill". I tested the various number of drops of ferrofluid 13 times each for both oil types. The oil was measured in microcentrifuge tubes.

Results
In both the mineral oil and motor oil results, the averages of oil removed increased along with the drops of ferrofluid.

Conclusions/Discussion
I concluded that using ferrofluid and magnetism is an effective method to clean up an "oil spill" of certain oils.

Summary Statement
I showed that certain oil spills can be cleaned up effectively by using ferrofluid and magnets.

Help Received
I planned and preformed the experiment myself (with some help labeling the data). I did receive some research topic ideas and suggestions for testing methods from my science teacher.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Alexandra Q. Morris

Project Number
J1121

Project Title
Household Materials Save Environment

Abstract

Objectives/Goals
Using safe, non-toxic household materials to absorb oil spills helps protect the environment and the people and animals that live in it. I wanted to determine which household material would absorb oil the most efficiently.

Methods/Materials
Used motor oil was measured with a measuring spoon and put into 15 identical glass bowls. The absorbents (flour, baking soda, bread crumbs, and cat litter) were measured with a separate measuring spoon and placed into the bowls with the motor oil. I used evaporation as my control. Each absorbent was tested three times. To measure the amount of oil absorbed, I used observations. Other methods of measuring the oil absorption could have resulted in the oil leaking out of the absorbent that I was testing.

Results
After testing multiple household materials to determine which one would absorb the motor oil the most efficiently, I found that in two out of three trials, the bread crumbs absorbed the most oil. In all trials, the control group of evaporation absorbed the least amount of motor oil.

Conclusions/Discussion
My hypothesis was that flour would absorb the most oil because it is made out of starch and gluten, which are both good absorbents. In the end, I found that flour, cat litter, baking soda and evaporation did not absorb as much oil as bread crumbs I believe this is because the bread crumbs act as a sponge to absorb the liquid. With this project and research, we can learn new ways to protect our environment and the things that live in it.

Summary Statement
I tested non-toxic, household materials to determine which would absorb an oil spill the most efficiently.

Help Received
I had help with obtaining the oil and tested materials I used for the experiments. I also had help with the proper disposal of the oil once the experiments were completed.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Isaac M. Pitts

Project Number
J1122

Project Title
Plastic Eating Worms for a Healthier Environment

Abstract

Objectives/Goals
Two worm species are known to have the ability to digest certain forms of plastic and excrete environmentally safe waste. The objective of this study is to determine which of the two worm species would break down the most plastic over a six week period.

Methods/Materials
An equal mass of waxworms and mealworms were placed separately in containers with either a styrofoam cup (polystyrene) or a shopping bag (polyethylene). The two types of plastic were then weighed weekly over a period of 42 days to determine how much of each sample had been consumed.

Results
Weekly measurements showed both worm species were consuming the two varieties of plastic used in the experiment. At the end of six weeks the final measurements showed the mealworms had consumed 3.8% more polystyrene than the waxworm, and 4.1% more of the polyethylene.

Conclusions/Discussion
The experiment confirmed the two worm species capable of digesting both polystyrene and polyethylene. The mealworms were found to be only slightly better than the waxworms at breaking down both types of plastic. Other factors such as worm cost and species longevity may need to be considered. Also, further testing should explore the impact of varying light, temperature, and humidity on plastic consumption.

Summary Statement
I was able to show that mealworms were slightly better than waxworms at consuming two varieties of plastic.

Help Received
None. I designed, built, and performed the experiments myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Eshan Rachapudi

Project Number
J1123

Project Title
Plant Water Conservation

Abstract

Objectives/Goals
Each year, droughts cause health issues and economic damage that affect millions of people around the world. Even California, a developed state, suffered a severe drought between 2011 and 2016, which caused crop damage, nearly 102 million trees dying, and reduction of water levels in lakes and the water table. Deforestation in many parts of the world is making this problem worse. We need to plant millions of young trees, but these plants need to be watered until their roots can grow deep enough to get water from the ground. The goal of the project was to develop a low-cost device that can extract moisture from the air and convert it to water, which can be given to young plants outdoors, or to indoor plants. Eighty percentage of the time each day the device should generate at least twenty-five ml of purified water.

Methods/Materials
The materials used included calcium chloride which is an inorganic, hygroscopic compound useful for absorbing humidity from the air, lye, a sodium hydroxide neutralizer, porous carbon electrodes for removing the salts, a hydrometer to test salinity and other materials required for design, construction and testing of the device. The design includes three stacked boxes, with calcium chloride in the top box, sodium hydroxide in the middle box, and the bottom box with electrodes that collects the liquid. The methods included a fan to blow the humid air onto the calcium chloride, testing the amount of lye needed to make the pH of the water close to seven so that it is not too basic or too acidic, and testing how well the electrodes removed the salts from the liquid.

Results
The device was able to follow three major steps where it was able to extract moisture from the air using calcium chloride, neutralize the extracted liquid using lye, and remove some of the salts from the liquid using carbon electrodes.

Conclusions/Discussion
The device extracted liquid from the moisture in the air and removed some of the salts. More research is needed to remove the remaining salts before the water can be given to plants. Further knowledge in chemistry and physics is required to convert the extracted liquid into salt-free water. For example there could be other chemicals for extraction or neutralizing with less salt in the extracted liquid. Special electrodes or filters may also be required to remove the large amount of salts.

Summary Statement
The purpose of this project was to invent a low cost device that would extract the humidity in the air and convert it to water that could be given to plants.

Help Received
I received help from two science teachers, Mrs. Mackewicz and Mrs. Avadhani, who explained the chemical reaction CaCl(2) and H(2)O and guided me to do research on Sodium Hydroxide to overcome the challenges encountered during testing of the project. My father taught me to use a drill and jigsaw

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Harsha Rohan Rajkumar

Project Number
J1124

Project Title
Glaze the Glaciers: Polyphenol Coat to Reduce the Melting of Glaciers

Abstract

Objectives/Goals
The objective is to study how efficiently melting rate can be reduced when polyphenols are coated on Ice

Methods/Materials
1. Measuring cups, 2. Thermometer, 3. 10 RED HEAT LAMP, power supply, 4. Ice lumps of uniform volumes, 5. Olive Oils, coconut Oil, vegetable oil, 6. Polyphenols from different extracts ex. strawberry extract, vitamin extracts, 7. Weighing Scales.

Procedures:
STEP 1: Freeze equal volumes of water in a similar container
STEP2: Measure 10ml of polyphenols of each concentrates.
STEP 3: Then add different oils of different volumes in each cup and mix them thoroughly with a bright food color (3ml, 7ml, and none) Vegetable oil and lubrication oil.
STEP 4: Mark each cup with a Name and note down the type, volume of polyphenols, oil
STEP5: Apply the coat of the various cups for each ice blocks frozen
STEP 6: Keep them under a measure transparent glass that is kept 2 feet from the heat producing light (wait 3 minuites)
STEP 7: Start measuring the volume of water collected as the ice starts melting over a period of 3 minutes and record the measures of lost water
STEP 8: Repeat the above steps for 5 trials, to get accurate results.
STEP 9: Prepare a Chart to understand the melting rate and impact of polyphenols.
Step 10: Record results

Results
Ice Blocks with higher proportion of polyphenols melts lesser than those of no or less polyphenol coats under identical conditions. From the experiment i observed 40% of melting rate can be reduced.

Conclusions/Discussion
Polyphenol with the solvent has properties to make it difficult for water molecules to move rapidly. This property helps the ice block containing the coat to resist melting for a longer time than the usual and be hard to melt easily.

Summary Statement
Reducing the melting rate of Glaciers using polyphenols.

Help Received
None. I performed the experiments by myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Rahul Ravi

Project Number
J1125

Project Title
Rely on Aquatic Plants to Reduce Global Warming

Abstract

Objectives/Goals
The objective of this study is to find out which aquatic plant absorbs the most carbon dioxide from the atmosphere to reduce global warming. My hypothesis was that algae would absorb the most carbon dioxide.

Methods/Materials
The materials used were 4 different plants, aquariums, National Geographic Aquarium Substrate, a thermometer, pH meter, KH test kit, and carbon dioxide generator.
With each of the aquariums containing 500 mL of water and 100 grams of the substrate, 90 grams of a plant was placed inside its corresponding aquarium.
For the outdoor experiment, the aquariums were taken outside at 8:00 AM, the results, pH value, KH value, and temperature, were recorded at 3:30 PM, and the aquariums were brought back inside the house at 5:30 PM.
For the indoor experiment, the aquariums were always inside the house with lights shining on them from 7:00 AM to 8:00 PM. The carbon dioxide generator, made from warm water, yeast, and sugar, was flowing into each of the aquariums at all times.
A carbon dioxide meter using an Arduino was created to alert a user's phone when the carbon dioxide level is high.

Results
For the outdoor experiment, on average, phytoplankton absorbed the most carbon dioxide at 440 PPM, and algae came in as a close second with 427 PPM, while elodea was the plant absorbing the least carbon dioxide at 159 PPM.
For the indoor experiment, algae absorbed the most carbon dioxide with 332 PPM on average, and phytoplankton absorbed just one PPM less than algae. This time, duckweed was the plant that absorbed the least carbon dioxide at 130 PPM.
Both experiments were conducted for 30 days.

Conclusions/Discussion
My hypothesis was partially supported as algae and phytoplankton absorb high amounts of carbon dioxide. However, phytoplankton releases toxic chemicals into the water, which would eventually be a disadvantage to other organisms. Algae is able to absorb lots of carbon dioxide because it contains cyanobacteria and a light-absorbing pigment called phycocyanin, helping to speed up the photosynthesis process.

Summary Statement
After measuring the amount of carbon dioxide different aquatic plants absorbed, I found out that algae is the most effective and efficient plant that is able to carry out this task.

Help Received
My dad helped me with the Arduino part of the project when I was not able to make some connections correctly at times. My mom helped me with setting up the experiment.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Raina E. Sawyer

Project Number
J1126

Project Title
Weeding Out Erosion

Abstract

Objectives/Goals
How do different types of weeds affect soil erosion by water? Which holds more dirt in place: soap root, milk thistle, or narrowleaf plantain?

Methods/Materials
For each trial, I used cardboard boxes with a volume of 1206.5 cubic centimeters as controlled environments for my experiment, and gave the plants a period of seven days to grow, watering them every three days. I put a different species of weed in three of the four boxes, and left one empty as a control.

Results
My hypothesis was that the soap root would protect the soil the most against water erosion, then the narrowleaf plantain, and finally, the milk thistle. However, the soil eroded the least with the narrowleaf plantain holding it in place, second least with the soap root, and the milk thistle's soil eroded the most, so overall my results disproved my hypothesis.

Conclusions/Discussion
Given the extreme rainfall and subsequent landslides that California has suffered from in recent years, it is important for us to study how we may be able to minimize the damages. Although many people think of weeds as being useless, my results indicate that they may be useful in erosion control. Weeds may not work as well as expensive cover crops advertised to prevent erosion, but unlike cover crops, weeds are free. They are also optimal for spreading over large areas, because they have adapted to reproduce quickly, and require very little care. Therefore, I think we can make use of this data by knowing that if we were to plant one species of weed on a hillside prone to landslides, plantain would be the one.

Summary Statement
I studied how different types of common Califonia weeds affect soil erosion, and discovered that narrow leaf plantain is the most effective.

Help Received
I designed, built, and performed all of the experiments by myself.

Name(s)
Sonia Swamy

Project Number
J1127

Project Title
AlgalPlast: Sustainable Bioplastic from Algae and Its Effect on Tensile Strength, Water Permeability, and Compostability

Abstract

Objectives/Goals
In spite of many benefits that plastics offer, negative impact has become a global problem that is affecting us economically and environmentally. Only 25% of plastic is recycled and rest ends up in landfills and ocean, contributing to environmental and aquatic pollution. Plastics take hundreds of years to degrade, in turn increasing global warming. In near future, there is an inevitable need for sustainable, low-cost, bio-based sources in the plastic industry. Marine algae are the fastest growing plants on earth and produce a variety of base materials such as starches, proteins, and oils that can be used for bioplastics production. Goal of my project is to compare the efficacy of bioplastics made from various algae types to determine if they are viable alternatives to petroleum-based plastic.

Methods/Materials
Part1:
Bioplastic was made from 3 algae types - Chlorella Vulgaris, Sprirulina Maxima, and Rhodophyta (Red Algae). Procedure to make the bioplastic involved key materials such as types of algae powder, glycerol, and water, applying heat, and molding to desired sheet form.
Part2:
Testing was performed to evaluate the efficacy of bioplastics made from the 3 types of algae. This was achieved through Tensile Strength test, Water Impermeability test, and Compostability test with petroleum-based plastic as the control.

Results
Bioplastics produced from algae types were compared based on ability to endure weight, resistance to water permeation, and disintegration in composting environment.
Results indicated that among bioplastics tested, Chlorella showed highest tensile strength, good resistance to water permeation, and highest compostability rate. Spirulina performed second best, followed by Red Algae as third.

Conclusions/Discussion
Performance of bioplastic from Chlorella Vulgaris was the most effective among algae types tested. One area where algae-based bioplastic was not as effective as petroleum-based plastic was in tensile strength. All bioplastics proved to be compostable - a significant advantage over petroleum-based plastic.
This project demonstrates that algae-based bioplastic is a sustainable and viable alternative to conventional plastic, which can help reduce environmental pollution and our dependency on non-renewable resources.

Summary Statement
I created a bioplastic from algae that is a viable, sustainable alternative to petroleum based plastic.

Help Received
My science teacher offered guidance and support through review and feedback

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
LeAnn Tai

Project Number
J1128

Project Title
Efficient Removal of Soil Contaminants Using Biodegradable Adsorbents

Abstract

Objectives/Goals
An explosion occurred in the Gulf of Mexico in 2010 due to sinking polluted soil. The use of chemicals and human industrial activity contributes greatly to soil contamination. Soil pollution affects all aspects of life and is a major cause of famines, illnesses, and countless other negative effects. The goal of this project was to combat soil pollution using natural adsorbents made from common and recyclable household waste.

Methods/Materials
This experiment was performed in three main parts. In Part 1, we studied the effects of different types of soil (organic, non-organic, backyard) and water (50 mM HCl, distilled, tap) on changes in pH and TDS. In Part 2, we tested how different metal contaminants (salts of copper, cobalt, nickel, zinc) affected the salinity of soil, which directly impacts soil fertility. In Part 3, we created adsorbents using different combinations of fruit peels (household waste) and tested them in the removal of CoCl(2) from soil. We used different ratios of grapefruit, mango, and avocado peel to create four batches of adsorbents. Adsorption experiments were performed using soil leachate solutions containing various amounts of CoCl(2) (0.01, 0.025, 0.05, 0.075, 0.01 g/mL water) and the batches were added into the soil leachate solutions separately. After filtering out the adsorbents, the absorbance of the unadsorbed cobalt chloride was measured using a spectrophotometer. The same protocol was performed for two different contact times. The efficiency of the chosen adsorbent was tested through the growth of a plant. To ensure accuracy of the data, we performed four trials for each experiment.

Results
Non-organic soil and tap water showed maximum resistance to pH and TDS changes (Part 1), and CoCl(2) raised the salinity of soil the greatest (Part 2). We continued with these controlled variables in Part 3. The final results showed that Batch 3 (20% grapefruit, 20% avocado, and 60% mango peel) adsorbed over 94% of the CoCl(2) in 60 minutes.

Conclusions/Discussion
The results reveal that the most effective adsorbent was Batch 3, supporting the hypothesis that fruit peels are an effective adsorbent for removing soil pollutants. On a large scale, the implementation of natural adsorbents would be a better alternative to modern agricultural practices that are used to lessen soil pollution since this is a natural, cheap, convenient, and effective way to extract soil pollutants out of land.

Summary Statement
This project aimed towards using biodegradable adsorbents made from common and recyclable household waste to provide an efficient alternative to removing soil contaminants.

Help Received
My science teacher, Mrs. Okenwa, overviewed my documents and procedures. Dr. Kanika Sharma Mittra advised me in some of the common procedures performed in adsorption experiments so that I can better understand how to design the procedure.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Vivian B. Tien

Project Number
J1129

Project Title
The Effect of Solar Energy on Water Filtration

Abstract

Objectives/Goals
The purpose of this experiment is to create a low-cost device that effectively filters contaminated water to produce purified drinking water using solar energy.

Methods/Materials
Filtered contaminated water using a magnifying lens suspended above a copper heating chamber into which unclean water was slowly dispensed, creating a focal point hotter than the original sunlight. A pulley system allowed the device to track the path of the sun through counterweights on either side that rotated the magnifying lens. Used a Purtest Bacteria Test Kit and MHT Drinking Water Test Strips to test the samples of water.

Results
The drinkability levels of the water from my device were much better than the levels found in tap water, my control variable. Compared to water treated by the traditional NaDCC tablet, my device produced water with less total alkalinity, pH, total hardness, and free chlorine/bromine. The water produced by my device had zero contaminants and an ideal 6.0 pH level. Tap water, water treated by the tablets, and water treated by my device all tested negative for the presence of E. coli and Coliform bacteria in the original pond water. The results of all three trials were very consistent.

Conclusions/Discussion
Drinkability test showed that my device successful filtered biologically contaminated water to a healthy 6.0 pH level with no contaminants. The bacteria test proved that my device could also filter out E. coli and Coliform bacteria. All of my trials proved that my hypothesis was correct. I was able to create a low-cost device that can effectively filter biologically contaminated water using solar energy.

Summary Statement
I created a low-cost device that can use sunlight to effectively filter biologically contaminated water.

Help Received
My father taught me how to solder and supervised the construction of the device. My science teacher reviewed my papers.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Zackary G. Tuzar

Project Number
J1130

Project Title
Can Coffee Grounds Absorb Heavy Metals?

Abstract

Objectives/Goals
The objective of this study is to find out whether used coffee grounds can absorb heavy metals from lead contaminated water.

Methods/Materials
Materials: ~168.816* milliliters of grounded spent coffee grounds, 1 Lead disk, Gloves to handle the lead, One 473.176 mL. paper cup, ~487.9632 milliliters of water (100 Celsius), ~236.588 milliliters of silicon, ~168.816 milliliters of sugar, 20 Heavy Metal test strips.

Procedure: Gather materials and put on gloves. Pour boiling water into a cup. Immediately put one lead disk into the cup. Wait 24 hours. While waiting, mix all of the silicone, finely ground coffee and coarse sugar thoroughly. Using the lead test strips, measure and record the lead content of the water. Try to remove the sugar from the hardened silicone mixture so that it is porous. Cut up the hardened silicone mixture into small pieces of approximately 3 cm x 2 cm so that the water will have a greater exposure to the material .Put one fifth of the cut up hardened silicone mixtures into each cup of lead water .Wait 24 hours. Using the lead test strips, measure and record the lead content of the water. Dispose of the used silicone mixture and the water. Repeat steps 2-11 four more times. Calculate the average difference between the amount of lead before and after the silicone and coffee ground mixture is put in. Using a bar graph and Google Sheets, graph and compare the data.

Results
My results prove that when spent coffee grounds are left to sit for 24 hours in lead contaminated water, there is an average of 90% lead reduction in the water.

Conclusions/Discussion
The question answered in the project "Can Coffee Grounds Absorb Heavy Metals?" is, "Do used coffee grounds absorb heavy metals?" The data shows that the amount of lead in the water before the hard silicone mixture interacted with it is noticeably more than the amount of lead after the hard silicone mixture had been exposed to the lead water for 24 hours. Based on the results, the data shows that the average amount of lead after the silicone mixture exposure is about 5 ppb (parts per billion). This means that on average, 90% of the lead in the water was extracted by the hard silicone mixture in just 24 hours. Therefore, one can utilize the over 16 billion pounds of coffee grounds disposed of annually for the crucial purpose of water purification.

Summary Statement
I was able to record that after 24 hours of exposure between spent coffee grounds and lead contaminated water, an average of 90% of the lead in that water was eliminated.

Help Received
I performed the tests and research by myself at home but asked Ben Page, a student at the University of Vermont, what the compound inside of the coffee grounds might be that filters out the lead.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Mari E. Ziegler

Project Number
J1131

Project Title
Biomimicry House

Abstract

Objectives/Goals
The objective of my project is to implement the systems that Cathedral Termites have created to keep their mounds at a consistent temperature into sustainable housing.

Methods/Materials
I used a thermometer, model house with a central chimney, and a fan. I built a model that circulated air, and recorded the model's temperature over several days.

Results
The temperatures I took, comparing the outside temperature against the inside temperature, showed that inside my house, the temperature range was smaller than the outside world.

Conclusions/Discussion
The temperatures of my model showed that, with minimal energy used, we can keep a house at a consistent temperature. I have concluded that these plans could be used by builders of all types.

Summary Statement
I designed a house that would stay at a consistent temperature using minimal energy inspired by the principles used in Cathedral Termite Mounds.

Help Received
My science teacher, Mrs. Morehouse, introduced me to bioimicry. My parents supported me when I hot frusturated, and were my sounding board for ideas.