CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Javeria Ahmed; Ynna Buriel; Rosie Chen

Project Number

J1101

Project Title

Greenhouse of the Future: A Low Maintenance, Low Cost, and Space Efficient Greenhouse Alternative

Abstract

Objectives

The purpose of this project is to build a new greenhouse to replace modern greenhouses by making it more space efficient, cost-efficient, and low maintenance.

Methods

The main materials group used to build our prototype were wood, polycarbonate, PVC pipes, and irrigation tubing. To test our device, our group grew 20 arugula plants in 2 chambers on the same conditions. Each chamber received 12 hours of LED light per day and was watered for 20 minutes on our water system every other day for 31 days. Each chamber also received the same amount of soil, until the topsoil reached the edge of our trapezoid. Our group measured how tall the plants were (taking the tallest plant for measurement) in cm from the soil level to the top of the leaves.

Results

The arugula grew 2.5 inches, which was just short of our criteria, 3 inches. However, our greenhouse fulfilled every other criteria and constraint. Our greenhouse was built under $100, was only about 4 feet by 0.5 feet by 3 feet, and had a working water system and LED light system.

Conclusions

From what we can conclude from our test, the arugula did not grow as well as we hoped, meaning that our prototype was environmentally friendly but cannot produce as many crops as the average greenhouse.

Summary Statement

We created a greenhouse that was more space efficient, cost efficient, and low maintenance that a regular greenhouse.

Help Received

We designed and built the greenhouse ourselves. We used our school's tools to build the greenhouse and we got some of our data from agrilyst.com.

Name(s)

Mardi Barnard

Project Number

J1102

Project Title

Do Soil Types Influence the Movement of Salt in the Soil when Treated with a Soil Wetting Aid?

Abstract

Objectives

To determine if a soil wetting aid can reduce salt or sodium (Na) levels in different soil types (sandy, sandy-loam and clay soil) so that plants have more water and nutrients available to grow.

Methods

Fill 12 plant containers with 3 types of soil. Fill 4 of the containers with the same amount of sandy soil, 4 with the same amount of sandy-loam soil and 4 containers with the same amount of clay soil. Mix 30 ml of table salt in 500 ml of water and apply the solution to all the containers. After 1-day place drip trays underneath the containers of each soil type and treat 2 of the containers marked as UTC (untreated control) with 500 ml of irrigation water in each soil type. Treat 2 containers with 500 ml irrigation water that is treated with 30 ml of soil wetting aid. After 24-hours, measure the amount of water and record the quantity of each drip tray. Save a sample of the water from each drip tray for the sodium (Na) analysis in an analytical laboratory. Record and add the 2 data points from each treatment of each soil type to get a total value and calculate the average, ex. (x + y) / 2 = average of each treatment.

Results

In sandy soil on average from 2 replicates 10.3% more sodium (Na) was recovered from the containers treated with water with a soil wetting aid than the untreated control. In the Sandy loam soil on average from 2 replicates 15.7% more sodium (Na) was recovered from the containers treated with water with a soil wetting aid than the untreated control. The clay soil on average from 2 replicates recovered 20.5% more sodium (Na) from the containers treated with water with a soil wetting aid than the untreated control.

Conclusions

A soil wetting aid is a soapy substance or formulation that reduces the surface tension of water. The lower surface tension of the water increases the mobility of water in the soil to move water in between the smaller soil particles which causes a specific soil type to hold more water. Salt or scientifically referred to Sodium (Na) accumulate in the soil as a by product released from fertilizer compounds used in crop production programs and irrigation water.

In all cases of different soil types more sodium was removed from the soil irrigated with water treated with a soil wetting aid than the treatments irrigated with water alone. More salt was removed from sandy soil. Although more sodium was recovered from the sandy soil the concentration difference between the treated and untreated control was the highest in the clay soil. This suggests that a higher concentration of sodium can be removed from clay soil than sandy soil types per volume of soil.

Summary Statement

My project focus on the rehabilitation of fertilizer contaminated soil by removing excessive sodium from the soil with a soil wetting aid and increasing the soil water holding capacity of different types of soil.

Help Received

I conducted the experiment myself. The collected water samples was analyzed for sodium content by a analaytical chemist Samantha Clooney in the analytical laboratory of Oro Agri Inc.

Name(s)

Maylene Barnard

Project Number

J1103

Project Title

Can an Organic Compound like Crude Glycerin Improve the Water Holding Capacity of Soil?

Abstract

Objectives

Can an organic compound like glycerin improve the water holding capacity of soil.

Methods

Use 8 x 1-gallon plant containers filled with a sandy loam soil to demonstrate the movement of untreated irrigation water against irrigation water treated with 2% glycerin per volume. (10 ml of glycerin in a 500 ml of irrigation water). Use oversized drip trays to collect irrigation water that was applied to the containers and that have moved through the soil. 4 containers in each treatment are used as replicates to calculate a statistical difference between the 2 treatments. A calibrated measuring jug is used to measure the amount of water retained in the drip trays and documented. The documented data of the 4 replicates are added together and divided by 4 to calculate the average of each treatment to statistically compare the 2 treatments. Containers and the oversized drip trays are marked with a permanent marker. (4 containers and drip trays marked A1 to 4 and 4 containers and drip trays marked B1 to 4).

Calculations:

1. (A1 + A2 + A3 + A4) / 4 = average of treatment A.
2. (B1 + B2 + B3 + B4) / 4 = average of treatment B.
3. Calculate the average % difference by subtracting the lowest average treatment from the highest average treatment value.

Results

The irrigation water treated with glycerin improved the water holding capacity of the soil by 46% when compared with the untreated control of irrigation water alone. Treatment B had an average of 66 ml of water retained in the soil treated with the irrigation water and added glycerin.

Treatment A, the control had an average of 112 ml of water retained in the soil treated with only water.

Conclusions

The irrigation water treated with glycerin improved the soil water holding capacity of the soil by 46%. The use of glycerin could mean less irrigation intervals and less water are needed for growers to grow a crop. A significant saving of up to 40% and more was observed in this study and soil type. This could have a huge economic implication for farmers growing crops as it will save them a lot of money on irrigation water and will contribute to nature conservation in a quest to save our planets most important resource, water.

Summary Statement

To determine if less water will move through the soil profile when treated with glycerin by improving the water holding capacity of soil.

Help Received

I conducted the experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Romina Blanco-Sarmiento; Miranda Gutierrez; Sarah Honer

Project Number

J1104

Project Title

Autonomous Marine Plastic Collection Robot

Abstract

Objectives

Our objective was to create a mechanism that could remove plastic from water. Our goal was to pick up 5 pieces of plastic from water in under a minute.

Methods

We custom fabricated our device using aluminum, stainless steel, rubber, and plastic. We tested the performance of the device in a bathtub. Various plastic objects were placed in front of the mechanism including a bottle cap, food wrapper, six-pack ring holder, spoon, and a plastic bag.

Results

We confirmed that the device could float with 2.42 pounds of collected material. Each of the five types of plastic tested was successfully captured. The performance of the first scoop design was able to collect a piece of plastic in 9.5 seconds. The best performing scoop took only 7.6 seconds to collect and deposit one piece of plastic, which is equivalent to 473 pieces of plastic per hour.

Conclusions

The conveyor belt our group designed is capable of collecting plastic from the surface of water. During our testing, we improved the performance of our device by changing the scoops on the conveyor belt that were used to pick up plastic. We came to the conclusion that scoops with less material picked up plastic better, as supported by the notable improvement in our test data.

Summary Statement

Our group demonstrated a custom designed mechanism that collected plastic floating on water.

Help Received

Our group designed, built, and tested our prototype in consultation with a mechanical engineer.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Claire Boles

Project Number

J1105

Project Title

Decomposing Drinking Straws

Abstract

Objectives

The objective is to determine what type of straw decomposes the fastest in manure compost

Methods

Three straws each of: wheat, paper, cornstarch, plastic, plastic-less with a bend, pasta. Bucket, manure based compost, thermometer, gram scale.

Measure straws in gram then put in manure compost. At weekly intervals, removed, measured, observed straws, and returned to compost for eight weeks.

Results

At the end of 8 weeks, all straws were at different stages of decomposition with the exception of the paper and pasta straws which had completely decomposed. At the end, the three cornstarch straws weighed 2.60 grams. The plastic straws weighed 4.46 grams. The wheat straws weighed a total of 2.41 grams. The plastic-less straws with a bendable top weighed a total of 2.75 grams.

Conclusions

I found that the pasta straw is the best alternative to plastic straws because they decomposed in six weeks.

Summary Statement

I decomposed six different types of straws in manure based compost to determine what straw has the least negative impact on our landfills.

Help Received

I designed the project by myself. Katie Boles assisted with editing and Luke Kampmann provided manure based compost and gave additional information on the decomposing process

Name(s)

Charlotte Brands; Stella Pepper

Project Number

J1106

Project Title

It All Flows to the Ocean

Abstract

Objectives

Our goal was to see if the change of slope effects how well a bioswale filters water.

Methods

We built a bioswale that we could change to different slopes, and poured polluted water down the bioswale. Then we tested the water with a turbidity meter.

Results

We filtered polluted water through a bioswale, setting the bioswale at three different slopes: 3%, 6%, and 10%. then we tested it with a turbidity meter. The water was filtered the best when the bioswale was set at 6%.

Conclusions

Multiple trials revealed that when bioswales are set to a 6% slope they filter water the best. This means that a 6% slope can give the best results when filtering pollution out of water.

Summary Statement

Our project is about filtering polluted road runoff with bioswales before the water reaches a storm drain and flows to the ocean to enter the water cycle.

Help Received

We got help from a Hydrolic Engineer, as well as from books supplied by Cal. Trans.

Name(s)

Zachary Brasher

Project Number

J1107

Project Title

Terminating Turbidity: Using a Turbidimeter and Flocculant to Reduce Suspended Solids in Local Water to Drinkable Levels

Abstract

Objectives

The goal of this experiment was to reduce the concentration of total suspended solids (from pollutants and organic sources) in local lake, river, creek, and reservoir waters to drinkable levels.

Methods

A homemade turbidimeter was constructed using a circuit board, led light, photoresistor, power source, and multimeter to measure the turbidity from total suspended solids (TSS) in local bodies of water. The turbidimenter was calibrated by measuring standard solutions of known concentrations of finely ground soil and water; a calibration curve was created from the standard solution data correlating resistance readings from the turbidimeter's multimeter with concentration of TSS. The turbidimeter was then used to measure the concentrations of TSS in water samples collected from rivers, lakes, creeks, and reservoirs within a 30-mile radius in Riverside County. To attempt to remove the TSS, a 10% alum/water flocculant solution was created and added, 1 ml at a time, to the local water samples. The turbidimeter was used to monitor and measure changes in the concentrations of TSS in the local water samples as the Alum flocculant solution was added. Drinkability was measured in comparison to resistance readings from local tap water and distilled bottled waters.

Results

The concentrations of total suspended solids (TSS) in half of the samples were able to be reduced to drinkable levels using the homemade turbidimeter and flocculant solution. Concentrations of TSS in samples that were collected from running water sources (creeks and rivers) were successfully reduced to drinkable levels comparable to tap water and bottled distilled water. Concentrations of TSS in waters that were collected from standing water sources (reservoirs and lakes) were not able to be reduced to drinkable levels.

Conclusions

The turbidimeter and flocculant solution created in this experiment were successful in measuring and reducing the amount of total suspended solids in local creek and river waters to drinkable levels. The turbidimeter and flocculant created in this experiment would be simple additions to household emergency kits and could be used to effectively remove suspended solids from waters in local sources. Concentrations of suspended solids in local standing water sources were not able to be reduced to drinkable levels with the methods in this experiment and would therefore not be drinkable sources of water in an emergency.

Summary Statement

I created a trubidimeter and flocculant solution and used these to successfully measure and reduce the concentration of total suspended solids to drinkable levels in local running water sources.

Help Received

I designed and built the turbidimeter myself. I researched about flocculants in pools and as treatments for super blooms and made my flocculant myself. My mom helped me to understand the math behind the calibration curve that I made using Excel. My Dad drove me to the local water sources.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Melia Crimaldi

Project Number

J1108

Project Title

Cooling the Urban Heat Island Effect!

Abstract

Objectives

This project studied green roof options to reduce city and individual build temperatures. The question studied was: Can special materials (plants or sun absorbing materials) reduce building and city temperatures (the urban heat effect)? The hypothesis predicts that cool roofs will lower a cities and building temperatures because it absorbs or reflects heat and prevents buildings from absorbing and releasing heat back into the atmosphere.

Methods

A scaled down city model of Louisville, Kentucky built and used in the testing since it is one of the top 10 cities with the biggest difference between urban and rural areas. Using Google Maps data a 1"(2.54 cm)=30ft(9.1 meters) model was built with 19 buildings (8 with black roofs, 3 had chemical cooling roofs, and 8 had plant roof). In Test 1, 6 temperature sensors where placed in the model city. 4 inside the buildings and 2 in the model city's centers. The temperature was record every 15 minutes using the data logger for 1 week at a time. The data was compared to see if the different buildings have different temperature results. In Test 2, the similar city set up was used with a chemical cooling roof made from HotSnapZ hand warmers.

Results

Test 1: The temperatures inside the yellow and green plant roofed buildings are lower than the temperatures of the normal black roofed buildings. The data shows that green roofs using plants are generally cooler than normal black roof buildings. The yellow plant roof had a maximum inside building temperature of 28.7 °C, which was 9 °C cooler than the black buildings. The green roof had an maximum inside building temperature of 32.9 °C, which was 5 °C cooler than the black buildings. So, on average, a plant roof lowered the temperature inside the building by 7 °C.Further, the plant roof buildings created lower maximum temperatures in the city center data. On average, the plant buildings created a 1.3 °C lower temperature in the city center than the black roof building. Test 2: Two sensors recorded temperature data and show that the Chemical Cooling Green Roof had lower temperatures than the normal black roof. On average the Chemical Cooling Green Roof was about 3 °C cooler than the black roof.

Conclusions

The experiment and results proved that the hypothesis was correct. The inside building temperature was cooler for both the plant roof buildings by an average of 7 °C and chemical cooling roofs by an average of 3 °C when compared to the normal black roofs. The outside city center temperatures for the green roofed city was cooler than the normal black roof city by an average of 1.3 °C.

Summary Statement

The researcher has shown that cool roofs lower building inside temperatures and outside surrounding temperatures in urban environments and reduce the urban heat island affect.

Help Received

I designed and built the model city myself with help from my dad when using the power saw and nail gun. I also got help from him with the statistical comparison of the data.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Gabriella Dow

Project Number

J1109

Project Title

Using Calcium to Combat Acid Rain

Abstract

Objectives

To find out if a pellet or powder form of calcium carbonate will buffer the negative effects of acid rain on a plant more efficiently.

Methods

Materials: 6 purple flowering kale plants, 6 plant water catchers, sm. (plastic), 4 calcium carbonate pellets (260mg each), 1 tsp. (1200mg) of calcium carbonate powder, distilled water, 2 spray bottles with mist function (28oz.), vinegar, ruler, water pH testing strips, ? cup measuring cup, and ½ tsp. measuring spoon.
Preparing the plants: I set up each plant in an individual water catcher and placed them in an area where each plant would get plenty of sunlight. I sprinkled ½ tsp. (600mg) of calcium carbonate powder on the top of the soil around the stems of two plants. I used a pill cutter to cut two calcium carbonate pellets (520mg) into fourths, and distributed the eight pieces somewhat evenly around the stems of two plants.
Making the acid rain: I poured distilled water into a 28oz. spray bottle right up to the narrow neck at the top. Then I kept adding vinegar until the pH of the mist when sprayed at a pH strip read at a level 4 and I shook the bottle well. I repeated these steps for a second spray bottle.
Performing the experiment: I filled the 1/3 measuring cup 1/2 way full with distilled water (1/6 cup) and watered each plant, pouring it over the soil and not the foliage, to make sure not to wash off the acid rain. I sprayed each plant 7 times with the mist function on, spraying from the top and around the sides to cover just the leaves with acid rain. I took notes on the condition of the plant s foliage and measurements of the plant s height in inches with a ruler and wrote them in my lab notebook each day. I repeated steps 1-3 every morning for nine days, then repeated steps 2 and 3 for five days until I saw clear results.

Results

The plants with calcium carbonate pellets did the best, with plant A growing 1 ¼ in. & plant B growing ¾ in. They were also in the best condition with all green foliage. The plants with no calcium carbonate did the worst, with plant A growing only ¼ in. & plant B growing 0 in. The plants with calcium carbonate powder did fairly well, both growing ¾ in.

Conclusions

My hypothesis was incorrect. The plants with calcium pellets did the best, not the plants with calcium powder. This is such an important topic because acid rain has horrible effects on the environment. I hope my project will help bring attention to the use of calcium carbonate pellets, a natural, efficient, and sustainable way to combat the many negative effects of acid rain.

Summary Statement

The purpose of my project was to discover whether a pellet or powder form of calcium carbonate will work more efficiently to buffer the negative effects of acid rain on a plant.

Help Received

My mother and father read over my report once and made some suggestions of what I could add or change.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ryan Drake

Project Number

J1110

Project Title

A New Desalination Method: Comparing Non-Toxic Carboxylic Acid Directional Solvent's Ability to Reduce Salinity Levels

Abstract

Objectives

The oceans contain over 97% of the earths water, however, only 1% of the worlds water is safe for human consumption, with 2.8 billion people currently living in water stressed areas. However, desalination could help solve this issue. Current desalination techniques are energy intensive, expensive and difficult to maintain, so alternate methods must be investigated. This project s objective is to determine the effectiveness of medium to long chained carboxylic acids contained in non-toxic soybean and coconut oil for their effectiveness in removing salt from both saline and hyper saline solutions.

Methods

Carboxylic acids are both hydrophilic and hydrophobic, allowing them to act as a directional solvent of solutions in water. Twelve experiments with ten trials each, compared the ability of soybean and coconut oil, both high in carboxylic acids, to reduce the salt level of water samples with initial salinity levels of 3.5%, 10% and 15% at two different temperatures, 70°C and 90%C. Soybean and coconut oil emulsions and saline samples were heated to temperature, mixed for 3 minutes, left to settle and then manually centrifuged allowing the salt/brine to precipitate out. Resultant water solution was measured for salinity concentration. An additional experiment with 15 trials was conducted evaluating the ability of the directional solvent to be reused.

Results

Coconut oil provided superior results to soybean oil due to the higher carboxylic acid concentration and that improved results occurs at higher temperatures for both soybean and coconut oil. A secondary experiment was conducted validating the ability of coconut oil to be reused, providing the next step to an economically viable solution to desalination. It was found that dependent upon the initial salinity level, type of oil and temperature of the experiment that 74% to 95% of the salinity was reduced from initial levels. Additionally, it was verified that coconut oil was able to be reused several times with consistent results.

Conclusions

A new low-energy, non-toxic desalination technique using coconut or soybean oils, high in medium chain carboxylic acids, as directional solvents was demonstrated. Salinity levels were reduced from 75% to 95% in samples dependent upon oil, initial salinity and temperature. Coconut oil could also be reused, providing an economical and environmentally friendly desalination solution. This method is less energy intensive and less costly than distillation or reverse osmosis, showing promise for pre-processing of hyper-saline solutions, which are not well suited to conventional desalination techniques.

Summary Statement

A new desalination technique was demonstrated using non-toxic carboxylic directional solvents specifically suited to reducing the salinity levels in hyper-saline solutions, reducing salinity levels up to 95%.

Help Received

My parents provided financial support to buy materials and my teacher Mr. Bolechowski provided project review.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Sarah Fong

Project Number

J1111

Project Title

H2O Generator

Abstract

Objectives

An ongoing problem in parts of the world is a lack of access to water. This project used the Engineering Design Process to create an H2O generator. The goal for H2O Generator was to build a condensation machine that successfully pulls water from the air. The criteria were: the device must be portable, made out of recycled materials or hardware store supplies, needs to operate through a variety of dew point temperatures and humidity levels, and eventually be solar powered.

Methods

The procedure to create the H2O generator was to start with a styrofoam container and attach two thermoelectric Peltier coolers to decrease the device s temperature below the dew point. The Peltier modules were attached to copper sheets to increase the surface area of the water production site. Two DC fans and heatsinks (recycled from computers) were added to the other side of the Peltier coolers to blow out the heat coming off of the Peltier coolers. This was all powered using a PC power supply that would later be attached to a solar panel.

Results

A test was conducted to show how humidity levels affect the amount of water produced. Under the right atmospheric conditions, an average of 5 mL of water was produced in about 10 to 13 hours. The trend showed at least 75% humidity was needed to create an optimal amount of water. The most water collected was 45.83mL in 79% humidity with a dew point of 11?. The data shows the goal was reached to produce water from the air using the process of condensation. The H2O Generator may be used to inexpensively generate water in areas of drought or with limited access to water.

Conclusions

The H2O Generator overcame the problem of dropping the temperature of the copper plate (water production site) under dew point to create a surface cool enough for dew to form.

Summary Statement

The H2O Generator is a condensation machine that utilized recycled computer parts to create easy access to water for people in drought areas.

Help Received

I thought of and designed the H2O Generator myself and received help from my father who taught me the science behind and details within computer mechanics and wiring.

Name(s)

Kian Ghasemi

Project Number

J1112

Project Title

Utilizing Magnetic Fields and Activated Carbon to Develop a Novel Microparticle Filtering System

Abstract

Objectives

The world s waters are continuously being contaminated and polluted by microplastics and microfibers with almost 30% of marine pollution coming from microplastics and microfibers alone. As of the present day, there is a lack of filters in the world that focus specifically on filtering these microparticles. In order to take action to reduce this microparticle pollution, the purpose of my experiment was to develop a microplastic and microfiber filtration system that was both cost-effective and efficient. Based on my research, I hypothesized that a filtration design that incorporated a mesh filter, a magnetic field, and a layer of activated carbon would be most effective in removing microcontaminants from tap water.

Methods

Three variations of filters were designed; a 0.7mm mesh filter, a magnetized mesh filter, and a magnetized carbon mesh filter. Separate samples of tap water were contaminated with a set amount of microplastics and microfibers and the mixtures were blended to disperse the microparticles evenly throughout the liquid. Then, 150µL samples of the mixtures of microparticles and tap water were passed through each filter and analyzed in petri dishes using a compound microscope under 40X magnification.

Results

The results indicated that the magnetized carbon mesh filter yielded the best results, then the magnetic mesh filter, and finally the mesh filter. The magnetic carbon mesh filter removed about 94.12% of the microplastics and 92.07% of the microfibers. Then, the magnetic mesh filter filtered about 82.03% of the microfibers and 54.01% of the microfibers. Finally, the mesh filter was able to remove about 51.96% of the microplastics and 23.37% of the microfibers. Thus, my hypothesis that the magnetized carbon filter would remove the highest amount of microplastics and microfibers was supported by the above results.

Conclusions

Altogether, this experiment helped me successfully design a cost-effective and extremely efficient microparticle filtration system. The utilization of a magnetic field as well as a layer of activated carbon proved very instrumental to the effectiveness of the filter. My next goal is to have the principles behind my filter designs implemented into household drainage systems and other drainage systems around the world so that eventually, we can eliminate the presence of these toxic contaminants within our aquatic environments.

Summary Statement

Through the utilization of magnetic fields and activated carbon, I designed and tested a microparticle filtration system that was able to remove more than ninety percent of contaminants from tap water.

Help Received

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

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ayush Ghosh

Project Number

J1113

Project Title

Reducing Ocean Acidification Using Aquatic Plants

Abstract

Objectives

Global warming is a significant issue for the earth's environment. The temperatures around the world are rising, causing many challenges such as more intense heat waves, shrinking glaciers and rising sea levels. Another critical impact of global warming is the increase in carbon-dioxide in the ocean water resulting in increased acidity of the water. This phenomenon is called ocean acidification, and it is a major threat to marine ecosystems and animals such as calcareous plankton and deep sea corals. The goal of my project is to reduce the impact of ocean acidification.

Methods

Experiment 1:

1. Clean all apparatus with distilled water and lab soap.
2. Pour sand into container until it reaches a height of 2 cms.
3. Clean sand by pouring distilled water inside the container. Then, mix it with sand and pour out. Continue until water is transparent.
4. Fill 2.5 liters of sea water in each container.
5. Add a different aquatic plant inside four containers while leaving fifth aside as control with no plants.
6. Place them all next to each other, put air tubes inside each container, close lid and turn on air pump.
7. Turn on fluorescent lamp facing towards containers.
8. Every day for six days, check and record pH of water inside the containers.
9. After trial is done, check final pH of water and record data.
10. Repeat steps 1-9 two more times.

The plant which shows the highest increase of pH between the trials is the best plant to reduce ocean acidification.

Experiment 2:

1. Follow steps 1-4 from Experiment 1 to prepare 4 containers.
2. Add Chaetomorpha (most impactful plant from Experiment 1) to two of the containers.
3. Use the Fluval Kit to add CO2 to one container with Chaetomorpha and one with only sea water. Set the CO2 rate to 1 bubble a second.
4. Follow steps 6-9 from Experiment 1 to measure the pH in each container on a daily basis for 5 days.
5. Observe how the pH differs for containers with and without CO2 as well as containers with and without the plant.

Summary Statement

I proved that ocean acidification, which is the increase of acidity in earth's oceans due to global warming, can be reduced by adding aquatic plants such as Chaetomorpha Algae to the ocean.

Help Received

My parents helped me by buying all the materials for me and assisting me. Dr. Nyssa Silbiger who teaches at California State University, Northridge, also helped me by giving me necessary information to begin my project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Nicholas Gomez

Project Number

J1114

Project Title

Soundwaves: Goodbye to Noise Pollution

Abstract

Objectives

Noise pollution, such as generated from airplanes, traffic, and construction can have negative effects on human health and lower quality of life. The objective of my experiment is to explore the possibility of cancelling noise pollution, without the use of headphones. Noise cancelling headphones function due to the property that two identical sources of sound can cancel each other if they are 180 degrees out of phase. My experiment investigates the possibility of using the same theory of wave interference in open air.

Methods

I built a sound stand with two speakers out of phase by 180 degrees. I played pink noise from one speaker, measured the decibel level, then activated the second speaker as the noise cancellation and re-measured the volume. During the experiment, I varied the separation distance of the two speakers to determine if distance between source and cancellation device had an impact. I also took volume measurements at different angles and distances from the sound source to study changes in the amount of noise cancelled at different positions in a room. In total, I measured the noise cancelled at 77 different configurations. The materials I used were a sound stand with speakers and an amplifier, decibel meter, tripod, and cell phone. Inside the house, I noticed several issues with sound reflecting off walls and furniture. As such, I collected more data outside where there were fewer objects to reflect the sound.

Results

Certain configurations showed promise, reducing noise levels by as much as 7dB and other configurations actually increased the noise pollution by as much as 3dB. The results indoors showed major challenges due to sound reflections off walls, furniture, and household items which reduced the effectiveness as distance from the cancelling speaker increased. The data collected outside showed consistent noise reduction regardless of the distance from the sound stand since there were fewer objects to produce echoes. Off angle measurements, however, continued to pose a challenge.

Conclusions

Noise pollution can be reduced using open air noise cancelling technology if the challenges of sound reflection and the positional dependence of constructive interference can be addressed. There are still major challenges, however, with open air noise cancellation that need to be addressed. Configurations where the noise cancelling speaker was not near the noise source or where the listener was not at 90 degrees from the speaker setup showed increased levels of noise.

Summary Statement

I found that open air noise cancellation technology can reduce noise pollution if some critical challenges can be overcome.

Help Received

I designed the experiment, configured the trials, and collected the data entirely on my own. I built the sound stand with the help and supervision of my father. I also consulted with various experts at UCLA to form a basic understanding of wave interference and sound propagation through air.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Akshit Gupta

Project Number

J1115

Project Title

Surface Water Cleaning Ro-Boat

Abstract

Objectives

Challenge:
Design a device that would help clean trash and garbage from the ocean.

Constraints:
The device must be:
- Handy
- Portable
- Easy to use and manage (clean the machine)
- Completed in two weeks
- Costing no more than $20.00
- Able to pick small and light items

Methods

6-volt rechargeable battery, gear motors, yoga mat, and plastic board. Tested to find the amount of trash (in grams) could my robot collect in 1 minute.

Results

Trials	Trash collected per minute (in grams)
1	37
2	33
3	38
4	35
5	41

Conclusions

I created this device to solve the purpose of cleaning trash in the ocean. Since it was just an initial prototype, I faced some constraints such as, that it had to be completed in 2 weeks with cost no more than $20 and that it could pick only small and light items. In the future, the advanced version can be modified into a remotely operated device with features like GPS tracking, mobile app etc. Prototype 2 seemed to be a more efficient prototype than Prototype 1, therefore, I decided to move ahead with Prototype 2 for the final model. As per my experiment, I found out that this device could pick small amounts of trash solving the main purpose. My data also supported the cause and purpose of making this device. The device on an average can pick 37

Summary Statement

This is functional prototype of a boat which can run on ground as well on water for cleaning surface water garbage

Help Received

Adviser - Mr. Robert Evans and Parents

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Elaine Haddox

Project Number

J1116

Project Title

MucilaGenius

Abstract

Objectives

The objective of this experiment was to find a more natural solution that could help replace chemical dispersants currently being used to help clean oil spills.

Methods

Mason Jars, Motor Oil, Prickly Pear Cactus, Aloe Vera, Flax Seeds, Chia Seed, Water, Measuring Utensils. In this experiment, 2 plants and 2 seeds were used to prove or disprove that they could help absorb oil.

Results

Several plants and seeds were tested to see whether they could help clean up or absorb oil. The Cactus absorbed the most, the Flax Seeds absorbed the second most, the Chia Seeds absorbed the 3rd most, and the Aloe Vera the least.

Conclusions

The Prickly Pear Cactus was proven to help clean up oil spills the best and the Aloe Vera the least best after multiple tests on the seeds and plants.

Summary Statement

The mucilage in 2 plants and 2 seeds was tested to see if it could help create a more natural solution to replace chemiants currently being used to help clean oil spills.

Help Received

I did the experiment completely on my own but received guidance and direction from my science teacher, Mr. Kubilos.

Name(s)

Katherine Humphrey

Project Number

J1117

Project Title

Reduction of Escherichia coli and Chlorine Levels Using a Simple Water Filtration System

Abstract

Objectives

One-third of the world's population lacks access to safe drinking water and 2.57 million people die annually from contaminated water-related illness. Adoption of currently produced colloidal silver lined clay pot water filters in developing countries has been difficult due to barriers in cost, local access to materials and manufacturing. The goal of this project was to develop a simple water filtration unit (WFU) using materials accessible in developing countries. The hypothesis was if Escherichia coli (E. coli) inoculated water treated with chlorine dioxide is filtered through a WFU consisting of terracotta clay, sawdust, activated charcoal and chitosan (clay+sd+ac+chito), E. coli and chlorine levels will be reduced to meet the U.S. Environmental Protection Agency (EPA) drinking water regulations.

Methods

WFUs were constructed consisting of combinations of terracotta clay, sawdust, activated charcoal, and chitosan. The terracotta clay disks were baked above the combustion point of sawdust at 260 degrees Celsius for one hour. One-half of E. coli inoculated water was treated with chlorine dioxide for four hours before being filtered. Non-chlorine treated and chlorine treated E. coli inoculated water were filtered through three of each WFU type. Chlorine levels before and after filtration were recorded. The number of E. coli colony forming units (CFUs) of filtered water inoculated on Luria Bertani petri dishes was recorded after 24 hours of incubation. Average chlorine levels and percent reduction in E. coli CFUs of filtered water compared to unfiltered water were calculated.

Results

Chlorine treated E. coli inoculated water filtered through the clay+sd+ac+chito WFU was found to have no residual chlorine and a 100% average reduction in E. coli CFUs. A 99.3% average reduction in E. coli CFUs was found in non-chlorine treated E. coli inoculated water filtered through the clay+sd+ac+chito WFU.

Conclusions

The results support the hypothesis with chlorine and E. coli levels meeting EPA drinking water regulations in chlorine treated E. coli inoculated water filtered through the clay+sd+ac+chito WFU. The 99.3% average reduction of E. coli CFUs in non-chlorine treated water filtered through the clay+sd+ac+chito WFU is similar to the percent reduction of E. coli using currently manufactured colloidal silver lined clay pot water filters. In this project, a simple water filtration system constructed with materials accessible in developing countries reduced E. coli and chlorine levels to meet the EPA drinking water regulations.

Summary Statement

A simple water filtration system constructed with materials accessible in developing countries reduced E. coli and chlorine levels to meet the U.S. Environmental Protection Agency drinking water regulations.

Help Received

My science teacher, Mr. Cantalejo, reviewed my research report and procedures. Dr. Ichiuji assisted in the acquisition and preparation of the E. coli Microkwik Culture and taught me how to inoculate the petri dishes. Both Mr. Cantalejo and Dr. Ichiuji served as adult supervisors and reviewed safety precautions.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Jack Jensen

Project Number

J1118

Project Title

Going Undercover to Save a Precious Resource

Abstract

Objectives

The problem I researched was water evaporation in uncovered finished water reservoirs. My goal was to determine which cover prevents the most water evaporation: white shade balls, black shade balls or a Hypalon cover.

Methods

A secure room and area so that all four containers received the same conditions, four 24.6L plastic boxes filled with 7000 ml water, measuring cup, plastic syringe, wooden rulers, black and white ping pong balls, three sheets of Hypalon, air thermometer, SteriPEN. Measured water volume at Day 0 and again at Day 21. Also measured water height during experiment as a control measurement. Measured air temperature and humidity levels every day. All materials purchased at store or Amazon.com except for SteriPEN which came from a mentor.

Results

The data showed the best way to reduce water evaporation was using the Hypalon cover as that reservoir lost only 3.24% water volume over the 21 days. The white shade balls had the second least amount of water loss at 7.5%. The black shade balls had the most water loss among the covered containers at 17.3%. The control pan had no cover and had the most evaporation loss at 27.6%.

Conclusions

From my experiment it was clear that any kind of cover reduces water evaporation. My results demonstrated a solid cover was better at reducing water evaporation than shade balls. But because of expense and large sizes of some water reservoirs, Hypalon covers aren't always financially feasible. In those cases, shade balls are a workable alternative to reduce water evaporation.

Summary Statement

I found that covers such as Hypalon and shade balls are effective in reducing water evaporation in finished water reservoirs.

Help Received

I designed, built & performed the experiment myself. I got background research info from Jini Mohanty, Office of Drinking Water at the EPA; & Dr. Newsha Ajami, Dir of Urban Water Policy, Stanford Univ. I got real life use experiences for shade balls from Steven Cole, Water Works Engineer, LADWP.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Shant Koutnouyan

Project Number

J1119

Project Title

Using Bioremediation as a Cost-Effective, Environmentally Safe, Alternative for Disposing Oil: A Commercial Application

Abstract

Objectives

It is estimated that 200 million gallons of oil is disposed of improperly in the United States annually, a portion of which is used engine oil. This project is designed to determine if bacteria could degrade used engine oil, and if certain additives would increase the rate of degradation. I calculated the cost of this method and compared it to the cost of incinerating used engine oil. I determined that this is environmentally safer than the current methods of disposing used engine oil. Lastly, I designed a comprehensive model to process used engine oil, which can be scaled up or down. Since 70-90 percent of engine oil consists of refined crude oil, and since some bacteria degrade the alkanes in crude oil, I hypothesized that some bacteria will also degrade engine oil. I also hypothesized that certain additives will increase the rate of degradation, that the byproducts are biologically safer than the byproducts of incineration, and that this method is cheaper than the current incineration method.

Methods

This experiment was performed in the Microbiology Laboratory of Adventist Health Glendale. I treated used engine oil with the bacteria Acinetobacter Venetianus, and the additives sodium nitrate, sodium chloride, and iron oxide. Bacteria was first cultured in nutrient broth and then added to used engine oil, divided into nine different testing conditions, and placed on a stirring hot plate. The first set of results were analyzed in three days, the second set in 13 days, and the final set in 23 days. The byproducts were analyzed with UV and IR spectrophotometers at the Chemistry Laboratory of Los Angeles City College. The cost of incineration was then calculated using the Waste to Energy International formula and compared to the cost of obtaining supplies and equipment needed for using the stated method of biodegradation.

Results

The bacteria did degrade engine oil. The test tubes with additives showed a higher rate of degradation. Of the additives, sodium chloride and sodium nitrate were the most effective minerals, and the test tubes with all three additives showed the biggest difference on the spectrophotometry graph. The calculated cost of biodegradation is significantly less than the cost of incineration, and I have designed two industrial models to scale this method for commercial applications.

Conclusions

My hypothesis was supported by my data. I believe this method can become a new standard for disposing of oil since it will cost a fraction of the current cheapest alternative, which is incineration. This new method also requires less maintenance, can be scaled up or down, and likely more gentle towards our planet.

Summary Statement

I demonstrated that engine oil can be degraded by some bacterial strains, and that certain additives aid in the degradation; I also designed a bioremediation model that can be installed in communities which improperly dispose of oil.

Help Received

I conducted the experiment by myself. However, Dr. Michele Cosgrove, Pathologist, Adventist Health Glendale, allowed the use of all microbiology equipment, and demonstrated sterile technique. Professor Marcos Alvarez, Laboratory Director, LACC, demonstrated correct spectrophotometry technique.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Danica Kubota

Project Number

J1120

Project Title

Biodegradable Take-Out Sauce Containers

Abstract

Objectives

The objective of my invention was to design a ratio of ingredients that are used in making biodegradable plastic and use this ratio to make biodegradable plastic that can biodegrade in a period of 1-2 months in garden soil and is resistant to water and weights placed inside it.

Methods

To conduct my invention, I used three different ratios of gelatin, glycerin, and hot water with varying amounts of glycerin in each and three different methods to dry the biodegradable plastic to see what ratios and methods produced one such plastic that was most resistant to water, able to hold weight, and was biodegradable.

Results

Three ratios of glycerin used in biodegradable plastic and three different methods of drying that plastic were used to make biodegradable plastic tested for biodegradability, water resistance, and the ability to hold weights placed inside. The results proved the ratio of biodegradable plastic made with the most amount of glycerin was able to pass the three tests and fare much better than plastic made from the other two ratios, and plastic dried using a blow dryer was able to pass the three tests and do much better than plastic dried using the other two methods.

Conclusions

The conclusions of my invention were that biodegradable plastic made with a higher amount of glycerin and dried using a blow dryer led to a better ability to biodegrade and a higher resistance to water and weights placed inside it and my engineering goal was achieved. For further research, I would like to use the principles and methods used in my invention and apply these principles to disposable sauce packets.

Summary Statement

As shown by the results, gelatin - based biodegradable plastic made using a greater amount of glycerin and dried using a blow dryer was able to better biodegrade, resist water, and better hold weights placed inside.

Help Received

My science teacher, Mrs. Bonny Basu, helped me with overcoming one challenge of my experiment, the fact I could not maintain a compost pile and still keep the bioplastic inside, by suggesting that I use a layer of garden soil instead.

Name(s)

Amelie Leviant

Project Number

J1121

Project Title

Petrochemical Waste Clean-up Using Polymers: A Proof of Concept

Abstract

Objectives

Petrochemical waste cleanup is expensive but important. This project began with the hypothesis that polymers could be used to capture both oil and waste water. Following research on new techniques for cleanup, such as the use of polymer sponges to collect oil, the goal of this project was to demonstrate capture of oil and waste water with polyvinyl alcohol (PVA) while controlling viscosity to allow for polymer fluid extraction.

Methods

The contamination test model consisted of 100 ml of water, colored with food coloring to simulate contaminants, and 50 ml of mineral oil. In Phase 1, using multiple trials, I mixed PVA powder into hot water to create my own PVA solutions and then injected PVA solutions of 4%, 6%, and 8% into the model. Next, 10 ml of a 4% sodium tetraborate solution was added. After mixing, I examined the visible percentage of oil and water captured in the polymer fluid and its viscosity. Not satisfied with the results, I later conducted a Phase 2 test, where, using the same model, I injected PVA solutions of 4.5%, 5%, and 5.5%, in multiple trials, to identify where most of the test model contents were captured in the polymer fluid but viscosity remained manageable. For Phase 3, conducted for my own scientific satisfaction, I examined whether PVA powder, added directly to the oil in the model, could capture just the oil from the model.

Results

Phase 1: Trials with 8% and 6% PVA solutions resulted in full incorporation of oil and contaminant-filled water, but the polymer fluid was highly viscous. Trials with 4% PVA solution resulted in almost no incorporation of oil and water. Phase 2: Trials at 5.5% PVA solution showed a very high degree of incorporation, estimated at 98%, but viscosity was still too high to extract with a syringe. Trials at 4.5% PVA solution were poorly incorporated (under 5%). Trials with 5% PVA solution showed a high degree of incorporation (estimated at 95%), but viscosity was low enough that some polymer fluid was successfully extracted with a syringe. Phase 3: After adding 20gm of PVA powder onto 50 mL of oil, 40 mL of oil was absorbed (an 80% sorption rate).

Conclusions

After Phase 1 suggested a PVA solution range needing more study, Phase 2 indicated that, at a solution strength between 6% and 4%, there exists a concentration(s) that could incorporate most of the oil and water while remaining at a manageable viscosity level that could be pumped. Phase 3, conducted to examine PVA behavior in oil, shows further evaluation of polymer-based remediation ideas is warranted.

Summary Statement

This project examines whether oil and waste water can be captured in a polymer fluid and then feasibly extracted by controlling viscosity with an ideal polymer solution concentration.

Help Received

My father assisted me with research and with the safe handling of hot water and the chemicals used in this project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Antonio Maldonado

Project Number

J1122

Project Title

The Effect of Compost Type on Blocking Water Run-Off

Abstract

Objectives

The purpose of my science experiment is to determine the effect of compost type on blocking water run-off. My hypothesis was that the cow manure compost will block the most water run-off due to the consistency of the compost allowing it to clump better thereby retaining more water. This is important because farmers need effective solutions to reduce water run-off while still maintaining or increasing their crop production in an environment that is still recovering from dyer drought conditions and restrictive water regulations.

Methods

For my experiment, I placed soil and compost in pans, placed pan slanted to allow water to run-off, placed an empty pan at the bottom to catch run-off water, poured 1,000 milliliters of water evenly over the compost, after water was poured I waited one (1) minute, poured run-off water from bottom pan into measuring cup, and then wrote down results. I repeated this 30 times for the bare soil, the green waste compost, and the cow manure compost. My manipulated variable is the type of compost; the responding variable is the amount of water run-off; the variable held constant is the amount of compost, soil, and water used; and the instrument of measurement is the measuring cup.

Results

I found that the cow manure compost had a lower amount of water run-off with an average of 409 milliliters; while the bare soil had an average of 484 milliliters of water run-off, and the green waste had an average of 573 milliliters of water run-off.

Conclusions

After concluding my experiment, my results showed that the cow manure compost had the least amount of water run-off thereby providing farmers a possible solution to decreasing their water run-off while simultaneously helping our State s recurring water shortage. This shortage despite the notion going around, that we are out of the drought and no longer in a water shortage, is still a serious problem due to the fact that most of this rain water is not being collected; and we will possibly see this problem again in the near future.

Summary Statement

The purpose of my science experiment is to determine the effect of compost type on blocking water run-off.

Help Received

Mrs. Martin assisted me in deciding on the project idea and direction. My parents helped me throughout the entirety of the project.

Name(s)

Himani Manjunath

Project Number

J1123

Project Title

Natural Water Purifier: Using Banana Peels to Remove Lead from Water

Abstract

Objectives

The goal of this project was to determine the effect of banana peels on lead contaminated water. My hypothesis was that if banana peels are mixed into lead contaminated water, then the amount of lead in that water would decrease. My objective for this project was to see if banana peels could be used as a purifier for water that is contaminated with lead and other impurities.

Methods

The experimental set-up was made up of 5 jars. Each jar was filled with 250 mL of contaminated water. The samples were tested for lead, pH, water hardness, and nitrate as the control. Each of the 5 jars was mixed with 50 mg of banana peels and then let it sit at room temperature. Samples were tested at various times (3, 6, 9, 12, and 24 hours) after the initial set up. The samples were tested for lead and other impurities using Novo Blue and Healthy Star water test strips and the results were recorded.

Results

All water samples containing banana peels showed a decrease in lead concentration over time. The pH level of the water with lead in it stayed at 6.0 all the time. The nitrate water sample that contained banana peels increased slightly. Banana peels didn t impact the water hardness. The pH level of tap water decreased constantly over time.

Conclusions

My results supported my hypothesis; banana peels have a positive effect in removing lead from lead contaminated water. Banana peels can be considered as a natural and environment friendly method for removing heavy metal such as lead from contaminated water.

Summary Statement

My project proved that banana peels are highly effective in reducing the amount of lead in contaminated water.

Help Received

Parents helped collect water from local resources and purchase test strips.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Alexandra Morris

Project Number

J1124

Project Title

Readily Available Materials Save Environment

Abstract

Objectives

The objective of this study was to determine which readily available material would absorb used motor oil out of fresh water the most effectively while absorbing the least amount of water.

Methods

I tested oil absorption in fresh water using seven different readily available materials; feathers, thin wood shavings, thick wood shavings, silica based cat litter, clay based cat litter, cotton balls, and hay. Oil, water, and test materials were placed together in a large glass pan for one hour. Liquids were separated from solids using a strainer and observations and measurements of oil and water absorption were made.

Results

Feathers absorbed 125 mL of oil and 5 mL of water, thin wood shavings absorbed 124.5 mL of oil and 77 mL of water, silica based cat litter absorbed 124 mL of oil and 68 mL of water, clay based cat litter absorbed 85 mL of oil and 352 mL of water, thick wood shavings absorbed 73 mL of oil and 25 mL of water, cotton balls absorbed 69 mL of oil and 182 mL of water, and hay absorbed 55 mL of oil and 18 mL of water.

Conclusions

My conclusion was that my hypothesis was incorrect, this is because I predicted that cotton would absorb the most amount of oil and clay based cat litter would absorb the least amount of oil. After conducting my experiment I learned that feathers absorbed all of the oil and also very little water. I think that the feathers did the best because the fibers in the feathers are attracted to the oil but repel the water. I also learned that hay was the least absorbent because it only absorbed 55 mL of oil and 18 mL of water. Oil spills can be very detrimental to the environment and the marine life around it. My test results and research could provide a safe and efficient way to absorb oil out of water.

Summary Statement

In this project you will learn what readily available materials will absorb used motor oil out of fresh water the most effectively.

Help Received

My father helped me understand why the oil and water separates and does not mix, he also helped me dispose of the oil and the test products that absorbed the oil. My science teacher also helped me problem solve how to measure how much oil and water the test product didn t absorb.

Name(s)

Rucha Mujumdar; Reva Sharma

Project Number

J1125

Project Title

Edible Membranes to Protect the Environment

Abstract

Objectives

ABSTRACT

Our science project is about protecting the environment by eliminating the use of plastic water bottles and minimizing water wastage, fertilizer runoff in gardening plants with the help of biodegradable and edible polymers.

It bothered us when we read that a turtle got a straw stuck in its nose and that a jellyfish thought plastic bottles are their prey, ate them and fell sick. Although water bottles are convenient to carry around, they create hazardous environmental waste. So, we propose the idea of capturing water in an edible membrane for easy portability and eliminating the need for plastic bottles, now people can safely eat their edible water bottles! Another major problem we are facing is water wastage and contamination of water with harmful fertilizers. A lot of water is being wasted when we water the plants, and the fertilizers are also lost to the environment. To solve the problem, we propose the development of degradable membrane-based water pods that spiked with fertilizers slowly release water and plant nutrients directly to the plant. It saves water and is also convenient for us because we can water the plant once in two weeks or a month as opposed to every other day.

We used sodium alginate, an extract from seaweed, for making edible water bottles that store water or fruit juices. Sodium alginate is a biodegradable and natural membrane, which you can eat and drink. It has a gelatin-like outside structure, with a liquid inside, it is tasteless. We can harden this gel structure using calcium chloride or calcium lactate. Similarly, we can also add fertilizing chemicals based on nitrogen, potassium, and phosphate to sodium alginate to develop water pods spiked with the required concentration and composition of fertilizers. We proved the concept of water and fertilizer releasing pods using potassium chloride and potassium nitrate solutions.

The Objectives of our project are:

1. Protect the environment by eliminating the use of plastic water bottles by replacing them with edible water bottles
2. Prevent fertilizer runoff and water wastage due to evaporation by developing biodegradable water pods containing plant nutrients that slowly release water along with nutrients to the targeted plant.

Methods

Materials:

Summary Statement

Our project is about helping the environment by eliminating the use of plastic water bottles, fertilizer run off and water wastage.

Help Received

We acknowledge our science teacher Ms. Kanchan Bhandare, Dr. Krishna Sharma, and Dr. Suhasini Kanagala for their help and advice.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Milan Pete

Project Number

J1126

Project Title

How to Re-purpose Plastic

Abstract

Objectives

Plastic pollution is a major problem all around the world. I constantly ask what we could be doing so far as dumping our plastic waste in dumpsters. My objective for this project is to re-purpose plastic waste into usable objects rather than having it enter the landfill.

Methods

I shredded various bottles of HDPE(#2 plastic),melted it down at 350 degrees in an oven, placed the molten plastic into a mold and let set.

Results

By using the proper materials (HDPE plastic) and melting them under the proper conditions, I successfully re-purposed the plastic into a bowl.

Conclusions

With using the proper procedures, recyclable plastics can be re-purposed/reused, preventing them from entering the waste stream.

Summary Statement

I created reusable bowls to educate the public on how to reduce plastic pollution.

Help Received

Manuel Rodriguez(my dad), Dionne Jackson(my mom)

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Landon Pretre

Project Number

J1127

Project Title

The Green Zone: Plants Filtering Our Air

Abstract

Objectives

The purpose of this project is to understand whether plants, such as Peace Lily, Snake Plant, and Spider Plant, can help clean our air especially when smoke or other bad chemicals are released.

Methods

The project measured the ability to plants to filter surrounding air over a 24 hour period within a greenhouse tent when toxins, including smoke from a burned sticky note, formaldehyde from car air fresheners, and benzene from wood stain paint were in the air. The toxins were released into the sealed tents with first one and then three plants. The plants tested were the Peace Lily, Snake Plant, and Spider Plant, which are known to be good air filterers. A control tent without a plant was used for comparison purposes in all tests. An identical air quality meter was put in each tent to monitor the air quality, measured by levels of Formaldehyde (HCHO), Particulate Matter (PM2.5), and Benzene gas and other toxic organic compounds (TVOCs).

Results

The results were mixed but especially interesting for the Smoke Test which showed the tents with one plant dropping pollution levels slightly more quickly than no plant. When there were three plants, there was a major difference between the time when the plant tents' pollution started dropping and the control tent pollution started dropping. The Spider plant won the Smoke Tests for both one and three plants, with the Peace Lily and Snake Plants not far behind, also doing significantly better than the control tent with no plant.

The data for the Air Freshener and Wood Stain Tests was inconclusive because it was hard to control the release conditions. However, from those tests, it was evident that these home products (air freshener and wood stain) did cause pollution in the air, especially releasing gases like benzene (and other volatile organic compound gases) and formaldehyde that are both harmful to humans.

Conclusions

Overall, this project proved the hypothesis that if toxins are released near plants, such as smoke, then the air will be cleaner than the air without plants, especially during the day time. Additionally, the more plants the better for cleaning the air. Perhaps plants can be used in cities near polluting factories to help reduce their negative impact on the environment?

Summary Statement

My project proved that certain plants can filter toxins like smoke and chemicals from the air during daylight time periods.

Help Received

I received help recording toxin levels when I was at school or at sports. Also, I had help from my dad in sealing the tents. I got the idea from my grandmother who showed me a plant air filtering sheet from her gardening club. My mom helped me order the air quality measuring equipment and tents.

Name(s)

Wahida Rahman

Project Number

J1128

Project Title

Using Waxworms (Galleria mellonella) to Reduce the Amount of Household Wastes in Our Landfills and Oceans

Abstract

Objectives

The objective of this experiment was to use Waxworms to biodegrade different types of plastic and household waste. It lowers the amount of time it takes for plastic to biodegrade on its own and the risks to human and wildlife. The hypothesis was If different types of household wastes like Styrofoam, plastic bottles, LDPE bags, aluminum foil, plastic wrap, plastic bags, and paper are fed to waxworms, then they will feed on the plastic bags the most because they are thin and easy to chew .

Methods

The materials used in this experiment were waxworms, different household wastes, an online ruler, a pencil, condiment containers, fish tanks, and oatmeal. The worms were divided into 105 groups of five in condiment containers with 2.54 x 2.54 cm pieces of household wastes (polystyrene, polyethylene, polyethylene terephthalate, polyvinyl chloride, aluminum, and paper). The amount consumed was measured after 72 hours using an online ruler as a guide.

Results

The Waxworms ate an average of 0.42 cm of the plastic bags, 0.371 cm of paper, 0.347 cm of plastic wrap, 0.132 cm of LDPE bags, 0.014 cm of Styrofoam, 0.012 cm of aluminum foil, and 0.002 cm of plastic bottles. The initial and final weight of the pieces were also recorded. The hypothesis was proved to be correct. Possible errors could have occurred due to the chemical treatment done to prevent pupation and in measurement of the amount eaten.

Conclusions

In the future, untreated waxworms will be tested and observed over a period of several days. To collect more sensible data I also weighed the 2.5 x 2.5 cm pieces of waste to make another, more detailed graph.

Summary Statement

I used Waxworms to reduce the volume and mass of waste to help humans, animals, and the environment to get rid of hazardous elements.

Help Received

None, I completed the entire experiment on my own, after some proper internet research on my topic.

Name(s)

Kabir Sahni; Neel Sharma; Ashar Siddiqui

Project Number

J1129

Project Title

Improving Existing Equipment for Oil Spills in the Ocean

Abstract

Objectives

In order to solve the problem of expensive clean up methods for oil-spills in the ocean, we decided to design an efficient device by improving upon the existing oil clean up equipment called the boom. Our goal was to improve the design by adding functionality, by using software and hardware technologies to the boom to make it efficient and cost effective. Our objective was that our device should clean up 2.5 gallons of oil spill in under 1.5 minutes.

Methods

First of all, we cut one hole on the top and other hole at the bottom of a flexible 12 feet pipe as boom. Next we attached a powerful pump inside the pipe. The pump's nozzle protruded out from the top hole, and the bottom hole allowed the oil and water to enter the closed ended pipe. On the top nozzle we attached vinyl tube so that oil could be pumped out from there and then it would be collected in another container so that it could be measured. We also cut another hole on the top of the boom to fit our distance sensor into the boom. This was our implementation of Raspberry Pi i.e. Raspberry Pi 3 B+ . The distance sensor measured liquid's height as it entered the pipe indicating to us when to turn on the pump, by indicating red, yellow or green LEDs. As the liquid's level rose in the boom the LEDs changed from red to yellow and finally to green indicating us to turn on the pump. Materials that we used were, distant sensors, three LEDs, male to female jumper wires, bread board, and 1K and 2k resistors.

Results

After testing our device in a container with 15 gallons of water and 2.5 gallons of oil, the data we collected portrayed that the boom pumped 0.2 gallons of oil every 5 seconds. In addition, our software components worked as expected for example when the liquid level was high, the green LED lit indicating to us to turn on the pump. As a result our project testing and results were successful. Our device cleaned up the 2.5 gallons of oil in less than 1.5 minutes showing that our device met our objective. It also met our criteria and constraint.

Conclusions

In conclusion, we saw that our prototype could collect the oil from the surface of water efficiently and met all the criteria and overcame all the constraints. Our criteria was that all of the oil must be cleaned up in less than 75 seconds. And the criteria that the distance sensor should work effectively. Our prototype did meet both of these criterion. Some constraints were that the prototype should be under $150. and the device should not be bulky and should be transportable. Our device has overcome those constraints. Our device is

Summary Statement

Our project is improving upon the existing oil spill equipment by adding functionality of Raspberry Pi to the boom, making it more efficient and less costly.

Help Received

We designed and programmed the algorithm ourselves after doing internet search on techniques. Our science teacher Mrs. Rahman reviewed our results.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Cameron Steagall

Project Number

J1130

Project Title

Do Walnut or Almond Hulls Affect Water Retention Rates in Soil?

Abstract

Objectives

The objective of this project is to study if different nut hulls (almond and walnut) affect water retention in soil.

Methods

Added ground up almond hulls and walnut hulls to loam soil in individual test pots. Added equal amounts of water to each of the soil mixtures.

Measured water retention using a moisture meter for 10 consecutive days.

Results

The addition of ground up almond and walnut hulls to loam soil had small positive effects on moisture retention in soil. Almond hulls had a greater effect than walnut hulls on moisture retention (by 7%).

Conclusions

My repeated tests revealed that water retention can be increased by adding ground up nut hulls to soil. The results can help us understand about how to conserve water and still make sure that soil retains adequate moisture to support crop production.

Summary Statement

I showed that adding nut hulls to soil can increase water retention over time.

Help Received

My science teacher, Mrs. Fidalgo helped me design my experiment.

Name(s)

Sonia Swamy

Project Number

J1131

Project Title

BioDeDye: An Eco-friendly, Low-cost, Agro-waste Biosorbent for the Reduction of Dye Contaminants in Aqueous Wastes

Abstract

Objectives

The discharge of dyes from various anthropogenic and technogenic sources into the aquatic system poses a threat to the health of biota. Many dyes and their breakdown products are carcinogenic, mutagenic and/or toxic to life. Removal of the dyes from the textile wastewater is often very costly, leading to an imminent need for sustainable, low-cost, bio-based treatment for the removal of dyes from wastewater prior to discharge. The goal of this project is to design biosorbents from various fruit wastes and determine which biosorbent is the most effective in the reduction of different types of dye contaminants in aqueous solutions. It will provide a two-fold advantage to environmental pollution. The first advantage is that waste water effluents could be treated at a low cost and the second advantage is to reduce the volume of waste materials.

Methods

Part 1: Three different types of fruit peels (orange peel, lemon peel, banana peel) were used to produce biosorbents. They were pre-treated with citric acid to enhance their adsorption capacity at binding sites. Part 2: 3 different tests were conducted to study the efficacy of each of 3 biosorbents. These were 1. Effect of varying dye types, 2. Effect of varying contact times and 3. Effect of different adsorbent dosages. Water was used as the control across all tests.

Results

Results from the experiment were conclusive that FWBs are viable solution for the reduction of dye contaminants in aqueous wastes. Rank1 was lemon peel which showed the highest adsorption capacity among the 3 peel types tested by showing the best efficacy in removing all the 3 dye types. Orange peel FWB was a close second with very strong results across all three tests, followed by banana peel as the third. For all the 3 kinds of FWB, the percentage removal reached the highest level at 5g of dosage, but rapidly dropped when reduced to 1g. Removal efficiency was consistently above 88% for orange peel, above 93% for lemon peel and approximately 75% for banana peel for adsorbent dosage over 5g. All dye types were able to be reduced, and the optimal contact time was determined to be 180mins.

Conclusions

All fruit peels used for biosorbent production proved viable for dye reduction, with lemon peel demonstrating the best results. A combination of several properties yield could have affected the efficacy of dye removal by these fruit peel based biosorbents. The presence of carboxyl and hydroxyl groups, and the surface properties of fruit peels indicate that they have more binding sites with rough and porous surface. This blend of properties makes them suitable as biosorbents for removing dyes from aqueous solutions.

Summary Statement

I created environmentally friendly, low-cost, agro-waste based biosorbents to reduce dye contamination in aqueous wastes and devised three different testing methods using a homemade spectrophotometer.

Help Received

I would like to thank my science teacher who guided my experiment approach and family who helped me to purchase the necessary materials.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Alyssa Torres

Project Number

J1132

Project Title

Mission Impotable

Abstract

Objectives

The purpose of my investigation is to determine which filter will have the greatest effect on non-potable water that was collected from around the San Joaquin valley.

Methods

I will be using an activated carbon granule filter, and my homemade carbon filter to determine which of these works best on non-potable water found in the valley. I will be using bottled water as my control water and San Joaquin river water, and tap water.

Results

The results of my investigation on different filter types were that the store bought filter had a greater effect than my homemade filter. Although the tap water (Filter A) didn t get the best results, it did have the greatest improvement.

Conclusions

After completing my investigation on both, different filters and different types of water, I found that the store bought carbon filter worked best on the tap water rather than the river water. My hypothesis stated that the store bought filter would work best, and my data shows that my hypothesis was correct. The water with the best quality besides the bottled water, was the tap water that was filtered using the store bought carbon filter. The TDS for the bottled water (total dissolved solids) came out to be 17.8 ppm (parts per million) which was the same average as the river water.

Summary Statement

Filters can be designed to make water potable.

Help Received

Robert Nelson, Jewely Lickey

Name(s)

Preston Wang

Project Number

J1133

Project Title

The Effect of Adsorption Abilities for Dehydrated Carbon and Activated Carbon Made from Different Food Waste

Abstract

Objectives

Access to a clean water is a pressing issue that we face worldwide. According to WHO (World Health Organization) and UNICEF (United Nations International Children's Emergency Fund), about 2.1 billion people which is more than a quarter of the population, do not have access to an improved water source worldwide. In light of the Flint lead water crisis and other reports with indications that our water may not be as clean as we think, even developed countries are seeking for an environmentally friendly and cost effective method. Both developing and modernized countries are in need for water filtration systems that are cost effective. Removal of hard metal is one of the essential parts of the water filtration. Conventional methods used in removal of heavy metals are expensive and some substances used are toxic themselves such as aluminum oxide, cellulose, and silica.

Methods

In this experiment, the effect of adsorption of lead (Pb), copper (Cu), and iron (Fe), and TDS, (dependent variable) are compared among dehydrated, carbon, activated carbon driven from banana, orange, and potato peels (independent variable) to determine which properties are the most effective approach to purify the water. Polluted water samples were created by dried lead paint, corroded water pipes, and iron vitamins. A filtration made with pebbles, coarse sand, and fine sand was tested to determine if pre-filtration would enhance the filtration of each type of properties.

Results

The experiment result showed that banana activated carbon adsorbed the most hard metals, followed by dehydrated banana, carbon banana, and rest of activated carbon. However the TDS increased for all carbons and dehydrated potato peel and for the ones that decreased, the percentage decrease were not in line with the hard metal adsorption percentage.

Conclusions

This results indicated that the hard metal adsorption depends on the form of the peel such that more surface area would adsorb more hard metals and at the same time, the types of peels also affect the adsorption abilities. If the peels contain negatively charged ions or specific properties such as carboxylic acid, its adsorption level alone increases as compared to surface areas of the peels. Dehydrated, carbon, and activated carbon peels and water formed suspension and colloid, thereby increasing the TDS level.

Summary Statement

My project is to find the effect of hard metal adsorption abilities for dehydrated, carbon, and activated carbon made from different food waste to purify water so that environmentally friendly water purification methods can be achieved.

Help Received

Santa Margarita Plumbing Inc provided me with the corroded pipes and Dunn Edwards Painting Inc provided me with the metal cans. My father started and extinguished the fire pit.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Caroline Worman

Project Number

J1134

Project Title

Eco-Friendly Filters: Effects on the Escondido Creek Water Quality

Abstract

Objectives

Last year I tested the Escondido Creek water quality at different locations attempting to find the source of problems that the Escondido Creek is notorious for. I wondered if there was a way to filter the creek water with eco-friendly materials. The objective of this project was to evaluate the water quality of the Escondido Creek and compare the it before and after natural filtration using peat moss and manganese sand.

Methods

I used a dipper to collect the water samples and recorded environmental observations around the test sites. I ran the sample water through six different variations of manganese sand and peat moss filters and varying number of holes in the bins. I performed 106 tests, 77 chemical tests and 29 plates. I used LaMotte and Hach kits and Coliscan Easygel to grow the bacteria.

Results

Overall, the sample water which filtered slower contained fewer harmful chemicals and bacteria. When filtered through the peat moss filter, copper was entirely eliminated from the water and slightly reduced in all other samples. Unfortunately, the samples filtered through manganese sand contained excessive amounts of nitrate and those filtered without the manganese sand contained less than 2 ppm nitrates. Hardness was decreased in slower filtering tests. Iron was eliminated entirely from each manganese sand filtered sample. Many of the bacteria plates had excessive amounts of non-coliform colonies and were even TNTC. The samples treated with peat moss contained significantly fewer E. coli and mold colonies compared to the samples filtered with manganese sand or peat moss.

Conclusions

From my results I concluded that peat moss and manganese sand filtration may be effective in reducing harmful chemicals and bacteria in polluted water sources, like the Escondido Creek. There were some negative effects on the water quality such as higher levels of nitrates with the manganese sand filtration method. A continuation of this testing and possible chemical modifications to the manganese sand might help to improve the water quality of Escondido Creek and many watersheds like it.

Summary Statement

After filtering the Escondido Creek water, I found that natural filters using peat moss and manganese sand may be effective in reducing harmful chemicals and bacteria.

Help Received

I received help from my parents, my nanny, and my science teacher, Mrs. Hunker, who provided me with the equipment and lab to perform my tests.

Name(s)

Ruhi Yusuf

Project Number

J1135

Project Title

Effectiveness of Different Plants as Coagulants to Purify Contaminated Drinking Water

Abstract

Objectives

According to the World Health Organization, globally 1.8 billion people are drinking contaminated water. Distributed water, surface water, and ground water are contaminated due to chemical runoffs and wastewater leaking into water bodies, making it unsafe to drink. These contaminants cause cloudiness of water, called turbidity, which can be reduced using chemical and natural plant coagulants. A coagulant is a natural or chemical substance that, when added to turbid water, aids in the process of coagulation. Chemical coagulants like Aluminum Sulfate (Alum) are expensive and have adverse health and environmental effects. Therefore, plant coagulants can be used as point-of-use technology in underdeveloped communities to purify contaminated drinking water since they are readily available, cost-effective, and biodegradable resources. The purpose of this experiment is to assess the effectiveness of plants such as Moringa, Okra, Nirmali, and Aloe Vera as coagulants, compared to Alum, to purify contaminated drinking water. The effectiveness of each coagulant was measured based on turbidity, pH, and Total Dissolved Solids (TDS). Moringa seeds have protein polymers with higher molecular mass and surface area compared to other coagulants. Thus, it was hypothesized that Moringa would be the most effective and Okra the least.

Methods

The synthetic turbid water was prepared by mixing Kaolin clay and tap water. Each coagulant was added to the synthetic turbid water samples and was allowed to settle for 3 hours. Coagulants remove impurities through adsorption, charge neutralization, interparticle bridging, and enmeshment processes. This results in increased water purification and decrease in turbidity. Readings were recorded for turbidity using a turbidity tube, the pH using a pH meter, and TDS using TDS meter for treated and untreated water.

Results

The results for Alum showed that TDS was not the right indicator for turbidity. Moringa decreased turbidity from 229 to 14 NTU, TDS from 383 to 313 ppm, and pH from 9.2 to 7.7. Moringa was the most effective, followed by Nirmali, then Aloe Vera, and Okra.

Conclusions

The experiment showed that the tested seed powders have varying levels of coagulating properties and are excellent biodegradable and ecofriendly alternatives to chemical coagulants to purify contaminated drinking water. Moringa was proven to be comparably the most effective plant coagulant.

Summary Statement

By testing the effectiveness of different plant coagulants, I concluded that Moringa is the most effective plant alternative to chemical coagulants like alum to purify contaminated drinking water.

Help Received

My science teacher explained the metrics to measure the quality of water. My parents helped by answering questions relating to creating Pivot data tables and charts in Excel.