CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Essey Afewerki

Project Number

J0901

Project Title

Effect of Fire on Soil

Abstract

Objectives

The goal of my project was to study the effect fires have on several of soils' characteristics. These are, organic matter content, water retention capabilities, and ability to support plant life.

Methods

To perform my experiment, I used all household materials. In my procedure, I began by drying and sieving the soil. For the first section, I calculated the average percent mass loss when put under 500 degrees C to represent a fire. Second, I compared the average mm of water lost per day in burned and control treatments(I consistently brought the weight back up to a set temperature each day). Finally, I grew corn in burned and control treatments of soil and compared the average height of plants in each treatment.

Results

I have found that fires cause soil loses an average of 6.7% of its' mass due to organic matter loss. Fires also cause soils' water retention capabilities to become greatly decreased. This all results in soil that cannot support healthy plants. This was judged by comparing the height of the corn in the control treatment versus the soil in the burned treatment. I found that the average height of the plants was significantly less in the burned treatments compared to the control.

Conclusions

In my study I have found that fires have several dramatic changes on soil characteristic that each have a significant effect. Fire causes soil to lose organic matter that includes essential nutrients. It also causes soil to be less able to retain water. This all results in unhealthier plants. With an unprecedented amount of fires raging across California, knowing what effect fires have on soils and the plants they grow would be of importance.

Summary Statement

My project is studying the effect fires have on soils' organic matter content, water retention capabilities, and ability to support plant life.

Help Received

Troy Souther, Teamrat Afewerki, Asmeret Berhe, CIMIS (California Irrigation Management Information System)

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Farah Aswad

Project Number

J0902

Project Title

Growing Algae in Different Conditions

Abstract

Objectives

The objective of this project is to test whether or not a supply of different concentrations of carbon dioxide, fertilizer and increased light exposure will increase algae growth, which can be useful in many ways such as producing oxygen for breathing. Based on the conducted research, it is hypothesized that the fertilizer will have the biggest effect on the algae growth.

To conduct the experiment, 50 ml of cultured algae was tested for growth under different conditions for 1 month: three different concentrations of CO2, (5%, 10%, 20%), three different concentrations of fertilizer (5%, 10%, 20%), and continuous exposure to light. Sugar and brewer s yeast were used to produce CO2 in reactor bottles to be released to the bottles labeled CO2, through a tubing apparatus connecting both bottles. A total of 40 bottles of algae were cultured (5 for the control, 5 for each of the CO2 concentrations, 5 for each of the fertilizer concentrations, and 5 for continuous exposure to light). Algae growth was analyzed using spectrophotometer.

The results showed that the 20% carbon dioxide concentration was the best for the algae to grow. Additionally, the algae grew with the higher concentration of fertilizer at a slower rate. Exposure to continuous direct light significantly decreased the amount of algae. Therefore, my hypothesis was proven incorrect in that fertilizer did not have the best effect on algae growth. The least effective was the control as it had no source of CO2 or fertilizer.

To further expand this project, I would like to test if different temperatures, level of pH of the water, and/or if vitamins, such as VIT B, VIT C, and VIT E are provided, would affect algae growth.

Methods

50 ml of cultured algae was tested for growth under different conditions for 1 month: three different concentrations of CO2, (5%, 10%, 20%), three different concentrations of fertilizer (5%, 10%, 20%), and continuous exposure to light. Sugar and brewer s yeast were used to produce CO2 in reactor bottles to be released to the bottles labeled CO2, through a tubing apparatus connecting both bottles. A total of 40 bottles of algae were cultured (5 for the control, 5 for each of the CO2 concentrations, 5 for each of the fertilizer concentrations, and 5 for continuous exposure to light). Algae growth was analyzed using spectrophotometer.

Results

Summary Statement

The objective of this project is to test whether or not a supply of different concentrations of carbon dioxide, fertilizer and increased light exposure will increase algae growth.

Help Received

I have conducted the experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Luke Billingsley; Trevor Buti

Project Number

J0903

Project Title

Waters of Change

Abstract

Objectives

We wanted to learn how different commercial building materials affect the contamination of rainwater. This project will help our community, nation, and world, because it will prove which materials do not pollute local water systems. It may also tell construction sites what materials they leave around are polluting our water.

Methods

Methods:
Rainwater is poured over commercial building materials, corrugated steel roofing, pressure treated wood, tar composite roofing shingles, concrete and sheet rock. The rainwater was collected and tests were conducted to determine the dissolved solids, salinity and pH of the rainwater.

Material:
2x4 wood, Plywood, Nails, Hammer, Saw horses, Plastic bag, Fresh rainwater from the same source, Plastic funnel, Big glass bottle, Glass bowls, Measuring cups, Hannah PH tester, Hannah TDS tester, ExTech salinity tester, Sheetrock, Concrete, Corrugated steel, Pressure treated wood, Tar composite roofing shingles

Results

We found that sheet rock produced the most contamination followed by concrete, tar composite roofing shingles, pressure treated wood. Corrugated steel polluted the water least.

Conclusions

Our results supported our hypothesis because the steel roofing resulted in the least contamination while sheet rock resulted in the most.

Summary Statement

Our project is testing of water runoff from materials found around your house and construction sites to prevent pollution of water.

Help Received

Mrs. Makenzie Neves Junior High Science teacher Mount St. Mary's, Mr. Chris Buti AP Environmental Science Nevada Union High School, Mrs. Kristy Billingsley.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Cameron Conner

Project Number

J0904

Project Title

Does Air Quality at Schools Near the Freeway Make the Grade?

Abstract

Objectives

The objective is to determine if air quality is lower at schools near the freeway.

Methods

An air quality monitor was built using multiple gas sensors and a PM2.5 sensor on an Arduino and Raspberry Pi setup. Python code and Arduino sketches were written to collect data from the sensors. Air quality was tested at 15 local schools during peak traffic times and GPS coordinates collected at each location. The data was entered in Google Sheets and then imported to ArcGIS Online to create maps of the findings.

Results

The data showed the school closest to the freeway had the poorest overall air quality and was similar to the air quality data collected directly on the freeway. The data also demonstrated how the schools farthest from the freeway had higher air quality.

Conclusions

I built an air quality monitor to measure overall air quality and PM2.5 particulate matter at local schools. The data I collected was displayed on several maps showing the distance of each school from the freeway and the air quality measurements. My hypothesis that schools closest to the freeway would have the lowest air quality was correct. The data from my experiment shows a correlation between the location of a school, its proximity to the freeway and the overall air quality.

Summary Statement

I built an air quality monitor to take measurements at local schools to see if proximity to freeways would impact air quality.

Help Received

I chose and designed the setup for my air quality monitor. I consulted my father when reading schematics. My parents drove me to the various locations where I collected data. I performed the experiments myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Sean Coontz

Project Number

J0905

Project Title

Which Wastewater Treatment Plant Discharges More Microfibers into Humboldt Bay?

Abstract

Objectives

My objective was to determine if the retention time of the wastewater from the Arcata Wastewater Treatment Plant (AWTP) and the Eureka Wastewater Treatment Plant (EWTP) affected the number of microfibers discharged into Humboldt Bay.

Methods

I collected water samples from both plants. One of the samples from each plant was during a period when there was no rain for three weeks (12/5/18). The other sample was collected the day after a huge rainstorm (12/21/18).

I then used a 47-mm filter funnel, manual vacuum pump and 47-mm .45 micron gridded filters to filter my water samples. I filtered 50ml of wastewater 4X for each plant on the dry and the wet day for a total of 16 separate filter samples. I could only filter 50 ml of wastewater at a time because the wastewater from the AWTP was full of algae that would clog the filters.

I then observed each of the filters under an Olympus BH2 Con Focal microscope.

Results

My overall results were 22 microfibers at the AWTP and 29 at the EWTP. Of the 22 at the AWTP there were 10 on the dry day and 12 on the wet day. For the EWTP there were 15 on the dry day and 14 on the wet day.

Conclusions

My conclusion is that the retention time of the wastewater at the sewage treatment plant has an important role in the number of microfibers discharged from each plant. On 12/5/18 the retention time was 30-40 days at the AWTP versus 1-2 days at the EWTP. On 12/21/18 the retention time was 10 days at the AWTP compared to one day or less at the EWTP. The longer retention time at the AWTP is due to their unique pond/marsh system. At the AWTP there were less microfibers counted on the dry samples that had a longer retention time, 20-30 days longer than the wet samples. However, there were more microfibers on the dry day, 15 microfibers, compared to 14 microfibers at the EWTP. I believe this difference is due to the fact there was not much of a difference in retention time between the dry and wet period at the EWTP.

Summary Statement

I showed that the retention time of wastewater at the wastewater treatment plant can reduce the number microfibers discharged from the plant.

Help Received

I received help from Maia McGuire from the Florida Microplastic Awareness Project, University of Florida. She helped me with the materials I needed and the filtration process. I also received help from Megan Smith-Zagone, M.D. whom helped me with the use of the microscope.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Julia de Andrade

Project Number

J0906

Project Title

Which Surface Is the Most Reflective?

Abstract

Objectives

The objective of this study is to see which surface, cement, grass, asphalt, and sand, will reflect the most amount of ultraviolet rays.

Methods

UV measuring beads, UV measuring putty, UV reading card, cement surface, grass surface, sand surface, asphalt surface, and UV blocking glass. All three measuring tools were placed above each surface in the direction of the sun, blocked by UV blocking glass, to measure reflection.

Results

The experiment was performed 10 time on each surface and the results indicated that the sand surface reflected the most amount of ultraviolet rays.

Conclusions

The results showed that the sand surface reflected the most amount of ultraviolet rays. This means that, while many parks and playground use sand because it can cushion falls and protect children, sand reflects the most amount of UV rays which too much exposure to, can later on cause skin cancer and eye damage. Which means it is not the safest surface for kids and can harm kids.

Summary Statement

I showed that a surface of dry sand reflects the most amount of ultraviolet rays compared to a cement, grass, or asphalt surface.

Help Received

None. I built and conducted the experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Adam Esch; Grace Millikin

Project Number

J0907

Project Title

Lichen Diversity: An Environment Indicator of Air Quality

Abstract

Objectives

Lichen is a symbiosis between fungi, yeast, algae and/or cyanobacteria. We learned about lichens sensitivity to air pollution, especially particulates PM(2.5) and PM(10), and wondered whether its presence might be an indicator of air quality. We hypothesized that a site with particulate levels of PM(2.5) and PM (10) above 35.5 micrograms/m^3 would exhibit lower lichen diversity than a site with levels below 35.5 micrograms/m^3.

Methods

To test our hypothesis, we chose two locations in Southern California: a site in Carlsbad, with particulate levels that were historically below 35.5 micrograms/m^3, and a site in El Cajon, with air quality historically above 35.5 micrograms/m^3. We visited both sites multiple times over several weeks and spent many hours locating and photographing lichen species at each site. Using a particulate meter, anemometer, hygrometer and probe thermometer, we measured and recorded levels of PM(2.5) and PM(10), wind speed, humidity, and temperatures of the air, soil, and lichen substrates. We identified, documented and correlated the number of lichen species to the air quality at each site.

Results

Overall, we documented 12 lichen species at the Carlsbad site, where levels of PM(2.5) averaged 31 micrograms/m^3 during our testing, according to the San Diego Air Pollution Control District (SDAPCD). SDAPCD PM(10) measurements were not available for this site. We documented 8 lichen species at the El Cajon site, where levels of PM(10) reported by SDAPCD averaged 42 micrograms/m^3 and PM(2.5) averaged 38 micrograms/m^3. Our particulate measurements differed from SDAPCD data, possibly because our instrument had a relative accuracy of plus or minus 15 micrograms/m^3. Of the 20 species we found, we identified three species in common at both sites: Xanthoria elegans, Acarospora socialis, and Xanthoparmelia cumberlandia.

Conclusions

As hypothesized, the test site with average particulate levels below 35.5 micrograms/m^3 exhibited significantly greater lichen species diversity than the site with particulate levels above 35.5 micrograms/m^3. Although we identified 33 percent more species in Carlsbad, which had significantly better air quality, other factors may contribute to this outcome, such as year round humidity levels. If we were to repeat this project, we would use a more accurate particulate meter. We would also expand our criteria to other pollutants including ozone, sulfur dioxide, and metals such as copper.

Summary Statement

This project investigates the correlation of lichen species diversity to ambient levels of particulates PM (2.5) and PM(10) at two sites in Southern California.

Help Received

After we identified some of the lichen species that we documented, we visited Julia Adams, Mitch Provence, and Andrew Sanders at UC Riverside to confirm identifications. We also visited the San Diego Air Pollution Control District website for historic pollution averages.

Name(s)

John Gerving

Project Number

J0908

Project Title

Predicting Wildfires with Neural Networks: An Approach to Preventing California Wildfires

Abstract

Objectives

In recent years, wildfires have caused billions of dollars worth of damage across the state of California. An increase in frequency and intensity of these wildfires has made it difficult for emergency managers and fire officials to plan for them. Scientists are currently looking for new ways to predict the occurrence of wildfires. The objective of this project was to develop a machine learning algorithm to predict the risk of a wildfire occurring within a given area.

Methods

Data of temperature, vegetation, evapotranspiration, and historical wildfire incidence was obtained from the MODIS satellite using the Google Earth Engine API. A deep neural network programmed using the Keras library in Python was trained on the data. The neural network consisted of three hidden layers, each with 128 neurons. The output layer had a sigmoid activation function.

Results

The neural network achieved up to 77.87% accuracy after 16 epochs (or passes over the dataset while training), and 65.99% validation accuracy after 20 epochs. The accuracy stayed approximately the same throughout the experiment, and the validation accuracy stayed in the range of about 55-65%.

Conclusions

The neural network showed signs of overfitting, a phenomenon where the neural network fits the training dataset too well. The difference in accuracy and validation accuracy is evidence that overfitting occurred. The overfitting was most likely caused by a lack of factors in the dataset. In a future experiment, if more factors were used than just temperature, vegetation, and evapotranspiration data, the accuracy and validation accuracy of the network might be closer to each other.

Summary Statement

I developed and trained a neural network on environmental variables from a satellite, and it predicted wildfires with moderate accuracy.

Help Received

I collected the satellite data and built the neural network myself. Nick Nauslar, a fire weather forecaster with NOAA, guided me on the MODIS satellite and the data it provides. Canyon Robins, a computer science major at Stanford University, told me about Google Earth Engine and gave me advice on how I

Name(s)

Abigail Goodman

Project Number

J0909

Project Title

Stay Cool under Fire: Can Pre-moistening Soil beneath a Prescribed Burn Site Reduce Soil Temperatures?

Abstract

Objectives

The objective of this experiment was to see if pre-moistening soil is an effective way to limit soil temperature during a prescribed burn. If so, this might be an effective tool for minimizing temperature-induced impacts of prescribed burns.

Methods

A heat-resistant ruler with attached thermistors was buried in soil to measure soil temperature at 4 depths during and after a simulated prescribed burn over dry (control) and moist (test) soil.

Results

Maximum temperature in moist soil was reduced by ~50% at all 4 depths in each trial.

Conclusions

The results suggest pre-moistening soil could be an effective technique for lowering maximum temperatures during prescribed burns, and thus could minimize ecosystem damage.

Summary Statement

By pre-moistening the soil below a fire, I reduced maximum soil temperatures during test burns, showing that this may be a tool to reduce ecosystem damage from prescribed burns.

Help Received

I built the project apparatus. My parents helped me conduct the prescribed burns, including safety support, and my dad helped me understand some of the science behind my results.

Name(s)

Reshma Kosaraju

Project Number

J0910

Project Title

Application of Meteorological Data to Predict the Chances of a Forest Fire Using Machine Learning and Neural Networks

Abstract

Objectives

Uncontrolled forest fires are a major problem all around the world due to their devastating effects on humans, ecosystems, and property. The current methods of fire detection have several limitations including timeliness of response, false alarms and cost of operation. The goal of my project is to develop an alternative approach to current methods of wildfire detection that addresses these limitations by analyzing meteorological and other fire index data.

Methods

A Neural Network model was developed using Machine Learning. The model familiarizes itself with the training data and utilizes logistic regression with binary classification to make predictions on the testing data. The parameters considered include relative humidity, wind speed, moisture content, temperature, burned area, coordinates, day and month, and certain established fire index ratings.

Results

I successfully developed a Neural Network model which divides the available data into training and testing sets, familiarizes itself with the training set, and tests its predictive power on the testing set. The model is able to predict with accuracy consistently > 60% when evaluated with the testing set.

Conclusions

My model takes a novel approach to predicting the chances of a forest fire. The model can proactively predict forest fires while current methods are more reactive in nature. The ability to predict a fire before it occurs could lead to saving precious lives and avoiding economic losses which have been estimated to be up to $350Bn annually in the U.S. alone. The model could also lead to effective firefighting resource management during peak wildfire season. The model utilizes readily available real-world meteorological data and its ability to make predictions is not impacted by weather conditions. This cost-efficient model is automated and the results are easy to interpret while minimizing the chances of human error.

Summary Statement

I built a Neural Network model that is able to learn from and use meteorological data to predict the chances of a forest fire.

Help Received

I built the Neural Network model myself. I took an online Coursera course (taught by Andrew Ng) to learn how to build Neural Networks.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Rebecca Kyo

Project Number

J0911

Project Title

What Is the Effect of Mixing Sand with Soil on the Moisture of the Soil?

Abstract

Objectives

The problem of drought increase in severity leads to the conservation of water and the efficiency of water use in the garden. With this idea, I decided to test how the moisture of the soil and its water retention can be affected when the sand and soil proportion is changed.

Methods

In the experiment, I first mixed the different amount of sand (independent variable) into the soil, then water the soil in each container, made with plastic 500 ml water bottles that I cut the top off and drilled holes at the bottom. After a period of time, I measured the moisture of the soil (dependent variable) with a soil moisture meter and repeat this for every hour for five hours.

Results

The result of the experiment supported my hypothesis, that if more sand is being mixed with soil, then the moisture would last shorter because there are air pockets in the sand that would absorb and lose the water quickly, because the mixtures with added sand started and ended with less moisture than the mixtures without added sand, which the starting moisture was 10 and the ending was around 8.67. The experiment also shows that soil can provide better water retainment without added sand.

Conclusions

My project helped me to see the average water retention scale for a certain amount of sand and soil proportions and I also learned that different water retention would be used differently to suit the different types of plants.

Summary Statement

This project tests how the moisture of the soil and its water retention can be affected when the sand and soil proportion is changed.

Help Received

I researched, planned, created, and conduct the experiment all by myself, with the exception of financial support from my parents to purchase and provide supplies needed for my experiment.

Name(s)

Charles Luke

Project Number

J0912

Project Title

Shedding of Polymeric Microfiber Particulate from Synthetic MTLs: Dryer Emissions as a Source of Environmental Pollution

Abstract

Objectives

This study examined the shedding and emissions of plastic microfiber particles from different synthetic materials during dryer cycles in order to determine the efficacy of internal filtration systems in preventing microfiber particulate emission into the environment.

Methods

Test materials were washed and then dried in an electric compact tumble dryer with an attached dryer vent duct. The Lighthouse Handheld 3016 (LH3016) particle counter was used to quantify particulate levels. In a clean zone, constructed with sealed plastic sheeting, control tests were run before all dryer cycles. The LH3016 was placed at the opening of the vent gathering particulate which escaped internal filtration mechanisms. Multiple cycles were tested for each material so that data could be organized and graphed. A range of filters were employed as potential abatement strategies and emissions were then quantified.

Results

Tests indicated that all synthetics produced significant particulate levels. Internal filtration was determined to be ineffective at preventing the emission of micro particle emission during dryer cycles. Furthermore, multiple washings and dryings did not reduce shedding, in fact, particulate emissions increased as materials were subjected to increased wear. Testing indicated that low grade air filters did not reduce particulate emissions; some may release their own micro particulate which would account for increased particulate levels. However, higher grade filters were substantively successful at particle reduction.

Conclusions

Results indicate that the use and cleaning of synthetics increases deterioration and shedding. Testing establishes that the micro-particulate that is shed is small enough to bypass internal filtration systems in a domestic dryer, successfully travel out of traditional ventilation ducts, and will be released into the environment. The rapid growth in the use of synthetic materials, domestically and abroad, is therefore leading to rapid increase in the prevalence of the release of these synthetic fibers into the environment. A low cost abatement strategy might be feasible for domestic dryers if it is attached near the duct opening. Given the mounting evidence that synthetic micro-particulate is detrimental to the health of organisms, it is prudent to pursue any strategies that may reduce the effect of the rising use of synthetics.

Summary Statement

I evaluated domestic dryers to determine if polymeric microfibers are released from synthetic materials during dry cycles, and tested air filters as an abatement strategy.

Help Received

1. Ruth Gramajo: teacher at Portola who supported process; 2: Jason Feldman: mentor who assisted in obtaining testing equipment to borrow from JPL, gave advice on process; Axel Scherer: CAL Tech professor who developed new spectrometer. This device could perform qualitative analysis of field

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ethan Luu; Sophie Wang

Project Number

J0913

Project Title

A Catastrophic Pacific

Abstract

Objectives

The purpose of this experiment is to decide which Southern California beach has the highest overall rating based on our own rating system that we researched and created.

Methods

1 liter handheld box core, 1 mm stainless steel mesh sift, mason jars, rubbing alcohol, a dissecting microscope that can go up to 4x, and a squeeze bottle. We collected 3 samples from 0 ft, 50 ft, and 100 ft into the ocean and sifted it through the mesh sift. Then, we collected all algae, pollutes, and shells from a 100 ft stretch.

Results

Treasure Cove ranked 1st, Laguna Beach was 2nd, Newport 3rd, Corona del Mar 4th, Huntington 5th, Seal Beach was 6th, and Long Beach was 7th. Huntington Beach in the rain was ranked lowest. This shows that Treasure Cove is the safest beach to visit and Long Beach is the most hazardous; additionally, it shows that rainfall has a negative effect on the health of the beach.

Conclusions

Our hypothesis was both correct and incorrect. We ve concluded that Treasure Cove is the safest beach to visit and Long Beach is the worst beach to visit. This will help our society discover which beaches need to be protected and which beaches we need to continue to clean up. Additionally, these results can assist in finding ways to manage runoff and organize cleanups that are necessary for the lower ranked beaches.

Summary Statement

After collecting from several beaches, we ve concluded that Treasure Cove is the safest beach and Long Beach is the most hazardous beach.

Help Received

Mr. Briner helped in the design of the tools; he also showed us how to use them.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Solveig Lyssand

Project Number

J0914

Project Title

The Effects of Changing Heights and Locations on Air Pollution Levels

Abstract

Objectives

The purpose of my experiment was to determine if more air pollution particles were collected depending on locations and heights. I do believe that locations and heights will change the amount of pollution particles that will be collected.

Methods

I conducted five trials that each consisted of 84 flash cards, the flash cards were covered in petroleum jelly, so it was able to collect particles. The cards were tested in 6 locations: My bedroom, living room, front porch, backyard, by the front door, and by the road. Each location had fourteen heights, which increased in ½ a foot increments starting at ½ a foot high and ending at 7 feet.

Results

The highest average of collected particles for the locations was by the road, and the lowest average was between both the bedroom and at the front porch. The highest average for the heights was at ½ a foot high, and for most areas as it got higher up, there were less collected particles.

Conclusions

I concluded that heights and locations do effect air pollution levels. This project helps to show the importance of our air quality, considering that there are so many air pollution particles around us. These particles are incredibly dangerous, and only cause problems for all of the plant and animal life around us.

Summary Statement

I showed that the changing of heights and locations does effect air pollution levels.

Help Received

My science teacher guided me throughout this whole project, she advised me to to more improvements as well, which I believe made my project a lot stonger. My county fair interview judges also left me some notes of things I could improve upon.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Madeline Manriquez

Project Number

J0915

Project Title

What Materials Last Longer in Wave Erosion?

Abstract

Objectives

The objective of my project was to see what materials would last longer in wave erosion and prevent the least erosion. For this my hypothesis was that the sand and clay mixture would last longest with the least wave erosion.

Methods

I purchased many different lengths and widths of wood, 5x eye hooks & 0.6cm, 2x medal guide rods at 63cm, and 1x plastic tub & 80cm long, 26cm wide, 14cm high. These materials were to build my wave machine that I would then use to conduct my experiment.

Results

In the beginning of my project I thought that the clay and sand mixture would prevent the least amount of erosion and last the longest. Then as I conducted my experiment with all the materials, I dropped the wood that creates the wave 20 times each round. I did this with each material, 3 times around at a 6 second interval, I found then that the sand and clay mixture did last the longest and prevented the least wave erosion.

Conclusions

Based on my data of what material last longer in wave erosion, I have come to my conclusion. I have concluded that the sand and clay mixture prevented wave erosion from happening the best. I have concluded this by coming up with my means which I did by subtracting the starting weight to the after weight of all 3 tests to all 3 mixtures, then I added them and divided by 3 to get my means. My means were, wet sand alone 125.363 grams, sand and pebbles mixture were 155.24 grams, and the sand and clay mixture were 55.83 grams. From this data my hypothesis was correct. I thought that the sand and clay mixture would hold up the best because they both stick together, and I was correct. As I was testing, it looked like the sand and pebbles were holding more and that the sand and clay was being eroded, but this turned out to be incorrect. I am very pleased with the outcome and would enjoy doing this experiment again with other materials.

Summary Statement

My project is to identify what materials would prevent wave erosion the least and last the longest.

Help Received

I designed and built the wave machine with the help of my Dad and Grandfather.

Name(s)

Sofia Mendonca

Project Number

J0916

Project Title

Energy Production in a Soil Microbial Fuel Cell Using a Variety of California Soils

Abstract

Objectives

The objective was to determine if the energy production in a soil microbial fuel cell is affected by soils from different location.

Methods

Soil samples were obtained from several locations in California. Soils were tested for composition by texture using a ruler, a graduated cylinder, and the USDA soil texture triangle. Soils were tested for soil nutrients using a commercially available NPK and pH kit. Soils were then mixed with water and placed in commercially available microbial fuel cells called Mudwatts. Voltage and current were measured with a digital multimeter and power was calculated.

Results

The soil from Clovis, CA produced the most power while the soil from Malibu produced the least power.

Conclusions

Repeated trials with multiple soils revealed statistical differences in power production. It is concluded that the type of soil is a strong factor in power production in a soil microbial fuel cell.

Summary Statement

As measured by power produced, I found that there are significant differences in power production by soils from different locations in California.

Help Received

I designed and carried out the experiment myself after doing an internet search on Mudwatt setup techniques and soil nutrient analysis. Carolyn Mendonca is the local A.P. Environmental Science teacher from Clovis High School who provided instruction on how to do soil texture analysis. Pam Cruz is my

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Holden Moreno

Project Number

J0917

Project Title

The Effect of Varying Air Pressure on the Fluidity of Different Sand Types

Abstract

Objectives

My project was to determine the effect of varying air pressure on the fluidity of different types of sand. I believed that the finer sand would fluidize more easily than the more coarse sand. I thought that the smaller, lighter grains would be moved more easily and allow the golf ball to sink faster.

Methods

I placed a pvc lattice with a valve connected to an air compressor in the bottom of a clear, plastic container. I alternately filled the container with 4 different types of sand (play sand, mesh sand, all purpose sand and washed all purpose sand) and turned on the air compressor (with 3 different pressures) and measured the time it took for a golf ball to sink below the sand. I performed 25 trials at each air pressure for each type of sand. Before coming to the State Fair, I am going to change the golf ball to a small piece of weighted plywood to more closely simulate buildings of different weights. I will also add more types of sand to my trials.

Results

According to the data the all purpose sand became more fluid when more pressure was applied. The larger grains of sand allowed more air to infiltrate between the particles and they moved more freely than the smaller grained sands (mesh sand and play sand).

Conclusions

As the particle size of the sand increased the faster the golf ball sank. There is a direct relationship between particle size and fluidity of the sand (liquefaction). It is concluded that liquefaction depends in part on the particle size of the soil.

Summary Statement

My project is about the fluidity of sand under varying air pressures.

Help Received

I built the device with the help of my father and performed the experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Erin Murray

Project Number

J0918

Project Title

Which Beach Has More Toxic Phytoplankton?

Abstract

Objectives

Thousands of marine mammals have been killed by paralytic shellfish poisoning (PSP), caused by consuming toxic shellfish. How did the shellfish get toxic? Research shows that it starts with toxic phytoplankton. In order to reduce such deaths, including damage done to humans who consume toxic shellfish, the location of toxic phytoplankton is vital to research. Here in San Diego, which beach has the most toxic phytoplankton, Oceanside or Pacific Beach? The hypothesis is that Oceanside Beach will have more because it is closer to the northern California coast, where large concentrations of toxic phytoplankton have been found.

Procedure: Phytoplankton was collected from Pacific Beach Pier and Oceanside Beach Pier weekly for four weeks using a phytoplankton net. While at the piers, water temperature was observed. The specimen collected was then brought back to the student s home to test salinity and identify phytoplankton.

Results: There were more toxic phytoplankton found in Pacific Beach. The most toxic phytoplankton sampled was Alexandrium, found at both piers, but slightly higher in Pacific Beach (4 to 3). Other toxic phytoplankton such as Pseudo-nitzschia, were equal in both beaches. Nitzschia was slightly higher in Pacific Beach at 2 to 1. The most frequent phytoplankton sampled was Ceratium Fusus. The least frequent were Cerataulina, Ditylum, Isthmia, Licmorpha, Lingulodinium, Nocticula, Pleurosigma, Rhizosolenia, and Scrippsiella. The average number of phytoplankton is 1.7 in Pacific Beach Pier and 1.5 in Oceanside Pier.

Conclusion: In the hypothesis, it was predicted that there would be more toxic phytoplankton found in Oceanside Beach Pier. Based on the results, the hypothesis was incorrect. The amount of phytoplankton found was more concentrated in Pacific Beach as well as more toxic phytoplankton found there as well. This shows that research should be done along the San Diego coastline, not solely in the northern part of the county.

Methods

Materials:
large phytoplankton sampling net
50 foot marine rope
Large testing tubes (2)
Microscope
Microscope slides & covers
Thermometer

Summary Statement

I tested the water at two different beaches to investigate which one had more toxic phytoplankton that can impact the health of human & marine ecosystems.

Help Received

The California Department of Public Health provided me with the catching net and the microscope. I collected the water by myself, but got help when the net was heavy and I tested for the phytoplankton my self.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ellie Naftaly

Project Number

J0919

Project Title

Does Dirt Drain?

Abstract

Objectives

The purpose of my science project was to compare the permeability rates of various typical soils. I used gravel, poorly sorted sand, well sorted sand, and clay and I measured permeability rate and the porosity. This information is essential to farmers with large scale farms or people with personal gardens and flood control workers. It will help people to know which soil is right for their plants and where to safely put buildings.

Methods

I obtained the various dirt samples from the gardening store, the beach, and an excavating site. I used a graduated cylinder, which I cut the bottom off of and covered with fine screen. All soils were dried completely in a household oven. The control was pouring 150 milliliters of water through the graduated cylinder without soil and timing how long it took to emerge. The way I measured the permeability rate was by pouring water through different types of soil and timing how long it took to come through and measuring how much was absorbed in milliliters.

Results

My hypothesis for this project was, if I measured the permeability in well sorted sand, poorly sorted sand, gravel, and clay, then gravel would have the highest permeability followed by well sorted sand, poorly sorted sand, and lastly clay. The results of this experiment showed that gravel is the most permeable, followed by poorly sorted sand, then well sorted sand, and lastly clay. The results show that the hypothesis should be mostly accepted except for poorly sorted sand had higher permeability than well sorted sand.

Conclusions

The results of this experiment prove that gravel has the highest permeability among gravel, poorly sorted sand, well sorted sand, and clay. It also has porosity, which because of the very high permeability, is hard to measure. The lowest permeability rate was in clay. However, clay had high porosity. The data from this experiment would be mostly beneficial to farmers or home gardeners because different plants grow better in different types of soils with different permeability. Also people working in public environmental services could use this information to determine where permeable pavement would be most effective and where it is most needed. These concepts could be useful to people in preventing floods because less permeable soils are more likely to flood and if they know the permeability in various areas they could predict which parts would be worse and more dangerous.

Summary Statement

I determined that gravel had the highest permeabilty, then poorly sorted sand, well sorted sand, and lastly clay, in order to evlaute how permeabilty effects land use.

Help Received

Mike Guinella, Professer of Environmental Horiculture at Santa Barabra City College, provided a botanist's perspective on how the results from my experiment could be put to use in the real world.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Rishank Pillay

Project Number

J0920

Project Title

Comprehensive Study of Tiday Pool Populations

Abstract

Objectives

The objective of this study is to identify whether the underlying factors of pH and water temperature have an effect on marine population when tested among six tidal pools on the Southern California coastline.

Methods

The brief procedure involved visiting multiple tidal pools, followed by scouting the area for sea anemone species, both Aggregating and Solitary. When found, a self-made 15 cm X 20 cm (made using a hacksaw) area marker was placed and pictures were taken for documentation purposes. Later pH and water temperature measurements were taken using an infrared thermometer and a pH meter.

Results

The results and data showed that there was no correlation between pH and water temperature with marine population. To further substantiate, the water temperature of Treasure Cove and Dana Point were exactly the same and the pH only differed by 2%, but the population differed by 80%. In addition, the population for Cardiff State Beach and Crystal Cove was the exact same, 40, but Cardiff State Beach was always above the average and Crystal Cove was always below the average for pH and water temperature.

Conclusions

My hypothesis was incorrect as there is no correlation between the underlying factors of pH and water temperature with marine population. It can be concluded that other factors apart from pH and water temperature (for example human accessibility and whitewater) affect marine populations when tested among 6 tidal pools comprising the Southern California coastline.

Summary Statement

In this project, I identified whether there is a correlation between the underlying factors of pH and water temperature with marine population when tested among six tidal pools comprising the Southern California coastline.

Help Received

I completed the project myself, but initially was helped by my science teacher and the MBC aquatic center. In addition, my parents drove me to all the tidal pools and helped me over the coarse of the project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Margherita Scussat

Project Number

J0921

Project Title

Impact of Rainfall on the Salinity and Water Level of Groundwater Wells

Abstract

Objectives

The objective of this study is to determine if rainfall has an impact on the salinity and water level of five groundwater wells located in a wetland restoration area in Goleta, CA. My data will help determine what species of native plants can be reintroduced in the restoration site.

Methods

I tested the salinity and water level of five groundwater wells. The salinity was measured in parts per thousand (ppt) using a sample of groundwater collected in a test tube and a handheld refractometer. The water level was measured using a commercial measuring tape and a wet erase vis-a-vis marker.

Results

Having tested the five groundwater wells 24 times each between July 2018 and March 2019, my data indicates that rainfall does not have a long term impact on the salinity of the groundwater wells. Specifically, rainfall has no impact on wells with a salinity <15 ppt and it only temporarily decreases the salinity of wells with a salinity >15 ppt. Regarding water level, four out of the five groundwater wells I tested show that rainfall increases their water level.

Conclusions

My conclusion is that rainfall does not have a long term impact on the salinity of the groundwater wells I tested and consequently, their salinity is affected by factors other than rainfall such as salts in soil and/or underground saltwater intrusion.

On the other hand, for the majority of the wells I tested, rainfall increases their water level.

Since the objective of the restoration area where the wells are located is to restore the original wetlands, my results will help determine which and where native plant species can be planted as all plant species have different salt tolerance and water needs.

Summary Statement

I found that rainfall increases the water level of the groundwater wells I tested but it does not have a long term impact on their salinity.

Help Received

I borrowed a handheld refractometer from UCSB's CCBER and was taught by them how to use it. Rainfall data was acquired from the Santa Barbara Hydrology Department. I went water quality monitoring weekly, created my graphs, and analyzed the data on my own.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Fabilu Tattersfield

Project Number

J0922

Project Title

Is There Water Contamination in Three Rivers, CA?

Abstract

Objectives

The purpose of this project was to see if my local water sources had an indication of water pollution.

Methods

Lettuce seeds, local water sources, table salt, round up, solutions, sandwich sized Ziploc bags, coffee filters, pipette, one liter graduated scientific flask, six inch ruler, three wool blankets, five day period, and controlled temperature.

Results

A lettuce seed bio assay was employed to show indication for water contamination, and five samples of water were taken from local sources of freshwater in Three Rivers C.A. Five seeds per concentrated solution were put on top of a coffee filter inside a Ziploc bag to test for an indication for water contamination. 315 lettuce seed radicles were measured in millimeters after five days of being covered with blankets, in a room with a temperature of seventy degrees. The length of the seeds varied depending on the concentrated solution they were put into.

Conclusions

Based on the radical growth of the lettuce seeds the hypothesis was accepted. Two out of the five local water sources indicated water contamination. Though contamination was indicated in the water, the identity and source(s) of the contamination remains unknown demanding further research.

Summary Statement

I used a lettuce seed bio assay method in five different local water sources to test for indication of water contamination, it was proved that two out of the five local water sources were contaminated.

Help Received

I conducted my experiment with the guidance of Mr. Cannon, a science teacher at Woodlake High School, and I phone called Luz Amador, a biochemist and inventor of the enzymatic method of producing a lactose free calcium product, about glyphosate.

Name(s)

Kyle Tianshi

Project Number

J0923

Project Title

Detecting Invisible Particles in Water Using Laser Microscopy and Image Processing

Abstract

Objectives

Microplastic particles in drinking water pose health concerns since they are invisible to drinkers and are difficult to filter. My goal is to create a simple and efficient method to detect microscopic particles such as microplastics in the water. When shining a powerful laser into the air, the dust particles floating in the air within the beam of light can be seen clearly. Taking this principle, I hypothesized that a strong laser beam projects into the water would allow me to see the micro-particles inside on the water. Using image processing, the particle size distribution can be calculated.

Methods

Different light sources including a green laser, 800x zoom microscope, Costco drinking water, tap water, and seawater (water samples), square cups, Python software to calculate the particle size distribution.

Results

A simple laser and microscope detecting method was developed and utilized to test with three different types of water- drinking water, tap water, and seawater. The micrometer-sized particles can be detected using a laser, and the particle size distribution can be calculated using both image and video processing. According to the results, the drinking water is clean, the tap water has ~20 particles between 1 and 700 micrometers, and the seawater contains over 500 particles of various sizes.

Conclusions

In conclusion, the size distribution of particles in the water can be calculated quickly and efficiently using laser microscopy and image processing. This was confirmed by measuring three different water samples. This method can detect as small as 0.5 micrometers. To make image processing more efficient, videos were used instead of a single image to improve detection accuracy.

Summary Statement

I created a quick and efficient method to detect microscopic particles in water.

Help Received

My science teacher provided materials for me to complete the experiments, and my dad helped me record the videos.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Amelia Totten

Project Number

J0924

Project Title

Does Air Pollution Affect Ocean Life?

Abstract

Objectives

To measure impacts of air pollution on marine life.

Methods

Using water samples collected from the Pacific Ocean, measured the impact on water pH levels using an "artificial" method (injecting CO2 directly into a sample by exhaling into a straw submersed in the water for two minutes) and a "natural" method by lighting a candle that floats atop a separate sample, and then covering the sample so the CO2 is absorbed by the water. PH levels of these two samples as well as a control sample were collected for two weeks using a store bought pH meter, at 24 hour intervals. In addition, to measure the impact of the pH changes to ocean life, mussel shells sourced from dead specimens found in nature where placed in each sample and before-and-after weight measurements and visual inspections were recorded.

Results

The results showed the largest change in pH was in the "straw" sample (the lowest pH level at the end of the experiment), and the impact to the mussel shell in that sample was the greatest as well, as measured by a .02 gram reduction in weight as well as a visual inspection (change in shell coloration and opaqueness).

Conclusions

The experiment demonstrates that long term, direct exposure of CO2 on ocean water has an adverse impact on pH levels (by lowering it), which in turn has an adverse impact on certain shellfish as measured by the impact of the lowered pH levels on the weight and coloration of the shell sample.

Summary Statement

The impact of atmospheric CO2 levels on ocean pH levels and certain marine life.

Help Received

My science teacher helped me refine my hypothesis and objectives, and my father taught me how to enter the data that I collected into Microsoft Excel and create tables and graphs to use in my report and presentation.

Name(s)

Jason Wang

Project Number

J0925

Project Title

Big Data Analysis of Climate Change: Extreme Temperature, Rain, Snow, and Ice Trends

Abstract

Objectives

Overall measurements of global warming average over areas that have both gotten hotter or colder, masking the severity of climate change. This project measures the extremes of climate change, and identifies geographic areas where:
-Temperatures have gotten Hotter or Colder
-Rainfall has Increased or Decreased
-Snowfall has Increased or Decreased
-Ice coverage change has affected climate

Methods

Public weather datasets with 2+ billion global records are analyzed with Google BigQuery, Tableau, and least squares linear regression to quantify regional climate trends over five decades. Weather measurements are very sensitive, however, to the numbers and locations of stations included in the analysis. To make measurements consistent and comparable, this analysis follows carefully selected groups of weather stations that existed every year from 1973 to 2018.

Results

The Arctic is warming 3 times faster than the global average, while portions of the Upper Midwest of the United States have gotten colder due to the polar vortex. The Southeast and Western States have received less rain, while New England and the Upper Midwest have receieved more rain, due to a weaker, meandering jetstream. Most of the United States has gotten less snow, while New England and the Great Lakes region has gotten more snow.

This research discovered dramatically increased snowfall in the Great Lakes region, specifically a 40 percent increase in February snowfall over the last 5 decades. Decreasing and delayed lake ice coverage contribute to more lake effect snow, but there are many other factors, e.g., air temperature, lake evaporation, water temperature, and jetstream humidity.

Conclusions

Different geographic regions show more severe effects of climate change than global averages. Extreme climate change trends appear to have started over 45 years ago, much earlier than recent public awareness. The discovery of dramatically increased February snowfall in the Great Lakes region over 5 decades shows the complexity of climate change.

Summary Statement

This project measures the extremes of climate change, and identifies geographic areas where temperatures have gotten hotter or colder, and rainfall, snowfall, and ice have increased or decreased.

Help Received

My father taught me SQL and Tableau, which I used to analyze and visualize my data.