CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Natalia C. Aiello

Project Number
J0901

Project Title
The Comparison of Acidity Level and Its Impact on Quantities of Plankton in the Monterey Bay

Abstract

Objectives/Goals
The purpose of this project is to show how acidity level is currently affecting plankton in the Monterey Bay. What I am hoping to accomplish is to spread a higher level of awareness of how global warming and ocean acidification is affecting plankton. Plankton need to be publicized so people understand what plankton do and how we can support them in their fight against global warming.

Methods/Materials
In this experiment there were two procedures conducted. One of them was the Pier Method. In this method a plankton net was hung from a pier for 20-30 minutes. Then the samples of plankton were collected into a jar and then a pH meter was inserted into the sample of water. The second method was the Beach Method. In this method the difference was that buckets were used to dump seawater into a plankton net. Next the samples were collected and tested using a similar procedure as the Pier Method. I evaluated the quantities of plankton using a flashlight and microscope.

Results
The results of this experiment were Monterey State Beach with the lowest pH level (7.6) and the highest quantity of plankton. However the method used for Monterey State Beach was different than the other locations (Pier Method). Next was Marina State Beach with a pH of 7.7 and a moderate amount of plankton. Seaside State Beach was another location that was tested with a pH of 7.8 with a low amount of plankton. Finally Pebble Beach with a pH level of 8.1 and a low amount of plankton.

Conclusions/Discussion
In conclusion, the data shows that the stated hypothesis is incorrect because the higher the pH was, the less plankton there were. What I hope this project shows is how plankton can be affected by a higher pH. After the research of how plankton are affected by ocean acidification and global warming it is now understood that plankton are at risk and many need to pay close attention to any large issues of depletion. Finally the real life applicability of this project is to introduce people to plankton and educate them on plankton and their significance to the ocean and human environment.

Summary Statement
I showed how pH levels can affect quantities of plankton at different beaches in the Monterey Bay.

Help Received
I borrowed a plankton net and microscope from MBARI (Monterey Bay Aquarium Research Institute). California Department of Fish and Wildlife gave me permission for the collection of plankton.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Elizabeth Dahlberg; Allison Yee

Project Number
J0902

Project Title
Neutralizing Soil pH Levels

Abstract

Objectives/Goals
Our project displays a simulation of a common rainfall in the San Joaquin Valley. The objective is to determine what rate common soils (sandy, silt, clay, and topsoil) found in this area neutralize the effects of acid rain. By mixing lemon juice and water, we created the correct pH of acid rain (5.0). Through careful testing, we were able to conclude that clay soil, a highly alkaline soil, neutralized the outcomes of the acid rain at the fastest rate. In the end, we were able to infer that the initial amount of alkalinity in soil will be a good indicator of how it will hold up to the pH of acid rain.

Methods/Materials
Soil pH tester, 4 different soil types, acid rain mixture, water. Measured soils' pH over 5 days after adding acid rain mixture.

Results
Several different soil types were water with acid rain mixture. Soils of higher initial levels of alkalinity tended to have a higher rate of change for pH.

Conclusions/Discussion
Results from our project indicate that clay soil, a highly alkaline soil, will neutralize the effects of acid rain at a much faster rate than other common soils.

Summary Statement
Our project displays a simulation of a common rainfall in the San Joaquin Valley and at what rate soils neutralize these low pH levels.

Help Received
Our coach helped us decide to focus on soil types commonly found in the Central Valley. These suggestions helped us make our project more relevant to our region.

Name(s)
Vedant V. Janapaty

Project Number
J0903

Project Title
Redirecting Water to the Roots: An Effective Way to Increase Water Absorbency

Abstract

Objectives/Goals
About 31.4 million acres are irrigated with sprinkler systems. In addition, 26.2 million acres are irrigated with surface water. Surface water evaporation is a key reason for loss of water in farms. The purpose of my experiment was to investigate if delivering water directly to the roots of trees and plants is more effective than sprinkling water at the surface. I hypothesized that delivering water directly to the root is at least 2-times more effective.

Methods/Materials
Soil samples were prepared into four experimental groups. Control Group (Group 1) consists of samples of soil where 100 ml is sprinkled on the surface. Three other groups were also tested where 100 ml is poured at a depth of 10.16 cm (Group2), 50 ml is poured at a depth of 10.16 cm (Group3), and 25 ml is poured at a depth of 10.16 cm (Group4). The moisture level was measured at a depth of 10.16cm at various times over 5-days using a Vigoro moisture meter. The independent variables in my experiment were 1) location of delivering water to the plant (surface vs depth) and 2) the amount of water. The dependent variable is the moisture level at 10.16cm depth. Control variables are temperature, atmospheric humidity, wind, and soil type.

Results
Results of this experiment show that at least 4-times less water can be delivered to the root to maintain the same moisture level as water delivered at the surface. Repeatable results were obtained over six trials.

Conclusions/Discussion
When water is sprinkled at the surface, surface water evaporation reduces the available moisture to the roots. When water is delivered deeper under the surface, water loss due to surface evaporation is reduced and moisture levels are maintained for a longer time. Evaporation of surface water depends on temperature, atmospheric humidity, wind, and soil type. The benefits of delivering water to the root may vary in different climatic conditions. This experiment should be repeated under different climatic conditions including high/low temperatures, high/low wind velocity, and high/low humidity to study how the benefits of this method vary.

Summary Statement
My project is about finding a more efficient way to deliver water to plants and trees and thus saving precious water

Help Received
My science teacher helped me understand the scientific method

Name(s)
Richard Li

Project Number
J0904

Project Title
The Concentration Levels of Carbon Dioxide in Pasadena over Certain Periods of Time

Abstract

Objectives/Goals
The objective is, first, to measure carbon dioxide levels in the atmosphere, and compare it to carbon dioxide levels taken at Mauna Loa. Second, the objective was to find correlations between the time and concentration of carbon dioxide.

Methods/Materials
First, the data was taken from a Picarro CO2 Isotopic Analyzer. The data was all plotted on a scatter plot. The linear trend was calculated and subtracted. The new data was then split into four groups. The groups were sorted and averaged to come up with four seasonal variations. The points were then plotted on a scatter plot. The same was done with the Palos Verdes data.

Results
First, the carbon dioxide concentrations and Mauna Loa concentrations both increased in ppm over 13 years. Next, there were correlations between the time of day, and the concentrations. The night time and winter had the largest concentrations of carbon dioxide. The drought period had a winter period that had much higher carbon dioxide concentrations than during other winter periods.

Conclusions/Discussion
First, there was an increase in both background and Pasadena CO2 levels. Second, there were correlations. Night time had the highest concentrations because there was no sunlight, meaning plants can't perform photosynthesis. Winter has the highest concentrations because of the temperature inversions. The drought period had the highest concentration during winter, possibly because of wind speeds. Overall, there was an increase in CO2 levels, and there were correlations.

Summary Statement
I analyzed thirteen years of carbon dioxide concentrations to find correlations between times of day and concentrations of CO2.

Help Received
I analyzed the data myself. I was supplied the data from Professor Yuk Yung from Caltech University, and Dr. Sally Newman.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Natalia N.Q. Marshall

Project Number

J0905

Project Title

Ice Killer: CO2's Effect on Solid H2O

Abstract

Objectives/Goals

The objective of this experiment was to determine if blocks of ice exposed to air with increasing levels of carbon dioxide will melt faster than a block of ice exposed to air with an average level of carbon dioxide without air temperature being a factor.

Methods/Materials

A block of ice, a container and press and seal wrap, balloons with air from lungs, car exhaust, and pure CO2. I collected gas of various CO2 concentrations in balloons and emptied the balloons into a sealed container with a block of ice. I measured the rate of ice melting over the next 24 hours.

Results

In the experiments I ran blocks of ice exposed to pure CO2 melted 24 minutes quicker than the block of ice exposed to normal air. This was in spite of the fact that normal air block of ice 388.681 cm3 larger than CO2 block of ice.

Conclusions/Discussion

Blocks of ice exposed to air with increased levels of CO2 melted faster than the block of ice in a normal air environment.This is likely due to the weakening of the structure of the ice crystals caused by CO2 interfering with the hydrogen bonding of the water molecules.In the environment filled with pure CO2 the block of ice melted 24 minutes quicker even though it was larger by 388.681 cm3 than the normal environment block of ice.At the 2 hour mark, the CO2 environment block of ice was 30.9% melted while the block of ice in the normal air environment was 13.3% melted. At the 22 hours mark, the block of ice in the CO2 environment was 94.1% melted while the block of ice in the normal air environment was 92.6% melted.

Summary Statement

As measured by the increased melting rate of blocks of ice, ice exposed to air with increased levels of carbon dioxide melted faster than a block of ice exposed to normal air.

Help Received

I designed the experimental procedure and collected the data myself, but I need help from my father purchasing the materials, collecting car exhaust, and sawing the blocks of ice.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Ellery B. McQuilkin

Project Number
J0906

Project Title
A Tale of Two Slopes: Aspect Creates Microclimates

Abstract

Objectives/Goals
I was curious to see if the different north and south facing aspects in Lundy Canyon create substantially different temperatures and snow depths due to varying amounts of sun exposure.

Methods/Materials
I placed temperature sensors on the north and south facing slopes of Lundy Canyon in the Sierra Nevada at 100 foot increments ranging from 7400-7900 feet. My project collected data from November to February. I measured snow depth with snow poles and time-lapse cameras on both slopes, recording snow depth at 15 minute intervals. I made a spreadsheet to record snow depth levels from each picture. I measured sun exposure using 27000 time-lapse camera photos. I used Excel to calculate daily slope sunlight from my photos.

Results
The north facing slope received 0.06% of the solar energy that the south facing received. In December there were 21 days with no sunlight, and when the sun rose high enough in the sky to finally shine on the north facing slope it had low solar energy, because of its low angle in the sky. I found that this caused the north facing slope to have colder temperatures and a longer duration of snow coverage. The south facing slope was up to 14°C warmer than the north facing slope during the day, but cooled down to similar temperatures at night. The south facing slope experienced a large temperature range.

Conclusions/Discussion
Both slopes create microclimates, places where the topography affects the local climate. The large temperature range of the south facing microclimate stresses rocks, which results in more rock falls. The north facing microclimate can be, at least temporarily, a refuge from climate change for hundreds of plant and animal species that need colder temperatures and deep snow coverage to survive.

Summary Statement
Due to different aspects, Lundy Canyon slopes have different sun exposures, creating microclimates with different temperatures and snow coverage.

Help Received
A big thanks to all the great people who helped me with my project: Dr. Connie Millar was my science advisor and loaned me iButtons. Dr. Greg Stock helped me with Lundy Canyon and geology background. My dad (Geoff) helped me with my experiment in the field. My mom (Sarah) helped me with display

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Arya H. Sadeghi

Project Number
J0907

Project Title
Shake! Shake! Shake!

Abstract

Objectives/Goals
I hypothesized that if I build a working seismograph that can measure seismic waves caused by ground movement, then the seismograph will be able to detect the nearby vibrations and measure their intensity. I chose this project because as a Southern California native, I was curious to understand the science behind earthquakes. With this project, I aimed to create a seismograph that could detect different intensities of seismic waves.

Methods/Materials
My seismograph was built with several wooden parts along with white paper rolls, an Aslong DC geared motor, Pixnor speed controller, and a binder clip. It was built using a hand drill, electric hand saw, a level, and sandpaper. The seismograph was built entirely from scratch. The science behind the seismograph is proven by Newton's first and second laws of motion, which I used as guidelines to understand seismic activity.

Results
First, I measured the differences in the seismic waves when balls of different weights were dropped from different heights. Overall, I noticed that balls with a larger mass dropped from a certain height produced larger seismic waves than a smaller ball dropped from the same height. In this project, I used weighted balls of 907.2g, 1814.4g, 2721.6g, and 3628.7g, and dropped each from heights of 33cm, 66cm, and 99cm. The largest amount of seismic activity was recorded when a ball of 3628.7g was dropped from 99cm, producing a surface wave of 5mm. While, the smallest amount of seismic activity was recorded when a ball of 907.2g was dropped from 33cm, producing a surface wave of 0.92mm. After gathering my data from my different tests, I proved that I built a successful seismograph with the ability to detect different intensities of seismic waves.

Conclusions/Discussion
This project proved that simple machines can be made to make understanding earthquake magnitudes simple and accessible. For future application, the technology of the seismograph can be further developed to identify earthquakes before the occur. In my results, heavier objects caused a greater amount of seismic activities than lighter ones. This information can be applied to the architecture of earthquake-heavy regions, such as the Ring of Fire. Earthquake simulations may be created in order to test the integrity of a building. Overall, my seismograph showed distinctions in seismic wave intensity, and proved that speed, mass, and height affect the magnitude of seismic waves.

Summary Statement
In this project, I built and tested a seismograph in order to understand ground movement by measuring seismic waves.

Help Received
Project built at home under supervision of a parent. Portion of project done at Amtrak/ Metrolink Moorpark and Simi Valley locations.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Alexander T. Severinghaus

Project Number

J0908

Project Title

Evidence of Increased Photosynthesis: Comparing Ratios of Oxygen Isotopes

Abstract

Objectives/Goals

The purpose of this project was to discover whether the ratio of 18O to 16O has changed in the atmosphere over time. Oxygen 18 is a stable isotope of oxygen, and the ratio of oxygen 18 to oxygen 16 can tell us about ancient atmospheres. I chose this project because I have heard a lot about climate change, which affects rainfall, farming, and water supply. After some research, I became interested in 18O and how its ratio to 16O can tell humans about past climates. I hypothesized that the ratio has been impacted by human activities over time which influence photosynthesis and climate. I expected to see an increase in 18O in the atmosphere from human activities.

Methods/Materials

I began by obtaining a modern air sample using an air pump and a two liter flask. I transferred the sample to a pipette, through a trap with liquid nitrogen to eliminate carbon dioxide and water vapor, then into a dip tube in liquid helium at 4 Kelvin for 10 minutes. I repeated this process with an air sample taken in 1974, but first pumped the air from its tank into a pipette at 0.1 liters per minute with a flow meter. I placed the dip tubes in the mass spectrometer for analysis.

Results

I evaluated about 1,000 measurements with the mass spectrometer. I only used 880 of these measurements because some measurements were contaminated due to accidental fractionation. I made 192 measurements of 2018 air, and 688 measurements of 1974 air. The result of the 2018 air was that the ratio of oxygen 18 to oxygen 16 averaged to be 8 parts per million. The result of the 1974 air was that the ratio of oxygen 18 to oxygen 16 averaged to be -11 parts per million. So, the change is 19 parts per million. I also found that the oxygen value has decreased from 1974.

Conclusions/Discussion

However, the change of the ratio of oxygen 18 to oxygen 16 was not significant due to fractionation when handling the sample. I cannot conclude that there was a change in the ratio in the atmosphere. If I were to repeat this project again, I would take 10 non-contaminated air samples of 1974 air and 2018 air, without any fractionation occurring. Because the oxygen value has decreased from 1974, my findings show that the depletion of oxygen is consistent with the increase of CO2, driving climate change.

Summary Statement

The purpose of this project was to discover whether the ratio of oxygen 18 to oxygen 16 has changed in the atmosphere over 44 years.

Help Received

I had help from my parents to drive me to Scripps Institution of Oceanography at UCSD where I performed my experiment. I was supervised at the laboratory but I completed my experiment by myself. I also received help from Scripps laboratory personnel, Dr. Jeffrey Severinghaus, Alan Seltzer, Benny

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Kayla L. Snyder

Project Number
J0909

Project Title
Which Type of Terrain Will Erode the Least?

Abstract

Objectives/Goals
I put soil in 3 different containers and left one with just soil, another one with just pebbles, and the last one with weeds and grass because it had roots. I then poured water on it and watched the water flow out of the containers containing different amounts of soil being carried with it. I discovered which type of terrain helped prevent the greatest amount of erosion to the soil.

Methods/Materials
3 large empty bottles, 3 medium sized empty bottles, soil, small rocks and pebbles, and grass/weeds. Procedure: Step 1: Get 3 of the 6 bottles and draw one large rectangular hole on each of them to use as an outline to cut on. Step 2: Cut out the rectangles in the bottles. Step 3: Use the other three Coke bottles and cut the top off horizontally and keep the bottom part. Step 4: Fill all three bottles with soil and press down firmly on the soil to make sure it's compact. Step 5: Leave one of the bottles filled with soil. With the second bottle, put a layer of rocks over the top of it. With the third bottle, plant some grass in the soil. Step 6: Get the bottoms of the bottles and twine and wrap the twine around the top and bottom so it looks like U-shape and tape it in place. Step 7: Tie the twine onto the tip of the large water bottle so it hangs from it. Step 8: start pouring equal amounts of water into the three water bottles and see how much of the soil is carried with the water and falls into the small bottle connected. Step 9: Record your data and decide which type of terrain helps soil erode the least.

Results
I discovered that pebbles on top of the surface of the soil is the best way to keep land from eroding. The water came out very clear so you could see through it and see the other side. I learned something new because I thought the water would go through the crevices and the soil would erode a lot. The pure soil did the worst because there was a lot of soil that traveled into the other water bottle and the water was very dark and almost looked black.

Conclusions/Discussion
In conclusion, the best way possible to keep your yard or some type of soil from eroding because of water, is to put a layer of rocks on top of the soil. There are many different types of erosion and water erosion is something we see very often because of heavy rainfalls. There have been many recent floods and landslides that were washing away homes, cars, plants, and much more.

Summary Statement
My project is about me experimenting with three different terrains and discovering which one will prevent the most erosion.

Help Received

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Cameron Steagall

Project Number
J0910

Project Title
Is There a Relationship between Soil Density and Water Evaporation Rates?

Abstract

Objectives/Goals
The objective of this project is to determine if different soil densities affect evaporation rates.

Methods/Materials
In 4 tests, measured the weight of 4 types of soil (sand, loam, clay and potting) with added water 2 times each day over a period of 3 days. Materials: pots, soils, water, scale and measuring cup

Results
Water evaporation rates were independent of soil density. The most dense soil was sand and the least dense was potting. Clay soil had the greatest water evaporation rate at 18 grams and potting soil had the least at 11.75 grams.

Conclusions/Discussion
The density of soil did not have an impact on water evaporation rates during the test cycle of 3 days. Further testing would need to be conducted to understand the longer term implications of which soil is best to hold water for specific plants.

Summary Statement
As measured by weight, I found that soil density does not affect water evaporation rate.

Help Received
I designed and conducted my tests by myself after researching my topic.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Jason C. Wang

Project Number
J0911

Project Title
How Accurate Are 10 Day Weather Forecasts? Can Similar Cities Foreshadow Future Weather?

Abstract

Objectives/Goals
This project answered 3 questions: (1) How accurate are the 10-day forecasts, for Walnut, CA and Boston, MA? (2) What cities have the most similar temperatures to Walnut and Boston, on the same day? (3) What cities have the most similar temperatures 10-days earlier?

Methods/Materials
Forecast Analysis: Every day for 8 months, I took 2 screenshots of my iPhone's 10-day weather forecasts, for Walnut, CA and Boston, MA. Using 516 total screenshots, I compared forecasts versus actual temperatures, and calculated the accuracies of 10-day forecasts.

Similarity Analysis: I downloaded actual daily temperatures from 2013 to 2017 for Walnut, CA and Boston, MA, along with 20 California and 20 East coast cities. (a) I computed the cities with the most similar weather on the same day, and (b) I identified the cities with the most similar weather 10-days earlier.

Results
The next-day forecast only predicts tomorrow's high temperature exactly ~27% of the time. The one-week forecast drops to less than ~10% accurate, and the 10-day forecast is only around ~6% accurate with wide variability. The cities most similar to Walnut, CA and Boston, MA matched temperatures ~13% on the same day. Cities most similar 10-days earlier foreshadowed temperatures ~5% of the time, almost as accurate as 10-day weather forecasts.

Conclusions/Discussion
Weather forecasting is extremely difficult. Surprisingly, tomorrow's high temperatures are exactly correct only a quarter of the time, and the 10-day forecast is barely better than random. There are cities that can foreshadow future weather as well as the 10-day forecast, however, it is difficult to know which city in any given year. With long-range forecasts, random variability resulted in statistical uncertainties, just as finding similar cities resulted in geographic uncertainties.

Summary Statement
Over 8 months, I took daily screenshots of 10-day weather forecasts to measure their accuracy for Walnut, CA and Boston, MA, and then found cities that foreshadowed their high temperatures as well as the long-range weather forecast.

Help Received
My father taught me how to use Microsoft Excel to analyze and visualize data.