CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Michael A. Castillo

Project Number
S0801

Project Title
Which Organic Material Has the Least Soil Compaction Rate and Allows for the Best Plant Growth?

Abstract

Objectives/Goals
My objective was to determine which organic material had the least soil compaction rate and allowed for the best plant growth. My goal was to prove that grape extract had the least soil compaction rate and allowed for the best plant growth.

Methods/Materials
My method was to fill a 5 gallon bucket 3/4 of the way with top soil mixed with 2 cups of the organic material with a wooden dowel sticking out of the bucket with a hook screw attached. Next, attach the compaction tool and pull from bucket and record the measurement in newtons. Thereafter, use the soil to grow wheat grass. The materials used were soil, 5 gallon bucket, dowel, water, grass clippings, small rocks, leaves, wood chips, potato peels, grape extract, compaction tool, measuring cup, hook screw, drill and drill bit, 2 bricks, ruler, wheat grass, 10"x20 1/2" container, and 20"x9 3/4" wooden pallet.

Results
The results of my project were that grape extract had 5 centimeters of growth and 11.5 newtons of compaction rate. Leaves had 3 centimeters of growth and 9 newtons of compaction rate. Potato peels had 3 centimeters of growth and 8 newtons of compaction rate. Wood chips had 3.5 centimeters of growth and 6 newtons of wood chips. Control had 4 centimeters of growth and 9.5 newtons of compaction rate. Grass clippings had 2.5 centimeters of growth and 7 newtons of compaction rate. Small rocks had 2 centimeters of growth and 9 newtons of compaction rate.

Conclusions/Discussion
After completing my investigation, my hypothesis was both incorrect and correct. My hypothesis was that grape extract had the least soil compaction and allowed for the best plant growth. Grape extract allowed for the best plant growth while wood chips allowed for the least soil compaction rate.

Summary Statement
To prove which organic material mixed with soil had the least soil compaction rate and allowed for the best plant growth.

Help Received
Father assisted with preparing bucket and dowel and gathering grape extract. Mother assisted with setting up graph.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Natalie Gallagher; Connor Lydon

Project Number

S0802

Project Title

Secrets of San Lorenzo Valley's Atmosphere

Abstract

Objectives/Goals

To determine the affect of atmospheric inversions on ground particulate matter 2.5 levels. And to compare San Lorenzo Valley's particulate matter 2.5 levels to neighboring areas.

Methods/Materials

We used: radiosondes, 200g balloons, helium, parachutes, dereelers, an i-Met 3050 Sounding System, and data from EBAMs. We collected atmospheric data over a period of three months, launching weather balloons three times a week, twice a day to obtain atmospheric data.

Results

Particulate matter 2.5 clearly was affected by atmospheric inversions, and increased greatly on inversion days. In some cases, PM 2.5 levels were "unhealthy" on inversion days and "healthy" on non-inversion days. Also, differing topography between San Lorenzo Valley and non-valley areas also influenced particulate matter 2.5 levels; most comparisons had "unhealthy" PM 2.5 levels in San Lorenzo Valley, while PM 2.5 levels in a neighboring area were "healthy". (Ratings [healthy/unhealthy/etc.] were derived from a modified Air Quality Index Table we had created).

Conclusions/Discussion

Inversions increase levels of particulate matter 2.5, and San Lorenzo Valley experienced many unhealthy days for particulate matter. San Lorenzo Valley experienced much higher particulate matter 2.5 levels then neighboring areas - to such extent that while another area may be experiencing "healthy" PM 2.5 levels, San Lorenzo Valley can be experiencing "unhealthy" PM 2.5 levels.

Summary Statement

Finding the affect of inversions on particulate matter 2.5 levels in San Lorenzo Valley and comparing particulate matter 2.5 data from San Lorenzo Valley to Santa Cruz particulate matter 2.5 levels.

Help Received

Received equipment/money and training from Monterey Bay Unified Air Pollution Control District and Inter-Met.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Maya A. Josyula

Project Number

S0803

Project Title

Earth's Carbon Sinks: Exploring the Effects of Melting Arctic Ocean Ice

Abstract

Objectives/Goals

This project studies how the Arctic Ocean is responding to increasing atmospheric carbon dioxide (CO(2)) and global warming. Sea surface temperature (SST) and chlorophyll a measure CO(2) absorption by air-sea exchange of CO(2) and carbon fixation by phytoplankton respectively. My hypothesis was that both will be higher when more sea ice has melted, as in the year 2012.

Methods/Materials

I tested this hypothesis by comparing MODIS/AQUA remote sensing data of the Beaufort Sea for May-October of 2012 with data from a previous year with minimum summer ice, 2007.

Results

The sea surface temperature and chlorophyll concentration of the Beaufort Sea were generally higher in 2012, which confirmed my hypothesis. Water in the Beaufort Sea was warmer in 2012 than in 2007 for all the months that I considered. In July and August of 2012, SST was 30-50% higher compared to the same months in 2007. Chlorophyll a concentration was higher during the seasonal blooms of July and September in 2012. In August, the dip in chlorophyll a was lower for 2012 than in 2007.

Conclusions/Discussion

Discussion: I think that the August dip is because nutrients in the surface waters were depleted by the earlier seasonal bloom. Higher water temperatures in 2012 caused greater stratification which prevented nutrients from being brought up from colder, nutrient-rich deep water. There was probably more mixing in August 2007 because the water was colder, and the chlorophyll a value was therefore higher.

Conclusion: I conclude that rapid melting of ice due to global warming results in more CO(2) fixation by phytoplankton. However, rising sea temperatures will offset this increase by reduced air-sea exchange of carbon due to decreased solubility. Higher temperatures further produce more stratification of the surface waters and can deplete nutrients during phytoplankton blooms, decreasing their productivity. The ocean may not be able to regulate the increased CO(2) amounts being introduced into the atmosphere. We need to actively find other ways to reduce our carbon footprint.

Summary Statement

I studied remote sensing data of sea surface temperature and chlorophyll a concentration in the Beaufort Sea, and found that they were both higher during 2012 when Arctic ice was at a record low.

Help Received

Prof. K. Arrigo (Stanford University) suggested that I look at chlorophyll a to measure carbon production, and that I limit myself to a region of the Arctic; Zach Brown (Stanford University) sent me a SeaDAS tutorial; Prof. G. van Dijken (Stanford University) provided ice data.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Cali Mendoza; David Tenney

Project Number
S0804

Project Title
Using an Upper-Stratosphere Data Collecting Systematic Apparatus to Monitor Atmospheric Phenomena

Abstract

Objectives/Goals
Our objective was to send a USDCSA (Upper-Stratosphere Data Collecting Systematic Apparatus) to make observations of key variables that determine how temperature, light, wind, radiation, humidity, and UVB change as you increase in altitude.

Methods/Materials
In total we launched 54 balloons in the course of 3 year. All balloons were launched from the same launch site (area) and at a consistent time. All balloons collected data that informed us of the above stated key variables.

Results
The 4 hypotheses that were validated were:

Hypothesis #1 As the weather balloon rises in altitude, there will be a decrease in temperature.

Hypothesis #4 As the weather balloon rises in altitude, there will be a change in direct light.

Hypothesis #5 As the weather balloon rises in altitude, there will be a change in wind speed.

Hypothesis #6 During an annular solar eclipse, there will be a decrease in UVB light.

Conclusions/Discussion
Our conclusion is that as you increase in altitude variables in the upper atmosphere change in very distinct ways. Our distinct conclusions are that during an increase in altitude a decrease in external temperature, and UVB light is observed. Also, during an increase in altitude an increase in direct light and wind speed is observed.

Summary Statement
Our project was to send weather balloons into the upper atmosphere to collect data on varied variables.

Help Received
We have received help and support from our teachers and the community.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Max B. Olsthoorn

Project Number
S0805

Project Title
Ocean Currents Flow, Direction, and Journey: Galapagos Islands Examination

Abstract

Objectives/Goals

Problem Statement: To test and discover where objects end up when there is a change in wind and direction of an ocean current.

Hypothesis: I believe that the closest islands to the origin of the ocean current will receive the most successful trials.

Methods/Materials

Materials: 2 Boxes of Moldable Clay
1 Large Tub
Hose and Water
4 Hand-Held Fans
1 Cup measure of Salt
1 Piece of Cork or Wood (small so it fits to scale)
Map of the Galapagos Islands

Procedure:
1. Print out a map of the Galapagos Islands and re-create the islands with the moldable clay. Try to make sizing#s to scale, but do not have to be precise, just approximate. Also, create the South American Coastline, including Panama and Ecuador.
2. Fill the tub with water using the hose. Once it is full, pour salt into the water and mix around, this way, there is a controlled environment for the experiment.
3. Place the 4 fans around the perimeter of the tub, one coming from the North, South, East, and West. Make sure that they are in the correct places to first create a control group.
4. Begin testing by turning the fans on and testing the object from each location. Do this for a total of 16 times each at the North, South, and East fans.
5. Once completed, move the fans around, have them coming from different directions and angles to be able to test the probability of where each object travels when coming from a different direction.
6. Make a graph for each of the 4 trial sets, 16 trials per each current, making for a total of 200 trials.

Results

Results: The Islands that were located closest to the new origin of the newly placed ocean currents, the Eastern Islands, did in fact receive the most debris. Most of the Western Islands rarely received any

Summary Statement

To examine the affect of Ocean Currents on the Galapagos Island's Species Richness and Diversity.

Help Received

Parents helped arrange board and with my experiment.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Christopher A. Powers

Project Number
S0806

Project Title
Investigating Wave Barriers to Reduce the Power of Storm Surges

Abstract

Objectives/Goals
Storm surges are the rise of water caused by storms like Hurricane Sandy. They flood and damage coastlines. My experiment tested which wave-barrier reduces wave power, but also minimizes cost and environmental impact and allows coastal navigation. Current barriers, such as movable walls or Reef Balls, do not meet all of these requirements. I hypothesized that a metal mesh suspended with small stones, simulating an artificial coral reef, would be the most effective barrier overall. Its irregular shape and surface area increase drag. This decreases wave height and time period between waves, reducing wave power.

Methods/Materials
I tested the following barriers: bricks, angled half-bricks, a window screen, a half-submerged, vertical piece of wood, a fully submerged, slanted piece of wood, a lowered metal mesh, and a raised metal mesh. I constructed a wave tank with an artificial beach to absorb rebounding waves, a wave generator plate, and a plexiglass viewing window. I attached rulers to measure wave height at fixed points before and after the barrier, located near the box#s center. For each barrier, I generated ten large single waves and five series of fifteen small waves at half-second intervals. I took videos of these waves through the viewing window.

Results
For the multi-wave tests, I calculated each wave#s peak to trough height before and after the barrier. The multi-wave height ratios were inconsistent because of rebounding waves and variable wave generation. The wave time period had a range of 0.3 seconds, which is insignificant. The single wave height ratios were more consistent. I ranked the barriers# height ratios from least to most effective: control, lowered metal mesh, window screen, two bricks, three half-bricks, slanted wood, raised metal mesh, and vertical wood. The vertical wood and raised metal mesh were effective partly because they were close to water level.

Conclusions/Discussion
The optimal barrier would be a lightweight, semi-porous material raised to the water level. It would significantly reduce wave power, have a low cost because of less material, and allow tidal flows, salt levels, and marine life to pass underneath. Gaps could allow navigation of ships. In future experiments, I could increase accuracy and test different positions, shapes, and materials for barriers.

Summary Statement
Using a wave tank, I tested which barriers most effectively reduced wave power, and concluded that a raised, semi-porous material is most effective, and practical in terms of cost and environmental factors.

Help Received
Dad helped construct wave tank.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ken K. Ross

Project Number
S0807

Project Title
Will Your Land Sink? The Effects of Porosity and Permeability of Different Grain Sizes of Soil on Liquefaction

Abstract

Objectives/Goals
The purpose of this experiment was to investigate the characteristics of different grain sizes of soil by determining their porosity and permeability and how these affect earthquake liquefaction susceptibility.

Methods/Materials
Five different grain sizes of soil were tested for porosity and permeability and then a liquefaction experiment took place. 500ml of each dry soil sample was used to determine porosity. For permeability of each soil, 40cm of dry soil samples were poured into clear PVC pipes. Next, 200ml of water was then poured into the pipe. The volume of water that passed through the soil per second was recorded. For liquefaction, 10 liters of each type of soil was poured in containers and saturated with water. A marked brick was placed on top of the saturated soil and vibration was administered as a seismic wave by tapping the side of the container with a rubber mallet. A metronome was used in order to ensure the tapping was consistent. After the rate and volume of sinking was calculated, five trials for each soil type, the results were analyzed with porosity and permeability data.

Results
As the porosity of the soil was high, the rate and volume of sinking was high. Over all, finer grain soils had higher porosity compared to coarser grain soils and had a higher rate and volume of sinking when the soil was saturated. As the permeability of the soil became higher the rate and volume of sinking became lower. Coarser grain soil had higher permeability but a lower rate and volume of sinking. Local soil had the lowest permeability, but it had the highest rate and volume of sinking.

Conclusions/Discussion
To mitigate liquefaction hazards, lower porosity and higher permeability must be achieved. It is possible that not only sandy (cohessionless) types of soil with high porosity and low permeability are more susceptible to liquefaction, but silt like soil with high porosity and low permeability is also severely susceptible to liquefaction in a different manner if the soil is saturated.

Summary Statement
The effects of porosity and permeability of different grain sizes of soil on liquefaction.

Help Received
My parents assisted with conducting the experiments since three people were required.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Hannah J. Washburn

Project Number

S0808

Project Title

Rehabilitating Hydrophobic Soil to Allow Indigenous Bunch Grass Growth

Abstract

Objectives/Goals

The purpose of my project is to determine if treating hydrophobic soil with an alkaline solution or an Aqua Gro L solution will speed the soil rehabilitation process and help allow native bunch grass growth. It is my goal to help the soil get back to its non-hydrophobic state.

Methods/Materials

I collected coarse, upland soil and covered it with dried leaves and wood. With supervision, I burned the organic material for 8 hours and let it cool. I then did a WDPT test to determine hydrophobicity. I had 4 test soils: untreated soil, hydrophobic soil, hydrophobic soil treated with an alkaline solution, and hydrophobic soil treated with an Aqua Gro L solution. I saturated 12 cups hydrophobic soil with the alkaline solution and allowed it to dry. I saturated another 12 cups with the Aqua Gro L solution. In bottom of 8x11 aluminum pan I spread 1 inch healthy soil, covered this with 1 inch layer of test soil, followed by 1 inch healthy soil, spread grass seed, covered with 1/4 inch top soil, watered, watched and documented growth. After 2 weeks I pulled 10 plugs from each test tray, rinsed soil away from root system, weighed and measured grass/root plugs. Total of 4 growing trays and 40 grass/root plugs.

Results

Untreated soil grass/root plugs had an average weight of 8.1 grams after soil rinse and an average root ball length of 7.8 cm.

Hydrophobic soil grass/root plugs had an average weight of 6 grams after soil rinse and an average root ball length of 4.8 cm.

Hydrophobic soil with alkaline solution grass/root plugs had an average weight of 1.05 grams after soil rinse and an average root ball length of 1.5 cm.

Hydrophobic soil with Aqua Gro L solution grass/root plugs had an average weight of 10.2 grams after soil rinse and an average root ball length of 8.8 cm.

Conclusions/Discussion

As a hydrophobic soil rehabilitator, Aqua Gro L has the most potential to allow water percolation and promote plant growth with a strong, penetrating root system. This could be a possible solution to the problem of erosion and mud slides of denuded hillsides due to fire. While the occasional fire is considered to be healthy for an ecosystem, hydrophobic soil is not. It can paralyze an ecosystem and be financially devastating due to loss of top soil from excessive erosion and mudslides.

Summary Statement

Finding a way to rehabilitate hydrophobic soil to promote plant growth with a strong penetrating root system is necessary for both a healthy ecosystem and the prevention of financial devestation due to top soil erosion and mudslides.

Help Received

My mother took photographs of my testing process

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Alice R. Zhai

Project Number
S0809

Project Title
Constructing a Multi-Variate Regression Model for Hurricane Loss and Its Application to Hurricane Sandy

Abstract

Objectives/Goals
Many empirical hurricane loss models consider only wind speed but neglect storm size. Such models may not accurately predict the losses from super-sized storms such as Hurricane Sandy in 2012, the largest Atlantic hurricane on record. The goal of this project was to construct a hurricane loss model as a function of both wind speed and size, and then apply this model to estimate the loss of Hurricane Sandy and quantify the relative role of wind speed and size.

Methods/Materials
I analyzed 32 hurricane cases that hit the United States between 1989 and 2008. The normalized hurricane loss and wind speed data were downloaded from the ICAT Damage Estimator. The hurricane size data were taken from the Extended Best Track data at the National Hurricane Center. I used the Microsoft Excel Data Analysis Toolpak to conduct multi-variate regression analysis to find the best fit to the data.

Results
I found that hurricane loss (L) approximately follows a power law relation with wind speed (V) and storm size (R), with L = c V^a R^b, where c is a scaling factor, and a and b are about 6.7 (7.4) and 2.4 (2.9) for unweighted (weighted) regression, respectively. By using both wind speed and size as predictors, the best fit model captures 75% of the variance of the losses, whereas by using wind speed or size alone, the captured variance is only 55% or 50%, respectively. Using the best-fit model, I estimated the normalized loss for Hurricane Sandy to be 51.4 billion in 2012 USD, the third most expensive storm behind Hurricane Katrina (2005) and Hurricane Andrew (1992). The size of Hurricane Sandy was 3.3 times of the average storm size, causing a loss about 30 times of the average-sized storm assuming the same wind speed.

Conclusions/Discussion
The enormous size of Hurricane Sandy played a predominant role in determining its loss. The actual loss of Sandy may be greater than what my best-fit model predicts because many complicating factors are not represented in the model. The example of Hurricane Sandy highlights the importance of storm size in determining hurricane loss. Hence, it is important to consider both wind speed and size in predicting hurricane loss.

Summary Statement
The enormous size of Hurricane Sandy played a predominant role in determining its loss. It is important to revise existing empirical hurricane loss models to include both wind speed and size as predictors.

Help Received
Parents taught me to use Microsoft Excel regression analysis tool. A JPL scientist, Dr. Lee Poulsen, provided the data for Hurricane Sandy.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Teo A. Palmieri

Project Number
S0898

Project Title
Soil Compaction

Abstract

Objectives/Goals
To test soil compaction in 5 different locations

Methods/Materials
Knitting needle
Spool
Rubber band
Permanent Marker
5 1/2 pound weight
Creek flood plain
Creek bank
Temperate forest
Mountain
Pasture land

Results
Most compact was the creek bank and the least compact was the creek flood plain

Conclusions/Discussion
My science fair is about soil compaction and which environments have the most and least compact soil. I observed, after averaging my data, the most compact soil was the creek bank at 1.85 cm, followed, in order, by pasture land at 7.0 cm, temperate forest at 8.0 cm, mountains at 10.33 cm, and creek at 14.2 cm. My hypothesis stated that the creek flood plain would be the least compact and the mountains would be the most compact. My data showed that the creek flood plain was the least compact and the creek bank was the most compact which made my hypothesis 50% correct. If I were to do this project again I would record weather patterns for 2 weeks before collecting data. I learned what to expect regarding soil compaction if I wanted to build a building in one of these 5 environments.

Summary Statement
Testing soil compaction in 5 different natural environments

Help Received
Mother helped with layout of board and brought me to the locations tested

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Hannah N. Johnson; Hannah R. Larsen; Zachary J. Larsen

Project Number

S0899

Project Title

Using Fossils to Reconstruct a Miocene Ecosystem in the Barstow Formation: Year Two

Abstract

Objectives/Goals

Our investigation asked whether animal and plant fossils from the Barstovian Miocene period could be used to reconstruct an ancient ecosystem. We compared isolated Merychippus bones to other prehistoric horse bones from the same time period, as well as looking at other animal fossils that we found. Fossilized plant evidence was subsequently collected. This investigation is important because by revealing the environment of that particular area, we can determine climate, habitat, environmental history, and the flora/fauna present at the time.

Methods/Materials

Over two years, we used common geologic approaches and recovered fossils from the Barstow Formation in California. Following established procedures for fossil recovery and preservation, we removed diagnostic fossils for further investigation. Recovered animal fossils were measured and compared to published measurements of the same species. Photographs of plant fossils were taken with a microscope and a measuring device. A geologist and an expert in ancient vegetation provided confirmation of the species.

Results

Recovered animal fossils were similar to documented fossils, allowing for species identification. Bones recovered were from Merychippus, a Miocene era three-toed horse. Other Miocene-era fossils found at the site were from Pseudolauris and a camel. In year two, plant species found in the Barstow formation included Thuja, Salix Willow, Sage Wood, Maple, Pine, Elm, and Ginkgo. This was the first time that Thuja had been found here. Our results show the area was vegetated with diverse species now found in temperate areas. Our conclusion has changed from year 1 since addition of the plant species shows this was not just a simple grassland. We conclude that this ancient ecosystem contained four distinct communities.

Conclusions/Discussion

Based on the fossil evidence, we conclude that the area consisted of four distinct communities. By comparing isolated bones to documented horse fossils we determined that the fossils found were from a Merychippus. Plant evidence included leaves, seeds, and fossilized wood of both evergreen and deciduous trees. Although the climate was likely semi-arid, plant material collected indicated that it was a diverse habitat interspersed with ponds that attracted animals for drinking. Based on the samples collected, we conclude the environment for the time consisted of savannah, riparian, marsh, highland areas.

Summary Statement

Our work uses paleontological tools, including fossil recovery and identification, to predict what an ancient ecosystem may have looked like.

Help Received

We were helped by a field geologist, Robert Reynolds and a University of California-Berkeley botanist, Tom Schweich.