CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Kristin E. Barker; Kayla V. Ladd

Project Number

S0601

Project Title

Simulation of Terrestrial Impact Craters

Abstract

Objectives/Goals

Simulation of terrestrial impact craters will determine if the parameters of low velocity impact craters obey power laws and confirm or extend published impact crater data.

Methods/Materials

The experiment was conducted by dropping projectiles from carefully measured heights to a containment vessel, which was filled with sand whose surface was leveled before each drop. Projectiles were released one at a time. The drop time was measured. The impact was recorded using a digital video camera. After impact, the depth and diameter of the resulting crater was measured. Each of the projectiles was carefully weighed and its diameter was measured.

Results

The impact energy for each trial was calculated from the drop height, neglecting any air resistance or drag. Crater diameter and depth were plotted against the impact energy. This data was plotted on linear, semi-logarithmic, and log-log plots to determine the relationship between crater parameters and impact energy. The crater diameter data were fit very well to a power law. The results of our project both compliment and extend published data.

Conclusions/Discussion

Low velocity impact crater parameters can be described well by power laws. We used our power law fit to extrapolate our results to compare with real terrestrial impact events, and we found remarkably good agreement. The video recording, when viewed frame by frame, allowed us to see how craters formed, and how the ejecta wave propagated. Avenues for further study were also identified.

Summary Statement

Low velocity impact crater parameters were characterized by power laws, which allowed comparison with terrestrial impact craters.

Help Received

Supportive mentoring was provided by Dr. John C. Howe and Dr. Charles Barker. They also provided ongoing supervision to ensure that proper safety procedures were followed.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Marcie Brendlen; Esther Viera

Project Number
S0602

Project Title
Four Features, Three Lakes

Abstract

Objectives/Goals
The objective is to determine if hardness in water correlates to nitrogen, phosphorus, and potassium in soil in three Northern California lakes.

Methods/Materials
We collected water from Lake Mendocino, Clear Lake, and Blue Lake and used CaCo3 strips to test for hardness. We gathered soil from the banks of the three lakes to test for nitrogen, phosphorus, and potassium testing kits.

Results
We discovered that of the three lakes Blue Lake was the hardest, although all of the lakes tested highest for hardness in the water. All of the lakes had high levels of potassium, medium levels of phosphorus, and depleted levels of nitrogen.

Conclusions/Discussion
Our results are inconclusive regarding a correlation between the nutrient content of soil with the hardness of the water in three Northern California lakes. There may be a negative correlation between nitrogen in soil and hardness in water, but more research must be done.

Summary Statement
My project explores whether hardness in water correlates with three major elements in soil.

Help Received
Our teacher edited our papers and my dad drove us to the three lakes.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Geraldine C. Duru

Project Number
S0603

Project Title
Cloud Formations + Wind Patterns = Weather Predictions

Abstract

Objectives/Goals
The purpose of my project is to determine if a person, such as myself, can forecast the weather by using simple techniques such as observing wind patterns, cloud formations and using simple measuring devices.

Methods/Materials
The materials used in my project were a barometer, scientific journal, camera, pen, thermometer, hygrometer and computer. The computer was used too look up additional barometric pressures on Internet sites. After I set my hygrometer, barometer and thermometer, I recorded the weather patterns and instrument readings for consecutive days. This experiment lasted for two trials.

Results
The results of trial I, which consisted of 12 day, were 55% of my predictions were correct and 45% of my predictions were incorrect. The results of trial II, which lasted for 10 days, were 67% of my predictions were correct and 33% of my predictions were incorrect.

Conclusions/Discussion
In conclusion weather predictions are possible by observing wind patterns and cloud formations. Accurate recordings of winds and clouds and the use of simple instruments can lead to weather forecast. Through this project I found out different clouds, such as stratus, cumulus and cirrus, and recordings of barometric pressures can lead to figuring out the weather of following days to come.

Summary Statement
My project is about investigating if weather prediction is possible by observing cloud formations and wind patterns.

Help Received
My science teacher provided me with the weather station, which is composed of a hygrometer, thermometer and barometer.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Alan D. Foreman

Project Number
S0604

Project Title
Toxic Boatyards: Are Newport Bay Boatyards a Point Source for Heavy Metal Pollution?

Abstract

Objectives/Goals
My objective was to determine whether Newport Bay boatyards were a point source for the heavy metal copper.

Methods/Materials
Materials:

15 bottles (small)	Filter	2 Large Ziploc bags
30 small plastic bags	5% HNO(3)	Sharpie Marker
30 sets of clean plastic disposable gloves	30 pipettes	Plastic Cup
HF acid	2N HCl	Centrifuge	7 clean plastic spatulas

Procedures:
A. Using "clean" procedures, two sets of seven water samples were taken at various locations in Newport Bay, and each location was recorded using a Global Positioning System.
B. Ocean water taken at a location off of Dana Point was used as a control for the experiment.
C. Unwanted particles and organic matter were removed through filtration.
D. The concentrations of copper were measured using an Argon Plasma Mass Spectrometer, and were calculated using the "Isotope Dilution" method.
E. 6 sediment samples were taken using a clean plastic cup at various locations around the bay. Each location was recorded using a Global Positioning System.
F. Sediment taken off of a relatively pristine sandy beach was used as a control.
G. The sediment was dissolved in acid, and the concentration measured using an Argon Plasma Mass Spectrometer. The concentration was then calculated using the "Isotope Dilution" method.

Results
The concentrations of copper in the water are two to three times higher around boatyards than they are in other areas of Newport Bay, and roughly 20 times that of the control. The concentrations of copper in the sediment are as much as 27 times higher in the areas adjacent to the boatyards than off of the relatively pristine sandy beach. The concentrations of copper in samples taken at the boatyards are also roughly 10 times as much as those taken near the marina.

Conclusions/Discussion
Boatyards are a point source for copper in Newport Bay. The concentrations of copper in both the sediments and in the water are significantly higher in the areas surrounding the boatyards than in other parts of Newport Bay or in the nearby ocean.

Summary Statement
I determined whether boatyards are a significant point source for copper in Newport Bay by taking water and sediment samples; I found that the concentrations of copper were significantly higher around boatyards than elsewhere in the bay.

Help Received
Used Argon Plasma Mass Spectrometer at Caltech under the supervision of graduate student Jeff Mendez in the Division of Geology and Planetary Science. Lab work for trace metal analysis was done in the laboratories of Dr. Jess Adkins, the research advisor to Jeff Mendez.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
John M. Greenfield

Project Number
S0605

Project Title
Fossil Source Material Movement Due to Tectonic Vibrations

Abstract

Objectives/Goals
My project was to determine if fossil source material could be vertically translated through the sedimentary layers due to tectonic vibrations. I believe that the fossil source material could be translated due to sediment liquefaction, density contrasts, and strong tectonic vibrations.

Methods/Materials
Using a depositional tank that I constructed, three shells were inserted into a sand slurry (sand and water mix). The three shells were placed in three separate horizontal locations in the slurry (Left, Middle, and Right) and at the same vertical level. After five minutes of vibration, I exposed the fossil source material in a cross sectional manner and measured the distance that each shell had been vertically translated.

Results
Each shell was vertically translated. Also a pattern appeared within the data. The middle shell was translated slightly less (30.5 millimeters) than both of the outside shells, which were both translated about the same amount (35.6 millimeters).

Conclusions/Discussion
Fossil source material can be vertically translated due to tectonic vibrations. Each shell was translated downward from the start position. This allows for possible flaws in interpretation relying on the geological law of superposition.

Summary Statement
Can the fossils in strata be altered by liquefaction, density contrasts, and strong tectonic vibrations?

Help Received
Used father's woodshop to construct tank assembly.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Travis J. Killmer

Project Number
S0606

Project Title
Effects of Porosity and Permeability on Diffusion

Abstract

Objectives/Goals
The goal of my project is to determine the relationship between porosity, permeability and diffusion in a model aquifer.

Methods/Materials
Five different soils (clay, gravel, potting soil, sand, and silt) were tested to find their porosity, permeability, and diffusion. I repeated the experiments five times to establish validity. Before performing any tests I baked all the moisture out of the soils. To determine the porosity, I filled each beaker to the 350 ml mark with soil and then poured water into the beaker until the water just reached the top of the soil. I then recorded the amount of water used and divided it by 350 to calculate the pore space. To determine the permeability, I filled a five-gallon bucket with soil and poured 2 liters of water into the bucket and recorded the amount of time it took to permeate through the soil. To determine diffusion, I filled a beaker to the 350 ml mark with soil and then poured one teaspoon (5 ml) of food coloring and water mixture into the soil and measured the spread of food coloring in milliliters.

Results
Soils arranged from most porous to least porous are potting soil, gravel, sand, silt, and clay. Dry soils arranged from fastest to slowest permeabilities are gravel, potting soil, sand, silt, and clay. Wet soils arranged from fastest to slowest permeabilities are gravel, potting soil, sand, silt, and clay. Diffusion arranged from greatest to least is gravel, potting soil, silt, sand, and clay.

Conclusions/Discussion
My hypothesis is partly correct in that gravel did have one of the highest permeabilities, porosities, and greatest rates of diffusion. I was also correct when I hypothesized that clay would not be very permeable and I was correct in that it would have a low porosity. When I hypothesized that sand would have very little pore space and one of the greatest permeabilities, I was absolutely incorrect. Sand has approximately the third greatest porosity and the third lowest permeability. When I hypothesized that silt would have little pore space and a low permeability I was correct. I was also correct in that potting soil would be porous and have a high permeability. Based on my results, I conclude that the porosity and the permeability directly affect the rate of diffusion in a soil. For the most part, the soils tested that had large amounts of pore spore and those that permeated quickly, such as gravel, also had some of the greatest diffusion rates.

Summary Statement
My project demonstrates the effect of porosity and permeability on diffusion in a model aquifer.

Help Received
Mr. Rob Kirkpatrick and Mr. Tim Hanna advised me on project; Mother helped edit my work; Father helped out with testing and took pictures while I was conducting my experiment.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Andrew D. Olson

Project Number
S0607

Project Title
The Effects of Size and Shape on the Formation of Strata in Sedimentary Rocks (Sandstones)

Abstract

Objectives/Goals
To demonstrate the formation of strata in sandstone using a mixture of art sand and granulated sugar.

Methods/Materials
Mixtures of art sand and granulated sugar, art sand and a contrasting color of art sand, sand alone, or art sand and streambed sand are poured into a plexiglass frames (with or without water). The resulting angles of repose in the strata formed is measured using a protractor.

Results
Whether the sand mixtures were poured into frames containing air or containing water, the formation of strata occurred.

Conclusions/Discussion
The hypothesis of this project was that the size and shape of granules affected the formation of strata in sedimentary rocks, such as sandstones. The irregularity of grains and grain-grain interactions influence the falling behavior and settling patterns regardless of whether this occured in air or in water. As a measure of this interaction, the angle of repose (the angle of visible layers in the sand) is recorded; the more similar in size and shape of the grains, the lower the angle of repose measured. In this project, a mixture of sand and granulated sugar resulted in an angle of repose greater than a mixture of sand and ultrafine sugar (indicating that ultrafine sugar is more similar in size to the sand than granulated sugar). A single sand source formed angles of repose lower than a mixture of two different colored sands (suggesting a size difference between the two sands). The sand and streambed sand had a very low angle of repose indicating a possible influence by the water medium versus air. The composition and characteristic qualities of granular particles affect the formation of strata in sedimentary rocks.

Summary Statement
To demonstrate the effects of grain size and shape on the formation of layering (strata) in sedimentary rocks.

Help Received
Father helped in pouring the sand mixtures into the frames.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Luke Penn-Hall

Project Number
S0608

Project Title
Soil Contamination by Heavy Metals in Glen Avon, California

Abstract

Objectives/Goals
The objective of this project was to observe the progress of the remediation process at the Stringfellow Acid Pits through soil testing in Glen Avon, California. By testing levels of the heavy metals Arsenic, Cadmium, Chromium, Lead, and Nickel in the soil and comparing those to previous samples on file with the EPA I hoped to chart the success or failure of the remediation plan.

Methods/Materials
This project required the use of a sterile scoop, two sterile glass jars, s pair of latex gloves, and a mass spectrometer. The soil samples were taken using the scoop, and placed into the jars. The jars were then sent to a lab through Earth Tech, mixed together, and processed using a mass spectrometer. A series of values derived from previous tests done at the same site in 2003 were used to create a comparative range for my results.

Results
I found that each of the metals I tested for were either below or within their respective ranges. Arsenic, Lead and Nickel were approximately in the middle of their ranges, with concentrations of 2.2mg/kg, 2.1mg/kg, and 2.4mg/kg respectively. Chromium was in the lower end of its spectrum with a concentration of 2.5mg/kg. And Cadmium was very low, with a concentration of 0.096mg/kg.

Conclusions/Discussion
From my results, I can reasonably conclude that the clean up has been proceeding at an acceptable rate. Most of my results were considerably lower than the concentrations gained during routine testing last year.

Summary Statement
The purpose of my project is to observe any lingering traces of contamination from the Stringfellow Acid Pits in Glen Avon, California.

Help Received
Jean Hall, my mother, assembled the board; Brian Weith, a professional geologist, consulted; Rick Bartko obtained the satellite photos; Dr. Zekai Nazikoglu advised initially.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Keara A. Schneider

Project Number
S0609

Project Title
Affect of Wildfire Ash on the Environment

Abstract

Objectives/Goals
The purpose of this experiment was to find out if when different substances are burned, will they have different pH levels, and how will the result of that pH affect the environment after a wildfire.

Methods/Materials
The materials used were common household items. The substances were plants substances, the measurements were taken by use of teaspoons, and a lighter was used to light the substances on fire. Sometimes a propane torch was used to light the substances. The water used was just regular tap water. The procedures are fairly simple. Make sure you have a metal bin that is clean. Burn the substance you chose in it until it is ash. Carefully put ash into a bag, and thoroughly clean out metal bin. Repeat until all substances are burned. For the second part, take a teaspoon of water and ¼ teaspoon of ash, and mix together in container. Then test the pH level with a pH strip. Repeat until all substances are tested.

Results
After doing the experiment, I found that the substances were bases and that the most likely affect that they would have on the environment is a negative one.

Conclusions/Discussion
My hypothesis was partially supported by this experiment. I thought that the pH level of the substances would be in the acidic range, but in fact they were in the base range. Some of the substances had the same pH level, but all of the substances were bases. From my research, the alkaline from these ashes would still have a negative affect on the environment by releasing too much alkaline into the soil.

Summary Statement
My project is about the affect of wildfire on the environment.

Help Received
father helped burn substances.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Matthew S. Shepherd

Project Number
S0610

Project Title
Correlation of Soil Nutrient Release and Pollutant Absorption at Geologic Equilibrium

Abstract

Objectives/Goals
I wanted to find a measurable soil characteristic to compare the relative ability of soil types to produce nutrients and remove pollutants over eons.

Methods/Materials
I set up a test column apparatus in the shower. Each weighed soil was placed in a glass column. Deionized (DI) water was run through each soil column to leach out ionic nutrients. To assess pollutant reduction, a common liquid with a lot of compounds, diet cola, was run through fresh soil columns. I monitored leachate conductivity for both DI and diet cola eluents in a small, continuously overflowing beaker under the column until each run reached a steady conductivity plateau. It took from several hours to several days for each soil leachate to reach the equilibrium plateau. Potassium chloride standards were used to calibrate my conductivity meter.

Results
There were short term effects for both eluents. When DI elution started, conductivity rapidly increased as the more soluble salts, nutrients, and minerals found in different soil samples dissolved. It then gradually decreased before reaching a steady conductivity reading. In most diet cola runs, conductivity dropped first before rising to a conductivity plateau representing the ion production rate expected at long term geologic conditions.

Conclusions/Discussion
At equilibrium many soil types were similar. There was little difference between sand, cat litter, or costly potting soils. It appears that the added fertilizer in potting soil will wash away with less than an hour's rainstorm, leaving only inert particles behind that do little to generate or absorb ions. On the other hand, highly complex garden soil or mulch provides continuing nutrients and also continues to absorb polluting ions. I found that comparing measured conductivity, directly, was not adequate because it did not account for the amount of soil or flow rate. I tried various ways to normalize conductivity data, such as dividing by the respective mass and eluent flow rate. I finally considered the ability of the soil to allow a liquid to permeate. After taking leachate conductivity, mass, flow rate, and permeability into account, I calculated a characteristic value for each soil. I found this characteristic correlated both the observed ion production and pollutant absorption (reduction in diet cola conductivity) of the soils. I am intrigued that the same characteristic allows comparison of seemingly opposite processes.

Summary Statement
I developed a method to correlate the long term ability of different soils both to provide nutrients and to absorb pollutants.

Help Received
Metropolitan Water District donated conductivity standards and deionized water. Mom helped arrange board. Dad critically reviewed my project and checked my math.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Jena B. Stucker

Project Number
S0611

Project Title
How Do Abiotic Factors Affect a River's pH?

Abstract

Objectives/Goals
To see how abiotic factors such as precipitation, ash fall, and temperature affect the Santa Ana River's pH.

Methods/Materials
I took samples of the Santa Ana River and tested the pH with litmus paper. I then recorded the amount of ash fall, temperature, and precipitation and compared it to the pH level.

Results
Ash fall made the pH level more basic due to its components, precipitation made it more acidic, and low temperatures made the pH level lower and higher ones made it higher.

Conclusions/Discussion
Ash fall made it more basic because wood and stucco (a main component in making houses) are basic compounds. Precipitation made it more acidic because most rainfall is more acidic. pH is temperature dependent. Higher temperatures would make the pH level go up and lower temperatures would make it go down.

Summary Statement
To measure the effects of temperature, rainfall, and ashfall on the Santa Ana River.

Help Received
Mother drove to test site.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Angeline R. Wolski

Project Number
S0612

Project Title
Burning Desire: The Effect of Prescribed Grassland Fire on Soil Nutrients

Abstract

Objectives/Goals
The objective of my project was to determine if prescribed grassland fires affect soil nutrients and are therefore beneficial or harmful to the environment. I also wanted to assess how deep the soil is affected by fire, and see if the changes are confined to the top layer or reach into the lower layer, and measure how long the changes persist.

Methods/Materials
I used a space-for-time substitution to test different ages of fire. I visited four sites in Redwood National Park, a burn from one month, one year, and five years ago, and one site that was not burned for more than 15 years (the control). I took soil samples from three random places at each site in the top (0-6cm deep) and bottom (6-12cm deep) layers of soil. Then I tested every sample for its pH, nitrogen, organic carbon, and potassium content.

Results
Overall, the most recent burn had the highest amounts of potassium and carbon and the most basic pH. Nitrogen, however, was highest in the five-year-old burn. The one-year-old burn had lower nutrient levels than the other sites. At all four sites, the top and bottom layers differed in nutrient content and the top layers showed the largest increase in nutrients following a fire.

Conclusions/Discussion
The nutrient increase was only in the top layer of soil because the fires were not intense enough to reach the bottom layer. In the one-month-old burn, the ash created by the fire increased carbon, nitrogen and potassium and turned the soil more basic. The one-year-old burn site had a lower nutrient content; this may be because the ash was weathered away and there wasn#t enough regrowth and build-up of vegetation to compensate for the loss of ash. The five-year-old burn had higher carbon content because of the fast regrowth of vegetation adding to the organic matter. The five-year-old burn had significantly more nutrients than the control, which shows the beneficial effects of fires last at least five years. Overall, the effects of the fires were positive because of the nutrient increase. This counteracts the popular view in today's society that all fires are detrimental.

Summary Statement
I tested the effects of prescribed grassland fires on soil nutrient levels, pH, and depth of change at four sites with different ages of fires.

Help Received
Mother was chauffeur; Humboldt State University provided muffle furnace for carbon testing; Redwood National Park provided background information on burn history.