Name(s)	Project Number
Bianca Aghakhan; Lilit Danelyan; Siranush Martirosyan	**S1101**

Project Title

Effect of the Great Pacific Garbage Patch on the Phoebastria immutabilis

Abstract

Objectives/Goals

The objective of this research project was to study the effect of the Great Pacific Garbage Patch on the Phoebastria immutabilis population and to bring awareness to this growing problem. Ninety percent of the world Phoebastria immutabilis population is located on the island of Midway Atoll found near the Great Pacific Garbage Patch. This is an area of debris that circulates in the North Subtropical Pacific Gyre of the Pacific Ocean causing the birds to ingest the garbage. Therefore, we hypothesized that if the amount of trash is not contained and minimized, then the Phoebastria immutabilis population will become extinct.

Conclusions/Discussion

From the effective research collected, we proved our hypothesis correct. The research displays how future generations of the Phoebastria immutabilis population will contain several birth defects due to the toxins and carcinogens found in the debris.Through the research collected it can be seen that if the ingestion of plastic garbage continues, the new generation of Albatross chicks will be born with birth defects and the death rate will escalate inevitably. The research can be used to understand the effect of the trash on the increasing endangerment of the Phoebastria immutabilis population, and help prevent any further damage to the species.

Summary Statement

The objective of this project was to analyze the growing endangerment of the Phoebastria immutabilis population due to the Great Pacific Garbage Patch.

Help Received

Data was collected from correspondences with Captain Charles Moore and the Algalita Marine Research Insitute

Name(s)	Project Number
Albert J. Barrios	**S1102**

Project Title

How Are Humans Affecting Sea Anemones' Population Distributions?

Abstract

Objectives/Goals
The purpose of this project was to bring awareness to water pollution and the importance of sea anemones in the environment.

Methods/Materials
Water samples were collected and test for ammonia, pH, and carbon dioxide were conducted. The numbers of sea anemones were counted per measure quadrant.

Results
It was determined two of the nine sites had higher numbers of sea anemones. These sites had lower measurements of ammonia, as well as high amounts of carbon dioxide.

Conclusions/Discussion
It is therefore concluded that there is a correlation between the number of sea anemones and the the chemical composition of the water. Specifically, the presence of ammonia and carbon dioxide result in a more neutral pH which is more favorable to the sea anemones.

Summary Statement

The study of water chemical contaminants and their effects on sea anemones' population.

Help Received

Cabrillo Marine Aquarium provided chemical test kits, field equipments, reverse osmosis water, and a vacuum pump.

Name(s)	Project Number
Zuhra Bholat; Jiayi Luo	**S1103**

Project Title

Performance of a Plant Microbial Fuel Cell with Oryza sativa

Abstract

Objectives/Goals

To construct a fuel cell that utilizes microbes and plants to produce energy. To analyze and compare the energy production of fuel cells consisting of Enterobacter cloacae (bacteria) only, Oryza sativa (rice) only, and both bacteria and rice. We predicted that the one with E. cloacae and O. sativa (a plant-microbial fuel cell) would generate the most electricity.

Methods/Materials

We constructed three fuel cells in aquarium tanks: one consisted of only E. cloacae and soil (tank 1), a second consisted of only Oryza sativa and soil (tank 2), and a third consisted of all three (tank 3). Carbon cloths were placed in the anode to pick up the electrons, agar salt bridges were used to transfer electrons from the anode to the cathode, and graphite rods were placed in a potassium chloride solution to build the cathode. All three fuel cells were subjected to the same conditions. We allowed each tank to run for 60 seconds while measuring the voltage with a digital multimeter and various resistors. To analyze the collected data, we used the voltage and resistance to calculate the wattage produced.

Results

We tested resistors with 9000, 24000, and 61000 ohms. Respectively, tanks 1, 2, 3 produced a maximum of 2714.4 nW, 3054.4 nW, and 4220.7 nW at 9000 ohms resistance. Trials with the 24000 ohm resistor and the 61000 ohm resistor produced similar results, where tank 3 had a significantly higher energy output than the others. The voltage decayed as time progressed. Tank 3 produced both a higher initial and final voltage. Plants provide a constant supply of nutrition for the bacteria and would therefore explain why the bacteria would produce more electrons in this communalist relationship.

Conclusions/Discussion

Tank 3 (both bacteria and rice) produced the most watts, followed by tank 2 and tank 1. We predicted that a fuel cell in which plants and microbes cooperate would be more efficient and effective, and our data proves that the hypothesis was correct. Potentially, this technology could be implemented in rice paddies, as the plants are not harmed in any way. If modified further to be more efficient, plant microbial fuel cells show promise for real world applications.

Summary Statement

Our project determines and analyzes the electrical output of a fuel cell with electrochemically-active bacteria and rice plants.

Help Received

Mrs. Messenger (teacher) helped with materials and procedure as well as monitoring our progress; Mr. Messenger helped with electrical calculations; Mr. Jan Arends provided research articles and references

Name(s)	Project Number
Steven H. Cao	**S1104**

Project Title

The Effect of Alum on Phosphate in Water and Its Effectiveness as a Solution to Northern Mexican Gulf Hypoxia

Abstract

Objectives/Goals
My objective was to determine the effect of dry aluminum sulfate (alum) on phosphate levels in water from P2O5, or rock phosphate, fertilizer and then to use the experiment's data along with data from the NOAA on the Mexican Gulf dead zone to determine whether or not alum was an effective solution to Northern Mexican Gulf hypoxia.

Methods/Materials
I added phosphorus fertilizer to water and used the test kit to figure out the concentration. I then adjusted the solution to get it to the desired concentration. Then, I poured some of the solution into different beakers and added different amounts of aluminum sulfate to each beaker, and after stirring well and waiting ten minutes, I recorded the amount of phosphorus that was in the beaker after the alum was added. Then, I repeated this for different concentrations of phosphorus. Finally, I created a graph out of the data and used it and Mexican Gulf dead zone data to find how much alum would be needed to reduce phosphorus concentrations in the dead zone to pre-dead zone levels.

Results
I found that alum had no effect on phosphate levels in water.

Conclusions/Discussion
This contradicts my hypothesis and shows that alum is not an effective solution to dead zones. This could have happened because the predicted product, Al2(HPO4)3, was still soluble and could still be picked up by the phosphate testing kit. It is also possible that the fertilizer that I used had a form of phosphorus that specifically did not react with alum. Phosphorus in lakes and wastewater come from many different sources, including fertilizer, industrial dumping, and natural sources, so alum most likely works with other forms of phosphate but not P2O5 fertilizer. This experiment shows that alum is not reliable in lowering phosphate levels. Not being able to bind with rock phosphate fertilizer would make alum an ineffective solution.

Summary Statement

My project is about the effectiveness of aluminum sulfate as a solution to high phosphate levels and the hypoxia it causes in the Northern Mexican Gulf.

Help Received

Mr. Spenner gave advice on information to include in the board; Dr. Blickenstaff helped in finding and deciding on materials and also supervised me during experiments; Mr. Korin listened to my presentation and looked at my board and helped me revise them; Dr. Koodanjeri answered my chemistry questions,

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Omer Cohen

Project Number

S1105

Project Title

Iron Fertilization in Relation to Oceanic pH

Abstract

Objectives/Goals
Ocean acidification and effects of climate change are important areas of research due to global impact. Ocean acidification occurs primarily because the ocean is a sink for carbon dioxide. As a result ecosystems of pH sensitive organisms such as coral reefs are lethally effected. The purpose of this experiment was to investigate whether lowering the pH can stimulate cyanobacteria growth by increasing the bioavailability of iron. Increased cyanobacteria density leads to decreased carbon dioxide levels.

Methods/Materials
In the first experiment, Synechococcus sp. growth was examined following incubation in Gulf of Maine seawater at 22°C under a 13/11 light-dark cycle.The dependent variable, cell density, was measured using a hemocytometer.The independent variables were iron concentration and initial pH. In the second experiment,the dependent variable was final pH.One trial, four samples for each variable were tested in duplicate.

Results
Synechococcus sp. density was generally found to be significantly increased at higher pH levels at concentrations of 6 and 12uM iron chloride. Growth did not significantly change in the absence of iron chloride.

Conclusions/Discussion
The results from these experiments do not support the hypothesis that with decreasing pH Synechococcus sp. would grow faster due to increased bioavailability of iron. However they raised interesting questions related to the reproductive ability of Synechococcus sp. at different pH levels. This also raised the question as to whether this species would survive conditions of lower pH levels in the ocean associated with ocean acidification.

Summary Statement

The purpose of this experiment was to investigate if lowering the pH in the ocean itself increases the bioavailability of iron which in turn would help decrease the level of carbon dioxide.

Help Received

High School teacher Dr. J. Willoughby, served as a mentor.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)	Project Number
Alexander D. Cowan	**S1106**

Project Title

Development of a Novel Method to Predict Wildfire Ignition Sites in San Diego County

Abstract

Objectives/Goals

Over 100,000 wildfires burn between 4 to 5 million acres across the United States every year. Wildfires cause over $800 million worth of damage in California every year. What is even more shocking is that 80-95% of all wildfires in San Diego County are ignited or intensified by humans or human activity. Most current wildfire models seek to model fire spread post wildfire outbreak, or to analyze weather patterns in order to determine wildfire danger zones. Often, the aspect of human behavior is ignored. The purpose of this project is to create a novel, proactive, and more effective high-risk fire ignition map of San Diego County that incorporates anthropological data on the urban-wildland interface.

Methods/Materials

In order to carry out this project, retrospective data was collected from the San Diego Association of Government (SANDAG) in order to generate weighted risk factors (weights) associated with fire causation within San Diego. The data collected by SANDAG represents actual cause data for 94 wildfires accounted for between the 2000 and 2005. The shapefiles used in this experiment came from two online geoportals: SANDAG and CalFire. The map generation and analysis completed in this project was done using the GIS program ArcGIS. Using Buffer, Union, and Dissolve tools, a Final Combined Union Risk Map was created using the shapefiles accessed online. The final map was divided into seven weight classes.

Results

In order to test the accuracy and integrity of the Final Combined Union Risk Map, the 972 wildfire ignition sites in San Diego County between 2006 and 2010 (Map 8) were overlain on the map. When tested against these ignition sites, the risk map captured between 47-70% of the fires that occurred, depending on the buffer zone used. The three different zones were wildfire ignition sites that fell within the fire risk map, sites that fell in or within 250 meters of the risk map, and sites that fell in or within 500 meters of the risk map.

Conclusions/Discussion

This test validated the hypothesis of generating a fire risk map that would capture 30% of fires. The predictive risk map developed, which took into consideration only human variables, was more accurate than previous ignition risk maps analyzing various geographic, climate, spatial, and vegetation aspects. This map could be a very useful tool in fire prevention and mitigation.

Summary Statement

A high risk area map for wildfire ignition sites in San Diego was generated using ArcGIS and a weights of evidence model; the final risk map was tested against actual wildfire ignition sites and achieved 71% accuracy.

Help Received

Name(s)	Project Number
Sahejvir S. Dhillon	**S1107**

Project Title

Electrolysis: The Quest for Hydrogen for a More Sanitary Economy

Abstract

Objectives/Goals
If I were to use the process of electrolysis to extract hydrogen gas from clean H2O, would that hydrogen be able to be used as a renewable energy carrier to make environmental friendly fuel for a more sanitary economy?

Methods/Materials
Fill the beaker with 3 quarters of water. Fill 2 test tubes with water. Put stoppers on test tubes. Invert the test tubes into the jar. Remove stopper underwater to avoid spillage. Insert copper wire in test tubes. Attach other end of wire to power source. Add a few mL of sulfuric acid to the water in the jar. Repeat the steps, until 3 trials for 1 electrolyte (i.e. sodium chloride, lemon juice, sulfuric acid) on both voltage powers have been tested. Do each trial for 30 minutes. The empty space in test tube is gas. Identify the gas created in the test tube attached to the #ve electrode as hydrogen. Put the stopper back into the test tubes underwater. Test the presence of hydrogen with a match or candle. A pale blue flame or a soft pop sound indicates hydrogen is present. Note the amount of hydrogen made in mL for each trial. Use a graduated cylinder to measure the water levels to determine the amount of hydrogen made in mL.

Results
My data consisted of four tables and four graphs. The values showed the hydrogen gas made with a 9v and 12v battery. The trends shown in each of the graphs were that the gas created by a specific electrolyte was in the order, sulfuric acid, sodium chloride, and lemon juice. The results of the experiment showed that the electrolyte, sulfuric acid had the most impact, but with the 12v battery rather than the 9v by a fraction of a difference.

Conclusions/Discussion
My hypothesis was if I create the electrolysis model, then it will work best when sulfuric acid if used with the 12v battery. I also predicted that the amount of hydrogen produced from the electrolyte, lemon juice will create the least amount of hydrogen. My trial examples and graphs support my scientific guess. There were many hardships during my project, but I managed to pull through. Some of these included, finding the right tools such as the 0.1 molar sulfuric acid and a graduated cylinder, and keeping the experiment constant so it will have the similar affect. In conclusion, the stronger an electrolyte and voltage of a power source, the better production of hydrogen there is.

Summary Statement
Finding the electrolyte that will create the most amount of hydrogen for a more sanitary economy.

Help Received
Adviser helped direct me on what to do; Father helped me with set-up.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Stacey Dojiri; Kelly Woo

Project Number

S1108

Project Title

The Potential Impact of Hyperion Treatment Plant's Effluent on the Coastal Environment: Science Influencing Management

Abstract

Objectives/Goals
In 2015, Hyperion Treatment Plant (HTP) will divert its effluent from the 5-mile outfall to the 1-mile outfall, resulting in a significant nutrient input into coastal waters, a potential phytoplankton bloom, and increase in bacterial levels at local beaches. Our study tests whether HTP should divert in the spring or fall to minimize the probability of harmful algal blooms. It also determines the amount of chlorine needed to effectively kill bacteria in the effluent and the effect of both non-chlorinated and chlorinated effluent onlarval abalone development.

Methods/Materials
In our June, October, and April phytoplankton experiments, seawater was collected from the 1-mile outfall terminus and different seawater-effluent dilutions were tested. After 6 days, phytoplankton identification and abundances were determined and samples were analyzed for chlorophyll and domoic acid. Our chlorine test involved dosing effluent with 2, 3, and 4ppm of Cl_2 and using the chromogenic substrate method to determine bacterial levels. Our abalone tests involved exposing red abalone embryos to effluent and effluent dosed with Cl_2 and counting normally and abnormally developed larvae.

Results
Our results indicated that harmful algal species Pseudo-nitzschia seriata was most abundant in April and June; therefore, we recommend that HTP divert in October. In the chlorine test, 3ppm Cl_2 with a 25-minute contact time was most effective in killing bacteria, while statistical tests on the abalone data showed non-chlorinated effluent had an effect on the larval development and chlorinated effluent had no effect.

Conclusions/Discussion
Results from University of Southern California's parallel in-harbor experiment match these in-lab results, further emphasizing the importance of diverting in October. Based on USC's and our results, HTP engineers have decided to reschedule the diversion for October and use 3ppm Cl_2 to dose the effluent. Lastly, because red abalone is an indicator species and was unaffected by chlorinated effluent, we hope that other, less sensitive marine species will also be unaffected.

Summary Statement

Our project aims to minimize the potential negative effects, including harmful algal blooms, bacterial level increases, and harm to marine organisms that may occur during Hyperion Treatment Plant's effluent diversion in 2015.

Help Received

Hyperion Treatment Plant provided environmental chamber and other lab materials; Dr. Caron and Dr. Seubert of USC provided USC's results and helped with phytoplankton training and counting; Hyperion Treatment Plant staff helped with water quality measurements and boat usage for seawater collection.

Name(s)	Project Number
Emma R. Freedman	**S1109**

Project Title

Sustainable Future for Endangered Species? Predicting the Impacts of the Wilmar Policy on Bornean Orangutan Populations

Abstract

Objectives/Goals
The Bornean orangutan has been classified as endangered since 1986. They are threatened by illegal poaching and habitat loss, largely caused by land conversion to palm oil plantations. In December 2013, the world's largest palm oil trader, published a "No Deforestation, No Peat, No Exploitation Policy." The objective of this study is to predict the effects of the policy on the sustainability of orangutan populations.

Methods/Materials
Using object-oriented Python, 36 orangutan habitats and their populations were mathematically modeled in 11 different scenarios with varying levels of logging, reforestation, and poaching as well as stochastic insertions of catastrophes and bonanzas and were used to produce 396 models with 100 replicates each. The sustainability of each scenario was analyzed.

Results
Without any intervention the Bornean orangutan populations could be extinct within 100 years. The only scenarios with sustainable populations are those with poaching is reduced from the current 4-12% annual rate. Sustainability doubles when poaching is reduced from 1% to 0.5%. There is an almost 10% increase in sustainability when additional protection of lowland mosaic is implemented.

Conclusions/Discussion
The Wilmar plan is necessary for orangutan survival when coupled with poaching management.
- Unsustainable populations should be connected to other sustainable areas, or exchanged to industry for the protection of lowland mosaic.
- The plan should be enhanced to include conservation of lowland mosaic, to provide a 10% increase in population sustainability.
- A focused effort to reduce poaching to 0.5% must be initiated as soon as possible.
Without intervention the orangutans may be extinct within 100 years. The urgency of this situation must be made clear so the species can be protected from extinction.

Summary Statement

This study predicts the effects of the top palm oil trader's "No Deforestation, No Peat, No Exploitation Policy" on the sustainability of the endangered Bornean orangutan populations.

Help Received

Name(s)

Julie A. Fukunaga

Project Number

S1110

Project Title

Autonomous Solar-Powered Boat for Algae Control

Abstract

Objectives/Goals

The warmer weather and current drought in California can stimulate a rapid growth of algae, or algal bloom. This process is also accelerated by the contamination of nitrates and phosphates in fertilizer runoff (cultural eutrophication) that drains to the water supply, depletes the aquatic life of dissolved oxygen, and causes high levels of water turbidity. The purpose of this project is to build an autonomous solar-powered boat to control algal blooms in a more environmentally and cost-effective way (chemical-free and not labor-intensive).

Methods/Materials

I built a device that transmits 40 kHz ultrasonic sound waves via a transducer to break the algae vacuole. Then, I tested the device by measuring the amount of chlorophyll before and after the device#s treatment using a spectrophotometer. The chlorophyll level was determined by measuring the absorbance and percent transmittance of light of eight samples at various wavelengths (410 to 650 nanometers) daily for 9 days. I mounted the device on a solar-powered catamaran made of PVC and ABS plumbing pipes.This autonomous boat, navigating using infrared and ultrasonic sensors, detects obstacles and automatically changes direction, like the Roomba vacuum cleaner.

Results

After calculating the average rate of change in percent transmittance as compared to the control, the eight samples showed an overall increase of up to 87.29% in average percent transmittance (and decrease in absorbance) at 410 nanometers.

Conclusions/Discussion

The results show that as the transducer was used, less algae (or less chlorophyll) was present in the samples. The autonomous solar-powered boat can be a natural alternative to chemicals in controlling algal blooms. It can further be adapted to measure the amount of chlorophyll, pH, dissolved oxygen, and temperature and can be used in monitoring ponds, lakes, pools, and aquaculture.

Summary Statement

The purpose of this project is to build an autonomous solar-powered boat to control algal blooms in a more environmentally and cost-effective way.

Help Received

Name(s)	Project Number
Shivani Gupta	**S1111**

Project Title

The Big Clean Up

Abstract

Objectives/Goals
The purpose of the project was to determine whether the height of tomato plants is significantly affected if they are grown in soil that has been restored by phytoremediation with bean, when in comparison to tomatoes grown in untreated polluted soil and those grow in untreated clean soil. Phytoremediation is a low cost natural method in which special plants, such as the bean, can clean-up contaminated soil. The hypothesis was that the height of tomato plants grown in phytoremediated (soil contaminated with used motor oil and then treated with bean plants) soil will not be significantly different than plant grown in uncontaminated soil.

Methods/Materials
The experiment was carried out in two stages with 5 trials each. For one trial, bean plants (seeds were pre-germinated) were grown in soil with different concentrations of used motor oil (0%, 3%, 6%, and 9%). After the 16th day, bean plants were removed from the soil, and 12 tomato seeds (pre-germinated) were planted in restored soil. To act as a control, 4 other treatment groups were added, which received same concentrations of oil contamination (0%, 3%, 6%, and 9%) but were not given bean treatment (grown in restored soil). Plant height was recorded on a daily basis for each seed, bean and tomato.

Results
The results showed that bean plant height was adversely affected as the level of oil contamination in the soil increased. For tomatoes, there was a statistically significant difference in plant height between those grown in remediated and untreated soil. There was no significant difference in plant height for tomatoes grow in treated polluted soil and those grow in uncontaminated soil.

Conclusions/Discussion
The hypothesis was correct. Bean plants can remove enough contaminants from the soil in order to provide a healthy environment for sensitive plants, such as the tomato, to flourish. Phytoremediation can be used as a natural replacement for conventional engineering technologies for treatment of polluted soil. In comparison to man-made technologies, phytoremediation is cost-effective, avoids dramatic landscape disruption, and preserves the ecosystem.

Summary Statement

This project determines whether the height of tomato plants grown in phytoremediated soil (cleaned by the bean) is significantly different when compared to tomatoes grown in uncontaminated soil.

Help Received

My father helped me with data analysis, and my brother and my mother helped me with the board.

Name(s)	Project Number
Matthew M. Hase-Liu	**S1112**

Project Title

The Effectiveness of the Natural Polymers Chitosan, Polyglutamic Acid, and Moringa Oleifera Seeds in Water Purification

Abstract

Objectives/Goals

We are seeing ever-increasing threats of contamination of fresh water, from industrial wastes, to nuclear power plant accidents, to pharmaceutical drug contamination of municipal drinking water. Activated Carbon and Zeolite are widely employed as purification agents, but are not effective for all contaminants. In this study, I looked for natural purification agents that were abundant in nature, highly effective, and required minimal processing.

Methods/Materials

In this study, I compared the natural polymers Chitosan, Polyglutamic Acid, and Moringa Oleifera Seeds with the commonly used Activated Carbon and Zeolite on reduction in water turbidity and concentration of the 4 types of common contaminants. Chitosan is derived from Chitin, Polyglutamic Acid is extracted from fermented soy beans, and Moringa Oleifera Seeds are obtained from Moringa Trees in Africa. I measured their effects on turbidity of a standardized mud suspension using a nephelometer and reduction in equilibrium concentration of the 4 types of common contaminants (transition metal cations, complex anions, simple halogen anions, and organic compounds) using a Spectronic 21D Spectrophotometer. I also monitored pH with a pH meter and AC conductivity with a TDS meter. Afterwards, I analyzed instrumentation errors and performed statistical analysis.

Results

Chitosan is an excellent purification agent against all 4 types of common contaminants. Polyglutamic Acid is excellent for reducing turbidity and all the chemicals except complex anions. Moringa Oleifera Seeds are good for reducing turbidity and all the chemicals except transition cations.

Conclusions/Discussion

Overall, I found Chitosan as the best purification agent in this study, performing even better than the commonly used Activated Carbon. In addition, all of the natural polymers outperformed Zeolite. As a current application, I propose making a multi-stage filter, consisting of Polyglutamic Acid to first reduce the turbidity, then Chitosan and Moringa Oleifera Seeds to filter out the remaining contaminants.

Summary Statement

The natural polymers Chitosan, Polyglutamic Acid, and Moringa Oleifera Seeds are effective water purification agents.

Help Received

Mrs. Alonzo provided advice on emphasizing important points (such as controls) needed in the project.

Name(s)

Adithi R. Iyer

Project Number

S1113

Project Title

The Effects of Common Californian Soil Treatments on Arbuscular mycorrhizal Succession in Nassella pulchra Specimens

Abstract

Objectives/Goals

The purpose of this study was to determine the effects of common Californian soil treatments in restoration plots on the development and activity of arbuscular mycorrhizal fungi as seen in the native grass Californian N. pulchra (purple needlegrass).

Methods/Materials

Soils collected from UCI and Crystal Cove, seeded with the invasive B. nigra, were taken from three groups: an untreated Control group, an annually treated Mow (physical plant removal) group, and an annually treated Herbicide (Roundup chemical application) group. 36 subjects were prepared and seeded with N. pulchra, grown for a period of 85 days split into 3 trimesters. After their growth was charted, the plants were harvested and roots were sterilized and dyed with acid fuchsin to color fungal structures. Afterwards, the roots were made into slides and read for presence of fungal structures and colonization by region coloration. The remaining soil was tested for aggregation through physical separation to gauge levels of soil quality and composition by mass, as indicated by a higher ratio of large (>2mm) to small (<2mm) aggregates.

Results

Herbicide treated plants had the most success in mycorrhizal succession, showing higher percent root colonization (40.30%), bioassay growth rates, soil quality (73%), and fungal hyphae (556). Mow treated plants showed the lowest percent colonization (19.44%), bioassay growth, soil quality (63%), and a considerably low presence of hyphae (446) compared to Herbicide. Control plants also had low soil quality (64%) and hyphal network (403), but fared better than the Mow in percent colonization (27.99%) and bioassay growth rates.

Conclusions/Discussion

Herbicide-treated plants were the most successful, largely due to their ability to remove saprotrophic fungi from the microbial ecosystem and allow succession of mycorrhizae- they had high soil qualities, growth rates, and numbers of fungal structures. Mow plants were likely the least effective due to high levels of saprotrophic fungi decomposing topsoil detritus left behind by the mowing process, combined with poor soil quality due to direct UV exposure. Control plots did not enjoy considerable success likely due to the allelopathic nature of the untreated B. nigra creating conditions hostile to mycorrhizae. These results suggest that in restoration plots, chemical treatments can be more conducive to sustainable ecosystems than physical methods of treatment.

Summary Statement

This study seeks to assess the effects of soil treatments for invasive species in restoration plots on the development of mycorrhizal soil networks in a new rehabilitated ecosystem.

Help Received

Name(s)
Rebekah Kaiser; Hannah Tufts

Project Number

S1114

Project Title
Agaricus bisporus Mycofiltration

Abstract

Objectives/Goals
The objective is to determine if water filtered through a Brita carbon-based water bottle filter is more effective at lowering levels of bromine and chlorine and maintaining pH than an Agaricus bisporus# mycelia filter.

Methods/Materials
The Agaricus bisporus mycelia filter was designed from a spice bag, half the top of an edible basidiomycete mushroom, and some large pieces of mulch. The mulch was tested alone as a control creating no affect on the water. Tap water was tested then filtered through the Brita water bottle carbon-based filter as well as the Agaricus bisporus mycelia filter. Each trial was tested with fresh, unfiltered water at the same temperature from the same faucet.

Results
The Agaricus bisporus filter lowered the levels of chlorine and bromine, and it maintained a more stable pH as compared to the Brita carbon-based water bottle filter. The Agaricus bisporus mycelia filtered water created safer water for human consumption.

Conclusions/Discussion
Questions are revealed about the design of water filters and if nature#s design of the Agaricus bisporus mycelium could improve water filters. Different categories of contaminants that affect humans when consumed could be measured for in the water going through each filter. Other types of Agaricus bisporus mycelia could be tested to measure the levels from the new mycelia. Engineers could base their new designs of water filters on the mycelia and recognize which parts extract the certain toxins that are unhealthy for human consumption. Overall, the data suggests that the Agaricus bisporus mycelia filter is a better choice than the Brita carbon-based water bottle filter, strictly based on levels of pH, chlorine, and bromine in the water.

Summary Statement
Water was filtered through a man-made carbon-based filter and a filter containing Agaricus bisporus mycelia to see which was more efficient in obtaining healthier levels of chlorine, bromine, and pH.

Help Received
No help received

Name(s)	Project Number
Sandeep Kambhampati	**S1115**

Project Title

A Novel DNA Electrochemical Biosensor for the Detection of Heavy Metals in Aquatic Ecosystems

Abstract

Objectives/Goals

The goal of this project is to develop a DNA electrochemical biosensor for the detection of lead nitrate in aquatic ecosystems. First, lead nitrate is studied through electrochemical methods to determine if it causes damage to DNA. If so, then this correlation is used in a biosensor and the DNA immobilization process is optimized to create a cheap and effective method of detection.

Methods/Materials

The major reagents used were 100 Grams Fish Sperm DNA, thiol modified DNA, 60 Grams Lead Nitrate, and 100 mL Buffer Solution of pH 4 and pH 10, and silanizing solution. ~50 Graphite working electrodes, a silver chloride reference electrode, and a copper counter electrode were used, in addition to materials for the transducer circuit. The working, counter, and reference electrodes were connected to the potentiostat, and voltammetry was run. After a clear correlation between lead nitrate and DNA oxidation was established, the various trials were run with the modifications (thin, thick and multi layer; various pH's; and physical vs. chemical adsorption primarily) placed onto the working electrode. The computer interface outputted a graph plotting measured current vs. applied voltage, revealing oxidation peaks that indicated if DNA damage occurred.

Results

The oxidation peak of the control was compared to the oxidation peak of a trial with lead nitrate and significant difference (more voltage and lower current at oxidation peak) was confirmation of DNA damage. The graphs revealed that guanine indeed was irreversibly oxidized. The quality of the output and was primarily used to determine which method of immobilization was most effective. The hypothesis was proved false regarding the technique of immobilization and thin-layer proved to be most effective. The hypothesis regarding the environment (acidic pH) of immobilization and method (chemisorption) was proved true.

Conclusions/Discussion

This experiment confirmed the hypothesis that lead nitrate is indeed much more harmful than previous thought. The pollution from industrial runoff of this heavy metal is a severe issue that must be dealt with immediately. This project developed an effective, optimized biosensor that has significant potential as it can help curb ever increasing cancer rates in modern society and hopefully aid developing nations by providing a cheap alternative to standard expensive, time-consuming laboratory tests.

Summary Statement

My project establishes a link between lead and DNA damage, and uses this correlation to create and optimize a biosensor that can detect lead pollution in the field.

Help Received

Name(s)	Project Number
Dhuvarakesh Karthikeyan	**S1116**

Project Title

MFCs Reloaded: A Novel Bio-Augmented Design to Enhance MFC Efficiency

Abstract

Objectives/Goals
My objective was to see if a bio-augmented design would increase the efficiency, as well as power production, of a Microbial Fuel Cell. Moreover, I aimed to analyze the extent at which it would optimize the power production, if optimization was achieved at all. I established a goal of increasing power production by 10-15%.

Methods/Materials
I came to discover that there were innate flaws in MFC design that were holding it back from realizing the potential of such a revolutionary technology and set out to change the design itself. The two-chamber MFC is highly inefficient due to its high internal resistance and the single-chamber MFC has both a low lifespan and is not cost-efficient. The same way by which researchers were inspired by nature in the pursuit for artificial photosynthesis, I used nature#s model to successfully design a more efficient MFC to reduce internal resistance, increase longevity, and increase the surface area to volume ratio of the system. I used PVC piping and PVC compression fitting to construct the system and was able to control the price to be $15-$18 USD.

Results
The design modifications increased the power production of the system by a factor of 60% in comparison to the baseline power produced. By using the extent at which the design changes were applied as a function of power production, as well as a matrix of meticulous controls, I was able to conclusively determine that it was indeed the modifications in design, and not any adverse affect that lead to an increase in power production.

Conclusions/Discussion
The 60% increase in power production overshot the expected 10-20% increase in power production by a huge margin. The next step would be determining and overcoming obstacles regarding scaling up the idea before implementation can begin in developing nations and integrated into developed nations.

Summary Statement

I was able to engineer a more efficient MFC design that yielded 60% more power production while simultaneously reducing its cost.

Help Received

Sister helped with the board; teachers helped streamline the design process with feedback; father helped with practical applications and outreach

Name(s)	Project Number
Anthony Lee; Soly Lee	**S1117**

Project Title

Natural Filtrations Tested by a Homemade Turbidity Meter

Abstract

Objectives/Goals
Our objective of the experiment was to determine which of the three filters we constructed would be best in removing particles in contaminated water. Also to build a simple electronic device to measure light scattering in the water after it has been filtered.

Methods/Materials
We designed 3 types of filtration methods for this experiment. Our focus when creating the filters was to keep it as natural as possible, make it easily accessible, and build it at a low cost. The biosand filter is made from sand, gravel, and PVC that is all contained within a plastic bucket. The algae filter is constructed by putting a leg stocking over a plastic canvas. Green algae is then placed on the stocking and held within a cylinder. The third filtration method is the tree branch filter. We cut small round pieces of wood and plugged them into clear vinyl tubes. Waterproof tape was added to stop small leaks along with a pump to quicken the process. The turbidity meter was constructed with the help of procedures and diagrams guiding us.

Results
The turbidity meter tested the water after it had been filtered. The average results shown from the filters were: 22.6 mv (biosand filter), 46.8 mv (algae filter), 24.6 mv(wood filter). From our results the biosand filter was the most effective. However, the wood filter's average results were almost as well as the biosand filter. The algae filter did not perform as well as the other filters.

Conclusions/Discussion
In conclusion, our filters were not able to get rid of all impurities in the water because many of them are microorganisms.

Summary Statement

The purpose of our project was to discover a cheap method to filter and test filthy water.

Help Received

Uncle helped wire some parts of breadboard; neighbor and uncle helped cut pvc and wood; teachers supplied beakers

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Dylan T. Lerner

Project Number

S1118

Project Title

Investigating Whether Varying Altitudes Affect Aerial Emission/Dispersion Rates of Ash Particulates in the Environment

Abstract

Objectives/Goals

My objective was to determine whether varying altitudes (the mountains-2185 meters, the Central Valley of California-113 meters, and the coast-5 meters) affect the aerial emission/dispersion rate and level of ash particulates in the environment. My hypothesis was if the altitude/elevation decreases, then the dispersion rate and level of ash particulates in the environment will increase.

Methods/Materials

I used the two types of wood previously determined in the year 1 and 2 studies to be the least harmful (Douglas Fir) and most harmful (store bought) for burning in the Central Valley of California. In order to measure whether varying altitudes/elevations affect the emission/dispersion rates, I kept track of how long each type of wood ash stayed in the air and measured how far the wood ash traveled when it was disturbed at three different altitudes (the mountains-2185 meters, the Central Valley of California-113 meters, and the coast-5 meters.)

Results

As the altitude decreased from 2185 meters above sea level to 113 meters above sea level, the dispersion rate and level of ash particulate did increase. However, when traveling from 113 meters above sea level to 5 meters above sea level, the dispersion rate and level of ash particulate was similar to the figures at 2185 meters, but still less than the figures at 113 meters above sea level. Even when you consider human error, the store bought wood has the potential to still be the most harmful type of wood to burn.

Conclusions/Discussion

Based on this Third Year Study, it is clear that altitude/elevation plays a significant role with respect to the amount of pollution that is dispersed in either direction of the Central Valley of California. The Central Valley is prone to increased pollution when compared to the mountain and coastal regions particularly when burning store bought wood. The results indicate that air pollution from ash particulates is better when measured in places significantly distant from the Central Valley. However, in addition to elevation, the temperature and humidity levels must also be considered as was tested in the second year study.

Summary Statement

My project was to determine the affect of varying altitudes on the dispersion rate and level of ash particulates in the environment.

Help Received

My mom helped type my project.

Name(s)	Project Number
Danny T. Luu	**S1119**

Project Title

The Effects of Stormwater Runoff on Salvia leucantha and Anna's Hummingbirds Interactions

Abstract

Objectives/Goals
The objective of this project was to determine if storm-water runoff would effect the Salvia leucantha (Santa Barbara Mexican Bush Sage) and its main pollinator the Anna's Hummingbird. The goal was to determine if there was a change of color in leaves, number of flowers, height of plants, numbers of interactions, and duration of interactions by storm-water fed Salvia leucantha compared to a distilled water fed Salvia leucantha perrenial plant.

Methods/Materials
To simulate storm-water runoff, ten different pavemented locations (gas station, parking lot, etc.) around the Santa Maria Valley were poured with one liter of distilled water. Then vacuumed up to be transferred into ten, ten milliliter graduated cylinder and froze in a freezer to obtain the amount of motor oil in one liter of storm-water runoff. After the average amount of motor oil from the ten locations were obtained, I started to calibrate the plants by trimming the heights, trimming the flowers, and having the same soil moisture levels for both plants. One day a week for four weeks, I would pour the average amount of motor oil with one liter of water into the experimental plant and one liter of distilled water into the control plant. From 8am to 12pm everyday for four weeks, I would record the plants by having an equidistant area of footage. Everyday after the recording, I would watch the footage on my video editing software with fast forward mode, then chart down the number of visits and durations of the hummingbird interactions for each plant.

Results
The results were that the experimental plant lost 64 percent of its flowers, decreased in height, and went from green to wilted color leaves while the control plant gained 18 percent more flowers, increased in height, and brought bright green leaves showing that storm-water runoff has an dramatic effect on the Salvia leucantha. Not only is the Salvia leucantha being affected by the storm-water runoff, but also the Anna's Hummingbirds by a decrease in interactions and durations compared to the control plant.

Conclusions/Discussion
My conclusion is that storm-water runoff does effect the Salvia luecantha plant and Anna's Hummingbirds interactions with the plants. The decrease in flower, height, and color intensity of leaves show the effects of what storm-water runoff could do to plants similar to the Salvia leucantha, also a decrease in Anna's Hummingbird visits and their durations with the plants.

Summary Statement

To determine if storm-water runoff could effect Salvia leucantha phenotypes and Anna's Hummingbirds visits/durations compared to a regularly watered Salvia leucantha plant.

Help Received

Name(s)	Project Number
Sanika Mahajan; Varsha Swamy	**S1120**

Project Title

Effect of Sediments Containing Polycyclic Aromatic Hydrocarbons

Abstract

Objectives/Goals
Our purpose was to ascertain whether or not parking lot and playground sediment contain compounds that can harm aquatic animals, and if they did, to determine the LC50 (or concentration at which 50% of the population perish) of each of them. . Our aim was to reveal the impact of each substance on urban runoff, since Daphnia Magna are prime examples of organisms affected by the runoff of toxic sediment into streams and rivers.

Methods/Materials
Our procedure consisted of using a broom and pan to sweep up sediment, operating a scale accurate to .0001 grams to weigh the sediment, and conducting a bioassay on the Daphnia Magna for 24 hours with different concentrations of each type of sediment in different habitats. After the bioassay was conducted twice, we took the average death rate for each concentration from the two trials. We then used Microsoft Excel to create graphs with the x-axis being the concentration, and the y-axis being the average number of deceased Daphnia. We then created a line of best fit that showed where the LC50 of each of the sediments would be.

Results
The data showed that the LC50 of the parking lot sediment was 53 mg/L and that of the playground sediment was 72 mg/L.

Conclusions/Discussion
According to our research, Daphnia Magna have been proven to accurately reflect the reactions of many aquatic organisms, which means that our results will apply to several other species. Parking lots and playgrounds are widespread facilities, oftentimes appearing within miles of freshwater, and there is a great probability of sediment from these areas polluting the water. Our results show exactly what concentration of the sediments is needed to wipe out half of many freshwater populations, and further research can be done in tandem with our study in order for scientists to be able to minimize the detriments of urban runoff from parking lots and playgrounds.

Summary Statement

We conducted a bioassay to ascertain the toxicity levels of parking lot and playground sediments, which often contribute to urban runoff.

Help Received

Used scale at Cupertino High School under the supervision of Daniel Stavis (teacher)

Name(s)	Project Number
Zahra B. Masood	**S1121**

Project Title

The Effectiveness of Bioremediation with Different and Varying Concentrations of Nutrients

Abstract

Objectives/Goals
The purpose of this project is to investigate the effects of different essential nutrients and their concentrations on the rate of bioremediation

Methods/Materials
Obtain necessary materials: Magnesium, Calcium, Sulfur, Fertilizer, Zinc, and Sodium Chloride. From the previous project, the optimum concentrations of nutrients were 0.4 grams of Sodium Chloride, 0.15 grams of Zinc, and 8 grams of garden fertilizer. Use five different amounts of Magnesium (0.25, 0.50, 0.75, 1, 1.5 grams) (In addition to Fertilizer, Zinc, Sodium Chloride) in 200mL sea water and 20 mL of oil. Leave each sample for 1 week and perform various filtration techniques to determine the amount of Magnesium which resulted in highest oil reduction (Experiment 1). Repeat the process using the optimal Magnesium found in experiment 1 and five different amounts of Calcium (0.3, 0.6, 0.9, 1.2, 1.8 grams) (In addition to Fertilizer, Zinc, Sodium Chloride) (Experiment 2). As a last step, repeat the process and use optimal amounts of Magnesium and Calcium with 5 different amounts of Sulfur (0.5, 1, 1.5, 2, 3 grams) (In addition to Fertilizer, Zinc, Sodium Chloride) (Experiment 3).

Results
In Experiment 1, 1.5 grams of Magnesium showed the greatest oil reduction (28.17%). In Experiment 2, 1.5 grams of Magnesium and 0.6 grams of Calcium showed greatest oil reduction (33.00%). In the Experiment 3, 1.5 grams of Magnesium, 0.6 grams of Calcium, and 3 grams of Sulfur showed optimum oil reduction (38.67%).

Conclusions/Discussion
The rate of bioremediation varied when using different nutrients in varying concentrations. The maximum amount of bioremediation obtained from this project was with the combination of the following nutrients: 1.5 grams of Magnesium, 0.6 grams of Calcium, and 3 grams of Sulfur. Bioremediation provides a cost effective and environmentally friendly method to clean up an oil spill and can be enhanced with the addition of various nutrients.

Summary Statement
Testing the effect of Bioremediation using various Nutrients

Help Received
Father helped supervise the project

Name(s)	Project Number
Manooshree R. Patel	**S1122**

Project Title

Biochar: Reducing and Removing Atmospheric CO(2) and Improving Soil

Abstract

Objectives/Goals

The rapid rise of unnatural carbon dioxide is beginning to negatively impact our planet and will continue to do so. Biochar is a solution. The purpose of my project is to make my own biochar out of commonly used materials and determine which biochar is the most efficient, sequesters the most carbon, and has the most positive impact on plant growth. I hypothesized that the biochar made from orange peels will be the most efficient biochar overall by producing the largest ratio of biochar to biomass, will retain the largest amount of carbon from the air, and having the most positive effect on plant growth.

Methods/Materials

My project has 3 parts.

Making the Biochar: I designed and constructed my own Biochar kiln and got a working design on my third attempt. I pyrolized Apple, Cherry, Hickory, Pecan, and Mesquite Woods, Orange Peels, and Corn Husks in my kiln. I also burned the biochar under 4 different air settings (none, natural, low, and medium air flows) which circulated through the bottom of the kiln and out the chimney. I recorded the date, time taken to pyrolize, and the color and mass before and after burning.

Carbon Retention Test: After my homemade test did not work, I conducted a butane retention test. I recorded the mass of the test tube with ground biochar. I then let the biochar soak in butane gas for 45 minutes and recorded the mass of the test tube with biochar and butane. Then I calculated the butane retention using a formula.

Effect on Plant Growth: I mixed soil, biochar, and manure in the ratio 2:1:1 for each experimental plant. I then grew brassica juncea plants for each type of biochar and I grew control plants without biochar. I monitored and recorded their height for 10 days to determine the tallest plants.

Results

The Hickory wood biochar helped the plants grow the tallest, but the orange peels biochar had a greater number of seeds that sprouted. The cherry wood burned under low air setting had the highest butane retention value.

Conclusions/Discussion

Overall, the biochar produced by the hickory wood was the most environmentally efficient because it had a high biochar to original biomass ratio, improved plant growth the most, and had above average carbon retention rates. This disproves my hypothesis.

In the future, I want to analyze the gas given off by this process and use it as an energy source that could power a factory or a machine. I also want to commercialize this process.

Summary Statement

The purpose of this experiment is to determine which Biochar, out of the selection that I produced, is the most environmentally efficient depending on carbon sequestration levels and impact on plant growth.

Help Received

Ms. Taylor Thomlinson, Communications Director of the International Biochar Initiative gave me suggestions through emails about the best Biochar kiln design. Mr. Frank Shields allowed me to come to Control Laboratories Inc. in Watsonville and perform a butane retention test. My dad drove me to the

Name(s)

Neel R. Patel

Project Number

S1123

Project Title

The Effect of Different Concentrations of Caffeine on the Production of Electricity from a Microbial Battery

Abstract

Objectives/Goals

The objective of this experiment was to determine if caffeine would have an effect on the electricity flow from a microbial battery. I hypothesized that caffeine would increase the electricity flow from a microbial battery.

Methods/Materials

A microbial battery was built using two plastic cups, a 19cm boba straw, and aluminum foil for the electrodes. Coffee filter was placed into the boba straw and a 200g sample into the anode and 200ml of 1M NaCl in the cathode. One battery was set up with 0g caffeine, one 0.3g, one 0.6g, one 0.9g, and one 1.2g of caffeine for 40+ hours. The Arduino-based microcontroller automated the data collection of the voltage readings.

Results

The control group showed a relatively steady average voltage output from the microbial cell. The group with 0.3g of caffeine showed a change of 0.0089 mV per second, a change of 0.0086mV. The group with 0.6g of caffeine showed a drastic change of 0.0188mV from control. The group with 0.9g of caffeine showed a steady average output of electricity production. The group with 1.2g of caffeine actually showed a slight decrease in the voltage output.

Conclusions/Discussion

Thus my hypothesis was supported by the data. The increase in caffeine did cause an eventual increase in the voltage production, particularly when 0.6g of caffeine was added to the microbial battery. Anything higher, the average voltage change decreases. Microbes at higher caffeine concentrations are toxic to the effects of caffeine.

Summary Statement

My project measures the effects of caffeine on electricity production from a microbial battery

Help Received

Mrs. De La Cruz provided access to laboratory equipment. My father supported me financially. My mother and sister helped with the creation of the board. My grandmother helped with providing expertise for the best soil located in the backyard.

Name(s)	Project Number
Cameron S. Robertson	**S1124**

Project Title

What's Your SHELLf Life: The Effect of CO(2)-Induced Carbonic Acid on Calcium Carbonate in Sea Water

Abstract

Objectives/Goals

The goal of this experiment was to demonstrate what high acidity levels in the ocean will do to calcium carbonate sea shells.

Methods/Materials

1500 milliliter samples of sea water were obtained from 3 different locations near Monterey, CA: open ocean, Elkhorn Slough, Monterey Harbor. 110 small clam shells were weighed and labeled according to sample group. Using a Vernier pH probe, the initial pH level was determined for the five control groups (no added CO2): tap water (pH 6.82), alkaline (pH 8.2), open ocean (pH 7.9), slough (pH 7.9), and harbor water (pH 7.72). Using a Planet Bike Airflation CO2 bike tire inflator, CO2 was bubbled into solution to reduce the pH for each of the 3 test groups (open ocean, slough, harbor). A sample set with pH 7.0 and a second sample set with pH 7.5 were created for each of the three test groups. Twenty milliliters of each sample set for both control groups and test groups were placed in a closed cup with a clam shell. The clam shells remained in the solutions for ten days before being removed, dried, and weighed again. Final pH levels were recorded for all control groups and test groups.

Results

The slough water samples dissolved the most sea shell material at both the 7.0 and 7.5 pH levels. The alkaline solution samples demonstrated the least amount of shell loss. Every sample demonstrated an increase in final pH level after 10 days. All 3 sea water test groups had final pH levels near 7.7 for both the 7.0 and 7.5 pH levels. The final alkaline sample pH was 8.42. The tap water control group showed the largest increase in pH from 6.82 to 7.87.

Conclusions/Discussion

There appears to be no correlation between the amount of shell loss and change in pH during the testing period. The experiment did not support the hypothesis that the harbor water samples would dissolve the greatest amount of sea shell material. Adding CO2 to a solution does effectively increase the acidity by reducing the pH level. There are other factors that may affect calcium carbonate breakdown besides pH level, including water temperature, time of exposure, and water source.

Summary Statement

This experiment explored the effect of CO2-Induced carbonic acid on calcium carbonates in sea water.

Help Received

My CART advisor, Staci Bynum, provided me the pH buffers and probe. Dr. Kenneth Clifton of Lewis and Clark College provided mentoring and suggestions for project modifications.

Name(s)	Project Number
Kaitlyn A. Russo	**S1125**

Project Title

Benthic Macroinvertebrate Bioassessment of the Fresno Rivers

Abstract

Objectives/Goals
Assess the levels of pollution in the fresnos rivers by testing and looking at the diversity of the macroinvertebrates.

Methods/Materials
After I selected three rivers I wade into the the river to get soil samples. I Place the kick net at the bottom of the river and kicked dirt into the net. Next I collected 2 cups of water from each river. Then I went home and tested the water for phospate, nitrates, and copper and analyzed the dirt for macroinvertebrates. Lastly, I looked for correlation between diversity of macroinvertebrates and pollution. I used a pole, a pillowcase, metal hanger, 6 storage containers, LaMotte Water Pollution Detection Kit, and duct tape.

Results
After my experiment, I found the San Joaquin River to be the most contaminated with a nitrate level at 3 ppm, phosphate level at 2.3 ppm and a copper level at .15 ppm. The Kings River to be the least contaminated with a nitrate level at 1.4 ppm, phosphate level at .6 ppm, and a copper level at 0 ppm. I also found the least amount of diversity of macroinvertebrates in the San Joaquin river and the most diversity in the Kings.

Conclusions/Discussion
After completing my investigation on the level of pollution in rivers based on the amount of macroinvertebrates, I found that my first hypothesis was supported by my data and my second one was not. The most contaminated river was the San Joaquin, and it did not have a wide variety macroinvertebrates. In the end, I learned that we as people need to be more careful on what we let go into the river because it is killing the macroinvertebrates and that affects all species within the food chain...including us.

Summary Statement

I tested to see if their was any correlation between diversity of macroinvertebrates and pollution

Help Received

Mother drove me to my locations and helped tape things on straight

Name(s)	Project Number
Jessica A. Schager	**S1126**

Project Title

The Correlation between Nurdles and Surface Currents

Abstract

Objectives/Goals
Preproduction plastic pellets, called nurdles, are one of the most common pollutants along the coastline. The objective of this project is to determine if the presence of nurdles on the beach may be affected by the direction of the surface current. It was hypothesized that if the current pushes towards the shore, there will be more nurdles found at the location.

Methods/Materials
Three locations with different directions of surface currents were chosen to conduct nurdles counts repeatedly. At the arrival of each site, the time was recorded. Then, a measuring tape was used to mark off a 70 centimeters square in the sand. Nurdles were collected using a sifter and counted from that square. Using the time recorded prior to the count, the direction of the surface current was noted for each trial.

Results
The sites with the current pushing towards the shore had the most nurdles, while the least amount of nurdles came from the trials with the current pulling away from the coast.

Conclusions/Discussion
My conclusion is that amount of nurdles I found on the shore supports that there may be a correlation with the directions of surface currents and nurdles. Nurdles float when put in water. Therefore, since surface currents push around the top 400 meters of the ocean, it is likely that the nurdles are being moved around with the water. With this in mind, perhaps clean-ups can be effectively planned at places where the surface current pushes floating debris onto the coast.

Summary Statement
My project exhibits that surface currents may play a role in the distribution of nurdles along the shore.

Help Received
My parents drove me to the sites.

Name(s)

Swetha P. Tummala

Project Number

S1127

Project Title

Harmful Algal Blooms in Santa Cruz Waters

Abstract

Objectives/Goals

My objective is to study how water quality indicators change before and after a Harmful Algal Bloom (HAB) in Santa Cruz waters.

Methods/Materials

I obtained data from the Southern California Coastal Ocean Observing System (SCCOOS) and the University of California-Santa Cruz Ocean Observing Platform (SCOOP) between 7/18/2012 and 9/5/2012 to study how water quality indicators including dissolved oxygen, water temperature, pH, total chlorophyll content, and Domoic acid levels change before and after an algal bloom. After collecting and graphing the data, I made observations on the different water quality indicators of HAB species.

Results

Baseline levels of domoic acid are less than 2 ng/mL and 0-1000 cells/L for Pseudonitzschia seriata, an HAB former. Around August 16, 2012, Domoic acid levels peaked at 9 ng/mL when the species count for Pseudonitzschia seriata was around 10,000,000 cells/L. After August 16, 2012, levels of both Domoic acid and HAB species count returned to baseline. My study shows a positive trend between Domoic acid levels and growth of algal bloom with Pseudonitzschia seriata species. No specific trends were observed with the other variables.

Conclusions/Discussion

My results suggest that water quality indicators do change before and after a Harmful Algal Bloom. My study showed a positive trend between Domoic acid levels and Pseudonitzschia seriata species. Marine biologists can use these indicators to predict peak times of algal blooms and warn fisherman and coastal communities about potential quarantine periods to protect their health. Further studies need to be done to confirm my observations.

Summary Statement

In this project, I study how water quality indicators change before and after a Harmful Algal Bloom (HAB) in Santa Cruz waters.

Help Received

My father bought the poster board.

Name(s)	Project Number
Nathaniel B. Tweed	**S1128**

Project Title

Clean Water for a Thirsty Third World 2

Abstract

Objectives/Goals
In my experiment my goal was to find out if solar ovens are more reliable and more cost effective than other pasteurization methods.

Methods/Materials
My method was to make four solar ovens that are exactly the same and put four water bottles full of water in each solar oven. Each 16 ounce water bottle was painted black in a different way. One bottle was all black, the 2nd bottle had the bottom half black, the 3rd bottle had the top half black, and the last one was clear. I put 16 ounces of water in each one, and placed them in their own solar oven. I took the temperature of each bottle every 30 minutes, and waited to see which one would reach 160˚F first.

Results
My results are that the bottle that was all black reached a max temperature of 166˚F, the top half bottle reached 139˚F, the bottle half bottle reached 151˚F, and the clear bottle hit 131˚F. The weather temperature hit a max of 71˚F.

Conclusions/Discussion
These results show that the all black bottle and the bottom half black would work in a third world country. It also shows that this method can be used almost year round in third world countries. In weather of 66˚F the all black bottle reached 166˚F. This method should be used instead of purification pills. The solar ovens are easy to make and are more cost effective.

Summary Statement

To prove that solar pasteurization is more cost effective and reliable than other pasteurization methods.

Help Received

Name(s)

Daniela Vainer

Project Number

S1129

Project Title

Cyanobacteria: A Renewable Energy Source

Abstract

Objectives/Goals

Sustainable energy never seemed so green. The use of cyanobacteria as a renewable energy source is highly innovative and current because the world has to look into new alternative ways to create energy that does not burn fossil fuels. The purpose of this project is to identify the most efficient way to create an electrical current generated by a redox reaction from cyanobacteria.

Methods/Materials

Two strains of cyanobacteria, Anabaena inequalis (freshwater) and Synechococcus sp. (marine) were cultured in fresh water Alga-Gro media and sea water supplemented with F2 Si respectively, at 22oC and a 13/11 light dark cycle. Each strain was placed in a voltaic bioreactor and the voltage and current were evaluated over time. Media controls were also run for each cyanobacteria.

Results

The results with Anabaena data show that an increase in cell density could be generally correlated with an increase in voltage. The results demonstrated the voltage output from both Anabaena inequalis and Synechococcus sp. had a cyclical nature that correlated to the 13/11 light dark cycle, with a higher voltage recorded during the light cycle. In this experiment, the freshwater cyanobacteria, Anabaena, produced an initially greater voltage than the marine cyanobacteria, Synechoccocus sp., at 24 hours, although this was not the case after 48 hours (cell density 0.70 absorbance).

Conclusions/Discussion

The results show that it could be possible to generate an even greater voltage with a greater cyanobacteria density. This shows the potential to scale up the voltaic bioreactor and generate a greater voltage. The light dark cycle demonstrated a greater voltage output during the light cycle coinciding with photsynthesis. It was not possible to conclude as to which strain of cyanobacteria had the greater potential from these experiments. However the voltage gradually declined over 3 days with both strains indicating that with the experimental set-up they were not self-sustaining in the long term. Future experiments are planned to explore further optimizations and test other strains.

Summary Statement

The purpose of this project is to identify the most efficient way to create an electrical current generated by a redox reaction from cyanobacteria.

Help Received

Dr. Willoughby as teacher and mentor.

Name(s)	Project Number
Elizabeth J. Vojvoda	**S1130**

Project Title
Suburban Nitrogen Runoff's Effects on Aqueous Ecosystems of Contra Costa County

Abstract

Objectives/Goals

Nitrogen (N) compounds are carried into bodies of water as nitrogen runoff (NR). While NR may have higher relevance in farming areas, NR from commercial products can be significant in suburban communities and affect the aqueous ecosystems of areas such as Contra Costa County (CCC). The goal of this experiment was to analyze the effects of NR on various bodies of water in CCC and to determine how levels of NR would affect the aqueous ecosystems and the safety of human interaction with those bodies of water. The study was subdivided into three parts. The first part of the study looked at N levels in water from multiple sources with connections to storm drains and suburban NR. The second portion explored the communities of bodies of water with various levels of N. The third portion looked at the effect of varying concentrations of ammonia on microorganisms from sample waters.

Methods/Materials

Samples from four different CCC bodies of water and tap faucets (control), were tested for levels of N using test strips on three consecutive weeks. The populations within the water samples were studied on a standard light microscope. The amounts and diversities of identifiable organisms were determined.

Results

The data revealed an isolated body of water (Tao Pond-TP) has higher amounts of N, greater population size and diversity than creeks with storm drain connections (Cow and San Ramon Creeks). San Ramon Creek (SRC) and Remington Creek (RC) had similar amounts of N and populations. In February 2014, the amount of N compounds in SRC was highest (1.65 ppm) and the population in SRC was largest (346 organisms). The data showed a connection between N levels and population characteristics. Microbes from samples collected were grown with varying amounts of ammonia. TP had the highest circular colony growth rate (109.97 colony/day) when enhanced continuously with ammonia (control trial: 67.264 c/d). SRC showed similar results for the circular colony growth. Cow Creek and RC#s control trial had the greatest logarithmic graph values and the variable trials showed inhibited growth.

Conclusions/Discussion

In all bodies of water, the overabundance of N compounds can cause eutrophication, toxicity, and other health concerns. NR has varying effects on different water bodies which should analyzed in all areas to find the dangers of human interactions. NR should be limited to reduce health risks.

Summary Statement
The goal of this project was to analyze the current effects of nitrogen runoff on various bodies of water in CCC and to determine how increased nitrogen runoff would affect the aqueous ecosystems and their safety for human interaction.

Help Received
Mother and Father edited written report, assisted in water collections, and helped organize poster; Mrs. Groch provided lab equipment and agar plates; peers edited written report

Name(s)

Alexandra N. Vredenburgh

Project Number

S1131

Project Title

Ocean Water Quality: Evaluating the Environmental Impact of Protective Boat Coatings on Marine Life

Abstract

Objectives/Goals

Boat paint companies argue that copper antifouling paints do not harm marine life, even claiming that copper is an essential micronutrient to life. This study independently evaluates this claim to determine the effects of copper paints on the aquatic environment. While most literature focuses on larger organisms such as mammals and fish, this study evaluated smaller organisms, planarian and egeria densa, that are lower on the food chain.

Methods/Materials

Create dilutions of copper sulfate solution (all in ppm): 0.001, 0.01, 0.01, 0.1, 0.2, 0.5, 3.0. Place 20 planarian in each 30 ml petri dish with 20 ml of each copper solution. Place 5 cm segment of egeria densa in each 50 ml conical tube filled with copper solution (Phase 1: control, 0.2 ppm, 0.5 ppm, 3.0 ppm; 2nd phase: control, 0.001 ppm, 0.01 ppm). For regeneration study, cut 10 planarian per experimental condition in half using scalpel and expose 20 planarian segments per condition to copper solution (control, 0.001 ppm, and 0.01 ppm). Study all specimens under microscope. Document changes to structures, behavior, and mortality rates.

Results

No difference in mortality rates for copper levels up to 0.5 ppm for uncut planarian; however, there was a negative impact on their health such as loss of eye spots and behavioral changes for the 0.5 ppm exposed planarian, indicating that copper affected the test organisms. The regeneration study suggests that the level of copper found in the San Diego Yacht Harbor (0.01 ppm) had a significant impact on ability to regenerate (85% death within 8 days, compared to 15% death for EPA control). Microscopic study indicated a change in the cellular biology of the egeria densa in all levels of copper, including the EPA allowed level of 0.001 ppm.

Conclusions/Discussion

When dissolved copper was introduced to aquatic plants (egeria densa) at levels of exposure found at the Shelter Island Basin, there was an effect on the cellular biology when compared to unexposed plants, and those exposed at the EPA level. While the EPA allowed copper level did not appear to affect planarian regeneration rates, the copper level found at Shelter Island caused significant mortality rates. Therefore, the boat paint company#s claim that copper was not harmful to marine life was misleading. These organisms are a very important part of the ecosystems they support, and their demise would be catastrophic within the food chain.

Summary Statement

This study evaluated the environmental impact of copper on planarian and egeria densa.

Help Received

Lab equipment was borrowed from Rancho Buena Vista High School. My father supervised dissections and chemical disposal.

Name(s)	Project Number
Kriya E. Wong	**S1132**

Project Title

The Effects of Sorting Refuse on Methane Generation in Landfills

Abstract

Objectives/Goals
This project is meant to show the benefits of waste segregation under landfill conditions in producing more methane as a source of energy than assorted landfill.

Methods/Materials
Four 1-gallon Nalgene bottles or #bioreactors# were created, one with paper and organic waste, one with plastic and organic waste, one with only organic waste and one with assorted waste collected from my own home, and the reactors were placed in a waterbath (cooler) at a temperature around 80-90 degrees Fahrenheit and attached to individual Flexfoil bags. The bags inflated as gas was generated and recorded.

Results
After a time period of 42 days, the organics only reactor produced the most gas and therefore methane, as expected, followed by the paper waste and organics mixed reactor which produced 60% more methane than did the plastic and organics reactor.

Conclusions/Discussion
First, it would be beneficial to create paper-organics landfills as opposed to assorted ones because it is clear that the plastics and various other kinds refuse in assorted landfills impede their ability to generate methane. Because the paper waste mix generated nearly 60% more biogas than did assorted waste, it is clear that separating refuse in landfills would enhance methane production on a large scale.
Since the all organics reactor produced far more gas than the others, why would we not support all organics landfills? Towards the end of my study the organics only reactors began to plateau while the paper mix maintained its increasing trend, suggesting that the paper mix is a more reliable and consistent option. In regards to the fact that the assorted bioreactor and plastics-organics bioreactor produced the same amount of gas which would never occur under natural circumstances, the assorted refuse produced low amounts of gas most likely because it was collected from my own house and did not contain exactly equal percentages of various types of refuse while the plastics-organics bioreactor was exactly half organic material and half plastic waste.

Summary Statement

My project demonstrates that segregating waste in landfills yields more methane as a source of renewable energy than does assorted landfills as exist today.

Help Received

Father helped prepare waterbath cooler; Mr. Dung Kong, senior engineer ph.D at Puente Hills helped with set-up and equipment; Rick Sanzone manager of Albertsons let me take compostable organic waste

Name(s)	Project Number
Yu Xia	**S1133**

Project Title

Phytoremediation: Colorimetric and Bio-chamber Studies of Air and Water Contaminants Removal Capacity of Various Plants

Abstract

Objectives/Goals
The objective is to determine the possibility of using easy and accessible materials along with plants to remove air and water contaminants.

Methods/Materials
In Phase I of the experiment, polytrichum (moss) and equisetum (horsetail)#s ability to absorb copper in water is tested. In Phase II, a primitive bio-chamber is constructed to test out the possibility of using triticum (wheat grass) as an air-filter.

Results
In Phase I, results showed that the intaking of water in plant metabolism absorbed copper in water as well.
As for Phase II, while quantitative data wasn#t able to be obtained, the qualitative comparison of the testing materials between the control and the experimental group showed that tritium did have some air-filtration effect.

Conclusions/Discussion
The experiment successfully proved that extremely accessible plants could be used as a way to remediate air and water pollution. This experiment also points to a new possibility of using bio-filter made from readily available plants to serve as a pollution control technique.

Summary Statement

This project looks at the possibility of using easy and accessible materials along with plants to remove air and water contaminants.

Help Received

Mother helped with the board design; Used school's lab equipment; Stepfather for drilling the chamber; Mr.Garabedian for teaching me how to use some laboratory equipments.

Name(s)

Jennifer J. Yu

Project Title

When and Where People Should Jog: Analysis of Local Atmospheric Particulate Matter

Abstract

Objectives/Goals

This project endeavored to find out what time of the day and which commonly used jogging path in Fremont, CA had the smallest amount of fine and coarse atmospheric particles.

Methods/Materials

Materials: Dylos air particle monitor, portable battery, hygrometer, thermometer, anemometer, and watch
Procedure:
1. Charging battery and plugging in air particle monitor
2. Using hygrometer, thermometer, anemometer, and watch to make sure humidity, temperature, wind speed, and time were the same
3. Recording PM1 and PM5 at four jogging paths and six different times on Saturdays and Sundays from April 2013 to March 2014

Results

1. The Mission Creek path had the lowest particle count at 21:00.
2. Central Park had the lowest particle count at 6:00.
3. Both results above opposed the hypothesis that the Mission Creek path had the least amount of air particles at 6:00.

Conclusions/Discussion

1. Morning joggers should go to Central Park.
2. Evening joggers should go to Mission Creek.
3. A detailed study may be needed to find out the specific components of the atmospheric particles at each tested time and place so the local residents will be able to decide when and where to jog based on their own physical condition.

Summary Statement

This project collected a whole year of weekend days' PM 1 and PM 5 values to find out the time and place that were exposed to the lowest levels of atmospheric particles in Fremont, California.

Help Received

My mother drove me to the tested sites every Saturday and Sunday from April 2013 to March 2014.

Name(s)

Amy Zhang

Project Number

S1135

Project Title

The Phytoremediation of Zinc by Lemna minor

Abstract

Objectives/Goals

Heavy metal pollution is an imperative problem worldwide. Two of the most problematic heavy metal pollutants are cadmium and mercury. If Lemna minor is proven to be a phytoremediatior of mercury and cadmium, it can be used to eliminate pollution in a cheap and effective manner. Due to the known toxicity of mercury and cadmium, zinc was used in this study, as it is in the same periodic group and exhibits similar chemical behavior.

Methods/Materials

Lemna minor is cultured in tanks of water containing various concentrations of zinc sulfate. Leaf parameters, such as total surface area covered and average change in fronds were calculated using a count tool on Photoshop and imageJ program. Also, a significance test was used to determine how significant the difference in surface area was from before and after one week. Finally, after one week of growing Lemna minor, the fronds were removed, dried, and sent to an independent laboratory for ICP-AES analysis of zinc bioaccumulation.

Results

The data from the laboratory showed that the entire sample of 10 ppm contained 4209 ppm of zinc. For 20 ppm, it was 10412 ppm. For 30 ppm, it was 21316 ppm. For 40 ppm, it was 30960 ppm. For the control, it was 841 ppm. Next, the statistical analysis found that the p-value of the paired-t test of the total surface area for each trial was .0035, less than the significance level, .05, showing that there is significant evidence that the true mean difference of surface area was negative; therefore, zinc had a negative impact on Lemna minor.

Conclusions/Discussion

The ICP-AES analysis of dried leaf matter shows that the Lemna minor bioaccumulates more zinc as concentration of zinc sulfate increases. Also, the statistical analysis displayed a negative trend in Lemna minor growth as zinc sulfate concentration increased, showing an inverse relationship between Lemna minor growth and bioaccumulation of zinc. Lemna minor does posses the ability to uptake zinc because it is a hypo-accumulator, a plant that can absorb metals and concentrate them in their tissues. Based on these promising results with zinc, Lemna minor may be able to remove mercury from contaminated water, and become a future eradicator of mercury pollution.

Summary Statement

If Lemna minor can bioaccumulate zinc from concentrations of zinc sulfate, then it can potentially help eradicate mercury pollution.

Help Received

Worked at Schmahl Science Workshop, an independent education institute