| Name(s) | Project Number |
|---|---|
| **Aamna J. Abbasi** | **S1101** |

**Project Title**

## Let's Get Drastic with Plastic... Again!  Year II

**Abstract**

**Objectives/Goals**

For last year's experiment, after I visited a landfill to explore ideas that I could address through an experiment.  I was told that if I found a way to help get rid of the plastic coming into the landfills, I would be doing a great service to society!So I began to look into plastics that are marketed as biodegradable, because if plastic is going to end up in a landfill anyway, why not use something that won't have a negative environmental impact? I explored biodegradable plastics, and came to a preliminary conclusion, but continued my research. I added a consumer analysis. I did an evaluation to determine the market availability of these products, and to evaluate the performance of these bags to meet the average consumer's needs.

**Methods/Materials**

32 Air-tight Mason Jars,32 grams of Plastic Trash Bags, Weigh scale, Substrates, Syringe with needles, Computer with Microsoft Excel, Infrared Gas Analyzer, Isotope Analysis. My experiment consisted of measuring 1 gram of each plastic sample with ~5 mls of four substrates representing common environmental conditions. The samples were placed in mason jars, and an infrared gas analyzer was used to measure carbon dioxide over time. There was one sample of each of the four plastics in a mason jar, with each of the four substrates, along with a duplicate. Leading to a total of 32 jars where the carbon dioxide was measured over a period of two months. Then a radioactive isotope analysis was conducted on each bag. I conducted a usability test based on data collected from over 50 households.

**Results**

For the biodegrability component, the oxo biodegradable additive plastic was the front runner and clearly had higher carbon dioxide concentrations. For the cost analysis, the plastic with the organic additive was the cheapest and the plant-based plastic was the most readily available in the market. For the usability test, the organic additive plastic was most successful.

**Conclusions/Discussion**

I believe based on each of these tests, the plant-based plastic would be the best option; balancing both consumer and environmental needs.

**Summary Statement**

Evaluating the biodegradation, cost, and consumer usability of biodegradeable plastic bags.

**Help Received**

Dr. Claudia Czimczik allowed me to use laboratory and work with her over the summer. My grandmother who is battling cancer gave moral support. My mother and family helped with general inquiries. LOVE YOU ALL :)

| Name(s) | Project Number |
|---|---|
| **Carina Aguirre** | **S1102** |

**Project Title**

## The Art and Science of Composting

**Abstract**

**Objectives/Goals**

My research experiment examined which soil medium would decompose different food waste particles the best to produce a better soil for producing the fastest, healthiest, and tallest plants. I used five soil mediums for this experiment: sand, manure, home made compost, dry soil, and potting soil. After mixing the foods with the different soils, I measured the temperature, pH, and conductivity of the mixtures. These measurements allowed me to monitor the rate of decomposition. After three weeks of composting, I planted five seeds in each of the soils to see which container allowed the seed to sprout the fastest. I hypothesized that manure might just be the best alternative by having the highest rate of decomposition and seed sprouting. My prediction turned out to be false and to my surprise, the best medium was the dry soil; the plants seemed to grow fastest, tallest, and healthiest in this medium. My second, repeated experiment yielded similar results. I also did a statistical analysis to see how much landfill space can be spared, if all the same food wastes that I used in my experiment could be turned into compost around US and in the world.

**Summary Statement**

Trying to see which soil produces the tallest, healthiest plants.

**Help Received**

My teacher helped me with the layout of my board.

Ap2/12

| **Name(s)** | **Project Number** |
|---|---|
| Amanda G. Arst | **S1103** |

**Project Title**

# Remediation of Hydrocarbon-Contaminated Soil Using Polypropylene Glycol to Restore Plant Growth

## Abstract

**Objectives/Goals**

The purpose of this experiment was to determine whether polypropylene glycol can remediate hydrocarbon-contaminated soil to restore plant growth. If so, will a higher concentration of polypropylene glycol be more effective in restoring plant growth relative to lower concentrations.

**Methods/Materials**

Phaseolus limensis (Lima Beans) seeds were planted into five containers with varying soil content. Samples compared were; seed starting soil, seed starting soil contaminated by 200 mL motor oil, seed starting soil contaminated with 200 mL motor oil but treated with 200 mL, 300 mL, and 400 mL of polypropylene glycol respectively. Soil and plant growth were observed for 50 days and were later analyzed. The soil content of nitrogen (N), phosphorous (P), potash (K), and pH balance levels were tested. The physical characteristics of the plant structure such as the leaves and roots were measured and observed at 50-times magnification using a microscope.

**Results**

Equal parts of polypropylene concentration added to the soil contaminated with motor oil (200 mL) worked to remediate the soil. However, higher concentrations of polypropylene glycol (300mL and 400mL) were not effective in remediating the soil. Tests showed that hydrocarbon oil did contaminate the soil. The soil with no hydrocarbon contamination was healthy with pH, N, P and K balance within normal range. The soil with the oil contamination, not treated with polypropylene glycol resulted in abnormal N, P, and K levels, and the pH balance was 6.0, acidic. The soil containing equal amounts of polypropylene glycol and oil (200ml) was slightly acidic. The higher concentration of polypropylene glycol (400 mL) affected the soil in a negative manner. The pH level of the soil with the higher concentration of polypropylene glycol (400 mL) was 7.5, Alkaline.

**Conclusions/Discussion**

My first hypothesis stating polypropylene glycol would remediate hydrocarbon contaminated soil leading to healthier plant growth was correct. The seeds in the soil containing 200 mL oil and treated with the 200 mL of polypropylene glycol had more plant germination than soil containing 200 mL oil that was not treated with polypropylene glycol. My second hypothesis was rejected because the higher concentrations of polypropylene glycol (300mL and 400mL) were too much to support plant growth. I would like to conduct future research during the summer time at an oil spill site.

**Summary Statement**

The purpose of this experiment was to determine whether polypropylene glycol can remediate hydrocarbon-contaminated soil to restore plant growth.

**Help Received**

Mother took some photographs and guided me on safety procedures.

| Name(s) | Project Number |
|---|---|
| Oliver Chen | **S1104** |

**Project Title**

## Method for the Sequestration and Utilization of Atmospheric CO(2)

**Abstract**

**Objectives/Goals**

My goal is to create a complete system of Carbon Dioxide Gas capture and conversion into usable substance, and the recycling of waste CO2. By capturing atmospheric Carbon Dioxide and converting it to usable substances such as syngas, synthetic natural gas, Carbon Dioxide can be successfully be reused in a renewable fashion.

**Methods/Materials**

Methods: The first step was to capture CO2 from the atmosphere. After some research I found that Sodium Carbonate was a good contender for carbon sequestration, or the removal of carbon dioxide from the atmosphere, and also could be easily reused. Next, the Carbon Dioxide had to be broken down into a usable substance. To achieve this, I build a tesla coil to breakdown the CO2 into CO, or carbon monoxide. I then built a Hydrolysis reactor to create Hydrogen and Oxygen. This Hydrogen and Oxygen was then mixed with the newly created Carbon Monoxide. This mixture of gasses is known as Syngas, short for synthetic natural gas. This mixture can then be later refined in chemical processes and used as fuel.

**Results**

I found that Sodium Carbonate effectively captured CO2 from the atmosphere and could be easily reused. I found that corona discharge can be used to break down CO2 into CO and mixed with Hydrogen made from electrolysis to produce Syn-gas, synthetic natural gas for use as a fuel or creation of industrial chemicals.

**Conclusions/Discussion**

I found that the use of Sodium Carbonate is a viable way for the capture of atmospheric Carbon Dioxide. It is not only efficient, but also reusable. Also, I found that the most effective use of Sodium Carbonate would be in areas of high Carbon Dioxide concentrations. I concluded that the most effective method of converting Carbon Dioxide into useful substances would be through a high voltage corona discharge, as is present in a tesla coil. After much research, I concluded that a conversion from CO2 to CO could be utilized to create syngas. According to efficiency tests of my electrolysis reactor, the device was able to produce roughly one liter of synthetic natural gas per minute. Finally, I found that through research that this mixture of Carbon Monoxide and Hydrogen could be utilized in its present state or be refined into pure natural gas through chemical processes. Overall I believe that this method of Carbon Dioxide capture and conversion to synthetic natural gas is a viable solution to the growing problem of rising CO2 levels.

**Summary Statement**

To create a complete and efficient system to capture and recycle atmospheric CO2 into a useful product for use as a fuel or refinement into industrial chemicals.

**Help Received**

Chemistry Teacher, Mr. Jones, provided classroom space to conduct the experiment

| Name(s) | Project Number |
|---|---|
| **Christina Y. Cho** | **S1105** |

**Project Title**

## Fresh Water Galore: Greywater Recycling II

**Abstract**

**Objectives/Goals**
The United States and many other countries are currently experiencing a fresh water shortage crisis. A major portion of this shortage crisis comes from excess use of water in homes. Most of the water used in homes comes from watering gardens and lawns. My objective was to find out whether greywater and green detergent are really efficient for plants. Another goal was to find out if it is effective to use food particles as fertilizer.

**Methods/Materials**
To test the efficiency of green detergent, I used grey water with conventional and green detergents. Furthermore, I constructed a home-made recycling system to recycle the sink water. I tested tap water, detergent sink water, recycled detergent sink water, green detergent sink water, and recycled green detergent sink water on ten plants on each type of water for 50 days.

**Results**
My results came out that the recycled green detergent sink water and recycled detergent sink water were very similar to the plants given tap water. Green Detergent Sink Water and Detergent sink water was also very similar to the results of the other two types. The detergent sink water plants placed last in average height compared to the other plants.

**Conclusions/Discussion**
My hypothesis was correct and greywater, recycled and non-recycled, with green detergent is efficient for plant growth. The conventional detergent sink water plants were surprisingly up to par with the other plants. Although the toxicity is higher in the conventional detergent, I concluded that both types of detergent can be used to water plants, but with the green detergent having a more progressive impact on the growth of plants. Economically, it would take 1.3 months for a household to profit if greywater recycling and homemade filtration system are used.

**Summary Statement**

I experimented with detergents to determine the environmental and economic efficiency of green detergents and greywater on plants.

**Help Received**

Father helped drill holes.

| Name(s) | Project Number |
|---|---|
| **Sydney F. Clark** | **S1106** |

**Project Title**

# Evaluation of Nitrogen and Phosphate Runoff from Residential Areas

**Abstract**

**Objectives/Goals**
Fertilizer contamination in runoff surface water is an important source of eutrophication and can have a number of negative environmental and economic impacts. Agricultural runoff is a major source of this contamination, but runoff from residential areas also may contribute. This study tests for nitrate and phosphate contamination in residential runoff water under real world conditions.

**Methods/Materials**
Several residential areas situated in canyons were identified. During or shortly after a rain storm, runoff water was collected from areas above, inteh middle of, adn below residential plots. Nitrate and phosphate levels were tested in the samples using a public health department laboratory.

**Results**
Nitrate and phosphates levels in the middle of and below the residential areas were significantly higher then levels from above the residential areas.

**Conclusions/Discussion**
These results demonstrate that residential areas are a source of nitrate and phosphate contamination in runoff water and hence contribute to eutrophication. This has implications for recommended residentila gardening paractices as well as possible regulatory implications.

**Summary Statement**

Testing for fertilizer contamination in residential water

**Help Received**

Monterey County Health Department assisted in sample testing, father drove me to collection sites

| Name(s) | Project Number |
|---|---|
| Ari Colton; Matan Kaminski | **S1107** |

**Project Title**

## Development of Algae as a Biofilter for Phosphate Reclamation

**Abstract**

**Objectives/Goals**
Phosphorus supply may become limited in the future. The world's food supply relies on a continuous supply of phosphate in the form of fertilizer. The purpose of this project is to see if the use of algae is a viable way to reclaim phosphorus and remove it from freshwater and in doing so prevent phosphorus from reaching the ocean where it is lost and can have a detrimental ecological impact.

**Methods/Materials**
Methods: Algae were cultured in a sterile environment, under illumination at 24&#9702;C. Cultures were maintained by media replenishment no less than once every week.
Experimental conditions were similar to culture conditions with varied concentrations of phosphates and nitrates at a density of 12g/L. Samples were removed for phosphate, nitrate, and/or weight analysis.
Materials: Algae were sourced from Caroline Biological, University of Texas Culture Collection, Petco. Alga-gro was the selected culture media.
Chemicals were sourced form chemical suppliers.

**Results**
Rates were calculated for the phosphate depletion by C. aegagropila at different starting concentrations of dissolved phosphate. It was calculated that the mean dissolved phosphate depletion at the lowest concentration of phosphate (mean $1.0 \pm 0.1$ mg/L) was $1.27 \pm 0.21$ x 10(-14) moles PO4/cell/hour. When the concentration of phosphate was increased to 5.3 mg/L the rate of depletion was $3.98 \pm 0.01$ x 10(-14) moles PO4/cell/hour. When the concentration of phosphate was increased to 9.8 mg/L the rate of depletion was $1.07 \pm 0.1$ x 10(-13) moles PO(4)/cell/hour. A scatter plot of phosphate concentration versus rate was created and approximated a curve showing a lag phase and an exponential component. A best fit curve revealed an equation of $y=7.66e^{0.2846x}$. Depletion rates for C. aegagropila were compared to alternative green algae species reported in the literature and found to be comparable.
A biomass evaluation demonstrated an increase of 53% over a two week period. During this study media was continually replenished every 48 hours to more closely model a continuous flow freshwater situation.

**Conclusions/Discussion**
These results support the hypothesis that if algae (specifically C. aegagropila) were to be incubated with phosphate under controlled conditions, the phosphate levels would gradually decline and the biomass of the algae will increase as the algae utilize the phosphate to grow. The results of this study support this hypothesis.

**Summary Statement**

The development of algae as a biofilter for phosphate reclamation and alleviation of excess runoff nutrients.

**Help Received**

Used lab equipment at the San Diego Jewish Academy high school under the supervision of our project advisor Dr. Jane Willoughby.

| Name(s) | Project Number |
|---|---|
| **Robert De Gregorio; Bill Nguyen** | **S1108** |

**Project Title**

## Assessing Absorption of Pb and Ni through the Phytoremediation of Cucumus sativus, Raphanus sativus, and Brassica alba

**Abstract**

**Objectives/Goals**
Unlike sifting and chemical purification, which respectively are too superficial and too costly for regular implementation, phytoremediation, the process by which plants vacuum heavy metals from soil, could viably put an end to heavy-metal deposits. So we tried to find a more inexpensive way to clean the soils with phytoremediation because impoverished areas of the globe not only lack the resources necessary to counter this accumulation but also would benefit most from such cleanup.

**Methods/Materials**
we have experimented with common, inexpensive plants known for their phytoremediative potential: cucumber, radish, and white mustard. After planting them in soil that we contaminated with 6 different heavy-metal concentrations#300 ppm Pb, 600 ppm Pb, 900 ppm Pb, 300 ppm Ni, 600 ppm Ni, and 900 ppm Ni#and allowing 4 weeks of growth, we removed the plants and dried them under heat lamps. We then took 0.6g of cucumber, 0.15g of radish, and 0.05g of mustard from each plot to soak in a diluted sulfuric-acid solution that broke down their fibers and removed the heavy metal. Using equal parts plant material and dithizone-chloroform solution as a heavy-metal indicator, we added enough sodium hydroxide to neutralize the acidic liquid so that the indicator, which is sensitive to basicity, would undergo a change in color. Afterward, we ran the samples through a spectrophotometer and compared their wavelengths and absorbencies to those of the standard solutions, ranging from 0.1 ppm to 10,000 ppm Pb or Ni, which we prepared prior.

**Results**
Our results suggest that, of the three types of plants, radish absorbs lead most readily, while white mustard best absorbs nickel.

**Conclusions/Discussion**
Although the United States might possess the resources to finance initiatives like Superfund, our findings could prove vital to the prosperity of third-world countries, where built-and-abandoned war bases and manufacturing plants have in many regions precluded rural cultivation. Planting radish or white mustard, then, would not only expand the agricultural opportunities of these marginalized nations but also serve as an affordable means of eliminating toxic heavy metals from the environment.

**Summary Statement**

Our project is trying to utilize plants to absorb common heavy metal contamination from soils around the world in a inexpensive manner.

**Help Received**

| Name(s) | Project Number |
|---|---|
| **Kayane K. Dingilian** | **S1109** |

**Project Title**

## The Manipulation of Soil Type and Height in Soil-Aquifer Treatment to Remove Nitrate and Hypochlorite from Wastewater

**Abstract**

**Objectives/Goals**
The objective of this experiment was to find the most efficient way of using Soil-Aquifer Treatment with different types of soils and different heights of soil columns to remove nitrate and hypochlorite from wastewater.

**Methods/Materials**
Materials used were NaOCl, KNO3, centrifuge, test tubes, distilled water, and chlorine and nitrate test kits. In order to represent nitrogen and chlorine, solutions of 200 parts per million (ppm) were created of nitrate ions ($NO_3^-$) and hypochlorite ions ($ClO^-$), respectively. These solutions were mixed with the adsorption medium # either sand, semi, or soil, and the effluent concentration of pollutant was measured using an indicator testing kit. The medium was rinsed with distilled water until the concentration of the pollutant in the effluent water reached 0 ppm.

**Results**
For nitrate, the sand, semi, and soil at 5.000 g took the same number of rinses for the concentration of the pollutant to reach 0. The behavior of nitrate in 7.500 g and 10.000 g semi and soil was very similar. For 7.500 g and 10.000 g soil, nitrate was adsorbed and did not desorb when rinsed. The hypochlorite remained adsorbed to all mediums for one more rinse than the nitrate. For the soil, the hypochlorite was adsorbed and did not desorb from the soil with successive rinses.

**Conclusions/Discussion**
It was found that hypochlorite adsorbed better than nitrate to all media, and that it adsorbed the best to soil. Nitrate, however, showed an increase in adsorption with a change from sand to soil. Also, the increase of bed height resulted in increased adsorption of the pollutant, usually by requiring an additional rinse in order for the effluent pollutant concentration to reach 0 ppm. These data can be used by scientists and engineers to formulate ideal parameters in soil-aquifer treatment as another step in purifying wastewater into water society can reuse.

**Summary Statement**

My project analyzed modifying soil type and bed height in the process of soil-aquifer treatment on how effictive it was in removing nitrate and hypochlorite from wastewater.

**Help Received**

Both Mr. Antrim and Father provided materials for the project.

**Name(s)**

Ailis C. Dooner

**Project Number**

# S1110

**Project Title**

## Endosymbiotic Sustainability: Effects of Ambient Nitrate and Phosphate on Zooxanthellae of Anthopleura elegantissima

**Abstract**

**Objectives/Goals**

This study evaluates the physiological effects of ambient phosphate and nitrate concentration in the aqueous environment on quantitative fluctuation of intracellular zooxanthellae of Anthopleura elegantissima (aggregating anemone), an essential mutualistic algal endosymbiont. Increased ionic concentrations of phosphates and nitrates simulate those imposed on the rocky intertidal, A. elegantissima's place of inhabitance, by human activity. Quantitative fluctuation in symbiont density is gauged utilizing hemocytometer quantification techniques.

**Methods/Materials**

Obtained 16 genetically identical specimens of Anthopleura elegantissima; analyzed longitudinal water quality reports of the Monterey Bay to determine ionic concentrations to which subjects were exposed. Tank A was exposed to increased synergistic phosphates and nitrates at concentrations of 0.36 ppm and 1.2 ppm, Tank B was exposed to heightened nitrates at a concentration of 1.2 ppm, Tank C was assigned as a control cohort, and Tank D was exposed to increased phosphates at 0.36 ppm. 1.25 cm tenticular samples were extracted every two days for ten day experimentation window and fluctuation in zooxanthellae population density was quantified in 160 homogenate aliquots using a hemocytometer counting technique.

**Results**

With synergistic exposure to 0.36 ppm phosphate and 1.2 ppm nitrate, zooxanthellae density (cells/mL tissue) declined by 0.000133, an overall 20.6% decrease. With heightened nitrate concentrations at 1.2 ppm, zooxanthellae density experienced a notable increase, climbing 0.005265 cells/mL tissue, a 1,238% gain from day 1 density. With no altered chemical composition, zooxanthellae concentration increased slightly by 0.00110 cells/mL tissue, a 159% increase. With increased exposure to phosphates at a concentration of 0.36 ppm, zooxanthellae density increased by 0.000815 cells per mL tissue, a 204% gain.

**Conclusions/Discussion**

Partially supportive of initial hypotheses, zooxanthellae density declined with exposure to synergistic nitrates and phosphates, increased with exposure to increased nitrates, slightly increased in control cohort, and increased with increased phosphates. Sufficient sample size and averaged double aliquot examination of all samples ensures statistical significance of results obtained.

**Summary Statement**

This study evaluates the physiological effects of ambient nitrate and phosphate on zooxanthellae, intracellular algal symbiont, of Anthopleura elegantissima (aggregating anemone).

**Help Received**

**Name(s)**

Yousef Joseph; Nick Mah

**Project Number**

# S1111

**Project Title**

## The Effect of Air Pollution on the Rate of Photosynthesis

### Abstract

**Objectives/Goals**

The objective is to study the effects of common airborne pollution on the wavelengths and luminosity of sunlight and its effect in photosynthesis on plants.

**Methods/Materials**

The experiment was performed with cuvettes containing DPIP, a chloroplast suspension, and a phosphate buffer. The cuvettes were then placed under the exposure of flood lights to stimulate photosynthesis. Then, we would measure the change in color of DPIP, which was being reduced through photosynethesis with a spectrophotometer. With the data, we would then check the overall rate of change with the other gas pollutants. The gas pollutants (nitrogen dioxide and sulfur dioxide) were prepared under a hood (except carbon dioxide) and collected through water displacement in square plastic bottles.

**Results**

Sulfur dioxide and carbon dioxide showed a detrimental effect on the rate of photosynthesis. However, nitrogen dioxide had a interesting effect on the rate of photosynthesis. It seemed to improve the rate of photosynthesis. Based on our results, we were able to infer that sulfur dioxide has a more deleterious effect on the rate of photosynthesis than carbon dioxide.

**Conclusions/Discussion**

In the data collected, we can conclude that sulfur dioxide and carbon dioxide had a harmful effect on the rate of photosynthesis. Nitrogen dioxide seemed to have a positive effect on the photosynthesis. We believe that these results are incorrect because nitrogen dioxide is a reddish-brown gas that alters the wavelengths of light. However, the gas we collected was clear leading us to believe that the gas collected was not nitrogen dioxide, but another gas that we have yet to identify.

**Summary Statement**

The purpose of our experiment was to test whether air pollution affected photosynthesis and if it did, to see how harmful the effects were.

**Help Received**

Mr. Garabedian allowed us the use of his equipment; Mrs. Mah helped with the layout of the board

| Name(s) | Project Number |
|---|---|
| **Aishvarya V. Korde** | **S1112** |

**Project Title**

## Analysis of the Effects of Bioremediation Using Glycerin and Acetate on Perchlorate Contaminated Water

**Abstract**

**Conclusions/Discussion**
Ever since its contaminations were discovered in ground water in 1997, perchlorate (ClO4-) has become a growing threat to inhabitants in the Western states of US. Most perchlorate contamination is found in ground water near industries which use explosives. If consumed at concentrations as low as 25ppb, perchlorate can be harmful to the thyroid and bone marrow. For this reason, immediate attention needs to be given to the remediation of perchlorate. But because perchlorate is highly soluble it travels quickly through the ground and remediation serves to be a challenge. Bioremediation which involves the use of naturally occurring microbes to reduce the perchlorate into chloride can be used to decontaminate perchlorate. With the use of acetate and glycerin as bioremediation promoting reducers, if favorable conditions consisting of a perchlorate degrading bacteria source and an anaerobic environment are given, the perchlorate concentration in the contaminated water will decrease. Acetate and glycerin are known to be effective reducers and are easily available and harmless. In order to test the hypothesis, two test groups were set up; three bottles containing contaminated water, soil, and acetate, and three other bottles containing contaminated water, soil, and glycerin. In order to determine the improvement in the results, two control groups were set up as well; three bottles with contaminated water and soil, and three bottles with contaminated water and acetate. The contaminated water was taken from groundwater near Beaumont and was known to have an initial concentration of 70 mg/L. The twelve samples were tested in an ion-chromatograph every two days after the fifth day of the experiment. The final sample was taken on the tenth day. The results proved the hypothesis true # with the favorable conditions, bioremediation took place, and acetate proved to be the more effective electron donor. After the seventh day of the experiment, no perchlorate was detected in the acetate bottles. The glycerin group experienced degradation, but at a slower rate, and the concentration did not reach zero, while the two control groups experienced no degradation. Bioremediation was most effective with the use of acetate because it proved to be the reducer with better reducing qualities.

**Summary Statement**

Perchlorate is a dangerous water contaminant found in most Western states, and bioremediation is being tested as a possible method to get rid of the perchlorate from ground water.

**Help Received**

Used lab equipment at UCR under the supervision of Dr. Matsumoto. Dad helped print poster. Teacher helped revise the report.

| Name(s) | Project Number |
|---|---|
| Nesha A. Larkin | **S1113** |

**Project Title**

## Map It Out: Pursuit of the Desert Tortoise

**Abstract**

**Objectives/Goals**
If aerial photos can be used to identify potential habitats of Desert Tortoises in a known location, then the habitats of Desert Tortoises in an unknown location can be identified using aerial photos.

**Methods/Materials**
Aerial Photos, marking tape, GPS, Google Earth, pedometer, compass, Magnetic Polycaster Protractor. Use aerial photos of a region where desert tortoises are known to live to identify likely desert tortoise habitats. Use aerial photos of a region where desert tortoises have not been known to live, and select ten areas that may be their possible habitats; five creosote, and five saltbush habitats. Visit the ten areas and mark a start point with marking tape. Walk forward 500m in a line using a pedometer to track the meters covered. Once the 500m mark is reached place another piece of marking tape and walk 10m to the right. Walk back and forth making trasects until there is a plot that is 500m by 50m. Measure the slope and aspect using a Magnetic Polycaster Protractor. Study each row for scat and burrows, and keep count of the number of plants to determine the dominant shrub in that area.

**Results**
Plot one had a creosote dominance ratio of 375:190. There were six burrows and three pieces of scat. Plot two had a saltbush dominance ratio of 410:250. There were no burrows or scat recorded here. Plot three had a creosote dominance ratio of 385:225. One burrow, but zero scat were recorded here. Plot four was a saltbush habitat with a dominance ratio of 470:200. No burrows or scat were found here. Plot 5 had a creosote dominance ratio of 361:215. However, there were no burrows or scat. Plot six had a saltbush dominance ratio of 413:180. There were no burrows or scat. Plot seven had a creosote dominance ratio of 382:175. There were no burrows recorded here, but there was one piece of scat. Plot eight had a saltbush dominance ratio of 419:280, and no burrows or scat were recorded. Plot nine had a creosote dominance ratio of 431:245. There were not any burrows or scat recorded. Plot ten had a saltbush dominance ratio of 381:250. There were no signs of desert tortoise burrows or scat.

**Conclusions/Discussion**
The data weakly supported the hypothesis. While three of the ten plots in the unknown region did have signs of desert tortoises, the remaining seven plots did not. Therefore using aerial photography to identify the possible habitats was only successful three-tenths of the time.

**Summary Statement**

Using aerial photography to identify possible desert tortoise habitats,

| Name(s) | Project Number |
|---|---|
| **Owen J. Lincoln** | **S1114** |

**Project Title**

## Are the Wetlands Working? The Effect the Goleta Wetlands Have on the Bacteria Levels in the Goleta Slough

**Abstract**

**Objectives/Goals**

My goal was to find out if the wetlands in the Goleta Slough had any kind of an impact on the amount of bacteria, specifically E. coli, and Total Coliform, found downstream from the wetlands at the mouth of the Goleta Slough.

**Methods/Materials**

I collected and then tested the stream water in the Goleta Slough 1,000 meters upstream from the mouth of the Goleta Slough, and at the mouth of the Goleta Slough, 1,000 meters upstream from the mouth of the Arroyo Burro Creek and at the mouth of the Arroyo Burro Creek where it runs into the ocean/beach. The Arroyo Burro Creek does not have an established wetlands area, where the Goleta Slough does have established wetlands. I collected a 100mL water sample using sterile bottle and gloves from each location. I took these samples to the Channel Keepers lab where I added a reagent to the water samples which enables the bacteria to grow. I then poured the water samples into IDEXX test trays where they incubated for 18 hours at 35 degrees Celsius. After the incubation time, the test trays were observed for change in color and for fluorescence under a black light and recorded my findings. I did this testing on five separate occasions over the course of three weeks.

**Results**

Four out of the five tests indicated that the bacteria levels of both E. coli and Total Coliform at the mouth of the Goleta Slough were lower than these bacteria levels 1,000 meters upstream. Four out of the five tests also indicated that the bacteria levels at the mouth of the Arroyo Burro Creek were higher than the bacteria levels 1,000 meters upstream. The fifth test showed bacteria levels at all locations being so high that there was no distinction between the mouths of the creek/slough and 1,000 meters upstream. This was most likely due to the rain fall of the day before the test.

**Conclusions/Discussion**

These results do support my hypothesis that the wetlands would filter out some of the bacteria as the water runs downstream to the ocean. The results also suggest that without a wetland area to filter the water, the bacteria levels do not drop and may actually become elevated, as was the case with the Arroyo Burro Creek water samples. This information obtained from my testing can be used to conduct further studies on what types of plants may be the best filters of bacteria, and support the argument for creek restoration, especially where the water runs directly into the ocean at public beaches.

**Summary Statement**

My project consisted of testing creek water to find out if the wetlands in the Goleta Slough acted as a filter to remove some of the bacteria from the water as it proceeded downstream to the ocean.

**Help Received**

I used lab equipment at Channel Keepers under the supervision of Penny Owens. Penny also gave me guidance on how to carry out the tests in a sterile manner. My Mom drove me to the testing sights.

| Name(s) | Project Number |
|---|---|
| **Raquel Mendoza Cabral** | **S1115** |

**Project Title**

## The Heat Is On: The Potential Effects of Predicted Rising Oceanic Temperatures

**Abstract**

**Objectives/Goals**

The marine plant Halimeda, a genus of calciferous green algae have important roles in marine ecosystems that range from producing sand to removing carbon dioxide from the water. My experiment is focused on how predicted oceanic temperatures would affect the growth of one species of Halimeda plant, by measuring parameters such as pH, salinity, dissolved oxygen, length, and mass. I hypothesize that increased will decrease dissolved oxygen, decrease pH, and increase salinity, and therefore result in a decrease in calcification and growth of Halimeda, as measured by mass and length.

**Methods/Materials**

#7 Halimeda plants
#6 Rubbermaid Containers (16Q, 15 lbs capacity)
#Distilled Water 18 gal +
#1 Thermometer (Range:-20&#730;c- 110&#730;c)
#6 Water heaters (Elite Radiant Water Heater 50w)
#1 Measuring Cup ( 2 cups capacity)
#Instant Ocean (15 lbs bag, 50 us gallons)
#1 pH meter (Pen Type pH meter. Range 00.1-14.0 pH)
#Dissolved Oxygen Kit (La Motte Dissolved Oxygen Code 5860)
#Refractometer (RHS-10ATC. Range: 0-100 ppt of Salinity.
#1 Ruler
#1 Food Scale
#1 bottle, Water Conditioner (Aqua Safe
Daily I measured the pH,temperature, and salinity. Four times a week I measured the DO and once a week I would measure each plants mass and length.

**Results**

The medium group experienced the most drastic change in percent change in mass, indicating that constantly changing water temperatures had the most affect in the changes of plant growth in the marine plant, Halimeda.

**Conclusions/Discussion**

Overall, the results did not entirely support my hypothesis. Instead my results indicated that fluctuating water temperatures have more profound effects on the growth and mass on the marine plant, Halimeda as opposed to increased water temperatures.

**Summary Statement**

My project is centered toward observing the possible effects of rising oceanic temperatures on the marine plant, Halimeda as a result of human activities that accelerate Global Warming and Global Climate Change.

**Help Received**

My mentor Breanna Harris, who is a graduate student at UCR helped me with proof reading my abstract as well as helping me find the equipment necessary for my project, such as the refractometer and the pH meter.

| Name(s) | Project Number |
|---|---|
| **Madison P. Meredith** | **S1116** |

**Project Title**

# An Assessment of the Environmental Health of the Water Quality of Success Lake in the Southern Sierra Nevada Mountains

**Abstract**

**Objectives/Goals**
Most often, the concern about water is 'quantity' or how much is available. However, an equally important concern should also be the 'quality' of this available water. Water quality can be determined by measuring parameters such as temperature, conductivity, pH, nitrate, phosphate and chloride. This study examines three questions on the water quality of Success Lake in Porterville, California: (a) how environmentally healthy is the quality of water in Success Lake? (b) has the environmental health of the water in Success Lake changed over time? and (c) do the three different tributaries affect the environmental health of the water in Success Lake?

**Methods/Materials**
Eight locations were sampled twice a week for three weeks during the months of February/March 2012 using a hand-held YSI Professional Plus multi-parameter instrument. The probe was kept at a depth of 1 meter or less (epilimnion level). Grab samples were taken from two site locations inside the lake and were tested for nitrate, phosphate, and chloride. The ARCGIS program was used to generate the maps for all sample sites located within each watershed.

**Results**
My data revealed an average temperature of 14.19ºC, conductivity between 91.2 and 228.2 μS/cm, and a pH range of 4.55 to 11.27. Grab samples collected from the lake did not detect any abnormal ranges of nitrate and phosphate, but both showed an above average level of chloride contamination. Compared to the US Army Corps of Engineers data from 2002, 2008, and 2011, the data revels that temperature, conductivity, and pH have increased. A correlation statistical analysis of the parameters relationship with temperature was conducted. Conductivity showed a relation, while pH showed no relation. Results can be observed.

**Conclusions/Discussion**
Water quality can be monitored accurately through the testing of temperature, conductivity, pH, nitrate, phosphate and chloride. Water quality monitoring should be kept not only in the lake itself, but also within the three tributaries leading into the lake. This study provides the foundation for an inferred water quality issue. Data from this test was compared to similar previous testing done by the USACE, showing the tested parameters have increased over time. Further research would be needed, not only testing the parameters listed already, but also things such as coliform and total bacteria, over a longer analysis time period.

**Summary Statement**

A study on the water quality of Success Lake in the Southern Sierra Nevada Mountains determined by physical parameters and their effects on the water now compared to past testing.

**Help Received**

Used field equipment from Tule Reservation, supervised by Kerri Vera; Used lab equipment from City of Porterville, supervised by Micheal Cotton.

| Name(s) | Project Number |
|---|---|
| **Corlin L. Palmer** | **S1117** |

**Project Title**

## Charcoal from Palm Waste

**Abstract**

**Objectives/Goals**
My objective was to efficiently produce charcoal from discarded palm waste that can perform well compared to other types of charcoal.

**Methods/Materials**
I designed a steel-based apparatus to more efficiently make charcoal out of palm tree droppings, which is done by burning with a restricted oxygen supply, crushing it into powder, mixing it with other ingredients, and pressing it into briquettes.

**Results**
The performance of the palm charcoal was very comparable to that of the commercial hardwood charcoal in every test, though undeniably a bit worse.

**Conclusions/Discussion**
Though not quite as good as its commercial rival, using palm waste for charcoal production could greatly reduce deforestation in the third world, improving lives with its cheap and easy production.

**Summary Statement**

By making charcoal out of the waste dropped by palm trees instead of hard woods, forests can be saved and lives can be improved.

**Help Received**

Mother helped with arranging and gluing the board

| Name(s) | **Project Number** |
|---|---|
| **Saiyeesh Rathish** | **S1118** |

**Project Title**

## eHarvesTree: An Energy Harvesting Robotic Tree with Analysis

### Abstract

**Objectives/Goals**

Currently in the United States less than 10% of our power is being produced by renewable sources. This is not only because research is still being done to increase their efficiency but also some of these systems are visually obtrusive. Not many people have solar panels or wind turbines around their house because it may not be aesthetically pleasing. But what if you could combine different forms of energy harvesting into an artificial tree? I decided to tackle this problem of visual appeal and functionality. My engineering goal was to create an aesthetically pleasing robotics tree (eHarvesTree) that looks life-like but is a fully functional showcase of renewable energy sources.

**Methods/Materials**

My eHarvesTree would be able to mimic the movements of a real tree to generate energy. I looked at various leaf structures and built two functional trees with different configurations. I experimented with multiple flexible solar panels and piezo-electric materials to build this tree. We can see the feasibility of a small scale design for everyday application. My methods include:
1. Observe tree movement to determine the mobility of the robotic tree
2. Test the amount of energy produced by one piezo-electric plate and one solar cell
3. Test out different ways in which the flexible solar panels and piezo electric generators can be arranged
4. Construct an artificial tree to demonstrate the concepts

**Results**

I have constructed two different eHarvesTrees based on different leaf structure and power generated. I used flexible solar panels as the primary energy harvesters and piezoelectric generators as the secondary energy harvester. I have provisions to use small hydroelectric generators and microbial fuel cells in this tree. Both of the trees can be used in a variety of applications including charging laptops, mobile phones, MP3 players and any 12-volt battery.

**Conclusions/Discussion**

Inspired by nature, and enhanced by technology, the eHarvesTree is a system for showcasing newer technology for energy harvesting or scavenging. In the current version, I have used both flexible solar panels and piezoelectric generators. I have made provisions to include both small hydroelectric generators and microbial fuel cells. I see applications for such trees in the parks, homes, streets and almost everywhere. In the future I hope to continue my research and experiment with other energy harvesting techniques.

**Summary Statement**

My creation, the eHarvesTree is an aesthetically pleasing robotics tree that not only looks life-like but is also a fully functional showcase of several renewable energy sources.

**Help Received**

| Name(s) | Project Number |
|---|---|
| **Nathaniel B. Tweed** | **S1119** |

**Project Title**
## Oily Polymers

**Abstract**

**Objectives/Goals**
The goal of this experiment is to find a way to separate oil from cross-linked polymers that is more environmentally safe.

**Methods/Materials**
I used oil that is similar to light crude oil and saturated the cross-linked polymers. I then used several different solvents, such as: denatured alcohol, acetone, paint thinner, lacquer thinner, etc, to try to separate the oil from the cross-linked polymers.

**Results**
After using the solvents, I found that denatured alcohol is the one solvent that separated the oil from the cross-linked polymer. Also some of the other solvents were hydrocarbons, so that is why they did not separate the oil from the cross-linked polymers.

**Conclusions/Discussion**
When cross-linked polymers are used to clean up an oil spill in a body of water the method of disposal is to burn the cross-linked polymers along with the oil. My conclusion is that denatured alcohol is a solution to separate oil from cross-linked polymers. This oil can be recycled and you can also distill the denatured alcohol and use it again. This is more environmentally safe than the previous method.

**Summary Statement**
I am finding a way to separate oil from cross-linked polymers that is more environmentally safe.

**Help Received**
Mrs. Reed help with lab

| Name(s) | Project Number |
|---|---|
| Gopal K. Vashishtha | **S1120** |

**Project Title**

# The Effect of Nano-scale Zinc Oxide on the Filtration Rate of Membrane Biological Reactors in Wastewater Treatment

**Abstract**

**Objectives/Goals**
The objective of this project was to prove that a correlation exists between the presence of manufactured nanoparticles in wastewater influent and membrane fouling in Membrane Biological Reactors (MBRs).

**Methods/Materials**
Polypropylene membranes with a nominal pore size of 200 nm were used for all runs. Three types of manufactured zinc oxide particles (termed ZnO-A, ZnO-B, and ZnO-C) were used in the experiment. Deionized water, tap water, and secondary effluent wastewater were filtered at a pressure of 12.5 in/Hg with nanoparticle concentrations of 2 mg/L. MBR effluent was weighed in grams every 3/7 second by a computer, and a zetasizer was used to analyze particle size distributions.

**Results**
There was no significant change in the flux of deionized water or secondary effluent wastewater with the addition of zinc oxide nanoparticles. When added to tap water, ZnO-A and ZnO-C both resulted in flux that was 20% below that of tap water. The addition of ZnO-B resulted in the mitigation of some of the fouling effects of tap water and at some points, flux was 20% above that of tap water.

**Conclusions/Discussion**
My hypothesis was proven to be mostly incorrect. Although I was correct in inferring that ZnO-A's relatively small particle size would clog the membrane, resulting in a flux decrease, I incorrectly concluded that ZnO-B and ZnO-C would both consistently result in flux decreases. ZnO-C yielded inconsistent results, with a tendency to reduce flux in tap water. ZnO-B, however, reduced fouling. This result, in conjunction with zetasizer analyses showing that smaller ZnO-B particles remained behind after filtration, may indicate that, while ZnO-B particles were small enough passing through membrane pores, they aggregated with other particles in doing so, reducing the number of particles capable of fouling the membrane. These data show that MBR yields in wastewater treatment might be significantly improved through the utilization of pretreatment to remove manufactured nanoparticles in wastewater influent prior to filtration.

**Summary Statement**

This project is about the effect of manufactured nanoparticles on microfiltration membranes in wastewater treatment.

**Help Received**

Used lab equipment at Professor Diego Rosso's Environmental Process Laboratory at the University of California, Irvine under the supervision of Joshua Smeraldi

**Name(s)**

Holly J. Zhou

**Project Number**

# S1121

**Project Title**

## The Effect of Fire on Hydrolytic Enzyme Activity in the Grassland/Shrubland Ecosystem: A Fluorometric Analysis

### Abstract

**Objectives/Goals**

The purpose of this project is to use fluorimetric assay analysis to determine the activity levels of CBH, BG, BX, AG, NAG, LAP, and AP four years after the 2007 Santiago Fire. If fire results in a long-term negative effect on enzyme activity, precautionary measures could be taken before carrying out prescribed burns and in creating ecosystem models.

**Methods/Materials**

Soil samples were gathered from Irvine Ranch (four samples from the burn site and four samples from the control site). I assayed for soil pH, soil moisture, and hyphal lengths in each sample. Fluorimetric analysis with fluorescent dye conjugated substrates and the addition of NaOH was then used to determine the activity levels of hydrolytic soil enzymes. Fluorescence was then converted into activity (nmol/gh).

**Results**

The wildfire did not seem to have a significant effect on enzyme activity ($P > 0.05$), but in the burn site, CBH, BX, AG, AP, and NAG had lower average activity levels than the control site. BG, however, had activity levels similar to those of the control site. This is coupled by lower NAG activity, which degrades chitin, a compound that makes up fungal cell walls.

**Conclusions/Discussion**

CBH, BX, and AG play an important role in C cycling, and a decrease in their activity could reflect a decline in fungal and bacterial abundance. Reduced AP activity may reflect a decline in P availability, which could be because of lower P mineralization. Decreased enzymatic activity may be associated with decreased soil $CO_2$ emissions, causing a negative feedback to climate warming.

**Summary Statement**

My project focuses on analyzing hydrolytic enzyme activity after a wildfire in the grassland/shrubland ecosystem using fluorometric analysis.

**Help Received**

Used lab equipment at UCI under the supervision of Dr. Treseder

| Name(s) | Project Number |
|---|---|
| **Gabriel J. Guerra** | **S1199** |

**Project Title**

**Dude, There's Still a Garden on Your Roof!  A Second Year Study on Rooftop Gardens and Their Effects**

**Abstract**

**Objectives/Goals**
I believe that using a rooftop garden on top of a household will keep ambient and internal temperatures close to or below daily temperatures- due to the soil medium, moisture, and vegetation- as opposed to the temperatures of conventional dark tile roofs found on households.

**Methods/Materials**
A scale one cubic foot section of a flat roof is to be constructed in order to create a sample model for the changes in temperature. A rooftop garden's membrane, soil, and vegetation are to be incorporated into the model. A scale one cubic foot section of a typical gable roof is to be constructed in the same matter but should reflect the 4/12" slope of a roof and use shingles. The tests should be taken to reflect the internal temperature of both models when testing and also the ambient temperature above the models. They should be taken with a temperature probe and a graphing calculator and recorded.
Materials:
2" x 4" x 8" Boards, Saw, 3" Nails, Hammer, Hot Glue Gun, Scissors, Graphing Calculator, (3) 1 sq. ft. Stone Tile, 2" x 12" x 24" Air Filter, Cardboard, Composite Tile Shingles, Soil & Vegetation, Temperature Probe

**Results**
The results of the tests show that the incorporation of rooftop gardens do actually help in reducing temperatures or keeping them at a moderate temperature. When testing on cloudless days in direct sunlight, the model with the rooftop garden increased and also decreased slightly in temperature. The results were about 0-3 °F above or even below the temperature for the hour. When testing on cloudless sunny days, the model with the composite rooftop increased greatly in temperature. The results were about 0-9 °F above the temperature of the hour.

**Conclusions/Discussion**
By using rooftop gardens, temperatures are affected in a positive way as the temperature decreases within individual households as well as the overall temperature locally due to the decreased ambient temperature. The tests showed that temperatures are closer to the daily temperature when using rooftop gardens on the tops of houses as opposed to conventional composite rooftop houses.

**Summary Statement**

The objective is to determine how houses with rooftop gardens can be modernized to incorporate additional green practices in addition to the lowering of temperatures in order to implement a lessened impact on the environment.

**Help Received**

Mother took temperature tests