Name(s)

Jillian Ames; Lauren Friend; Elizabeth Reid-Weinscoat

Project Title

Is the River Doing Its Job?

Abstract

Objectives/Goals
Our objective is to monitor the water quality of the San Lorenzo River in Felton specifically levels of nitrate, turbidity and dissolved oxygen in addition to water velocity and temperature. Our hypothesis is that the river will maintain acceptable levels of these factors, but naturally fluctuate due to rainfall and human impacts.

Methods/Materials
In the field, we use a Vernier Lab Pro, graphing calculator and assorted probes to measure our parameters. We are comparing two sites along the river, Henry Cowell State Park entrance and the Felton Covered Bridge. At our two sites (every Sunday at 8 AM from Nov 07 to Feb 08), we collected our water sample, made observations, calibrated our equipment and performed water testing procedures.

Results
We have found all of our results to be in the healthy range.

Conclusions/Discussion
We are currently analyzing our results to correlate rainfall data and the interaction of each factor.

Summary Statement

By exploring two sites along the San Lorenzo River, we observed whether the difference in location had an affect on the correlation of water quality between the two sites.

Help Received

Environmental Science Teacher Jane Orbuch as advisor; Mentor Chris Berry offered comparision of results; Statistics teacher Kim Armstrong helped analyze results

Name(s)

Logan Brabham; Erica Fine; Michael Laity

Project Number

S0902

Project Title

The Potential for Vegetable Oil Based Fuels as a Substitute for Diesel

Abstract

Objectives/Goals

This research explores the potential for vegetable oil based fuels as substitutes for diesel. Increased oil prices and environmental concerns have focussed attention on alternative fuels. Our project hypothesis is that the use of waste vegetable oil (WVO), virgin vegetable oil (VO) and Bio-Diesel made from vegetable oils are all viable alternatives to using petroleum based diesel fuel.

Methods/Materials

To reach our conclusions, the research addressed the trade-offs in emissions, performance and economics of running vegetable oil based fuels in cars as compared to diesel. In addition, emissions data was collected for eight randomly selected gasoline cars to understand the emissions from gasoline. The economics of using corn derived ethanol (E-85) was also included in this study although the team did not conduct any emission testing on this bio-fuel. A 1987 Mercedes Benz 300 Turbo Diesel was converted by Lovecraft Bio-Fuels to run on vegetable oil. The conversion requires specialized pumps, filters and heat exchangers to accommodate the higher viscosity fuel. In addition, the vehicle was outfitted with a secondary test tank to accurately measure fuel consumption. Testing was conducted on a fixed course of 11.4 miles. The vehicle was driven in a controlled manner replicating each run with a variation of only 2-3% between tests. The amount of fuel consumed was measured in grams and converted to gallons.

Results

The results support our hypothesis that vegetable oil as a viable fuel source. The emission of carbon monoxide for diesel engines was lower than the typical gasoline car. Nitrous Oxides, however, appear to run 4-6 times higher than gasoline, an issue that can be corrected if pollution control equipment were to be installed on diesel cars. WVO appears to produce 17.5% lower NO emissions than diesel fuel. The fact that the CO2 emissions from vegetable oil fuels are re-cycled by plants means the environmental impact is significantly lower than petroleum fuels which release new carbon into the atmosphere.

Conclusions/Discussion

WVO, which requires no special processing,is the most environmentally favorable. In terms of economics, WVO fuel is considerably cheaper at a $0.02 per mile in cost versus Diesel at $0.12 per mile. Bio-Diesel ($0.15/mile) and gasoline ($0.17/mile) were considerably higher. Ethanol came in at $0.25 per mile undermining its potential as a viable substitute for gasoline.

Summary Statement

Our project studies the potential for vegetable oil based fuels as substitute for diesel to meet the combined goals of reducing fuel cost, lessening dependence on foreign oil and decreasing carbon dioxide emmissons.

Help Received

High School teacher Marta Wood provided guidance on our scientific process. Lovecraft Biofuels assisted with the retrofit of the 1987 Mercedes. Lunada Bay Automotive provided emissions testing. Parents provided advice and logistical help.

Name(s)	Project Number
Wilder Bunke; Han Kim; Karl Marrett	**S0903**

Project Title

When Growing Orange Goes Green

Abstract

Objectives/Goals

We tested to see which street trees are most effective in removing atmospherical carbon dioxide and the pollutant ozone, testing the broad spectrum of Palm, Pine, and Oak. We also wanted to know the environmental benefits of orange groves, the extent of their decreasement over time, and ultimately the carbon value of a grove.

Methods/Materials

For the core of our data, we used a Gas Exchange System created by Licor. This gave us conductance and photosynthetic rates which we used for our wintertime data (for orange we used a diurnal curve) and used cited summertime data for each species. We then found the leaf area from each species used a planimeter to trace the leaves out, then estimated leaves per tree. We also experimented with a program called STRATUM but we disregarded these numbers for various reasons. For orange, in particular we used three aerial photographs of Redlands to trace out the areas of orange groves within city limits. Afterwards, we traced these areas with a planimeter then scaled from ground counts to find the approximate amount of trees in Redlands during those three years.

Results

Due to its high ozone uptake and decent sequestration Oak is the best overall tree species of the ones we tested. Pine does have the highest carbon dioxide but due to its low conductance had weak uptake of ozone. Palm had low leaf area and was a poor street tree Orange did decently in both areas we tested.

Having one metric ton averaging twenty dollars, in 1959, when there were 3,357,760 orange trees within the city limits of Redlands, which would have brought in roughly $100,733 in carbon credits for the city. In 2005, there were 959,056 trees, which diminished the revenue from annual carbon sequestration to $28,771.

Conclusions/Discussion

While Oak trees may be best as an overall subjects such as maintenance, water usage, and VOC emission of the species should be taken into account for.

Orange groves, which are environmentally and economically beneficial, are decreasing rapidly. In order to slow, stop, and hopefully even re-inflate these grove areas, Jon Harrison (the mayor of Redlands), using our new data of orange grove carbon credits, is hoping to discourage this disappearance of these precious groves by getting carbon credits for them as well as enforcing mitigation for the carbon sequestration lost when a grove is destroyed for infrastructure.

Summary Statement

On a botanical basis, what are simple ways for a city to improve atmospherical benefits.

Help Received

Nancy Grulke taught and supervised use of the gas exchange system and introduced the program STRATUM as well as answered miscellaneous questions related to our project. Jon Harrison provided us with aerial photographs. Eric Bunke provided and supervised use of the planimeter. Finally, Kelaine

Name(s)	Project Number
Anna A. Chen	**S0904**

Project Title

Efficacy of Insolation Conversion of Alternative Energy Sources

Abstract

Objectives/Goals

Renewable, alternative energy sources such as photovoltaic and crop biomass (ethanol and biodiesel) are essentially solar energy conversion. If the efficacy of insolation conversion is modelled and calculated, then modern photovoltaic technology will prove to be more effective than any of the crop biomass sources.

Methods/Materials

This research is from a scientific point of view and does not consider the economics of building the production infrastructure, thus providing a theoretical upper limit of solar energy conversion efficiency by which to compare the long-term potential of each alternative. A model was constructed for each alternative for calculation, and data on the energy used and produced by each of the specific alternative energy sources was researched for input into the model.

Results

The results prove the hypothesis that photovoltaic technology is the most efficient for solar energy conversion at 15% to 20% for conventional solar cells. Sugarcane ethanol is a distant second at 0.183% followed by corn ethanol at 0.118% and soybean biodiesel at 0.0267%.

Conclusions/Discussion

This means that the land area for a photovoltaic farm is more than 100 times smaller than that required for a biomass farm to produce the same amount of energy. Not only is the land area smaller, but it also does not have to be arable or irrigated thereby promising a future that does not force us to choose between food and energy. Additional research and calculations indicate that photovoltaic farm area the size of California is sufficient to supply all the global annual energy demand.

Summary Statement

Solar energy conversion efficiency is modelled for biomass conversion to ethanol and biodiesel and compared with conventional photovoltaics.

Help Received

Father helped find scientific periodicals.

Name(s) Monica L. Chen	Project Number **S0905**

Project Title
Optimum Sodium Phosphate Concentration for Oil Bioremediation

Abstract

Objectives/Goals
This project was designed to identify the concentration of sodium phosphate tribasic at which oil-degrading bacteria would most effectively remediate oil-contaminated water. By pinpointing this concentration, biostimulation of oil-degrading bacteria can be maximized using a preset level of nutrients which can enhance microorganisms digestion of hydrocarbons. Oil spills, ubiquitous catastrophes in recent times, can be handled cost-efficiently using this method, without the production of toxic byproducts.

Methods/Materials
Six containers were filled with a constant amount of water, oil, and oil-degrading microbe suspension. Then, varying amounts of Na_3PO_4 were added to the containers, starting from 0ppm in the control and thereon increasing by increments of 500ppm until the highest dosage, 2500ppm, was applied to the last container. Every 4 days, starting from Day 2, samples were taken to a laboratory for analysis of remaining hydrocarbon.

Results
Laboratory analysis revealed that the container with 2500ppm of Na_3PO_4 had the least amount of hydrocarbons remaining. Other containers also presented substantial evidence that Na_3PO_4 can boost the performance of the bacteria, speeding up oil degradation. Some anomalies were present in the data, so scatter plots with trend lines were created to show the relative rate of hydrocarbon loss.

Conclusions/Discussion
The remaining amount of hydrocarbons in the containers implied that the higher the Na_3PO_4 concentration (less than 2500ppm), the higher the amount of hydrocarbons degraded. During the conditions that prevailed in this experiment, 2500ppm of Na_3PO_4 was found to be the optimum concentration necessary for the degradation of oil in water by certain bacteria.

Summary Statement

Various concentration of sodium phosphate were applied to containers holding an inoculum of oil-remediating bacteria and oil to find the concentration at which the most amount of oil degradation occurs.

Help Received

Mom bought supplies and drove me around and delivered samples; Mr. Carr introduced me to several experts and allowed me to use his lab to execute my experiment; samples analyzed at Associated Labs; Dr. Faad Hashemi helped with project design; Mr. Starodub guided in research process

Name(s)	Project Number
Timothy D. Chen	**S0906**

Project Title

The Effectiveness of Water Purification Systems on Decreasing Ion Concentration and the Level of Microorganisms

Abstract

Objectives/Goals
The purpose of my project was to determine the efficiency of carbon, ceramic, reverse osmosis, and ultraviolet purification systems of water. Their performances were determined by their effectiveness of filtering ions and bacteria.

Methods/Materials
Filtration: Tap water control, ultraviolet, carbon, and reverse osmosis, were repeated four times, 30 mL of tap water poured into one cup unless stated otherwise. The Hanna Instruments TDS meter was used to measure the total dissolved solids, in parts per million, of the trial. Ceramic had 1 Liter of tap water was poured and tested.
Micro-organisms Growth
Agar Plates: Repeated 24 times for each system to be plated onto 5 agar plates.Water was plated by syringe onto plate.
Aerobic Agar Films: Repeated 19 times for each system to be plated onto 4 agar films.Water was plated by syringe onto film.
Incubating the Agar:The agar & agar films were incubated and removed after 36 hours.

Results
Reverse osmosis filtration system removed 199 ppm, 93.77%, of the water#s ions.Ceramic processed water filtered out -186 ppm, -87.69% of the hydrated ions.The ceramic filtered plates had an average of 157 colonies per sq centimeter an average deviation of 32.2 colonies per sq centimeter.There was bacterial overgrowth in the trials shown-there were too many colonies to count.Ultraviolet Radiation filtered out an average of 2 ppm. Carbon Filtration filtered out an average of 22 ppm. For the bacterial growth in the agar plates and films: reverse osmosis, ultraviolet, and carbon had no growth in the agar plates or films.

Conclusions/Discussion
Osmosis was the most effective purification system, because of the semi-permeable membrane's indiscriminate filtration. Carbon#s lackluster performance was probably a result of an obstructed, overused carbon filter. Ultraviolet#s lack of filtration was expected; radiation does not filter. Ceramic must have added its own TDS by fragments of ceramics or silicon shells and added its own bacteria-despite the nano-silver impediment.

Summary Statement

Which Purification System best filters water available to urban America.

Help Received

Mother assisted in procuring experiment's materials, Dr. Cheng lent the incubator.

Name(s)	Project Number
Nick K. Davis	**S0907**

Project Title

The Advantage of Evolutionary Democracy: How Microorganisms Could Save Man's World

Abstract

Objectives/Goals
The objective of this experiment is to identify which, if any, inorganic nutrient can be added to the environment of naturally occurring petrophilic (oil-degrading) microbes (namely a fungal strain, Penicillium; and a bacterial strain, Pseudomonas) in order to induce an increase in the rate at which oil spills in the ocean can be efficiently cleaned up.

Methods/Materials
Methods undergone during experiment include: 1) growing bacterial/fungal cultures; 2) introducing a set volume of oil and one of seven inorganic variables into an erlenmyer flask isolated for each strain; 3) allowing each separate experimental setup rest under simulated conditions characteristic of the ocean surface (i.e. artificial light source providing visible light spectrum, orbital shaker to simulate wave motion) for three days, after which a light spectroscopy was conducted on each flask in order to assay the relative rate at which oil was degraded; and finally, 4) comparing the light spectroscopy readings between variables against 10 controls to conclude best "accelerator."

Results
After a three day period of inorganic nutrient present in the oil slick environment of these naturally occurring oil-degrading microbial populations, urea yielded the highest average percent increase in transmission of 49 percent.

Conclusions/Discussion
The fact that urea (a compound often seen in biology as the excretory compound of nitrogenous waste from the hydrolysis of proteins) yielded the greatest increase in average percent transmission may offer greater insight into the metabolism of these petrophilic microbes, which is ultimately a scientific goal of this experiment. The results not only support my hypothesis that an inorganic nutrient bearing a relatively high percent of fixed nitrogen would act as the greatest accelerating compound, but also provoke intrigue regarding the use of microorganisms for the bioremediation of oil spills in order to preserve the photosynthetic activity of the euphotic zone and fragile marine ecological systems in environmental control.

Summary Statement

Accelerating the rate of oil spill bioremediation via the introduction of inorganic nutrients to the environment of oleophilic microbial populations.

Help Received

Use of lab equipment under supervision of Wayne Garabedian, biology teacher at Clovis West High School. (Note: complete experiment conducted in a high school laboratory).

Ap2/08

Name(s)	Project Number
Fatema Fakhreddine; Jane Kim; Joyce Lin	**S0908**

Project Title

Urban Eutrophication: A Field Study of Increasing Concentrations of Nitrates

Abstract

Objectives/Goals

The purpose of this experiment was to analyze the effects of nitrate as a cause of eutrophication, specifically in the wetlands of Hidden Valley Wildlife Preserve, and to compare the resulting data from year 2006 with those from year 2007. The hypothesis stated that if the duckweed infestation at the Hidden Valley Education Pond is triggered by eutrophication, then the nitrate concentration from year 2007 should be greater than that from year 2006.

Methods/Materials

Part of the process was collecting water samples from the Education Pond at Hidden Valley Wildlife Preserve. These samples were then taken to the Riverside Regional Water Quality Treatment Plant, where they were placed into an ion chromatograph and tested for nitrate concentrations. This procedure was repeated once a month for two months, in order to obtain more accurate results. The data was recorded and analyzed.

Results

The amounts of nitrates in parts per million (mg/L) for the year 2007 were significantly greater than the amounts for the year 2006. The nitrate levels in 2006 were 12.49 mg/L and 6.05 mg/L, while the nitrate levels in 2007 were 19.26 mg/L and 19.99 mg/L.

Conclusions/Discussion

The nitrate concentrations in year 2007 were significantly higher than those recorded in year 2006, which most likely caused the mass production of duckweed at the Education Pond of Hidden Valley Wildlife Preserve. The main cause of eutrophication is known to be the continuous supply of nitrates into bodies of water. The data from this experiment proves the hypothesis correct. Analysis of the results from years 2006 and 2007 reveals that there is a correlation between nitrate concentrations and eutrophication.

Summary Statement

The purpose of this experiment was to analyze the effects of nitrate as a cause of eutrophication, specifically in the wetlands of Hidden Valley Wildlife Preserve, and to compare the resulting data from year 2006 with those from year 2007.

Help Received

The Riverside Regional Water Quality Treatment Plant tested our samples for nitrates with their ion chromatograph machine.

Ap2/08

Name(s)	Project Number
Joshua J. Kim	**S0909**

Project Title

Water Quality Impairment of Upper Newport Bay: What Impact Water Quality at the Santa Ana Delhi Channel?

Abstract

Objectives/Goals
Upper Newport Bay is an important natural reserve but unfortunately the Bay is threatened by numerous sources of pollutant loading by tributaries of its watershed. Santa Ana Delhi Channel is a main input of urban runoff into Bay, so that fecal indicator bacteria (FIB) concentrations in the Bay are thought to be forced by dry weather and storm water runoff from the Channel. Three investigative questions were identified. What are the dominant seasonal variations of water quality? What are the environmental factors contributing to water quality? What are the possible major sources of water pollution?

Methods/Materials
To get scientific answers for the questions, two hypotheses were made, one is fecal pollution in the Bay could be forced by dry weather and storm water runoff from the Channel and the other one is sediment would be a source of fecal pollution to the Bay in addition to runoff input. Materials and equipments used are sampling bottles, ropes, ice chest, temperature gun, UV lamp, bacteria incubator, pH meter, salinity meter, Colilert, Enterolert, quanti tray 100, and phosphate buffer solution. Field grab samples were collected at the Channel for total 19 times, 10 samples during dry season and 9 samples during wet season. Samples were analyzed for escherichia coli (EC) and enterococci bacteria (ENT).

Results
For the surface water samples, FIB concentration was higher in the dry season than in the wet season. Also, FIB concentration was higher in the dry season than in the wet season for the sediments samples. EC bacteria concentrations measured in the surface water samples exhibit high correlation with salinity but low correlation with sediment. ENT bacteria concentrations measured in the surface water samples exhibit high correlation with ENT bacteria in the sediment samples.

Conclusions/Discussion
Based on the data analyses and discussions with year-long data, the following conclusions were made. EC in the water has bigger impact by Salinity and smaller impact by sediment and rainfall. EC in the water is more sensitive by sea water intrusion. ENT in the water has higher impact by sediment but less impact by Salinity and rainfall. ENT in the water is more sensitive by sediment suspension. EC in the water gets bigger impact by sea water intrusion and ENT in the water gets bigger impact by sediment. The conclusions agree with my basic hypotheses and proved that my initial hypotheses were correct.

Summary Statement

To find out what are dominant variations, environmental factors, and major sources of pollution for water quality at the Santa Ana Delhi Channel which leads to Upper Newport Bay.

Help Received

Dr. Ahn guided me for sampling and laboratory analysis work and Dad helped me for data discussion and make conclusion.

Name(s)	Project Number
Jason Lin; Daniel Nguyen	**S0910**

Project Title

An Ethanol World Economy? A Comparison of the Financial Viability of Ethanol Production from Grass vs. Woodchips

Abstract

Objectives/Goals
The purpose of this experiment was to produce ethanol from green garbage, in this case, grass and wood and calculate the amount of ethanol yield from each substrate, otherwise known as biomass. After the amount of ethanol yield was calculated, prices were estimated to compare with present day gasoline cost to see if using ethanol would be more inexpensive and environmentally efficient. If ethanol can be produced from garbage containing cellulose, then the U.S. can stop importing fuel, stop using petroleum and fossil fuels as a main source of fuel, and start using biofuels such as ethanol as a new source of recyclable fuel.

Methods/Materials
In this experiment, grass and wood were the variables as their sugar content (glucan and xylose are main sugars) is unknown. Wheat straw and sugar bagasse were the constants as they were used as the standard reference materials (SRS) and their sugar content is known. The standard reference materials were developed be the National Institute of Standards and Technology. After the completion of the hydrolysis, drying, filtering, gathering weight data, and neutralization of each substrate, the samples were analyzed by a HPLC system, which analyzes the sugar content in each sample. Grass and wood could be compared against wheat straw and sugar bagasse.

Results
Carbohydrates such as glucan, xylan, arbinose, and cellubiose are the main sugars in grass and wood. Grass and wood can be produced into ethanol through many steps. The hypothesis for this experiment was both correct and incorrect. Because garbage with carbohydrates, especially sugars, can be produced into ethanol, the U.S. has the choice of stopping importing fuels from foreign countries and become independent on terms of fuel however, although ethanol can be used as a new source of fuel, there must also be ways to advertise and to convince the community to use ethanol fuel instead of gasoline.

Conclusions/Discussion
If this experiment were to be done again in the future, the start of the experiment would be sooner in the year because of the lengthy time it takes for each step in producing ethanol; also, have more of each sample to have a better average when collecting data in case some are inadequate; in addition, other substrates such as cardboard, paper, and other waste materials could be used.

Summary Statement
We compared the pros and cons between ethanol and petroleum fuels and the amounts of sugars yielded by grass and wood.

Help Received
Used Lab Equipment At UCR Bournes College of Engineering under supervision of graduate Vu Nguyen working for Bin Yang.

Name(s)
Francesca McClintic; Janel Raab; Sarah Roberts

Project Number

S0911

Project Title
Corn, Cornstalk, Bamboo, or Sugar Cane?

Abstract

Objectives/Goals
Title & Purpose of Exhibit: Corn, Cornstalk, Bamboo, or Sugar Cane?
 The theme of this exhibit is ethanol production using different materials. Ethanol is alcohol that is produced from sugars by the process of fermentation. This experiment is to explore more options in the materials used in this process other than corn. Using corn to produce ethanol is economically unrealistic; it takes more energy to produce the ethanol than the amount collected. This experiment will compare bamboo and cornstalk to the corn and sugar cane. The outcome can then be used find a better and more realistic alternative to replace the use of petroleum.
Hypothesis: If corn, cornstalk, green and dry bamboo, and sugar cane are used to produce ethanol, then the amount of ethanol produced will be the highest for sugar cane, then cornstalk, then corn kernel, then green bamboo, then dry bamboo will be the lowest.

Methods/Materials
Experimental Design: Collect the materials need to get 500mL of grinded malt. Grind each material down using various methods. Divide into to cups of 250mL and boil for 30 minutes. Then put it in a plastic container and add water so that it rises to 2Ls. Add ½ a teaspoon and set a side to ferment for more than five days. After fermentation is done, open the brew and measure alcohol level using a vinometer.

Results
Results: Corn kernel produced an average of 90mLs of alcohol, and sugar cane produced an average of 240mLs of alcohol. Cornstalk had an average of 95mLs of alcohol, green bamboo had an average of 80mLs of alcohol, and dry bamboo had an average of 40mLs of alcohol.

Conclusions/Discussion
Conclusion: In conclusion, though our hypothesis was correct, this experiment provided data that shows that there are other materials that produce more alcohol than corn kernel, such as cornstalk. Cornstalk is not a profitable material, so if used to make into ethanol it will not affect the economy. Also it shows that bamboo can also be used which is a realistic material because it is like grass, in that is grows fast and is a non-profitable.

Summary Statement
Our project purpose is to find a more efficient way to produce ethanol from plant materials rather than corn kernel.

Help Received
mother helped proofread report, fathers provided materials and supervision, a wine maker provided measuring tools.

Name(s)	Project Number
Sambavi Ramakrishnan	**S0912**

Project Title

Alternative Method for Absorption of Oil Spills

Abstract

Objectives/Goals
To find an alternative method for absorption of oil spills

Summary Statement
to find an alternative method for absorption of oil spills

Help Received

Name(s)	Project Number
Madison J. Russell	**S0913**

Project Title

Determining How Liquid Pollutants Travel through Different Soils

Abstract

Objectives/Goals
My project was to determine how quickly different pollutants would travel through different soils

Methods/Materials
I Collected Clay Loam, Sand, and backyard Soil (a mixture of clay and sand). I then compacted the soils into 45inch rain gutters. 3 for each soil. These were then placed at a 20 degree angle. I placed a measuring cup at the low end of the 20 degree slope.
I then poured two cups of pollutants into the soils. The pollutants I used were: paint, motor oil, and Dawn Dish Soap. I poured a different pollutant into each soil type. 3 rain gutters for clay - 1 for motor oil, 1 for paint, and 1 for Soapy water. Repeat for each soil type.
I then recorded the daily amount of liquid that passed through the soil into a measuring cup.
Repeat experiment five times.
Record and compare results.

Results
I found that pollutants traveled through the sand at a faster rate than the other soils. By the 4th day 1/4 cup of motor oil was collected. by the 5th day 1 cup of soap was collected. Clay Loam proved to be more dense than the other soils. Only the oil motor oil traveled through the clay loam. 1/32 of 1 cup traveled through the clay loam. The paint didn't even seep inot the soil at all. The soap seeped through, but no travel. Backyard soil 1/8 of a cup of motor oil was collected after 6 days 1/4 of a cup of soap was collected after the 3rd day. none after that.

Conclusions/Discussion
My hypothesis stated that the oil would seep through the clay loam slower than paint or soap and that the soap would seep through the sand faster than the other pollutants. I was correct with the pollutant soap. The soap seeped through the soil and sand, but not the clay loam. I was incorrect with the pollutant motor oil. Motor oil was actually the only one that seeped through the clay loam. But of course it was a very small amount that seeped through. In my project I was able to prove that not all pollutants are going to travel through soils at the same speed. The types of soils and the types of pollutants are important factors in how they will travel into different depths for cleanup.

Summary Statement
I determined how different pollutants traveled through different soils.

Help Received
Parent help with collecting materials and putting board together.

Name(s)	Project Number
Manali S. Sawant	**S0914**

Project Title

Starch-Based Biodegradable Materials: It's Time to Go Green!

Abstract

Objectives/Goals
The purpose of my study is to create a biodegradable packaging material using starch, glycerin, vinegar, and baking soda solution. The quality of the biodegradable packaging material is based on two major standards: usefulness or practicality and the biodegradation rate. All materials will be created using similar procedures, differing only in the type of starch and amount of glycerin used.

Methods/Materials
To create the material, water, one of the three types of starch (potato, corn, or tapioca starch), vinegar, and glycerin were mixed so that the percentage composition of water was 67%, starch 11%, vinegar 11%, and three various amounts of glycerin 5%, 10%, or 15%. The solution was heated on low. When the mixture started to thicken, baking soda solution was added and the heat was increased. The thickened solution was then poured into molds and baked in the oven at 185 degrees Fahrenheit for four hours.
The material was buried in soil for 1 week, 2 week, and 3 week intervals. Observations included the surface area and weight before and after the burial, the number of bacteria on the surface, and the colonial and morphological characteristics. The physical tests on the material included elongation, tensile strength, and torsional strength.

Results
The weight after removal from soil was less than the initial weight for most materials. The average number of bacteria on the surface of the material increased with the period of time the material was buried in the soil.
The greater the level of glycerin, the weaker the material was and the less load it could hold. For potato and tapioca starch-based materials, torsional strength improved with higher glycerin levels. Glycerin added to the flexibility of the material.

Conclusions/Discussion
The materials biodegraded since their surface area after removal from soil was less than the initial surface area. The tapioca starch-based materials exhibited the fastest biodegradation rate, but they were the weakest. Potato starch-based materials took the longest time to biodegrade, however, they were the strongest. The strength and biodegradation rate of the corn starch-based materials were in between that of the potato and tapioca starch-based materials. This study suggests that potato starch with 5% glycerin content may potentially be a practical component in starch-based biodegradable materials.

Summary Statement

The purpose of this study is to create practical biodegradable packaging materials with varying concentrations of glycerin and different types of starch.

Help Received

Ms. Alonzo, my mentor, guided me through this project and allowed me to work at lunch, after school, and seventh period. I would also like to thank other teachers at Lynbrook for their support. My parents encouraged me and helped me acquire all the needed materials.

Name(s)

Wiley D. Strahan

Project Title

What's in Your Water?

Abstract

Objectives/Goals

To determine the levels of lead, chlorine, copper, nitrate, nitrites, hardness, alkalinity and pH present in selected water samples and to quantitatively measure whether the levels were affected as a result of contact with plumbing fixtures, meters, or filtration devices.

Methods/Materials

Lead Check- 1. Fill collection bottle to the line with water sample. Use #First Draw# water# water that has been in the pipes for several hours for the highest levels of particles. Add tablet from #LeadCheck# pouch to water sample. Shake vigorously until the table is dissolved.Add content of the small bottle marked #LeadCheck Carrier Solution# to the water sample. Shake for 30 seconds. Let the capped bottle sit undisturbed for one minute. There should be a blue layer below a layer with clear or yellow liquid. Insert a #LeadCheck# strip into the neck of the bottle and let it hang by the label so that the bottom of the strip extends into the top layer of liquid no more than 1/4# only.Let the stip sit undisturbed for 5 minutes. When the liquid has migrated to within 1/4# from the top of the strip, remove the strip from the bottle and place it on a clean plastic wrap. Allow the strip to air dry for one minute. After the strip has dried, activate a #LeadCheck# Swab by crushing it at points #A# and #B# and shaking to mix the chemicals. Drip two drops of the Swab solution onto the test strip about 1/2# up from the bottom of the strip. Immediately observe the strip for the presence of a pink line about 1/2# from the bottom. Rinse with a small amount of water to remove excess dye color from the surface. If a pink line or partial pink line forms across the strip 1/2# from the bottom of the strip, then the test is positive for lead. The thicker and darker the pink line, the more lead in the sample.

Results

I fund two different sources of lead and with a filter there was none left and when I tested various other sources all from faucets there was no lead in the water.

Conclusions/Discussion

As a result of my experimentation I came to the conclusion that because there was lead and hardness present before the faucets and not after, which was probably due to the filter or water softener, the faucets were not the source of the lead and hardness. In Assembly Bill 1953 lead was the major concern expressed in the bill and due to my experiments the claim of the bill that the faucets were the source of lead can be invalidated in this case.

Summary Statement

I tested lead along with various other particles to determine if the faucets and pipes were the causes of the lead and other chemicals which was addressed in AB 1953 or other sources were the culprits.

Help Received

Mother found the lead tests on the internet due to the difficulty in finding one that measured to parts per billion

Name(s)	Project Number
Michael J. Vredenburgh	**S0916**

Project Title

Evaluating the Effectiveness of Real-Time Surrogate Measures of BOD in the Wastewater of Fruit Processing Plants

Abstract

Objectives/Goals

A key issue regarding water quality is an excess of nutrients. Fruit processing wastewater poses a unique problem due to the high level of nutrients and the lack of prior empirical research evaluating this issue. While a test for biological oxygen demand (BOD) is the government standard, this procedure takes a week for the results. Two other wastewater tests, chemical oxygen demand (COD) and total suspended solids (TSS) can be performed in real-time; however, they are not direct measures of BOD. This study evaluates whether these real-time tests are reliable surrogate measures of BOD.

Methods/Materials

Eleven years of real-time test and BOD test data were used to evaluate the ability of real-time tests to predict BOD levels. The data were consolidated and input in an Excel spreadsheet. For statistical evaluation all data were imported into SPSS. This study also evaluated the effect of contaminates on the reliability of the real-time measures since fruit processing produces different waste products than facilities that existing test reliability data are based on. The lab tests to evaluate contaminates were performed at the Encina Wastewater treatment plant in Carlsbad, California. The three tests (BOD, COD and TSS) were performed on a control (wastewater) and three contaminants (cleaner, bleach and dairy sample).

Results

All three measures were significantly correlated. TSS and COD were significant predictors of BOD, $R^2 = .458$, $F_{(2,150)} = 62.54$, $p < .01$. COD (105 mg/liter, 859 mg/liter) had a lot more variance than the BOD (41 mg/liter, 065 mg/liter); in this case, it was more than twice as much. All contaminants affected the reliability of the measurement of COD but not TSS. Bleach and cleaner invalidated the COD test but did not impact the reliability of the TSS test.

Conclusions/Discussion

These findings indicate that real-time tests to monitor nutrient levels can serve as a surrogate measure of the BOD tests. However, if cleaner or bleach contaminate the water, TSS tests are more reliable real-time predictors of BOD; COD reliability is affected by cleaner and bleach. Industry's overdosing the oceans with nutrients, including sugars, is feeding an excessive growth of harmful algae and bacteria. Real-time tests allow fruit processing plants to quickly respond to nutrient levels and reduce the amount of nutrients that are released into the ocean which serve as a fuel for eutrophication.

Summary Statement

This project's goal is reducing pollution in the ocean by using real-time surrogate measures to predict BOD levels in fruit-processing wastewater.

Name(s)	Project Number
Margaret Yoo	**S0917**

Project Title

Phase IV: The Removal of Fuel Oxygenates: Saving the Future from Yesterday

Abstract

Objectives/Goals
The objective of my experiment was to determine an economical and efficient method of MTBE, DIPE, ETBE, and TAME removal in an acute situation of fuel oxygenate contamination by analyzing the chemical or physical removal of MTBE, DIPE, ETBE, and TAME through the use of different adsorbents. The efficiency of each adsorbent in three different matrices of water, groundwater, treated wastewater, and surface water, was analyzed.

Methods/Materials
To prepare the 5-point calibration standard, varying concentrations of the 200g/mL MTBE, DIPE, ETBE, and TAME standard were added to 100mL deionized water to create the .5ppb, 2ppb, 5ppb, 10ppb, and 20ppb standards. Water from various sources with varying degrees of organic content was spiked with the MTBE, DIPE, ETBE, and TAME stock solution to create a concentration of 10ppb. 2g of Bio-Rex 5, coconut carbon, divinylbenzene polymer, granular activated carbon, and high density glass beads were manually packed in separate 6mL cartridges. The efficiency of each adsorbent was determined through the filtration of the three water samples, which represented the three different matrices of water, using a vacuum pump manifold. The Gas Chromatograph/Mass Spectrometer was used for the determination of the remaining MTBE, DIPE, ETBE, and TAME in the filtered water sample. A total of 60 samples were tested.

Results
The Santa Ana River water with the divinylbenzene polymer had no remaining MTBE, DIPE, ETBE, or TAME in the water after filtration, and only trace amounts of the fuel oxygenates remained in the other water matrices, groundwater and treated wastewater. The experimental group Santa Ana River water treated with the high density glass beads had the least amount of MTBE, DIPE, ETBE, and TAME removed after filtration.

Conclusions/Discussion
The level of organic content in the water does not have an effect on the removal of MTBE, DIPE, ETBE, and TAME for no direct, consistent correlation between organic content and adsorbent efficiency was found, and the divinylbenzene polymer proved to be efficient regardless of organic content. Along with acute, irreversible neurotoxic effects, MTBE, DIPE, ETBE, and TAME are potential causes of cancer and tumors at multiple organ sites. Therefore, if our water supplies are contaminated by fuel oxygenates, then the affected water should be filtered using the divinylbenzene polymer for the ensured purification of the water.

Summary Statement
I determined that adsorbents can reduce the amount of fuel oxygenates in the water past the MCG, and the type of water, whether groundwater, treated wastewater, or surface water, does not influence the effeciveness of the adsorbent.

Help Received
I received training on the Gas Chromatograph/Mass Spectrometer for the last two years from supervising chemist Lee J. Yoo at Orange County Water District. During the past three years, I also received training on the Varian Cary 50 UV/Visible Spectrophotometer for the determination of the level of nitrate after