CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Bryce C. Caputo

Project Number
J0801

Project Title
What Goes Around Comes Around: Turning Trash into Fuel

Abstract

Objectives/Goals
The objective was to determine if an average family can support its home's fuel needs for a week by converting a week's worth of organic garbage into alcohol fuel.

Methods/Materials
A fraction of a family's organic garbage output was mashed and fermented in a warm environment for 7 days. A homemade still, built from a pressure cooker, 10 feet of copper tubing, a coffee can, and a small bowl, distilled the newly formed alcohol out of the fermented organic trash. The amount of alcohol fuel was measured and used to calculate if the average family could support their energy needs using this method.

Results
After fermentation, the mashed organic garbage contained 10 percent alcohol. Using the still, the mash was distilled to 1200 ml of 27 percent alcohol. This was distilled again for 933 ml of 39 percent alcohol, and once more for a final 532 ml of 50 percent alcohol fuel.

Conclusions/Discussion
Using statistics from the California Energy Commission's pamphlet "ABC's to AFV's", the experimenter compared the average family's organic garbage output and the average household's fuel requirements to the results of the experiment. Calculations showed that the fuel produced from an average family's week's worth of organic garbage could power the average family's household for 8 days.

Summary Statement
To recycle organic trash into alcohol fuel at a home-based level in order to meet the average household's energy requirements.

Help Received
Teacher helped finalize permits; father helped build still; mother bought materials

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Steven P. Dewey

Project Number
J0802

Project Title
Drink the Dew: Can Fog Be Harvested?

Abstract

Objectives/Goals
The objective was to determine whether a model of the Stenocara beetle, which harvests all of its water from desert fog, would collect more or less water vapor than models of a funnel collector and a net collector, which are being used in the world today. I predicted that the beetle model would harvest the most.

Methods/Materials
Three model vapor collectors were constructed. Each model was placed in a large pot, one at a time, with 625 milliliters of water in the bottom. The pot, with the collector and water in it, was placed on a burner and brought to a boil. The steam created was allowed to condense on each collector. When the set time was up, the collected water was measured and recorded. There were 3 trials.

Results
The results of my experiment followed more or less to my hypothesis. The Stenocara model collected approximately 4 times more than the two others, harvesting an average of 5 milliliters. The funnel model collected an average of 1.83 ml, and the net model took last with an average of 0.87 milliliters, and the control (no collector at all) harvested an average of 1.13 ml.

Conclusions/Discussion
The availability of clean drinking water is one of the world's largest problems. People already harvest fog, but my experiment showed that the model of the Stenocara beetle consistently collected more water than two other methods of fog collection. I think that if scientists were to study nature's methods, it would make the world a better place.

Summary Statement
My project is a comparison of three designs of fog collection devices: the net collector, the funnel collector, and a model of the Stenocara beetle's back.

Help Received
Amy Dewey helped with general support, Tom Dewey helped in the construction of the apparatus, and Kevin Lane helped in the project design, and editing the abstract.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Jennifer E. Fox

Project Number
J0803

Project Title
Using Plants to Remove Pesticides from Storm Water Run-Off

Abstract

Objectives/Goals
My project is Using Plants to Remove Pesticides From Storm Water Run-Off. The farmers in the Central Valley are required to control the run off water from their farms. The reason they need to do this is so pesticides in the runoff water will not get into the ground water.

Methods/Materials
1. Mix 10 gallons of Malathion at 12 1/2% of the recommend label strength.
2. Divide the 10 gallons into 5 containers or 2 gallons in each container. Each container is 14 in wide by 23 in. long and 6in. deep.
3. Add one type of plant to each container (Hard Stem Bullrush, Common Cattail, Parrotfeather, and Smooth Scouring Rush) -. Plants take up about 25% of the area of the container. One container with no plant in it is the control.
4. Using 5 different cups, dip out a cupful of liquid from each container.
5. Use a fish net catch a tadpole from the main container and place one in each cup.
6. Record time of death for sample

Results
The result of my investigation indicates that all 4 plants helped remove pesticides from water. All the plants worked better than the control. Hardstem Bulrush was over 100% better at removing pesticides than the control.
The reason that I believe it works is that the plant adds oxygen to the water and soil. The oxygen helps organism such as algae, protozoa's, and fungi to break up chemicals in the water into there base elements.

Conclusions/Discussion
My Hypothesis was correct. My Hypothesis was that plants could help purify contaminated water from farm runoff. The best plant removed over 100% more Malathion than the control. The reason that it worked is because the roots or rhizome of the plants let oxygen into the water that allowed aerobic bacteria such as fungi, algae and protozoa to live. They help break up the Malathion into its base elements of Sulfur and Phosphorus.

Summary Statement
Using plants to see if they could filter out storm water run-off from farms.

Help Received
Mom helped me put together my board and Mr. Jeff Halsted from the Kings River Conservation District helped me choose plants.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Megan Lynn Lopez

Project Number
J0804

Project Title
Conserving Water and Minimizing Nitrogen Pollution Caused by Nitrate Leaching

Abstract

Objectives/Goals

Nitrogen Pollution is caused by the leaching of nitrate fertilizers. When watering plants, much of the water is not absorbed and drains through the soil. As the water flows downward, it leaches away the nitrate fertilizers. This water eventually flows down into the water table and out into other water systems like rivers and lakes.

Nitrates serve as plant food. When they accumulate in these water systems, they cause a sudden growth of plants. Eventually, these plants die and decay. As they decompose, the oxygen in the water is used up and other aquatic life dies because of the lack of oxygen.

This experiment looked into using a drainage system that can recapture the unused water that normally flows down through the soil and into the water table. This would minimize the amount of nitrates that reach the water table. If the recaptured water is collected, it can be used again to water the plants.

The experimenter created a planter system with a drainage channel to collect the excess water applied during irrigation. The experiment#s objective was to determine the best angle to set the drainage channel at to maximize the amount water collected.

Methods/Materials

To test the idea on a small scale, the experimenter created a planter in a rain gutter and added a drainage channel. The drainage channel was simply a layer of rocks in the soil separated from the soil with felt pads. Since water flows in the path of least resistance, the idea is that it will flow sideways through the rocks instead of down through denser soil. The experiment#s objective was to determine the best angle to set the drainage channel at to maximize the amount water collected.

Conclusions/Discussion

The experimental results showed that a drainage angle of one degree was optimal. This allowed for approximately 50% of the water to be recaptured. Angles greater than one degree only increased this percentage slightly. Angles less than one degree resulted in significantly smaller percentage of the water being recaptured.

Summary Statement

This experiment evaluated the effectiveness of using a drainage channel under the soil to recapture any excess water during the irrigation of plants.

Help Received

Father helped me to buy and setup the project.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Connor K. Patrick

Project Number
J0805

Project Title
Solar Desalination

Abstract

Objectives/Goals
The objective was to find out if the temperature of the water used to cool the condensation plate of a homemade solar powered desalination device affects the amount of desalinated water produced.

Methods/Materials
A desalination device was made that would allow heated seawater to be run into an evaporation chamber with a condensation plate on top. The condensation plate would be cooled to different temperatures so it could be determined if condensation plate temperatures effect the amount of desalinated water produced. The evaporator was constructed using Plexiglas, copper and plastic tubing were used to conduct the heated salt water and direct the cooled water onto the condensation plate, a photo-voltaic cell was used to charge the battery to run the 2 bilge pumps. A solar oven was used to heat the ocean water. The salt water was heated to 60^{o} c. Water was used to cool the condensation plate to 3 different water temperatures (5degrees c., 20 degrees c., and 34 degrees c.) Each test ran for 3 hours during which the amount of desalinated ocean water produced was measured at 30-minute intervals. Due to weather conditions, instead of a solar oven a hot plate had to be used to heat the salt water taken from the ocean for the first 6 tests.The solar oven was used in the last 2 tests to heat the salt water.

Results
The results showed that 26.4% to 28.8% more desalinated water was produced when the condensation plate was at its coolest (0 degrees c.) than at the two higher temperatures (approximately 20 degrees c. and 34 degrees c.)

Conclusions/Discussion
In conclusion, the colder the condensation plate the more desalinated water is produced. This means that my hypothesis was correct. By taking cooler water from deeper levels in the ocean and using it to cool the condensation device and by using solar power to heat the salt water and to run the pumps used in a desalination system it is possible to make desalinating water more cost effective and environmentally friendly. Desalination plants exists but fuel costs to run these plants make them impractical. By 2025, scientists predict a major water crisis. New ways need to be developed to help save our water supply.

Summary Statement
To build a complete desalination system that uses strictly solar power.

Help Received
Father helped in cutting the plexiglass, wood, pipes used in my experiment.He also helped me in my design and paid for the parts. Mom helped to edit and correct my typing mistakes. My brother helped me design my graphs.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Narayan S. Subramanian

Project Number
J0806

Project Title
Do Extreme pH Conditions Quench Respiration in Secondary Wastewater Treatment Mixed Liquor?

Abstract

Objectives/Goals
The purpose of my experiment was to measure the rate of respiration in mL of carbon dioxide produced per hour in a sample of mixed liquor from the secondary wastewater treatment process at varying pH. Mixed liquor is a combination of partially treated wastewater and activated sludge. Activated sludge consists of many of the microorganisms that live in the wastewater. Mixed liquor consumes many of the dissolved and suspended solids that do not get filtered in the primary settling basins. I hypothesized that the rate of respiration of microorganisms in a sample of mixed liquor from the wastewater treatment plant will decline as the pH of the mixed liquor is adjusted to acidic(low pH) or basic (high pH) conditions. And furthermore, that the rate of respiration will be highest for the unadjusted mixed liquor(nearly neutral pH~7.4).

Methods/Materials
I conducted an experiment to measure the rate of respiration in two samples of mixed liquor at varying pH. For one sample, I measured the rate at the starting pH of 7.3 and then at pH's of 6.8, 6.3, 5.8, 5.3, and 4.8. In the other sample I measured the rate at the starting pH and then at 8.0, 8.5, 9.0, 9.5, 10.0, and 10.6. I added 1N Sulfuric Acid to decrease the pH and 1N Sodium Hydroxide to increase the pH. For each sample I placed 1.5 L of mixed liquor in a sealed chamber in the respirometer. The respirometer calculated the instantaneous rate of respiration in mililiters of carbon dioxide produced per hour (ml/hr) and I recorded it after 15 minutes.

Results
The results of my experiment clearly show that the production of Carbon Dioxide greatly decreases in extreme pH conditions. To scientifically prove my results, I entered my raw data into an excel spreadsheet and made a graph. The best-fit curve to the data points was a downward facing parabola. The r-squared value of 0.89 is close to 1 indicating that the points fit the curve well.

Conclusions/Discussion
In Conclusion, my experiment would be of great help to waste water treatment plants all around the world. Treatment of wastewater with microorganisms in activated sludge is one of the vital steps of secondary wastewater treatment. This type of experiment will be able to determine an optimum pH level for mixed liquor so the microorganisms can thrive. It would also help determine how much the treatment of the wastewater would slow down if acidic or basic wastewater entered the wastewater treatment facility.

Summary Statement
My project was conducted in order to see if extreme pH conditions would quench the respiration in secondary treated mixed liquor.

Help Received
The Watsonville Water Treatment facility provided the instruments I used in my project. Mr. Mike Crane taught me how the instruments were used and supervised my experiment. My mom helped with the artistic aspects of my board.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Katie K. Teresi

Project Number
J0807

Project Title
Biodiesel vs. Diesel

Abstract

Objectives/Goals
I'm trying to fird out which diesel fuel works the best on a CAT tractor from the 1970? Because I'v learnd that there are other types of diesel that our natural fuels.
My hypothesis is that nuber 3 diesel will work better.

Methods/Materials
I used the scientific method and my matierials are, one tractor, red die number 3 diesel, home made biodiesel, bought biodiesel, ripper, etyl alcohol, corn oil, one gallon tank, stop watch, paper, pencil, cooking pot, and termometer.

Results
Bought biodiesel: 85 sec
Home made biodiesel: 83 sec
Diesel: 85 sec.
I did this run for 300 ft.

Conclusions/Discussion
My hypothesis was incorrect, the home made biodiesel wworked the best than the other fuels because, it was a little thiker and the mor it is thiker the more fuel will be injected into the cylinder.

Summary Statement
My project is about trying to find out which Diesel fuel works the best in time?

Help Received
My parents helped me cunduct the experement. My mom helped with my research paper. Ed Bless (he works for this company that trys to find new natural fuels) helped me in information.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Nilesh Tripuraneni

Project Number
J0808

Project Title
Is Seawater an Efficient Medium for Electrolysis? A Model for Solar Powered Hydrogen Production

Abstract

Objectives/Goals
The basis of my project was to investigate if natural seawater was comparable to artificially prepared solutions in providing an efficient means of hydrogen production through solar-powered electrolysis. This was an attempt to provide a model for a completely natural means for the production of hydrogen as a substitute for petroleum fuels.

Methods/Materials
Seawater and 1.0 M solutions of sulfuric acid and sodium hydroxide were electrolyzed in a self-constructed, solar-powered electrolysis apparatus capable of measuring the temperature, pressure, and volume of the hydrogen gas produced. The experiment was repeated in identical controlled conditions seven times for each of the three solutions that were tested. Due to the fact that equal volumes of gas were not being collected in each of the trials, millimoles of hydrogen produced were divided by time elapsed to produce consistent data. Millimoles of hydrogen produced were calculated by manipulating The Ideal Gas Law, Daltons Law of partial pressures, and Guy-Lussacs Law.

Results
From the accumulated data, the 1.0 M Sodium Hydroxide solution proved itself to be slightly more efficient in hydrogen production. It generated an average of .66661 millimoles of hydrogen (H2) produced per hour. The 1.0 M sulfuric acid produced an appreciable .65790 millimoles of hydrogen per hour. The seawater solution produced a comparable .65714 millimoles of hydrogen per hour. From the data acquired in the seven trials for each of the solutions I calculated the standard deviations to emphasize and ensure the consistency of the data. The standard deviations for the three solutions are 0.02732, 0.03706, and 0.05299 respectively.

Conclusions/Discussion
My data suggested that seawater was comparable to 1.0 M sodium hydroxide and 1.0 M sulfuric acid solutions in the efficiency of solar- powered hydrogen production. There was only a 1.4% difference in hydrogen production per hour than the most efficient solution, sodium hydroxide, and a mere 0.1% less than the sulfuric acid.

Summary Statement
My study focused on determining if seawater was comparable to artificial solutions in the efficiency of solar-powered hydrogen production.

Help Received
Mr. Garabedian provided supplies necessary for my project. Mr. and Mrs. Hoffmann also provided supplies and advice. Parents helped assemble board.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Deborah I. Wildey

Project Number
J0809

Project Title
Can You Create an "Antifreeze" out of Frost Hardy Plants?

Abstract

Objectives/Goals
The object of this experiment is to determine if an #antifreeze# can be created out of frost hardy plants by grinding them and extracting juice.

Methods/Materials
A container of two tablespoons of plain water was put in the freezer. It was observed every five minutes for the formation of ice crystals. Results were recorded. Then juices were extracted from bok choi, spinach, broccoli and kale. Each sample mixture was prepared by adding one tablespoon of water to an equal amount of plant extract. Mixtures were placed in the freezer and checked every five minutes for the formation of ice crystals. Results were recorded and compared.

Results
Some of the plants that resisted freezing for a longer amount of time included: kale, bok choi and spinach. While water took ten minutes to show signs of ice crystals, kale took twice as long. Spinach and bok choi both added five minutes to the freezing time of water.

Conclusions/Discussion
My conclusion is that some non-toxic plants can increase the freezing time of water. Plant extracts may provide an environmentally friendly alternative to modern antifreeze.

Summary Statement
This project tests the ability of various plant extracts to increase the freezing time of water.

Help Received
Mother helped cut out lettering for title.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

Margaret E. Yoo

Project Number

J0810

Project Title

Nitrate, Nitrite, Nitrogen: A Study on the Removal of Nitrate in Groundwater and Treated Wastewater

Abstract

Objectives/Goals

The objective of my experiment was to determine an economical and efficient method of nitrate removal in an acute situation of nitrate intrusion by analyzing the chemical or physical removal of nitrate through the use of different adsorbents. Also, the efficiency of each adsorbent in groundwater or treated wastewater was analyzed.

Methods/Materials

A calibration standard was created using different concentrations of a 1,000 ppm nitrate stock solution to create a 2, 5, 10, 20, 50, 100, and 500 ppm calibration standard. Water from various sources with different levels of organic content was spiked with 50 ppm of the stock solution. 2g of Bio-Rex 5, coconut carbon, IMAC HP555, Ambersorb 572, and Ambersorb 563 were manually packed in separate 6 mL cartridges. The efficiency of each adsorbent was filtered with eight different water samples using a vacuum pump manifold. The Varian Cary 50 Ultra-Violet/Visible Spectrophotometer was used for the UV determination of the remaining nitrate in the filtered water sample. A total of 80 samples were tested, and the effectiveness of the various filters at different pH levels of 4, 7, and 11 was also determined.

Results

Mesa Consolidated Water District water, which represented colored or treated wastewater, filtered with Bio-Rex 5 had the most amount of nitrate removed, but coconut carbon was most effective in removing nitrate from groundwater, or water without a high organic content. The experimental group Orange County Water District water treated with Ambersorb 563 had the least amount of nitrate removed after filtration.

Conclusions/Discussion

The level of organic content in the water can have an effect on nitrate removal. A high organic content negatively affects the effectiveness of adsorbents that physically removes nitrate, though a high organic content has a positive effect on adsorbents that chemically remove nitrate, such as the Bio-Rex 5. Infants under six months of age are susceptible to nitrate poisoning - methemoglobinemia, also known as the "blue baby syndrome," and they could die from the oxygen deficiency caused by the methemoglobin. Therefore, if there was a nitrate intrusion in our water supplies, then the affected water should be filtered using the Bio-Rex 5 or coconut carbon, depending on the level of organic content in the water.

Summary Statement

I determined that certain adsorbents can considerably reduce the amount of nitrate in the water, and the type of water, whether it is groundwater or treated wastewater, can drastically influence the effectiveness of these adsorbents.

Help Received

I received prior training on the Varian Cary 50 UV/Visible Spectrophotometer from supervising chemist Lee J. Yoo during the past three years. Lab work for the detection and removal of nitrate was done in the inorganic laboratory of OCWD under the supervision of Lee J. Yoo.