CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Travis S. Adams

Project Number
S0501

Project Title
The Use of Exothermic Reactions of Alkaline Battery Materials as a Precursor to Predicting Battery Performance

Abstract

Objectives/Goals
Alkaline batteries consist of a strict combination of different elements in order to produce energy; however the quantity of different ratios or combinations possible is near unlimited. Instead of trying to combine the numerous ratios or combinations possible, I wanted to find a screening method that could predict battery performance. Since I could not test every ratio in a battery form, I looked at the base materials# exothermic properties. The ratio with the hottest reaction would be made into a battery and compared to a battery based on a common alkaline battery.

Methods/Materials
1. Calculate the different ratios for tests 1-9, 2. Measure out each amount of Zn, MnO2, and KOH according to the ratio and test all of them, 3. Find the ratio with the hottest temp, 4. Take that ratio and calculate the anode and cathode sides, 5. Do this again for the ratios of the Duracell Battery (High MnO2), 6. Make a single cell alkaline battery for both the high Zn and high MnO2 mixtures, 7. Connect the batteries through a circuit, 8. Record the voltage over time, 9. Graph the results to see which battery had the highest capacity.
1. Zn, 2. MnO2, 3. Carbon, 4. Resistor, 5. Multimeters, 6. Thermometer, 7. Calorimeter, 8. Aluminum/ copper/ nickel mesh, 9. PPE, 10. Scale, 11. Beakers and Utensils, 12. KOH

Results
I found that the ratio from the hottest exothermic reaction would make the most efficient battery. The highest temperature occurred during test #7 at 88.2°. The ratio from this equation was taken and made into a battery and was compared to a battery formed from ratios derived from a Duracell alkaline battery. The Zn battery put out 244% more power than the high MnO2 battery or Duracell battery.

Conclusions/Discussion
Yes, it is possible to enhance the performance and power output of an alkaline battery by changing the ratio of anode and cathode materials to exceed that of a commercial or common alkaline battery. Therefore, there is a correlation between exothermic reactions and the chemical energy in a battery. This experiment demonstrated that the mixture of Zn, MnO2, and KOH that had the highest exothermic property produced more energy than that of a mixture with a low exothermic reaction.

Summary Statement
This project explores the exothermic properties of alkaline battery materials and their correlation to power production in battery form.

Help Received
I received help from the Lithchem Energy Lab including Dr. Novis Smith as well as help from my parents who helped me decorate the board and make the batteries.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ryan Bogie; Robert Larsen; Michael Yoshimura

Project Number

S0502

Project Title

Fuel Go Boom

Abstract

Objectives/Goals

To measure the energy output during the combustion of biodiesel- petrodiesel fuel blends
To determine which fuel/fuel blend will optimize energy output

Methods/Materials

0.250 L of biodiesel
0.250 L of commercial-grade petrodiesel
Benzoic acid tablet
Iron fuse wire
Bomb calorimeter
XLinx Software
1)Place sample in crucible
2)Twist fuse wire onto both ends of calorimeter to allow a current to pass
3)Place wire so it comes in contact with sample
4)Assemble calorimeter
5)Detonate bomb
6)Record temperature change using software
7)When temperature graph asymptotes, remove and clean bomb.
8)Repeat steps 1-7 for other samples.

Results

Biodiesel yielded 8556.90 kilocalories per liter of fuel combusted.
50-50 biodiesel to petrodiesel blend yielded 8415.01 kilocalories per liter of fuel combusted.
Petrodiesel yielded 8324.81 kilocalories per liter of fuel combusted.

Conclusions/Discussion

The hypothesis of the experiment was correct. As the percentage of biodiesel increased in a biodiesel-petrodiesel fuel blend, the energy output increased in a somewhat proportional manner. This helps to demonstrate the feasibility of biodiesel as a mass-produced alternative fuel. In order to better model this relationship, a greater variety of fuel blends should have been used. This was unable to be accomplished due to time-restraints in the lab. Overall, project was valid. Little systematic error, and the errors caused by uncertainties in lab equipment would only yield a ±0.6039% change in the worst-case scenario.

Summary Statement

This project measured the average energy output during the combustion of biodiesel, commercial-grade petrodiesel, and a 50-50 mixture of the two

Help Received

Used lab equipment at University of California RIverside under the supervision of Dr. Zhang and two graduate students; Mr. Larsen, father of partner, helped in the construction of the board; Mr. Bernard Ramey helped attain biodiesel sample

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Xiaoyu (Carrie) Cao

Project Number

S0503

Project Title

Glucose Monitoring in Porous Silicon Photonic Crystals

Abstract

Objectives/Goals

Porous silicon as a sensor is useful in many applications throughout the real world, from monitoring toxins and chemicals in the environment to sensing proteins and hormones in the body that can indicate the onset of fatal heart attacks. One situation in which sensors are critical is diabetes, a disease in which the level of blood sugar, or glucose, is dangerously high.The purpose of this project is to determine a relationship between the concentration of glucose molecules in a solution and the amount of shift in the visible light spectrum of a porous silicon chip.

Methods/Materials

A porous silicon chip was prepared by immersing a regular silicon wafer in a solution containing aqueous hydrofluoric acid, and exposing it to an electric current defined in a computer program. After the chip was submerged in solutions of varying concentrations of glucose and the spectrum was taken, various computer programs were used to analyze the peak wavelengths and determine their relationship with the glucose concentrations. Materials used included a Teflon etch cell, aspectrometer with tungsten halogen lamp as a light source, petri dishes, and pipettes, among others.

Results

A distinct shift was observed between the peak wavelength of spectra in air and the peak wavelength of spectra in the solutions. The relationship between the glucose concentration and the wavelength of light of the peak was observed to be positively associated and linear. As a control, the peak wavelengths of the spectra were taken in air between each solution, and they remained unchanging throughout each trial.

Conclusions/Discussion

Because consistent results displaying a linear relationship between glucose concentration and peak wavelength were obtained, the discovery of such a relationship reinforces the usefulness of porous silicon as a sensing material and perhaps provides the foundation for a new chemical monitoring device, since the concentrations of various substances in a solution can then be detected and monitored based on the shift in the visible light spectrum of the chip. The chip itself was also confirmed to be an successful sensing device because the peak wavelengths of the porous silicon chip in air remained stable, which shows that the surface chemistry of the chip remained stable.

Summary Statement

A porous silicon chip was etched and used to monitor glucose levels in aqueous solutions as a potential new sensor for diabetics and to explore the stability and effectiveness of porous silicon in sensing applications.

Help Received

Used lab equipment at the University of California, San Diego under the supervision of Professor Michael Sailor and mentor Jennifer Park

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Yenyu Chen

Project Number
S0504

Project Title
Electrolyte Turns On the Solar Cell

Abstract

Objectives/Goals
(1) How do the different berries influence the solar cell#s output energy?
(2) How does the different used of pencil effect the used of solar cell#s output energy?
(3) How do different electrolytes influence the solar cell#s output energy?
(4) How does different amount of Titanium Dioxide affect the solar cell#s output energy?

Methods/Materials
(1)Add 10 ml vinegar to 6g Titanium Dioxide. (2)Add one drop of clear dishwashing detergent. (3)Wait for 15 minutes. (4)Test the glass slides with the multi-meter, determine which side is conductive. (5)Mask 3mm on the three sides of the glass. (6)Drop 3-5 drops of the TiO2 solution on the slide. (7)Wait for the slide to dry and remove tape. (8)Place the slide to dry for a 10-60 minutes. (9)Blend some berries in the blender and add a tablespoon of water for every 10 berries. (10)Put the slide (face down) into the juice (berries + water) wait for 5-10 minutes. (11)Use soft pencil to coat the entire surface of conductive side on the other slide. (12)Burn the conductive glass slide(with the soft pencil drawn on) with a candl. (13)Put two sides together. (14)Drop 1-2 drops of Iodide tincture to the crease between the two slides.

Results
(1)How do different berries influence the solar cell#s output energy? Strawberries doesn#t work; Blackberries work better than blueberries.
(2)How does different used of pencil (2B,3B#8B) effect the used of solar cell#s output energy? 2B>3B>4B>5B>6B>7B>8B
(3)How do different electrolytes influence the solar cell#s output energy? l2 > HCl > Na(OH)2
(4)How does different amount of Titanium Dioxide affect the solar cell#s output energy? 12g/10ml > 6g/10ml > 18g/10ml

Conclusions/Discussion
The first test conclude that blackberries captures the highest energy output from the sun; the strawberry cannot bind with the titanium dioxide. The blackberry has a greater amount of anthocyanin and was well bind with the titanium dioxide. The second test is the test of the different types of pencils, which had showed that the 8B pencil had the highest energy output. When the materials in the solar cell are well blended the more energy output the solar cell produce. The third test conclude that the Iodine tincture works that best; since it is easier for the solar energy to be captured by a darker color than a lighter color.

Summary Statement
The used of different chemical reactions in the solar cell.

Help Received
My chemistry teacher, who had spent time with me and lend me his lab; my advisor, who had read my project and correct my English mistake; and all my other teachers who had helped me as I finished my project. Thank you to my mother, who had drove me to wherever the experiment is going to take place

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Bryce W. Cronkite-Ratcliff

Project Number

S0505

Project Title

The Nonhomogeneous Intermolecular Bonding Structure of Liquid Water: An X-ray Study

Abstract

Objectives/Goals

A detailed understanding of the bonding structure of ambient liquid water is of high importance and interest. The intention of this project is to probe the bulk structure of ambient water with a novel X-ray technique to determine the details of its intermolecular structure.

Methods/Materials

X-ray Raman based X-ray Absorption Near-Edge Spectroscopy is a novel X-ray technique that uses hard X-rays to probe for absorption information that lies in the soft X-ray region. Experiments were performed at a high-brightness synchrotron lightsource with incident energy ranges of ~6-7 KeV. Using a 14-crystal analyzer spectrometer, the energy losses (~500 eV) necessary to observe the oxygen K-edge were detectable with high energy resolution. Spectra were analyzed by comparison with hexagonal ice spectra and by application of a model based on Density Functional Theory.

Conclusions/Discussion

The spectral analysis suggests that liquid water is not a near-homogeneous distribution of tetrahedrally bonded molecules, as has been generally thought. Instead, a nonhomogeneous bonding model is presented, wherein about 80% of water molecules are bonded to only two neighbors while about 20% are bonded to four neighboring molecules. This finding is supported by some studies, but is disputed by others.

Summary Statement

The application of novel X-ray spectroscopic techniques to investigate the bonding structure of water seems to indicate that water structure is more complex than generally assumed.

Help Received

I was part of a 3-person reserach team; I worked full-time on the experiment, and completed data processing and preliminary analysis myself. The project presentation was developed independently. Dad helped proofread.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Zoe E. Dubrow

Project Number

S0506

Project Title

F.L.A.S.H.; The Formation and Characterization of Floating Self-Assembling Super-hydrophobic Nano-particle Membranes

Abstract

Objectives/Goals

While working on traditional super-hydrophobic surfaces, a method to create self-assembling membranes on the surface of water from hydrophobic fumed silica nano-particles was discovered. The purpose of this project was to characterize the properties of the membranes and determine possible applications.

Methods/Materials

Properties of the membranes such as permeability, porosity, contact angle, inhibition of evaporation as well as vapor phase reactions across the membrane were investigated.

Results

It was discovered that when hydrophobic fumed silica nano-particles are vigorously agitated in water, they self-assemble at the air/water interface. The monolithic membrane that forms was determined to be approximately one micron in thickness and had pores of 10-100nm in diameter. When a drop of water is placed on the silica membrane, it exhibits a contact angle above 150 degrees and rolls. There is no liquid water diffusion between drops on the surface of the membrane and the water below it. The vapor permeability of the membranes were determined and found to be dependent on thickness. Vapor phase chemical reactions were performed between the underlying aqueous layer and drops on the surface.

Conclusions/Discussion

A method for the creation of ultra-thin floating super-hydrophobic membranes through the agitation of hydrophobic fumed silica particles in water was discovered. Super-hydrophobic membranes formed using this method are self-assembling and self-repairing requiring no organic binders or special chemistry. The membrane reduced the evaporation rate of water only about 10% when floating on its surface. Liquid water does not migrate through the membrane despite its thin low density structure. It was demonstrated that vapor phase chemical reactions can take place between a drop on the surface of the membrane and the underlying liquid poolThe membranes have enough structural integrity to support a 5mm polystyrene ball and can be removed from the water surface with a glass slide intact.

Applications of these membranes for chemical sensing are also discussed.

Summary Statement

Vapor permeable, super-hydrophobic, monolithic membranes were created in-situ on the surface of water by the self-assembly of hydrophobic silica nano-particles and properties of the membranes were investigated for use in applications.

Help Received

Jay Goldman operated the scanning electron microscope and gave his opinion on the membranes; Bob Dubrow gave valuable advice; Nanosys Inc., Palo Alto Ca., for allowed use of their laboratories and equipment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Kenna N. Falk

Project Number
S0507

Project Title
The Effects of FD&C Blue #1 on the Reaction Time of the Cyanoacrylate Fuming Latent Fingerprint Experiment

Abstract

Objectives/Goals
The purpose of this experiment was to determine if the concentration of FD&C Blue #1 would effect the time it took a latent fingerprint to become visible in the Cyanoacrylate Fuming Method test.

Methods/Materials
A fuming chamber was created. A controlled technique for fingerprinting was established. Control fingerprints were taken in black ink on microscope slides. Latent prints were made on microscope slides, then added to the chamber along with superglue, boiling water, and depending on the trial, the coloring agent. Then the lid was closed and the fume timing was started. A control trial was done without the coloring agent, then three concentrations of FD&C Blue #1 were tested. For each trial 3 slides were tested.

Results
It was found that as the concentration of the FD&C Blue #1 increased, the reaction time increased. On average, when the concentration was doubled the average reaction time for a fingerprint to be developed was increased by four and a quarter minutes. It was found that trial 3, which was conducted with a FD&C Blue #1 concentration of 20%, had the lowest percent deviation at 4.22%. The control group, which contained a 0% concentration of FD&C Blue #1 had the second lowest deviation at 7.78%.

Conclusions/Discussion
It was found that in this particular experiment, as the concentration of the FD&C Blue #1 increased, the reaction time increased also. These results fit the expected outcome because based on the chemical formulas, the FD&C Blue #1 would not have reacted with the Superglue and the humidity to produce the same Cyanoacrylate gas that is known to be attracted to the trace elements of amino acids, fatty acids, and proteins. Therefore, it would have inhibited the reaction from occurring naturally and slowed it down. Also, as the concentration of FD&C Blue #1 increased, the overall fingerprint quality decreased.

Summary Statement
This project tested the effects of various FD&C Blue #1 concentrations on the time it took a latent fingerprint to become visible in the Cyanoacrylate Fuming experiment, as well as the overall quality of the resulting fingerprint.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Dave S. Ho

Project Number
S0508

Project Title
The Optimal Temperature for the Decomposition of Biuret to Urea in Solution

Abstract

Objectives/Goals
Fertilizers used for better crop growth mainly depend on urea. However, the impurity biuret(harmful to plants) is also created as a residue. It is possible to convert biuret to urea in a closed container, manipulating the temperature to create the best yield. The main objective of this project was therefore to develop a trend between the temperature and the yield of urea from the biuret and to find an optimal temperature range where this reaction could occur, thereby allieviating the food issue today.

Methods/Materials
METHODS: Biuret can be decomposed at the basic pH of 12.5 in the temperature range of 0-100 centigrade. 0.5 grams of biuret was dissolved in 0.05 M NaOH at temperatures between room temperature and 100 degrees Celsius for the decomposition to urea. Because urea is a powerful protein denaturant, the protein gelatin was added, and the non-denatured gelatin was later stained with the dye ninhydrin. Concentration of the dyed gelatin were later calculated using the Beer-Lambert Law after measuring absorbance using a spectrophotometer.
MATERIALS: Biuret Powder, Fume Hood, Glassware, Goggles, Apron, Stirring Rod, Hot Plate, Thermometer, Stopwatch, Camera, Gelatin Powder, Spectrophotometer, Cuvettes, Water, Ninhydrin Dye Assay, Ethanol, Sodium Hydroxide, Water, Magnetic Stir-bar, Magnet, Labeling Tape, Marker, Paraffin Film, Eye glass

Results
Apparently, the concentration yields in order of temperature created a sinusoidic trend, with the best temperatures around the local maximas of the function $f(x)=-0.182\sin(0.262x-2.98)+.452$ between 0 to 100 degrees centigrade. The results of this experiment were unexpected. Largely contrasting the hypothesis, where decomposition of biuret is not more proficient at a higher temperature.

Conclusions/Discussion
As stated, the data does not follow any conventional pattern explained in any rate law. The concentrations recorded did not have a positive, linear, or even logarithmic trend. Therefore, no verifiable conclusion was reached.
By understanding that urea can be optimally purified at certain temperatures, low-biuret urea can be made more efficiently. This would then slightly lessen the enormous food shortages around the world from the increase of population. From this, the decomposition of biuret to urea in ideal conditions would aid society.

Summary Statement
To address the situation of world famine, an optimal temperature range was attempted to be found where biuret (a plant harmful compound) can be decomposed into urea (a fertilizer).

Help Received
Chemistry teacher (Ms. Bunch) offered her labratory room for this experiment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Emmelyn S. Hsieh

Project Number
S0509

Project Title
Comparisons of D-Glucose and D-Fructose Levels in Consumer Products

Abstract

Objectives/Goals
This project is investigating the correlation between fructose and glucose levels and the listed carbohydrate levels in various consumer products. The experiment was constructed to measure the levels of fructose and glucose in frequently consumed products, and was aimed at discovering the true carbohydrate levels in products claiming to be "sugar free" or to withhold "zero calories". This project was ultimately designed to give the population an idea of how daily diets should be regulated and to help people realize the ways they are impacting their body and health through their eating habits.

Methods/Materials
Several samples of consumer products such as juices and energy drinks were analyzed with tandem gas chromatography-mass spectrometry (GC/MS). Assays were conducted for samples with and without prior hydrolysis treatment. Assuming that all glucose and fructose in the samples originated from sucrose and/or high fructose corn syrup, the hydrolysis reaction promoted dissociation of the disaccharides and/or oligosaccharides into the two monosaccharides of interest, allowing quantification of all available glucose and fructose in the sample. A linear standard curve was prepared and utilized to determine the quantity of glucose and fructose based on the GC/MS intensity ratio of the monosaccharide and its respective internal standard.

Results
This report presents the glucose and fructose concentration of various consumer products. When the hydrolysis step was omitted prior to analysis, the sugar levels were in the range of the listed values in the nutrition label of each product. All samples showed significantly higher fructose and glucose content when all sucrose was completely hydrolyzed prior to analysis.

Summary Statement
This project is investigating the correlation between fructose and glucose levels and the listed carbohydrate levels in various consumer products using hydrolysis treatment and GC/MS analysis..

Help Received
Used lab equipment at LA Biomed under the supervision of Dr. Catherine Mao, Dr. Mary Beth Patterson, and Paulin Wahjudi.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Ben J. Kaiser

Project Number
S0510

Project Title
Hess' Law and Thermochemistry

Abstract

Objectives/Goals

Background: Hess# law states that if a reaction can be carried out in a series of steps, the sum of the enthalpies for each step should equal the enthalpy change for the total reaction. This statement emphasizes the conservation not only of matter, but also of energy. If certain reactions are difficult to study, their enthalpy can be calculated from Hess# law.

The purpose of this experiment is to use a calorimeter with a thermometer to investigate the enthalpy changes in several different reactions. After all the data have been collected from the different reactions, the data will be analyzed in order to determine whether or not the data supports Hess# law for a reaction that is otherwise difficult to measure.

Methods/Materials

Methods: The heat capacity was first determined for the calorimeter that was to be used. The enthalpy change was then measured in several separate reactions that could eventually be added up to compare the measured and the calculated ÄH of the third reaction. Each reaction was performed 3 times and the mean was taken for the graphical data analysis.

Results

Results: The reactions R1a = HCl + NaOH --> NaCl + H2O and R2a = NH4Cl and NaOH --> NaCl + H2O + NH3 both were exothermic. The ÄH of the target reaction R3a = HCl + NH3 --> NH4Cl could be measured and calculated.

Similarly, I used R1b NaOH(s) + H2O --> Na(aq)+OH(aq) and R2b = NaOH + HCl --> H2O + Na(aq) + Cl(aq) to calculate R2b = NaOH(s) + HCl --> Na(aq) + Cl(aq) + H2O and compare it with the measured values.

Conclusions/Discussion

Hess# law is an important principle even for things in life today. Hess# Law states that if two chemical equations can algebraically be combined to give a third equation, the values of ÄH for the two equations can be combined in the same manner to give ÄH for the third equation. The experiments that were previously performed show how a reaction that is difficult to perform and measure as an experiment can be calculated based on Hess# law.

While the large scale of Hess' law could be confirmed, there was some discrepancy of the calculated enthalpy change which is thought to be caused by the loss of energy in the relatively simple calorimeter used in the experiments.

Summary Statement

Hess# law underscores the conservation of energy which is the reason why a #perpetuum mobile# (endless motion) is impossible as energy cannot be generated from nothing.

Help Received

Teachers helped with the experiments, parents helped with a statistical software to average the triplicate experiments, as well as with the practical construction of the board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Isabel R. Lally

Project Number
S0511

Project Title
Effect of Varying Oxidizing Agent in a Luminol Mixture on Chemiluminescence Time

Abstract

Objectives/Goals

This experiment explored the question: #What is the effect of varying Molarity of the oxidizing agent (Hydrogen peroxide) used in a luminol mixture on the duration time in minutes of chemiluminescence?# Luminol is a mixture that reacts with iron, so is often used in crime scenes to determine if there is blood. In blood, the reactant is the hemoglobin, but the glow only goes on for so long. The blood patterns need to be photographed and studied, before the end time of chemiluminescence, so it is important to get the longest duration time possible. The hypothesis was: #If the varied Molarity of the oxidizing agent (Hydrogen peroxide) used in a luminol mixture is .18M Hydrogen peroxide and .018M Potassium ferricyanide, then the duration time in seconds of chemiluminescence will last the longest.# As the Molarity of oxidizing agents went up, the time period of chemiluminescence went up, up to a certain point; therefore it did not support the hypothesis.

Summary Statement

The concentration of hydrogen peroxide and potassium ferricyanide was varied in a luminol chemiluminescence reaction, and the luminescence time was measured.

Help Received

I received help from my father, who helped me get supplies and supervised my experiments. I also received help from my teacher with the formatting of the written report.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Ashley R. Lo

Project Number
S0512

Project Title
The Removal of Alcohol from the Body through Esterification

Abstract

Objectives/Goals
The objective is to determine if organic acids can react effectively with ethanol in an esterification reaction, and possibly be used to eliminate alcohol from the human body.

Methods/Materials
Ethanol reacts with acetic acid to form water and ethyl acetate, an ester commonly found in food products. The reaction was tested in vitro, using initial concentrations of ethanol ranging from 0.4 M to 1.0 M, which represent the average molarity of ethanol in beer. In separate beakers, a specified volume and concentration of ethanol was added to the same volume and concentration of acetic acid. After 5 minutes of vigorous stirring and 30 total minutes of reaction time, titrations were performed using potassium permanganate at 50-60 degrees Celsius, to find the amount of ethanol remaining in each beaker. Final molarities of ethanol were compared to the initial, and percent decreases were calculated.

Results
Using initial concentrations of reactants between 0.4 M and 1.0 M, an ethanol decrease of 80-90% was yielded consistently across four trials. These results are fairly similar to the theoretical ethanol decrease (79-86%) for molarities of ethanol and acetic acid between 0.4 M and 1.0 M, calculated using the equation $C_2H_5OH + CH_3COOH \rightarrow H_2O + CH_3COOCH_2CH_3$, and the known equilibrium constant of 45. Experimental results also indicated that, consistent with what was expected, there was a positive correlation between the initial concentrations of the reactants and the % of ethanol decrease at equilibrium.

Conclusions/Discussion
Results indicate that acetic acid can be an effective remedy for intoxication. However, drinking vinegar will result in esophagus damage due to the acidity. Also, after ethanol has entered the bloodstream, which starts to happen 30 minutes after consumption, it is too late to synthetically remove it. If the results of this experiment are to be used commercially, or developed into an effective drug, an organic acid that is already a solid, such as citric acid, or another solid compound containing the acetate ion, such as potassium acetate, must be made into capsules. These capsules can be swallowed like vitamins immediately before alcohol consumption.

Summary Statement
Increasing the rate of alcohol elimination from the human stomach through an esterification reaction between ethanol and an organic acid, thus expediting sobriety.

Help Received
Experimental supervision and academic advising in Torrey Pines High School under Dr. Belyea; Academic advising from Dr. Lo (Dad, professor at UCSD); Mom helped compile poster

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Melissa J. MacEwen

Project Number
S0513

Project Title
Synthesis and Decomposition of Aspirin

Abstract

Objectives/Goals
The objective of my project was to formulate and use an assay that would help me test the purity of aspirin, and then help me determine the aspirin#s decomposition over time.

Methods/Materials
I used: a spectrometer (Spectronic 20), salicylic acid, iron (III) nitrate, iron (III) chloride, phosphoric acid, sulfuric acid, acetic anhydride, anhydrous sodium acetate, methyline chloride, hydrochloric acid, and samples of old, expired aspirin in order to synthesize aspirin in four different ways with different acids and bases, and test its purity. I tested the aspirins# purity by combining a sample of the aspirin with my assay (either iron (III) chloride or iron (III) nitrate; both worked exactly the same way). I tested the purity and decomposition of expired aspirin the same way: I combined the aspirin with my assay and measured the absorbance of light through the resulting mixture in a spectrometer.

Results
Despite difficulties, I developed an iron (III)-based assay for salicylic acid that was sensitive and reliable of 0.01 molarity. I was able to use my assay to test the samples of aspirin that I had synthesized, and test samples of expired aspirin taken from my neighbors. The tests of the synthesized aspirin were very successful in determining which catalyst (phosphoric acid) generated the highest yield of aspirin. Also, the tests of the expired aspirin showed something interesting, and logical: the enteric coating around aspirin turns out to preserve aspirin very well by protecting the actual aspirin from moisture and light, while contrastingly, aspirin with little or no coating decomposes much more rapidly.

Conclusions/Discussion
I succeeded in determining the ideal concentration of an assay, iron (III) for testing my aspirin. I manufactured aspirin using both acids and bases, and then could test both the purity of this aspirin and of decomposing aspirin, using my assay. Though the assay worked well enough for my experiment, I the exact equilibrium between iron (III) and salicylic acid remains a curiosity; I would like to look further to determine exactly why the iron of my assay appears to disobey LeChatlier#s Principle by becoming less reactive at higher concentrations.

Summary Statement
By working on this project, I successfully accomplished my objective by developing an iron (III)-based assay of 0.01 molarity that could be used to acurately test aspirin that I had synthesized, and to test expired, decomposing aspirin.

Help Received
I used equipment from the Stevenson School chemistry laboratory; my mentor Dr. Wenzel helped me understand asprin, and outline procedures for how to accurately perform the experiment and then helped me analyze bizarre results; my mother helped me collect aspirin samples from my neighbors.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Mikael H. Matossian

Project Number
S0514

Project Title
Plasma Treatment of Automotive Engine Exhaust

Abstract

Objectives/Goals
The objective of my science project was to use a plasma discharge to modify the Nitrogen Dioxide (NO2), Nitrogen Monoxide (NO), Carbon Monoxide (CO), and Hydrocarbon (HC) composition of automotive exhaust gas. My hypothesis is that since plasmas use high-voltage electric fields to ionize, dissociate, or modify gases into different species, it should be very effective in modifying the composition of automotive exhaust gas and may have advantages over conventional catalytic converters.

Methods/Materials
MATERIALS
- Plasma created by high-voltage plasma generator
- Automotive exhaust simulated by radio-controlled (RC) nitromethane car
- RAE colorimetric gas detection tubes

METHODS
1. Plasma production kept constant during all tests.
2. Automotive exhaust gas flow rate kept constant by stable operation of RC car.
3. Gas concentraion levels measured 3 times for stability and reproducibility.

Results
1.Plasma treatment of nitromethane exhaust was very effective in reducing the the two most noxious components (CO and NO) to non-measureable levels.
- Specifically, plasma treatment reduced the CO and NO concentration levels by over a factor of 40.

2.Plasma treatment of nitromethane exhaust increased the NO2 and HC concentration levels.
- Specifically, plasma treatment increased the NO2 concentration levels by factor of 80 and the HC concentration levels by a factor of 4.

Conclusions/Discussion
Plasma treatment is a non-thermodynamic technique that can effectively modify the chemical compositions of exhaust gases. Nitromethane exhaust, which has similiar composition to actual automotive engine exhaust, is comprised of CO and NO, as well as NO2 and HC's. Plasma treatment reduced the concentrations of CO and NO to non-measurable levels. In contrast, it increased the concentrations of NO2 and HC's. Plasma treatment could be used in conjuction with conventional catalytic converters to improve conversion of toxic exhaust gases into more benign species.

Summary Statement
Plasma treatment of automotive engine exhaust can eliminate NO and CO emissions to non-measureable levels.

Help Received
1. Professor Antonio Machado (CSUN) helped me understand the various chemical reactions in nitromethane fuel exhaust. Father helped with assembly of the high-voltage plasma generator.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Saraf Nawar

Project Number
S0515

Project Title
Synthesis of Novel Zintl Phase Compounds for Thermoelectric Applications

Abstract

Objectives/Goals
Synthesis of doped Zintl phase compound and structural and thermoelectric analysis

Methods/Materials
metal flux synthesis technique was used to synthesize the doped compounds. Subsequent characterization by x-ray powder diffraction and other properties.

Results
Synthesis of viable doped compound on high yield. Stuctural characterization indicated a ideal compound.

Conclusions/Discussion
Novel compound was synthesized.

Summary Statement
Synthesis of new Zintl phase compounds to be used for thermoelectric applications

Help Received
worked at UC-Davis chemistry lab

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Nicholas L. Okita

Project Number
S0516

Project Title
The Correlation Between Conductivity and Corrosion Potential of Solutions in Simulation of an Oil Field Environment

Abstract

Objectives/Goals
To determine the correlation between conductivity and corrosion rates in various solutions in simulation of a typical oil field environment.

Methods/Materials
Part I: Carbon-steel corrosion coupons (3#x.5#) were weighed and placed in the following solutions: sodium chloride solution, produced water (from an oil field), hydrochloric acid (pH 4), and carbon dioxide solution (pH 6). The solutions were sealed and placed at either room temperature or 50ºC (120ºF) for one week. The coupons were then removed, cleaned of excess corrosive residue, and the final mass was obtained. Each solution was tested ten times at both temperatures for a total of 80 trials.
Part II: An LPR probe was placed in each of these solutions for one hour at both temperatures. A reading [in mils per year] was then obtained from the probe. A conductivity reading was taken using a conductivity probe.

Results
The coupon results show that hydrochloric acid was the most corrosive (when heated it had 68.33 mpy and 55.01 mpy at room temperature). The carbon dioxide demonstrated an average loss of 7.72 mpy when heated and 11.39 mpy at room temperature. Produced water showed an average loss of 4.44 mpy when heated and 1.16 mpy at room temperature. Sodium chloride solution was the least corrosive with 1.35 mpy when heated and .77 at room temperature. The LPR Probe demonstrated similar results with the hydrochloric acid being most corrosive (2281.11 mpy heated, 209.68 room temp.), followed by produced water (209.68/125.76), and sodium chloride (100.40/43.48). The conductivity results also mimic this progression.

Conclusions/Discussion
My hypothesis was supported by the data. Hydrochloric acid was far more corrosive then all of the other solutions. With excess hydronium ions in solution in the acid, the formation of hydrogen gas (and therefore the loss of electrons from the metal) is greatly increased. This allows for the oxidation of iron to be much more prevalent (which indicates that greater amounts of iron would be lost into solution as oxidized ions). In general, the effects of heat produced a more corrosive environment. As conductivity increased, the amount of corrosion also increased. While the conductivity meter is not perfect, it can be useful in understanding general corrosion trends of a solution. For a low budget project that needs supportive results, the conductivity meter can be used effectively.

Summary Statement
To determine the correlation between conductivity and corrosion rates in various solutions in simulation of a typical oil field environment.

Help Received
Mr. Jim Griffin provided the LPR probe; my dad helped come up with the project idea; and my mom assisted with the assembly of the board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Aurora L. Ostrom

Project Number
S0517

Project Title
Deposition of Metal Coatings on Nanoparticles in an Ionic Liquid

Abstract

Objectives/Goals
The purpose of this project is to coat nanoparticles of silver, zinc, tin, and iron oxide with copper (from copper nitrate) and nickel (from nickel nitrate) in the presence of an ionic liquid. Ionic liquids have previously been used to synthesize nanoparticles, but they have not been used to coat them. It is hypothesized that this should be possible since the nanoparticles would provide a site for depositing the metal, which is expected to be more favorable than generating nanoparticles of copper or nickel.

Methods/Materials
In this experiment, microwave heating of copper nitrate and then nickel nitrate dissolved in 1-butyl-3-methylimidazolium tetrafluoroborate in the presence of nanoparticles was performed in an effort to coat copper and nickel onto each different metal nanoparticle. UV-Visible spectrophotometry was used to analyze the solutions before and after heating. Coating formation would be identified by changes in the spectrum of the nanoparticles suspended in the ionic liquid after heating. For comparison, additional spectra were collected from the ionic liquid, copper nitrate, nickel nitrate, and each of the metal nanoparticles.

Results
Spectra collected from test solutions before heating were compared with those taken after heating. Post-heating spectra show the formation of a new absorption peak that did not come from the ionic liquid, the copper nitrate, nickel nitrate, or the metal nanoparticle added. Photographs taken before and after heating also document this change.

Conclusions/Discussion
The new absorption peak present in the spectra collected after heating is attributed to the deposition of copper (in the case of copper nitrate experiments) and nickel (in the case of nickel nitrate experiments) onto the nanoparticles present in solution. These results support my hypothesis that it is possible to deposit metal coatings on nanoparticles using an ionic liquid.

Summary Statement
This project attempts to coat different metal nanoparticles with copper and nickel using an ionic liquid and analyze the results spectrophotometrically.

Help Received
I used chemcials and lab equipment at the Naval Air Warfare Center (China Lake), where Dr. Andrew Guenthner was the qualified scientist. My father completed the application and supervised experiments.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Rachel E. Palfini

Project Number
S0518

Project Title
Is Mercury Released from Dental Amalgam in an Acidic Environment?

Abstract

Objectives/Goals
The purpose of this experiment was to determine if mercury is released from silver amalgam dental fillings in different acidic environments that simulate the human body.

Methods/Materials
Dental amalgam fillings were placed in 12 extracted wisdom teeth. The teeth soaked in 3 different pH solutions of pH1, pH4 and pH7 for 48 hours. After 48 hours, the teeth were removed and the solutions were tested for the presence of mercury. A mercury test swab was used to that detects the presence of 2 micrograms of mercury in solution.

Results
The solutions of pH 4 and pH7 all tested positive for the presence of mercury while the solutions of pH1 tested negative. I observed the same result in all 4 trials of each pH solution.

Conclusions/Discussion
My tests indicate that mercury is released from dental amalgam fillings in an environment of pH4 and pH7 but not pH1. Although the pH4 and pH7 solutions tested postive for mercury, I was not able to quantitate the amount of mercury released. Numerous health authorities have concluded that trace amounts of mercury do not adversely effect human health. This was an unexpected result as I expected the mercury in dental amalgam to react more in an acidic environment, not a neutral or mildly acidic solution.

Summary Statement
I wanted to test if mercury is released from dental amalgam in pH environments similar to the human body.

Help Received
Chemicals and equipment were borrowed from Annie Tibbets at Laguna Hills High School, Dr. Roberta Dornan (mother) let me use her office to drill teeth and place amalgam fillings, Dr. Richard Mandel provided the extracted wisdom teeth.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Jayant S. Sirdesai

Project Number

S0519

Project Title

Evaluation of Drinking Water from Various Sources: Does Bottled Water Have More Contaminants than Other Sources of Water

Abstract

Objectives/Goals

The objective of this project is to test for impurities and contaminants of various water sources in order to perhaps prove that bottled water does have more contaminants than other sources. This experiment was run in order to test for which water source relatively had the greatest number of impurities. The ultimate goal was to see bottled water and ice maker waters as the most contaminated sources out of those that were tested.

Methods/Materials

The materials used were Waters from various sources,a Manifold,bacterial broths,petri dishes,Filter paper,Autoclave,GC-MS,HPLC,Meltemp,sugar,a heater, pH meter,Chlorine meter,and a Becton Dickinson ampoule for Oxidase tests. The Methods used to test the various sources of water were HPLC,GC-MS,Chlorine tests,pH and conductivity,Bacterial tests,and melting point.

Results

HPLC results showed that Irvine and North Hollywood Tap Waters had the highest TDS counts, which shows that they were the most contaminated sources; meanwhile, bottled water had the second lowest TDS count. GC-MS results showed that both the Bottled water and Old bottled water had 198 and 82 peaks respectively leaving them as the most contaminated sources based on this experiment. The Chlorine tests resulted in both the tap waters 1.28 and .58 parts per million of Chlorine; thus, the tap waters were the most contaminated source in this experiment. The Melting POint Data showed that Irvine Tap water had the greatest deviation in temperature from the control,leaving it as the most contaminated; however, bottled water was the closest to the control leaving it as the least contaminated source. The conductivity test reculted in Irvine Tap water having 1064 in comparison to most others that had around 200. Irvine tap water's pH was also fairly low in comparison to the others,which had 7,as it had a pH of 5.01. The bacterial test resulted in bottled water having a too numerous to count result for the TGE broth and it tested positive for oxidase test.

Conclusions/Discussion

Although many results deviated from one experiment to another, the general conclusion was that Irvine Tap Water was the most contaminated source of water that was tested. I was incorrect by hypothesizing that tap waters were less contaminated than bottled waters, but I was successful in proving that bottled water and ice maker water did have many contaminants.

Summary Statement

This project tests to see if bottled water, which is thought to be the purest source by many people, actually has more contaminants than various other sources of water.

Help Received

Professor Prasad Tongaonkar from UCI Department of Pathology helped me with HPLC tests; Rohani Effendi a chemist at OPI helped me perform GC-MS; Susanna Tsang a chemist at OPI helped me perform bacterial tests;

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Clayton P. Skousen

Project Number
S0520

Project Title
Electrical Cleavage of Mineral Ore: A Series of Tests Seeking to Extract Metals from Ore by Electrolysis

Abstract

Objectives/Goals
If an electrical current passes through an ore that contains certain metals, while in a saline solution, then metals will be emitted off the ore in small molecular amounts.

Methods/Materials
Roughly 50 pounds of Barium ore were extracted from an abandoned open pit mine in the High Sierras. The ore was cut into small cubes using a rock table saw. The actual size of the barium ore cubes varied slightly. A circuit with a switch was built using a 6-volt battery. The wire coming off the switch had an alligator clip soldered on, that held a conducting rod. A 4-oz container filled with 4 tbs of saltwater was placed in the circuit. The rod was placed in a stable position in the saltwater through a hole drilled in the lid. The ore samples were dipped into the salt solution and placed in a large alligator clip and dangled from the lid through a second hole in the container lid. The ore sample was suspended in the salt water near the rod. The lid was placed on top of the container holding the salt solution. The clip with the rod was placed into the salt water through the hole drilled for it. A timer was set for the specific test time limit (1, 2, 3, 4, 8 and 12 hour tests). Both timer and switch were turned on simultaneously. After testing, the circuit was turned off, and the rock dried. Test products were taken to a radiology unit where they were x-rayed for metal extraction evidence. Samples were then taken to the Edwards AFB#s Hazmat Lab, where they were processed by an ICP-MS, which analyzed the amount of Barium in the ore.

Results
After all of the ore samples were tested they were re-weighed; all of the samples weighed the same as they did before tests were conducted. The x-rays revealed no additional information due to the high amounts of salinity in the solutions. Fortunately that was not a problem for the ICP-MS.

ICP-MS Results (concentrations are in ug/L)

Container-	1	2	3	4	5	6	7	8	9	10	11	12
Barium-	12400	1609	13141	2698	8696	3217	4301	5360	2829	3480	9424	33058

Though the amount of Barium varied in the tests. There was still plenty of evidence that there was barium emitted from the ore samples. In fact, roughly 33,000 ug/L of Barium was found in test 12.

Conclusions/Discussion
Overall, the data did support the hypothesis, barium was extracted from the ore samples through electrolysis.

Summary Statement
The purpose of this project is to create an easier and safer way for miners and scientists to extract metals from ore.

Help Received
Father helped type report; Used lad equipment at a BEAL lab; a friend helped me learn the basics of electrolysis, Used x-ray machine at Edwards AFB Clinic

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Joseph S. Stearns

Project Number
S0521

Project Title
Electrophoresis

Abstract

Objectives/Goals
The objective is to determine what the relationship is between molecule size and pigment of food coloring dyes.

Methods/Materials
An electrophoresis chamber was constructed, and an agarose-based gel was used in the electrophoresis process. Five dye samples were placed in the chamber and separated through electrophoresis in order to determine the relationship between molecule size and pigment color.

Results
The orange dye was found to have the smallest molecules, followed by purple, red, and then blue. This dye order held true throughout the two hour electrophoresis process.

Conclusions/Discussion
The results of my experiment indicate that under certain conditions the dye pigment of lightest color has the smallest molecules. Further testing is needed to determine if this theory holds true under other circumstances.

Summary Statement
It was shown, using electrophoresis, that dye samples of lighter color have smaller molecules than dye samples of darker color under certain conditions.

Help Received
My mother was the photographer for this project, who took and formatted all the pictures of the experiment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Or S. Weizman

Project Number
S0522

Project Title
Synthesis and Characterization of a Self-Healing Polymer

Abstract

Objectives/Goals
Polymers are very useful materials that are used in many applications, but over time they undergo wear and tear. An appealing solution to this problem is the creation of self-healing polymers, polymers that have the ability or mechanism to self-repair cracks that form in them. The objective of this project is to synthesize building blocks for a new polymer that is cross-linked by Diels-Alder bonds. The reversibility of the Diels-Alder reaction allows the polymer to be repeatedly mended under mild heating condition. The design of the new polymer is based on cross-linking between maleimide and furan groups. The new monomer has a different symmetry from previous works, which makes it less flexible and is made by fewer synthetic steps. The new design will create an easy to synthesize monomer that can be polymerized to give a polymer that regains its resistance to fracture.

Methods/Materials
New molecules were synthesized using organic chemistry techniques. The reactions were set under inert conditions (under argon) using dry solvents. The compounds were isolated by extractions and column chromatography. The structure of the molecules was then confirmed by Nuclear Magnetic Resonance and Mass Spectrometry. The monomers were polymerized under different conditions followed by Differential Scanning Calorimetery to study the formation and behavior of the polymer.

Results
I was able to successfully synthesize two monomers. Nuclear Magnetic Resonance and Mass Spectrometry confirmed that the desired monomers are indeed the molecules that were designed. The monomers were polymerized under various conditions to form stable polymers. Differential Scanning Calorimetery studies showed an increase in the melting temperature compared to previous polymers. While having higher melting point, the new monomer 3FT is synthesized in fewer steps and has a higher chemical stability at room temperature. Heating and quenching experiments demonstrated the reversibility of the Diels-Alder reaction that allows the polymer to be repeatedly mended under mild heating condition.

Conclusions/Discussion
Modifying the symmetry and flexibility of the furan building block resulted in more chemically stable monomers and thermally stable self-healing polymers

Summary Statement
New molecules were synthesized and polymerized to form a polymer that is capable of self-repairing cracks

Help Received
Worked at University of California San Diego under the supervision of Christian Nielson and Professor Nemat-Nasser

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Emily W. Banks

Project Number
S0599

Project Title
The Effects of Dye on Different Types of Fabric

Abstract

Objectives/Goals
I love tie-dying yet I am often disappointed by the end result. Some fabrics just don't absorb dye as well as others, which makes me wonder: how exactly does dye work? Do different colors of dye have more impact on a fabric? Do different fabrics react and absorb dyes with varying outcomes? My experiment attempts to answer these questions by testing a given dye's effectiveness on a wide range of fabrics.

Methods/Materials
For my experiment, I chose four natural fibers (cotton, silk, linen, and wool), three synthetic fibers (polyester, rayon, and spandex), and one control fabric (cotton) and submitted them to the same dying process. In order to get the most accurate results, I repeated the dye process six times with different sets of fabric samples.

Results
I hypothesized that there would be significant variation across the different fabrics in terms of absorption of the dye, that the natural fabrics would absorb the dye more effectively than the synthetic fibers, and that the cotton would bond the best with the dye overall. According to both my data and further research, this assumption was correct.

Conclusions/Discussion
The purpose of this experiment was to test a given dyes effectiveness on a wide range of different types of fabrics. I wanted to see just what would happen so that when I ever tie-dye in the future, I might know just what to expect after the dying process is completed. At the start, I hypothesized that there would be significant variation across the different fabrics in terms of absorption of the dye, and that the natural fabrics would absorb the dye more effectively than the synthetic fibers, and that the cotton would bond the best with the dye overall. All of the different components of this hypothesis were supported by the data I collected. This is because cotton ended up being the fabric with the best scores, meaning closest to 100% saturation and 50% luminance, with an average of 100% saturation and 40% luminance. Because cotton is a natural fiber, the data I collected also supported that segment of my hypothesis. There was also a great deal of variation between each fabric, which supported the first segment of my hypothesis.

Summary Statement
My experiment attempts to explain how and why the chemicals in dye react differently with different types of fabric.

Help Received
I performed this experiment on my own.