



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Laura A. Beyer	Project Number S0501
Project Title The Effect of Sodium Lactate on the Saponification Process	
Abstract Objectives/Goals To determine if sodium lactate is a beneficial additive in soap. Specifically does it affect the pH level, or affect or accelerate dehydration? Methods/Materials For each test I made five small batches of soap. The control batch had no sodium lactate; the remaining four batches had varying rates of sodium lactate. pH levels were measured every five days and a sample bar from each batch was weighed daily for a minimum of three weeks. Results My tests showed that sodium lactate does not significantly affect the pH level, or the dehydration that is typical during saponification. The pH was very close or even a little higher on the soaps with sodium lactate. Likewise, the bars with sodium lactate weighed the same or very close to the bars without sodium lactate throughout the tests. Conclusions/Discussion The primary benefit of lowering the pH of soap is to produce a milder soap. Accelerating dehydration would produce a soap that is ready to use or sell sooner. I have concluded that sodium lactate does not significantly affect either of these properties, and thus would not be considered a beneficial additive for these purposes. However, I did notice that the texture of the soap with sodium lactate was smoother than soap without. This suggests there may be other reasons to consider sodium lactate as an additive.	
Summary Statement Determining the effect of sodium lactate on saponification.	
Help Received My mother provided general guidance on this project.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Stephanie R. Debats	Project Number S0502
Project Title Effect of Concentration and Temperature on the Optical Rotation of Aqueous Solutions of Sucrose, Fructose, and Glucose	
Abstract Objectives/Goals The purpose of this experiment was to determine how the optical rotation of aqueous solutions of sucrose, fructose, and glucose is affected by concentration and temperature. Optical rotation is caused by the chiral properties of these three sugar molecules. The hypothesis was that as the concentration or the temperature of the solutions increased, the optical rotation would also increase. Methods/Materials A polarimeter was used to measure the optical rotation of a beam of polarized light projected through solutions of sucrose, fructose, or glucose at various temperatures or concentrations. Results As the concentrations of the all three sugar solutions increased, the optical rotation also increased. As the temperature of the solutions increased, the optical rotation increased for sucrose and decreased for fructose and glucose. Conclusions/Discussion There is a direct correlation between concentration and optical rotation. As concentration increases, the number of molecules possessing chiral properties also increases, resulting in greater optical rotation. The relationship between temperature and optical rotation is less distinct, requiring further investigation.	
Summary Statement This project is an investigation of the chiral properties of sugars and the factors affecting the optical rotation of sugar molecules in aqueous solution.	
Help Received I borrowed laboratory equipment from my school, Woodbridge High.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Jennifer Dong	Project Number S0503
Project Title Photooxidation of Cobalt-Bound Thiolato Ligands	
Abstract Objectives/Goals The goal of this project was to determine how reaction rate of the complex bis(ethylenediamine)-(-2-amino propane thiolato - N,S)cobalt(III)chloride differs when photooxidized in varying solvents. Methods/Materials The complex was diluted with three different solvents: Dimethylformamine (DMF), water, and methanol. A sensitizer, Methylene Blue was also added to the mixture. A strong light lamp was shined at the mixture while oxygen was bubbled into the mixture through a hypodermic needle from above. The light excited the sensitizer, which then was able to transfer the acquired energy to the oxygen being bubbled in. The excited oxygen, now called singlet oxygen, was able to react with the complex in the mixture. Each solvent mixture was photooxidized for different intervals of seconds. After each time period of photooxidation, some of the mixture was quickly transferred to a Cary 300 Bio UV Visible Spectrometer, which plotted the mixture's absorbance wavelength. The reaction was then continued. This procedure was repeated for each solvent mixture. Results From the absorbance wavelengths taken from the UV-Vis, Oxidation product of the complex dissolved in Dimethylformamine had highest absorbance after only 45 seconds of photooxidation. The oxidation product of the complex reacted in water had the highest absorbance at 15 minutes of photooxidation. The oxidation product of the complex reacted in methanol had the highest absorbance after 8 minutes of photooxidation. Conclusions/Discussion From the results, it can be concluded that oxidation product was able to form more quickly when the complex was dissolved in Dimethylformamine than when the complex was dissolved in water or in methanol. Water's highly polar structure is probably the reason for this; water was probably able to bond to the complex and stabilize the intermediates, inhibiting the reaction to occur quickly to full completion. Water also displays protic behavior. DMF, on the other hand, is also polar but displays aprotic behavior and does not form bonds to other things as readily as water does. Methanol is also protic, like water, but doesn't behave like water does to that extreme; therefore, it accumulates the most oxidation product at a time period between the time DMF and water accumulate the most of their oxidation product.	
Summary Statement A comparison of reaction rates during photooxidation of the complex cobalt cystamine in varying solvents	
Help Received Used lab equipment at the California State University of Los Angeles under the supervision of Dr. Matthias Selke; received help from lab mentor Cesar Galvez to understand the chemical phenomena involved.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Jennifer Duncan; Rachel Nuno	Project Number S0504
Project Title Are Your Clothes Really Clean?	
Objectives/Goals The objective is to determine which laundry detergent (comparing Tide, Cheer, Oxy Clean, and Store Brand) removes stains from cotton the most effectively.	
Abstract	
Methods/Materials Twelve Hanes white 100% cotton t-shirts were put through a rinse cycle to remove any manufacturing residue. The t-shirts were then stained with 15ml of grape juice, mustard, spaghetti sauce, and grass; and were then hung for 5 hours to dry. The t-shirts were then washed one at a time in 120ml of each type of detergent (Tide, Cheer, Oxy Clean, and Store Brand(generic)). They were then hung until dry.	
Results In each of the three trials, Tide eliminated stains more efficiently than each of the other brands of detergent. In Trial #1 on a scale of 1-5 with 1 being whitest, Tide ranked a 3 in grass, 2 in spaghetti sauce, 3 in mustard, and 2 in grape juice. In Trial #2 Tide ranked 2 in grass, 3 in spaghetti sauce, 2 in mustard, and 1 grape juice. In Trial #3 1 in grass, 2 in spaghetti sauce, 3 in mustard, and 2 in grape juice. The overall average of Tide is 2.16 in whiteness.	
Conclusions/Discussion The Tide proved to be the best overall detergent (comparing Tide, Cheer, Oxy Clean, and Store Brand) at removing stains from cotton.	
Summary Statement This project tested the stain removing ability of Tide, Cheer, Oxy Clean, and Store Brand detergents.	
Help Received N/A	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Nick R. Ennis	Project Number S0505
Project Title Exposure of Super Absorbent Polymers to Time and Natural Elements	
Objectives/Goals My objective is to observe the effects of time and weather on the application of crystalline and amorphous Super Absorbent Polymers in domestic fire prevention. Also, I want to study the configuration and conformation of cross-linked polyelectrolytes.	
Abstract Methods/Materials To demonstrate how Super Absorbent Polymers can protect household exteriors I constructed small models using common household building materials. In choosing these materials I used stucco as the most common form of household siding in our area, coated with common exterior paint and primer. The most common roofing materials include high definition laminated roofing tiles, and Spanish clay roofing tiles. I applied multiple varying polymer mixtures to the surfaces. After Super Absorbent Polymers membrane formation, I tested their resistance toward direct heat over time, and charted the results.	
Results Due to the drastic temperature changes throughout the winter months of November and December, the membrane formed by the Super Absorbent Polymers became brittle and began to break down. The burning ring increased over the six-week period, indicating that the polymer mixture was not tolerating the environmental elements. Based on the presented data, the Super Absorbent Polymers mixtures absorbed water as expected, swelled in mass, and transformed to a gel like state. The polymer gel created a protective barrier for the stucco.	
Conclusions/Discussion The barrier was effective in protecting the stucco from heat and fire damage initially, however with exposure to a variety of climate changes, the Super Absorbent Polymers began to break down and lose effectiveness. The semi-permeable membrane began to deteriorate and lose effectiveness as a barrier. The combination of amorphous and crystalline polymers created a protective membrane with properties from both types contributing to the effectiveness of the barrier gel.	
Summary Statement My project studies the effects of time and weather on Super Absorbent Polymers by combining crystalline and amorphous polymers in a fire prevention application.	
Help Received My Father supervised the application of fire, and polymers were provided by BASF International	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Doraly Espinoza	Project Number S0506
Project Title Determination of Avogadro's Number	
Objectives/Goals Create a monolayer of oleic acid. Calculate total number of moles of acid by using measured volume and known concentrations. Calculate Avogadro's number by dividing the number of molecules by the number of moles.	
Abstract Methods/Materials Oleic Acid(C ₁₈ H ₃₄ O ₂), watch glass, micro pipette, bottled water, Isopropyl Alcohol 99%, chalk dust, 25ml beaker, plastic gloves, face mask, timer. Investigation One: Diluting Oleic Acid The goal is to achieve a solution that is 1% oleic acid in 25 ml. There are one million micro liters in a liter and one thousand micro liters in a ml(using formula $M_1V_1=M_2V_2$). Investigation Two: Time for Alcohol to Evaporate Determine the time between drops on a water surface, so that the alcohol has time to evaporate. Investigation Three: Determine Avogadro's Number(dividing total number of molecules by total number moles in the layer).	
Results Estimated Value of Avogadro's number: 5.0×10^{19} Percent Error: 99.99% Information needed: density of pure oleic acid(g/cm ³), number of moles, volume of acid in layer, thickness of acid monolayer, number of molecules(assuming acid occupies cubical space). Avogadro's number is the number of particles in exactly one mole of a pure substance. Avogadro's number is 6.022×10^{23} and is rounded to 6.022×10^{23} .	
Conclusions/Discussion Results of experiment were not accurate. The estimated value of Avogadro's number is 5.0×10^{19} . Far from Avogadro's true number(6.022×10^{23}). Percent error was high at 99.99%. Avogadro's ideas explain the relationship between mass and the number of atoms. Possible Mistakes: dilution of oleic acid too drastic, use of different solvent(for dilution), volume of drops used per trial, number of trials.	
Summary Statement Calculate a value of Avogadro's number by spreading a film of oleic acid one molecule thick over a water surface.	
Help Received My chemistry teacher and my mom helped me to get my materials.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Daniel O. Fishman	Project Number S0507
Project Title Photoinduced Electron Transfer and Spectral Analysis of Anthocyanin Based Organometallic Dyes	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The Objective was to determine if the addition of transition metal compounds to anthocyanin (a naturally occurring photosynthetic plant dye) affected the dye's absorption spectrum and electron transfer characteristics. Could a relationship be shown between the intensity or wavelength of the light absorbed by an organometallic dye and its electron transfer efficiency?</p> <p>Methods/Materials The absorption spectrum of anthocyanin dye (cyanidin-3-glucoside) in distilled water was measured between 350nm and 995nm using an ultraviolet/visible light spectrometer. The absorption spectra of several transition metal compounds in water and mixed with anthocyanin dye were also measured under identical conditions. These same mixtures of metallic compounds and anthocyanin formed new organometallic dyes which were used to construct dye-sensitized solar cells. By measuring the voltage and current outputs of these cells, the electron transfer properties of the organometallic dyes were evaluated.</p> <p>Results Most of the organometallic dyes showed higher light absorbance over a larger range of frequencies than pure anthocyanin. However, several compounds, especially the acetates, actually had a decrease in absorbance. There did seem to be a direct relationship between light absorbance at 500nm and pH. There also seemed to be a correlation between pH and solar cell current. Only cells made from nickel chloride produced both higher average current and voltage than those of pure anthocyanin.</p> <p>Conclusions/Discussion Light absorbance for anthocyanin in water peaks around 500nm (there may be other peaks in the near ultraviolet spectrum beyond the range of the spectrometer used in this experiment). Data indicates that bonding and electron transfer between anthocyanin and metallic compounds increases as the pH decreases. Compounds therefore with a pH of around 1.5-2.0 and light absorbance that peak at 500nm will yield an organometallic dye that produces strong currents. Results indicate that further research using nickel chloride may produce dyes with superior electron transfer capabilities. Research into clean and renewable energy sources such as dye-sensitized solar cells may hold the key to sustainable and continued life on this planet.</p>	
Summary Statement This experiment indicates that there may be a relationship between the absorption spectra of certain anthocyanin based, organometallic dyes and their electron transfer capabilities in dye-sensitized solar cells.	
Help Received Margaret Carlberg answered questions---Mr Antrim provided spectrometer and chemicals	



CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s) Henry Fong; Johanna Tang; Allen Tran	Project Number S0508
Project Title Quantum Yield Studies of Singlet Oxygen Production by Bis-cyclometalated Ir(III) Complexes	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To measure the quantum yields of singlet oxygen production of five bis-cyclometalated Ir(III) complexes.</p> <p>Methods/Materials Five Iridium(III) complexes (BSNIr*, BSNIrG, BTIrPy, BTIrG, and FIrPic) were investigated for their quantum yields of singlet oxygen production through time-resolved infrared luminescence spectroscopy. Quantum yields were obtained in various solvents. Quenching rates were also measured by similar principles.</p> <p>Results At 532 nm in benzene, the quantum yield of singlet oxygen production of BSNIrG (Quantum yield = 0.81), BTIrPy (Quantum yield = 0.95), and BSNIr* (Quantum yield = 0.77) are all above those of our standard, TPP (Quantum yield = 0.62), whereas BTIrG (Quantum yield = 0.43) are below our standard. At 355 nm in benzene, the quantum yield of FIrPic (Quantum yield = 1.0) and BTIrPy (Quantum yield = 0.96) are above those of our standard, TPP (Quantum yield = 0.62), whereas BSNIr* (Quantum yield = 0.60), BSNIrG (Quantum yield = 0.54), and BTIrG (Quantum yield = 0.50) are below our standard.</p> <p>Conclusions/Discussion Comparison of quantum yields in benzene shows that FIrPic has the greatest quantum yield. The decrease of FIrPic's quantum yield in methanol (Quantum yield = 0.46) indicates that H-bonding stabilizes its first excited state. There seems to be some correlation between a red shifted sensitizer, which has a high quantum yield, and a more blue shifted sensitizer, which has a considerably lower quantum yield.</p>	
Summary Statement This project measured the quantum yields on Iridium(III) complexes for its potential application in photodynamic therapy.	
Help Received Use lab equipment at California State University, Los Angeles under the supervision of Dr. Matthias Selke and Billy Hernandez.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Amreeta K. Gill	Project Number S0509
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Project Title
Improving Hydrogen Production in the Electrolytic Cell of a Solar Hydrogen System: A Third Year Study

Abstract

Objectives/Goals
My objective is to increase the amount of hydrogen evolved in the electrolytic cell of a solar hydrogen system by varying the type and the concentration of the electrolytes, the surface area of the electrodes, and the distance between the electrodes.

Methods/Materials
The manipulative variables were the cations and anions of the electrolytes with varying molarity, and the size and the distance between the electrodes. The controls throughout the experiments were the steel electrodes and the input voltage. The performance parameters were the amount of hydrogen evolved with respect to the electrolytic concentration, distance and size of electrodes, and conductivity of the electrolytes. Using stoichiometric calculations, aqueous solutions of varying molarity for each electrolyte were created. The distances between the electrodes and the surface area of the electrodes were varied. The volume of hydrogen, conductivity and pH was measured for each molarity. Mean and standard deviation were computed for error estimation. Materials: 4 photovoltaic panels, electrolyzer, electrolytes of varying sizes and charges of the cations/anions, steel electrodes of different surface areas, digital multimeter, conductivity meter, pH meter, 0.1 ohm resistor.

Results
Hydrogen production increased with increasing electrolytic concentration for all electrolytes with KOH producing the most hydrogen. The electrodes with a larger surface area produced more hydrogen ($R^2=0.9796$). The amount of hydrogen produced increased as the distance between the electrodes was reduced ($R^2=0.9899$).

Conclusions/Discussion
The increase in hydrogen evolution with increased electrolytic concentration is because of a greater number of effective ionic collisions in unit time. The production of hydrogen increased in the order of increasing ionic radii with respect to both anions and cations, following the Hofmeister series. Hydrogen production also increased with increasing electrolytic conductivity. With decreasing distance between electrodes, the electrical charge increases and the resistance of the solution decreases, thereby producing more hydrogen. The electrodes with larger surface area produce more hydrogen because there is more surface area for the reaction to occur. Consistent with Faraday's first law of electrolysis, the charge passed was directly proportional to the amount of hydrogen produced.

Summary Statement
The amount of hydrogen evolution in the electrolytic cell of a solar hydrogen system can be increased by increasing the electrolytic concentration, the surface area of the electrodes, and by decreasing the distance between the electrodes.

Help Received
Used lab equipment at California State University, Fullerton, under the supervision and guidance of Prof. Katherine Kantarjieff and Dr. Steven Herron. Ms. Shannon Regli, my science teacher, provided advice. Parents helped make the display board.



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Mackenzie M. Grieman	Project Number S0510
Project Title Investigating Halide Anion Interaction with Water Molecules	
Abstract Objectives/Goals The objective of this experiment is to determine the difference in energy interactions of halide anions of different sizes with water and what they may depend on. Methods/Materials A calorimeter was used to determine the enthalpy of solution of a series of sodium halides. Each of these values were then added to their respective sodium halide lattice energy to find the energy involved in the interaction of gas phase ions with water molecules. These results were then plotted to determine their dependence on the anion radii and volumes. Results It was discovered that the smaller the anion, the more exothermic its interaction with water. More of a linear relationship was found with the radii than with the volumes. Conclusions/Discussion Because the linear relationship is better between the ionic radii and the change in enthalpy of solution, I am led to believe that the closeness of the water molecules to the ions is more likely to be the reason for the anions interacting differently with water than the number of water molecules that interact with each ion. I would like to further study these anions by using other salts to test this conclusion to learn if it is correct. It would also be fascinating to investigate difference of interaction between cations and water molecules.	
Summary Statement Heat of solutions were used to study the interaction of halide ions with water molecules.	
Help Received Used lab equipment at Pomona College.	



CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s) Amber V. Hess	Project Number S0511
Project Title Organic Chemistry without Solvents	
Abstract Objectives/Goals The purpose of this experiment is to investigate "solvent-free" aldol condensation reactions. Solvent-free reactions in industry would reduce costs because there are fewer steps than a reaction with solvents. There are also fewer dangerous by-products to get rid of, making solvent-free reactions environmentally friendly. It is hypothesized that the chemicals Veratraldehyde and 1-Indanone will react with the catalyst NaOH when ground together in a mortar and pestle without solvents. Methods/Materials The chemicals Veratraldehyde and 1-Indanone were ground together with a base catalyst NaOH in a mortar and pestle. Samples of the mixture were taken at specific time intervals and tested with thin-layer chromatography (TLC). Different concentrations of hexane and ethanol were used in the TLC chamber to shorten or heighten the difference between the spots seen on the TLC slides. Rf values for the slides were calculated to compare the original chemicals with the new product. NMR was used after the experiment to verify results. Results The TLC slides show that the reaction between Veratraldehyde and 1-Indanone appears to have reacted completely and formed a single product. However, the NMR, which is more accurate, shows that the reaction went approximately 90% to completion and formed equal quantities of two isomers which are alpha, beta unsaturated ketones (or enones). Conclusions/Discussion This experiment shows that a solvent-free aldol condensation reaction is possible, establishing that the hypothesis is correct. This solvent-free method is possibly the start of a huge renovation to present techniques in organic synthesis if the method works for other chemicals.	
Summary Statement I proved that environmentally friendly, "solvent-free" aldol condensation reactions are possible.	
Help Received Dr. Geoffrey Dreyer of Applied Biosystems (and a Science Buddies Advisor) answered my questions by email when I needed help. Varian, Inc., Palo Alto, California, donated time on a MERCURYplus NMR spectrometer, and Dr. Jarrett Farias assisted me in running the machine.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Ben Laniado	Project Number S0512
Project Title An Inexpensive Microscale Method for Studying the Laws of Definite and Multiple Proportions	
Abstract Objectives/Goals The laws of definite and multiple proportions were major clues leading to the atomic theory. We have devised a method to observe both laws in a simple inexpensive microscale experiment. Methods/Materials . Steel wool was burned in air. The product was characterized as iron(II) iron(III) oxide (Fe_3O_4) in a yield of $105\% \pm 7\%$. This was treated with hydrochloric acid giving a product that was characterized as iron(III) chloride (FeCl_3 , yield $100\% \pm 3\%$). The FeCl_3 was hydrolyzed and the product was characterized as iron(III) oxide (Fe_2O_3 , yield $107\% \pm 13\%$, at the time of writing) Conclusions/Discussion The good reproducible yields of Fe_3O_4 and FeCl_3 demonstrate the law of definite proportions. The simple ratios of mass of oxygen per gram of iron in the two oxides demonstrate the law of multiple proportions. Further work is needed to improve the precision of the measurement of Fe_2O_3 .	
Summary Statement We observed the laws of definite and multiple proportions using a simple, cheap, fast, method.	
Help Received Teacher did some preliminary experiments. High school lab was used.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Edward Lee; Varun Pulakanti	Project Number S0513
Project Title The Rust Identity	
Objectives/Goals Our objective is to determine the factors that cause rust and determine whether or not nanobacteria/bacteria have a part in accelerating the rusting process.	
Abstract	
Methods/Materials Materials: Iron nails, Jars of equal size and volume, pH tester, soil sample, labels, distilled water, bleach, sand paper, strong disinfectant (any anti-bacterial agents) Methods: 1. Get four glass jars and fill them with purified water. 2. In two of the jars, put bleach in the water to kill all the bacteria. 3. Then take sand paper and clean the nails to take any oil coatings off. 4. Next in the last two jars, put a pinch of dirt from the ground into them. 5. Then place one nail into each jar. 6. Then place one of each jar in the sun and shade. 7. Checked them twice every day and take regular recordings of the weight of the nails.	
Results Our experiment definitely showed these results as the water solution underneath the nails were beginning to show a red tinge, a by-product of the rust. Each day a couple of mg was lost off the nails. Also, we noticed pH change would be able to corrupt the rust. In our control group, we added a bit of HCL to a solution and noticed that the rust increased but the reddish tinge was destroyed. In effect, the nanobacteria that caused the rust most likely died off due to the pH change. Our experiment was pretty much controlled and our only improvement would be able to use a powerful electron microscope, hopefully from a mentor, to actually view the bacteria at work. Also perhaps a more sterile condition would be more suited for most likely more types of bacteria were present in our culture than we believed.	
Conclusions/Discussion Conclusion With respect with the data and observations we took, we concluded that many different environmental factors, simulated in the experiment, caused the process of rusting to occur. Our hypothesized factors of water, bacteria, and air all seemed to be represented by our experiment and one unknown factor, alcohol, was also concluded as a factor to create rust. The first factor obviously was the dissolved oxygen present in the atmosphere.	
Summary Statement Our project is determining the effectors of rust especially the role of nanobacteria in the rusting process,	
Help Received used lab equipment and supervision from Professor Garza-Lopez, received materials such as environmental jars from father's office	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) So-Ky R. Loren	Project Number S0514
Project Title Electroplating	
Objectives/Goals The problem I tried to solve was what would cause more mass of cobalt metal to precipitate out of a cobalt nitrate solution, a greater amount of voltage or a higher concentration of solution.	
Abstract I went about my project by setting up two electrodes in a cobalt nitrate solution. I made a 1, 2, and 3% solution. I would dissolve the cobalt nitrate and then place electrodes into the solution and connect each end to a wire which lead to either a positive or negative side of a battery. I tested 3, 6, and 9-Volt batteries with each concentration. When the electrodes were connected to the battery I would start a timer and wait for 5 minutes. During the five minutes I would then observe what happened, and at the end I would disconnect an electrode to stop the reaction. I would then measure the mass of grams separated by scraping off the cobalt on the electrode and using a filter to collect any flakes in the solution. I would then repeat the process for a total of 3 trials.	
Methods/Materials I went about my project by setting up two electrodes in a cobalt nitrate solution. I made a 1, 2, and 3% solution. I would dissolve the cobalt nitrate and then place electrodes into the solution and connect each end to a wire which lead to either a positive or negative side of a battery. I tested 3, 6, and 9-Volt batteries with each concentration. When the electrodes were connected to the battery I would start a timer and wait for 5 minutes. During the five minutes I would then observe what happened, and at the end I would disconnect an electrode to stop the reaction. I would then measure the mass of grams separated by scraping off the cobalt on the electrode and using a filter to collect any flakes in the solution. I would then repeat the process for a total of 3 trials.	
Results At a 1% concentration I recorded an average of .02 grams separated at 3-V, .30 grams at 6-V, and .35 grams at 9-V. At a 2% concentration I recorded an average of .08 grams separated at 3-V, .3 grams at 6-V, and .53 grams at 9-V. At a 3% concentration I recorded .29 grams separated at 3-V, .6 grams at 6-V, and .75 grams at 9-V.	
Conclusions/Discussion My research told me that when you increase the voltage of a single concentration there will be a greater amount of cobalt separated than if you increase the concentration at a certain voltage. The differences between my trials showed that a low voltage in any concentration caused the metal to become a durable coating, while a high voltage in any concentration caused the cobalt metal to float around in the solution. This shows that low voltages are better at plating objects, while high voltages are better for separating a metal from an ore in order to gather it.	
Summary Statement I wanted to know if a higher voltage or greater concentration would be better for separating more cobalt.	
Help Received My Science Teacher helped me make graphs, my English Teacher checked my work for grammatical errors, all my materials came from the school's science room, and I used a friend's mat cutter.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Jason G. Mak	Project Number S0515
Project Title The Effect of Steam on Gas Combustion for Emission Reduction	
Abstract Objectives/Goals My objective was to lower the amount of toxic pollutants released during combustion. Methods/Materials Undesirable emissions are generally formed at different temperatures in different zones of a diffusion flame during combustion. These emissions may be reduced if the flame structure can be modified to become more homogeneous. An apparatus was built which allowed a controllable amount of steam to mix with a controllable amount of propane during combustion, to homogenize the flame structure, and hence reduce the amount of emissions. Results Results showed that with the correct proportion of steam and gas mixture, the structure of the flame can be significantly modified from a long yellowish flame with separate blue zone to becoming a short and homogeneous pale blue flame with lower amounts of emissions. However, this pure flame exhibits instability and can transition to a flame out unless the amount of steam and gas are maintained to a precise ratio. Conclusions/Discussion Steam can reduce the amount of emissions during combustion, but the amount of steam and gas must be kept at a certain ratio to prevent a flame out.	
Summary Statement By mixing steam with the gas fuel, the amounts of emissions were reduced during combustion.	
Help Received Father helped create apparatus and procedures	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Alison S. Mathis	Project Number S0516
Project Title Ionic Concentration vs. Electrical Conductivity in a Saline Solution	
Abstract Objectives/Goals The objective was to determine if there was an optimum level of concentration (OLC) in a saline solution. Another thing i wanted to find out, was if the temperature had any affect on where the OLC is, if there was an OLC. Methods/Materials After figuring out .25 mole of NaCl was 14.608 grams, I measured the tare weight (a plastic cup) and I added the 9.3 grams to the 14.608 grams and got the number I could use to measure out the .25 mole. I measured out 1 liter of distilled water. After the water was measured, I mixed the .25 mole of NaCl and the 1 liter of water together. I waited 10 minutes for the NaCl to dissolve, then measured out 400 ml. into a 2 cup measuring cup. I put the ohmeter into the water and gave it 10 minutes to satblize. After the reading was recorded, I dumped out the solution and measured another liter of distilled water and then mixed .5 mole of NaCl into the water. I repeated the steps until I got 2 readings that showed that the conductivity worsened instead of getting better. Results The lower temperatues needed larger amounts of NaCl before the optimum level of concentration was found. The gigher the temperature, the less amont of NaCl was needed to reach teh optimum concentration Level (OCL). Conclusions/Discussion My data shows that there is an optimum level of concentration in a saline solution. During my testing, I noticed that the higher temperatures needed less NaCl to reach that level than the colder temperatures did.	
Summary Statement I tested to see if there was an optimum level of concentration in saline solutions.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Dana A. Mead	Project Number S0517
Project Title What Effect Does Substrate Have on Growing Crystals?	
Objectives/Goals My project was to determine if different kinds of substrates will make a difference in how fast or good salt crystals will grow.	
Abstract	
Methods/Materials Label 9 bowls and place in 3 lines which are 1ABC, 2ABC, and 3ABC. Put wood, styrofoam, and charcoal in proper bowls. Day 1 mix 2 tablespoons of each bluing, salt, water, and ammonia then pour in bowls over substrate. Day 2 add 2 tablespoons of salt in each bowl. Day 3 repeat day 1 and don't pour on crystals. Repeat day 1 as needed or when bottom of bowl is dry.	
Results By 24 hours crystals were forming on all the substrate. The wood and the styrofoam had crystals start first. Crystals even grew on the sides and bottom of the bowls. By the end of the project the crystals on the styrofoam were more dense and concentrated. The crystals on the coal were not as dense and concentrated. The crystals on the wood were still finer. The bowls that still had fluid in the bottom did not have crystals formed in the bottom. The styrofoam had white crystals, wood had purple, and coal had blue.	
Conclusions/Discussion I found out that some substrate will allow salt crystals to form quicker than others. Salt crystals will form from vapors and evaporation of the solution. Crystals will form on crystals as the liquid moves to the surface of the new formed crystals. Salt crystals will have a tint due to the minerals in the substrate. The crystals are very fragile and powdery. My conclusion is that salt crystals will start growing faster and will be denser depending on the substrate.	
Summary Statement My project is to see if salt crystals will grow differently on different types of substrate.	
Help Received Grandfather helped gather material for project	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Christopher C. Moore	Project Number S0518
Project Title The Effect of Hydrogen Peroxide as the Main Oxidizer in a Polymer Electrolyte Fuel Cell	
Objectives/Goals The goal of the experiment was to develop and test a polymer electrolyte fuel cell, which utilized hydrogen peroxide, as an oxidizer, as well as a traditional oxidizer of diatomic oxygen found in the atmosphere. Both oxidizers were also tested with variations in temperature and pressure for further comparison between the two main operating differences.	
Abstract Methods/Materials The fuel cell was constructed using nafion 115 as the perflourinated proton exchange membrane, pressed between two plates of a platinum/carbon catalyst. The catalyst also functions as an conductor and passage way which allows the passage of hydrogen ions and hydrogen gas. The cell was operated at various temperatures, and pressures. Trials were done using oxygen as the oxidizer as well as hydrogen peroxide, and the pressure and temperatures were also varied. The performances in terms of voltage DC out were compared from the hydrogen peroxide to the oxygen gas.	
Results The data showed that the hydrogen peroxide did produce a greater electric potential in the cell. It created a larger voltage on average than the oxygen gas did. The voltage of the hydrogen peroxide cell increased with temperature and reached 0.32 volts at a high point, and on average reached 0.30 volts. The oxygen powered cell was also dependant on its surrounding temperature, however its max average voltage reached only 0.28 volts. The hydrogen peroxide cell was drastically affected by the change in hydrogen gas pressure, while the oxygen powered cell remained at a constant voltage output.	
Conclusions/Discussion The percent deviations for the trials involving the change in temperature and pressure remained on average below 5 percent. It would seem that the hydrogen peroxide was able to produce a larger voltage because of the stronger ionization energy, and the therefore greater affinity of hydrogen ions. It is also important to notice that the hydrogen peroxide creates water, which is necessary to keep the cell hydrated at all times. The hydrogen peroxide, when ionized in solution, becomes water which helps reduce the impact of osmotic drag on dehydrating the anode. The hydrogen peroxide liquid, while not greatly improving the performance, does offer a viable alternative to more dangerous and expensive oxidizers such as fluoride or liquid oxygen	
Summary Statement A study of the effects of hydrogen peroxide as an oxidizer in hydrogen fueled polymer electrolyte fuel cell.	
Help Received none	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Jaimie Murayama; Lily Tang	Project Number S0519
Project Title How Do Cleaning Agents Affect Fabrics Colorfastness, Surface Texture, and Strength?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To determine which cleaning agent will deteriorate fabric the most and the least in colorfastness, surface texture, and strength. If fabrics deterioration is related to the cleaning agent, then sodium hypochlorite will cause the fabric to deteriorate the most and liquid Tide laundry detergent in Clean Breeze will cause the fabric to deteriorate the least.</p> <p>Methods/Materials We used four different cleaning agents for our experiment: sodium hypochlorite, liquid Tide laundry detergent, Dawn dishwashing soap, and sodium lauryl sulfate. We used a 6% concentration of each of the cleaning agents. Then, we developed four dilutions of the agent: 100%, 75%, 50%, and 25%. We placed 5 strips of black fabric in each dilution for 30 minutes. We rinsed the fabric and set it out to dry. Then, we repeated the experiment again for a second trial. We tested the fabrics colorfastness by comparing the tested fabric pieces to the original. Then, we tested the fabrics surface texture by comparing the surface texture of the tested fabric to the original under a microscope. To test the strength of the fabric, we placed weights on the end of each fabric strip until the razor blade in the center began to cut.</p> <p>Results In colorfastness, all the fabrics remained the same color as the original except those soaked in sodium hypochlorite. The ones in sodium hypochlorite turned into various shades of salmon pink; the higher the concentration the lighter the color. In surface texture, the ones in sodium hypochlorite had longer strands sticking out all over the place; all the others had short strands sporadically sticking out. In strength, all the strips of fabric took approximately 1,250 grams of weight for the fabric to begin cutting.</p> <p>Conclusions/Discussion In conclusion, we found that our hypothesis was partially correct. The sodium hypochlorite did deteriorate the fabric the most in colorfastness and surface texture, but not in strength. Also, Tide did not deteriorate the fabric the least because the results gathered from it were similar to the results from the other cleaning agents.</p>	
Summary Statement We found that sodium hypochlorite deteriorated the fabric the most in colorfastness and surface texture, but not in strength; the Tide laundry detergent did not cause the fabric to deteriorate the least.	
Help Received This experiment was made possible with the assistance of our chemistry teacher Ms. Wright and the chemistry lab at Notre Dame High School.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Christine E. Nielsen	Project Number S0520
Project Title Affecting Latex Film Formation and Adhesion for Paint Removal	
Abstract Objectives/Goals This project determines whether by applying a surfactant and/or base to the surface prior to painting, latex paint film formation can be disrupted enough to make it easier to remove. It was hypothesized that the application of a combination of base pH and a surfactant would be effective at disrupting the film formation of latex paint enough to make it easier to remove. Methods/Materials The removal of latex paint on coated areas would determined by coating a plate of glass with small squares of several different coating substances. The glass plate was then painted and allowed to dry. The paint was removed by lightly rubbing the painted plate with a sponge. The percentage of paint removal was measured by dividing each coated square into several smaller squares and estimated the approximate percentage of paint removed on each one, and then these values were averaged to find the approximate percentage of paint removed per coating. Results Dish soap, a surfactant, had a significantly higher percentage of paint removal than the other coatings. Ferrous salt did very well when mixed with a surfactant. Also, mixtures with fabric softener work well. Borax does not seem to cause paint removal whatsoever. Conclusions/Discussion Surfactants generally improved the amount of paint removal, whether or not they were mixed with bases. Also, bases did not seem to improve latex paint removal by large amounts by themselves. Further research should be done to find out why bases have less effect than surfactants.	
Summary Statement This project determines whether by applying a surfactant and/or base to the surface prior to painting, latex paint film formation can be disrupted enough to make it easier to remove.	
Help Received Father helped edit report, Mother helped with board	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Sarah L. Nothnagel	Project Number S0521
Project Title Do Acids in Sodas Weaken Orthodontic Bonds?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Three questions were to be answered in this project: 1) Do sodas weaken orthodontic bonds?; 2) Is phosphoric acid in the sodas the reason for weakening?; and 3) Are some sodas worse for bonds than others?</p> <p>Methods/Materials Approximately 100 screws were bonded to bovine teeth with orthodontic cement to simulate the bond between orthodontic brackets and human teeth. These orthodontic bonds were exposed to water, four sodas, 4.46 mM phosphoric acid, 100 mM phosphoric acid, or 100 mM citric acid. The break strength of these bonds was tested at three intervals by suspending each tooth on a platform, hanging a bucket on the screw, and adding sand to the bucket until the bond broke.</p> <p>Results The bonds exposed to water, the sodas, and the lower concentration phosphoric acid showed no significant weakening in bond strength over time. The higher concentration acids did show weakening over time, though.</p> <p>Conclusions/Discussion The data from this experiment suggest that sodas do not weaken orthodontic bonds and that there is no appreciable difference between sodas. Phosphoric acid does weaken orthodontic bonds, but only at levels far higher than in soda.</p>	
Summary Statement This project examines the effects of acids found in sodas on orthodontic bonds.	
Help Received Grandfather helped get teeth; father obtained other materials, helped prepare teeth	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Stanton Y. Quan	Project Number S0522
Project Title Solubility of Different Calcium Pills in Varying Acidic Solutions	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of my project was to determine if there was a difference in the rate of dissolution of common, commercially available calcium pills.</p> <p>Methods/Materials Eight brands of calcium pills were tested in various solutions - water, 5% acetic acid (household vinegar) and acetic acid with three different amounts of sugar (carbohydrates). The percentage of the pill dissolved was calculated at one and two hours, the latter being the normal transit time through the stomach.</p> <p>Results While all pills dissolved to some degree, the rate of dissolution varied considerably among brands. Without exception, all pills dissolved more after two hours compared with one hour. Pills dissolved faster in a more acetic environment. With increasing amounts of sugar, the rates of dissolution slowed down proportionally. Among the subgroups of carbonates and citrates, there existed major differences in the rate of dissolution. One pill outperformed all others in solubility in every solution.</p> <p>Conclusions/Discussion For calcium pills to be utilized by the body, they first need to be dissolved. The findings of this experiment show that commonly available calcium pills dissolve at vastly different rates. The presence of carbohydrates further adversely affects the dissolution. The data suggests people taking "slower dissolving" brands may require higher doses to get the equivalent amount of calcium of the "faster dissolving" brands. Further studies more closely resembling a true stomach environment are needed to decide if dissolution is important to overall bioavailability.</p>	
Summary Statement The objective of this project is to test the dissolution of calcium pills in solutions designed to simulate stomach acid content.	
Help Received My dad helped me research the background information for the experiment. My mom explained and assisted me with the statistical analysis. My science teacher provided supervision of the project.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Emma S. Richter	Project Number S0523
Project Title Cellulose - Cellulost: An Attempt to Save the Printed Word	
Abstract Objectives/Goals My objective was to test whether adding different anti-oxidants to recycled paper pulp would produce paper that would not deteriorate as fast as regular (untreated) paper when exposed to fluorescent and sunlight (UV). Methods/Materials I pulped "clean" recycled newspaper and made new, chemically-modified recycled paper, by adding an anti-oxidant (Ester C and EDTA) into the pulp mixtures. I exposed samples of all papers to fluorescent light and sunlight (UV) and also kept samples in the dark as a control. I then analyzed whether the paper I made with anti-oxidants had "deteriorated" (photo-oxidized) less than the paper made without anti-oxidants through use of visual inspection, spectrophotometer test results and tests for "yellowing," "brightness" and "whiteness" of the papers. Results Tests for "yellowing," "brightness" and "whiteness" showed that the papers treated with Ester C (non-acidic Vitamin C) "protected" the paper from deterioration better than EDTA and better than if there was no anti-oxidant added. Tests run with the spectrophotometer before and after exposure turned out not to be so reliable because I could not be sure the concentrations among the pulp samples were the same. Visual observations allowed me to see that paper exposed to sunlight yellowed more than paper exposed to fluorescent light or kept in the dark, but I could not scientifically tell if the paper made with one or the other anti-oxidant was "better" than the control. Conclusions/Discussion I demonstrated my objective, which meant that it is possible to overcome "aging" problems due to the weakened cellulose found in recycled paper and therefore that it is not absolutely necessary to cut down more trees to produce paper of the quality needed to preserve the printed word for future generations.	
Summary Statement To create recycled paper that would not photo-oxidize so as to prove that recycled paper has the permanence needed to preserve writing for future generations, as well as to help save the environment by decreasing the demand for "new" paper.	
Help Received I had help from Dr. Eefei Chen, UCSC Chemistry Department, who let me work in the chemistry lab and supervised me and helped me with tests. I also had help from John Tucker, of the Weyerhaeuser Container Board Testing Lab as he conducted the whiteness, yellowing and brightness test for me to	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Nelly M. Turley	Project Number S0524
Project Title The Effects of Higher Fermentation Temperatures on the Phenolic Compounds and Color of Wine	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals In the winemaking process, there are many different components that affect the wine's flavor and color. There also are a multitude of chemical changes going on in the wine during the fermentation process. I tested the effects of fermentation temperature on epicatechin, polymeric phenols, polymeric anthocyanin, malvidin glucoside as well as the color of the wine, the intensity of the coloring (Chroma) and the L* value, the lightness of the wine. These different compounds are known as phenolics. There are many more different phenolic compounds but those are the four that will be analyzed in the experiment. Both a phenolic report and color analysis allows winemakers to analyze the quality of their wine.</p> <p>Methods/Materials In this experiment I tested pre-fermented syrah wine in four 5-gallon buckets. Two of the buckets had fish tank heaters set at 80° F while the others did not. The buckets without the heaters were the control because during normal fermentation the wine is left in barrels and not heated. All the buckets were kept in a temperature controlled barrel building set at 60° F and 76% humidity</p> <p>Results At the end of a nine day period three of the four phenolic compounds from the heated treatments were higher than that of the control. Malvidin glucoside was the only compound where the final amount was almost equal for both treatments. The final chroma levels of the hot treatments were only one higher than that of the cold treatments, and this makes no difference in the final color of the wine. This is also true for the L* values of the wine they were so close that I had to accept my null hypothesis because the higher temperature had no effect on the final product. The hue angle of the hotter treatments was higher making the wine more orange.</p> <p>Conclusions/Discussion With these results a winemaker will know how to manipulate their wine in order to achieve the desired result. The final data points are not to be used as values that define a good or bad wine, but as a reference value so that someone would know how a higher temperature would change their wines.</p>	
Summary Statement My project sought to discover how higher fermentation temperatures affects how the compounds, the color and ultimately the taste of wine.	
Help Received In order to determine the levels of each phenolic compound as well as the color, I had the assistance of ETS Laboratories because the equipment needed was not available to me.	



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Rui Wu	Project Number S0525
Project Title Iron Nanowire Fabrication through Electrochemical Step Edge Decoration on Highly Oriented Pyrolytic Graphite	
Objectives/Goals I wish to construct Fe wires through an electrochemical process that has the capability to generate high density nanowires with small diameters. Through step edge decoration on graphite, I want to develop a growth process for the iron wires.	
Abstract Methods/Materials Materials: Counter electrode (made from stainless steel wire with mercury and platinum flag encased in a glass rod), reference electrode (Fe wire and a Saturated Calomel Electrode), working electrode (made from stainless steel encased in a Teflon tube), FeSO ₄ , Na ₂ SO ₄ , nitrogen, desiccant, potentiostat with computer software PowerSuite, Scanning Electron Microscope, energy dispersive x-ray spectroscope. Procedure: Initially, cyclic voltametry must be done using the potentiostat on the 12 mM FeSO ₄ , 0.5 M Na ₂ SO ₄ solution to select the proper growth and nucleation potentials. Then, the instruments for the electrodeposition process must be made with carefully selected materials. Trials are done against an SCE and Fe wire reference electrode and various oxidation, nucleation, and growth potentials were used. Samples were taken to the SEM and also EDXed to make sure they were indeed Fe. Visual evidence of iron wire creation can be taken from the electron microscope.	
Results Wire creation occurred best at conditions of oxidation at 1.1 V for 4 sec., nucleation at #2 V for 60 ms, and growth at #1 V for 600 sec against an Fe wire used as the reference electrode. Wires with diameters of approximately 60 nm have been created. Nitrogen bubbling during growth and desiccation to prevent Fe oxidation after deposition seemed to improve results. SEM and EDX confirmation of Fe wires were done.	
Conclusions/Discussion Through the ESED process on HOPG, Fe wires can be made easily and efficiently. By altering the growth and nucleation time, the diameter and density of the wires can change. Such wires have potential in uses of chemical sensing and computer memory.	
Summary Statement Nanodiameter iron wires can be successfully constructed and easily controlled using electrochemical step edge decoration.	
Help Received Used equipment at UC Irvine in the lab of Professor Reginald Penner; Stacey Rogers and Ben Murray helped out with materials and direction of the project	



CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s) Tammy N. Ziembra	Project Number S0526
Project Title The Effect of Different Ratios and Combinations of Solutions on Temperature Change and Evaporation Rate	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Problem: The point of this experiment was to determine the effect of different ratios and combinations of water to Methanol to Ethanol to Acetone to Propanol solutions on temperature change and evaporation rate. Hypothesis: I hypothesized that the smaller the molar mass of a liquid solution, the greater the temperature change it will have and the faster it will evaporate.</p> <p>Methods/Materials Materials: The materials needed are a computer, data Studio 1.6 program, USB link and temperature sensor, water, Methanol, Ethanol, Acetone, Propanol, test tube and beaker, graduated cylinder and funnel, and filter paper. Methods: # Labeled the test tubes. # Made up each solution (10mL each) by using the solution ratios. # Took 2.5 cm X 2.5 cm piece of filter paper and covered the temperature sensor. Used a rubber band to secure the paper. # Put the temperature probe with filter paper into the test tube containing a solution. # Pressed "start" on Data Studio 1.6 and recorded for 4 minutes & 15 seconds. # Recorded the final temperature</p> <p>Results Results: The solution with the greatest temperature change of 19.56°C and a molar mass of 45.02g/mole is the 1/2Acetone+1/2Methanol solution. The solution composed of 1/3Propanol+1/3Acetone+1/3Ethanol with a molar mass of 50.68g/mole had the lowest temperature change, which was 8.34°C.</p> <p>Conclusions/Discussion Conclusion: In conclusion, the data collected can not support the hypothesis. The only prediction of the hypothesis that was correct was the decision that the solution composed of 1/3Propanol+1/3Acetone+1/3Ethanol would have the lowest temperature change.</p>	
Summary Statement The point of this project was to determine how different ratios and combinations of solutions composed of water, Methanol, Ethanol, Acetone and Propanol would affect temperature change and evaporation rate.	
Help Received My science teacher gave me the chemicals necessary for this experiment.	