



**CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY**

<b>Name(s)</b> <b>Erik J. Aidukas</b>	<b>Project Number</b> <b>S0501</b>
<b>Project Title</b> <b>The Effects of Wetting Agents on the Thermosensitive Capillary Action of Poly(N-isopropylacrylamide) Coated Glass Tubes</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The project addressed the effects of various wetting agents on the capillary action of poly(N-isopropylacrylamide) coated glass tubes. Poly(NIPAAm) is the most commonly used biocompatible thermosensitive polymer. Wetting agents tested were representative of most wetting agents in their respective categories.</p> <p><b>Methods/Materials</b> After cleaning, capillary tubes (100um (ID)) were filled with toluene solution of 10% Bind-silane and left to soak. The tubes were then rinsed with ethanol and water. An aqueous mixture of NIPAAm, methylene-bis-acrylamide, and TEMED in one syringe and ammonium persulfate (APS) in a second, were pumped into each capillary. Polymerization time was short and at room temperature. Wetting agents tested were 20% m/v ethylene glycol, 10% m/v tetraethylammonium chloride, and 5% m/v sodium dodecyl sulfate. The solutions were placed on a hotplate/stirrer. Temperature and column height was collected through a CBL system.</p> <p><b>Conclusions/Discussion</b> The data collected did not support any findings after analysis. The thermosensitivity of the control group was fit into an inverse sigmoidal curve but the standard deviation was so large that the column height change was statistically insignificant. Three of the constants used to model the data had no theoretical basis. This suggests that the system cannot be represented as a simple two-state system dictated by an equilibrium constant. More accurate results could be collected by using an individual capillary tube multiple times at a narrower range of temperatures, avoiding temperature shock or denaturing of the polymer. A further study may consider thermosetting the solutions and tubes at set increments in an incubator before measuring capillary height, which would allow for more accurate analysis of the end states. Also, contact angle measurements could be made by photographing the meniscus and drawing a tangent line at each temperature interval. All suggestions for future study made on this application are planned to be carried out after the filing date.</p>	
<b>Summary Statement</b> The project addresses the effects of wetting agents on the thermosensitive capillary action of poly(NIPAAm) modified tubes.	
<b>Help Received</b> Lab equipment at CSUCI was used under the supervision of Dr. Philip Hampton.	



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<b>Name(s)</b> Alexandra M. Chrystal	<b>Project Number</b> <b>S0502</b>
<b>Project Title</b> <b>Formation of Disinfection Byproducts: The Effects of Drinking Water Treatment</b>	
<b>Abstract</b> <b>Objectives/Goals</b> The objective was to test the effect of chlorine on disinfection byproduct formation: 3 source waters from varying locations and 1 "purified" water (Arrowhead bottled water) were collected. As a control, reagent water containing no organic matter. The variables provided were the varying water source types. These types were treated ground water, treated surface water, and raw surface water as well as the control. <b>Methods/Materials</b> Four different source waters were collected. Twelve 40mL amber glass vials were used to obtain 3 samples of each water type. A syringe was used to add Clorox Bleach (10 microliters of bleach) to each sample. The samples were then given 7 days to let the total trihalomethanes form in water samples. Then a Gas Chromatograph coupled to a Mass Spectrometer (GC/MS) was used for testing and the results were given by Edward S. Babcock & Sons Inc. (environmental laboratory). <b>Results</b> The raw surface water proved to contain the highest levels of total trihalomethanes (THMs) formed which proved my hypothesis correct. However, the Arrowhead bottled water showed to contain nearly the same amount of THMs as the treated ground water. The results also provided the specific THMs (quantity) that formed in the water samples. <b>Conclusions/Discussion</b> The results found were supportive of the hypothesis that if a water source contains an elevated content of organic matter, then, upon treatment with chlorine, the disinfection byproducts will be greater. The results supported this because the raw surface water tested proved to hold the most organic materials and also resulted in the most disinfection byproducts formed. On the other hand, the already treated surface water and ground water proved to have very few disinfection byproducts due to their low amounts of organic materials already existent in the water. The higher amount of THMs formed in the Arrowhead bottled water could be caused by its plastic container.	
<b>Summary Statement</b> To test the effect of chlorine on disinfection byproduct formation.	
<b>Help Received</b> Edward S. Babcock & Sons Inc.	



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<b>Name(s)</b> Colin M. Delaney	<b>Project Number</b> <b>S0503</b>				
<b>Project Title</b> What Is Really in That Beer? Barley, Wheat, Barley, Hops, Water and ... ?					
<table border="0"><tr><td data-bbox="77 611 698 672"><b>Objectives/Goals</b></td><td data-bbox="698 611 1539 672"><b>Abstract</b></td></tr><tr><td colspan="2" data-bbox="77 672 1539 1619">I want to find out what is in Becks Beer, and what is in Corona Beer. Both very popular beers.</td></tr></table>		<b>Objectives/Goals</b>	<b>Abstract</b>	I want to find out what is in Becks Beer, and what is in Corona Beer. Both very popular beers.	
<b>Objectives/Goals</b>	<b>Abstract</b>				
I want to find out what is in Becks Beer, and what is in Corona Beer. Both very popular beers.					
<b>Summary Statement</b> I want to find out what someone is really drinking when they drink Becks or Corona					
<b>Help Received</b> Mr. Maxwell supervised me while i tested the alcoholic drinks. used chemicals from Ventura High science department.					



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2008 PROJECT SUMMARY**

<b>Name(s)</b> <b>Zoe E. Dubrow</b>	<b>Project Number</b> <b>S0504</b>
<b>Project Title</b> <b>Rocking and Rolling on Nano-Structured Super-Hydrophobic Surfaces</b>	
<b>Abstract</b> <b>Objectives/Goals</b> The purpose of this project is to demonstrate a practical method of creating super-hydrophobic surface coatings and then to characterize the movement of water droplets on these coated surfaces for use in three potential applications. In addition, the unanswered question of whether water drops roll or slide on super-hydrophobic surfaces will be resolved. <b>Methods/Materials</b> A versatile thin film coating method was developed that used hydrophobic nano-particles, a polymer binder and solvent to create the super-hydrophobic surfaces on plastic films and complex shapes. A goniometer was used to determine the contact angle of water on the surfaces. Roll off angles, the effect of additives to the water drop and answering the question of whether water drops slide or roll on a superhydrophobic surface were conducted using a simple inclined plane. <b>Results</b> The contact angle of a 3 $\mu$ l water drop on this super-hydrophobic surface was 168° The smaller the volume of a water drop, the higher the roll-off angle of the drop. Water containing ingredients such as sugar, salts, and carbonation roll down super-hydrophobic surfaces. <b>Conclusions/Discussion</b> A simple super-hydrophobic surface coating based on a 30-year-old patent was recreated. It was proven that water drops roll down super-hydrophobic surfaces. A super-hydrophobic racetrack was built where water drops could complete a vertical loop and jump. The concept of an improved fog collection device was demonstrated. A targeted drop shooter was tested.	
<b>Summary Statement</b> The purpose of this project is to demonstrate a practical method of creating super-hydrophobic surfaces and then to characterize the movement of water droplets on these surfaces for use in three potential applications.	
<b>Help Received</b> Dad helped take pictures; Nanosys Inc. supplied materials	



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<b>Name(s)</b> <b>Madeline T. Fortner</b>	<b>Project Number</b> <b>S0505</b>
<b>Project Title</b> <b>Flour Power! The Effect Flour Has on the Density of Angel Food Cake</b>	
<b>Abstract</b> <b>Objectives/Goals</b> This projects goal was to determine if different types of flour used in an angel food cake would affect the density. I believe that cake flour will produce the least dense cake because it has the lowest level of gluten protein. <b>Methods/Materials</b> Four different types of four were used to bake angel food cakes. Traditional cake four was used according to the recipe, and then was substituted by all-purpose whole wheat and spelt flour. Each cake was baked under the same conditions, using the same ingredients other than flour. Three cakes were baked per flour type. <b>Results</b> Cake four with the least amount of gluten proteins produced a significantly less dense cake than the others. Whole wheat flour with twice as much gluten protein as cake flour was the densest. <b>Conclusions/Discussion</b> My conclusion is that the less amount of gluten protein present in the flour the lower the angel food cakes density will be. This supports my hypothesis and proves cake flour makes the lightest angel food cake.	
<b>Summary Statement</b> My project is about how different types of flour affect the density of an angel food cake.	
<b>Help Received</b> Mother helped shop for supplies; Dr. Jang (teacher) gave feedback; Mrs. Treager acted as project consultant	



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<b>Name(s)</b> <b>Wyatt Gormley; Jaime Higareda</b>	<b>Project Number</b> <b>S0506</b>
<b>Project Title</b> <b>Electrolysis Anthology</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The purpose of this year's science project was to explore the process of electrolysis of water by using a Hoffman apparatus. Specifically, we tested the variables of the voltage, electrode material, the electrode's surface area, and mass. Our tests included fifteen separate trials in five (changing electrode materials) sets of three (changing the voltage).</p> <p><b>Methods/Materials</b> The metals used in our test were aluminum, copper, iron, and magnesium, while the control would be an inert semiconductor, graphite carbon. We learned that during water electrolysis, an electrolyte is necessary, and we chose to use a one percent, solution of NaHCO<sub>3</sub>. In respect to voltage, we tested our anodes and cathodes using three, four and a half, and six volts of electricity; each trial lasted for a period of eight hours. Our means of data collection consisted of observing the products of gas, oxides, and hydroxides using inverted containers to measure the production of hydrogen over the cathode and oxygen over the anode.</p> <p><b>Results</b> The results revealed that although larger surface area yields more chemical reaction with the electrodes, the electrode must be able to sustain the voltage passing through it in order to create such a reaction. Additionally, an increase in voltage increased the reaction rate exponentially, while for some peculiar reason, a higher electrical resistance in the electrodes tended to cause a greater reaction. Also, we deduced that certain ratios in the data can yield answers as to what the electrodes reacted with inside of the water.</p> <p><b>Conclusions/Discussion</b> Electrolysis Anthology produced applicable information that may possibly influence a myriad of industry including, the paint companies (used in pigment production) the boating industries (preservation of the metals exposed to the salt water electrolyte solution), and hydrogen production plants. Although, it is conceivable, and rather likely, such industries may have already conducted similar tests.</p>	
<b>Summary Statement</b> Electrolysis Anthology is an attempt to explore the nature of electrolysis of water by using a Hoffman apparatus and to test the effects of voltage, electrode material, mass, and surface area on the process's efficiency.	
<b>Help Received</b> Parents help to obtain materials: Dr. Malhotra (teacher), Tyler, and Michael (lab assistants at Thousand Oaks High School) gave valuable insight and criticism.	



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<b>Name(s)</b> <b>Erika Kern; Analiese Scrivano</b>	<b>Project Number</b> <b>S0507</b>
<b>Project Title</b> <b>Is Going Green Good?</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Ethylene gas production has been shown to affect the spoiling rate of produce (especially in high concentrations). This experiment examined the ability of differing containers to maintain the freshness of produce, possibly due to the container's ability to diffuse ethylene gas. The hypothesis was that the Debbie Meyer Green Bags would keep the produce freshest for the longest period of time.</p> <p><b>Methods/Materials</b> Materials used in this experiment included brown paper lunch bags, Debbie Meyer Green Bags, Zip-Loc bags, twelve apples, twelve onions, twelve bananas, and eight cups of pre-cut lettuce. Three pieces of produce, or two cups of lettuce, were placed in each container. A control group, no container, was also done. All were observed for fourteen consecutive days and measured with a differentiated rating scale.</p> <p><b>Results</b> The results showed that Debbie Meyer Green Bags kept the produce freshest for all of the tested produce. The brown paper lunch bags' and the Zip-loc bags' results varied depending on the type of produce, the ethylene gas production and the published sensitivity rate of the produce. Results are ongoing as further repetitions are being performed.</p> <p><b>Conclusions/Discussion</b> Overall, the control group spoiled at the most rapid rate. The hypothesis was correct due to the Debbie Meyer Green Bags' Natural Oya' mineral form of Zeolite which absorbed and removed the ethylene gas that causes ripening and rotting. The other containers used in the project do not possess the same mineral that absorbs ethylene gas. More specialized equipment would need to be used to measure the ethylene concentration within these containers.</p>	
<b>Summary Statement</b> The observation of ethylene gas production and sensitivity in a variety of produce when stored in various containers.	
<b>Help Received</b> Dr. Selgrath and Mrs. Wilke helped supervise the project. Our parents provided workspace in their kitchens.	



# CALIFORNIA STATE SCIENCE FAIR 2008 PROJECT SUMMARY

<b>Name(s)</b> Amy Lee; Thomas Wooding	<b>Project Number</b> <b>S0508</b>
<b>Project Title</b> Save the Condors	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Bill 821 becomes law on July 2008 the Californian Senate passed legislation to ban lead ammunition that is poisoning endangered Californian Condors. The bill is designed to protect condors by requiring hunters to use non-toxic ammunition for game so that condors will not consume lead particles in any carcasses not recovered. The objective of our project is to determine if solid lead from a hunter's bullet can be absorbed in the condor digestive fluids.</p> <p><b>Methods/Materials</b> We shot copper only bullets, conventional copper jacketed lead core bullets from a 30-06, .22 long rifle lead bullets, steel shot, and lead shot from a shotgun into separate boxes of magazines to represent typical bullets and shot used by hunters. Then we placed the respective collected bullets, fragments, and shot into a solution similar to that of a condor's stomach fluid that consisted of HCl, amylase, and pepsin. This stomach content was at a pH of 1.9. We poured 100ml of simulated stomach tissue with lead fragments, and used a magnetic stir rod in flasks that was placed on a magnetic stir plate set at 37 degrees Celsius for five hours. The solution was filtered through an acid-free quantitative filter paper and 10 drops of potassium chromate was added to test for lead. This was done for test subjects #2-7. Then we let the residue on the filter paper dry for 48 hours. Then we weighed contents for #1-6 and analyzed data. We repeated this procedure twice for each specimen.</p> <p><b>Results</b> The steel shot contained no lead, but came out as a positive test result. The steel shot pellets were a bright gray color, but after the experiment the steel shot pellets were a dull gray color. The copper bullets were negative. The lead fragments with simulated stomach had a slight yellow, which indicated a slight lead presence within the solution. The .22 fragments with simulated stomach tissue had a slight yellow result also. They had a positive test and the second brightest yellow result. The lead fragment results came out positive and had the brightest yellow, which indicates that the most lead was present.</p> <p><b>Conclusions/Discussion</b> Our hypothesis that lead bullets and fragments can be absorbed in stomach acid was proven correct. Lead bullet fragments from both the 30-06 and the .22 LR, tissue with lead impact spray were all dissolved in the stomach solution and showed positive test results. Our test results support Bill 821 rather than some hunters' opinions.</p>	
<b>Summary Statement</b> This project to determine the amount of lead and corrosion in bullet fragments absorbed in simulated digestive fluids of a condor.	
<b>Help Received</b> Dr. Stenger-Smith helped us to conduct this experiment at the Cerro Coso Community College lab and providing all the necessary materials.; Mr. Ostermann, for purchasing the amylase; Eric Wooding obtained the bullet fragments	





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<b>Name(s)</b> <b>Jesse A. Most</b>	<b>Project Number</b> <b>S0509</b>
<b>Project Title</b> <b>Coffee Darkness</b>	
<b>Abstract</b> <b>Objectives/Goals</b> The objective to my experiment was to discover the optimum grinding time of coffee beans to make the darkest coffee within a given percolation time. <b>Methods/Materials</b> The way in which I measured this was I shot a laser beam through a coffee sample and into a solar panel. Then I measured the millivolt output of the solar panel to see how dark the coffee was. Materials: coffee beans, coffee maker, coffee grinder, water, laser pointer, solar panel, voltmeter, plastic transparent container <b>Results</b> I discovered that at approximately 12 seconds of grinding time the millivolt output of the solar panel was virtually unmeasurable as it was about 4 millivolts which is such a tiny amount. That trial did however comply to the 5:00 minute percolation time maximum as well. <b>Conclusions/Discussion</b> This experiment was one designed to benefit the food market and in particular the coffee industry by providing research on how coffee bean grinding times affect the flavor and darkness of coffee. Also, the percolation times are also a key aspect in how this project can benefit the coffee industry. The percolation data which I composed show what the optimum percolation times are for various darknesses of coffee. I think that this experiment can be very useful, and I hope to follow my fascination with the food science field in the future.	
<b>Summary Statement</b> My experiment is designed to gather information and data about coffee bean grinding to benefit the coffee industry in the world.	
<b>Help Received</b> No help received	



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<b>Name(s)</b> Meenakshi T. Mukherjee	<b>Project Number</b> <b>S0510</b>
<b>Project Title</b> <b>Synthesis of a Substituted Carbamate for Imaging Acetylcholinesterase</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The goal was to synthesize a carbamate, bromomethylphysostigmine (BMPHY) for use as an imaging agent for Alzheimer's Disease using positron emission tomography (PET). This required reaction of a substituted phenol or phenolate with bromoethylisocyanate (BEI). BEI has two reactive positions, the isocyanate group or the bromide atom. The goal of this project was to establish reaction conditions: 1. Conduct pilot reaction of phenol with BEI to evaluate formation of N-bromoethylphenylcarbamate (BEPC); 2. React eseroline and BEI for the formation of the desired product, BMPHY.</p> <p><b>Methods/Materials</b> Sodium hydride (NaH), potassium tert-butoxide (KOBu), tetrahydrofuran (THF), diethyl ether (DEE), eseroline, BEI, dichloromethane, NaHCO<sub>3</sub> were from Sigma-Aldrich. TLC and electrospray mass spectra analyses were obtained on samples. Phenol (94 mg) was dissolved in 1 mL DEE and in THF (1 mL). 2 vials of DEE and 2 of THF were without base; 2 (one DEE and one THF) with KOBu, 112 mg and 2 (one DEE and one THF) with NaH, 42mg. BEI (0.09 g) was added and reaction monitored. Without base reactions were checked at 25 oC and 50 oC. To eseroline (15 mg) in DEE (1 mL), KOBu (5 mg) or NaH (4 mg) was added. After 15 mins, BEI (0.004 mL) was added. After 30 mins water (0.5 mL) was added. The ether layer was separated and checked by TLC and mass spectrometry. A similar set of reactions were carried out in THF.</p> <p><b>Results</b> For phenol no reaction occurred in the absence of base. With base, THF dissolves the phenolate salts better compared to DEE. The best yields of product were obtained with THF and KOBu. The next best was DEE and NaH. The product, BEPC was confirmed by TLC and mass spectra (M+H = 244, 246 and M+Na = 266, 268). This can partially be explained by solubility, but the reaction may be more complex because of the bromine atom present leading to complex side products. In the case of eseroline, the best solvent was found to be DEE rather than THF because the reaction was cleaner with little side products. BMPHY was confirmed by TLC and mass spectra ( M+H = 368, 370 and M+Na = 390, 392).</p> <p><b>Conclusions/Discussion</b> The two new products, BEPC and BMPHY were successfully synthesized. THF and KOBu gave the highest product yield in the case of the model phenol reaction, but not for the reaction of eseroline and BEI. The yields were significantly lower. Best yields were obtained when DEE was used with eseroline.</p>	
<b>Summary Statement</b> A substituted carbamate was successfully synthesized for potential use in imaging Alzheimer's Disease.	
<b>Help Received</b> Used Laboratory equipment at University of California - Irvine under supervision of Dr Jogesh Mukherjee	



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<b>Name(s)</b> <b>Saraf Nawar</b>	<b>Project Number</b> <b>S0511</b>
<b>Project Title</b> <b>Novel Approach for the Self-Assembly of Gold Nanorods</b>	
<b>Objectives/Goals</b> I'd like to demonstrate high-yield synthesis of gold nanorods and their self-assembly into ordered structures. The assembly of gold nanorods into 2-D structures was carried out using a pH-sensitive polymer, polyacrylic acid. Because gold nanorods are covered with a cationic surfactant in solution, the pH-dependent assembly of the nanorods is directed by electrostatic interactions between the positively charged nanorods and the negatively charged, deprotonated polyacrylic acid. Because the chemically-directed, spontaneous self-assembly of nanoparticles by manipulating environmental factors such as pH are rare, such modes of assembly can be used as a precursor for synthesizing future nanodevices.	
<b>Abstract</b>	
<b>Methods/Materials</b> Gold nanorods were created via the seed-mediated approach. After their synthesis, nanorod self-assembly was carried out using a pH-sensitive polymer, polyacrylic acid. After the addition of the acid to the gold nanorod solution at pH of 7, the solution was observed using light scattering experiments, zeta-potential measurements, and absorption spectroscopy to see if any gold nanorods had self-assembled into ordered structures in solution, in addition to TEM.	
<b>Results</b> Gold nanorods assembled into 2D ordered structures with polyacrylic acid at pH of 7 but not at a pH of 3 to yield 2D ordered structures. Zeta potential measurements indicated that negatively-charged polyacrylic acid is adsorbed on the surface of gold nanorods, and light scattering experiments indicated that nanorods formed aggregates of 4-5 gold nanoparticles in solution. The absorption peak also shifted 20 nm left, indicating side-to-side assemblies in solution.	
<b>Conclusions/Discussion</b> The self-assembly of gold nanorods in solution prompted by the presence of polyacrylic acid was achieved. While most assembly was induced by solvent evaporation due to particle-particle interactions, light scattering experiments and absorption spectroscopy showed that some self-assembly also occurs in solution. These aggregates are estimated to contain 4-5 nanorods in solution, and upon evaporation, form assemblies containing hundreds of nanorods as observed by TEM. The mechanism for self-assembly is believed to be electrostatic attractions, and as a result, nanorods were aggregated in solution. It is expected that the present studies on the controllable connection of nanoscale building blocks into desired shape might find application in future nanodevices.	
<b>Summary Statement</b> I discovered how to self-assemble gold nanorods using electrostatic interactions between nanoparticles.	
<b>Help Received</b> Prof. Wendy Chiu helped me at UC Davis chemical engineering department	



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<b>Name(s)</b> Apollo Nestoras	<b>Project Number</b> <b>S0512</b>
<b>Project Title</b> <b>Minimizing Surface Tension of Water</b>	
<b>Abstract</b> <b>Objectives/Goals</b> My project was to determine whether the type of water and its temperature affects the ability of a surfactant to reduce surface tension. I believe that if hot salt water is combined with a detergent, then it will yield the least amount of surface tension. <b>Methods/Materials</b> A single beam balance was constructed and used to determine the amount of force necessary to make a needle break free from the surface tension of the water being measured. Distilled, tap, and salt water were evaluated at various temperatures both with and without detergent. Each experiment was repeated ten times. <b>Results</b> The use of a surfactant reduced the surface tension by about 40%. Also, the higher the temperature of the water, the lower the surface tension. Hot water and detergent combined produced lower surface tension. Surprisingly, though, hot distilled water without detergent yielded the least amount of surface tension. <b>Conclusions/Discussion</b> My conclusion is that surface tension is best minimized with the combination of high water temperature and the use of a detergent. Furthermore, the use of hot distilled water, since it is free of minerals and additives, does not need the use of a detergent to minimize surface tension.	
<b>Summary Statement</b> My project is about determining whether detergents, water temperature, or type of water has the most influence in reducing surface tension.	
<b>Help Received</b> None	



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<b>Name(s)</b> Nicholas L. Okita; Edith M. Teng	<b>Project Number</b> <b>S0513</b>
<b>Project Title</b> <b>The Effect of Steel Exposure on Corrosion Rates in an Oil Field Environment</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> To determine the effect of steel exposure in comparison to corrosion rates in simulation of an extreme oil field environment.</p> <p><b>Methods/Materials</b> Five carbon steel corrosion coupons (7.5 cm x 1.2 cm) were coated with epoxy spray paint. One coupon was not coated, one was fully coated, and three had two stripes of exposed metal that were ½ cm, 1 cm, and 2 cm in width. Each metal's mass was then recorded, and the metals were immersed in 200 mL of a 1.60 pH solution of water and muriatic acid. The metals were then exposed to carbon dioxide for five minutes, sealed, and placed in a 170°F oven for seven days. The exposed metal was then cleaned of any excess rust, and the mass was taken. The process was repeated fifteen times for a total of seventy-five trials.</p> <p><b>Results</b> The non-coated coupon lost an average of .83 g, the 2 cm exposed lost an average of .83 g, the 1 cm exposed lost .91 g, the ½ cm exposed lost 1.18 g, and the fully coated lost 1.32 g. The effects of pitting corrosion were most noticeable on the metals as the exposed surface area decreased.</p> <p><b>Conclusions/Discussion</b> Our hypothesis was not supported by the data. As the surface area exposure decreased, the metal exhibited more concentrated corrosion and increased corrosion rates. If the results continued, the non-coated coupon was projected to last 88 days before it was fully penetrated, the 2 cm exposed would last 88 days, the 1 cm exposed would last 81 days, the ½ cm exposed would last 62 days, and the fully coated would last 56 days. This proves that under-deposit corrosion (corrosion which occurs between a protective deposit and the metallic surface) has a faster corrosion rate and increased pitting corrosion on the coupons that were fully coated. Since the tests in this experiment were run under extreme conditions, further investigation must be done to prove that the results would be consistent in all oil field environments. However, these results show that an oil company should either invest in a good coating or not coat the metals at all. Cheaply coated metal is susceptible to greater pitting corrosion and earlier replacement.</p>	
<b>Summary Statement</b> To determine the effect of steel exposure in comparison to corrosion rates in simulation of an extreme oil field environment.	
<b>Help Received</b> Mr. and Mrs. Peter Okita helped with project ideas as well as supplied the room to run our experiment. Mr. Jim Griffin provided us with the steel coupons.	



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<b>Name(s)</b> <b>Aurora L. Ostrom</b>	<b>Project Number</b> <b>S0514</b>
<b>Project Title</b> <b>The Effect of Gravity and Counter Ions on Hydrogen Ion Diffusion</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> This project investigates the effect of gravity and counter ions on the rate of hydrogen ion diffusion. This rate is determined by measuring the time it takes for hydrogen ions to travel a given distance. Solutions of hydrochloric, nitric, sulfuric, and phosphoric acid are used to supply the hydrogen ions. Replicate measurements are collected for each acid at a series of three different distances in a horizontal configuration. The results are plotted and a comparison of the rates for each acid is made to determine the effect of the anion (chloride, nitrate, sulfate, and phosphate) on the rate. All of these experiments (three replicate measurements of four acids at three different lengths) are repeated with the test stand in a vertical configuration. The results obtained horizontally are compared to those measured vertically to determine the effect of gravity.</p> <p><b>Methods/Materials</b> A series of three, 1-inch PVC pipes (2-ft, 3-ft, and 4-ft) filled with 18 Megaohm deionized water were used as the test apparatus. 25-ml volumes of 10 Normal hydrochloric, nitric, sulfuric, and phosphoric acids were used as the test solutions. A pH electrode connected to a pH meter was used as the hydrogen ion sensing device. A stopwatch was used to measure the time in each experiment.</p> <p><b>Results</b> A graph of the results collected in the horizontal configuration revealed a difference in the rate of hydrogen ion diffusion depending on the acid used. A graph of the results collected in the vertical configuration showed little difference in the rates of hydrogen ion diffusion measured for each acid. A significant increase in the times measured in the vertical configuration versus those measured horizontally was observed.</p> <p><b>Conclusions/Discussion</b> Counter ions in the acids used did have an effect on hydrogen ion diffusion. However, the trend did not follow the mass of the anion as hypothesized. A change in the hydrogen ion diffusion was observed in the vertical configuration relative to that in the horizontal configuration. However, the rates did not increase due to gravity as hypothesized, but rather decreased significantly. Furthermore, the diffusion rates for the acids tested vertically were very similar. Since the first set of experiments showed that counter ions do effect hydrogen ion diffusion, it is proposed that another force is overriding any effect of gravity and equally controlling the hydrogen ion diffusion in all the acids.</p>	
<b>Summary Statement</b> This project is designed to determine the effect of gravity and counter ions on hydrogen ion diffusion by measuring the diffusion rate of different acids in both horizontal and vertical configurations.	
<b>Help Received</b> Father completed the application and handled the acids during the experiments.	



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<b>Name(s)</b> <b>Sheba S. Plamthottam</b>	<b>Project Number</b> <b>S0515</b>
<b>Project Title</b> <b>Green Preparation and Characterization of Superparamagnetic Iron Oxide Nanocrystals</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Many of the approaches for synthesizing superparamagnetic iron oxide nanocrystals require complex processes and the use of toxic materials. I selected a co-precipitation method that follows the green chemistry principle (environmentally friendly and economical) to prepare superparamagnetic iron oxide nanocrystals. Polyacrylic acid (PAA) was then used to create a stable ferrofluid.</p> <p>The particles were characterized by Optical Microscopy, Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD), and Raman Spectroscopy. Surprisingly, TEM showed the formation of nanorods, in addition to the expected nanocrystals. Therefore, this could be a good method to synthesize superparamagnetic iron oxide nanorods, as well.</p> <p>The prepared nanocrystals could have potential in environmental and biomedical applications (such as in targeted drug delivery and in magnetic resonance imaging).</p> <p><b>Methods/Materials</b> Solutions of ferric and ferrous chloride reacted in the presence of a base (sodium hydroxide) to form iron oxide nanocrystals. PAA was used as a surfactant to stabilize the particles.</p> <p><b>Results</b> The reaction produced what appeared to be a black solution, which separated from the solution when a magnetic field was applied. After stabilization the black fluid moved along with the magnet, and no clear solution formed at the top of the beaker.</p> <p>XRD results confirmed that the precipitate that formed was indeed crystalline Fe<sub>3</sub>O<sub>4</sub>. Optical microscopy imaging proved the paramagnetism of the sample. TEM studies found the size of the particles to be nanosized, confirmed its crystallinity, and also found some nanorods. Raman Spectroscopy further confirmed the structure of the nanocrystals.</p> <p><b>Conclusions/Discussion</b> Since the precipitate formed was confirmed to be superparamagnetic, nanosized, and crystalline, it proved that this was a successful method of synthesizing superparamagnetic nanocrystals, and possibly nanorods, of Fe<sub>3</sub>O<sub>4</sub>, and that they could have potential in environmental and biomedical applications.</p>	
<b>Summary Statement</b> A green co-precipitation method was used to prepare superparamagnetic nanocrystals of Fe <sub>3</sub> O <sub>4</sub> , which were then characterized by Optical Microscopy, TEM, XRD, and Raman Spectroscopy.	
<b>Help Received</b> Used lab equipment at the University of Riverside, CA, in the Yin Labs under the supervision of Dr. Yadong Yin and Dr. Jianping Ge.	



**CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY**

<b>Name(s)</b> Gian E. Sonza	<b>Project Number</b> <b>S0516</b>
<b>Project Title</b> <b>Metal-morphosis</b>	
<b>Objectives/Goals</b> I chose to do this science experiment to determine how different metals react with hydrochloric acid. I hypothesized that Aluminum will be the most reactive metal tested, followed by zinc, iron, then copper. My hypothesis is based on the Periodic Table of Elements and the Reactivity Series. Metals are placed according to properties on the Periodic Table of Elements. I used test tubes to hold the metals while they were being tested with hydrochloric acid. Ring stands were used to hold the test tubes upright in a steady position. When each metal was each placed in its individual test tube, I poured a sufficient amount of hydrochloric acid to cover the metal. Immediately after I poured hydrochloric acid into the test tubes, I covered each test tube with a different color balloon. A balloon was placed on the rim of each test tube to determine which metal was most reactive. The more a balloon was inflated, the more hydrogen was released. I then watched the experiment carefully, and charted results. Photographs were taken before, during, and after the process of testing the activities of metals. After different trials of testing the reactivity of each metal, I began to see different outcomes and results with each metal. It soon became obvious that there was a relationship between the way the Periodic Table of Elements is grouped together and my results. All of my results were logged and charted. After all of the experimentation was finished, all of the metals, and pertinent equipment were saved for display.	
<b>Abstract</b> <b>Conclusions/Discussion</b> After performing the exhibition trial to this science experiment, I decided that I needed to try to estimate the same surface area for the metals. That is why I needed to place two aluminum tacks, two copper tacks, and two zinc nails to approximately equal the surface area of one iron nail. Then after performing this science experiment a number of times, I determined that my hypothesis was semi-correct; that Aluminum is the most active metal being tested, followed by zinc, iron, and then copper. Aluminum took first place every test. The results between iron and zinc would fluctuate. Copper did not react to the hydrochloric acid at all. All of these changes in results were due to the fact that I did not have a more exact method of measuring which metal gave off the most hydrogen.	
<b>Summary Statement</b> The object was to determine which metal (iron, copper, zinc, aluminum) reacted with Hydrochloric Acid to displace hydrogen.	
<b>Help Received</b> Teacher helped supervise experiment	





**CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY**

<b>Name(s)</b> Narayan S. Subramanian	<b>Project Number</b> <b>S0517</b>
<b>Project Title</b> <b>A Preliminary Investigation of the Effectiveness of Freeze Desalination</b>	
<b>Abstract</b> <b>Objectives/Goals</b> The purpose of this project was to determine the viability of freeze desalination (FD) as a preliminary treatment process to reverse osmosis (RO) by measuring its efficiency through theoretical analysis and assessing its effectiveness through experimentation to find the removal of salts. FD involves a process in which seawater is placed in a freezer unit circulated with a refrigerant at very low temperatures until it is partially frozen creating an ice-brine slurry. The freezing process causes impurities to be largely excluded from the ice crystals which are relatively salt free. The ice is then separated from the brine and melted resulting in a solution with lesser saline concentration. It was hypothesized that FD would be a viable feeder process to known processes such as RO because of its potential to increase overall efficiency and decrease costs by decreasing pressure and membrane requirements through its removal of salts. <b>Methods/Materials</b> The theoretical analysis was conducted by utilizing Van't Hoff's equation: $\pi=cRT$ and determining the independent energy requirements to conduct FD and RO. The experimental analysis was conducted by designing an FD apparatus consisting of a constant temperature bath and a stainless steel vessel with an external jacket to circulate a refrigerant. 500mL of synthetically produced seawater solutions were then frozen at times of 35, 40, and 45 minutes. <b>Results</b> The results of the theoretical analysis comparing the energy requirements for RO and FD, showed that RO would take ~11.6 kJ and FD would take ~370 kJ to produce one liter of filtered water proving that RO is far more efficient than FD. The experimental data showed that the volume of ice proportionally increased with higher freezing times. The entrainment ratio, the ratio of brine that adheres and freezes in the ice during the process, however, increased as freezing time progressed and the percentage of removal of salts consistently decreased showing that freezing for a lower time would allow for less entrainment along with a higher removal of salts lowering energy costs for reverse osmosis, but would entail lesser yield. <b>Conclusions/Discussion</b> It was concluded that with current conditions, FD is not a viable feeder process to RO, but the experimental results still prove the effectiveness of the process in removing salts suggesting its future viability with further innovation.	
<b>Summary Statement</b> A study aimed to determine the efficiency and effectiveness of an unconventional desalination process which utilizes freezing.	
<b>Help Received</b> Facilities and guidance were provided by the Indian Institute of Technology in Madras, India and Dr. Shankar Narasimhan	



**CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY**

<b>Name(s)</b> <b>Justin To</b>	<b>Project Number</b> <b>S0518</b>
<b>Project Title</b> <b>Much Ado about Nothing: An Analysis of the Creation of Subcritical Silica Aerogel and Its Properties</b>	
<b>Abstract</b> <b>Objectives/Goals</b> Objectives: To create silica aerogel under subcritical conditions. <b>Methods/Materials</b> Method/Materials: In the first stage of a three-part process, tetraethyl orthosilicate is combined with methanol, water, and an acid; afterwards, it is sealed and put into a drying oven. In the second stage, an additional mixture of isopropyl alcohol and a base is added, and the mixtures remain in the oven. In the final stage, the mixture is unsealed and is allowed to dry. By experimenting with the time each stage spends in the oven, I can optimize the final result. A basic water displacement experiment was done to determine each sample's density, and I used a dual-pressure sensor to determine how much force it took to crush each sample. <b>Results</b> Results: The various samples that I created were not very similar to aerogel in terms of properties, and so I doubt they can be classified as aerogels. Although some of the samples looked identical to aerogel, they lacked aerogel's characteristic low density, optical traits, and mechanical strength. <b>Conclusions/Discussion</b> Conclusion: As I am inconclusive as to whether I have created aerogel or not, I can not properly compare the properties of that of my samples to those of normal aerogel. I am still conducting research into refining my methods and possible new methods in creating subcritical aerogel at this time.	
<b>Summary Statement</b> Creating aerogel under subcritical and economical conditions	
<b>Help Received</b>	



CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY

<b>Name(s)</b> Xuanji Wang	<b>Project Number</b> <b>S0519</b>
<b>Project Title</b> <b>The Synthesis of Silicon Nanoparticles for Macrophage Cellular Imaging in Atherosclerosis</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Currently, angiography is the primary method in imaging plaques, but it is an invasive technique and cannot determine the plaque's vulnerability to rupture. As heart diseases are the number one cause of death in America, it is crucial to develop a non-toxic biomarker that could be safely injected into human patients in order to detect and image plaques that cause atherosclerosis.</p> <p><b>Methods/Materials</b> For a biomarker, silicon nanoparticles are optimal due to our ability to synthesize sufficient quantities necessary for clinical applications as well as surface modification of the particles for the attachment of biomolecules for disease detections. The synthesis of the silicon nanoparticles is consistent of a reaction consisting of NaSi with the solvent dimethylformamide. The reaction is kept under reflux temperature for three days before propargylamine was added to coat particles with amine groups. Maleyl groups were then attached to purified silicon nanoparticles to create a negatively charged surface to bind to the scavenger receptor on the surface of macrophages. Macrophages were incubated with the maleylated silicon nanoparticles for confocal microscopy imaging.</p> <p><b>Results</b> Our results show that the silicon nanoparticles show very promising qualities as an inert biomarker to imaging vulnerable plaques. Cell toxicity analysis shows that about 95% of the cells are still viable after 4 hours of incubation. And, imaging studies show that there is successful uptake of the silicon nanoparticles in macrophages, proving that these biomarkers could indeed be used to target vulnerable plaques.</p> <p><b>Conclusions/Discussion</b> My results provide the first evidence showing that the targeted maleylated silicon nanoparticles can be used for in vivo diagnosis and assist with treatment of humans with atherosclerosis. The biomarkers are bio-compatible and inert even in high concentrations. For future work, once the silicon nanoparticles are verified to be a successful biomarker on the cellular level, it is important to test them in animal studies. For this we use mice and rats with damaged carotid arteries. We are currently synthesizing Mn doped silicon nanoparticles, a multimodal contrasting agent that could use fluorescence and MRI imaging to verify the clinical utility. Lastly, high quantities could be produced for clinical utility. Hopefully, an Investigational New Drug application will be submitted to the FDA within the next year.</p>	
<b>Summary Statement</b> Synthesizing a non-toxic biomarker that could image plaques in the blood stream that cause heart diseases and strokes.	
<b>Help Received</b> Thank you to Dr. Angelique Louie and Zane Starkewolfe for helping me with this project; Used lab equipments at Louie Lab at University of California, Davis; Participant in the Young Scholars Program.	



**CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY**

<b>Name(s)</b> <b>Shamik Mascharak</b>	<b>Project Number</b> <b>S0599</b>
<b>Project Title</b> <b>Fingerprinting with Genipin: A Green Reagent for Protein Detection in Solution and on Surfaces</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objectives of this project are to determine whether Genipin, a naturally occurring compound found in the Gardenia plant, could be used as a fingerprinting reagent on paper, and to determine whether Genipin could be used as a green analytical reagent for qualitative and quantitative detection of amino acids and peptides.</p> <p><b>Methods/Materials</b> Materials: Genipin, Ninhydrin, amino acids, peptides, Trypsin, BSA, ethanol, ethyl acetate, petroleum ether, Cary 50 UV/Vis Spectromphotometer, Perkin-Elmer Flourimeter, Typhoon Trio Imager, water bath, thermometers, various kinds of paper, hot air oven. Methods: Aqueous solutions of amino acids of different concentrations were mixed with ethanolic solutions of genipin (1:1, 1:2 ratio) and heated at 70 deg oC for 1 hour. The intensities of the blue/purple colors (absorption max 580-620 nm) were measured specrophotometrically to evaluate the utility of genipin as a colorimetric reagent. Two peptides (KKRP and GGGGG) and two proteins (Trypsin and BSA) were detected with genipin using the same method. Latent fingerprints on different types of paper were then developed using a developing solution of genipin in ethanol/ethyl acetate/pet ether and heating the papers in a humidity chamber. The fingerprints were detected by their blue color as well as their strong fluorecence (excitation: 590 nm, detection: 620 nm).</p> <p><b>Results</b> Amino acids can be detected by genipin up to micromolar concentrations, and the intensity of the blue coloration is proportional to the amino acid concentration. Stains of amino acids on paper and skin can be easily detected by genipin. Peptides and proteins can also be detected by genipin. Latent fingerprints on white and brown paper are easily detected by using genipin as the reagent. Such fingerprints are stable and very comparable to those obtained with Ninhydrin. Additionally, the fingerprints can be viewed by fluorescence (unlike Ninhydrin).</p> <p><b>Conclusions/Discussion</b> Genipin is an effective reagent for the detection of amino acids, peptides, and proteins. As hypothesized, it can also be used as a fingerprinting reagent. In contrast to the potential health hazards of Ninhydrin, Genipin is a safe compound and affords fingerprints which can be viewed by fluorecence (an advantage over Ninhydrin when the fingerprints are on colored paper).</p>	
<b>Summary Statement</b> This project is about using Genipin as a green reagent for fingerprinting instead of toxic Ninhydrin.	
<b>Help Received</b> Rashia Turner (a graduate student at UCSC) provided the amino acids and N-protected amino acids. The peptides were obtained from the laboratory of Professor Glenn Millhauser. Michael Rose, a graduate student of UCSC, helped me in the spectrophotometric measurements.	