



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Xiaoyu (Carrie) Cao	Project Number S0501
Project Title Malleable Polymer-Imprinted Porous Silicon Photonic Crystal Composites	
Abstract Objectives/Goals Porous silicon as a sensor is useful in many applications throughout the real world, from detecting toxins in the environment to monitoring levels of chemicals in the living systems. But while porous silicon possesses assets of reliability and efficiency, it lacks certain practical qualities such as biocompatibility, flexibility, and adaptability to a myriad of environments - qualities offered by polymers. The purpose of the project is to create composite materials comprised of porous silicon nanofilms infiltrated by various polymers. Methods/Materials The two polymers used were ethylene vinyl acetate and polydimethylsiloxane. In etching the porous silicon chip, using a HF-ethanol solution under an electric current, numerous current settings were attempted that allowed optimum polymer infiltration. Conditions of polymer application, such as exposure to high temperature, length of time in and out of heat, as well as procedure and method, were adjusted over the course of trial-and-error. After successfully synthesizing the composites, they were placed under a spectrometer in air and ethanol, and various computer programs were used to analyze the spectral shifts to determine the material's sensing value. Results A reliable method of polymer infiltration and formation of the composite was developed. It was found that a lift-off etch was necessary in order for polymer-film removal from the bulk silicon. The composites demonstrated significant spectral shifts when placed in ethanol, confirming their viability as sensors. Conclusions/Discussion I successfully created a novel sensing material integrating the sensing properties of porous silicon photonic crystals with polymers. The discovery that the sensing ability of the flexible and chemically stable composite materials remains relatively secure paves the way for further study and optimization of these novel hybrid sensors.	
Summary Statement A novel flexible sensing material was created that integrated the sensing properties of porous silicon nanofilms with polymers.	
Help Received Used lab equipment at the University of California, San Diego under the supervision of Professor Michael Sailor	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Tiffany Chien	Project Number S0502
Project Title Modifying TZD Drug to Improve Function in Body	
Abstract Objectives/Goals This study investigates the particular interaction between the current TZD drugs and its protein active site to help propose more efficacious analogs of this drug. Computational experiments will primarily analyze the drug's stereocenter, which will further examine the importance of chirality in a drug's metabolism in the human body. Methods/Materials I first found the crystal structures of some known TZD drugs: trogliazone and rosiglitazone on the RCSB Protein Data Bank. I created the drug derivatives on Gaussview and docked those drugs with Fred Receptor with the known crystal structure. After determining the active site, I determined which drug should be the scaffold for building new drug analogs. I used this pharmacophore to construct conformers on Gauss View, which were also docked into the active site. The scores after the docking procedure proved which analogs were the more successful binding candidates. Results VIDA visualization aid helped identify which amino acids were interacting with the protein in the active site. I noticed potential hydrogen bonding or electron affinity interactions and began constructing conformers with stronger, more electronegative tails. I also tested how the new drug would interact if a functional group were to attach. I resolved that the oxygen replacement was the most promising modification. To further my research, I also looked into drug chirality, a prominent issue that pharmaceutical chemists have to face regularly. I analyzed how each enantiomer of rosiglitazone would bind to the binding site, and as predicted, one of the enantiomers did not interact at all with the protein, which proved that enantiomers are distinct entities of the same drug. Conclusions/Discussion This drug design project focused on analyzing how certain components of a molecule interacted with its corresponding active site. I built the active site using the crystal structures given from the PDB website, and I docked my molecules into that structure. I created numerous analogs, and compared the docking scores of each one to propose the most successful modification. The oxygen I added to the aromatic ring proved to be the most useful in picking up another interaction with a neighboring amino acid, and thus it received the best score. The more negative the value, the better the docking.	
Summary Statement This study investigates the particular interaction between the current TZD drugs and its protein active site to help propose more efficacious analogs of this drug.	
Help Received Used Software and Computer at UC Davis under the guidance of Dr. Dean Tantillo and two of his graduate students.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Julia N. Daniel	Project Number S0503
Project Title Protecting Our Water: The Effects of Common Household Chemicals on the Decomposition of Acetaminophen	
Objectives/Goals To determine whether household chemicals can be used to decompose acetaminophen, which would allow consumers to treat their expired medications so they will not pollute local aquatic ecosystems after disposal.	
Abstract Methods/Materials I made a stock acetaminophen solution and added to a sample of this solution a common household chemical that I was testing for effectiveness against acetaminophen - methanol, hydrogen peroxide, household bleach, or nothing (control). I used thin-plate chromatography and an iodine chamber to see whether a reaction had occurred and to obtain Rf values (distance spot traveled divided by distance solvent front traveled) for the products. The amount of treated solution applied to the plates and amount of acetaminophen in the treated solution before treatment were constants.	
Results More than one Rf value was always obtained from a spot of bleach-treated acetaminophen, and the acetaminophen solution fizzed and formed a brown precipitate upon contact with the bleach. This happened no matter how many drops of bleach were used; when I used ten drops per milliliter, however, the effects were much more sudden. I found that no matter how many drops of methanol or hydrogen peroxide were used, the methanol had no effect on the acetaminophen, and the Rf values obtained for the untreated solution and for a methanol- or hydrogen peroxide-treated solution were consistently the same.	
Conclusions/Discussion From the multiple Rf values obtained after bleach treatment, I concluded that more than one product was produced when pure acetaminophen was treated with bleach; the bleach decomposed the acetaminophen into simpler chemicals. It was clear that a reaction occurred between the bleach and the acetaminophen, due to the release of gas and the formation of a precipitate. Consumers may be able to treat their acetaminophen-containing drugs with bleach so they pollute less, and sewage treatment agencies may want to investigate treating sewage in a way that could decompose acetaminophen and possibly other pharmaceuticals as well.	
Summary Statement I treated acetaminophen to see if a common household chemical could be used to decompose acetaminophen, which is a pollutant to aquatic environments. I found that chlorine bleach decomposes acetaminophen, and could be used before disposal.	
Help Received Chromatography advice from Mr. Oscar Acevedo; advice and photography help from my father; some experimentation done at Tamalpais High School chemistry lab under supervision of Dr. Leslie Hart, chemistry teacher. No help was received for experimentation, data collection/analysis or project assembly,	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Reece T. Fenning	Project Number S0504
Project Title Silver Nanoparticles	
Objectives/Goals If TSC is increased in the solution, then the wavelength of visible light will increase because the size of the nanoparticle will increase. If PVP is increased, the wavelength of visible light emitted will decrease because the width of the nanoparticles will increase.	
Abstract Methods/Materials Materials: H ₂ O (solvent); AgNO ₃ (silver source, oxidizing agent); Sodium citrate tribasic (TSC) (surfactant); Poly vinyl pyrrolidone (PVP) (surfactant); H ₂ O ₂ (reaction controller); NaBH ₄ (Reducing agent); Precise Scales; Spectrometer; Vials; Mixing plates; Pipettes . Procedure Step 1 Place 25 mL of water into Erlenmeyer flask and on a stirring plate set stirring plate for 600 rpm Step 2 Add 50 microliters of AgNO ₃ into the solution Step 3 Add 1.5 mL of Sodium citrate tribasic Step 4 Add .3 mL of PVP into the solution Step 5 Add 60 microliters of Hydrogen Peroxide Step 6 Add 250mL of Sodium Borohydride Step 7 Wait 30min to 40min for the reaction to complete Note: The PVP and TSC are subject to change depending on the results we tried to obtain and different pipettes are used for each step.	
Results As more of the TSC is added, the wavelength absorbed increases and the color emitted tends to be a blue or purple. As more PVP is added, the wavelength absorbed decreases and the color of the solution changes to a yellow or red color.	
Conclusions/Discussion The hypothesis was proved to be correct. The PVP surfactant binds with the triangular bases, which helps prevent the length to grow. This corresponds with the wavelength range of usually 350 to 600 nanometers. The TSC binds with the square sides, which helps prevent the growth of the width. This causes the orientation of the silver nanoparticles to become very long with a skinny width and the wavelength ranges between 700 to 1000 nanometers. This experiment shows that the silver nanoparticles do not always act the same as the bulk material.	
Summary Statement This project is about observing the effects of certain surfactants on silver at the nano scale level.	
Help Received Dr. Yadong Yin and his graduate students helped me perform the experiment and helped explain what was occurring chemically.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Simon He	Project Number S0505
Project Title Synthesis of Boronic Acids	
Objectives/Goals To synthesize 2-methylpyridine-5-boronic acid and 3-fluoropyridine-5-boronic acid from 5-bromo-2-methylpyridine and 3-bromo-5-fluoropyridine respectively.	
Abstract Methods/Materials In this experiment, two boronic acid compounds were synthesized from pyridine bases and triisopropyl borate. This was done by first dissolving the chosen pyridine reactants and dissolving them into solution in tetrahydrofuran. Then, the triisopropyl borate was added to the solution to prepare for the further reaction. Afterwards, butyllithium was added into the solution, the resulting reaction of butyllithium and the pyridine starting compounds would form a pyridine complex that would not need as much energy to react with the triisopropyl borate as the 5-bromo-2-methylpyridine or the 3-bromo-5-fluoropyridine substances would. The intermediate generated by the lithium + ?-pyridine molecule would readily react with with the triisopropyl borate (boric acid) to generate the desired products. which are 2-methylpyridine-5-boronic acid and 3-fluoropyridine-5-boronic acid after decomposing in water	
Results The desired products, which are 2-methylpyridine-5-boronic acid and 3-fluoropyridine-5-boronic acid were successfully synthesized. These products were found in high purities (~99%) and in generally large yields (above 80%).	
Summary Statement The synthesis of two boronic acids in high yield.	
Help Received Thank you to the supervising adults Dayan He and Linyong Mao for overseeing the procedures of the experiment and performing the addition of the n-butyllithium to the solution, which was deemed too dangerous for the student worker to perform. Also, thanks to the employees of Combi-Blocks	



CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s) Audrey W. Ho	Project Number S0506
Project Title The Structures and Energetics of Non-Classical Fullerenes	
Abstract Objectives/Goals To 1) provide computational (theoretical) data on 7 non-classical fullerene derivatives (all of which have no previously published characteristic values), 2) compare the calculated cage structures of the test fullerenes with the control X-ray structure, and 3) examine and explore the mechanism for C(62) synthesis and its applications. Methods/Materials The procedure consisted of a dry lab experiment; I obtained the computational data by running Gaussian 03 software for many weeks. (The calculations per molecule are very time-consuming.) All calculations were performed on a hybrid density functional level (B3LYP), based upon Becke's 3-parameter formulation, coupled with a 6-31G* (also called 6-31G(d)) basis set. I first tested these settings on the control molecule (C(62)tolyl(2)), to ensure that the results would match the X-ray structure for proper comparison, and then applied it to the 7 test molecules. Results included that for bond lengths, bond angles, pyramidalization angles, and band gap of the 4-membered carbon ring. Results The structural data for the seven C(62) derivatives very strongly supports my conclusion. The band gap for each derivative is higher than that of C(60). (The numbers are not included to conserve space.) Some categories varied more than others, most likely due to the sterics of the substituents attached to the fullerene cage. An analysis of the proposed mechanism reveals several slow steps with extremely high activation energies. A step was taken toward the possibility of more :CC: insertions; the structure and mechanism of C(64) was also explored, with similar structural and energetic results. Conclusions/Discussion The data strongly supports a cyclobutene structure for the 4-membered ring in C(62), answering the question of whether the ring structure is that of [4]radialene or cyclobutene. The molecule is overall energetically unstable and highly reactive (due to the high band gap, aka HOMO/LUMO energy gap). This could be useful in a commercial setting, with regards to photovoltaic efficiency (solar cells). The molecule's structure may also be of use in the field of immunology.	
Summary Statement The computational study carried out here of C62, which provided both structural and energetic data, is the first step toward extensive reactive and innovative research regarding this molecule and other non-classical fullerenes.	
Help Received Graduate student helped provide access to online publications and the Gaussian software (not available to high school students)	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Edward J. Kronfli, III	Project Number S0507
Project Title Make Your Sweat Work Harder?	
Objectives/Goals Is it possible to cool your body down during exercise using chemical means? Through the application of chemicals to athletic garments, it is possible to make the sweat on the garment "work harder"? My hypothesis is that Xylitol, a sugar alcohol, is the most endothermic chemical of a set of: Sucrose/Glucose, Citric Acid, and Sodium Bicarbonate, because of its presence in mint flavored chewing gum, which usually has a "cooling feeling." In addition, Xylitol has a very low heat of solution of -36.5 cal/g, lower than any other chemical listed. With Xylitol's negative heat of solution, it becomes possible to have sweat absorb more body heat, effectively cooling the body faster.	
Abstract	
Methods/Materials The hypothesis was tested through a battery of 5 experiments. A key experiment included testing for the heat of solution of Xylitol using a calorimeter. A second key experiment included placing Xylitol treated textiles under a heat lamp, and monitoring its temperature over a period of time.	
Results Results showed the heat of solution of Xylitol to be -34.305 cal/g, in comparison to an actual heat of solution of -36.5cal/g. Application of Xylitol to garments offered a difference in temperature of up to 4 degrees Celsius.	
Conclusions/Discussion The application of Xylitol is an effective way to make sweat colder so that it can absorb more body heat. Problems lie in the heat of evaporation, effectively giving back any cooling effect that they Xylitol might have offered. Regardless, in areas where sweat is not evaporated, it offers a significant effect for the athlete. It leaves room for many promising applications.	
Summary Statement The project is about using Xylitol as an additive to textiles to improve the cooling effect of sweat.	
Help Received Used laboratory at Antex/Matchmaster textile mills. Had guidance from resident textile chemist	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Samir Malhotra	Project Number S0508
Project Title Correlation of Temperature to Bisphenol-A Release from Polycarbonates	
Abstract Objectives/Goals Polycarbonate containers are widely used for food and beverage products. These containers are frequently exposed to heat/sunlight for long periods of time. Current study was undertaken to see if there is any correlation between temperature and BPA leaching in different polycarbonate products. Methods/Materials For conducting my research, I used Reverse Phase-High Performance Liquid Chromatography (Agilent 1100 series). The mango juice, ice tea, and water bottles were incubated at room temperature or placed in an incubator at a high temperature for different time periods. Samples were taken from these bottles and transferred to glass vials. The glass vials were stored in the refrigerator until RP-HPLC analysis. Calibration curves were made using a whole range of BPA concentrations diluted from the stock BPA dissolved in methanol solution. The limit of detection (LOD) was found to be 0.5482 ng/mL and the limit of quantification (LOQ) was found to be 0.229275 ng/mL. Results My data shows that there is no correlation between temperature and BPA leaching from polycarbonate bottles. BPA leached into water at about 168 ng/mL, with less BPA leaching into either the mango juice (27.28 ng/mL) or the green tea (5 ng/mL). Less BPA was observed leaching into either the mango juice or green tea at an elevated temperature than at room temperature, but this effect was not observed in water. Significant amounts of BPA leached when water bottles were left at room temperature for a short period of time. Conclusions/Discussion These observations, together with the finding that BPA appears to bind or adsorb directly to at least one component of green tea, suggest that leaching of BPA into aqueous beverages can be masked by binding or adsorbing to components of the beverages and that heating can remove the bound BPA species from the solution. The present study supported my hypothesis that there is no correlation between temperature and BPA leaching from polycarbonate bottles. I would like to investigate the nature of binding between different species and BPA in several drinks.	
Summary Statement Is there a correlation between temperature and bisphenol-A leaching from polycarbonates?	
Help Received Used lab equipment at Amethyst Life Sciences Inc. in Thousand Oaks	



CALIFORNIA STATE SCIENCE FAIR 2010 PROJECT SUMMARY

Name(s) Donald S. Mathis	Project Number S0509
Project Title An Investigation of Oxygen Exposure and pH Levels	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Is it possible to alter the pH of a selected fruit juice (orange) by varying the volumetric exposure to oxygen?</p> <p>Methods/Materials Fresh oranges were obtained, washed, peeled, then squeezed. The juice was collected into a very clean mason jar where the pH was measured for a control. To measure the volume of the test tubes, they were filled completely with water, and then a stopper was added, which displaced the water. The water in the test tubes was emptied into a graduated cylinder to accurately measure their respective volumes. The test tubes were marked at various levels corresponding to target volumes to serve as a guide when adding the oxygen. When testing, the test tubes were completely submerged into the juice and inverted, with the top still submerged in the juice. A vinyl tube was inserted into the juice below the test tube opening and the oxygen bubbles were allowed to enter the inverted test tube. When the desired oxygen level was reached, the vinyl tube was removed and the test tubes were capped off and dried. This process was repeated several times at varying volumes of oxygen. The test tubes were set in a rack to prevent them from being disturbed. The solutions were shaken every hour for nine hours, then were allowed to sit for five hours. They were then shaken every hour for another ten hours. After 24 hours, the test tubes were uncorked and the pH was measured immediately. The pH probe was calibrated before every use to ensure accurate readings. The data was recorded and analyzed.</p> <p>Results Overall, the control pH was higher in those solutions that were exposed to Oxygen levels for an extended period of time. This was due to the lower temperature and, because the function that the pH probe uses to measure pH is affected by temperature, the pH was measured a little high. However, after applying a pH temperature correction indicator, the pH of the control was 3.30. Therefore it can be assumed that the control was more acidic.</p> <p>Conclusions/Discussion Throughout the tests, there was doubt whether a closed system would affect the data. The pH did change in a small, increasing manner as a function of volume of oxygen exposure, which supported the hypothesis. The pH increased from 3.48 (average control) to 3.49 at 0% oxygen. From there it continued to increase to 3.53 (20%), 3.57 (40%), 3.61 (60%), and finally to 3.67 at 80% oxygen.</p>	
Summary Statement To determine the affect of oxygen exposure on the pH of orange juice.	
Help Received My father helped me obtain the materials needed for this project and helped add the oxygen to the test tubes.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Jaimie M. Mayner	Project Number S0510
Project Title Is Rinsing Your Apple Enough?	
Abstract Objectives/Goals The objective is determine whether or not rinsing is an effective method of removing pesticides and preservatives from apples. Specifically, I tested Diphenylamine, a common antioxidant found on most apples. Because Diphenylamine is slightly soluble, I hypothesized that the longer I rinsed an apple slice, the less Diphenylamine would remain. Methods/Materials Four apples were cut into four slices to eliminate the variability from apple to apple within a batch. Each apple slice was rinsed under a tap for varying time periods of 0, 15, 30, and 45 seconds. The slice was then sonicated in 150ml of water for 20 minutes to hasten the dissolving of the Diphenylamine. 20 micro liters of an internal standard D-10 Diphenylamine was added and an SPME Fiber was then injected to adsorb the Diphenylamine and internal standard molecules in a process called solid phase micro-extraction for 30 minutes. This SPME Fiber was then injected into a Gas Chromatograph-Mass Spectrometer, which separates the injected compounds and measures their abundances based on their molecular masses. The ratio of the abundances of the Diphenylamine and the D-10 Diphenylamine were then compared to calculate the mass of Diphenylamine removed during the sonication process. The difference in amounts of Diphenylamine removed after rinsing and without rinsing was the amount of Diphenylmaine removed due to rinsing. Results There appeared to be no correlation between the time spent rinsing each apple slice and the amount of Diphenylamine detected by the GC-MS. There was even more variation from apple to apple than there was between each apple slice rinsed for varying time periods. Out of interest, an organic apple was tested and was found to not contain any Diphenylamine. Conclusions/Discussion Because there was more variation from apple to apple than there was between apple slices rinsed for different periods of time, rinsing is an ineffective method for removing additives. Even if a miniscule amount of Diphenylamine is removed while rinsing, it is an insignificant amount because there theoretically could be much less Diphenylamine on a different apple from the same batch that hasn't been rinsed.	
Summary Statement My project tests to see how effective it is to rinse apples with water to remove the common preservative Diphenylamine using a Gas Chromatograph-Mass Spectrometer.	
Help Received Used lab equipment at UCSB under the supervision of Dr. James G. Pavlovich, Ph.D.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Mark T. Nakata	Project Number S0511
Project Title Walking on Water: A Study of Surface Tension	
Abstract Objectives/Goals The objective of this project is to investigate the property of surface tension of liquids and to determine how it is affected by rising temperatures and detergent additives. I hypothesize that in both cases, the surface tension will decrease. Methods/Materials I constructed a single beam balance. I used the balance to record the number of drops of water needed to pull a needle out of the fryer containing water at different temperatures. I ran ten trials at nine different temperatures. The test was repeated using corn oil. I then added detergent in 1 ml increments from 0 ml to 10 ml, to a cup of room temperature water and used the beam to record the number of drops needed to pull the needle out of the solution at each ml of detergent added. I ran 10 trials at each ml. Results I converted the number of drops into surface tension and found that at every temperature, the surface tension of water was greater than that of corn oil. The surface tension of both liquids decreased linearly. The surface tension of the detergent solution also decreased linearly for the first 2 ml; then it remained unchanged between 2ml and 10ml of added detergent. Conclusions/Discussion The experimental results supported my hypothesis. The results suggest that adding an extraordinary amount of soap to an extremely dirty load of laundry will accomplish nothing since surface tension is directly related to cleaning potential. With increasing temperature and pollution, it is very important to study the effects of detergent and temperature on surface tension since it plays such a vital role in our world.	
Summary Statement My project explores how rising temperatures affect the surface tension of liquids and examines the effect of detergent additives on water surface tension.	
Help Received Mother helped produce EXCEL graphs and assemble the backboard; Mr. Hunt , my biology teacher, lent me laboratory supplies; Father helped pay for everything.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) David L. Polyakov	Project Number S0512
Project Title Up in Smoke: The Effects of Additives on the Fire Resistance of Paint	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To determine if the addition of common chemicals to interior and exterior house paint improves the fire resistance of the paint.</p> <p>Methods/Materials Methods: Purchased necessary materials. Cut the wood into equal one-foot pieces and painted each with an appropriate mixture of paint and additive. I constructed a testing assembly and then painted testing boards with each solution, resulting in a total of 47 trials. I used a power drill with a whisk attachment to mix in the additives and then evenly painted each board. I labeled the backside of each board. I photographed the experiment and recorded the burning time with a stop watch. After burning a Control Group of unpainted wood, I randomly selected painted sample to eliminate bias. After the torch was started, I then measured the time it took for the paint to separate from the wood and for the wood to catch on fire. Materials: 1. Stopwatch, 2. Propane Torch, 3. Propane gas, 4. 4in by 1in by 10ft pieces of wood (cut into one foot sections), 5. Fire Extinguisher, 6. Sodium bicarbonate (baking soda), 7. Potassium bicarbonate, 8. Calcium carbonate, 9. Flour, 10. 2 gal of Glidden exterior paint, 11. 2 gal of Glidden Interior paint, 12. Paint roller, 13. Power drill, 14. Whisk</p> <p>Results The experiment produced rather consistent results. The exterior paint proved to be more fire resistant than the interior paint on almost every trial regardless of additive. Sodium bicarbonate provided more resistance to fire than the other two chemicals. The best fire protection result came from the mixture of 6% sodium bicarbonate and exterior paint, as it took over 5 minutes to catch on fire. The best time for the calcium carbonate was the mixture of 5% combined with interior paint. This sample lasted just over 4 minutes. The best result for the potassium bicarbonate was also the mixture of 5% with the interior paint which lasted for just over three minutes. Unpainted wood performed the worst.</p> <p>Conclusions/Discussion Sodium bicarbonate worked best, calcium carbonate second best, and potassium bicarbonate was last. But each of the three additives provided more fire protection than the paint alone or bare wood. The best results were achieved with the mixture consisting of 5 to 6 percent additives combined with paint. Too much of an additive caused the paint to separate from the wood and the wood to catch fire faster.</p>	
Summary Statement My project tested whether adding various chemicals to interior and exterior paint will increase their fire resistance.	
Help Received Father helped buy supplies, build structure, light torch, prepare video showing actual burning.	



CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s) Sarine G. Shahmirian	Project Number S0513
Project Title Propargyl Methyl Ethers: Novel Precursors to Cobalt-Complexed Propargyl Cations	
Abstract Objectives/Goals The generation of transition metal-stabilized organic cations under neutral conditions has long been sought after in the field of organometallic chemistry. Traditionally, unsaturated organic ligands are treated with strong Lewis acids, such as tetrafluoroboric acid (HBF ₄). This method, however, is inapplicable for substrates containing functional groups sensitive to acids, in particular benzyloxy and acetal groups. Methods/Materials The novel method for the generation of Co ₂ (CO) ₆ -complexed propargyl cations under neutral conditions was developed: employing the metal-bonded methyl propargyl ethers as substrates and triflic anhydride as a reagent. Results Ionic propargyl triflates are formed in situ as intermediates, due to successive nucleophilic substitution reactions. The transition of these reactive intermediates to the respective propargyl radicals readily occurs at 83°C (3-6 min), by way of the cluster-to-cluster and cluster-to-ligand single electron transfers. The carbon-carbon formation alpha to the metal clusters affords polysubstituted 3,4-diaryl-1,5-alkadiynes in high yields (>80%) and excellent d,l-diastereoselectivity (89-97%). Conclusions/Discussion The scope of the reaction was expanded by involving topologically diverse propargyl ethers, particularly those containing methoxy groups on the periphery of the aromatic nuclei.	
Summary Statement I found that, by utilizing propargyl methyl ethers instead of the traditional propargyl alcohol, I can optimize the synthesis of compounds that can potentially be used in breast cancer prevention and treatment.	
Help Received Used lab equipment at California State University, Northridge under the supervision of Dr. Melikyan. Participant in Southern California Academy of Sciences Research Training Program.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Harold F. Smith	Project Number S0514
Project Title Environmental Temperature Affects Crystal Formation in Bismuth	
Abstract Objectives/Goals Bismuth crystals have a very unusual shape; they appear terraced. My goal was to improve crystal "hopping" by slowing down crystal formation. Hypothesis: environmental temperature affects crystal formation in bismuth. Methods/Materials Several small chunks of bismuth were initially melted on the kitchen stove and allowed to freeze into the shape of a measuring cup at room temperature. The cup of bismuth was melted on a hot plate. The oxide layer was scraped aside and removed. The hot plate was then set to a temperature below 271°C. Crystallization time was recorded. Crystals were removed and quenched during the process. Temperatures assayed were: 35°C, 154°C, 183°C, 215°C, and 248°C. Each temperature was given three trials. Results Only three crystals formed at 215°C and none at all formed at 248°C. Below 215°C, once crystallization began, it continued until the bismuth froze solid. Thus, crystallization occurred for longer duration producing more crystals, the slower the bismuth cooled. In addition to the temperature effect, I observed four distinct crystal formations: hopper crystals, domed rectangles, spikes, and flat squares. Distinct forms grew in different trials. Rarely did different types form in the same batch. Conclusions/Discussion Temperature of the surroundings affects crystal formation. High temperatures inhibit growth. The data suggest that the environmental threshold for crystal formation is near 215°C. To narrow this down, more sophisticated equipment is needed. However the crystals formed at higher temperatures were not attractive. Really, the goal is to form beautiful hopper crystals. My new hypothesis is that crystal habit depends on the details of seeds in the oxide layer. Batches left heating for different amounts of time had different oxide layers and different crystal habit. I believe these are correlated.	
Summary Statement This project is about the affect of environmental temperature on crystal formation in bismuth.	
Help Received My parents helped me obtain the supplies I needed for this project.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Rebecca Su	Project Number S0515
Project Title Separation and Analysis of Marine Compounds Using TLC	
Abstract Objectives/Goals Marine natural products have demonstrated potential in treating cancer and other diseases. The goal of this experiment was to separate, recover, and identify structures of compounds found in a series of marine organisms. By working with smaller quantities of crude extract, it evaluated the effectiveness of a miniaturized analysis process. Methods/Materials One-dimensional (1D) and two-dimensional (2D) thin-layer chromatography (TLC) techniques were used to separate compounds within 62 extracts from marine organisms. Extracts were developed in different solvents to determine which solvent would provide optimal separation; the stationary phase was a silica-coated TLC plate. Next, 30 and 150 µg of a pure, known compound (C(34)H(49)BrO(2)) were spotted on a 2D TLC plate. The compound was recovered and analyzed with UV spectrometry to determine a percent yield. Nuclear magnetic resonance (NMR) was used to determine the chemical structure and identity of an unknown compound from a marine sponge extract. Results Overall, 2D TLC proved more effective than 1D TLC because it revealed many additional spots by further separating the compounds in a second direction. The 2D solvent combination of 1:9 CH(3)OH/CH(2)Cl(2) and 40:8:1 CHCl(3)/CH(3)OH/NH(4)OH provided optimal separation. The experiments involving the UV spectrophotometer revealed that the recovered compounds had an average 93.1% recovery rate. NMR peaks of the unknown compound revealed distinct structural features indicating that the unknown compound belonged to the spongian diterpene family. Conclusions/Discussion This experiment supported the hypothesis that the compounds within a crude marine extract can be analyzed on a microgram scale. It was shown that TLC can be used as an effective, time-efficient method for separating compounds within a crude extract from a marine organism. It also demonstrated that small masses recovered from the TLC plate can be detected and quantified using UV spectrophotometry. Finally, the experiment demonstrated that a compound from a TLC plate can be recovered and accurately analyzed using NMR spectroscopy to identify its structure. This outlined process can be used in the future as a miniaturized method for finding and analyzing novel compounds within marine organisms.	
Summary Statement Using thin-layer chromatography to miniaturize the analysis process, this project separated, recovered, and identified structures of compounds found in marine organisms.	
Help Received Used lab equipment at University of California, San Diego under the supervision of Prof. Tadeusz F. Molinski; Brandon Morinaka provided additional supervision; Mother helped build board; Mrs. Newman provided guidance and support	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) H. May Sumi	Project Number S0516
Project Title The Effects of D-Limonene Extracted from Different Citrus Fruits on the Disintegration of Polystyrene Foam	
Abstract Objectives/Goals The purpose of this experiment was to determine the effects of d-limonene extracted from different citrus fruits on the disintegration of Polystyrene foam, widely known as Styrofoam. Methods/Materials The d-limonene was collected by extracting oil from limes, lemons, orange, tangerines, red grapefruit, and oroblanco grapefruit. The oils were extracted by shaking ethanol and 50g of each citrus fruit's peels together, dissolving the oil in the ethanol. The solution was filtered and evaporated to obtain a pure extract oil. The extracted oils were applied onto Styrofoam blocks to compare the effects and disintegration. Results The results showed that all the citrus fruits disintegrated Styrofoam, but red grapefruits disintegrated the most by an average of 6.742cm ³ , and the lime the least by an average of 2.290cm ³ . The % deviation ranged from 6.33-12.55%. In general, the thicker the peels, the more it disintegrated. But overall all the fruits were respectably effective in disintegrating Styrofoam. Conclusions/Discussion In conclusion, all the citrus fruits disintegrated the Styrofoam, the red grapefruit having the most effect and the lime the least. This can be applied into a system in which the citrus fruit peels and Styrofoam, both a prominent waste product, can be collected and processed to reduce waste. It can be estimated that this would slowly but surely improve the environment by diminishing landfills and can be used as an alternative to the incineration of Styrofoam in which hazardous chemicals had been released to recycle.	
Summary Statement This project was about discovering the effects of d-limonene extracted from different citrus fruits on the disintegration of polystyrene foam.	
Help Received Father helped in the experiment; Mr, Antrim helped in my experimental design and gathering material.	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Brendon D. Telliard	Project Number S0517
Project Title Your Metallic Food	
Abstract Objectives/Goals I was determined to find out how much aluminum in cookware was absorbed into our acidic foods, which in turn, we ingest and may cause harm to our bodies. My hypothesis is that the most likely combination of cookware and acids to have the highest absorbency of aluminum in the water and acid solution will be aluminum foil and vinegar. Methods/Materials For the experiment I used aluminum cookware and an assortment of acidic edibles such as, tomatoes, lemons, and vinegar to conduct 32 trials. I also used chemicals, Aluver 3, Ascorbic Acid, and Bleaching 3 for the spectrophotometer. To conduct the experiment I put several acidic foods combined with water into the aluminum cookware and cooked it. Afterwards, I used a collection of chemicals and a spectrophotometer to analyze the absorbency of aluminum. Results The test results showed vinegar and foil as the most potent of all the acids (total average of both trials) and lemon juice as the most reactive with all wares (found by averaging the results per aluminum ware). The two highest results were aluminum foil cooked with vinegar resulted in a 73.9% increase in aluminum compared to the control. The second highest was a cake pan with lemon which had a 34.8% increase. Also, my research proved that there are side effects to ingesting too much aluminum. Conclusions/Discussion In conclusion, the trials proved my hypothesis to be true that aluminum foil and vinegar would have the largest aluminum absorbance and I was very satisfied with the results. The process as a whole was very enlightening after conducting this experiment it appears conclusive that the process of cooking acidic foods in aluminum is causing us as a culture to collectively ingest potentially harmful amounts of aluminum into our bodies unknowingly.	
Summary Statement The mix of aluminum and acids causes aluminum to seep into our food and the project proves this and shows how much is absorbed by the acid.	
Help Received Mr. Schiller (Poly High School Chemistry teacher) taught how to use spectrophotometer	



**CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY**

Name(s) Symphony Y. Yu	Project Number S0518
Project Title Rotational Barriers and Protein Backbones	
Abstract Objectives/Goals The objective of my project is to explore the effects of R-groups with varying electronegativities on the structures of protein backbones through the determination of the rotational barriers of the R-groups of nicotinamide, the model protein in this experiment. Methods/Materials Methods in computational chemistry were implemented to find the rotational barrier. The molecule sample, prepared in a solution of deuterated nitrobenzene, is first analyzed using NMR spectroscopy, with data points collected at incremented temperatures. The raw data collected by the Bruker TOPSPIN program is then transferred to Mathematica 7.0 for nonlinear regression. A composite curve is obtained and the values of the change in enthalpy and the change in entropy and solved for, using the transition-state theory. Results According to the experiment, the rotational barrier of 6-CH ₃ -nicotinamide was found to be $H = 16.012$ kcal/mol, the rotational barrier of 6-CF ₃ -nicotinamide was found to be $H = 12.90$ kcal/mol, and the rotational barrier of 6-Cl-nicotinamide was found to be $H = 12.6$ kcal/mol. Conclusions/Discussion The results from the experiment yielded a percent error of 27.079% for 6-CH ₃ -nicotinamide, a very large percent error, and relatively smaller percent errors for 6-CF ₃ -nicotinamide and 6-Cl-of 0.077% and 0% respectively. Although the experimental values of the rotational barriers closely matched those of the theoretical values, some data points on the apparent rate graph had such a large percent error that these points were nulled and cut out of the data analysis in order to achieve the similarity between the calculated and experimental values of the rotational barriers. With such high percent error, even if the rotational barriers matched, the results are inconclusive. The percent error in the apparent graph was in part due to some discrepancy in the best-fit model and errors in the assumptions on which the theory that is the foundation of the project is based upon, in addition to procedural issues.	
Summary Statement I explored the effects of R-groups with varying electronegativities on the protein backbone structures by the determination of the rotational barriers of the R-groups of nicotinamide through NMR spectroscopy with computational chemistry.	
Help Received Used lab equipment at the University of California, Riverside under the supervision of Professor Leonard J. Mueller and the graduate students in his research group, Jin Feng Lai and Tian Ye; mother and father helped decorate display board	