



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Nadia Ansari	Project Number J0601
Project Title Removal of Dye Nanoparticles Using a Natural Coagulant with Electrocoagulation in Series to Remediate Wastewater	
Objectives/Goals Dye waste generated by the textile industry is now the second leading pollutant of water worldwide and is expensive to remediate due to its chemical and physical properties. The objective of my study is to examine if pre-treatment with a natural coagulant, Chickpea, can be combined, in series, with a novel process of electrocoagulation to remove dye nanoparticles from wastewater.	
Abstract Methods/Materials 5 cm x 1.5 cm Aluminum, Iron, and Zinc electrodes, Methylene Blue Dye, Digital Scale, Magnetic Stirrer, 12 V Solar Cell Charger, alligator clips, 400 ml beakers, Glass jars, Funnel, Coffee Filter, 1000 ml Flask, TDS digital meter, UV-Vis Spectrophotometer 1. Measure varying amounts of chickpea (.080, .160, .320 g). 2. Add chickpea powder to 225 ml of dye water and stir for 10 minutes using magnetic stirrer. 3. Slide each electrode (AL, Fe, or ZN) into wood block at desired length (0.8 or 1.5) and place in container of chickpea water. 4. Apply 12 V using solar panel with alligator clips for 20 minutes. Allow for settlement time of an hour. 5. Drain through a coffee filter. 6. Take out samples of filtered water for spectrophotometer and TDS measurement. 7. Set the spectrophotometer to calibrated wavelength. Record the absorbance and transmittance and calculate dye removal efficiency as initial absorbance minus final absorbance divided by initial absorbance.	
Results Although dye removal was possible with natural chickpea coagulation, the highest dye removal efficiency achieved was 33.5% with chickpea concentration of 800 mg/L. Electrocoagulation was a more efficient process than using a natural coagulant. The highest dye removal efficiency was achieved with aluminum anode and distance of 1.5 cm between electrodes and was 82%. The best dye removal process involved using a chickpea powder concentration of 800 mg/L, with aluminum anode, distance of 1.5 cm, which resulted in dye removal efficiency of 99.1%.	
Conclusions/Discussion My study using the chemical properties of a natural coagulant as well as ions created from electrocoagulation to attract and coagulate dye nanoparticles, made larger by this process, is novel. The larger size allows for more simple ways, like filtration, to remove this pollutant. Given the efficiency seen in coagulating and removing dye nanoparticles, this new process could be tested in future studies for removing other small pollutants, like microbes (including viruses) from wastewater.	
Summary Statement My study shows that natural substances, like chickpea, can be combined in series with a novel technique, electrocoagulation, to be more effective in removing dye nanoparticles from water than either method alone.	
Help Received I learned basics of Chemistry and electrocoagulation using Khan Academy videos. My dad cut wood blocks to hold my electrodes and supervised when I was using the solar cell and alligator clips.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Jacob Armstrong; Amanda Vega	Project Number J0602
Project Title Natural Ways to Dye a Tagua Nut	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this science fair project was to determine the effectiveness of natural pigments at dyeing a Tagua nut, an Ecuadorian plant also known as "vegetable ivory" which is used in making jewelry and figurines.</p> <p>Methods/Materials Sanded and sliced Tagua nut samples were exposed to pigments obtained from boiled blackberries, beets, and turmeric for up to 48 hours. Pigment saturation was compared using a scale we defined.</p> <p>Results The Tagua nut slices had the strongest saturation in the blackberry pigment solution, earning a 5/5 on our pigment saturation scale after 48 hours of exposure. The nut slices exposed to the beet and turmeric solutions earned a 4/5 rating on our scale.</p> <p>Conclusions/Discussion We found that the Tagua nuts are able to be dyed using natural pigments. The increased movement of molecules due to the heat used to extract the pigment from the cells, increased the saturation of the nut slices. The blackberry may have more pigment in its vacuole than the beet and turmeric plant because it is used to attract animals. The beet and turmeric plant may have less pigment and more water in their vacuoles because they store water for the plant. The results are important because this "vegetable ivory" could be a replacement for elephant tusk ivory.</p>	
Summary Statement We found that pigment heated and extracted from blackberries was more effective at dyeing a Tagua nut than turmeric and beet solutions.	
Help Received Martha Cantos was important to our introduction and understanding of the Tagua nut.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Aria K. Asmuth	Project Number J0603
Project Title Mixing Iodine and Bleach	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I wanted to know the exact ratio of iodine to bleach to make 100mL of water stay clear. What is the bleach doing to the iodine in this demonstration? Why is it happening? Will the water remain clear?</p> <p>Methods/Materials After putting on safety equipment I filled 3 beakers with 100mL of water and added differing amounts of iodine to each beaker. Next, I slowly started to drop in bleach with a dropper and stirred it with a popsicle stick. Then, we waited to see what would change. My classmate helped me take notes.</p> <p>Results Much to my surprise, the water turned even darker in color while slowly dropping in bleach, but as I sped up the drop speed, it finally turned clear. after being left alone for a few minutes, it returned to its earlier dark color. So we added more bleach, waited, and it finally stayed clear.</p> <p>Conclusions/Discussion It turns out that the ratios all factored down to approximately 7 drops of bleach to 1mL of iodine. Finally, if anyone else or I decide to redo this experiment, I recommend that they drop the bleach at a constant speed, not reducing or increasing it to see if the liquid still gets darker.</p>	
Summary Statement I studied the effect that bleach has on iodine and found out how much bleach is required to make the iodine clear.	
Help Received None. I set up and performed the experiment myself and had a friend take notes.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

Name(s) Kalin S. Baca	Project Number J0604
Project Title Q=mc(deltaT) Using the Specific Heat Capacity of Water and a Calorimeter to Measure and Compare Thermal Energy	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Understanding the world through scientific and mathematical laws can be overwhelmingly difficult. But the laws don't change, and there are constants that act like anchors that keep things grounded. For this project, I worked with a formula with a universal constant, c, the specific heat of water, and performed a well-designed experiment to see if I can get reliable scientific results. Using $Q=mc(\Delta T)$, I compared theoretical vs. experimental thermal energies expressed in Cal/g that are released from burning nuts. I wanted to conduct a practical experiment to and to help with understanding the formula $Q=mc(\Delta T)$.</p> <p>Methods/Materials I used a simple calorimeter to measure the thermal energy released from burning nuts. My methods include the consistent assembly of the calorimeter for each trial run. Looking at the formula $Q=mc(\Delta T)$, the factors that will affect Q are m and delta T, so I employed methods to accurately measure the mass of water and its change in temperature. In addition, I needed to calculate Q, the thermal heat energy absorbed by the water, in Cal/g so accurate measurements in the change in mass of the nuts were also taken.</p> <p>Results I hypothesized that if I can get the calorimeter to perform consistently, I will be able to calculate results using $Q=mc(\Delta T)$ that will allow me to know, in order, which nuts have the least to the most amount of Cal/g. Of the 7 nuts tested, my results show that I was able to differentiate between nuts that had the least and the most Cal/g, however, I was not able to correctly put all 7 nuts in order of increasing Cal/g. 4 out of the 7 nuts had Cal/g values that were too close in theoretical values. I should have tested nuts that had significant differences in Cal/g values because my calorimeter was not sensitive enough to detect small differences in heat released.</p> <p>Conclusions/Discussion The percent error values for all the samples tested fell within a small range from 50.46% to 54.70%. Although these values were high, I didn't need the experimental Cal/g values to be close to the theoretical values because I knew that the calorimeter was not 100% efficient. A significant amount of heat released is lost in the surroundings. I just needed the calorimeter to perform consistently so I can make an accurate comparison between the Cal/g values. Applying scientific laws and universal constants to an experiment makes it easier to understand how it works!</p>	
Summary Statement I used $Q=mc(\Delta T)$ to measure and compare thermal energies released from burning nuts.	
Help Received I received help with brainstorming of the experimental design, plotting of data graphs, taking pictures while conducting the experiment, printing pictures for my poster, and review and proofreading of final school report from Miriam Baca.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Dominique E. Bhatti	Project Number J0605
Project Title Exploring the Physics and Chemistry of Slime	
Objectives/Goals My project is exploring the physics and chemistry of slime, a non-Newtonian fluid, the result of a chemical reaction between Polyvinyl alcohol (found in glue) and Sodium Tetraborate (Borax). The objective of this project is to scientifically characterize slime. I designed and performed 6 experiments: bounce, stretch, dry time, adhesive strength, water solubility and solvent agents. I created 4 slime recipes by varying the amount of Sodium Tetraborate and Polyvinyl alcohol. My 3 hypotheses are: (1) as Sodium Tetraborate increases, the polymers get tangled making the slime thick, (2) lemon juice would be the best solvent, (3) slime would stick best to wood.	
Abstract Methods/Materials Glue, Borax, homemade force meter, stopwatch, camera on tripod, ruler, lemon juice, vinegar, glycerin, stones, aluminium plates, acrylic discs, wood. Used a camera to capture bounce and stretch distances. Observed different behaviors when samples are stretched in 1 second or 5 seconds. To measure dissolution, I tested lemon juice, vinegar and glycerin. Experimented with wood, plastic, metal, ceramic and stone, and measured the prying force.	
Results For dissolving agent, vinegar was the quickest while lemon juice slowest. Varying the amount of solvent did not speed up the process. The surprise result was vinegar beating out glycerin as the best solvent for slime. I had not predicted the 2 different behaviors for stretching which made sense since slime is a non-Newtonian fluid. For the drying test, I thought slime would dry uniformly. However, even when the outside is dry, the inside remains soft. I saw a thin layer of skin that seemed to protect the inside from air.	
Conclusions/Discussion I designed and performed 6 experiments to scientifically characterize slime. The results from these experiments gave information about the chemical and physical properties of this non-Newtonian fluid that resulted when Polyvinyl Alcohol (glue) reacted with Sodium Tetraborate (Borax). I tested 8 different samples with varying amount of Borax mixed in to see what influenced the physical and chemical properties of slime. The results indicated that as the long polymer chains of Polyvinyl Alcohol interacted with Borax, they get tangled and stick together, making the result a malleable solid.	
Summary Statement This project explores the scientific characteristics of slime: adhesive strength, stretch and bounce, dissolution, drying time and water solubility were measured.	
Help Received None	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) James V. Bittleston	Project Number J0606
Project Title Horse Power	
Abstract Objectives/Goals The goal of my project is to determine if horse manure is a viable source of energy compared to traditional sources of energy such as wood and coal. Methods/Materials I built a calorie meter from 2 tin cans and used that device to measure the energy output from each sample which there is 9 total (3 samples per fuel source). I measured each fuel source sample for weight and took high and low temperature readings of the water heated by each burning sample to find the temperature difference between the two. Then converted that data into calories burned and multiplied it by the specific heat of water (4.18). That gave me the correct number for Joules generated for each sample. I then averaged each sample and was able to create specific graphs that was related to the conclusion of my project. Results All 9 samples data was recorded and each of the three fuel source samples were averaged. This allowed me to compare each sample in terms of joules to find out which fuel source was better. Coal (1239 Joules) was by far the best with wood (696 Joules) coming in second and horse manure (404 Joules) a close third. Conclusions/Discussion Horse manure came in last on the Joules chart but if one compared the time burned to the mass of each sample then one can conclude that Horse manure is a viable source of energy.	
Summary Statement The purpose of my project is to show that horse manure is a viable source of energy compared to wood and coal.	
Help Received My Dad, Brad Bittleston, helped me build my calorie meter by drilling holes into the tin cans.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Eva Y. Chen	Project Number J0607
Project Title The Optimal Extraction Method of Medicinal Components from Lingzhi	
Abstract Objectives/Goals The objective of my project is to find what is the most effective way to extract the medicinal components from lingzhi. Methods/Materials I first cut five grams of lingzhi into smaller pieces. Added 20 ml. of methanol, ethyl acetate, hexane, acetone, and water in five separate flasks. That was then filtered then evaporated in a hood. Which I then added chloroform-d and put them in the NMR spectrometer. Finally, I compared the critical components that were extracted. Results The components that were extracted and filtered was compared with their respective NMR spectra. My data showed that methanol was the most effective out of all five extracts. Conclusions/Discussion The methanol worked the best out of all five chemical extracts. Since it extracted the most polysaccharides and triterpenes out of the five extracts. While the water extract was the worst out of the five extract. This concludes that methanol extracts the most critical components from lingzhi.	
Summary Statement I made five different extracts and tested them to find which method was the most effective.	
Help Received My chemistry professor taught me how to do extractions and how to use the NMR. I also recieved safety training and technic training.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Sejal Chopra	Project Number J0608
Project Title From Fryer to Fuel	
Abstract Objectives/Goals The purpose of this experiment is to find out which frying grease will produce the most biodiesel in terms of quantity and quality as an end result. Methods/Materials First, I filtered my four, restaurant obtained oils (Vegetable Oil, Olive Oil, and Canola Oil, then Canola Oil) and removed any traces of water by boiling it. Then, I created methoxide, which was necessary for creating the "base" of my biodiesel. Next, I mixed my heated oil and methoxide and let it sit for three weeks. Distinct layers of glycerol and biodiesel started to form and after three weeks, I siphoned out the oil. Finally, to really test its quality, I ran a few tests, such as the 3/27 methyl alcohol test, to see if my biodiesel truly was biodiesel. Results My hypothesis is the following: If the amount of biodiesel made is tested from Soybean Oil, Vegetable Oil, Olive Oil, and Canola Oil, then Canola Oil will produce the most biodiesel in the end result. In correspondence with the hypothesis, the average oils produced biodiesel from a greater amount to the least amount in the following order: Vegetable Oil (193 ml), Canola Oil (155 ml), Soybean Oil (116 ml), and Olive Oil (57 ml). Conclusions/Discussion I learned a lot from doing this project. I learned that out of four commonly used frying greases, Vegetable Oil is the best oil to use in making biodiesel in terms of quantity and quality. From this, I saw how easy it was to accomplish making a simple batch of diesel, and more importantly, the chemistry behind it. This further expanded my knowledge in chemical reactions, which I can definitely apply in the future.	
Summary Statement I will test which frying grease will produce the most biodiesel in terms of quantity and quality from four commonly used frying oils.	
Help Received My mother and father helped me obtaining my oils. My science teacher, John Briner, supervised me during my time experimenting in the lab.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Isabella V. Hanck	Project Number J0609
Project Title Oscillating Chemical Reactions with Malonic Acid	
Abstract Objectives/Goals The objective of this study is to find the amount of malonic acid that provides the quickest color changes in the chemical reaction to apply to smart glass. Methods/Materials Manganese sulfate monohydrate, varying amounts of malonic acid, sodium iodate, sulfamic acid, hydrogen peroxide, distilled water, starch, Science Journal light sensor. Two solutions were made, one with distilled water, sodium iodate, and sulfamic acid, the other with hydrogen peroxide, malonic acid, manganese sulfate monohydrate, and starch; solutions were placed on light sensor and mixed. This was repeated five times for each of the five malonic acid amounts for a total of twenty-five iterations. Results Results showed the solutions containing 1 gram malonic acid had quickest color changes, ranging from 11.49 to 13.68 seconds for each color change. The solutions containing 1/3 gram malonic acid changed colors slowest ranging from 22.28 to 26.84 seconds. Conclusions/Discussion Benefits of creating oscillating reactions using malonic acid include: saving energy from previous costs on heating and cooling systems and reducing greenhouse gas emissions by using smart glass. In conclusion, the scientist determined that by using the right ratio of malonic acid, the optimal rate of color change in smart glass can be achieved.	
Summary Statement I devised an oscillating chemical reaction using the optimal amount of malonic acid to change colors quicker than the existing chemical reactions used in smart glass.	
Help Received I received supervision while handling the chemicals during the experiment and performed the rest of the experiment independently.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Miles O. Kennedy	Project Number J0610
Project Title How Red Is Your Sports Drink?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of my project is to show how much red dye we ingest by consuming a common sports drink or soda. I also want to learn which drink has the most red dye, so if you are to buy and consume one of the drinks in my experiment, you can make an informed decision and choose the drink that is least harmful. I also want to call attention to the health dangers caused or associated by/with red dye. In all, my goal is to help people become aware of the consequences of red dye and how much someone ingests on a regular basis.</p> <p>Methods/Materials Made a simple circuit that consisted of a photoresistor and an LED, used a multimeter, obtained a commercial Thermo Scientific Genesys 20 spectrophotometer, used both to test the relative concentrations of dye present in several liquids, compared results to a calibration curve.</p> <p>Results The commercial spectrophotometer was a very sensitive measurement tool while the homemade photoresistor was not as sensitive. Each sample tested had large amounts of red dye in them.</p> <p>Conclusions/Discussion My prediction that the drink with the darkest red color would have the most dye was confirmed. Making a homemade spectrophotometer is relatively easy and although not as sensitive as a commercial grade spectrophotometer, it was able to detect the amount of dye in a sample. Current research links red dye to hyperactivity, allergies and cancer.</p>	
Summary Statement I built a homemade spectrophotometer and use a commercial grade spectrophotometer to measure the amount of red dye in various sports drinks.	
Help Received Dr. Justen Whittal loaned me and taught me how to use the ThermoFisher Genesys 20 spectrophotometer.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Aubree Larson; Melody Pledger	Project Number J0611
Project Title Invisible Fire Extinguisher	
Abstract Objectives/Goals There are many ways to put a fire out, but how does Co ₂ put out a fire? This is the question that is on our minds. We decided to choose this topic because we are curious about how fires start and the different options available for putting them out. We will create our own fire extinguisher of carbon dioxide gas using vinegar and baking soda to see if it will put out votive candles. Methods/Materials Measuring utensils, Vinegar, Baking soda, votive candles and a lighter. Results It took several trials, but we eventually were successful extinguishing all four votive candles. The first trial we failed because we covered the glass with cardboard and not our hands which allowed too much gas to escape. Our second trial we failed again due to not making enough carbon dioxide. The remaining trials were successful. Conclusions/Discussion We were able to prove that carbon dioxide puts out fire, however a certain amount of carbon dioxide was needed to put the candles out. In addition a certain amount of skill was needed to control the amount of gas going onto the candles.	
Summary Statement We successfully created a fire extinguisher that created enough Co ₂ to put out four votive candles.	
Help Received We setup and performed this experiment by ourselves after reading Science Mini-Investigations by Marjorie Frank and consulted with our science teacher Mrs. Steward.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Cole M. Larson	Project Number J0612
Project Title Rust Wars: The Effect of Acidity on the Oxidation of Steel	
Abstract	
Objectives/Goals This experiment was performed to test how fast steel wool corrodes after being soaked in different acidic liquids. It was expected that if lemon juice is used, then the steel wool would corrode the most. This was expected because lemon juice has the lowest pH of all five liquids, so it would cause the most corrosion.	
Methods/Materials In this experiment, five liquids were used (distilled water, lemon juice, tomato juice, orange juice, and vinegar). Five trials were done with each liquid. For each trial, a strip of steel wool was soaked in a liquid, then put inside a test tube with a thermometer for 20 minutes. Corrosion releases heat, so after the 20 minutes was up, the temperature of the steel wool was recorded. The more corrosion, the higher the temperature.	
Results The vinegar had the highest average temperature: 24.82°C. It was the second most acidic liquid used. Lemon juice, the most acidic had the second highest average temperature: 24.28°C.	
Conclusions/Discussion The results did not support the hypothesis. Even though the lemon juice was the most acidic, it got the second highest average. Vinegar got the highest average temperature. However, in general more acidic liquids tended to have higher temperatures than less acidic liquids. There may be some other aspects of these liquids that affects corrosion, in addition to pH.	
Summary Statement In general acidity increases the corrosion of steel wool, but this relationship is imperfect and may be impacted by other factors.	
Help Received I designed and conducted the experiments, my father found and purchased the materials, my mother took pictures, and my younger siblings assisted me by handing me materials.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Eric Larson; Jacob Mansbach	Project Number J0613
Project Title Optimum Thrust in Homemade Rocket Fuels	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this study is to test different types and ratios of homemade rocket fuel.</p> <p>Methods/Materials Stump Remover (KNO₃), Sugar, Hot Plate, Various additives, protection equipment, mixing devices, recoding device, laptop, pan, rocket casings, fuses We tested multiple types of fuels multiple times to get an average burn rate for each fuel. We then recored the data and compared our results to figure out which fuel we made was the most powerful.</p> <p>Results Five rocket motors of identical dimensions were made, each containing a different compound. Each compound was tested three times, and the average burn rates were observed. The best fuel was observed to be the one that included rust powder and normal sugar. It burned the fastest of any of the fuels made with an average of 9.6 grams per second. This fuel mixture yielded the greatest performance and significantly outperformed three of the five fuels tested.</p> <p>Conclusions/Discussion After reviewing the data, we accept the hypothesis. Looking back over this project, we see that we successfully proved our hypothesis. Compared to a commercially available Estes E motor, we could make 12 complete equivalent motors for the same cost. We also successfully made a fuel that is fast-burning and that provides enough thrust to launch a model rocket. Our best performing fuel had an average burn rate of 9.6 grams per second which is comparable to an Estes motor. This average supports our hypothesis and proves that it is both easy and inexpensive to produce our own solid rocket fuel.</p>	
Summary Statement We created a simple, efficient, and inexpensive rocket fuel at home.	
Help Received We designed, tested, and organized our experiment alone. We received help from Mr. Mark Morey in the chemical aspect of our project.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Audrey M. Meadows	Project Number J0614
Project Title Water Originated Corrosion	
Abstract Objectives/Goals The objective of this project was to establish an answer as to why the water related event occurred in Flint, Michigan in April of 2014. This project also works to understand how a solution to these events can be found. Methods/Materials Measured the corrosion of black iron pipe under the effect of water of three different chemistries. The amount of corrosion was determined through the concentration of iron in each water sample. An inductively coupled atomic plasma spectrometer (ICP) was used to measure the concentration of iron in the water. Results The concentration of iron present in each sample at the end of the experiment was compared to one another. The results showed that the water with the greatest amount of dissolved solids, most notably calcium and magnesium, was the least aggressive and caused the least amount of corrosion. Conversely, the water containing no dissolved solids caused the most corrosion of the metal pipe. Conclusions/Discussion This project validates that there is a difference between water chemistries and that their properties will effect the rate of corrosion in metals. The results of this experiment can be used to aid research regarding this topic and how that research can be used to prevent events similar to Flint, Michigan.	
Summary Statement I tested the effects of three water samples, all of different chemistry, and their effects on the corrosion rate of black iron piping.	
Help Received I received help from Babcock Laboratories, specifically Mr. Kyle Andrew and Mr. Brad Meadows (my father), in order to set up the experiment and analyze my data.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

Name(s) Jacqueline Prawira	Project Number J0615
Project Title Bio.fiber.plastic: The Effect of Lignocellulosic Fibers in Enhancing the Formation & Tensile Strength of Rice Bioplastic	
Abstract Objectives/Goals To enhance the formation and tensile strength of rice bioplastic using lignocellulosic fibers from garbage/recycled materials in bio.fiber.plastic. Methods/Materials Rice bioplastic formula was modified from last year's project with broken rice as a control in preliminary stage. Four lignocellulosic fibers (3 different grade recycled paper-UOP#36, SMP#2, OCC#11, 3 different old cotton t-shirts, corn husk, rice husk) went through hydro-pulping and soda ash pulping. Six different ratios of fiber to broken rice for each type of lignocellulosic fiber were tested. Tensile strength of each sample was calculated. Maximum force was measured using digital force gauge and its thickness with digital Vernier caliper. Flexibility was tested by bending the sample 180 degrees repeatedly for 3 data points (crease, tear, and break) Results The results showed that bio.fiber.plastic's tensile strength increases as the ratio of fibers increases, ranging from 36% to 734% improvement compared to control (to a certain ratio and depends on the type of lignocellulosic fiber). Paper fiber had the highest tensile strength and was not affected by paper grade and/or fiber length. Cotton fiber had higher tensile strength at lower ratio of fiber to broken rice. Corn husk fiber's tensile strength increased steadily as the ratio increased. The flexibility was affected by the length and type of lignocellulosic fiber. Rice husk was unsuccessfully broken down through soda ash pulping due to high lignin content. Tensile strength equation was derived for each type bio.fiber.plastic based on linear regression trendline. Anomaly was found and possible sources of error were addressed. Conclusions/Discussion My hypothesis was partially proven correct because the recovered cellulosic fiber, not hemicellulose or lignin, improves the tensile strength. Flexibility has an inverse correlation to tensile strength. I concluded that recovered cellulosic fiber provides the structure and enhances the tensile strength, while amylose and amylopectin in broken rice works as a "glue" and gives the plastic-like quality of bio.fiber.plastic. Ratios and types of fiber determine the intended application of bio.fiber.plastic products. Plant-based garbage/recycled materials can be a source of lignocellulosic fibers and reusing these fibers otherwise thrown away, into bio.fiber.plastic helps to reduce the landfill and plastic problem. Prototypes were successfully created.	
Summary Statement I developed a fusion of rice bioplastic and lignocellulosic fibers from garbage to enhance the formation and tensile strength, by upcycling cellulosic fibers to extend their useful life as a new product/material, bio.fiber.plastic.	
Help Received Thanks to Mr. Lee, my science teacher, for support and feedback; special thanks to my parents for providing the materials and adult supervision.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Alicia Roice; Ashlyn Roice	Project Number J0616
Project Title Radical Terminators! Comparing Antioxidant Acitivity of Different Polyphenol Rich Food Using BR Reaction & Raspberry Pi	
Abstract Objectives/Goals The purpose of our science fair project was to compare antioxidant content of different polyphenol rich food samples and to use a Raspberry Pi to automate data capture. We used the Briggs Rauscher(BR) reaction as a method to generate free radicals. The BR reaction is an oscillating chemical reaction in which a mixture of chemicals go through a sequence of color changes, which repeats periodically. Adding antioxidants to BR reaction mixture increases the interval between blue cycles of the reaction. Our hypothesis for this project was, if different food samples are added to the BR reaction mixture, then the time interval between second and third blue phases will increase, depending on the food's antioxidant content. We hypothesized Gooseberry to have most antioxidants and ivy gourd the least. Methods/Materials Food samples were prepared by adding 5 gram of food to 95mL of distilled water. Mixture was centrifuged at 3000rpm. BR reaction mixture contain distilled water, sodium iodate, sulfamic acid, hydrogen peroxide, malonic acid, manganese sulfate and starch. BR reagents were mixed well with an overhead stirrer. 5ml of food sample was added to BR mixture at onset of second blue phase with overhead stirrer still active. Used light sensor connected to Raspberry Pi to record intensity of light passing through BR mixture. Data captured was analyzed to compute delay between second and third blue phases of the reaction. Three trials were conducted for each food item. The control was delay between second and third blue phases of BR reaction without adding any antioxidants. Results The delay between second and third blue phases was 15 seconds for the control. Bilberry produced the highest difference (498 seconds) from the control, indicating that it has the most antioxidant content among the food tested. Ivy gourd produced lowest difference with 8 seconds. Conclusions/Discussion Our hypothesis was partially correct. Different food samples produced varying delays between second and third blue phases of BR reaction. Billberry had the most antioxidants, and ivy gourd had the least antioxidants. Consuming food rich in antioxidants is essential for maintaining proper health. Antioxidants help neutralize free radicals. Excess free radicals can cause illness such as cancer, autoimmune disorders, rheumatoid arthritis, cardiovascular, and neuro-degenerative diseases.	
Summary Statement We used the Briggs-Rauscher reaction to compare the antioxidant content of different food samples and used a light sensor attached to a Raspberry Pi to capture intensity of light passing through the BR mixture.	
Help Received Our parents supervised us while we conducted the experiment, took photographs and helped with layout of the board. Our science teacher, Mr. Lee, provided guidance throughout the project.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Nadia Salah	Project Number J0617
Project Title Which Oil Makes the Best Ferrofluid?	
Abstract Objectives/Goals The incentive of this project is to discover the oil that makes the most effective ferrofluid, and the reason behind its favorable quality. Methods/Materials I used 9 oils and made 3 different ferrofluids with each oil. Each oil went through four trials. The first trial was testing the quality of the Ferrofluid by putting a magnet under the petri dish to measure the hump produced by the surface tension of the magnetic field from the ferrofluid and the magnet. The second trial was measuring the height of the spikes. The third test was testing the viscosity of the ferrofluid. The fourth and final trial when measuring the amount of ferrofluid attracted by the magnet. Results The oil that made the ferrofluid with the best properties was grapeseed oil. Although peanut oil is the oil with the lowest viscosity, it's only made up of 32% (PUFA), polyunsaturated fatty acid while grape seed oil is made up of 70% (PUFA). Oleic acid is an acid found in PUFA and that acid is what improves the quality of ferrofluid. Oleic acid is used as a surfactant to prevent clumping in ferrofluid. The oil with the lowest quality was coconut oil. The reason behind its poor performance was because coconut oil is made up of 1.8% PUFAil Conclusions/Discussion In conclusion, the oil that makes the most favorable ferrofluid is grapeseed oil because it contains a high percentage of polyunsaturated fatty acid. The future work of this project will be directed on making nanoparticle suits containing ferrofluid for military soldiers. It will be able to stiffen to provide splints for broken bones so they have a higher chance of survival.	
Summary Statement The incentive of this project is to discover the oil that makes the most effective ferrofluid, and the reason behind its favorable quality.	
Help Received N/A	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Isabel Salazar	Project Number J0618
Project Title Liquid Evaporation	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this study is to learn which liquid between orange juice, water, nail polish remover, and rubbing alcohol would evaporate the quickest.</p> <p>Methods/Materials 4 measuring cups, nail polish remover, orange juice, water, and rubbing alcohol. Tested the speed of evaporation of various liquids.</p> <p>Results The speed of evaporation of various liquids was tested over a 1 week period. The liquid with acetone proved to evaporate the quickest due to its weaker intermolecular force.</p> <p>Conclusions/Discussion It is concluded that the liquid with a weaker intermolecular force will evaporate faster compared to liquids with stronger intermolecular force due to the strength of the bonded molecules.</p>	
Summary Statement Measured the amount of time it took for various liquids with different intermolecular forces to evaporate.	
Help Received I conducted the experiment on my own. I received help from my mother and sister in the construction of my project board.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Alannah I.M. Sanchez	Project Number J0619
Project Title Got Gluten? Testing the Gluten Levels in Different Types of Flour	
Abstract Objectives/Goals The purpose of this project is to investigate the claim that Flours don't have labels that say how much gluten is in the flour. Therefore, the experiment was to test how much gluten was in these flours. Methods/Materials I made a dough using the same amount of flour and water. I then took the dough and put it in a strainer and rinsed away the gluten for 2 minutes. The gluten is left behind because it is the most stable. Important materials: All purpose, bread , german and wheat flours. A strainer and A sink. Results According to data collected, the control which was All purpose flour averaged 1.8 oz. The independent variable which was wheat flour averaged 1.8 oz. The data collected shows that independent variable Bread flour had an average of 2.8 oz. In comparison, the fourth independent variable which was German Flour averaged 1 oz. Overall, the variable that mostly proved the experiment wrong, was Bread flour because this Flour had 2.8 oz of gluten and my hypothesis stated that All purpose Flour would have the most amount of gluten. Conclusions/Discussion The results prove that bread flour has the most amount of gluten because on my trials bread flour had high amounts of gluten in ounces. This result occurred because in bread you need gluten to make the bread stable and not cake like so this is why bread flour contains a lot of gluten. Using the control to isolate the results and compare the variables one at a time showed that there was not a significant difference in the data because most of the flours are similar to each other.	
Summary Statement My project tested gluten level in different types of flour.	
Help Received My mom, Deb for purchasing the necessary tools for my project. Dr. Cathy Cira taught me about gluten sensitivity, Celiac disease and German Flour.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Nathaniel S. Shin	Project Number J0620
Project Title Using Silicone Caulk and Turpentine to Create a Novel Hydrophobic Coating by Utilizing Silica Nanoparticles	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Micro/nanostructuring a surface has been proven to amplify its hydrophobic tendencies. Considering the role of nanostructures in hydrophobicity, I attempted to create a water-based stain repellent with silica nanoparticles by dissolving silicone caulking into turpentine in various concentrations.</p> <p>Methods/Materials Using a warm water bath and vortexer, silicone and turpentine were mixed in a scintillation vial to create a novel compound capable of repelling water. Hydrophobicity was determined by measuring the absorption of a fixed volume of water delivered through a transfer pipet onto cotton swatches treated with turpentine only, or 0, 1, 2, 3 or 4 g/ml of solution. The amount of absorption was compared across concentrations using GraphPad Prism statistical software.</p> <p>Results Each concentration of silica was dissolvable in turpentine after heating and vortexing. Although the 3g/10mL concentration repelled all of the water, statistical analyses showed that each group proved to be equally effective as a hydrophobic barrier relative to both the negative control and the turpentine only groups.</p> <p>Conclusions/Discussion In addition to reaffirming the role of nanostructures in hydrophobicity, the present study shows that all of the concentration groups exhibited a degree of hydrophobicity. Furthermore, the results suggest that 1g/10mL is the most cost efficient concentration without compromising effectiveness.</p>	
Summary Statement Inspired by structural hydrophobicity in nature, I created a hydrophobic coating using silica nanoparticles and found a concentration of 1g/10mL provided the most cost efficient protection without compromising effectiveness.	
Help Received I received assistance in borrowing some equipment as well as help understanding the statistical analysis of data from Mr. Don Shin. My science teacher helped me understand the scientific method and the conduct of a scientific investigation.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Akalpiti A. Shukla	Project Number J0621
Project Title Is There Life on Mars? Can You Imagine Boiling a Liquid without Heating?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The question that is trying to be answered is if there is life on Mars. The purpose of this project is to find evidence that life might have existed before on Mars. The main goal of this work is that if the pressure is decreased to that of Mars, then water (any liquid) will evaporate faster without heating resulting in lowering of temperature of the remaining liquid.</p> <p>Methods/Materials The materials for the first experiment was a vacuum jar, supporting plate, vacuum pump, a thermometer, a pressure gauge, a rubber pipe, and a cup filled halfway with water. The general procedure for this experiment is to place the water in the vacuum chamber and record the times at which the first bubble, frequent boiling, and extreme boiling occurs. The 2nd experiment is to show that light exerts pressure and uses a Crookes Radiometer and a light source. The closer you bring the light source to the radiometer, the vanes/flags inside will start to spin.</p> <p>Results The results of the first experiment showed that photons of light exert pressure on surface they hit. The pressure exerted by the light was determined by Crookes Radiometer (Light Mill). The second experiment showed that when Mars lost its atmosphere, the pressure was dropped dramatically to a very low level which caused water to evaporate without being heated, which resulted in the continuous lowering of the temperature of the remaining water that finally froze on Mars' surface. Mars' atmospheric pressure was mimicked by using a simple vacuum chamber, a vacuum pump, and the pressure was measured by a digital pressure gauge and the temperature of the remaining liquid was measured by using a thermometer.</p> <p>Conclusions/Discussion This study provides evidence that water and life were possible on Mars, but later Mars lost its water to space. It is possible that microscopic life might have already migrated under the ground on Mars.</p>	
Summary Statement Boiling a liquid without heating at a low pressure helps answer the questions about life on Mars, and also health problems that effect climbers and ocean divers.	
Help Received Dr. Miguel Moreno, at Los Angeles Trade Technical College, Los Angeles	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Owen M. Smith	Project Number J0622
Project Title How Does Melting Temperature of an Oil Affect Its Soap's Hardness?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I studied if the melting temperature of an oil could predict its soap's hardness. I hypothesized that the higher the melting temperature of the oil the harder the soap it would make.</p> <p>Methods/Materials I made eight soaps using six different oils and two mixtures. I tested the soap hardness when the soap was wet by dropping a lead ball on the soap from the same height (n=3 for each soap). I also dried the soaps and measured their hardness using a static method where I attached a round metal teaspoon to the bottom of an 11.3 kg weight which I set on the soap for 20 seconds (n=3 for each soap). This second method was needed because the drop ball method cracked the dried soaps. For both tests I measured the diameter of the dent to represent hardness. The harder the soap the smaller the dent and the smaller the diameter.</p> <p>Results I first plotted the hardness of the wet soaps versus the literature melting points for the oils and fats and got no correlation. I decided to measure the freezing points of the oils myself and to plot the graphs using my values instead. This resulted in graphs with a trend showing that oils with melting temperatures of 6°C or higher made harder soaps with increasing melting temperature and oils with melting temperatures lower than 6°C, the opposite was true, with hardness increasing with decreasing melting temperature.</p> <p>Conclusions/Discussion The results showed that my hypothesis was half right. While the hardest soaps were made with fats with the highest melting temperature fats, the softest soaps were not the ones made with oils with the lowest melting temperature oil. Also, adding a higher melting temperature fat to a lower temperature oil did not always make a harder soap and in fact the mixed soap was softer than either of the pure oil soaps. Some other observations were learned in this study. One was avocado oil had a different freezing point than stated in the literature. It should freeze at 6-9°C but it froze a -15°C, which leads me to believe the avocado is not pure or maybe is not even avocado oil. Also, lard should be very hard but the lard I used was soft. I think this was because it had some non-triglycerides in it because I got it from the non-pure source of frying bacon. This study proved that a soap's hardness cannot be predicted based solely on the melting temperature of the starting oil.</p>	
Summary Statement This study proved that a soap's hardness cannot be predicted based solely on the melting temperature of the starting oil.	
Help Received I weighed out all the materials. My dad and mom mixed the soaps with the immersion blender because I was splattering sodium hydroxide in the kitchen. I decided when we reached traced. My mom plotted the data on the computer. I told her what I wanted in the plots.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

Name(s) Pujita S. Tangirala	Project Number J0623
Project Title A Green, Low-Cost Solution for the Removal and Recovery of Dye from Industrial Wastewater (A Second Year Study)	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Dyes are used in many industries. Because the process of cleaning dye out of wastewater is expensive, a cost-effective, eco-friendly method is needed. The purpose of this project was to test the effect of temperature on adsorption and pH on adsorption and desorption of dye by spent tea leaves (STL) and to find the maximum adsorption capacity and percent desorbed by performing continuous studies. The hypothesis was that a higher temperature and pH would lead to more adsorption and a lower pH would lead to more desorption.</p> <p>Methods/Materials STL was prepared by washing, drying, grinding, and sieving tea residue. A column adsorption filter system was used for all tests. Four temperatures (31, 39, 50, and 58 °C) and five pHs (4, 6, 7, 8, 10) were tested for adsorption. Five pHs (2, 4, 6, 8, 10) of distilled water were tested for desorption. Continuous adsorption studies were conducted with three different concentrations (1, 2, 3 mg/mL) by running the dye solution through the STL until it was exhausted. Continuous desorption studies were conducted by running pH 2 distilled water solution through exhausted STL. Three trials were conducted for all tests. Samples were analyzed using a homemade spectrophotometer.</p> <p>Results Adsorption capacity increased from room temperature to 39 °C by 10.4 mg/g and remained constant from 39 to 58 °C. Adsorption capacity remained constant from pH 4 to 6 and increased by 12.64 mg/g from pH 6 to 10. Maximum percent desorbed of 26.78% was achieved at pH 2. Percent desorbed decreased from 0.38% to 0.27% from pH 4 to pH 10. Maximum adsorption capacity increased while time decreased as concentration increased but was not affected by pH for continuous adsorption studies. Continuous desorption led to 94.44% of dye being desorbed using pH 2 distilled water.</p> <p>Conclusions/Discussion Maximum adsorption capacity of 228.36 mg/g was achieved using 0.6 g of STL and flow rate of 1.46 mL/min for continuous adsorption studies with 3 mg/mL dye solution. Maximum adsorption capacity increased by 139% from a single cycle to a continuous adsorption study. Desorption studies led to 94.44% recovery of dye; so, there is a potential for reuse of dye and STL. It can be concluded from the two-year study that this column adsorption filter system using STL can be scaled to an industrial level and used as an effective, low-cost, eco-friendly solution for not only the removal but also the recovery of dye from wastewater.</p>	
Summary Statement Studied factors affecting adsorption and desorption of dye by spent tea leaves using a column adsorption filter system to find maximum adsorption capacity and maximum percent desorbed, and concluded that this system could potentially be used to remove and recover dye from industrial wastewater..	
Help Received My mom supervised this experiment. My parents bought the supplies for this experiment. My teacher let me borrow supplies from school.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

Name(s) Sofia N. Truong	Project Number J0624
Project Title Another Nail Bites the Rust	
Abstract Objectives/Goals America has spent over 300 billion dollars in repairs for rusted bridges and buildings. The purpose of this project is to determine what is the effect of a certain pH of a liquid on the rusting process of metal. This project tests what liquid will induce an untreated nail to rust the fastest. Methods/Materials Four acidic liquids (vinegar, orange juice, Coke, and Sprite) and three basic liquids (water, salt water, and boiled water) were chosen for this project. Two pre-weighed common untreated nails were placed in each liquids with the head of the nails resting on the edge of a container to see the difference as the nails rusted. The nails were observed daily for 14 days for its appearance, luster, color, and weight. Results My experimental results showed that plain water and salt water had created the most rust on the nail and had an increase in weight because of the rust that had formed on the nails. The color of the rust was orange and signs of rust had started in the first 24 hours. Conclusions/Discussion My hypothesis that the most acidic and most corrosive liquid will rust the nail the fastest did not happen with my experiment. My research for this experiment showed that rusting process of metals are affected by the ph of a liquid. It will be interesting to further this experiment by finding out the effects of evaporation and carbonation on the ph of a liquid.	
Summary Statement The purpose of this project is to determine the effect of ph of liquids on the rusting process of metals by using liquids of different levels of pH and immersing untreated nails in them for 2 weeks and observing for levels of rusting.	
Help Received My mother supervised the experiment and help me put together my board. My father helped me fill up this form.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Rosemary Ventura	Project Number J0625
Project Title How Many Calories Are in Different Types of Food?	
Abstract Objectives/Goals Objective: To find out which food sample (Hamburger patty, small potatoes, and dried blueberries) contains more calories, by using a calorimeter. Methods/Materials A thermometer, 3 tin cans, an 8x7 steel vent cylinder, a digital gram scale, lighter, steel bowl, 100ml of water, and 3 food samples. A calorimeter was used to measure the energy released in heat from food samples. Results I performed 3 trials for each food sample. The hamburger patty had an average of 0.198 Calories, the small potatoes had an average of 0.175 Calories, and the dried blueberries had an average of 0.303 Calories. Conclusions/Discussion My experiment verified that foods with higher fat content contained more calories. The dried blueberries had more calories because they are known to be calorie dense. Meanwhile, the two food samples with less fat content averaged lower calories.	
Summary Statement To find out which food sample contains more calories, by using a calorimeter.	
Help Received Jose and Maria Ventura	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Malia E. Walker	Project Number J0626
Project Title Cookies: Can You Blame the Burnt Ones on the Cookie Sheets?	
Abstract	
Objectives/Goals My goal with this project was to see if different cookie sheet types affected the color of the bottom of the cookie.	
Methods/Materials My materials were: Cookie batter from sugarspunrun.com An ice cream scoop for consistent cookie size 4 cookie sheets (insulated, aluminum, stainless steel, nonstick) Parchment paper I created a color scale from black to light yellow to give a number scale to each cookie bottom. I cooked all sheets at 375 degrees Fahrenheit for 10 minutes with half a dozen cookies on each.	
Results The cookies were baked, and they all turned out different. The insulated cookie sheet cookies made golden brown, non-burnt cookies (5 on the color scale). Nonstick made burnt, black cookie bottoms (10 on the color scale). Aluminum also made burnt cookies (8 on the color scale). Stainless steel cookies were under-baked (2 on the color scale).	
Conclusions/Discussion The result of my experiment was that cookie sheets do determine how well done a cookie is baked. Insulated cookie sheets made golden brown cookies.	
Summary Statement My project shows that different cookie sheets have an effect on if cookies get burnt bottoms or not.	
Help Received My Mom helped me with taking my cookies out of the oven.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Athena A. Wigo	Project Number J0627
Project Title A Quantative Analysis on the Effect of Additives on Various Crystal Structures, Lattices, and Physical Properties	
Abstract Objectives/Goals The objective of this study is to determine the effect of additives on crystal growth. Methods/Materials Glass jars, wooden sticks, clips, filtered water, sugar, salt, measuring tape, chlorophyll, beet juice, clean cloth. I made solutions for salt, sugar, and borax crystals. I added chlorophyll to one solution and beet juice to one solution. The third solution in each group was left as a control. I waited the same amount of time for each group, and then measured growth. Results Various crystal types were grown, and additives (chlorophyll, beet juice) were added to some of the solutions, the rest were left as the control group. I measured the crystal growth after controlled growth times. The beet juice solutions, then chlorophyll, then the control group, had the most crystal growth. Conclusions/Discussion My additives had a positive effect on crystal growth. It is important to know that additives can change the growth rate and structure of crystals. This knowledge can be applied to other materials as well and used in various real world applications. For example additives may be used to hinder scale and crystal growth on machinery. An example a material of common usage, which we could test additives on is metals. Additives may improve machinity, heat resistance, etc. of different metals.	
Summary Statement I showed that additives, in this case, chlorophyll and beet juice, have a positive effect on the growth of crystals.	
Help Received My Science teacher reviewed my data and explained the process of calculating error bars.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Henry Yao	Project Number J0628
Project Title The Effect of Time and Temperature on Nitrite Level in Cooked Foods	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Many kids bring lunch to school, and we have been hearing suggestions about what foods are suitable for lunch packing, due to concerns of nitrite content in foods stored overnight. This project aimed to evaluate the effect of storage time and temperature on nitrite level in cooked foods. My hypothesis was that nitrite level in cooked foods increases over time, but lowering the temperature in food storage helps reduce bacteria actions, and therefore decreases the speed of nitrates decomposing into nitrites.</p> <p>Methods/Materials Six types of food were randomly selected for testing: beets, cabbage, mushroom, bok choy, sausage, and shrimp. Each food was prepared in the same way, and was measured for nitrite level right after cooking to establish the baseline, using nitrite test strips. The foods were then organized into 2 groups of 6 foods each: one group stored at room temperature (controlled at 20 degrees Celsius), and the other group in a refrigerator (3 degrees). Nitrite level in each food was measured at 8, 16, 24 and 48-hour intervals after cooking. Results were compared against the baseline and prior measurements to evaluate nitrite increase.</p> <p>Results All foods showed nitrite level increase over time. Nitrate/nitrite-rich foods (beets, cabbage, and sausage) showed nitrite levels more than doubled 24-48 hours after cooking when stored at room temperature. Beets showed the highest nitrite level at 20 mg/kg after cooking; the level jumped to 40 mg/kg in 8 hours and 100 mg/kg after 48 hours. Sausage and cabbage showed similar trends but at a reduced level. Bok choy and mushroom showed the lowest nitrite level. For the test group stored in a refrigerator, results indicated that refrigeration slowed nitrite increase in all foods, and more noticeably in the nitrate-rich foods. The decline varied from 25% to 100%.</p> <p>Conclusions/Discussion This project proved my hypothesis: the longer the foods were stored, the higher the nitrite level rose due to bacterial actions that decompose nitrates into nitrites. Foods with higher nitrate/nitrite levels (such as root vegetables and cured meats) should be consumed right after cooking. Mushroom and bok choy, which showed lower nitrite level increases, are better for lunch packing and overnight storage. Refrigeration reduces bacteria actions and therefore slows nitrite increase. Leftovers or lunch boxes stored overnight should be refrigerated and consumed in less than a day or two.</p>	
Summary Statement This project evaluated the effect of storage time and temperature on the nitrite level in cooked foods, and proposed what foods are better suited for lunch-packing, especially if prepared the night before.	
Help Received I designed and conducted the experiments, and summarized results by myself. I did research about nitrates and nitrites through internet and science magazines. My science teacher reviewed my project at school.	