



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Briana O. Ani	Project Number S1801
Project Title The Viscosity of Motor Oil	
Abstract Objectives/Goals # Calculate the density of the different motor oils. # Record the temperature and how it affects the viscosity of the motor oils. Methods/Materials The motor oils that were used in my experiment were 5W-30, 10W-40, 20W-50. Marbles were used to measure the oil's velocity and density. Temperature readings were done by thermometers and timing was done using a stopwatch. The oils were placed in graduated cylinders and marbles were dropped in the cylinder. This was done four times at 20°C, 0°C, and 70°C. The different variables that were used to solve for viscosity are density, volume, and velocity. Results The higher the SAE rating the slower the speed of the marble. The data revealed that the oil that had a higher grade was more viscous. My findings were that 5W-30 had a viscosity of -150.3 g/cm^3 at 0°C. At room temperature, which is 20°C, the marble moved at a medium rate. When the oil was cooled, the marble fell at a very slow rate. The heated oil was very thin like water. The marble fell through the heated oil in less than a second. Conclusions/Discussion I found that the different types of oil such as 5W-30, 10W-40, and 20W-50 differ in their viscosity. I believe that the 20W-50 oil would be beneficial if used in cars or trucks with big engines. The 10W-40 oil would be better if used in cars with mid-sized engines. 5W-30 oil would be good if used in small engines. The way that you would apply this to your everyday life would be to use a combination of your knowledge about the SAE ratings and knowledge about the viscosity levels to determine what grade of oil will be best used in different types of engines.	
Summary Statement My project tests the viscosity or resistance that oil places on the parts of your car's engine at three different temperatures.	
Help Received Parents helped buy the materials; Chemistry teacher, Dr. Castillo helped with the experiment and helped me put together my abstract.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Edward N. Bañuelos; Benjamin D. Wright	Project Number S1802
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Project Title Surfing on Sound

<p style="text-align: center;">Abstract</p> <p>Objectives/Goals In today's technology, smaller processing chips & parts are needed to make functional devices. Acoustic levitation ensures that certain parts of those devices can be made in a contaminant free environment. This project was designed to test the different conditions that are best suited to levitate an object.</p> <p>Methods/Materials This project began by borrowing an industrial speaker & a frequency generator from NASA, which were connected to a stereo amplifier. A 1½" florescent light tube was used to focus the sound. A concave circular soap dish was mounted & used as a reflector atop a tripod in order to change the distance between the speaker and the reflector. Pieces of tissue paper, Styrofoam, & plastic were weighed and modified so that each weighed 0.5 grams. Ear buds & headphones were worn during testing. Each material was placed into the acoustic field using clamp scissors at a starting frequency of 1 kHz to 20 kHz in increments of 5 kHz. At each 5 kHz interval, volume was increased in increments from 1 to 10. A dB meter was used to gauge the dB readings for each test. Half of the tests were conducted with a reflector to create a standing wave. On tests using the reflector, the distance of the reflector was changed for each kHz because of the different wavelengths. The formula to calculate wavelengths was $\lambda=c/f$. The formula to calculate the distance was $\lambda/2 \times$ a multiple of the wavelength. A multiple of 3 was chosen, which provided the appropriate distance, in inches, to set the reflector.</p> <p>Results In order to quantify the data, a rating scale was developed based on consistent visible findings: #1-no movement, #2-bouncing, #3-near levitation, #4-levitation. Near levitation was defined as the material floating in a constant position, while being supported by the tube or speaker on one edge. After analyzing 600 results, the total percentage of near levitation was 11.3%, bouncing was 60.67%, & no activity was 28%. Levitation was not able to be achieved. It was noted that the materials with the greater surface area, such as the Styrofoam, were more impacted by the sound waves.</p> <p>Conclusions/Discussion Overall, levitation could not be reached, however. Lower frequencies such as 1 kHz, produced a better outcome, as seen by a greater number of near levitations than bounces. The creation/maintenance of a proper standing wave was difficult due to not being able to procure proper amplifying and measuring devices.</p>

Summary Statement A Study to Determine the Effects Most Favorable for Acoustic Levitation

Help Received Larry Wright for helping us design and conduct project;Liz Wright for guidance and support;Emily Wright for help with the board;Maria Caballero for the NASA documents;Lionel Banuelos for letting us borrow a triple beam balance.



CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s) Vikas C. Bhetanabhotla	Project Number S1803
Project Title A Theoretical Study to Increase Molecular Specificity in Nuclear Magnetic Resonance Spectra	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this theoretical research is to study ways to increase the molecular specificity in Nuclear Magnetic Resonance (NMR) spectra, thus providing earlier detection of life-threatening diseases, such as cystic fibrosis and COPD.</p> <p>Methods/Materials Using an exponential function modeling spin-lattice relaxation time T1 ($Mz(t)=[Mz(t)-M(\text{Infinity})]*e^{(-t/T1)}$), it is graphically shown that T1 does not vary with changes in the strength (Mz) or angle of the magnetic pulse applied in NMR. Various values of Mz and the angle of the pulse were plugged into the function. The resulting functions were graphed, yielding graphs of Mz(t) vs. t, where t is the elapsed time after the pulse is applied.</p> <p>Wilson et al. proposed a new method of Dynamic Nuclear Polarization (DNP), which minimizes the amount of hyperpolarization lost, and thus increases the molecular specificity of the NMR spectrum. In their research, C13-acetic anhydride is hyperpolarized, and then mixed with 5 amino acid derivatives, hyperpolarizing them also. Wilson et al. state that C13-acetic anhydride is a good substrate to use in their method since it has a long T1 and can react rapidly with many amines. A long T1 is beneficial since it decreases the amount of polarization lost, and thus increases the molecular specificity of the NMR spectrum. In this study, C-13-glycine is proposed as a better alternative to C13-acetic anhydride.</p> <p>Results It is observed graphically that T1 does not vary with changes in Mz and the angle of the magnetic pulse. C-13-glycine is proposed as a better alternative to C13-acetic anhydride since it has a longer T1, meaning that it would provide even greater molecular specificity in an NMR spectrum. Furthermore, C13-glycine can also react rapidly with many amines.</p> <p>Conclusions/Discussion The fact that T1 does not vary with strength and angle of the magnetic pulse applied shows that it does not vary with changes in the external conditions, but rather varies with changes in the internal physical characteristics of the sample. This justifies that C13-glycine and C13-acetic anhydride can have different T1 values. C13-glycine is a better alternative to C13-acetic anhydride since it has a longer T1 and can also react rapidly with many amines. Therefore, C13-glycine, when used in NMR, would increase the molecular specificity of an NMR spectrum even more.</p>	
Summary Statement In this theoretical study, I propose a compound that provides greater molecular specificity in NMR spectra, allowing for earlier detection of life-threatening diseases such as cystic fibrosis and Chronic Obstructive Pulmonary Disease.	
Help Received My faculty mentor at school advised me on some of the technical aspects of my study.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Carrie (Xiaoyu) Cao	Project Number S1804
Project Title World of [Structural] Color: Novel Photonic Polystyrene Nanostructures for Chemical Sensing	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Chemical nanosensors are becoming increasingly important in the nanotech field due to the reduction of cost and potential of real-time monitoring offered by portable devices. Polymer-based photonic materials possess immense potential in as stable and hydrophobic optical sensing agents, but a method for constructing a truly photonic polymer has not yet been successfully developed. The objectives of this research were to synthesis nanostructured polymers and investigate their potential as chemical or biosensors.</p> <p>Methods/Materials Porous Si nanostructured films were prepared using anodic electrochemical etch from silicon wafers in a solution of 48% hydrofluoric acid and ethanol in a 3:1 ratio. The reaction was driven by a sinusoidal electric current. After this initial etch, an electropolishing current was applied to produce freestanding lift-offs, then thermally oxidized to porous SiO₂. Polystyrene of various molecular weights were prepared in toluene and solution-cast into the films. After curing, the templates were removed by HF dissolution. Spectroscopic (visible and infrared) monitoring was utilized to characterize the process.</p> <p>Results An optimum molecular weight of around 45,000 g/mol was optimized through numerous trials. Lower molecular weights infiltrated the pores completely but lacked structural stability to maintain the sinusoidal porous shape, while higher molecular weights were unable to diffuse into the pores. Successful polystyrene replicas displayed vivid structural color, and the optical signal changed drastically in response to various solvents while maintaining polymeric properties such as hydrophobicity and mechanical stability.</p> <p>Conclusions/Discussion In this research, a complete replication of a porous Si oxide nanostructure was achieved using polystyrene; it was also demonstrated that optical properties were retained in the polymer, and that the novel nanostructured polystyrene responded vividly to various analytes. Complete rejection of water (humidity) was also achieved using this material. This is also the first study that has been done to characterize the templating process and, in doing so, to develop and optimize a novel, reliable methodology of template-based synthesis.</p>	
Summary Statement A novel nanostructured polymer was synthesized using a porous template for chemical and biological sensing applications.	
Help Received Used lab equipment at the University of California, San Diego under the supervision of Professor Michael Sailor.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Abrar Choudhury	Project Number S1805
Project Title Analyzing the Effects of the Andromeda Galaxy (M31) on Its Dwarf Spheroidal Galaxies (dSphs)	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Many galaxies have smaller satellite galaxies orbiting around them, known as dwarf spheroidal galaxies (dSphs). Recent discoveries of new dSphs around the Andromeda Galaxy (M31) prompted me to understand the relationship between the dSphs' properties and their distances from Andromeda. I hypothesized that the dSphs closer to Andromeda would have greater mass-to-light ratios and greater radial velocities, but smaller masses.</p> <p>Methods/Materials I used the velocity data collected for many of the stars in each of four dSphs (And I, And II, And III, And VII). However, I first removed contaminant stars from Andromeda's halo. Using a program that runs Maximum Likelihood, a statistical method, I fit two Gaussian curves to the data, one for the dSph's stars and one for the halo stars. Using the velocity dispersion of the dSphs' stars from its Gaussian distribution, I got the radial velocity and calculated the mass and mass-to-light ratio of the dSphs.</p> <p>Results Comparing the radial velocity, mass, and mass-to-light ratios of the dSphs to their distances from Andromeda, I found that the radial velocity decreased as the distance from Andromeda increased. However, there was no direct correlation between the mass and the distance. Finally, I found a relationship, where the mass-to-light ratio decreased as the distance increased, but only if And III's data was ignored.</p> <p>Conclusions/Discussion The values that I calculated for radial velocities corresponded closely with previously published data, corroborating my conclusion that Andromeda's gravitational force has a direct impact on the dSphs' radial velocities. The correlation where the mass-to-light ratio increases as the distance decreases only exists without And III. This is because either And III's data is more prone to error or And III's small mass makes it an outlier. Furthermore, because mass-to-light ratios are directly proportional to dark matter content, this correlation proves that the dSphs closer to Andromeda and with a higher mass-to-light ratio have more dark matter. Based on current simulations of dark matter by various researchers, there should be many more dwarf galaxies than have been discovered. If the dSphs with the highest dark matter content are near Andromeda, then it is possible that the dark matter we are looking for has actually been assimilated into Andromeda through gravitational forces.</p>	
Summary Statement I discovered the relationship between the Andromeda Galaxy and its dwarf spheroidal galaxies, which reveals an increasing density of dark matter closer to Andromeda.	
Help Received Professor Puragra Guhathakurta of UCSC provided the data and mentored me; my younger sister helped with my board	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Scott Chow	Project Number S1806
Project Title Photovoltaic Cells vs. Concentrated Solar Power in Work Produced	
Abstract Objectives/Goals The objective of this experiment is to compare the amount of work produced by two types of solar-harnessing technologies: concentrated solar power and photovoltaic cells. Methods/Materials In this experiment, a concentrated solar power array is constructed using plywood, screws, mirror pieces, and silicone glue. The mirrors are adjusted to reflect sunlight at a single point on a beaker of water. By measuring the rise in temperature of the water, one can use the specific heat equation to calculate the amount of joules that the water absorbed from the focused beam of sunlight. In order to allow for direct comparison, the number of joules absorbed is divided by the time between the measurements. At the same time, a solar panel is trained towards the sun and the amount of volts and amps generated by the panel is recorded by a multimeter. This data can be translated into watts through the formula: Watts = Volts X Amps. Watts, by definition, is a measurement of Joules per second. Surface area is also factored in by dividing each result by the surface area of their respective arrays. Using this method, one can perform a direct comparison between the joules per second per square centimeter generated by the solar panel and the concentrated solar power array. Results Overall, the solar panel was able to generate about 10% more energy than the concentrated solar panel array. However, it should be noted that at different parts of the day, there were times at which concentrated solar power was more efficient. Under direct sunlight, such as at noon, photovoltaic cells performed better than the array. On the other hand, under the diffused light of the rising and setting sun, the concentrated solar power array produced more joules than solar cells did. Conclusions/Discussion The results of this project may be used to indicate that in areas with constant, direct sunlight, such as in the desert, it may be more beneficial to implement a solar panel based system; while in areas that may be cloudy in the winter, one may consider using a concentrating solar power array instead. In general, however, solar panels are still the more efficient and convenient method to harness the energy of the sun.	
Summary Statement This project compares two up-and-coming methods of harnessing solar power: photovoltaic cells and concentrated solar power.	
Help Received I received help from my parents in buying the many materials needed to conduct this experiment as well as the assembling of the backboard. My teachers, Mr. Hunt and Mrs. Corbett, helped by verifying my ideas and equations used in the experiment.	



CALIFORNIA STATE SCIENCE FAIR 2011 PROJECT SUMMARY

Name(s) Daniel R. Cook; Megumi Tso	Project Number S1807
Project Title Color Express	
Objectives/Goals Objective The purpose of this experiment was to find which wavelengths of light provide the strongest photovoltaic effect in a solar-powered vehicle.	
Abstract Methods/Materials Materials and Methods We used colored cellophane filters to isolate a specific color wavelength of light, and then exposed a solar-powered model car to this filtered light in a sealed environment. We were trying to see which of the main spectral colors (Red, Yellow, Green, Blue, Violet) would produce the highest voltage. We used a clear filter as a control. Our car used a 1-volt, 1000 RPM motor, powered by two 1-volt solar panels wired in sequence. We were originally going to test the voltage produced as a function of how fast it took the model car to travel a meter. Unfortunately, due to non-standard parts, our car could not propel itself. We tested the solar panel directly using a voltage meter, because we could not measure the resultant voltage as a function of speed.	
Results Results We found that Red and Blue light allowed the solar panel to function at maximum strength (1-volt). We also found that Yellow, Green, and Violet light all reduced the power of the solar panel by a small amount, allowing it to produce 97-98 percent of maximum power (E.G. 0.97-0.98-volts). Surprisingly, our clear control filter resulted in the lowest power output, only 0.90-volts.	
Conclusions/Discussion Discussion Solar panels are made up of units called cells, which are designed to facilitate photovoltaic reactions, allowing them to produce electricity from sunlight. Sunlight, or visible light, is comprised of the colors of the rainbow, and has a wavelength range of around 400-700 nanometers. Most solar cells are low efficiency, but there are modern high-efficiency cells that are being developed. Due to this low efficiency, large amounts of cells are required to make solar energy a practical power source. Solar energy has been praised by environmentalists, due to its ability to provide a non-polluting source of electricity. Solar-powered vehicles have been in the development stages for years, but, with the present available technology, they are not an economical or convenient mode of transportation.	
Summary Statement Testing the effect of a specific wavelength of light on the energy output of a solar panel.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Lucy Cui	Project Number S1808
Project Title Be Bright. Protect from UV Light!	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this experiment is to determine which fabric is the best to wear in the summer for the most UV protection and prevention against skin cancer.</p> <p>Methods/Materials Twelve samples of the following: cotton knit, cotton woven, polyester knit, polyester woven, silk woven, silk knit, nylon, and rayon, were used to cover the UV probes under direct sunlight. Percentages of UVA and UVB blockage of the different fabrics were calculated by collecting data prior to each trial (control) and during each trial (independent variables) in microWatts per square meter (mW/m²).</p> <p>Results Cotton woven had the highest average UV protection from both UVA and UVB radiation and rayon had the least. Overall, woven fabrics were more sufficient at protecting and blocking UV radiation than the knit fabrics. Therefore, how stretchy and lightweight a certain fabric is should be considered to determine which fabric would allow for the most UV protection.</p> <p>Conclusions/Discussion My hypothesis was slightly disproved by the data collected. Polyester woven, expected to be superior to the other fabrics, followed closely after cotton woven. Heavier and more stretch resistant fabrics block UV radiation more because it allows for less holes and translucency for light to seep through. This study helps explain permeability of UV radiation through different fabrics and light absorbencies to help better draw awareness to the importance of wearing the right clothes in the summer and protecting one's skin from overexposure to the sun's harmful UV rays.</p>	
Summary Statement The composition of fabrics were tested to determine their effects on UV protection.	
Help Received Mother helped gather materials; Used lab equipment from Tracy High School under the supervision of Mr. Waggle	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Ryan A. Dinubilo	Project Number S1809
Project Title On the Transparency of the Universe and Cosmic Expansion	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective is to propose a theory that solves the apparent "transparency paradox" of the universe; how the universe transitioned from being physically opaque to transparent after the Epoch of Re-ionization. We define the mechanism to be an intrinsic and unavoidable property of the universe, based on its expansion rate and the ionization rate of the intergalactic medium.</p> <p>Methods/Materials An algebraic ratio of the expansion rate to the ionization rate of the universe at a given time is used to determine the corresponding physical state of the universe: opaque or transparent. Mathematical calculations of the expansion rates starting at the end of the Re-ionization Era up until present day are obtained by solving the Friedmann equations for the Hubble Parameter as a function of redshift. The corresponding ionization rate of the intergalactic medium is defined in recent scientific papers and the current ionization rate is obtained by linear extrapolation of this data. The two values are then compared to give the physical state of the universe at that time.</p> <p>Results It was determined that by the end of the Re-ionization Era, the expansion of the universe had diluted the opaque contents of the intergalactic medium, lowering its density fraction below a threshold value that allowed large-scale transparency.</p> <p>Conclusions/Discussion Our calculations supported our hypothesis of the effects of the homogenous expansion of space on the density of the ionized intergalactic medium and indicated that transparency is directly related to metric expansion. The widely overlooked "transparency paradox" was a fundamental problem in physical cosmology, providing an unexplained gap in the timeline of the universe. Our research provides a possible method of filling this hole using simple mathematical tools and current astrophysical data.</p>	
Summary Statement Mathematical manipulation of current astrophysical theories and data is used to solve a fundamental problem in cosmology about the transition of the universe between physical states.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Jacki S. Edens	Project Number S1810
Project Title Bubble Screens: Mitigating Noise Pollution in the Ocean	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this project was to try and mitigate simulated industrial noises with air bubbles in water to reduce the effect of sound, thereby providing a possible reduction of noise pollution for marine mammals in the future. I hypothesized that the bubble screen would reduce the noise level (measured in mV at certain hertz ranges) produced by the projected noise.</p> <p>Methods/Materials I tested this by placing a circle of perforated rubber tubing on the sea floor connected to a scuba tank at a depth of 12 feet. The ambient noise was recorded using a Guitar Hero microphone housed in a protective covering that was plugged into a computer and recorded using AudioXplorer #. In the center of the bubble circle, a tape recorder was placed on #play# after recording a running Skilsaw #. Recordings of this noise was taken at various depths: at 8-feet, 4-feet, and on the surface. The tank was turned on, and the air ran through the hose to create bubbles. The sound was then recorded again at the same depths.</p> <p>Results The desired effect was not achieved by the bubbles being transmitted because the bubbles coming from the tubing was louder (1.25 mV*) than the noise in ambient conditions (0.5 mV)</p> <p>Conclusions/Discussion This evidence did not support my hypothesis. However, if proper materials were used to fully test this idea, I believe the reduction of noise through air created by bubbles could be produced. There was an unfortunate artifact in the experimental procedures; the noise generated by the tape recorder was not adequately louder than the noise produced from the bubble tubing. If I could build something that represents a wall of air in the water, and have a device capable of generating at least 3 mV, it would allow for a more direct testing of the effect of air on the sound traveling through water.</p>	
Summary Statement This project is about mitigating industrial noise pollution through air in the ocean.	
Help Received Teacher, Kim Quaranta supported me and dove for me; Dion Johnson supplied BC; Rob Haas controlled the boat and outfitted our diver; My dad, Jim Edens, Drove me around	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Lena S. Eiger	Project Number S1811
Project Title Calculating the Double Slit Experiment	
Abstract Objectives/Goals I wanted to recreate and mathematically calculate the Double Slit Experiment to prove that it worked and to help understand how it worked. Methods/Materials First, I calculated the spacing of the interference maxima of the pattern using a ratio, and a specific trigonometric function that I interpreted from many initial equations to calculate the intensity of light throughout the entire pattern. Next, I calculated it using four slits instead of two, assuming that a four-slit pattern was just a superposition of two double slit patterns, and changed the equation to being the sum of two of the intensity equations to apply to the situation. I set up the double slit experiment with a red laser shining through a Cornell slit film with set distances, and recorded the data to see if it matched my calculations. I repeated the process with a green laser, and then both using four slits. Results The green laser maxima were 7.5 mm apart in the double slit and 22 mm apart in the four slit experiment. The red laser maxima were 12 mm apart in the double slit and 16mm apart in the four slit. All of these values were confirmed by real-life measurements and calculations. Conclusions/Discussion The data for four slits at first did not match up, but I divided the spacing between the slits by 2. This follows because the only slits that affect the spacing of the interference pattern are the two outermost slits, being that the amount of wavelengths of light between the edges of the source and the screen are what determines the spacing of the pattern. The maxima of the green laser were more spaced out than the maxima of the red laser. This can be explained by the fact that the red laser is a longer wavelength than the green laser, and that there is an inverse relationship between the wavelength and the spacing of the pattern.	
Summary Statement I calculated the intensity of light throughout the pattern created by a double slit and four slit experiment, and compared it to real-life measurements.	
Help Received Consulted with Dr. Lynn Cominsky and Steve Anderson at Sonoma State University, and Greg Huffman, an engineer.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Brandon W. Ferguson	Project Number S1812
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Project Title
Effectiveness of Coatings of Differing Abrasiveness, Luster, and Color on Reflectivity at Three Different Wavelengths

Abstract

Objectives/Goals
Project was a continuation of a previous project that I had done. It concentrated its results on the variables of reflectivity rather than the variables of a stealth vehicle in the visible spectrum. A stealth coating should use these findings and incorporate them into a stealth coating design.

Methods/Materials

- 1) Panel (1) was situated at a specified distance from the beam source and 7.5cm x 20cm solar panel
- 2) Panel was clamped by a holding device (2) and a piece of flat wood was supporting the panel from the back to ensure the panel didn't warp.
- 3) Solar panel (3) was positioned so would be perpendicular to the incoming light.
- 4) 200mW Red, Green, or Violet Laser (4) was mounted so it strikes the panel at dead center.
- 5) A visual porthole (5) was used to help guide the laser beam to the center of the panel.
- 6) A digital camera (6) was later installed to indirectly view the laser beam for eye safety reasons.
- 7) A volt meter (7) was used to measure the voltage produced by the received light on the solar panel.

Results
Abrasive materials had slight increase in reflectivity with finer material
Reflectivity varies with luster
Darker colors reflected less than lighter colors

Conclusions/Discussion
As ruggedness of abrasive decreased, voltage readout increased.
May be due to increase in specular reflection
Diffuse reflection would increase with reduction of FEPA rating for abrasive (coarseness)
With decreasing abrasiveness, there was increasing reflectivity
Darker colors absorb more light
Panel with greater luster will reflect more.

Summary Statement
This project intends to show how the variables of abrasiveness, luster, and color affect reflected light and how these findings could be applied to stealth technology in the visible spectrum.

Help Received
Dad helped with expenditures with purchases of materials



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) James T. Flynn	Project Number S1813
Project Title Friction: Can You Beat It?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of the project was to determine what method of limiting friction was both most efficient and cost effective. My hypothesis was that the electromagnetic repulsion track would provide both the greatest efficiency and the least cost for its performance.</p> <p>Methods/Materials Using a homemade, spring-loaded launcher I propelled a cart over 1 meter of track, timing how long it took to cross the meter using photogate timers. I used an air track, a simple wood track, ferromagnets, and electromagnets with a variable power supply to create four different tracks to test four methods of reducing friction. Using the times, I calculated the average velocities of the cart and was able to use the Law of the Conservation of Energy to approximately calculate the conversion of mechanical energy into thermal energy, which I then used to approximate the friction of each track.</p> <p>Results The wheel group (control) had both the second lowest velocity and second highest friction, but the lowest cost. Also, the air track had the fastest times, but the highest costs due to the cost of the specialized track and the needed air supply. In addition, the magnetic track using ferromagnetic materials had the second fastest times and the second lowest cost. Lastly, I found that the Electromagnetic track had the worst times and the second highest costs.</p> <p>Conclusions/Discussion My hypothesis of the electromagnet track being the best was incorrect. The air track had the least amount of friction with the air repulsion to levitate the car but the highest cost, while the magnetic tracks and the control group that used wheels had higher friction but the lower costs. The Ferromagnets had the best cost/mechanical energy efficiency balance based on this test, but further testing and testing on larger scales would be needed to check that ferromagnets would be the best in light of other conditions.</p>	
Summary Statement The point of this project was to find the most efficient way to limit the effects of friction on the mechanical energy of a system.	
Help Received My father helped with the construction of components for my project in the use of power tools; my high school allowed me to borrow air track equipment, photogate timers, and a multimeter; my father's cousin allowed me to borrow his variable power supply.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Shannon Foy; Anna Haupt	Project Number S1814
Project Title Bring on the Heat	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Our objective was to see which color was affected the most by heat by absorption of light. Our hypothesis was the the color black would have the greatest average increase in temperature and that red would have the least.</p> <p>Methods/Materials The materials we used were glass cups (of the same brand and make), three 60-watt lamps, measuring cup, water, thermometer, timer, and foil. The Procedure was: 1. Fill 3 glasses with 300mL of water 2. Leave in designated room for 1 hour 2. Take and record temperature 3. Pour in 15 drops of food coloring of the designated color 4. Set under lamps exactly 2 inches away from bulb 5. Set timer for 10 minutes, turn on lamps, and start 6. After the 10 minutes, take temperature and record then set for 10 more minutes 7. Do this for a total of 4, 10 minute intervals for a total time of 40 minutes 8. Repeat for all 20 tests 9. Compile data and find average temperature increase and compare</p> <p>Results Black had the highest average increase with 27 degrees Farenheit and the clear, or constant, had the lowest with 17.6 degrees Farenheit. Red resulted with an average increase of 18.8 degrees Farenheit and blue with an average increase of 24.6 degrees Farenheit.</p> <p>Conclusions/Discussion Our project concluded with our hypothesis being both right and wrong. Black did have the highest average increase of heat but the constant group ended up having the lowest. Finding these results, we looked back at our research on visible light wavelengths for answers. We found that black absorbs all wavelengthd while red absorbs all wavelengths except for red itself. This means that clear, or no color, reflects all color wavelengths. If we could do this project again, we would use these results and find how they apply when finding results in artificial light versus natural light.</p>	
Summary Statement Our project was about finding which color would affect the heating of water by absorption of light the most.	
Help Received Parents bought supplies	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Cody Garcia; Nicholas Perry; Mark Rivera	Project Number S1815
Project Title Blinded by the Light	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This experiment examined the efficiency of two headlights (High Intensity Discharge and Halogen) commonly used by cars around the world. By discovering which headlight has the better range, length, and brightness, it was determined which one will be safe on the road at night and that will help economically in the long run. Commencing with several tests to determine the effectiveness of both headlights, the first tested the range of the headlights by backing up both cars side-by-side into an empty driveway and turning the lights on. Then, one measured the base width of the lights and the furthest visible light span. For the length, the cars were parked in an empty street, and then the cars were turned on. Using three subjects dressed in all black, the subjects would walk forward until the subject was no longer visible by the driver. For every ten yards, there would be a mark on the ground using green chalk. This is significant because people will want to know which headlight should be fitted in their car that will serve them the best, without having to change the light frequently. The conclusion was that the High Intensity Discharge (HID) headlights would serve best without being too costly, in addition to providing safer driving at night with a more visible surrounding area.</p> <p>Methods/Materials Two cars, one with High - Intensity Discharge (HID) lights and one with Halogen; The same lens covers for HID lights as well as the Halogen headlights; Chalk of various colors; (1)Tape measure; (1)Measure wheel; (20)Cones; Test subjects in black attire; A notebook to record measurements; (1)Camera; 30 subjects.</p> <p>Results The results of the experiment conclude that the High-Intensity Discharge (HID) headlights out perform the Halogen headlights in distance and width. However, the subjects surmised that the glares caused by the HID headlights are greater than that of the Halogen system and thus more distracting. Overall, despite the glare impediment, the HID headlights prove to be an overall better buy.</p> <p>Conclusions/Discussion The results show that HID headlights are all around a better buy for the driver, however the glare caused by them negatively shines upon the oncoming driver.</p>	
Summary Statement The central focus of our project is to determine whether the modern High Intensity Discharge (HID) headlights better suit the driver than the standard Halogen headlights in distance, width, and glare for the oncoming driver.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Adam S. Hall	Project Number S1816
Project Title Electrostatic Fields and Arcs	
Abstract Objectives/Goals Objective: The purpose of my project is to find out whether or not an electric discharge will disrupt an electrostatic field. Also, I wanted to find the correlation between relative humidity and approximately how much voltage was yielded. Methods/Materials Materials and Methods: In order to do my project I used PVC, copper pipe, a brass knob, a gallon water bottle, aquarium line and valve, screws, a wooden base, an aluminum comb, and a large rubber band to make a Ramsden machine with an attachment for running water past the capacitor. I also made a discharge rod out of wiring with a rubber insulator and a spectrometer with a jar and cork, copper wire, a tin plate and thin aluminum foil. For the first part of the experiment I ran water past the capacitor to show the effects of the electrostatic field and an indicator as well. I charged up my machine and the water stream bent, and I then discharged my capacitor using my discharge rod. For the second part of my experiment I measured how much charge was relatively built up with my spectrometer and used an electronic meter to find the relative humidity in the air. Results Results: When the capacitor was discharged, the water stopped bending indicating that the electrostatic field had dissipated. Also, when the humidity was increased the machine did not vary much in the initial voltage but the amount of time it took for the energy to discharge was decreased. Conclusions/Discussion Conclusion: Discharge of an electrostatic field will lead to its dissipation. When the humidity rises, a capacitor loses its charge faster.	
Summary Statement The effects of ESD and relative humidity on an electrostatic field.	
Help Received Father has expertise in electronics and helped me build the Ramsden machine and Spectrometer. Mother helped put together board.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Ellie K. Hara	Project Number S1817
Project Title Effects of Excess Heat Generated by UV Laser Irradiation on the Exposure Process of Photostructure Glass	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Glass-Ceramics are a commonly used material, found in for example mugs and stove tops. A new machining method is the Direct-Write method: a stationary pulsed UV laser and a sample moving on the x, y and z axis. The UV laser induces the incorporated Ce³⁺ ions to eject photoelectrons that are then trapped in the glass. The next steps of the machining process uses said trapped electrons. A possible problem arises with the photon absorption generating heat, which may reverse the photoelectron ejection process</p> <p>Methods/Materials This project investigates the effect of manipulating the laser energy distribution, and thus the heat, on the material exposure (formation of trapped electrons) as measured by optical absorption spectroscopy. The energy distributions are a set of 10008 points on a spreadsheet that define the amplitude profile of the deposited energy and the total energy is held constant among the different distributions. A Cary5000 spectrophotometer was used to measure the absorption of the electron from 250-290 nm.</p> <p>Results Out of the seven amplitude distributions tested, two having the profile of Triangle and Columns showed signs of being more efficient than the current process used, Top Hat. Columns was more efficient than Triangle.</p> <p>Conclusions/Discussion I believe Columns was more efficient because the profile had five columns dictating when the pulsed laser is turned on punctuated by spaces that lets the sample cool, thus decreasing energy available for the reverse reaction. By knowing how to better use the laser to trap electrons, scientists can create complex structures more efficiency with less energy wasted from inducing the reverse reaction.</p>	
Summary Statement To observe the effects of the UV laser's heat on the exposure process (Ce ³⁺ reaction), different heating rates were tested; it was shown that heat does effect the reaction and two tested distributions were more efficient than the standard.	
Help Received Using lab equipment at The Aerospace Corporation; mentoring from Dr. Henry Helvajian	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Alexander N. Iatrou	Project Number S1818
Project Title Paraffinsulators: Ice Cube Insulators Made of Candle Wax	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of my project was to determine if a paraffin wax coating on an ice cube acts as a thermal insulator and delays the melting time of the ice cube. It was hypothesized that as the thickness of the paraffin wax coating on an ice cube increases there will be an linear increase in the melting time of the ice cube.</p> <p>Methods/Materials One control set of 16 ice cubes with no paraffin wax coating and five test sets of 16 ice cubes having increasingly thicker paraffin wax coatings were prepared. Set #1 had one coat of paraffin wax, set #2 had two coats, set #3 had three coats, set #4 had four coats, and set #5 had five coats. The ice cubes in each test set were set out at room temperature and the time to melt was recorded for each ice cube. After the ice cubes had melted, the wax wall thickness of each ice cube was measured with calipers, and the thickness of the wax was recorded.</p> <p>Results With the exception of one test set, as the thickness of the wax coating on an ice cube increased there was a linear increase in the melting time of the ice.</p> <p>Conclusions/Discussion The results of the experiment suggest that paraffin wax acts as a thermal insulator and slows heat transfer to an ice cube. As paraffin wax does not have a dense hydrocarbon structure, heat energy from outside the wax coating does not transfer well to the lattice structure of the ice cube. Because less heat enters the ice structure, it takes longer for the ice cube to melt. Increasing the thickness of a paraffin wax coating on ice cube decreases the transfer of heat to the ice cube and increases the time to melt of the ice cube. With the exception of one test set, as the thickness of the wax coating on an ice cube increases there is generally a linear increase in the melting time of the ice cube. Test set 4 was an exception to my conclusion. It is unknown why a thicker coating of wax did not build up and why the average time to melt per ounce was less than in test set 1. The other test sets were not frozen as long as test set 4. Perhaps a molecular change in the water or wax occurred when left in the freezer longer than the other test sets.</p>	
Summary Statement This project examines if paraffin wax acts as a thermal insulator and delays the melting process of an ice cube.	
Help Received Parents purchased experimental equipment and helped with the dipping of ice cubes in melted wax.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Jonathan W. Kim	Project Number S1819
Project Title Single Transducer, Gradient-Force Ultrasonic Microparticle Trapping	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This project investigates a potential method of trapping microparticles (particles with diameter ~100 microns) with high-frequency sound (more specifically, acoustic Bessel beams, which are non-diffractive waves). The project sought to create a special single transducer device that could trap microparticles.</p> <p>Methods/Materials Two devices were tested, both of which used the same principles to potentially trap microparticles. The first device was composed of a refractive axicon lens mounted on the surface of a single-element transducer, and the second was a multi-focus Fresnel lens device. The experimental procedure involved placing microparticles- either oil microdroplets or polystyrene microspheres (both types ~100 microns in diameter) into a glass vessel which had either one of the two devices submerged within it. Then, the device would be actuated, and its trapping and manipulating ability observed.</p> <p>Results Only the second device, the multi-focus fresnel device, was able to trap and manipulate multiple microparticles on a consistent basis. It consistently captured both oil microdroplets and polystyrene microspheres with an extremely steady hold, and would not release the particles until the device was switched off.</p> <p>Conclusions/Discussion The results are unprecedented in that for the first time a single ultrasonic transducer has been shown to consistently trap and manipulate microparticles. This technology could potentially be used to expose individual cells to novel environments to study what the effects would be. In addition, this technology and device could also be used for construction on the micro-scale, of microtechnology devices and so on.</p>	
Summary Statement The project created an ultrasonic device that is capable of trapping and moving around particles of approximately 100 microns.	
Help Received used lab equipment at University of Southern California under supervision of Mr. Choe; USC Machine shop fabricated axicon lens device that I designed; used Fresnel lens device fabricated by Mr. Choe	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Donald S. Mathis	Project Number S1820
Project Title An Investigation of the Relative Effect of Salinity and Temperature on the Viscosity of Water	
Abstract Objectives/Goals Which of the following has a greater effect on the viscosity of water: Salinity, or Temperature? Methods/Materials Two (10 cm x 20 cm) glass plates were cut from one section of 2# x 2# glass. 8 lb. tensile strength fishing line was fixed to the upper glass plate and a second section of line was loosely attached to the first, thread through a pulley to decrease friction, and a 25g weight was then attached to it. Both plates were given corresponding dots to provide a reliable indication of the displacement of the plate. 10 cm were measured from the reference point and marked for a stopping point. A refractometer was used to verify the salinity of the water solution. Temperature was maintained at 23°C. A pipette was used to deposit 15 ml water on the stationary plate. The sliding plate was placed on top of the stationary plate and restricted from moving. The top plate was then allowed to move freely as gravity pulled the weight down and the fishing line pulled the top plate horizontally across the bottom plate. The time it took to travel 10 cm was measured and recorded. Iodized salt was used to increase the salinity by increments of 10 parts per thousand (ppt) from 0 ppt to 100 ppt. Temperature was then varied while keeping salinity constant at 0 ppt. The plates were submerged in distilled water and allowed to equalize, brought up into testing position, and measured with an infrared thermometer focusing on the dot on the top. When the desired temperature was reached, the test was repeated. Tests were completed from 45°C to 25°C in 5° increments. Results At first glance, the salinity had a greater effect on the viscosity of the water, but after closer examination, it shows that, although an increase in salinity did increase the viscosity of water, the temperature had a greater influence. Conclusions/Discussion After analyzing the data, it was clear that the temperature did have a greater effect on the viscosity of water than the salinity and therefore supported the hypothesis. However, there was no direct way to measure the reduced cohesive forces, its effect on the time it took for a plate to pass a set distance allowed for the calculation of the viscosity.	
Summary Statement Which has a greater effect on the viscosity of water: Salinity, or Temperature?	
Help Received Father helped acquire materials.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Emmaline A. Meill	Project Number S1821
Project Title Burn Notice! The Effect of Different Types and States of Materials on Ignition Time and Combustion Rate of Cloth Swatch	
Abstract Objectives/Goals The objective is to determine how quickly different types of cloth under different states of wear and different temperatures ignite and how quickly they combust. Methods/Materials 20.32 cm by 20.32 cm swatches of different materials -100% wool, linen, acetate, cotton, and polyester, silk, felt, nylon, 50/50 nylon polyester blend, 80% polyester, 20% spandex blend, and hemp- were subjected to wear (repeated washings in a washer and dryer) and different temperatures, then the swatches, both worn and new, at room temperature and body temperature, were burned and their ignition time and combustion rate timed/calculated. Combustion rate was calculated by dividing the amount burned (in cm ²) by the time burned to find the rate in cm ² /second. Results The material with the longest ignition time was polyester, with a 9.98 second ignition time, while the materials with the shortest ignition times were hemp and silk, both with 1.58 second ignition times. The material with the slowest combustion rate was wool with 2.39cm ² burned per second, while acetate burned the most quickly, with a combustion rate of 17.52 cm ² burned per second. The data for wear and temperature for both ignition times and combustion rates was found to be statistically insignificant. Conclusions/Discussion This experiment provides examples of materials that are in their nature, without any specific flame-retardant treatment, flame resistant # materials that take longer to ignite and combust slower, that could better one#s chance of survival and/or not sustaining serious injury in a fire-related situation. The findings of the experiment were that polyester had the longest ignition time while hemp and silk had the shortest, and that wool had the slowest combustion rate while acetate had the fastest.	
Summary Statement The purpose of this experiment was to test the effect of different types of materials, the temperature of materials, and wear of materials on the time taken for a material to ignite and the rate the material combusts.	
Help Received My mother assisted me in conducting the trials, as well as in assembling the necessary materials for the experimental setup.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Dylan E. Moore	Project Number S1822
Project Title Finding Harmonics in Plasma	
Abstract Objectives/Goals Electroluminescent tubes ionized at a high frequency demonstrate a distinct beading pattern characterized by bright, equally spaced plasma beads or oscillations. The purpose of the project was to discover what causes this phenomenon and predict the oscillation spacing comparing the relationship between gas pressure, tube diameter and the distance between oscillations. Methods/Materials Glass tubes 50cm long with diameters of 6mm, 8mm, 10mm, 12mm, 15mm and 20mm were evacuated and backfilled with neon at pressures of 5torr, 10torr, 13torr, 15torr, 20torr, 25torr, 30torr and 35torr. Each tube of gas was ionized separately using the same transformer and photographed. With the digital images, the distance between the plasma oscillations were measured and analyzed. Results The plasma oscillations in the tubes were the visible result of plasma behaving sympathetically to an electromagnetic standing wave produced by out of phase 25kHz electromagnetic pulses transmitted from the electrodes at the ends of the tube. The bright centers of the plasma beads coincided with the antinodes of this standing wave and distance between them was measured to find L_n , the wavelength of the n th harmonic. The frequency of the n th harmonic, f_n , was calculated with a model based on harmonic motion equations, designed so that pressure and tube diameter could be related to f_n . Conclusions/Discussion Linear relationships were discovered in the comparison of diameter and pressure to the distance between antinodes. These were used to find the equation: $L_n = (-0.0734)(P) + (0.5631)(D) + 5.9029$ which directly related L_n to pressure (P) and diameter (D) and produced relatively accurate projections. The effect of different tube diameters and pressures on plasma oscillations demonstrated the tendency of plasma to self-organize differently under various boundary conditions. For this project, the plasma waves were contained in cylindrical tubes and could therefore be examined linearly. With more time and experience, the Vlasov-Maxwell equations could be used to model the behavior of plasma waves in higher dimensions with a wider set of boundary conditions.	
Summary Statement This project predicted harmonics in standing plasma waves in electroluminescent tubes by analyzing the relationship between gas pressure, tube diameter and the distance between plasma oscillations.	
Help Received The tubes were fabricated at the Crucible, an industrial arts school in Oakland, and there was adult supervision during all experiment trials.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Kelly L. Moore	Project Number S1823
Project Title Harvesting Light: An Investigation on the Effect of Refraction through a Glass Panel	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective is to test if a photovoltaic cell can still absorb light through a glass panel from different angles.</p> <p>Methods/Materials A box was constructed to hold a photovoltaic cell during all tests and trials. The box was made of flat glass, white pine, masonite, wood screws, and flat black paint. A 100 watt spotlight was set in a table saw stand. Four feet were measured between the glass panel and spotlight. There were three readings taken without the glass panel in place and the spotlight placed at 90° compared to the photovoltaic cell: ambient (surrounding) light, "raw" (spotlight and ambient) light, and corrected (ambient subtracted from "raw"). Ten trials were conducted at the angles of 90°, 75°, 60°, 45°, 30°, and 15°. Each test had the ambient reading taken, and then the "raw" reading with both the garage light and spotlight on. The ambient reading was subtracted from the raw reading to generate the corrected reading. An overall average was taken for each of the six angles. The averages were calculated for all three light readings: ambient, raw, and corrected.</p> <p>Results The values for the 90° readings were the highest for all three of the categories. It was higher than the unrestricted value, which was .555 volts. The raw values for 90° were all within .005 volts of the unrestricted level. Otherwise the voltage decreased throughout the experiment. The lowest reading was a raw voltage of .145 volts at 15 degrees. The averaged raw data indicated a decrease of .407 volts. As the angle decreased the averaged correct data shows the cell's output decreased a total of 0.404 volts.</p> <p>Conclusions/Discussion The experiment supports the hypothesis that the angle of light through a glass panel definitely affects the output. The farther from perpendicular the light source was in relation to the glass panel, the output from the photovoltaic cell decreased. This could be because since there was nothing for the light to reflect off of inside the black box once it had been refracted. Only a limited amount of light hitting the glass at a certain angle bent enough to the cell without being reflected a different way. Any light that had its direction changed lost strength and therefore caused a reduction in the light absorbed by the cell. However, photovoltaic cell can still absorb light from a source if there is glass over it, despite the effect of refraction.</p>	
Summary Statement Light was shone from six different angles in comparison to a photovoltaic cell, with a piece of flat glass placed in between the light and solar cell to see if the solar cell could still absorb light despite the effect of refraction.	
Help Received Father helped construct the box holding the solar cell.	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Korina M. Myers	Project Number S1824
Project Title Fatter Is Hotter: A Study of Cooling Rates Comparing Surface Area to Volume	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To find which surface area to volume ratio whether it be big or small has the fastest cooling rate.</p> <p>Methods/Materials 2 sets of 1 square, 1 rectangle, and 1 triangle are cut out of the same wood using a saw and tape measure. The mass of each shape is the same within sets. One set is half scale of the other. The surface area of each shape is recorded. After measuring the area for all of the shapes drill a hole in each shape for a thermometer. Put the digital thermometer in the hole. Place that shape into the pot of boiling water until the shape reaches 90 degrees Celsius. Pull out the shape using a pair of tongs and monitor the temperature. Record the temperature shown every 60 seconds until the temperature stops dropping. Repeat until all of the figures have been tested.</p> <p>Results In the ratio of surface area to volume the small rectangle had the largest ratio which means the small rectangle cools the fastest. The large square had the smallest surface area to volume ratio. The large square had the slowest cooling rate only losing 0.83 degrees Celsius every minute. The small rectangle lost 2.46 degrees Celsius every minute. This suggests the bigger the surface area to volume ratio the faster it cools.</p> <p>Conclusions/Discussion In conclusion the data support the hypothesis. The results show that having a bigger surface area to volume ratio will cause the object to cool down faster while having a smaller surface area to volume ratio will cause the object to cool down slower. Although there are more shapes to be tested like sphere, cylinder, cone, or trapezoid, with knowing the cooling rates of these three different shapes; square, rectangle, and triangle there can be new ways to make cooling systems.</p>	
Summary Statement This project is about cooling rates comparing surface area to volume.	
Help Received father helped cut shapes and make data graphs	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) Tulsi S. Shah	Project Number S1825
Project Title Blue Sky on Mars? An Analysis of Using Terrene Filtration Methods to Remove Dust Particles from the Martian Atmosphere	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The Martian atmosphere is extremely toxic, composed of 99% limonite particles and 1% magnetite particles. My project tests two filtration devices--the N-95 mask and the Ionic Pro Turbo--to see if they can sufficiently remove the dust particles from Mars to the extent that the Martian sky would be blue.</p> <p>Methods/Materials I tested both the N-95 mask and the Ionic Pro Turbo using equipment such as the SMPS, or Scanning Mobility Particle Sizer, CPC, or Condensation Particle Counter, an atomizer, and a silica drier. The atomizer changed the limonite or magnetite solution into air particles that could be passed through the drier. The Condensation Particle Counter counted the number of particles of the size inputted by the SMPS. I used this device to count the particles before and after using the filter and used my data to calculate the efficiency of particles removed.</p> <p>Results The N-95 mask was 81.29% efficient in removing the particles, whereas the Ionic Pro Turbo was 99.99% efficient.</p> <p>Conclusions/Discussion From analyzing the data I gathered, I concluded that the N-95 mask and the Ionic Pro Turbo are sufficiently efficient filtration devices to remove dust particles. Assuming an average 81% particle filtration and a linear effect of particle number on scattering properties, the reduction of particles in the atmosphere may change the color of the Martian sky to greenish-yellow using the N-95 mask. On the other hand, the Ionic Pro Turbo is extremely efficient to remove the thousands of particles on Mars and completely change the scattering. With a rounded 100% efficiency, the almost complete elimination of particles in the atmosphere will change the color of the Martian sky from a red to a blue. From these conclusions, I made the assumption that if the Ionic Pro Turbo, the obviously better filtration device, has the ability to eliminate so many particles, then it is worth trying to use a similar device on Mars.</p>	
Summary Statement My project determines whether two earthly filtration procedures--the N-95 mask and the Ionic Pro Turbo--can efficiently remove dust particles from the Martian atmosphere by representing limonite and magnetite as the dust found on Mars.	
Help Received Professor Akua Asa-Awuku at Bournes Engineering at the University of California, Riverside guided me with this project, and allowed me to work in her lab and perform the experiments under her supervision. Xiaochen Tang, a graduate student at UCR, also supervised me in the lab.	



CALIFORNIA STATE SCIENCE FAIR 2011 PROJECT SUMMARY

Name(s) Judy Shon	Project Number S1826
Project Title Study of the Heat Absorbing Abilities of Different Fibers and the Effects of Laundering on Their Flame Retardancy	
Abstract Objectives/Goals The purpose of this experiment was to determine the heat absorbency and flame retardancy of cotton, polyester, nylon, wool, and the flame retardant fiber, nomex. Another purpose was to find out if washing affected the flame retardancy of these fibers. Methods/Materials The fibers used were cotton, polyester, nylon, wool and nomex. For the heat absorbency test, the materials included a heating apparatus consisting of a ring stand, a ring clamp attached to the stand, a Bunsen burner under the clamp, and two pieces of wire all set up inside a fume hood. Also used was a Raytek infrared thermometer. For the TGA wash test, a SDTQ600 Thermogravimetric Analyzer, Mettler Toledo analytical balance, washing machine, drying machine, and laundry detergent were used. The heat absorbency test was completed by placing each fiber above a flame using a heating apparatus, and measuring the temperature every twenty seconds using a Raytek infrared thermometer. A SDTQ600 thermogravimetric analyzer was used to measure the percent weight loss of each fiber while they were being subjected to intense heat. The original flame retardancy of each fiber was determined using this method, and the process was repeated after each fiber went through ten wash cycles. Results It was determined that the nomex was the safest fiber because it had lower heat absorbency temperatures and was not affected during the test while the other fibers caught fire, melted, or formed a layer of char. Also, the nomex had over 40% of material remaining after the TGA and had higher weight percentages at 300oC and 500oC when compared to the other fabrics. The results of the wash test were inconclusive because there was not a large discrepancy between the washed and non-washed fibers. Conclusions/Discussion The nomex was the best fiber to wear for protection against fire. It had lower heat absorbency temperatures compared to the wool and took longer to heat up, which showed that it was safer to wear in an area with high temperatures. Also, the wool was burned during the test, which was shown through the formation of a char layer while the nomex was not affected. The TGA test showed that the nomex had the highest flame retardancy because it had the greatest amount of material left over after the test. The results of the wash test were inconclusive because the differences between the non-washed and washed fibers were so small.	
Summary Statement Measured the heat absorbing abilities of different fibers, including one flame-retardant fiber, and tested to see if laundering affected the flame retardancy of these materials.	
Help Received Used lab equipment at California State University Long Beach under the supervision of Dr. Young Shon	



CALIFORNIA STATE SCIENCE FAIR 2011 PROJECT SUMMARY

Name(s) Benjamin O. Shultz	Project Number S1827
Project Title A Comparison of Red and Green Laser Pointer Light Diffraction on CDs and DVDs	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The main research question addressed the issue of how the wavelength of a laser pointer (red versus green) affects the diffraction of the laser beam reflecting off a CD versus DVD in measuring the width of the data tracks. The hypothesis that was addressed was, If the wavelength of the laser beam is narrower (green versus red), then the diffraction measurements will be more consistent (i.e., less variable) for both a CD and DVD.</p> <p>Methods/Materials The primary materials needed for this experiment included, a red (650 nm wavelength) and green (532 nm wavelength) laser pointer, a CD, a DVD, a protractor, and a digital camera to record images. The procedure for this experiment was to first place the CD or DVD label side down on the workspace. Next, I attached a protractor to an index card at the bottom of a sturdy box on top of the CD or DVD in order to measure the diffraction angles. I then directed the laser pointer beam down the face of the index card. When the indicated beams became visible I marked their locations and took a digital photo. I then entered the values into an Excel spreadsheet in order to compute the width of the data tracks. I repeated these steps for both the red and green laser pointers for both the CD and DVD for five trials each.</p> <p>Results The variability was relatively high across the five trials for each of the various diffraction angles. In general, the red laser pointer was more consistent (i.e., had a smaller standard deviation) in measuring M1 and neg M1 angles, while the green laser pointer was more consistent in measuring the M2 and neg M2 angles. The results of the Levenes test for the equality of variances indicated that of the eight comparisons made, the red laser pointer was significantly less variable for CD neg M1 and DVD M1 distance measurements, while the green laser pointer was significantly less variable for the DVD M2 measurements.</p> <p>Conclusions/Discussion The results were consistent with the hypothesis only for M2 and neg M2 measurements, while just the opposite occurred for the M1 and neg M1 measurements. If I were to conduct this experiment again, I would use a mechanical device to hold the pointer at the exact angle at which it was programmed to be at in order to obtain more precise results and also have two observers measure the diffraction angles and average the two observers values, thus reducing individual level measurement errors.</p>	
Summary Statement Comparing the variability of red and green laser pointers in measuring data tracks on CDs and DVDs	
Help Received Father helped with data collection and analysis: Both mother and father proofread final report and provided suggestions	



CALIFORNIA STATE SCIENCE FAIR 2011 PROJECT SUMMARY

Name(s) Kiran N. Vodrahalli	Project Number S1828
Project Title Increasing Silicon Solar Cell Efficiency by Improving Light Absorbance with Near-Zero Reflectance Nano-Textured Surface	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Silicon based solar cells are important in the green energy market. To improve efficiency of these devices, improving the light absorbance of the silicon surface is important. In industry, a common technique is to texture the surface and improve light trapping capability. This project investigates a novel surface texturing method and assess its improvement in both cell light absorbance and cell efficiency.</p> <p>Methods/Materials The structure investigated is known as silicon nano-towers, or SNTs. Three heights of SNTs (types A (2 um), B (4 um), C (8 um)) are created, characterized and applied to the construction of mono-crystalline p-doped CZ silicon solar cells. Contact metals used for the solar cells were Al on the backside and Ti/Ag on the front side. The n-dopant was phosphorus. The optical reflectance was measured with an ellipsometer after the SNTs were created. Wavelengths over a range of 3000A to 10,000A for incident light angles from 20 degrees to 80 degrees from the normal were tested. To build the solar cells, I created the SNT structure on the silicon wafer, created the p-n junction, etched SiO₂ and did the metal coating, and then tested efficiency.</p> <p>Results Optical: The results showed that for incidence angles of 60 degrees and below, reflectance of the type B and C SNTs was < 0.1%, and for the type A, < 2%; at the more pertinent 40 degrees incidence all three showed a reflectance of < 0.1%. Efficiency: Solar cells built with type A SNTs had the best overall efficiencies and the highest improvement over the control. The maximum efficiency recorded was 14.2%, and the average improvement for the type A SNT cells over the control was 57% (or an average absolute efficiency improvement of 5.5%).</p> <p>Conclusions/Discussion Though the type C cells had the best (lowest) reflectance, the average efficiency change for the type C cells was negative. In contrast, the type A cells, though they had worst (highest) reflectance, had the best efficiency improvement. This phenomenon is related to the direct relation between surface area and carrier recombination, indicating a need to optimize the height of the SNTs (since type A was the best, the optimum is probably around 2 um). Future work will involve characterizing cells built with SNTs on solar grade FZ material and multi-crystalline silicon to assess the full potential of the SNTs.</p>	
Summary Statement I built silicon solar cells and textured them with a black-colored nano-structure to improve cell efficiency: the result was an improvement 5.5% raw efficiency (8.7% control to 14.2% modified), potentially reducing cell cost/watt by 30%.	
Help Received Allvia Inc. provided facilities and mentoring; Tango Inc. provided metal deposition capability; Stanford Nanofabrication Lab provided doping capability; Kent State Ohio University provided optical testing capability; RETC provided efficiency testing capability; Dr. Achintya Bhowmik provided guidance.	



CALIFORNIA STATE SCIENCE FAIR 2011 PROJECT SUMMARY

Name(s) Weishuang L. Xu	Project Number S1829
Project Title Light Curve and Orbital Analysis of Amor Asteroid 2000NF5	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this project was to investigate the physical parameters and orbital properties of the NEA 2000NF5 to ascertain whether it would be a suitable target for an asteroid spacecraft mission in the near future.</p> <p>Methods/Materials Observations were taken almost nightly from 9.14.10-11.13.10 in 80s exposures through V bands. After subtracting bias and flat frames, astrometry was done using stars from the USNO A2.0 catalog in a least squares plate reduction. 3 points were used in a Gaussian orbit determination using the 4th expansion of f and g series. Orbital data of 2000NF5 was run through Swift.RMVS3 to assess precession in the next 200Myr. Photometric data was obtained using reference stars in USNO A2.0 and standard Landolt THPE stars taken on the same night. Corrections for phase angles, nightly extinction, and air mass were applied. A light curve was plotted using 323 points.</p> <p>Results The asteroid 2000NF5 has a semi-major axis of 2.21 AU, eccentricity of 0.441, inclination of 1.31°, longitude of ascending node of 282.5°, argument of perihelion of 8.9°, and time of perihelion passage of 2455364.6637 JD. Its rotational period is 59.3h with amplitude of 0.8137, and absolute magnitude of 16 yields a diameter estimate of 1.68-3.75 km.</p> <p>Conclusions/Discussion NF5 is a slow rotator which also happens to be sizable, traits both desirable for spacecraft missions. The low inclination of this orbit and its mars-crossing nature suggests 2000NF5 to be accessible. If we follow the triaxial ellipsoid model with axis a, b, and c ($a > b > c$) and assume it to be rotating about axis c, since that would be most stable, the axis ratio a:b is found to be 2.116 if we ignore variations in amplitude due to phase change, suggesting that NF5 has a highly elongated shape which may prove problematic. However this is assuming both the model and an assumed uniform albedo is correct. This asteroid has a volatile orbit due to mean-motion resonance with Jupiter in the 2/7 Kirkwood gap, and therefore it is likely that NF5 will either be flung into the Sun or out of the solar system. This is however not for millions of years. In conclusion; 2000NF5 appears to have potential as a future target for spacecraft missions, particularly those directed towards Mars, due to its Mars crossing orbit, slow rotation and size; however, much more data must gathered: NF5 has not yet been named nor is its SMASII class known and these must be determined.</p>	
Summary Statement To plot the photometric light curve of asteroid 2000NF5, determine its orbit and changes in orbit due to mean-motion resonance, and ascertain whether it is a suitable candidate for spacecraft missions.	
Help Received Participant in Summer Science Program at Westmont, CA 2011	



**CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY**

Name(s) William Xue	Project Number S1830
Project Title Thermoreflectometry for Detecting Corrosion in Steel Reinforced Concrete	
Abstract Objectives/Goals The objective is to integrate electromagnetic heat induction and infrared (IR) thermograph technology for nondestructive detection of steel corrosion in concrete, by taking advantage of the difference in thermal characteristics of corroded and non-corroded steel. Methods/Materials Material for preparing bare and concrete rebar (RC) samples includes cement, sand, aggregate, steel rebar, 3% NaCl solution, and copper plate. The impressed current method was adopted to induce accelerated corrosion on the rebar. The thermoreflectometry consists of an inductive heater to remotely heat the steel rebar from concrete surface, and an IR camera to record IR intensity. Bare rebars and concrete samples with different rebar cover depths were prepared. The inductive heater heated the sample from one surface and the IR thermograph record the image from the opposite side simultaneously. Results From the bare rebar test, it is found that the peak IR intensity depends on the rebar corrosion amount; the more corroded rebar exhibits higher peak intensity, and faster heating and cooling rates. From RC sample test, it is observed that the corroded rebar causes higher heat intensity on its surface than the non-corroded rebar, and the heating rate in the corroded sample is also higher than that in the non-corroded sample due to the steel volume loss and the reduced heat capacity of the rebar. For the RC sample with a deeper cover depth, a longer induction heating time is required. Conclusions/Discussion From the experiment results, it is confirmed that for a corroded steel rebar, increase in the electrical resistivity and relative permittivity make it easier to be heated by an inductive heater due to the Joule and hysteresis effects. Meanwhile the decrease in the thermal conductivity in the corroded steel rebar results in a slower cooling rate once it is heated. In conclusion, the proposed thermoreflectometry is able to measure the temperatur variation during the heating and cooling process quantitatively. This study demonstrates a potential of the integrated inductive heating and IR thermograph for nondestructive detection of rebar corrosion in concrete.	
Summary Statement Develop a thermoreflectometry for non-destructive detecting of corrosion in steel reinforced concrete	
Help Received Used lab equipment at UC Irvine with helps from lab technical assistants	