



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Claire R. Arakelian	Project Number J0701
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Project Title
How Temperature Affects Carbon Resistors

Abstract

Objectives/Goals
Determine how temperature affects carbon resistors' resistance. Preliminary research showed that resistance is directly proportional to temperature, $R=R(\text{ref})\{1+a[T-T(\text{ref})]\}$, where a is the temperature coefficient of resistance.

Methods/Materials
For five 100 Ohm, 1/4 W resistors, measured each resistor's resistance $[R(\text{ref})]$ at room temperature $[T(\text{ref})]$ and resistance $[R]$ at temperatures $[T]$ of -198, -60, 23.6 (Room Temperature) 50, 100, 150, 200 and 250 degrees C.

Results
My average measured resistance at temperatures -198, -60, 23.6, 50, 100, 150, 200 and 250 degrees C were 103.88, 99.34, 98.26, 97.32 96.1, 95.3, 94.425, and 93.9 Ohms, respectively. I fit this data by use of least squares fit to $R=-0.02T+98.74$. From the slope, -0.02, determined the temperature coefficient of resistance to be -0.0002 /C.

Conclusions/Discussion
Data didn't support hypothesis - resistance increased as temperature decreased. Further research showed this as typical for carbon - a semiconductor.
Semiconductors have an energy gap between the valence and conductive bands. Heating carbon introduces more electrons in the conductive band decreasing resistance; cooling forces the electrons from the conductive band down to the valence band, increasing resistance. Semiconductor resistors have a negative temperature coefficient of resistance, metal resistors - positive.

Summary Statement
The effect of temperature on carbon resistors' resistance.

Help Received
Father provided materials; Aunt helped with charts and graphs; Professor Ares Rosakis, (Director of Director of Graduate Aeronautics Laboratories at Caltech), and Dr. Dale Connors, (Material Science Department at Caltech), for aiding me in interpreting the results and outcome of my experiment.



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Joshua M. Arreola	Project Number J0702
Project Title The Electrical Freeze	
Abstract Objectives/Goals The objective is to determine if exposing Duracell batteries to freezing temperatures for short periods of time will cause them to die faster than Duracell batteries that are not exposed to freezing temperatures. Methods/Materials To start, ten size-D Duracell batteries and twenty 15-centimeter long electrical wires were used. With wire scissors, cut 1 to 1 ½ centimeters off the edges so the inside wires are exposed. Then with a soldering gun, solder two of the wires to the positive and negative sides of each battery. In the first group, the five batteries that are going to be exposed to freezing temperatures (0 degrees Celsius), are labeled as A, B, C, D, and E. In the second group, the other five batteries left at room temperature (20 degrees Celsius) are labeled as A2, B2, C2, D2, and E2. Place the first group of batteries into the freezer at the same time. Take A out in 20 min., B out in 25 min., C out in 30 min., D out in 35 min., and E out in 40 min. Leave the second group of batteries alone at room temperature. After removing the first group of batteries from the freezer, take all ten batteries and solder on ten 2.47 volt light bulbs to the other ends of the wires, with one wire being soldered on the bottom of the light bulb, and the other wire being soldered on the side of the light bulb. Observe the light bulbs every ten hours, and once the light bulbs start to dim, check more frequently. After all the light bulbs die, record how long each battery lasted in the observation log. Transfer data to a graph. Results According to my graphs, the batteries that were exposed to freezing temperatures for short periods of time lasted longer than the batteries that were not exposed to freezing temperatures. Conclusions/Discussion My data shows that my hypothesis was incorrect. The batteries from the freezer actually lasted longer than the batteries left at room temperature. Even for short periods of time, it appears that batteries placed in the freezer can help the batteries last longer.	
Summary Statement The purpose of this project was to determine whether freezing temperatures would have an affect on a battery's life span.	
Help Received Mrs. Bloom, my teacher, for explaining things I did not understand. My Dad for showing me how to use a soldering gun. My Mom for helping me with ideas for my project.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Robert J. Becerra	Project Number J0703
Project Title What Are the Effects of Weather on Laser Communications? Free-Space Optics	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of the project was to test fog and rain effect on laser communications(free-space optics) systems using a laser transmitter of three different wavelengths and a receiver with a light detector. The hypothesis was that the amount of light being scattered is a function of its wavelength and ultimately reduces signal strength in laser communications(free-space optics) systems.</p> <p>Methods/Materials Three different lasers(532nm, 650nm, 980nm) were set up in a transmitter circuit and aimed through a Fog Testing Cube and Rain Simulator. A test signal was sent to the transmitter using a signal generator and the output from the receiver was measured in decibels using a spectrum analyzer. I'd gather the results from the spectrum analyzer and log the data. I also set up a light scatter detection circuit at a 90 degree angle to the laser to measure light scatter through fog and took measurements using a multimeter.</p> <p>Results My results showed the 532nm green laser had the most scatter through rain and fog due to the fact that shorter wavelengths scatter more than longer wavelengths. The 532nm laser communicated the best through rain in the transmitter circuit. The 980nm infrared laser had the least scatter through rain and fog due to its longer wavelength and had the largest fade margin. It's also the best to communicate through fog. The 650nm red laser was the worst to use of the three and also had the smallest fade margin. Overall, the 532nm laser is the best to use in the transmitter circuit.</p> <p>Conclusions/Discussion My hypothesis was correct. The amount of light being scattered through fog and rain is a function of its wavelength. I was able to find out which wavelength had the most scatter through rain and fog. By plotting data on a graph, one can see a difference in light scatter. The 980nm infrared laser had less scatter because it had the longest wavelength of the three and the 532nm green laser had the most scatter due to its short wavelength.</p>	
Summary Statement The amount of light being scattered is a function of its wavelength and ultimately reduces signal strength in free-space optics systems.	
Help Received My father downloaded the Spectrum Analyzer software to help gather data and helped me build the Fog Testing Cube and the Rain Simulator. He also ordered the materials for my project and built the display case.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Michael Benner	Project Number J0704
Project Title Conductivity As a Water Quality Measurement	
Abstract Objectives/Goals The purpose of this project was to determine if electrical resistance could be used to determine water quality. Methods/Materials Various samples of water were checked for conductivity with a DATAQ datalogger and a 3-volt battery. Results Water with more dissolved solids did conduct electricity better than those with less. Conclusions/Discussion My tests showed that water quality for dissolved solids could be measured with conductivity.	
Summary Statement This project tests whether electrical conductivity of dissolved solids in water can be used to indicate water quality.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Cody E. Bulgarelli	Project Number J0705
Project Title The Effect of Temperature on an Electromagnet	
Objectives/Goals Does temperature affect the strength of an electromagnet?	
Abstract Methods/Materials A. I wrapped 22 gauge copper wire around a 14 centimeter iron nail 100 times to make the electromagnet. B. I heated or cooled the electromagnet in the freezer, dry ice, room temperature, and at three different temperatures in the oven for 10 minutes each. C. I laid out 300 staples and connected my electromagnet to a 9 volt DC battery. D. I hovered the electromagnet over the staples and picked up as many as possible. E. I disconnected the electromagnet from the battery and counted the staples that were picked up. F. I wrote down my data and graphed it on a chart. I conducted each test 3 times in each of the temperatures so that I would have accurate results. G. I measured the temperature with a digital thermometer in Fahrenheit and I measured the nail with a ruler in centimeters.	
Results The average results of the three tests in each temperature were: In the dry ice at -109 degrees, the electromagnet picked up 158 staples. In the freezer at -3 degrees, 170 Staples. In room temperature at 74 degrees, 185 staples. In the oven at 140 degrees, 193 staples. In the oven at 210 degrees, 238 staples, and in the oven at 285 degrees, 282 staples. I believe I got these results because the electromagnet could take on a stronger charge in the heat rather than the cold, creating a stronger magnetic field.	
Conclusions/Discussion My results show that my hypothesis should be accepted because the electromagnet picked up an average of 128 more staples in the heat at 285 degrees than in the cold at -109 degrees. During my experiment, as I increased the temperature of the electromagnet, the resistance of the circuit increased. According to Ohms Law, the current decreased. From my research I learned that as the current increases in an electromagnetic circuit the magnet becomes stronger. In my experiment the strength of the electromagnet increased even though the current decreased. This contradiction may have been caused because the iron core was able to take on a stronger charge at higher temperatures, even though the current decreased.	
Summary Statement How temperature affects the strength of an electromagnet.	
Help Received	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Christopher Chen	Project Number J0706
Project Title Switch and Save: Can Switching to a Different Type of Lightbulb Really Save You Money?	
Objectives/Goals My Science Fair project is about switching types of light bulbs to save energy and money. The question is "Do you really save money by switching from an incandescent to a fluorescent light bulb?" I chose my project because I wanted to find out how much money my father was really saving when he changed a regular incandescent light bulb to a fluorescent. In this project, I compared the energy usage of incandescent and fluorescent light bulbs. The purpose of my experiment is to prove that we can save energy and money by switching a light bulb. My hypothesis was that fluorescent light bulbs would use up much less energy than incandescent light and produce the same amount of brightness and quality of light.	
Abstract	
Methods/Materials To complete my experiment and execute my project, I used a "Seasonic Power Angel", a wattmeter that measures current, voltage, and watts. I measured 60, 75, and 100-watt incandescent and fluorescent light bulbs, and recorded my data to be used in calculating the cost of energy per light bulb.	
Results An average household with twenty 60-watt light bulbs would save about \$280 per year, 75-watt bulbs would save about \$376 per year, and 100-watt bulbs would save about \$516 per year.	
Conclusions/Discussion To make sure that the light bulbs produced the same brightness, and did not cheat buyers, I had to measure the brightness of light in each bulb. To do this, I used a photography light meter and placed it about one foot away from a small lamp. Then, I inserted bulbs and tested how many units of light coming from the bulb the light meter read. The more units of light produced by the bulb, the brighter the light was. Each bulb measured about the same amount of brightness for its equivalent.	
Summary Statement My project proves that switching from incandescent to fluorescent light bulbs can save energy and money.	
Help Received Father helped buy equipment and materials; mother and brother helped with board display	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Brittany Cheng; Shannon Lee; Audris Teh	Project Number J0707
Project Title Wave Energy Buoy	
Abstract Objectives/Goals Our project was to simulate a wave energy buoy using magnets and springs that would generate electricity by converting wave energy to electrical energy. We would conduct several experiments using the buoy. The buoy had to meet a set of design criteria including low cost, a portable size, and the ability to make energy using electromagnetism. Methods/Materials We built the buoy using wood, nails, and springs. The springs were used to simulate the movement of waves. Using an oscilloscope we measured the voltage of the electricity produced by the buoy under different circumstances. Our experiments involved several variables. First, we used magnets with different strengths: alnico and neodymium-iron-boron magnets. Secondly, we used magnetic wire with 25,000 and 15,000 coils. And finally, we experimented with different speeds of agitation of the magnet through the coil. We tabulated the results, graphed them, and analyzed the data. Results We found out that using two alnico magnets instead of one would produce four times more electricity. Also, we concluded that using a coil of wire wrapped 25,000 times produced 4.375 times more electricity than using a coil of wire wrapped 15,000 times. Lastly, we discovered that the slower the speed of agitation the less voltage is generated. If the agitation was slower than a certain speed, the voltage would drop suddenly. Conclusions/Discussion This project is significant because it addresses a new type of renewable energy source, wave energy. We conclude that the best conditions for a wave energy buoy would be rough longitudinal ocean waves, magnetic wire coiled many times, and a strong magnet. This was a successful project because we learned about renewable energy sources, experimented with magnetism, and learned about how using different types of coils, magnets, and agitation speeds affects the amount of electricity we can produce.	
Summary Statement Our project was to simulate an electricity-generating wave energy buoy using magnets and springs, and experiment with magnets to create electricity, and study electromagnetism in a motion similar to waves.	
Help Received Audris' Mom helped supervise and gave us guidance; Peter Lawrence donated magnetic wire and NIB magnet; Shannon's Dad for the wood and oscilloscope; Audris' Dad for helping us cut and drill the wood.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) David Chu; Sol Moon; Tim Yaoprake	Project Number J0708
Project Title Electricity Generation in Reversed Faraday Setup: Effect of Magnet Geometry?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objectives are to answer the questions regarding electricity generation in "reverse" Faraday's setup: 1) Does the reverse of Faraday's setup generate electricity? Spinning a magnet versus spinning a coil? 2) How will changes in the geometry of magnets in a generator setup, change the amount of energy produced: serial, parallel, or ring?</p> <p>Methods/Materials To build our generator, we used 2 in. wide PVC Pipe to hold up our coil. We then wrapped about 1000 yards of copper wire around the center of the pipe. We built the different magnet arrangements by attaching 4 strong neodymium magnets in the parallel, serial and two different ring formations. Then, we spun the magnets 20 times per configuration with a drill. We recorded an alternate current generated with a digital ammeter. Materials used include 8 Neodymium Magnets, Digital Ammeter, >1000 yards of copper wire, 3 ball bearings, 16 in. of 2 in. wide PVC Pipe, 3/6 wooden rod, 2 ft. x 1 in. of wooden pole, Epoxy, 18V electric drill.</p> <p>Results 1) Reverse of Faraday's setup is proven to generate electricity. The faster the magnet spins, the more current was generated qualitatively. 2) It turns out that the configuration of the magnets does affect the current generated. The greatest mean current was made by the serial form at 1031 μA. The average current for the parallel formation was 165 μA. We did not receive much power in our Ring Formation #1. The average was only 20 μA. Ring formation #2 was also less in power averaging 650 μA. The serial formation did generate electricity, which was greater than all the others.</p> <p>Conclusions/Discussion We have showed that spinning the magnets inside of a stationary coil, reverse of Faraday's setup, would generate electricity, the faster the magnet spins, the more current was generated. For the magnet geometry, the serial pattern worked the best in generating an electrical current. The attraction of the three magnets all lined up created a stronger magnetic field around the coil, more than that of the other configurations. Regarding the efficiency, we think that we lost a lot of energy due to friction in the ball bearings and resistance of the copper coils, as its resistance was 77.5 ohms. We have learned a lot about Michael Faraday's work from 1821 ~ 1831. This is especially intriguing as to see how we could exploit this finding to create more energy with the same amount of force.</p>	
Summary Statement Electricity is proven to be generated in reversed Faraday's setup, and how the arrangement of magnets can affect the current generated.	
Help Received Neighbor helped with comments on the project; Dad bought and brought supplies, supervised cutting of wood PVC pipe, and drilling.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Zak H. Cook	Project Number J0709
Project Title Can Magnets Make a Roller Coaster Faster?	
Abstract Objectives/Goals I hypothesized that the car with magnets would go further than the car without magnets. Methods/Materials A wooden car and track were made. A bar magnet was attached to each side of the car. Four magnetic gates were placed in the track in position A, B, C and D. Each magnetic gate is about 4 inches from the next one. The angle of the gates to the car was 30 degrees. The car was launched using a rubberband slingshot pulled back to 3 inches each time. The number and position of the magnetic gates were changed and tested at least 30 times to see how it affected the car distance traveled. Results The magnets in the last gate (D position), located 11.75 inches from the start, propelled the car the furthest traveling on average 41.37 inches compared to 36.45 inches when no magnets were used. Conclusions/Discussion Magnets can accelerate the roller coaster car to go further than the car without magnets. The number of gates and the position affects the distance the car traveled. Having four magnetic gates slowed the car but it was still faster than having no magnets.	
Summary Statement Determine if magnets can accelerate a roller coaster and what positions and angles are the best to do this.	
Help Received My dad cut the wood and helped me to measure the distance traveled	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Philip T. Cunningham	Project Number J0710
Project Title WiFi Waves	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of my experiment is to determine which materials would cause the most interference for wireless networking: stainless steel, wood, plastic, or glass and at which distance: 14 feet or 38 feet?</p> <p>Methods/Materials Materials: 1. A Linksys wireless-g router; 2. A Dell laptop; 3. One plastic bowl; 4. One stainless steel bowl; 5. One wood box; 6. One glass bowl; 7. Paper and pencil to record data; 8. Tape measure to measure distances.</p> <p>Procedure:</p> <ol style="list-style-type: none">1. Turn on the laptop and router2. Place the laptop 14 feet away in clear view of the wireless router so no substances will interfere3. Check the signal strength and signal speed on the laptop in megabytes per second (mbps)4. Record the Mbps and signal strength5. Place one of the bowls or boxes over the router and wait one minute6. Check the signal strength and speed on the laptop7. Record the Mbps and signal strength8. Repeat steps 5, 6 and 7 with different bowls or boxes over the router.9. Repeat steps 3 # 8 for a total of five trials with each material10. Now place the laptop 38 feet away from the router11. Repeat steps 3 # 8 with the laptop 38 feet away from the router with each material for a total of five trials each <p>Results The results of the experiment showed that the signal strength was affected by the stainless steel when the laptop was 38 feet away from the router.</p> <p>Conclusions/Discussion The conclusion I came to is that the distance from the router to the laptop played the biggest role in signal strength. The substances tested only slightly weakened the signal strength.</p>	
Summary Statement To determine which substances most interfere with wireless networking.	
Help Received Dad helped with measurements, brother helped switch materials.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Christopher R. D'Elia	Project Number J0711
Project Title Micro Dynamometer	
Abstract Objectives/Goals The purpose of my experiment was to build a small dynamometer that could measure the output power, torque, and RPM of a HO scale slot car. Methods/Materials I researched dynamometers to learn all the different methods and approaches to building them. I designed the dynamometer based on the principles of an electric dynamometer. I built the dynamometer to the specifications in my design. I tested the dynamometer with different cars and by adding a resistor to the motor. I recorded six sets of data. I graphed the data on a scatter chart and analyzed its trend. I compared my results to the standard behavior of electric motors. Results I built a dynamometer that is capable of measuring the power of a HO scale slot car. Conclusions/Discussion I concluded torque as a function of RPM, follows a polynomial curve, and power as a function of RPM, follows a higher order polynomial curve. The data should eventually drop off, but I did not have enough input voltage to prove this theory. In the future I will use more input voltage to the car, a different power supply, and a more sensitive scale. I will experiment more with the effect of loading the motor with a resistor.	
Summary Statement My project reflects the process of building a device to accurately measure and confirm the torque and output power of a slot car.	
Help Received I received assistance from my father. He helped to machine the base and supports. All of the machine work was done to my specifications and according to the drawings that I made. I am in the process of learning to use a mill and a lathe, but I have not yet received permission to use these machines.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Michael A. Day	Project Number J0712
Project Title The Effect of Different Sized Rods and Amount of Wrapped Wire on an Electromagnet	
Objectives/Goals The purpose of this project was to find out if different sizes of rods have an affect on the strength of an electromagnet.	
Abstract	
Methods/Materials 1- 12 volt battery; 1- Roll of 30 guage wire; 4 - Solid steel rods of different diameters (2 at 1/8# & 2 at 1/2 in); 1 # Hollow copper rod; 1 # Switch; 1 # Pack metal safety pins; 5 # Coated Paper Clips; 7 # 3.7 (g) nails. The first thing I did was create an electromagnet using the materials above. Two of the different sized rods were wrapped 100 times each with 14 gage wire. Then each rod was attached to the 12 volt battery. The 14 gage wire produced no results. The wire was to too thick and 30 gage wire was then used. This produced the results for the experiment. The first of the rods used was the copper,it had no charge. The copper rod was no longer used throughout the experiment. The next rod used was the 1/8 inches in diameter. This rod was wrapped 100 times with the wire. I was able to pick up 37.6 grams of metal with this rod connected to the battery. Next I used the 1/2 inch diameter rod. This rod was also wrapped 100 times with the wire. This time I was able to pick up 95 grams of metal. After I tested the two above rods, I then used the 1/8 inch diameter rod that was wrapped 200 times with the 30 gage wire. This picked up 41.3 grams of metal. The last rod I tested was the 1/2 inch diameter rod that was wrapped 200 times with the 30 gage wire. This picked up 98.7 grams of metal.	
Results Just as I had hypothesized, the thicker the rod, (larger diameter), held the most weight. Adding to this was when wrapped more times with the wire, it was a bit stronger. Also, the hollow copper rod was not magnetic and held no magnetic charge.	
Conclusions/Discussion Why did the magnetic field increase when you wrapped the rod with more wire? The magnetic field increased because you increased the number of coils, and thus, the strength of the field. As long as you wrap it in the same direction, the field will continue to increase with each additional coil.	
Summary Statement It was my hypothesis that if you have two rods with two different diameters, the thicker if the two rods will hold more magnetic weight than the thinner rod.	
Help Received Father helped cut display board with saw.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Adin T. Dobkin	Project Number J0713
Project Title Will Changing the Composition of a Hydrogen Fuel Affect the Power Output?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Will putting different materials in a hydrogen fuel cell affect the power output? I think that copper will give off the most power output because it is used in solar cells for conducting electricity. I think that lemon juice will also give off more power than a regular fuel cell because when there is no power running through it, it still gives off power.</p> <p>Methods/Materials # Clear Cup; # Popsicle Stick; # Platinum coated nickel wire; # Nine volt battery; # Nine volt battery clip; # Voltmeter; # Various metals and materials. Part I: Building the fuel cell 1. Twist 6 inches of the wire around a small nail; 2. Tape the twisted wire onto the popsicle stick; 3. Using wire cutters cut the battery clip wires in half; 4. Attach the cut wire from the clips to the platinum wire and attach the non cut wire still connected to the battery clip to the wire; 5. Attach the cut wire and the voltmeter probes together. Part II: Using the fuel Cell 1. Turn on voltmeter; 2. Pour water and material into cup; 3. Quickly touch battery to clip for three seconds then let go; 4. Record volts every five seconds; 5. Repeat steps 2 through 4 with every material.</p> <p>Results Area Under the Curve was used to generate these results. Regular water alone had a total output of 21.7 volts, the third most overall. Salt had a combined average of 10.905, the first set was 13.51, and the second set was 8.3. Salt was the worst material used and decreased output in the fuel cell. This may have happened because the energy from the fuel cell was used to split the sodium and chloride atoms in the salt. This may also explain why during the salt trials there was chlorine gas coming from the fuel cell. Sugar had a total voltage of 16.69, the fourth highest output in the tests. Lemon juice had a total output of 28.23 volts, the highest out of all the tests. Copper had a total output of 28.19 volts the second highest of all the materials. Aluminum had a total output of 15.05 volts, the fifth highest of all the materials.</p> <p>Conclusions/Discussion These results supported my thesis because I thought that copper's conducting and storing properties would save extra energy each test, and lemon's negative hydrogen ions that are naturally produced in lemon would combine with the hydrogen ions that give power to whatever the cell is powering. To further test this you could use different materials or different combinations.</p>	
Summary Statement Testing different materials to see if they postively or negatively affect the power output	
Help Received My dad recorded the information I told him, My uncle supplied me with the metals	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Thomas N. Gautier, IV	Project Number J0714
Project Title Electrical Conductivity of a Candle Flame	
Abstract Objectives/Goals The objective of my project was to test the electrical conductivity of a candle flame. Considering the basic structure and physics of a flame, I thought that the center darker part of the flame would be most conductive, as I believe it would contain the most unburned carbon. Methods/Materials An apparatus was used to hold two electrical probes a steady separation of 0.6 mm apart inside the flame. An ohm meter was used to read the resistance between the probes. Three measurement runs were made in each of ten locations in the flame. The results were recorded in the log. Results The resistance between the electrodes varied from 80 to several hundred megohms at different locations in the flame. The outside of the bright yellow part of the flame showed the highest conductivity and the top of the flame showed the least conductivity. Conclusions/Discussion My conclusion is that the dark central part with the most unburned carbon does not have the highest conductivity. I believe that the outer part of the flame had the most conductivity because it is the hottest, which makes it the easiest to ionize, allowing electricity to easily flow through it.	
Summary Statement I used an ohm meter and specially made probes to measure the electrical conductivity of various parts of a candle flame.	
Help Received Dad helped me build the aparatus, lent me his ohm meter, and helped me with 2 runs of exparament, a two person job; A friend helped me with another exparamental run; Dad also helped me put together poster.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Benjamin J. Giglione	Project Number J0715
Project Title Can a Braitenberg Vehicle React to Sound?	
Objectives/Goals This study compared the behavior of a Braitenberg vehicle equipped with light sensors to a vehicle equipped with sound sensors. A Braitenberg vehicle is a light sensing robot used in synthetic psychology (the study of robots that mimic behaviors founded by Valentino Braitenberg in 1984). These vehicles can follow and run away from vibrations the robot's sensors sense. Can these vehicles react to sound?	
Abstract Methods/Materials Using Lego Mindstorms 2.0 standard programming interface, a new program was written. A second program with similar functions had been written in the NQC (Not Quite C) language. First the computer was programmed to run toward/away from light as Braitenberg described using both programs. New sensors were built, as the variation, to similarly cause the vehicle to run towards/away from sound with both programs. Materials included custom made Mindstorms sound sensors, one extra Lego light sensor, a computer to download the programs to the Mindstorms RCX brick, a USB tower to send the program to the robot, a flashlight, and a strong sound source such as a human voice or and a portable music player with speakers.	
Results The vehicle test runs evaluated the ability of the robot to function with the various sensor and program combinations. Sensor wise, the robot responded similarly to both programs, reacting to the type and intensity of stimuli each sensor was specifically designed to detect. With the light sensors, the robot responded to light sources and when using sound sensors, the robot reacted to sound. A strong stimulus either attracted or repelled the robot depending on the programming or hardware configuration.	
Conclusions/Discussion It shows the Braitenberg vehicle's behavior is similar when using either light or sound sensors. Vehicles may be programmed to react to stimuli other than light. These synthetic behaviors can have a wide variety of theoretical and practical applications.	
Summary Statement A robot that runs towards or away from light can be made to do the same with sound.	
Help Received Used robotics equipment at Portola Middle School under the supervision of Mr. South. Father helped build sensors. Mother helped type report. Mrs. Shah helped develop project.	



CALIFORNIA STATE SCIENCE FAIR 2006 PROJECT SUMMARY

Name(s) Kimberly Ha; Jodi Loo	Project Number J0716
Project Title Maximizing Solar Panel Power by Tilting Its Angle towards the Sun	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Our objective is to determine the effect of tilting a photovoltaic solar panel in order to maximize its output power for designing an efficient solar energy system.</p> <p>Methods/Materials Two photovoltaic solar panels were juxtaposed in an open space almost free from shadows. One panel was tilted at 34-degrees and the other was at 57-degrees. We chose these two angles because during the two equinoxes in September and March, the earth axis is parallel to the sun axis. Therefore, we placed one panel to the latitude of Agoura, at 34-degrees, which was where the experiment was taken place. However, during the two solstices in December and June, the earth axis tilts 23.5-degrees away from the sun axis. Therefore, we tilted the second panel at 57.5-degrees by adding 23.5-degrees to the latitude of Agoura, 34-degrees. In our experiment, we collected the short circuit current (I_{sc}) from the two solar panels for six hours in each of the five days. This was recorded in 60-second time intervals from a current meter to a laptop computer using data acquisition software that was commercially available. The I_{sc} was then converted to the maximum power (P_{max}) by multiplying it to the open circuit voltage and fill factor for both panels. We then plotted the P_{max} as a function of time to compare the panel performance on each day. We also calculated each panel's total power from the P_{max} versus the time plots by integrating the area under the curves. We then converted the total power to kWh for a day-to-day energy comparison.</p> <p>Results Our results showed that on clear days, the 57-degree panel received about 20% more total power per day than the 34-degree panel. This proved our hypothesis because the 57-degree panel was more perpendicular to the incoming rays from the sun, since we experimented during the winter when the earth tilts 23.5-degrees away from the sun. However, on raining days, there was very little power received from the sun, so the total power was about the same for both panels.</p> <p>Conclusions/Discussion Our conclusion is that the panel needs to be perpendicular to the sun to receive the most power. Designing a solar system by tilting its angle to maximize the output power can actually save the system cost by using fewer panels and using less panel area. Our experiment shows that this improvement can be possible by 20% when we tilt the angle from 34-degrees to 57-degrees in areas around Los Angeles during the winter.</p>	
Summary Statement We measured and compared the output power of two photovoltaic solar panels tilted at two different angles to see which one yielded more power to design an efficient solar panel system.	
Help Received Father explained how solar cells work, data analysis and helped purchase solar panels; Mother bought board supplies; The teacher and school science fair gave helpful comments	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Vitorio N.G. Lorenzini	Project Number J0718
Project Title Controlling Static Electricity in Critical Environments	
Abstract Objectives/Goals My objectives/goals were to determine what was the best method to remove static electricity from different common materials in various environments. Methods/Materials I used 17 different common materials. I induced a charge by tribo-electric charging, or charge generation by separation. I then measured the materials with a static meter and recorded the results. Then, I used two most commonly used static control methods. The first method was grounding, utilizing a wrist strap and grounding mat. The second method was ionization. An ionizer emits an equal amount of both positive and negative ions, which then mate with their opposite neutralizing the charge created. These experiments were conducted in three separate and different environments; ambient temperature and relative humidity, elevated temperature and relative humidity, and lowered temperature and relative humidity. Results My results were in ambient temperature and relative humidity the charge results varied considerably day by day. Certain materials such as polystyrene and low density polyethelene were susceptible to considerable charge generation. In elevated temperatures and relative humidity, the charge results were lower than the other trials. In the lowered temperature and relative humidity, the charge results were extremely high compared to other trials and environments. In almost all cases ionization was the most effective method to remove charges. Conclusions/Discussion Grounding was not an effective method of charge elimination on non-conductive materials. Ionization, in almost all cases, was the most effective and efficient method of eliminating charges. Furthermore, the best environment for controlling static electricity is an elevated temperature with elevated relative humidity.	
Summary Statement Controlling static electricity in various environments with different materials	
Help Received Dad helped me understand project and theories, Interviews were conducted with professionals in manufacturing, Mom helped assemble display board, Mrs. Reed provided guidance and suggestions for project success.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Luke A. McKee	Project Number J0719
Project Title Back from the Dead: Charging NiMH Batteries from "Dead" AA Alkaline Batteries	
Objectives/Goals To evaluate 3 different methods of transferring residual energy from "dead" AA batteries into a nickel metal hydride (NiMH) battery to make it useable.	
Abstract Methods/Materials A NiMH battery charger was designed and built. It uses 8 "dead" AA batteries, connected in series and in parallel, as a power source. The efficiency of 3 different systems was evaluated and compared: direct connection, fuel cell intermediary, and capacitor intermediary, each of which could be chosen by a series of switches. 1 set of 8 "dead" AA batteries was used for each of 2 tests of the 3 conditions. Each experiment was run until voltage levels in the NiMH battery plateaued. Voltage in the AA array was measured before and after each discharge. Amperage flowing through the circuit during energy transfer was also measured and recorded.	
Results The Direct Connection method took between .2 and .6 volts from the AA array to charge the NiMH battery to 1.3 volts. There was a decrease in the flow of amperage through the circuit over time as the energy was transferred. The Fuel Cell method took between .23 and .46 volts from the array to charge the NiMH battery to 1.3 volts. There was an increase in amperage flowing through the circuit as the fuel cell stack generated electricity from the hydrogen produced by the reversible fuel cell (powered by the AA array), as it charged the NiMH battery. The Capacitor method transferred the largest amount of voltage on the first discharge, and drained the least amount of total voltage from the AA array.	
Conclusions/Discussion All 3 methods were shown to successfully increase voltage in the NiMH battery. It appears that the capacitor system it may be the most efficient method, based on the amount of voltage drained from the AA array. However, in the course of this project I learned about battery capacity (mA X time) which is what is measured by battery testers, which place a brief load on the battery while measuring its output (though testing the battery also drains some of its energy). Next year I want to find a way to measure capacity in the NiMH battery quantitatively so I can run a lot of experiments with my system and see how much total useable energy can be transferred from "dead" AA into NiMH batteries, and how many times it can be repeated before the AA batteries are truly dead.	
Summary Statement Residual energy in "dead" AA batteries can be used to charge NiMH batteries, which could have significant environmental/energy implications if proven practical and implemented widely.	
Help Received Mother helped with carpentry involved in making the board (I did circuit design, soldering, and heatshrinks). Dad ran countless errands gathering supplies. Peter David Ph.D., electrical engineer, spent several hours discussing my ideas with me, and helped me work out how to use capacitors for the system.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Jozefa S. McKiernan	Project Number J0720
Project Title Electrostatics	
Abstract Objectives/Goals My project was done to learn about electricity, specifically static electricity, using a charge detector and accumulating charge by combing hair. I hypothesized that the more charge (supposedly gained through more comb strokes), the further away it will be detected. I also hypothesized that a longer antenna would increase the detector's sensitivity and that it would not matter who combed their hair to accumulate charge. Methods/Materials I built a charge detector from a transistor, a light-emitting diode (LED), and a 9-volt battery. I had someone comb their hair with a plastic comb to accumulate charge and then placed the comb on a non-conducting stand, varying at different times the number of strokes, the person combing their hair, and the length of the antenna. Then I moved the charge detector closer until it could sense the charge. I also conducted an experiment on charge blockage to determine whether the charge detector could sense the charge through a barrier of a varying material. Results I found that there was not much difference in the detection distances at which varying numbers of strokes were sensed. There also was not much difference between the distances at which the charge from different people's hair was sensed. When I extended the antenna, the LED (on the charge detector) behaved unpredictably. I tested the extra-long antenna in different places and concluded that either a), there was charge on the plastic insulation surrounding the wire or b), the detector was so sensitive it could sense charge from up to 20 feet away. The experiment on charge blockage was inconclusive because I could not be sure whether the detector was sensing charge on the comb or the barrier. Conclusions/Discussion In conclusion, I learned a lot about how charge is accumulated through friction/contact and about electricity.	
Summary Statement I conducted a series of experiments about how static charge is accumulated through friction/contact and detecting those charges.	
Help Received Mother typed report; Father answered questions about background reading.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) William C. Meyer	Project Number J0721
Project Title Magnetic Linear Accelerator	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My experiment was designed to find the maximum efficiency setting of a simple magnetic linear accelerator.</p> <p>Methods/Materials Ruler x1, Duct tape, Magnets x4, Nickel-plated steel balls x9, Stopwatch/other electronic timer.</p> <ol style="list-style-type: none">1. Tear duct tape into strips roughly the width of one of the magnets.2. Tape first magnet to ruler at 1-inch mark.3. Tape second, third, and fourth magnet to the ruler at 2.5-inch intervals. (Ex.: The first magnet is at the 1-inch mark, the second would go at the 3.5- inch mark, the third at the 6-inch mark, etc.)4. Place two steel balls in the groove in the ruler to the right of each magnet.5. Set up two strips of duct tape 20 feet apart, preferably on a wooden surface. These will be your start and finish lines.6. Line up the ruler behind the first strip of duct tape. Make sure it is as straight as you can get it.7. Place the 9th steel ball in the ruler groove to the left of the magnet farthest to the left on the ruler.8. Use the stopwatch (or other timing device) to record the time it takes for the ball to travel past the second strip of duct tape.9. Realign the balls and run the experiment twice more at the same setting. (Or however many times you want to repeat it; three times is the minimum amount to obtain a rough average, but if you want to ensure accuracy you can do more trials.)10. Repeat steps 1-9 with various combinations of numbers of magnets and spacing of magnets. (In my experiment, I used 2, 3, and 4 magnets at 2.5, 3, 3.5, and 4 inches apart, except for 4 magnets at 3.5-inch and 4-inch spacing as that would not fit on the twelve-inch ruler.)11. Chart your results onto a graph or table. <p>Results The optimum setting of a small-scale magnetic linear accelerator is 4 magnets spaced 2.5 inches apart.</p> <p>Conclusions/Discussion The optimum spacing of magnets for a magnetic accelerator of this type is roughly 2.5 inches apart. The more magnets placed on the accelerator, the faster the projectile will travel. My hypothesis was wrong; I believed that the optimum spacing was 2 inches apart, which turned out to be impossible as the second ball was attracted to the wrong magnet due to the magnets being too close together.</p>	
Summary Statement A magnetic chain reaction accelerates and launches a steel ball.	
Help Received Father helped time the speed of the balls	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Raman V. Nelakanti	Project Number J0722
Project Title How Do Different Kinds of Antennas Work in Outdoor Conditions for WiFi?	
Abstract Objectives/Goals WIFI uses devices called Access Points that may use antennas to transmit signals for a receiving client to access the internet. The purpose of my experiment was to find out which antenna sends the strongest signal to the receiving laptop in two different outdoor conditions, through trees and in an open field (straight line and at an angle). It was hypothesized that if an antenna could be made to direct the signal, then this type of antenna would direct the strongest signal to the receiver. Methods/Materials The four antennas (coffee can, Yagi Pringles, Plain Pringles, and commercial Linksys) were placed in a park and readings were taken every ten feet for 100 feet and every twenty feet after that. The results were analyzed according to the distance from the antenna and the type of antenna that was used. Results The results showed that the coffee can was omni-directional and showed the strong signals in the three different environments. The directional Yagi Pringles antenna performed the best in open conditions when you needed a signal in a particular direction. Conclusions/Discussion It was concluded that omni-directional antennas perform best in outdoor conditions because they reflect signals off surrounding objects to send multiple signals to the receiver.	
Summary Statement The main point of my project was to find out how different types of my homemade antennas worked in outdoor conditions for WIFI.	
Help Received My father helped me understand the concepts of wireless networks and helped in setting up the equipment.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Harry L. Powell, Jr.	Project Number J0723
Project Title Electromagnetic Motor Configurations	
Abstract Objectives/Goals Electromagnetic motors specifically run on electricity and magnetism. When you put these together they may run very fast. My project's main purpose is to test the different effects that different ways of wrapping wire around the rotor affects the speed of the motor. Methods/Materials If you look on you will see all the tests I have done to see the difference in the way you wrap the wire around the rotor. I tested five different ways of wrapping. Each of the wraps has different styles of wrapping. The different wraps were all unique. All of the settings that I used were exactly the same. I also used the same batteries every time. When I tested the batteries they were one volt less then when they were fresh. Results In the end I found some interesting results. I found that with more wraps and less gaps that the motor seems to run quite a bit faster. The runs with gaps were ok but the rotors with more wraps and fewer gaps were the best. Conclusions/Discussion The rotors with more wraps surprised me a lot. They ran much faster then I expected. I also found that there is a so-called point of safe return where too much weight makes the motor run much slower. When this happens, it was a good time to stop.	
Summary Statement My project is an attempt to find the different effects on the speed of a rotor with different styles of wrapping.	
Help Received Mother helped transport project; mother bought materials; father bought materials; used wood and objects from the LJCDS workshop; built project under the supervision of Thomas Smith	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Megan K. Schmidt	Project Number J0724
Project Title Deduct Your Electricity Bill	
Objectives/Goals The goal of my project is to see if I can generate electricity by evaporating water. The main reason I did this project is that the world is currently having problems with electricity. I thought that with this method I could help the world's electricity problem a little.	
Abstract A Meter; 5 1/2 powerful magnets; A glass cup; A coil of wire; A Classic Drinking Bird; Water. For this experiment I used a Classic Drinking Bird to show how electricity can be generated by evaporation. By wetting the bird's head, and tapping it to start the motion, you can create an endless bobbing motion. By attaching a magnet to its beak, and letting the bird dip into a glass of water wrapped in a metal coil, you can generate an electric current. The Classic Drinking Bird works by a liquid moving up a tube connected to the bird's head. If you wet the head with water, it becomes colder than the bottom of the bird due to evaporation. Because it is colder, the vapor pressure in the head is lower and this is what causes the water to move up the tube. The liquid starts rising, making the bird bob deeper and deeper, until the beak dips down and meets the water surface. When the bird dips into a glass of cold water, the liquid in the head goes back down to the bottom of the bird.	
Methods/Materials A Meter; 5 1/2 powerful magnets; A glass cup; A coil of wire; A Classic Drinking Bird; Water. For this experiment I used a Classic Drinking Bird to show how electricity can be generated by evaporation. By wetting the bird's head, and tapping it to start the motion, you can create an endless bobbing motion. By attaching a magnet to its beak, and letting the bird dip into a glass of water wrapped in a metal coil, you can generate an electric current. The Classic Drinking Bird works by a liquid moving up a tube connected to the bird's head. If you wet the head with water, it becomes colder than the bottom of the bird due to evaporation. Because it is colder, the vapor pressure in the head is lower and this is what causes the water to move up the tube. The liquid starts rising, making the bird bob deeper and deeper, until the beak dips down and meets the water surface. When the bird dips into a glass of cold water, the liquid in the head goes back down to the bottom of the bird.	
Results Because I was interested in getting the most electricity that I could, I tried to make the bird bob as fast as it could go. I found that the bird's bobbing rate depended on how fast the water on its head evaporates. By using a small, hand-held electric fan, I could make the bird bob faster. With the fan, the evaporation process is faster. I tried using salt water to see if the bobbing rate would change, and it did. This is because salt water evaporates more slowly than fresh water.	
Conclusions/Discussion I have discovered from the data I have collected, that my hypothesis is correct. Evaporation can produce electricity. The experiment I have done could be taken up another level. The design I have conducted can only produce enough electricity to move a needle, but with a bigger design, and more powerful magnets, it could be enough electricity to light up a light bulb, a lamp, or a small town. I think this could help solve our energy problems.	
Summary Statement My project is to see if evaporation can produce electricity.	
Help Received Dad helped measure electricity; Mom helped explain evaporation	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Michael C. Schmit	Project Number J0725
Project Title Launching Ball Bearings	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My project was to determine whether magnets could increase the momentum of rolling ball bearings in order to launch one uphill and several inches through the air. I believe that having magnets at the beginning and end of the track will maximize the launch distance.</p> <p>Methods/Materials I used 20 magnets, 10 approximately 1/2" in diameter and 1/8" thick, and 10 more approximately 3/4" diameter and 1/8" thick. 16 steel ball bearings were also needed to complete my project. For the track, I used a piece of aluminum angle that is 3/4" on each side and 27-1/2" long. The magnets were mounted to the angle with masking tape. The aluminum angle is mounted on a wood stand that I painted with acrylic paint.</p> <p>Results The evidence proves that if the majority of the magnets are set at the beginning and end of the track, the ball will launch to it's maximum distance.</p> <p>Conclusions/Discussion Magnets have a major effect on increasing the momentum of rolling ball bearings.</p>	
Summary Statement My project shows how magnetic forces can interfere with objects in order to create a change.	
Help Received My father helped me cut the wooden stand on his saw.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Courtney J. Shipp	Project Number J0726
Project Title Gun Power: Experiments with a Gauss Rifle	
Objectives/Goals The purpose of this project is to determine if a smaller or larger spacing between the magnets on a Gauss Rifle will maximize the distance the projectile travels. It is hypothesized that when the magnets are brought closer together, the distance the projectile travels will increase. This hypothesis is based on the assumption that when the magnets are closer together, the balls will lose less energy as they travel from one magnet to the next and therefore transfer more energy to the projectile.	
Abstract	
Methods/Materials A Gauss Rifle is a linear accelerator that uses a magnetic chain reaction to launch a steel marble at a rapid speed. The experiment involved making a Gauss Rifle, firing it and recording the distance of each shot fired. The intervals were then changed and the process was repeated with uniform intervals between the magnets of 3, 4, 5, 6, 7, 8 and 9 inches.	
Results The four-inch spacing was the optimal spacing of the tested intervals with the distance declining with spacings greater than and less than 4 inches. The four-inch test had the longest average results and the nine-inch test had the shortest average results. Therefore, the hypothesis was mostly supported.	
Conclusions/Discussion The equation for kinetic energy is $Ke = \frac{1}{2}mv^2$. The four-inch spacing is optimal because each moving ball has reached its full speed before impacting the next magnet thereby transferring the most kinetic energy. At spacings of 5 inches and above each moving ball has already reached its maximum speed and has begun to slow down when it impacts the next magnet, thus transferring less kinetic energy. At the three-inch spacing each moving ball has not yet reached its maximum speed and therefore does not have as much kinetic energy to transfer.	
Summary Statement This project tested 7 different spacings of magnets on a Gauss Rifle to determine which spacing would yield the farthest shot and found that 4 inches was optimal.	
Help Received I would like to thank my parents for supporting me and helping me with my experiment. My dad helped me understand Newton's Second Law and the kinetic energy equation and my mom helped me arrange my display board.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Anna K. Simpson	Project Number J0727
Project Title Overcoming Background Variations in Line Following with Multiple Light Sensors	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to find out if robots could follow lines better with more than one light sensor when the it is faced with an unknown or changing background lighting. I hypothesized that multiple light sensors would erase problems with background lighting that the single sensor cannot combat.</p> <p>Methods/Materials I tested the sensors by adding them to a simple robot that I built, programming the constants to follow the line in my control lighting. I made the robot so that it could hold combinations of one, two, and three light sensors. Then, I had the robot follow the lines on 3 different courses in 6 different background lightings, while recording the percentage of the total distance that it covered and the time it took to do so. I did five trials with everything constant for each combination.</p> <p>Results The single light sensor was unable to follow the line when it was really bright, really dark, or when the lighting changed during the test. Three light sensors did it all but when it was really dark and the lighting changed. Two light sensors were able to do it in one hundred percent of background lightings. On a straight line (one of my courses), the robot went at an average speed of 4.2 cm/s when equipped with one sensor, 1.5 cm/s when equipped with two light sensors, and 7.6 cm/s when equipped with three sensors.</p> <p>Conclusions/Discussion The double light sensor is most accurate and the three light sensor is not as good as the double, through it was about four times as fast. I would have to utilize a more complicated programming language to get better speed with the two light sensors or more accuracy with the three. I found that two light sensors are slightly better than three so my hypothesis was supported.</p>	
Summary Statement Multiple light sensors make robots more accurate at line following when the background lighting is unknown or changing.	
Help Received My advisor and science teacher helped me with the preparation of my project; Mr. Robin Laird gave me some opportunities for research; Mother and Father helped me reseach and put my poster together and helped check my experimental conditions and change batteries;	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Wylan R. Simpson	Project Number J0728
Project Title Is Temperature a Factor? Solar Panel Efficiency	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My project was designed to test whether the temperature of a solar panel has an effect on the voltage it produces. I believed that the greater the panel temperature, the greater the voltage it would produce.</p> <p>Methods/Materials To test my hypothesis, I used two similar solar panels. I used small test panels, about 6 cm by 5.5 cm. I heated one panel in direct sunlight, while cooling the other in the refrigerator. When the panels reached the target temperatures (7 degrees Celsius for the "cold" panel and 43 degrees Celsius for the "hot" panel) I took the panels and placed them on pegs, side-by-side in the sun. I then attached multimeters to each panel to measure voltage. Then, once every minute, I took multimeter readings and used a laser temperature reader to measure panel temperature until the panels reached equal temperature. The variance in voltage between the panels was so minute that it did not affect my results, at the most varying .03 volts. To eliminate the potential for even the smallest panel variations to affect my results, I rotated panels between tests.</p> <p>Results The cold panel consistently yielded greater voltage than the warm panel, though the difference was small. On average, from all four of my tests, every 1 degree Celsius that the temperature of the "cold" panel rose, the voltage output decreased .02 volts. This difference is so small mostly because the panels were small, never producing more than 5 volts.</p> <p>Conclusions/Discussion The lower the temperature, the better the conductivity, so greater voltage is produced. This is the exact opposite of my hypothesis. From this data, I gathered that it would be worthwhile to install a "solar panel cooler", a device to keep the panel temperature low on sunny days. This "solar panel cooler", while perhaps not efficient on small scale, one-panel arrays, could be used on large industrial arrays to great benefit.</p>	
Summary Statement My project was designed to test if the temperature of a solar panel affects its voltage output.	
Help Received Peter Johnstone, from the Schatz Energy Laboratory, Humboldt State University, helped plan the project, provided equipment, and helped graph data with Excel. Ms. Skiles, science teacher, and my classmates provided review and critique.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Matthew A. Soderstrom	Project Number J0729
Project Title Battle of the Batteries	
Abstract Objectives/Goals This project will determine if the less expensive Costco Kirkland Signature Alkaline AA batteries and the Walgreens Ultra Alkaline Supercell AA batteries will prove to be a better value than the more expensive Duracell Coppertop, Energizer Max, and RadioShack Alkaline Enercell brand AA batteries. Methods/Materials A light box was constructed to simulate a load on the test batteries and to allow measurements to be taken. An ammeter was used to measure amps, a voltmeter for volts, and a light meter for light output. The tests were conducted using two sets of two batteries for each brand. Readings were taken and recorded on 30#minute intervals, for a total of four hours, for each two-battery set. The data was then analyzed by calculating and graphing the following for each brand of AA batteries: amps, volts, power, and light output over the four hour test as well as average amps, average volts, average power, average light output, and cost per battery. Results The results show that the less expensive Costco Kirkland Signature Alkaline AA batteries and the Walgreens Ultra Alkaline Supercell AA batteries prove to be a better value than the Duracell Coppertop, Energizer Max, and RadioShack Alkaline Enercell AA batteries. Conclusions/Discussion The hypothesis was supported by this experiment. Further experiments might be conducted to compare how the value of AA rechargeable batteries compare to the alkaline batteries previously tested. Additionally, experiments could compare the battery performance when used with other types of loads, such as; toys, radios, cameras, etc. Further study could also compare #high-performance# batteries such as the Energizer E2 Lithium, Energizer E2 Titanium, and Duracell M3 Ultra to standard alkaline batteries.	
Summary Statement To determine if Costco Kirkland Signature Alkaline AA batteries and Walgreens Ultra Alkaline Supercell AA batteries are a better value than more expensive brand AA batteries .	
Help Received Mother helped type 1/2 of report and worked with me on board display, and Father taught me how to graph results in Excel.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Paul A. Starceвич	Project Number J0730
Project Title Magnet to Electromagnet	
Objectives/Goals The purpose of my science fair project is to answer the question, #Does adding electric current to something that is already magnetized increase or decrease the power of the magnet?# I know that I can make an electromagnet from a piece of soft iron rod by wrapping it with copper wire and giving it an electrical charge-this made me think that I might be able to increase the power of a regular magnet by giving it an electrical charge from a battery. I also knew from my research that magnets can be demagnetized if they are dropped, which disorganizes the ions in the magnet. I wondered if maybe by running an electrical charge through a magnet, I might disorganize the magnet and end up with iron that is not magnetized.	
Abstract I used a cow magnet (ranchers have cows swallow them to catch metal in their stomachs). I put it in a box of paper clips. I pulled it out and counted the number of clips that were stuck to it. I repeated this procedure three times. I then wrapped the cow magnet with ten turns of copper wire. I attached the wire to the poles of a 9 volt battery to create an electromagnet. I then placed the electromagnet in the box of paper clips. I pulled it out and counted the number of clips that were stuck to it. I repeated this three times. To find out if the magnet was disorganized and weaker or demagnetized after I had used it as an electromagnet, I took the wire and battery off of it and placed the magnet in the box of paper clips. I pulled it out and counted the number of clips that were stuck to it. I repeated this three times. Methods/Materials Materials:I used a stainless steel cow magnet, one yard of covered copper wire, one 9 volt battery, a box of paper clips, a wire cutter and stripper, and tape.	
Results The magnet with no electric current held 48,47 and 50 paper clips, an average of 48.3 paper clips. The magnet with the electric current held 70,77 and 74 paper clips, an average of 73.6 paper clips. The magnet that had been used as an electromagnet held 62,58 and 57 paper clips, an average of 59 paper clips .	
Conclusions/Discussion I found that I could make a magnet stronger (able to hold more paper clips) by using a battery and copper wire to make it into an electromagnet. I found that adding an electric current to a magnet did not destroy or weaken the magnet.	
Summary Statement Does adding electric current to something that is already magnetized increase or decrease the power of the magnet?	
Help Received My mother helped type my report.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Brent T. Timm	Project Number J0731
Project Title Batteries: The Most Bang for Your Buck	
Abstract Objectives/Goals The objective of this project was to determine which major brand of AA alkaline batteries, by scientific testing, offers the best value to the consumer. Methods/Materials I shopped to find the best prices of major brands of batteries. Then these batteries were placed under a given load, 22 ohms, and their voltage was measured using an HP Data Logger 34970A to determine how long it took until it dropped below a useable value (0.9 volts). This process was repeated at a second load condition, 10 ohms. To determine value, the cell cost was divided by the average amount of useable time by brand. Results I logged about 14,000 voltage readings on the 60 cells tested. At the 22 ohm load the life varied from 45.40 hrs. to 49.22 hrs. At the 10 ohm load the life varied from 18.70 hrs. to 20.16 hrs. Kirkland offered the best value, not because of its performance, but because of its low price. Conclusions/Discussion There is hardly any difference in the performance of the batteries. The price was the most influential factor in the value of batteries. That is why the least expensive battery, which in this case was Kirkland, offers the best value. If the Kirkland batteries are not available, I recommend that you purchase the battery with the lowest cost.	
Summary Statement My project is to determine which major AA alkaline battery manufacturer offers the best value.	
Help Received My father provided me with consultance. Carlos Gonzales loaned me the HP Data Logger.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Jacob L.C. Titherley	Project Number J0732
Project Title Magnetic Electricity	
Abstract Objectives/Goals My hypothesis is that a spark will arc from an electrical source to the north polarity of a magnet. Methods/Materials A Van de Graff generator was constructed so I would have a free source of electricity. A compass was also constructed in order to determine the polarity of the magnet. I then performed several experiments where I touched the magnet to the generator and tested how well electricity could travel through each of the magnet's polarities. I was looking for electricity to be drawn out of the generator in the form of a spark. Results My results were varied. Sometimes I saw a large spark arcing toward the north polarity from the generator. And sometimes no spark could be seen arcing at all. The exact same thing happened with the south polarity. Conclusions/Discussion My hypothesis was not correct. The electricity could not be seen arcing from the generator to the north polarity at a greater degree than to the south polarity. There is still a lot to learn about the similarities and differences between electricity and magnetism.	
Summary Statement My project is about finding out whether electricity is magnetic.	
Help Received Mom helped type this application and helped with board.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Mariel T. Williams	Project Number J0733
Project Title Ride the Energy Tide	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My main objective for my project was to find whether or not it was possible for me to create a new way to generate energy from the power of waves, and if it could be cost competitive to that of a nuclear power plant.</p> <p>Methods/Materials I first brainstormed different plans for the model. When I finally chose the most effective of plans I started a list of materials and a projected procedure for my project. I first decided that I would use a shake-powered flashlight to represent the main production area. I then started the construction of a Plexiglas, sloped wave tank to best simulate the ocean floor, then created the handle and paddle on the front face of the tank that pushes the water into a wave when the model is full of water. When the wave surges it hits another paddle that is attached a bridge on the top of the tank holding the flashlight. In the flashlight I first removed the outer barrier and the bulb. In the handle area of the flashlight there is a magnet that moves in and out of a wire coil as the flashlight is shaken and creates an electrical surge. In the absence of a bulb I placed a plastic rod and bearing that connects to the magnet on one side and the moving paddle on the other. So as the paddle is moved by the current the magnet moves through the coil creating an electrical force. Finally I used a soldering iron and glue gun to attach two prods of an electrical gage to the main production center in the flashlight so that I was able to monitor the energy production.</p> <p>Results For my project I took the average power produced on my model and scaled it up to the same production rate and corresponding cost as a chosen local power plant. The overall cost for a nuclear power plant like SONGS with a 25 year life span would be \$15,050,000,000. Also the cost per year would be \$602,000,000. Over an equal life span to that of SONGS the overall price of a wave energy generator would be 14,945,625,000. Also, the price per year of a 25 year lifespan would be \$597,825,000. Therefore, my model of a possible wave generated electricity center is cost competitive to nuclear power plants.</p> <p>Conclusions/Discussion One of the greatest conclusions that I came to during the course of my project was that the concept of wave generated energy is one that could be an incredibly successful and appropriate decision for an alternate energy in coastal communities, being that it has great economic and environmental benefits.</p>	
Summary Statement I created a wave generated energy production model and then I compared it's cost to a nuclear power plant's.	
Help Received Father helped prepare materials.	



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Anjian Wu	Project Number J0734
Project Title Semiconductor Lighting	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective is to understand the operation of Light Emitting Diodes (LED) and determine if modern LEDs have the advantages to replace incandescent light bulbs for energy-saving purposes.</p> <p>Methods/Materials The primary materials used include high-brightness LED samples in red, green, and blue. I constructed a 70-piece-LED assembly based on appropriate number of green, red, and blue LEDs so that it would emit white light. A high-efficiency AC-DC conversion circuit is used to power the LEDs. The assembly was then tested along with nitrogen and halogen incandescent lamps to find their efficiencies. This was done by adjusting the input power at different points and measuring the light output.</p> <p>Results The LED assembly designed and constructed by me successfully matched incandescent light bulbs in light output. The LED cluster showed strikingly high conversion efficiency: 8x better than a nitrogen incandescent light bulb and 5x better than a halogen lamp.</p> <p>Conclusions/Discussion LEDs are five to eight times more efficient than incandescent light bulbs. This is because light generation from LEDs is through transitions of electrons between energy states, with little loss in heat. Although each LED is small, when combined into a group, high luminance comparable to light bulbs can be obtained, with less waste of energy. LEDs have other advantages such as their relatively constant color and high efficiency regardless of input power. Incandescent light bulbs, on the other hand, depend on heat radiation to generate light with lots of waste energy. Also, at low wattages, the light wavelength of the bulbs is long and is mostly infrared, which is invisible. It is only at high wattages when the light becomes more visible.</p>	
Summary Statement This project is to explore the potential of Light Emitting Diodes (LED) as an efficient lighting source by constructing a LED assembly and comparing its performance against incandescent light bulbs.	
Help Received Father taught me theory of semiconductors, helped acquire LED samples and advised on designing AC-DC converter. Father also participated in valuable discussions of experimental results.	



CALIFORNIA STATE SCIENCE FAIR 2006 PROJECT SUMMARY

Name(s) Justin K. Yeh	Project Number J0735
Project Title Cell Phone Radiation	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals On Oct 14 2004, Reuter News reported a study by Sweden Karolinska Institutet showing that ten or more years of mobile phone use increases the risk of developing acoustic neuroma. The TCO 99 standard for computer monitor limits the EMF to 2mGauss at a distance of 30 cm from the front of the monitor. If I apply the TCO 99 standard to a cell phone how far do I have to be to get an EMF exposure of 2mG? My HYPOTHESIS was that the minimum distance from a working cell phone to get an electromagnetic field exposure of 2mG was 4 cm.</p> <p>Methods/Materials Using 8 different cell phones, I measured the distance from the phone when the EMF is 2 mGauss for 5 modes: standby, connect, listen, talk and listen+talk; with MagnaScan 88 EMF detector from LeeF Technology Inc.</p> <p>Results The distance to 2mG for standby mode was 0 cm for all 8 phones. The average distance for connect mode was 12.39 cm, with the shortest being 2.12, and the longest being 33.02. The average for listen mode was 13.6 cm, with the range of 4.23 to 33.02 cm. The average for talk mode was 13.92 cm with the range of 3.39 to 33.02 cm. Finally, the average for listen + talk mode was 18.67 cm, with the range of 2.96 to 43.18 cm.</p> <p>Conclusions/Discussion My hypothesis is incorrect. In most of the modes, all but 2 cell phones emitted 2 mGauss of EMF for a distance of more than 4 cm. The average distance of listen + talk was the longest at 18.67 cm. I expected that because listen + talk mode involves two frequency bands, thus more EMF. I was surprised that connect mode generated almost as much as the listen + talk mode. That suggested that even though when there wasn't any one talking, the cell phone continues to send and receives signals. Further research is needed to see why there is such a great variation of EMF emission among the cell phones and how to lower the radiation.</p>	
Summary Statement My project was to measure the EMF from 8 cell phones using 5 different modes: standby, connect, listen, talk and listen+talk mode.	
Help Received Sister Tiffany helped me with the measurements. Mother helped decorate the poster. Relatives provided some of the cell phones. My father's friend, David Law, provided the MagnaScan 88.	