



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Cassidy A. Aarstad	Project Number J0701
Project Title The Speed of the 21st Century	
Objectives/Goals My objective was if the amount of storage space and RAM effect the speed of a computer. I chose to do this project to find out if I could simply add more storage space and RAM instead of installing a new Processor. I hypothesised that More storage space and Ram will increase the speed of a computer.	
Abstract Methods/Materials Material:two 20GB Hard Drives with WindowsXP Operating system Installed two 60GB Hard Drives with windowsXP Installed two 128MB RAM two 512MB Ram two Identical computers without Hard Drives or Ram installed A Program to install that will take up much space on the Hard Drive A Time Watch with batteries Procedure: I built two computers with out Hard Drives or Ram installed then Alternated the Hard Drives and RAM listed above and timed how long the program took to install on the computer.	
Results When the computers had 60GB of storage spacde and 512MB of Ram, it computed faster than when it had 20GB of storage space and 128MB of Ram.	
Conclusions/Discussion I concluded that the More amount of storage space and memory(RAM) will increase the speed of a computer.	
Summary Statement My project tests the speed of a computer with different amounts of storage space and memory	
Help Received teacher advised and supervised my project	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Maliha S. Ahmed	Project Number J0702
Project Title The Effect of Wire Looping and Layering on the Strength of Electromagnets	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To determine the effect of wire looping and layering on the strength of an electromagnet. By varying the number of coils in an electromagnet, one can measure its strength by testing its ability to pick up different masses. In addition, to determine if layering the number of coils has an effect on the electromagnet's strength.</p> <p>Methods/Materials The following materials were used in performing one trial of the experiment: a 20.3 cm long iron nail, one 6-Volt battery, flat steel-washers, thin insulated copper wire, triple balance beam, and a wire cutter. To create an electromagnet, copper wire was looped around the nail a number (x) of times. The wire was coiled tightly over the central portion of the nail. The ends of the wire were exposed by using a wire cutter to remove the insulating covering. One end of the wire was connected to the positive terminal of the battery and the other end was connected to the negative terminal. The electromagnet was then placed in a pile of washers for 20 seconds. After this time, the electromagnet was disconnected, and the attached washers were massed on the ! balance beam. This measurement gave the mass picked up at 'x' number of loops. This procedure was repeated for all the single layer tests (x = 25, 50, 75, 100, 150, and 200 loops). To investigate the layering effect, the same procedure for looping the wire was used except two layers of loops were wound over the nail. After the first layer was coiled over the nail, the second layer was coiled on top of the first layer. The two-layer combinations were the following: 25 loops per layer, 50 loops per layer, 75 loops per layer, and 100 loops per layer.</p> <p>Results From all three trials involving 50 loops, the electromagnet picked up precisely 8.2 grams. From all three trials of 75 loops, the electromagnet picked up an average of 14.9 grams. From all three trials of 100 loops, the electromagnet picked up an average of 27.1 grams. The results for the layering effect involves conducting more trials to determine the results.</p> <p>Conclusions/Discussion The hypothesis was proved correct because increasing the number of loops increased the strength of the electromagnet. This increase in strength was shown by an increase in the total mass picked up by the electromagnet. After graphing the data, the relationship between electromagnetic strength and the number of wire loops was shown to be linear. These results agree with the background research that stated that increasing the number of coils concentrates and increases the magnetic field. This additive effect of each turn around the nail makes the iron nail highly magnetized. The conclusion for the layering effect has not</p>	
Summary Statement The effect wire looping and wire layering has on the strength of electromagnets	
Help Received My brother for teaching me about the basics of electricity. My mother for getting my materials. My science teacher for encouraging me and explaining the rules.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Benjamin J. Bairrington	Project Number J0703
Project Title Infinite Power of Electromagnets	
Abstract Objectives/Goals My objective in doing this project is to learn more about electromagnetism used for a future design of cars and transportation. Using my homemade electromagnets, I think I can increase their power by wrapping more coils of wire around them, I think I can magnetically levitate a car on a rail, and I think I can make the car move forward through an electromagnetic tube. Methods/Materials In the first step to study electromagnetism, I wrapped fine wire around a nail, attached to a battery, to pick up staples. In the next step, I constructed a wooden rail and attached magnets to levitate a cardboard car. Finally, I tried to move the levitated car down the rail, through a tube, wrapped with about 600 coils of heavy wire, to induce a more powerful electromagnetic field than the nail. Results In the first step, the nail wrapped with 10 more wraps each time, consistently showed an increase in electromagnetism by picking up a greater number of staples. Next, the cardboard car levitated on the rail higher with flat circular magnets, but the flat bar magnets, positioned closely together, allowed the car to move forward more smoothly. The last step showed that a metal coin bank tube moved faster through the electromagnetic tube or tunnel than the other designs. Conclusions/Discussion My results supported my hypothesis in experiments one and two because more wraps of wire made the electromagnet more powerful, and I was able to levitate my car with repelling magnets on a rail. My hypothesis in experiment three was incorrect. I could not make my levitating car move on its own, down a rail, through the electromagnetic tube, EMT, but I discovered that the metal tube would move rapidly, on its own, through the EMT. Someday with more efficient methods of building EMT's, and generating electricity for the EMT, our planet might be criss-crossed with tunnels over land, and under the oceans, where people can safely travel at high speeds without further pollution.	
Summary Statement To explore strengths of electromagnetism and use it to move an object through an electromagnetic tube.	
Help Received Father helped type report and set up equipment.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Michael H.H. Beitman	Project Number J0704
Project Title Potential Solar Cells for the Developing World	
Objectives/Goals I hope to develop a solar cell consisting of inexpensive, easily found and commonly available materials useful in powering radios, cell phones, lights, small motors, and other basic devices.	
Abstract Methods/Materials Materials to be tested: aluminum, brass, copper, copper oxide, cuprous oxide, galvanized steel, lead, screen, stainless steel, silicon, steel, titanium and zinc. Electrolytes used: aluminum potassium sulfate, cuprous oxide, salt water, silicon (as a benchmark), water and zinc oxide. Equipment Required: Computer; current and volt meter, pan, plastic containers, stove, blowtorch and radio, motor, LED to serve as loads to run with generated power. Some materials I wanted to test were not available to me due to safety or security reasons. 1. I created some of the needed components by heating, sanding, coating or mixing raw materials. 2. I built trial solar cells using combinations of the materials to be tested. Each solar cell required two electrodes and usually an electrolyte. Wires were attached to the electrodes. 3. The components were put in a container and the voltage and current produced were measured with a digital meter while minimal light fell on the assembly. 4. The measurements were taken again as a 100 watt bulb was shone on the cell. 5. I repeated the tests on 116 combinations of materials, each without and with light. 6. I assembled the best performing combination of materials into a cell array and tested it on practical load devices like a motor, light, etc. 7. I recorded the data in graphs and tables and included the information in my Log Book. 8. I drew conclusions and supported them with data.	
Results The best current results were from thick cuprous oxide and galvanized steel in salt water, producing an extra .13 volts and 1.15 milliamps from the light. The best combination for current was Aluminum and thick cuprous oxide in Zinc oxide and water, which gained 7 milliamps, but only .007 volts in light. For my final solar cell, I used thick cuprous oxide and galvanized steel, because it produced a reasonable combination of current and voltage.	
Conclusions/Discussion I found combinations that produced additional electricity when exposed to light, but the output was minimal. I have not created a true solar cell, but a hybrid; part battery, part solar cell. Solar power alone, from the materials I tested, is not enough to power common devices.	
Summary Statement Is it possible to develop a solar cell consisting of inexpensive, easily found and commonly available materials useful in powering radios, cell phones, lights, small motors, and other basic devices?	
Help Received Parents drove me to stores, ordered some materials online, supervised use of blowtorch and took photos of me doing experiments.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Chapin B. Bouffard	Project Number J0705
Project Title Plug into Water: Generating Electricity through Electrokinetics	
Objectives/Goals The hypothesis of this project was if different types of salts were added to water, then there will be an increase in the efficiency of generating electricity using the Kelvin Water Dropper.	
Abstract	
Methods/Materials 500g of magnesium sulfate was added to 12.0L distilled water to make the magnesium solution. Also, 500g of sodium chloride was also added to 12.0L distilled water to make up the sodium solution. When the tests were run, the water tank had to have the same amount of pressure for each trial in order to get efficient results. Three trials were run for each solution with the following results:	
Results Average Number of Discharges in the allotted time Distilled Water: 68.33 Discharges Tap Water: 65.33 Discharges Sodium Chloride: 62.33 Discharges Magnesium Sulfate: 63.00 Discharges	
From these results, sodium chloride or NaCl was the least efficient in generating electricity. Magnesium sulfate or MgSO(4) was next then came tap water. Distilled water was the most efficient in producing electricity the fastest.	
Conclusions/Discussion The hypothesis was not proven by this experiment. The distilled water is pure and has naturally occurring positive hydrogen ions (H ⁺) and negative hydroxide ions (OH ⁻) which allowed the Kelvin Water Dropper to function properly. When dissolved in water, salts spilt and create positive and negative ions, Na ⁺ and Cl ⁻ for sodium chloride and Mg ⁽²⁺⁾ and SO ^{(4)⁽²⁻⁾} for magnesium sulfate. However, rather than increase the number of ions in the water, they may have mixed in with other elements such as the copper in the wire or the metal in the can to form new compounds reducing the number of free ions in the water.	
Summary Statement In this project, an attempt was made to increase the efficiency of the Kelvin Water Dropper by mixing salt solutions to increase the number of free ions available to generate electricity faster.	
Help Received My father taught me how to use the power tools to build the Water Dropper, check over my report, and encourage me when things weren't going well.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Julia N. Cooperman	Project Number J0706
Project Title Propagation Station	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To test and observe the behavior of radio waves (propagation) when passed through wire mesh obstacles of varying weaves and distances from the transmitting station.</p> <p>Methods/Materials 2 Motorola Talkabout walkie-talkies, sheets galvanized steel hardware cloth, a one-tone alarm clock ring (for the transmission), two plastic stools (for transmitting and receiving stations), and a Digital-Display Sound-Level Meter.</p> <p>Results Surprisingly, the 1/2" weave was the optimal obstacle, even though it wasn't the loosest weave. I believe this has to do with the property of the diffraction of radio waves.</p> <p>Conclusions/Discussion The findings in my project could be expanded upon for scouting optimal radio transmission locations, improving the clarity of transmissions, and creating radio-wave impervious materials.</p>	
Summary Statement "Propagation Station" is a project studying the behavior of radio waves and how it can be affected when the radio transmission is sent through hardware cloth mesh of varying weaves and distances from the transmitting station.	
Help Received Mother edited and proofread experimental write-up drafts; Father and younger brother helped perform experiment; Dr. Bob York of UCSB gave advice on the subject matter and answered various questions.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Nicole L. Corlett	Project Number J0707
Project Title Does Temperature Affect the Performance of a Fuel Cell?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this project is to determine if temperature has an affect on the performance of a fuel cell.</p> <p>Methods/Materials Materials: Thames and Kosmos Fuel Cell Car and Experiment Kit; distilled water; Beckett waterfall pump, Model Number G235AG20; digital multi-meter; 1/8 inch polyethylene tubing; digital infrared thermometer; stopwatch; misc. plumbing fittings; adult supervision.</p> <p>Procedure: The first step is to characterize the solar cell to develop a characteristic curve, determine how much power is generated, and determine the efficiency of the solar cell. The second step is to characterize the electrolyzer function of the fuel cell by determining the presence of hydrogen and oxygen, measuring the amount of gas generated, and determining the efficiency of electrolysis. The next step is to characterize the fuel cell by measuring the generated voltage and measuring no-load voltage, operating voltage, and short-circuit current. The last step is to determine the effects of temperature on the performance of the electrolyzer/fuel cell. This is accomplished by regulating the temperature of the supply water to the fuel cell in the electrolyzer function and the temperature of the supply gases in the electricity generation mode. For three temperatures (warm, room temperature and cold), determine the time required to fill the hydrogen and oxygen tanks, the temperature of the fuel cell and supply water/gas, and the elapsed time to run the fuel cell out of fuel.</p> <p>Results As expected, electrolysis was completed in 18 minutes and 9 seconds using warm water for heat transfer, while electrolysis was completed in 20 minutes using room temperature water and 22 minutes using cold water for heat transfer. Generation of electricity from the fuel cell follows closely with the time required to generate and store the hydrogen and oxygen gases, about 18 minutes using warm gases and about 22 minutes using cool gases.</p> <p>Conclusions/Discussion Based on the data, one can state that temperature does affect the performance of a fuel cell. The electrolysis process in a fuel cell is completed faster when the water entering the electrolyzer/fuel cell is warm rather than cold. Similarly, the generation of electricity with a fuel cell takes longer when the gases entering the fuel cell are cold rather than warm.</p>	
Summary Statement My project is to determine the affect that temperature variations have on the performance of a fuel cell.	
Help Received Received advice and suggestions from Mr. John Del Frate of NASA and Mr. Dale Ritter; Adult supervision and financial support fom Father; Mother helped with preparation of the display board.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) David K. Crowther	Project Number J0708
Project Title Avoiding the Subject: AVOIDER Robot's Performance in Mazes and Obstacle Courses	
Abstract Objectives/Goals Determine if a simple walking robot designed to avoid objects, can pass through mazes more quickly than obstacle courses. Methods/Materials Materials include: "Spider 3 Walking AVOIDER Robot Kit" from the Mondo-Tronics Robot (Internet) store, Phillips screwdriver, pliers, plastic screwdriver, razor blade, various obstacles (different sizes, shapes, colors and textures), cardboard, linoleum floor, duct tape, paper, pens (multiple colors), camera, and pillows. We timed the robot through a total of four obstacle courses and three mazes. I traced the path of the robot through each course and maze for each run. Times for successfully completed runs were averaged and compared to each other. Results The average time to complete the obstacle courses was 1 min. 31 sec. The average time to complete the mazes was 6 min. 47 sec. Conclusions/Discussion We proved our hypothesis. On average, the robot went through the obstacle courses faster than the mazes. The major reason for this result is the difference between a maze and an obstacle course. A maze is a twisted path that requires intelligence to get through quickly. An obstacle course is an open path with objects in the way of the robot. This experiment proved that the robot can detect and avoid objects, but the robot cannot "think" it's way through a maze.	
Summary Statement We tested a robot, designed to avoid objects, to see if it could get through mazes or obstacle courses faster.	
Help Received My brother, Jonathan, helped me build the robot, design the mazes and obstacle courses, write some of the run notes and the report. My parents helped type the report and assemble the presentation board. My dad helped assemble the robot, took pictures, and advised on scientific method.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Nitin K. Egbert	Project Number J0709
Project Title The Design and Construction of a Less Expensive Satellite Launcher	
Abstract Objectives/Goals The objective is to see if I can propel a satellite to orbital velocities using magnetic attraction. Methods/Materials The satellite launcher was constructed with a stiff tube mounted to point slightly upwards. Coils were wrapped around the tube at intervals to attract the satellite through the tube. Each coil was connected to a capacitor that is discharged by a SCR (silicon controlled rectifier) at the moment the model satellite nears the coil. This accelerates the satellite through the coil. As the nail passes the center of the coil, the charge in the capacitor dissipates, leaving nothing to hold back the satellite as it continues its journey through the tube. This process is repeated at each coil, increasing the satellite's velocity. Results Magnetic attraction can be used to propel a satellite to orbital velocities. Conclusions/Discussion I have learned many things by building this project. Friction is a major problem in this design. The friction in the tube makes it difficult to accelerate the model satellite beyond a certain point. Also, timing circuits are hard to tune and are unreliable for objects of different masses. The self-timed circuit with a phototransistor is a lot more reliable and can handle objects of different masses.	
Summary Statement My project is about a cheaper and more environmentally friendly way to launch satellites.	
Help Received My father helped me choose parts and drill and saw the spacers and the tube mount.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Kyle R. Felsman	Project Number J0710
Project Title The Effect of Light on a Solar Panel	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I wanted to find out which type of light bulb (150 watt, 75 watt, 60 watt fluorescent, incandescent, and halogen) would make a solar panel produce the most amount of light.</p> <p>Methods/Materials For my project I used 150, 75, and 60 watt fluorescent, incandescent, and halogen light bulbs, a lamp holder, 9 1/2" by 9 1/2" wooden plank, cardboard box, multimeter, alligator clips, resistors, and a solar panel. First, I placed a solar panel inside a cardboard box and sealed the corners of the box so no other light could get in. Then I connect resistors and a multimeter to the solar panel. Finally, I used Ohm's Law to find the amount of power each light bulb produced.</p> <p>Results I found out that the 150 watt incandescent light bulb produced the most amount of power.</p> <p>Conclusions/Discussion I learned that it is not the amount of light a light bulb produces, but the wavelength or spectrum of the light that determines how much power a solar panel produces.</p>	
Summary Statement I wanted to find out what type of light bulb made a solar panel produce the most power.	
Help Received I would like to thank my dad for helping me with the Ohm's Law formulas.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Megan K. Fisher	Project Number J0711
Project Title Is Your Cell Phone Cooking Your Brain?	
Abstract Objectives/Goals To determine the relative radiation power emitted by various types of cell phones at three different distances away from the phone as a potential measure of safety. Methods/Materials After obtaining a radiation power meter that measures cell phones, with the help of my dad, I built a small wooden stand to keep the meter and cell phone stationary at one inch, six inch, and twelve inch distances. I went to two different shopping centers on many different days to test peoples cell phones. At my house, we have two phone lines. My dad unplugged one of them, so no one would answer. For each test I dialed the unanswered line and let it ring with no answer for all three of the tests. I took three readings at every distance for each phone. I then recorded the cell phone type and model next to the recorded data. Results All cell phone types showed a large drop in radiated power as the phone was moved away from the meter (your head!). The older cell phone types showed the largest amount of radiated power during the test. Conclusions/Discussion My conclusion is that keeping the phone farther away from your head reduces the amount of radiation to your head. The use of earpieces or speakerphones can help accomplish this because the phone would be farther away from your head.	
Summary Statement Testing different types of cell phones for radiation power at different distances.	
Help Received Father helped construct a stand to hold a cell phone and radio-frequency meter.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Mariah C. Heller	Project Number J0712
Project Title The Ancient Baghdad Battery	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To get this battery to generate at least 0.87 volts of power</p> <p>Methods/Materials 2 clay jars, paint on asphalt, quik-rete, copper pipe, iron rod, heinz vinegar.</p> <p>Results It worked! But if I add salt to the vinegar, it works better.</p> <p>Conclusions/Discussion If I use a different form of electorlyte, it will be a higher voltage</p>	
Summary Statement A battery made 2,000 years ago that I re-created.	
Help Received Dad helped me buy the materials	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Anand Kesavaraju	Project Number J0713
Project Title Fuel Cells: Which Catalyst to Choose?	
Objectives/Goals My objective for this experiment is to find out the catalyst that will make a fuel cell more efficient.	
Abstract	
Methods/Materials The materials used are: Five Catalyst wires/foil (Pt,Ni,Au,Cu,C), a DC Power Source, a voltmeter, an ammmeter, a jar, 1.25 cup of water with one teaspoon of baking soda, wires with banana clips to connect, a stopwatch, and a 20 Kilo Ohm resistor.	
Procedure: 1. Produce Hydrogen and Oxygen using electrolysis. 2. Disconnect DC power source and record voltage and current of the fuel cell with the 5 different catalysts. 3. Calculate efficiency using Power Density.	
Results The order of efficiency of the catalysts used in this experiment is as follows: Platinum (most efficient), Nickel, Carbon, Gold (least efficient).	
Conclusions/Discussion From the data collected, when a load is applied to the fuel cell, the cell with Platinum-Platinum as electrodes is able to generate the highest power density. A higher Power Density means that the fuel cell can produce more energy with more efficiency. This proves that the hypothesis is correct. While carbon has the highest open circuit voltage, it is not possible to draw much current from it. This means that Carbon is not useful in everyday uses such as powering appliances. This means that the open circuit voltage is not a conclusive measure for efficiency of a fuel cell. The important factor is the power density under load.	
Summary Statement I am trying to find out the most efficient catalyst in a fuel cell.	
Help Received I would like to thank Dr. S.R. Naryanan, the Fuel Cell Technical Team Lead at JPL, for providing the catalysts and fuel cell kit, and overall guidance.	



CALIFORNIA STATE SCIENCE FAIR 2004 PROJECT SUMMARY

Name(s) Albert C. Kim	Project Number J0714
Project Title Sound Detector Radar	
Abstract Objectives/Goals The goal of this project is to find out the location of an object based on the sound it makes. Methods/Materials The theory of this project is to place 5 microphones in two perpendicular rows like a cross to capture the sound signal, measure the sound delays between the microphones, calculate the distance differences, and apply the 3-D Pythagorean Theorem to find the location of the sound source. To hold the microphones in place, I used a piece of wood. With the help of my dad, I was able to cut and drill the wood into the shape I wanted it. Then I inserted all the necessary equipment. However, the magnitude of a captured sound signal is not big enough for my computer to read. So, I created two circuits and inserted them to my wooden board. The first circuit would amplify, or magnify, the sound waves to a readable size. The second circuit would turn the curvy waves, into rectangular waves, which are binary signals, so that my computer can read it. Finally I hooked this all up to my computer and programmed with Visual Basic.net to read the sound waves automatically and calculate it. The materials needed for this project are wood, speakers, a breadboard, resistors, capacitors, comparator chips, OP AMP chips, a Data Acquisition Board, an USBee connector, and microphones. Results I am glad to say that after all my hard effort put into this project, it actually worked a lot of times. Some of the computer-calculated distances were really close to the actual distance, such as 45 inches and 44 inches. It was a bit disappointing to find that some of the calculated distances were incorrect. Conclusions/Discussion Half the time, I was able to get the correct data because the original sound source was not interrupted by other sound waves. However, the other half of the time was not so lucky because I picked up other sound waves and it corrupted the calculations. To overcome this weakness, I could program the computer to recognize only a certain patten of waves. That way, the other sound waves cannot interfere. This project could be use if you wanted to know how far away a moving object is, like a dog, based on the sound it makes. I've found out that this kind of thing is used in the navy. Submarines use detectors to measure the frequency of the ocean waves to see if anything has disturbed it. Also GPS satellites are very similar to the project I've created. Speed guns from the police, also work like my project.	
Summary Statement This project is to find the location of a certain object that makes some sound.	
Help Received Father helped me cut the wood and design electronic circuits.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Brian T. Kim	Project Number J0715
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Project Title
Which Is More Efficient: Fuel Cells or Solar Cells?

Abstract

Objectives/Goals
The objective in this science fair project is to determine which #green# power source is more efficient: fuel cells or solar panels.

Methods/Materials
Materials:
Fuel Cell Experiment Kit (Thames & Kosmos, Solar panel), Hydrogen fuel cell, Resistors (4.7, 10, 20 Ohms, Cables and Connectors, Syringe, Multi-meter (1st), Multi-meter (2nd), Sunlight, Desk lamp with a 60W incandescent light bulb, Distilled water, Stop watch

The solar cell power efficiency was calculated by the maximum power output divided by the light power input. The maximum power output was determined by the voltage-current plot over different resistors. Both the sun and a 60W light bulb were used as the input light source. In both experiments solar cell efficiency was about 15%. Then fuel cell efficiency was obtained by fuel cell electrolysis experiment followed by dissipation experiment. Fuel cell electrolysis generated hydrogen and oxygen by splitting water with electricity to fill up the gas tanks of oxygen and hydrogen. Then fuel cell dissipation experiment determined total energy output. The fuel cell efficiency was about 40%.

Results
The solar cell efficiency is 15.33% under a 60 watt incandescent light bulb, and is 15.13% under the sun. The fuel cell efficiency is 36.32% with dissipation after electrolysis under a 60W light bulb and is 40.04% with dissipation after electrolysis under the sun.

Conclusions/Discussion
The fuel cell was about 2.5 times more efficient than the solar panel.

Discussion:
We are running out of fossil fuels quickly. Green power sources do not use fossil fuels and don't pollute the environment. Green power sources such as solar cells and fuel cells need to be efficient to be practical. Solar cells are already in use as secondary power generators, while fuel cells are about to be used in #non-polluting# cars. There are already places that use either one of these power sources, but they do not produce enough power to provide on a city level basis.

Summary Statement
The project experiments with the efficiencies of two green power sources, the Fuel Cell and Solar Panel

Help Received
My mom helped me with the board, and my dad helped explain the electrical theories.



CALIFORNIA STATE SCIENCE FAIR 2004 PROJECT SUMMARY

Name(s) Zach Mattingly; Carl Satterberg	Project Number J0716
Project Title Saving with Solar	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective is to find out how we can convert a standard 1500 sq.ft. home and a 4500 sq. ft. home to solar power, how much money it would cost, and how much money we would save over a period of 5, 10, and 20 years.</p> <p>Methods/Materials We found two suitable homes for the experiment, and gathered the electricity bills for both. We inspected the houses for the kinds of electric appliances and made a chart of these. We researched information about solar power and how it works. We met with a solar expert to find out how much a power was required for each home, how much the solar systems would cost. We subtracted the the amount of rebate from the California Energy Commission. Then we looked at our PG&E bills to find the cost per watt. With an estimated 3% inflation rate, we found the cost per watt up to 20 years. From the cost per watt, we calculated the amount saved for each of the years. Then we added up the savings for each year to find cumulative totals at 5, 10, and 20 years. We found the year where the savings exceeded the cost of the systems.</p> <p>Results The cost of solar system for the 1500 sq. ft home was \$13,256(after the rebate from CA Energy Commission). Excluding the cost of the system, the actual amount saved by not paying for electric power over 5 years was \$3,4844. Over 10 years, the amount saved was \$7,528, and over 20 years the money saved was a whopping \$17664! The cost of the solar system for the 4500 sq. ft. home was \$18,776(after rebate). Excluding the cost of the system, the actual amount saved in 5 years was \$9,844. \$21,254 was saved over 10 years, and in 20 years, a vast amount of \$49,815 was saved!</p> <p>Conclusions/Discussion We learned that solar power is quite expensive to pay the cost at first. The California Energy Commission cuts the cost in half, which is a BIG help. Over time, the solar system quickly pays for itself. Our inflation rate was a modest 3%, which has already increased to 6%. This would make our savings much greater, much quicker. Also, even if you sold your house, and you don't get the reap the financial benefits over time, the value of your house would be much higher. Solar power is infinite and is definitely the way to go in our sunshine state!</p>	
Summary Statement We learned how solar power works and how much money you can save by converting an existing home to solar power.	
Help Received A neighbor, who owns his own solar power company helped us to learn about solar power and showed us how to figure out the cost and savings. Mother typed this application, copying from the project display already completed by the students.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Aaron J. Mendonsa	Project Number J0717
Project Title A Sonar Device: An Application to Prevent Auto Collisions	
Abstract Objectives/Goals To find out whether a sonar device can be used to avoid auto collisions on busy freeways. Methods/Materials Full 14 Lines in Notebook 1. Follow Circuit Diagram of A Basic Sonar Device 2. Create a common ground of all components (ranging module, transducer, and OoPic microcontroller) 3. Recheck diagram to check if power is connected in all materials 4. Once completed, successfully,connect the interface cable to the laptop 5. Commence readings and data ·600 Series Transducer,·OoPic Microcontroller,· 6500 Series Ranging Module, ·Interface Cable,·LED,·9Vlt Battery,·Bread Board,·4.7K Pull-Up Resistor, ·1K Resistor,·4 AA Batteries,·Data Transfer Cable,·18 in. square base board, ·Electronic circuit wire,Battery carriage,·Laptop Results The results were based on initial starting and critical distance points and the frequency of emittance by the built sonar device. Graphical formats show that a sonar device can be used in the future as a device to help a person know if he is at a dangerous speed or stopping distance. Conclusions/Discussion My hypothesis was correct because I thought that it is possible to use a sonar device to prevent auto-collisions. I learned that sonar can be used for many applications, not only to detect the stopping distances of cars, but can be used as alarms and in the military. If I were to do this experiment again, I would use a more effective sonar device to reach distances greater than 35 feet. Overall, this has been an excellent project that taught me a little about electronic circuitry as well as the wonders of modern science and its positive application in daily lives.	
Summary Statement If a sonar device can be used as an application to prevent car collisions	
Help Received Father with assembly	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Frederick J. Meyer	Project Number J0718
Project Title An Analysis of Active vs. Passive Electronic Filters	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The goal of this science project was to understand the properties of active filters. I studied the basic theory behind operational amplifiers (op amps) and showed how they can be used along with capacitors and resistors to create any kind of filter in the audio frequency range. I designed many working active electronic filters and compared their performance to same-value passive electronic filters and simulated filter designs.</p> <p>Methods/Materials After studying op amp theory, I began by designing simple op amp circuits like integrators and voltage followers to understand the advantages of high input impedance. I also experimented with negative feedback to understand how it can change the shape of filter plots. I designed active filters and tested their properties and compared them to their passive versions. Using Microcap circuit simulation software I compared my actual bode plots with the simulated plots. I designed and built low pass, high pass, band pass and band stop filters. Finally, I tested a very high quality Klipsch passive crossover filter and compared it's bode plot to a Microcap simulation of the circuit and then designed and built an active filter version of this device ending with a 6th order active crossover. My test bench was a PC with a sound card and shareware spectrum analyzer/oscilloscope software, woofer and tweeter speakers, and an audio amplifier.</p> <p>Results Active filters allowed much finer control of the filter shape and Q, did not have losses and were, in some ways, easier to design than passive filters. They were easily modified and had greater linearity.</p> <p>Conclusions/Discussion This experiment showed how active filters can duplicate much of the functionality of passive filters at lower cost, higher performance, greater flexibility and smaller size. The high input impedance and low output impedance made higher order filter designs straightforward.</p>	
Summary Statement The goal of this science project is to understand the properties of active filters and to use the data gathered to design working active electronic filters and compare their performance to passive electronic filters.	
Help Received My Mom did the spray glue for my display board. My Dad drove me around to buy electronic components, and to the UCSC library for research. I designed and drew all my own circuits, built all my filters and did all tests.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Anna K. Nowak	Project Number J0719
Project Title Static Discharge Danger at the Pumps	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This science fair project investigates everyday activities that could create static electricity sufficient to cause a danger at a gas station. If two materials rub together, a static charge can be created and cause a fire or explosion if the right mixture of gas fumes and oxygen are present. Based on the triboelectric series, the following hypothesis was made for the experiment: If analyzing static generating activities at gas stations, then sliding across a polypropylene seat cover while wearing leather would generate the most static electricity, while combing hair with a polypropylene comb would be the next highest static generator.</p> <p>Methods/Materials In defining the experiment, a list was first made of everyday activities that occur at gas stations. Those activities include for example sliding across the car seat, taking a hat off, removing your cell phone or wallet from your pocket, rubbing your cell phone against your hair, removing a sweater. A list of materials that rub together during these activities was generated. After gathering samples of the materials, combinations of materials were rubbed together and an electrostatic voltmeter was used to measure the static voltage that had been generated. The experiment was performed on both a high and low humidity day.</p> <p>Results Standard deviations were consistently on the order of 33% of the average value for all measurements, indicating acceptable experimental variation. The plots of voltage versus material combinations showed good agreement with that predicted using the triboelectric series. An additional experiment was run to investigate one major discrepancy with that predicted. Tests run on a low humidity day showed higher average voltages compared to tests on a high humidity day, as expected. Combinations of materials which generated in excess of the 1000 volts which could cause a static discharge to ignite gas fumes are identified on the plots. Polypropylene and hair created the biggest voltage.</p> <p>Conclusions/Discussion My conclusion is that there are a number of material combinations which can create a danger when rubbed together during normal activities while pumping gas. While signs at gas stations warn people not to use cell phones while pumping gas, there are other common activities besides using a cell phone that are potentially dangerous.</p>	
Summary Statement The purpose of this project is to investigate dangers at gas pumps from static charge build-up that can result from normal things people do.	
Help Received dad helped rub materials, Unisys lent me an electrostatic voltmeter	



CALIFORNIA STATE SCIENCE FAIR 2004 PROJECT SUMMARY

Name(s) Trenton J. Paddock	Project Number J0720
Project Title Wave Energy: Power of Our Future	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My experiment is about whether wave amplitude and frequency affects the amount of electricity that can be produced by a water wave generator. I want to determine if larger wave amplitudes and higher wave frequencies will produce more electricity. After extensively researching my project, I think that more electricity will be produced at higher wave amplitudes and frequencies.</p> <p>Methods/Materials I designed and constructed a water wave maker to generate waves, a wave float attached to a reciprocating pump to capture the energy of the wave and convert it to hydraulic energy, and an impulse turbine to convert the hydraulic energy to electrical energy. I constructed a large, 15 foot water wave tank for my apparatus. With my wave maker, I was able to accurately control wave amplitude and frequency. My wave float was designed to follow the profile of the wave from crest to trough. This allowed my reciprocating pump to be driven up and down with the wave float, as the wave float encountered the waves. My reciprocating pump pumped water through a nozzle, which was aimed at my impulse turbine. The impulse turbine was connected to the generator through reduction gears. When the water sprayed through the nozzle, the impulse turbine spun, creating electrical power.</p> <p>Results After 135 tests with my water wave generator system, I found that the highest wave amplitude combined with the highest frequency produced the most electricity. On average, the highest wave amplitude of 7.62 cm. and the highest wave frequency of 60 WPM produced the highest electrical output of .112 watts. I was very pleased with the accuracy of the output of the wave maker (wave amplitude and frequency.)</p> <p>Conclusions/Discussion My hypothesis was correct. By conducting my experiment, I confirmed that wave amplitude and frequency does affect the amount of electrical energy that can be produced by a water wave generator. I think that my experiment is important for the future, because the world is running out of oil and we need to start finding new energy sources. Scientists in the United States need to explore wave energy as an alternative energy source. The United States has done little research on this energy source, while other European countries are ahead of us and actually have working wave energy power plants.</p>	
Summary Statement My project is about wave energy, and determining whether wave amplitude and frequency affect the amount of electrical energy that can be produced by a water wave generator.	
Help Received Mom helped me put together my board; Dad supervised my use of power tools; neighbor loaned me his air compressor; Mr. David Langston from WaveGen Corporation provided me important information for my project.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Vanessa D. Padron	Project Number J0721
Project Title Does the Amount of Hydrogen Used in a Fuel Cell Affect the Amount of Electricity Produced?	
Abstract Objectives/Goals My objective was to determine if the amount of hydrogen used in a fuel cell affect the amount of electricity produced. Methods/Materials I assembled a Proton Exchange Membrane (PEM) hydrogen fuel cell system which consisted of a fuel cell, PEM electrolyser and a solar panel. The solar panel was connected to the electrolyser in order to produce hydrogen gas. The fuel cell system is then tested for any leakage. The leakage rate is then recorded and used in calculations to detrmine the actual consumption rate. The fuel cell is test using different current levels,the amount hydrogen used was recorded and the time it took to use all the hydrogen was recorded as well. A minimum of 5 test were performed for each current and timed. Results The results showed that the consumption of hydrogen produced through the PEM electrolyser was proportional to time when the current remained constant and the consumption rate of hydrogen was proportional to the current produced for a constant time period. Conclusions/Discussion The results supoported my hypothesis. The amount of hydrogen used did not effect the amount of electricity produced. In fact the hydrogen consumed was proportional to time regardless of the level of current it was being tested. The results of each test were consistant with each other with very minimal variations. As long as hydrogen gas was made available electrical current was produced.	
Summary Statement A proton exchnage membrane (PEM) hydrogen feul cell system was assembled and tested the amount of hydrogen consumption under various current drawn from the fuel cell.	
Help Received Father help with the internet research and my mother helped with some typing.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Evie Pless	Project Number J0722
Project Title Lunar Communication: Determining Laser Power Needed	
Objectives/Goals 1. To build a laser communicator that transmits a sound signal using a laser beam. 2. To test how far the laser communicator can operate. 3. To calculate the laser power needed for this device to communicate to the moon.	
Abstract Methods/Materials First, I developed and built a simple laser communicator. Using research and my dad's advice I adapted the apparatus to use pulse width modulation. Next, I was able to test the apparatus over increasing distances up to a half mile. In order to estimate how far my device could communicate, I created a simulation based on these distance tests. Lastly, I made some reasonable assumptions, researched a few aspects of lunar communication, and calculated the laser power that would be needed to reach the moon.	
Results I was able to build a laser communicator that operated by means of pulse width modulation. According to my testing and simulation the device can transmit audio signals at least one mile. Calculations show that the laser would have to be 10,000 times more powerful for my current device to communicate to the moon.	
Conclusions/Discussion Communication by means of pulse width modulation in lasers is very reasonable. Even with my lower quality equipment I would only need a 30 watt laser to communicate to the moon. Although radio is the established means of communication in space, laser communication could be used effectively.	
Summary Statement I developed and built a laser communicator, experimented with how far it worked, and calculated the laser power needed for lunar communication.	
Help Received My dad taught me about circuits and engineering. He also talked to me about my project and offered advice. Both of my parents helped edit my written work.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) David M. Sicktich	Project Number J0723
Project Title Factors that Affect a Magnetic Linear Accelerator Projectile Distance	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To determine the affect that magnet spacing, ball bearing mass and number of magnets has on the distance a home made linear accelerator can project a steel ball bearing. Which combination can launch the ball bearing the farthest?</p> <p>Methods/Materials To make the linear accelerator I used high powered neodymium-iron-born magnets, a length of three sided aluminum channel, steel ball bearings, duct tape and a wooden base. To determine the affect of magnet spacing I launched the ball bearing horizontally from a fixed height of 75 cm and measured the distance. I tested the spacing of the four magnets, at 5, 6, 7 and 8 cm. Using the best magnet spacing I tested the affect of mass using steel ball bearings weighing 16.5 and 3.6 grams. I then added more magnets to the linear accelerator. I tested how far the linear accelerator launched the larger ball bearing using four, five, six, seven and eight magnets. Finally, with the six magnet linear accelerator, I used a ballistic pendulum to determine the speed of the projectile.</p> <p>Results In my first experiment the five centimeter magnet spacing didn#t work because the magnets pulled the ball bearings apart. The six cm magnet spacing projected the ball bearing an average of 144 cm. The seven cm magnet spacing projected the ball bearing an average of 80 cm and eight cm spacing projected it an average of 84.5 cm. On my second test the 3.6 gram ball bearing went 209 cm and the 16.5 gram one went an average of 144 cm. On my third experiment, with five magnets the average distance was 180 cm, with six the average was 191 cm, seven averaged 199 cm and eight magnets averaged 203 cm. Nine magnets gave the lowest distances averaging 126 cm.</p> <p>Conclusions/Discussion On my first two experiments my hypothesis was correct, the six cm magnet spacing was best and the smaller ball bearing went farther. My last experiment showed that increasing the number of magnets increased the distance. Adding more than eight magnets gave lower distances. I think this is because the tape couldn#t hold the last magnets in place due to too much power.</p>	
Summary Statement To determine the affect that magnet spacing, ball bearing mass and number of magnets has on the distance a home made linear accelerator can project a steel ball bearing.	
Help Received My Uncle and Dad helped me build the ballistic pendulum.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Ravi K. Solanki	Project Number J0724
Project Title Danger: High Voltage Shocking Solutions	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals I tried to figure out which electrolytic solution would produce the longest sparks when used in a bottle capacitor for a Tesla coil. I hypothesized baking soda would work the best.</p> <p>Methods/Materials A tesla coil, 12 glass-12 oz bottles with plastic caps, 12-1/4" by 7-8" carriage bolts with 2 matching nuts and washers each, aluminum pan and aluminum foil, adjustable grounded rod, ring terminals, 10 AWG insulated wire, 144oz. of baking soda water, salt water, and Gatorade. methods: First construct a tesla coil that employs bottle type capacitors. Use the required amount of capacitors to match the capacitance needs of your coil, in this case, 12. Then, fill the bottle capacitors the first test subject, salt water, and a 1/2" layer of motor oil to prevent corona leakage. Utilize the carriage bolts and nuts and drill them through the plastic caps, and use the nuts to secure the bolts in place. Using ring terminals, connect the capacitors in parallel. Envelop the liquid filled bottles in foil and place atop an aluminum pan. After this, check all wiring and arrange grounded rod a few inches away from the top load of the coil. Situate far away and power up the tesla coil, wearing safety goggles, rubber gloves, and rubber soled shoes. Tune the primary tap to obtain greatest spark length. Then, while the coil is on, gradually and carefully move the rod away from the top load. As soon as the spark no longer arcs to the rod, stop moving the rod, turn off the coil, discharge all components, and measure and record where the coil stopped arcing to the rod.</p> <p>Results The average results for each independent variable are as follows. Using salt water in the capacitors, the coils average spark was 5.91 inches, using baking soda, 5.65 inches, and using Gatorade, the spark was 4.15 inches. Thus I found out what solution would produce the longest arcs.</p> <p>Conclusions/Discussion The results showed salt water produced the longest arcs, and the hypothesis was that baking soda would produce the longest sparks, therefore, the hypothesis was not supported. Since salt water particles are fairly large, it was easier for the electricity to pass between the ions and making a higher energy build up inside the capacitors. Thus proving it more conductive in this use. In addition, the longer the spark length, the larger the electro-magnetic field in which energy is capable of being wirelessly transmitted, leading to wireless energy transmission everywhere.</p>	
Summary Statement I made a tesla coil, and tested which electrolytic solution would produce the longest sparks when used in a bottle type capacitor for a tesla coil, I found that salt water made the longest sparks and largest wireless energy field.	
Help Received Mother helped put together board; Father helped make tesla coil base; Ed Sonderman helped troubleshoot coil problems.	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Gary K. Suvagian	Project Number J0725
Project Title Kirlian Photography	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Do extreme temperatures applied to a plant leaf affect the Kirlian photo of that plant leaf?</p> <p>Methods/Materials Five manzanita leaves, each 3 to 4 inches long were gathered. The first leaf was placed in the oven for 5 minutes, the second leaf was placed in the oven for 10 minutes, the third leaf was placed in the freezer for 5 minutes, the fourth leaf was placed in the freezer for 10 minutes and the fifth leaf was left in a room of average temperature. Each leaf's ohms were measured and their Kirlian photo was taken.</p> <p>Results On average, the leaf that was in the oven for 5 minutes had a corona of .17cm, while the leaf that was in the oven for 10 minutes had no corona. On average, the leaf that was in the freezer for 5 minutes had a corona of .25cm, while the leaf that was in the freezer for 10 minutes had a corona of .26cm. On average the control leaf had a corona of .24cm.</p> <p>Conclusions/Discussion My results support my hypothesis that extreme temperatures applied to a leaf do affect the Kirlian photo of that leaf. My results taught me that the Kirlian device can show if an organism has been exposed to extreme temperatures.</p>	
Summary Statement How exposing plant leaves to extreme temperatures will affect the Kirlian photo's of the leaves.	
Help Received Mother helped in dark room; Step-father helped build the Kirlian device; Science teacher helped review project	



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Micah J. Wylde	Project Number J0726
Project Title Discourse on Asymmetrical Capacitors	
Abstract Objectives/Goals The goal of my project was to test three different shapes (square, isosceles triangle, equilateral triangle) of asymmetrical capacitors to see which produces the most thrust when 30kv of electricity are run through it. Methods/Materials Materials: 1. 30kv DC power supply; 2. 8 1 ½ v D batteries; 3. 2 casings that connect 4 D batteries each and make one 6v battery; 4. Balsa wood; 5. Aluminum foil; 6. 30 gauge enameled copper magnet wire; 7. 40 gauge copper wire; 8. 16 gauge copper wire; 9. Scissors; 10. Super glue; 11. Hobby knife; 12. Meter stick; 13. Triple beam balance; 14. Parchment paper; 15. String. Procedure: 1. I built the three shapes of Lifters; 2. I weighed all three of the Lifters; 3. I added tape to the isosceles triangle and the equilateral triangles to make them the same weight as the square (3.5g); 4. I hung the Lifters on a string from the ceiling like a pendulum. I ran 30kv at 1ma through them and measured how far off center they moved; 5. I correlated and interpreted my data. Results The equilateral triangle and the square performed very similarly, with only 1.3cm difference in the averages. However, the isosceles triangle performed did not do nearly as well as the others. Conclusions/Discussion The difference in average height between the equilateral triangle and the square are negligible. However, the isosceles triangle did not perform very well; showing me that either even angles or sides boosts the performance of the craft.	
Summary Statement My experiment was to test three different shapes of asymmetrical capacitors to see which produced the most force.	
Help Received My mother held a ruler up to measure the distance traveled.	