CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Sarah J. Adams

Project Number
J0701

Project Title
An Eye on Lithium Batteries

Abstract

Objectives/Goals
My objective was to learn about the underlying chemistries of the lithium ion and lead acid batteries in order to better understand why their discharge capacities were affected by different temperature extremes. I wanted to determine which chemistry would work best at very low temperatures. I hypothesized that the batteries would lose a large portion of their energy capacities due to the fact that most chemical reactions slow with a temperature drop.

Methods/Materials
The primary materials used were two identical lead acid batteries, A and B, that were both discharged at the same rate at 68 deg. F. Then, after being simultaneously charged up again, they were both submerged in 35 deg. F ice water for 30 minutes. The lead acid batteries were then separately discharged at 35 deg. F, and their voltages were recorded every minute. For the lithium ion batteries, I contacted a battery testing lab in Philadelphia where they were able to follow my instructions to duplicate my lead acid testing. They discharged three lithium ion cells at: 0 deg. C, 20 deg. C, and 40 deg. C and measured their voltage over time.

Results
The results of my testing proved my hypothesis correct. Both the lithium ion and lead acid batteries showed a decrease in their energy capacities as they were discharged in the colder temperatures. However, what was rather surprising was that the lead acid battery, as a percentage of its overall capacity, showed less of a drop than that of the lithium ion. The lithium ion battery is a very useful, high energy capacity battery that ran longer than the lead acid battery. But when the lithium battery was subjected to extreme cold, essentially, it failed to function as a battery whereas the lead acid showed a nominal drop in its energy capacity.

Conclusions/Discussion
In conclusion, though a lithium ion battery is a very light weight, high energy density battery that is commonly used, in a cold temperature, its energy capacity droped severely. However, the lead acid battery, a heavy and toxic battery with a low energy density, proved more efficient during cold temperatures. This project shows great social implications because primarily, most everything we depend upon today is battery powered. With the knowledge of what might affect the performance of a battery, such as temperature, certain precautions may be taken by battery companies in order to enhance their products.

Summary Statement
My project explores the effect of varying temperature extremes on the relative energy capacities of lithium ion and lead acid batteries as measured by their voltage drop over time when subjected to a constant, resistive load.

Help Received
Father helped build display and gather research; the services of a lithium ion battery testing lab were utilized in order to perform specific testing under my direction

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Michael S. Bertch

Project Number
J0702

Project Title
Are Voltage and Current Directly Related to the Force Generated by an Electromagnet?

Abstract

Objectives/Goals
The purpose of this experiment is to determine the relationship of varying voltage and magnetic force generation in an AC electromagnet. My interest in electricity prompted me to examine the variable of changing the voltage and measuring the actual force produced by an electromagnet.

Methods/Materials
I decided to measure the force generated by an electromagnet as voltage is gradually increased starting from zero volts. I used a 120-volt AC relay as my test platform. The relay has a built-in electromagnet, which actuates its function. It made sense to use an electromagnet that was already wound with wire rather then starting from scratch. There were several reasons for this including safety.

I had to employ a load cell with a display in grams to record the force generated. I included a voltmeter to measure voltage and an amp meter to measure AC current. The relay was connected to the load cell assembly by a spring.

It made sense to start off at zero volts to measure and record force findings and voltage measurements to make it easy to chart this information on a graph. My voltage source was the use of a variac (variable AC Voltage transformer).

The display and the load cell have their own voltage source to operate. The load cell was pre-calibrated to accurately measure the force in grams. At the beginning of each trial I reset the #zero# on the force display.

Results
I did 6 trials consisting of 14 voltage and force readings. I would increase the voltage until an increase of force was noted. I continued to increase voltage on each trial noting a force change until I had 14 readings per trial. In some trials I had 14 readings before reaching my maximum voltage. I found an increase of voltage was closely proportional to the force generated as shown in my graphs.

Conclusions/Discussion
Based on the data from each graph and the composite average graph my hypothesis proved correct. I found a direct relationship between voltage applied and force generated in an electromagnet. Ohm#s Law states that voltage equals resistance multiplied by current with both alternating and direct current circuits. Because the resistance in the circuit was more or less stable the voltage applied also raised the current proportionally. The electromagnetic field was increased in proportion to power applied. As the electromagnetic field increased the force generated on the tension gauge increased proportionally.

Summary Statement
Demonstrating that Electromagnetic force is directly proportional to the volage and current applied.

Help Received
My father helped me with the load cell sensor and the safety involved with household voltage.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Alexander L. Bishop

Project Number
J0703

Project Title
The Effect of Temperature on Battery Life

Abstract

Objectives/Goals
My project was to determine at what temperature Alkaline and Lithium batteries last the longest and provide the highest voltage output. I predicted that batteries running in high temperatures will perform the best because the heat will charge the electrons.

Methods/Materials
I placed two new AA Energizer lithium and two new AA Duracell alkaline batteries in a AA battery holder. I then connected two sets of wires from the battery holder to two sets of two load resisters. The first test was performed at room temperature or 65 degrees Fahrenheit. I had the batteries run off the load resisters for three hours. I connected a volt meter to each set of resisters every ten minutes during the three hours and recorded the data. I repeated the test putting the battery holder in the freezer at 5 degrees Fahrenheit and again in the toaster oven at 120 degrees Fahrenheit

Results
The voltage output for both the lithium and alkaline batteries was the lowest for the batteries running in the coldest temperature tested. As the temperature became warmer the batteries provided greater voltage output and lasted longer. They performed the best at the 120 degree Fahrenheit temperature. The lithium batteries lasted a lot longer than alkaline. The alkaline reached their cut off point prior to the end of the three hour time period while the lithium did not.

Conclusions/Discussion
My results confirm my hypothesis that batteries will provide a higher voltage output as the temperature rises. The alkaline batteries lasted longer as well. The lithium batteries did not reach their voltage cut off point before the three hour time frame so I could not make a conclusion about how long they lasted.

Summary Statement
This project was to determine the effect of various temperatures on the voltage output and life of lithium and alkaline batteries and it was determined that batteries work better as the temperature rises.

Help Received
My father taught me how to use a soldering iron to attach the wires and helped me purchase the proper materials. My mother helped me to insert the digital pictures into my report.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Ryan T. Bridge

Project Number
J0705

Project Title
Sending an Electrical Signal Over a Telegraph

Abstract

Objectives/Goals
My objective was to see if I could use one "D" battery and send a clear signal over 25 feet. I beleive I can send a signal over 25 feet.

Methods/Materials
A simple telegraph made of an electromagnet, a key, a sounder, wire, and batteries. I used from one to four "D" batteries and tested them over a 1 to 135 foot wire.

Results
The 4 "D" batteries could send a good strong signal 125 feet while the 1 "D" battery went only 2 feet.

Conclusions/Discussion
My conclusion is that the longer the leanth of wire the more power (bateries) that is needed to send a good electracal signal over a telegraph.

Summary Statement
How far you can send a good clear signal over a telegraph with one "D" size batery.

Help Received
Dad helped build telegraph and type my report.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Alex Brouillette

Project Number
J0706

Project Title
Electric Motors and How They Work

Abstract

Objectives/Goals
The objective of this experiment was to build an electric motor and to change different parts of the motor to see how it effects motor speed.

Methods/Materials
Electric motors are made of a power source, an armature, a magnet and a switch. In my project, I experimented with different armatures and power sources to see how this could effect the motor's speed. The motors were constructed using a C-battery, two paperclips, a rubber band, a ceramic magnet, insulated magnet wire and Lego#s.
Two electric motors were built to test different armature windings and shapes. I built one armature with 7 windings (loops) and one with 15 windings.
Each armature was then placed in the motor and the speed of the motor was observed and recorded.
Two D-cell batteries were then connected to the paper clips and motor speed was compared to a single C battery.

Results
The motor speed was fastest when one of three things happened:
1. The armature had more windings
2. The armature was near the center of the ceramic magnet
3. The armature was round vs. square

More windings (loops) made a bigger magnet and bigger magnetic field.
The round armature makes a stronger magnetic field than a square shape making more magnetic force.
Increasing battery power did not seem to increase the motor's speed.

Conclusions/Discussion
The experimental results supported my first hypothesis that more windings (loops) on the armature would increase motor speed. The second hypothesis that a square shaped armature would run faster than a round shape was not supported. Round shapes may make stronger magnetic fields and more powerful motors.
The third hypothesis that increasing power from one to two batteries would increase motor speed was not supported.
Electric motors are used by almost everyone on a daily basis but few people understand how they really work. This experiment demonstrated the concept of how an electric motor operates by converting electrical energy into mechanical energy through the use of electromagnetic force. This experiment helped me understand these important relationships.

Summary Statement
This project was to build electric motors and experiment with different designs to see which runs the fastest.

Help Received
My Grandfather helped type my report.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Alexander T. Case

Project Number
J0707

Project Title
Touched by an Angle: Which Angle of a Windmill Blade Will Produce the Most Energy?

Abstract

Objectives/Goals
The purpose of this experiment was to discover which angle of the blades of a windmill would make the windmill spin faster and produce more energy. My hypothesis stated that the blades at a 15 degree angle would spin faster and produce more energy than blades at other angles.

Methods/Materials
The first order of business in this project was to build the windmill and four sets of blades at angles of 15, 30, 45 and 60 degrees. After the structure was built, it was testing time. To do this, a vacuum put into reverse was placed two feet in front of the windmill. The vacuum was turned on for ten seconds, the blades started to turn, and the volts were measured on a multi-meter attached to the windmill. This was repeated for each set of blades. I tested each blade twice to get a more accurate result.

Results
When the test runs were complete, the hypothesis was correct. The blades at a 15 degree angle spun faster and produced more energy than blades at 30, 45 and 60 degree angles.

Conclusions/Discussion
My conclusion is that in order to create more energy when using windmills, the blades should be placed at 15 degree angles. This gives the air coming at the windmill a bigger target to hit, thereby making the blades spin faster and producing more energy.

Summary Statement
In this project, I measured the energy output of a windmill with blades at 15, 30, 45 and 60 degree angles to determine which angle produced the most energy.

Help Received
Father helped with building the windmill structure and blades; Mother helped with the tri-board and editing the written report; and my Aunt helped with the computer-generated chart.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
David K. Crowther

Project Number
J0708

Project Title
What's the Big Attraction? How to Make an Electromagnet More Powerful

Abstract

Objectives/Goals
Determine the characteristics of an electromagnet that produce maximum holding force. I varied core length, core diameter, wire size, number of turns and power applied.

Methods/Materials
Materials: Threaded rods, steel washers and nuts, angle iron, magnet wire, hack saw, grinder, screws, wood, (2 x 4 and 2 x 6), drill, miter saw, epoxy, 2-DC power supplies, Volt/Ohm/Ammeter, bathroom and food scales, and steel tools.
I made magnets with a variety of configurations and tested them using multiple power settings.

Results
My measurements for the performance of the six magnets, using seven power settings from two power supplies, gave a range of holding forces for each magnet. Magnet #1 held 0.454 kg-1.36 kg. Magnet #2 held 0.227 kg-0.454 kg. Magnet #3 held 1.81 kg-3.18 kg. Magnet #4 held 3.63 kg-13.6 kg. Magnet #5 held 0.085 kg-2.27 kg. Magnet #6 held 0.454 kg-5.44 kg.
Measurements of voltage and amperage across the magnets again provided a range of values across all power settings. Using these values to calculate the power applied to all six magnets showed that there was a broad range for power (Watts) applied to the magnets (0.16 Watts to 41.0 Watts). Efficiency of the magnets (kg holding force per Watt) showed magnet #4 had very high efficiency at lower power settings and magnet #2 had very low efficiency at all power settings.

Conclusions/Discussion
After building and testing six electromagnets, magnet #4 proved to be the strongest electromagnet at all power levels. This electromagnet has the largest (2.54 cm) core diameter, larger wire gauge (22 AWG), a short coil length (2.54 cm), and moderate wire length (75.6 m). Magnet #2 was the weakest.
Performance of magnet #6 proved that a major limitation to holding force in electromagnets is the resistance of the wire in the coil. Higher resistance reduces the amount of power that can move through the coil to produce a magnetic field.

Summary Statement
I designed and tested electromagnets to determine the characteristics that produce the most holding force.

Help Received
My Dad assisted me with buying materials and designing magnets. He also provided extra hands, training, and safety tips for the tools I used.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Andrew L. DeCuir

Project Number
J0709

Project Title
Circuitry

Abstract

Objectives/Goals
I will investigate how connecting devices (3 light bulbs) in parallel affect the electric current in a circuit.

Methods/Materials
Method: 1) Attach voltage meter to a board and use this as a brightness tester. 2) Make a parallel curcuit by connecting two flashlight bulbs to a 1.5 V battery and measure the voltage with the meter. 3) Continue to add more bulbs (resistance) to the curcuit and compare any change in voltage. Record observations.4) Disconnect one bulb in the parallel circuit and measure any change in voltage.
Materials: One piece of 6" by 12" wood board. Light bulbs(1.5 V) (4). Battery (1.5 V) (1). Voltage Meter. Pieces of insulated wire, each about 10 cm long (8). Battery holder. Minibulb sockets (4).

Results
As I added more light bulbs (resistance) to the circuit, the voltage on the meter became weaker. I also obvserved that the brightness of the bulbs got dimmer. When I disconnected one bulb from the circuit, the rest of the bulbs stayed lit and got brighter.

Conclusions/Discussion
When the resistance in a parallel circuit increases, the current decreases. When one bulb is disconnected, the circuit continues to work. Parallel circuits are used in homes and schools so that if one part of the building looses electricity the rest of the building will still have eletricity.

Summary Statement
The current in a parallel circuit changes when more than one light bulb is connected to it.

Help Received
My mom helped me type this report. She also helped me buy the materials. My Dad helped me wire the board and my Science teacher, Ms. Coward gave me advice to improve my results.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Alden D. Deran

Project Number
J0710

Project Title
How Can I Build a Nitrogen Laser and Prove that It Can Lase?

Abstract

Objectives/Goals
The purpose of this project was to construct a Nitrogen laser, determine which types and arrangements of components work best, and prove that it can lase. There are two types of Nitrogen lasers: the TEA, which operates at atmospheric pressures, and the low-pressure, which operates at lower than atmospheric pressures. I hypothesized that the TEA laser would work better with stiff aluminum plates as capacitors, rounded edged electrodes, and about 7000 Volts of power. I expected it to be more difficult to achieve lasing with the TEA laser.

Methods/Materials
I first built the TEA laser with materials I had on hand and tested it with only 3,000 Volts. I observed the arcing at the spark gap and between the two electrodes in the laser channel, modified components to improve the arcing #- I wanted to see as much arcing between the electrodes as possible -- and retested until I saw evidence of lasing. Then I attempted to prove lasing by photographing the dot, attempting to diffract the dot through a grating, and watching what happened to the dot when I moved the paper further away.

After many tests and modifications to components, the TEA laser finally worked. I used most of the components from the successful TEA laser in the first test of the low-pressure laser, but I used a sealed electrode channel in place of the TEA electrodes and connected the channel to an old refrigerator compressor. The low-pressure laser worked during the first test.

Results
The TEA required sharp electrodes, a transformer that produced 7000 volts, and large aluminum foil capacitors. The beam from the low-pressure laser was smaller and brighter than the beam from the TEA laser. There was more arcing all along the sealed electrode channel.

Conclusions/Discussion
The results disproved my hypothesis that the best TEA electrodes would have rounded edges and that the best capacitors would be stiff aluminum plates. Aluminum foil made a better capacitor, because static electricity caused the top plate to stick to the bottom plate without leaving air pockets. I think that the rounded electrodes did not work because the arcing could happen anywhere along the height of the electrode edges. Since there was less gas in the low-pressure tube, the arcing was able to excite a higher percentage of it.

Summary Statement
The purpose of this project was to construct a Nitrogen laser, determine which types and arrangements of components work best, and prove that it can lase.

Help Received
My Mom helped with the tables of my report and reviewed my written work. My Dad supplied the variac, taught me techniques for building some of the components, and supervised the operation of the laser.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Cory R. Emmett

Project Number
J0711

Project Title
The Effect of CD Drive Speed on Data Access Speed

Abstract

Objectives/Goals
To see if the speed of a CD drive effects the data access speed off of that CD drive.

Methods/Materials
Methods:
1.Put fastest CD drive into computer.
2.Put in the music CD
3.Open up iTunes.
4.Time how long it takes the CD drive to write the iTunes track to the hard drive.
5.Time the loading screen on game #1.
6.Repeat step #5 with game #2.
7.Time the installation of game #3 (it shouldn't have already been installed).
8. Uninstall game #3.
9.Repeat steps 2-8 with the other two CD drives.

Materials:
Workiing computer
Three game CDs
One music CD
Three different CD drives

Results
In my results, I concluded that the 52x drive was the fastest with 18 seconds for the song, five seconds for the first loading screen, nine seconds for the second loading screen,and nine seconds to install the game. The 32x drive was second and had 26 seconds for the song, nine seconds for the first loading screen, 25 seconds for the second loading screen, and one minute, 26 seconds to install the game. The 12x drive took last at a surprising 14 minute and 37 second time for uploading the song. It then took 18 seconds for the first loading screen, and 43 seconds for the second one. For some reason, it took less time than the 36x drive to install the game, coming in at one minute, 21 seconds.

Conclusions/Discussion
Overall, I learned that the speed of a CD drive really does effect the speed of the data access off of that CD in that CD drive. So, if yo uspend money on a really cheap CD drive, you will not get the performance of a more expensive drive.

Summary Statement
My project was designed to see if the speed of a CD drive effects the speed of which data is pulled off of that CD in that CD drive.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Danielle E. Frasier

Project Number
J0712

Project Title
More Efficient Solar Energy

Abstract

Objectives/Goals
I moved into a house with a solar heated pool. The solar technology seemed outdated. I wondered if the technology could be improved by adding electrical energy in combination with the sun's energy. The purpose of this project was to evaluate how much more efficiently water could be heated by adding electrical energy generated by solar radiation (photovoltaic cells) to a homemade solar water heater. A secondary project was to see if there was a difference in efficiency of heating the water between the months of August to January.

Methods/Materials
A homemade solar water heater was constructed. The device was placed in the sun around noon and temperature measurements were taken with a digital thermometer every five minutes for an hour and fifteen minutes. This experiment was repeated eleven times. A 12V battery was charged with a 15watt solar panel for eight hours. The experiment was then repeated using electricity from the battery to light three 12V lightbulbs to generate heat inside the water heater. This second experiment was also repeated eleven times.

Results
The combination of solar energy and solar electrical thermal energy heated the water more rapidly and to a higher temperature than the solar energy alone. In each month from August until January, the combination energy source heated the water more efficiently. The water temperature for the combination energy source was 14.5 degrees C to 17.7 degrees C higher than the solar heater alone.

Conclusions/Discussion
On overcast or rainy days, the combination of solar electrical thermal energy could be used to heat the water to a greater degree than the sun alone. The addition of electrical thermal generated from solar cells in combination with the solar water heater was a far more efficient way to heat water. There was not a significant difference in efficiency for each month.

Summary Statement
This project evaluated how much more efficiently water could be heated by adding electrical energy generated by solar radiation to a homemade solar water heater.

Help Received
Mother helped with board; Dad supervised experiment.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Everett O. Frost

Project Number
J0713

Project Title
Gone with the Wind: The Days of Oil Dependency

Abstract

Objectives/Goals
Developed alternative energy sources such as wind power would free this country from its dependence on foreign oil.
This project is a study of extracting electrical power out of the wind using a wind turbine with three rotor configurations, three angles of incidence into the wind under two different wind speed conditions.
The objective is to compare the power generated from various rotor configurations and each rotor configuration with its theoretical maximum power output calculated using Betz#Law.

Methods/Materials
In order to test these different rotor configurations, I built a wind turbine and a wind tunnel. I built the wind tunnel using a house fan I found in my garage. I built the turbine out of foam core, a brass rod, a gear, and an electric motor. I tested each configuration multiple times and I averaged the results from the experiments to make comparisons of performance and efficiency. Efficiency came from comparing the actual power output with the maximum theoretical output as calculated using Betz# Law.

Results
My hypothesis was proved incorrect as the most effective wind turbine blade configuration was the rotor with four rectangular blades set to a 19.6 degree angle. That configuration also proved to have the highest percentage of output compared to the theoretical maximum output. The four-bladed rotor also proved to be the most effective in the low wind speed setting.
The two-bladed rectangular rotor performed almost as well as the four-bladed rotor in the high wind condition, but did not turn at all in the low wind condition. The four-bladed rotor efficiency decreased approximately 26% with the increase in the wind tunnel speed.

Conclusions/Discussion
In both the high wind and low wind condition the four-bladed rotor was the most efficient and extracted the most power compared to the theoretical maximum. From the low wind condition to the high wind condition, the efficiency of all configurations dropped off dramatically.

Summary Statement
My project is about extracting electrical power out of the wind using different rotor configurations.

Help Received
My science teacher, Ms. Margulis, helped me to fix problems in my report and helped me design my project.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Kia R.R. Hayes

Project Number
J0715

Project Title
What Barrier Materials Reduce Wireless Computer Signal Range? Why Does WiFi Not Fly Further?

Abstract

Objectives/Goals
My objective was to learn how the range of a WiFi wireless computer signal is reduced by passing through different barrier materials. My research led me to believe that metal materials would completely block the signal while other materials would reduce its range.

Methods/Materials
A WiFi wireless computer base station was surrounded by different materials including redwood blocks, aluminum foil, a metal pan, two types of wire mesh, two types of #Faraday# cages, cinder blocks, and bricks. A laptop computer was moved away from the base station until the computer lost the wireless signal. The distance from the base station that the signal reached was measured for each of the materials.

Results
Redwood blocks greatly reduced the range of the wireless signal. The metal and other materials did not have as much influence on the signal range as I expected.

Conclusions/Discussion
My conclusion is that redwood blocks significantly reduce the range of a WiFi wireless signal. My other conclusion is that there is some unexplained reason why the metal pan, aluminum foil, wire mesh, and Faraday cages did not greatly reduce the range of the wireless signal. I want to find out why. Understanding how different materials block wireless signals will help people set up their wireless computer networks more effectively.

Summary Statement
My experiment tested how the range of a WiFi wireless computer signal was reduced by passing through different materials.

Help Received
My Dad helped me wire the grounding circuit for the Faraday cages. I borrowed a laptop computer from my school.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Vicki Hsieh

Project Number
J0716

Project Title
More Rotors, More Motors, More Power?

Abstract

Objectives/Goals
Though it would be satisfying to have a wind turbine utilize all of the energy in the wind surrounding it, it is not possible. But by changing the design of the wind turbine so that it could generate more electricity seemed possible. With that thought in mind, I created the objectives for my project. The objectives of my project were to construct a windmill with two sets of rotors and motors and prove that it could generate more electricity than a windmill with only one set of rotor and motor.

Methods/Materials
The materials for the construction of the windmill were mainly PVC pipes, two small DC motors, wooden dowels, wooden hubs with adapters, and balsa wood. The windmill (with either one set or two sets of rotor and motor) was blown at from a fan one meter away. The amount of electricity generated by the DC generators was measured in mVolts and mAmps with a digital multimeter. Each variable was tested 25 times. The measurements in mVolts and mAmps were used to calculate the measurement in mWatts by using the following formula: Electrical Force (mVolts) x Electrical Current (mAmps) = Electrical Power (mWatts).

Results
The construction of a windmill with two sets of rotors and motors was possible. Overall results show that the windmill with two sets of rotors and motors generated 66.6% more electricity than the windmill with one set of rotor and motor.

Conclusions/Discussion
My results suggest that the overall efficiency of windmills could be increased through the addition of a second rotor and motor. If these windmills were installed, the extra energy produced by these windmills could substitute for the power generated by the coal and nuclear power plants. This would, as a result, lower the amount of greenhouse gasses emitted into the air and better the atmosphere and environment.

Summary Statement
The purpose of my project is to enhance the power-generating capabilities of a windmill by adding a second set of rotor and motor and compare its output to the output of a windmill with one set of rotor and motor.

Help Received
My parents helped me when I needed a third hand in building the windmill. My teacher helped find typing errors.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Erik S. Hwang

Project Number
J0717

Project Title
Does the Sun's Angle Have Any Effect on the Efficiency of Solar Panels?

Abstract

Objectives/Goals
The objective of this experiment is to see if whether or not the angle at which sunlight hits a solar panel has any effect on how much current is produced.

Methods/Materials
This experiment required a solar panel, a protractor, and a multimeter. Using the protractor to measure, the solar panel was pointed at various angles at the sun, and the current was determined using the multimeter. Starting at the 0 degree mark, the solar panel was slowly rotated until it reached the 180 degree mark. The current, in amps, was then recorded at each point the solar panel moved 15 degrees.

Results
In the end, it was found that the angle at which light hit a solar panel did indeed affect how much current was produced. The current was greatest when the panel was at a 90 degree angle, and lowest when it was at the 0 degree and 180 degree angles. Starting at 0 degrees, the current would gradually increase as the solar panel was turned towards the sun. Upon reaching 90 degrees, the current was its greatest and it gradually decreased as the solar panel approached 180 degrees.

Conclusions/Discussion
Based on my results, I found that my conclusion agreed with my hypothesis. The panel generated the greatest amount of current when it was at 90 degrees to the sun. The information gathered in this experiment shows that to increase the efficiency of solar panels, they must be placed in specific locations or positions in relationship to the sun.

Summary Statement
The effect of the sun's angle on solar panel efficiency.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Rui Jin

Project Number
J0718

Project Title
How Can Magnetic Fields Spin a Rotor?

Abstract

Objectives/Goals
Design and build a spinning device completely composed of common materials to study how magnetic fields drive a rotor to follow the rotation of a controller.

Methods/Materials
The spinning device consists of two portions, a rotor and a controller. Both portions are built with common materials such as screws, wires, boards, etc. The rotor portion is composed of four electromagnets and a rotor that is a magnet. The controller sequentially alternates the current direction of the electromagnets to change magnetic field polarities (N and S poles). The correct electromagnet polarity is ensured by using the Right-Hand Rule. Each time the controller is manually turned 90 degrees, electricity is supplied to one pair of electromagnets that generates magnetic fields to align the rotor with this pair of electromagnets. Therefore, the rotor can imitate the rotation of the controller in a stepper motion. Different electromagnets and resistors are experimented with to improve the performance of the device.

Results
A spinning device is successfully created, reaching the design goals. When the controller is continuously turned 90 degrees per step in a circular motion, the rotor exactly imitates the controller rotation. Changing the dimensions of the electromagnets can increase magnetic field strength to improve the rotor rotation. After experimentation with resistor values in the circuit, a resistor is selected to reduce battery consumption.

Conclusions/Discussion
Magnetic principles can be applied to create a spinning device with the rotor imitating the angle movements of the controller, which is a simple master-slave system. Four electromagnets used in this project are the minimum number for a circular rotation of the rotor. If increased to six or eight electromagnets, the rotor can turn 60 or 45 degrees in each step respectively. Therefore, the number of electromagnets determines the angle of rotor rotation in each step.

Summary Statement
Design and build a spinning device completely composed of common materials to study how magnetic fields drive a rotor to follow the rotation of a controller.

Help Received
Parents helped by giving advice

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Samuel A. Johnson

Project Number
J0719

Project Title
Fuel Cells: The Power of the Future

Abstract

Objectives/Goals

My experiment focuses on two of these types of fuel - the Polymer Electrolyte Membrane (PEM) and the Direct Methanol (DM) Fuel cell cell. These are the most promising of the six types for powering small electronic devices. The goal is to find out which one is better for running small appliances such as electric motors. My hypothesis is that the PEM is more efficient because it is more widely used. In my experiment, I measured the power generated by each of the two fuel cells. Energy sources like batteries provide power by supplying a current and voltage to a circuit that contains some sort of load, or in other words, an obstacle that needs work to overcome. For electrical circuits, the load is usually a resistor or a small device like a motor. I set up a test circuit connected to the fuel cells. With this circuit, I could connect different resistances (this my variable) and measure the currents and voltages in the circuit. I generated a # power curve# for each fuel cell by varying the resistor (load) and calculating the power for each load. The power curve is plot of the current used to generate power. The power is found by multiplying the current and voltage together. I also added small electric motors and measured the current needed to produce enough power to run them (either 35 or 100 mW). The power curves for each fuel cell was different, even though both cells provided about the same amount of voltage when no load was put on them The PEM produced much more power as the same amount of current or needed less current to make a certain amount of power. This was true for the motors too. The conclusion is that the PEM is a better fuel cell because is more efficient using current o produce power. However, current efficiency is not the same thing as fuel efficiency. Fuel efficiency measures the amount of fuel used to produce the current or power. From the background information, both the PEM and the DM were rated at approximately the same fuel efficiency # about 35 to 50%. Measuring fuel efficiency when the fuel is something like hydrogen is difficult to do and takes a lot of time. In the future, I would like measure fuel efficiency too.

Summary Statement

i wanted to know what type of low heat fuel cell was better, more efficent, for powering small electronics.

Help Received

my mom helped type the report and my father helped me aquire the materials and helped me to write the report

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Aaron Z. Kirschen

Project Number
J0720

Project Title
Solar Panel Power Booster

Abstract

Objectives/Goals
To show that reflectors can boost the electrical output of solar panels.

Methods/Materials
I used insulated wire to construct an electrical circuit. The circuit included a solar panel, an ammeter, and an automotive headlamp. I monitored the electrical output of the solar panel while varying the number of reflectors to see if adding more relectors would increase the electrical output of the solar panel. I repeated the experiment 6 days in a row at the same time of day.

Results
As reflectors were placed around the solar panel, electrical output increased.

Conclusions/Discussion
My results supported my hypothesis that using reflectors to concentrate the sun's rays onto a solar panel would increase the electrical output of the solar panel. Using reflectors with solar panels can increase their effectiveness and lower the cost of this type of energy.

Summary Statement
This project shows that reflectors can increase the energy output of solar panels.

Help Received
My dad helped with providing materials and setting up the electrical circuit for this experiment.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

Michael Madden; Garrett Wymore; Cameron Yu

Project Number

J0721

Project Title

The Use of a Stirling Engine as an Alternative Energy Source

Abstract

Objectives/Goals

Our objective was to demonstrate running a Stirling engine continuously on light alone, generating energy by maximizing heat, absorption, and transfer of light heating the air that the engine runs on. Our goal was to create a model of a Stirling engine run on sunlight modified for indoor use and demonstrate its potential as an alternative energy source that produces no emissions and uses sunlight that hits the Earth. We also wanted to show its economical advantages by comparing the Stirling engine#s initial costs, fuel costs, and long-term costs with other sources of energy.

Methods/Materials

Our first task was to research and build a Stirling engine using parts purchased from an online vendor. We then had to construct a structure to position the Stirling engine and parabolic mirror in a way to maximize the light intensity reflected onto the engine. Experiments were done to determine the ideal parameters of light, color and materials to optimize energy production of the Stirling engine, and the data was analyzed with computerized sensors. After maximizing the power produced by the model and finding the Stirling engine would work continuously just on light, we did mathematical calculations to show it was a very economical choice by comparing it to an internal combustion engine, solar photovoltaic cells, and hydrogen fuel cells.

Results

Sunlight was the most powerful light source, however in the laboratory setting, halogen spotlights produced the most heat. Painting the cylinder cap on the engine black reflected the least light therefore creating the most heat, and using a glass reservoir created the hottest air consistently because of the greenhouse effect. Our research found that the Stirling engine emits no pollutants, while being very cheap compared to photovoltaic cells and hydrogen fuel cells. We calculated that it would take many of these Stirling units to produce adequate energy because of their low energy output, making them just a temporary transitional energy solution until hydrogen fuel cell power is fully available.

Conclusions/Discussion

Stirling engines powered by sunlight are economical and effective alternative energy sources. We reached our goal of making a model to expand public knowledge of a relatively unknown energy source that is an option to higher priced energy alternatives like solar photovoltaic cells and fuel cells.

Summary Statement

We successfully created a model of a Stirling engine run completely on light and showed that it could be an economic and effective alternative energy source of the future because of its economical capabilities.

Help Received

Teacher loaned us parabolic mirror, lenses, light and temperature sensors, graphing calculator, and sensor hub; Mother helped fund project and drove us to stors to buy materials;Teacher got us involved in fair and gave us idea for Stirling engine

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Robert W. McRae, Jr.

Project Number
J0722

Project Title
How Adding Solar Panels Affects the Running Time and Distance Traveled by an Electric Go-kart

Abstract

Objectives/Goals

After converting a gas-powered go-kart to electric and adding solar panels, affects of solar panel use, and running time to deplete the batteries were investigated. The dependent variable, running time to deplete the batteries, was measured in minutes and seconds. The independent variable is solar panel use. The go-kart was run on a 1.61 kilometers course and tested without solar panels to create a control group. After recharging the batteries the go-kart was then run using the solar panels. The hypothesis was that the tests with the solar panels would increase the running time and the increase would be at least 15% or more. The hypothesis was accepted because the go-kart ran 29 minutes or 17% longer with the solar panels. Energy from the sun was collected by the solar panels and transferred to the batteries allowing the go-kart to travel an extra 11 kilometers.

Summary Statement

A gas engine was replaced with an electric motor, solar panels were added to the go-kart, and running time was investigated.

Help Received

Science teacher guided me; Gary Rutberg loaned me a motor and helped with electrical configuring; Todd of Sun Cowboy guided with solar panel wiring; mother took pictures and videoed; father took me for supplies, guided construction, drove to testing sessions and timed trials.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Frederick J. Meyer

Project Number
J0723

Project Title
Designing Active Audio Noise Canceling Circuits

Abstract

Objectives/Goals
The goal of this science project was to understand how active audio noise canceling is achieved and to use this knowledge to design noise canceling circuits, then test and compare these circuits and measure their effectiveness over the audio frequency range.

Methods/Materials
First I researched audio noise canceling theory. Then I designed, prototyped and tested a noise canceling circuit that had only a 180 degree phase adjust. Later I researched variable phase adjustment methods and output delays. I built additional circuits that allowed a notch phase adjustment and finally a uniform phase adjust across the frequency range from 20Hz-10kHz. My most complex design worked over the full 20-20kHz range. For each design, I tested the efficiency of the circuit with test instruments and my ears. :: Circuit Boards, Bread Boards, Multi Meter, Function Generator, Headphones, Microphones, Computer, Solder, Soldering Iron, misc. electronic components, Computer Software, Display board, Spray Glue, Photos taken with my Mom's digital camera.

Results
All of my noise canceling devices worked very well at suppressing all kinds of repetitive noises (like a motor), but the circuits with phase adjustments worked much better than those without. Being able to adjust the phase made a big difference and gave my circuits the ability to better suppress noise by lining up the canceling and source waves.

Conclusions/Discussion
In this project I learned how audio noise canceling devices work and I built many complex circuits. Even the noise canceling circuit that didn't have a phase adjust did surprisingly well and canceled many common machine noises. I can think of many applications for this powerful technology.

Summary Statement
The goal of this project was to understand how electronic noise canceling devices work and to design and build my own operating circuits with various features.

Help Received
Dave Rank (retired UCSC astronomer) gave me ideas about how to improve my circuit. Eric Swartz gave me tips on how to make my own PCBs and answered questions when I got stumped. My Dad helped me locate and order my circuit components. My Mom helped me glue down my display board presentation.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Zaheer A. Mohiuddin

Project Number
J0724

Project Title
Effect of Direction and Tilt Angle of Solar Cells on Power Generated

Abstract

Objectives/Goals
As fuel prices go up, solar cells can be used as an alternative source of energy. My objective was to find out the best direction and tilt angle to place a set of solar cells to maximize the voltage.

Methods/Materials
I used a few solar cells connected in a series, a volt meter to measure the volts, a protractor to measure the angle, a compass to find the direction, and a wooden stand where the solar cell was placed. First I gathered all my materials. After that I placed my solar cell on a stand. I used a protractor to set the angle of the solar cell, and a compass to set the direction of the solar cell. After that I took the reading of my voltage meter at various angles and directions. I then repeated this procedure at different times of the day. Finally I collected the data and compared.

Results
My results were that the solar cell captured the most sunlight facing South at a 60° vertical angle at noon. The highest reading was 4.3 volts. The highest readings were mostly recorded in the south direction.

Conclusions/Discussion
The conclusion I reached was that the solar cell would capture the most sunlight if the solar cell was facing South and if it was at a vertical angle of 40° to 70° at 2:00 PM. The combination of a direction facing south and a tilt angle of 40° to 70° provides the best set-up for maximum power generated in the solar cell. According to some research, the tilt angle should be different during different times of the year. I took readings every hour from 11 AM to 4 PM for different tilt angles and sun directions. The directions used varied from South East 60° to South West 60°.

I performed this experiment in December. At this time of the year, the sun is in the southern hemisphere. During the summer months, when the sun is in the northern hemisphere, I expect slightly different direction and tilt angle. I would also like to experiment on cloudy days. This experiment was done in San Francisco Bay Area at latitude of 37° N. I expect the different results if the experiment were performed in a different location such as Los Angeles or in Seattle.

Summary Statement
To find out the best direction and tilt angle to place a set of solar cells to maximize the voltage.

Help Received
Father helped with wooden stand.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Dennis G. Moore

Project Number
J0725

Project Title
How Far Can a Computer Take You?

Abstract

Objectives/Goals
The purpose of this experiment is to try to find if distance has any effect on the speed of two computers connections.

Methods/Materials
First, to test this, the program Ping would have to be open and running. Then, the IP address of the computer must be pinged 5000 times (ping xxx.xxx.xxx #n 5000). After this is completed, the results are recorded and the next IP address is pinged 5000 times.

Results
Some of the more interesting results were Ethiopia; it was the farthest distance away, but it got a regular time of 108 milliseconds. Hong Kong is similar to this. It is 11823 km away (7th greatest distance) and it tied for fastest with the Bahamas.

Conclusions/Discussion
Most of the results were that there was no correspondence between the distance and speed of a computer. There was a very general increase of the speed as the distance increased, but no specific conclusion was reached. This was due to the lack of variables in the project.

Summary Statement
"How Far Can a Computer Take You?" tested the speed of a computer over varying distances.

Help Received
Research Paper correction by Parents and neighbors Kim and Larry Chan; My science teacher Mrs. Gillum for helping me do my best work possible.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Susanna G. Murray

Project Number
J0726

Project Title
From Sunlight to Light Bulbs

Abstract

Objectives/Goals
The purpose of this project was to find out the efficiency of collecting, storing, and reproducing solar energy to produce artificial light. The hypothesis was the efficiency would be less than 10% and the LED would be best for reproducing the energy. The controls in this experiment were the amount of time the solar panel collected solar energy and the location of the solar panel. The variables were the types of light bulbs and the uncontrollable variables were the weather, battery voltage, and the number of lumens outputted.

Methods/Materials
There were three types of light bulbs: the incandescent, fluorescent, and LED. They were each tested 7 times creating a total of 21 tests. Each test included collecting solar energy for 9.5 hours, with the solar panel connected to the battery where the energy is stored. Then, at night one of the three lights was turned on, and the lumens or light outputted was measured and an hour later the light was measured again and the same after two hours and so on if it was still running.
Materials include one incadescent, fluorescent, and LED light, solar panel, 2 lead-acid batteries, light meter, Fluke Multimeter, and one mounting board.

Results
The results of this experiment were that the LED lasted a lot longer than the fluorescent and incandescent light and that the efficiency was 2%.

Conclusions/Discussion
It was concluded that the LED was the most efficient light for reproducing the energy because it lost less energy in the form of heat and saved up more energy to produce light. The overall efficiency using the LED was 2%, which proved the hypothesis correct. I knew that the efficiency of using solar energy was low, but it was surprising to discover that the energy left over was only 2% out of the original 100%.

Summary Statement
The purpose of this project is to find the efficiency of collecting, storing, and later reusing solar energy to produce artificial light and the most efficient light type for doing so.

Help Received
Dad helped get supplies and helped set up apparatus for experiments.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
James Noraky

Project Number
J0727

Project Title
Dynamic Diffractions: The Effect of Laser Light on Storage Capacity

Abstract

Objectives/Goals
The goal of this experiment is to determine the capacity difference between various medias (CDs and DVDs) when created with different lasers. Another objective is to view the differences between Burnt Media, CDs or DVDs created with a piece of Computer Hardware called a Burner, and Pressed Media, store purchased CDs or DVDs created using a press. In addition to the comparison of the Burnt and Pressed Medias capacity, the incident point's shape is compared and analyzed.

Methods/Materials
The experiment is to be conducted by creating an apparatus that would mimic another apparatus, Diffraction Grating. To get around actually creating a Media with the different lasers, the measurements obtained from the appartus will be interpretted by an equation and estimate the capacity of the Media. This way actually creating the media will not be necessary when the difference of capacities is important.

Using a support, preferably a box, a thin sheet will cover it and act as the area onto which the laser reflects onto. Using a stand to hold a laser still, the laser shall shine onto a hole punched specifically the size of the laser tip. Underneath it all, a media shall be placed [Note: The elevation on which the laser is above the media shall be kept constant] and when pressed the distance between the incident and other points shall be measured.

Results
The results show that:
* The distance between the incident and the refracted points is greater for lasers with a shorter wavelength
* The bits per nm^2 is greater with lasers with the shorter wavelengths than the longer wavelengths for all medias tested
* Burnt and Pressed Medias have about the same capacity
* The estimated percent error is 10%

Conclusions/Discussion
From the analysis and research, it can be concluded that:
* The results show that the wavelength of the laser affects the capacity of the media (CD/DVD).
* These results are interesting, since more media can be stored by just changing the laser beam (wavelength) used for reading the media.
* It also found that burnt CDs and DVDs did show similar bit size to the pressed CDs and DVDs which

Summary Statement
The focus of this project is to determine the capacity differences of various medias by "creating" them using different lasers.

Help Received
Kevin Tetz; Dr. Saidaine

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Alexandra N. Ooms

Project Number
J0728

Project Title
Hydro Energy

Abstract

Objectives/Goals
TO PPOVE THAT THE HIGHER THE FALL OF WATER, ASSUMING THE SAME FLOW OF WATER, THE MORE ELECTRICITY IS GENERATED.

Methods/Materials
I USED THE FOLLOWING MATERIALS:
SMALL GENERATOR, TUNA CAN, BOX CUTTER, MEASURING TAPE, DRILL, VOLTAGE METER, LADDER, 10 FT ½ INCH PVC PIPE, PIPE CUTTER, SUMP PUMP, SOURCE OF WATER (POOL OR JACUZZI), STOPWATCH, BEACH BUCKET, 2 LITRE SODA BOTTLE, EXTENSION CORD OUTLET.
I PERFORMED THE FOLLOWING PROCEDURES:
1. FIRST MAKE A WATER WHEEL USING AN EMPTY TUNA CAN. ON THE SIDES, CUT OUT 8 SLOTS ABOUT 1 INCH APART TO LOOK LIKE A WATER WHEEL. ATTACH IT TO THE GENERATOR. 2. TAKE A 2 LITRE SODA BOTTLE AND FILL IT UP WITH WATER. DUMP THAT WATER INTO YOUR BEACH BUCKET. CONTINUE TO DO SO UNTIL THE BUCKET IS FULL, COUNT THE # OF TIMES A FULL BOTTLE WAS DUMPED INTO THE BUCKET. TAKE THIS #, MULTIPLY IT BY 2, (2 LITRE BOTTLE). TAKE THE AMOUNT OF LITRES AND DIVIDE IT BY 3.7 TO CALCULATE THE GALLONS IN BUCKET. 3. RECORD THE FLOW OF THE WATER. GET THE 10FT PIPE, A LADDER, AND A SUMP PUMP. PLACE THE SUMP PUMP HOSE INTO THE PIPE. NEXT GET THE STOPWATCH AND THE BUCKET. ATTACH SUMP PUMP. START PUMPING THE WATER AND PRESS START ON STOPWATCH. PRESS STOP ON STOPWATCH WHEN THE WATER COMPLETELY FILLS THE BUCKET. RECORD THE TIME. 4 .FIND OUT HOW MUCH ELECTRICITY THE 10 FT. PIPE PRODUCES. USE SUMP PUMP, EXTENSION CORD, POOL, LADDER, GENERATOR WITH ATTACHED WATER WHEEL 10 FT. PIPE, AND VOLT METER. PUT THE SUMP PUMP INTO THE POOL, PLUG SUMP PUMP INTO OUTLET. PLACE LADDER NEAR THE POOL SO THAT THE WATER BEING PUMPED WILL FLOW BACK INTO POOL. STAND ON THE TOP OF THE LADDER, WHILE HOLDING THE 10FT. PIPE AND ATTACHED SUMP PUMP. STAND AT THE BOTTOM OF THE PIPE WITH THE GENERATOR, WATER WHEEL, AND THE VOLTMETER AND MEASURE THE ELECTRICITY. 5. DO THE SAME PROCEDURE FOR A 5FT AND 2.5 FT PIPE.

Results
OVERALL, THE 10 FT. PIPE PRODUCED THE MOST ELECTRICITY, THE 2.5 FT. PIPE

Summary Statement
TO SHOW THE HIGHER THE FALL OF WATER, GIVEN A CONSTANT FLOW OF WATER, THE MORE ELECTRICITY IS PRODUCED.

Help Received
DAD HELPED WITH EXPERIMENT

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

Brennan C. Plassmeyer

Project Number

J0729

Project Title

Creating an Accoustic Guitar Pickup Using Optical Components

Abstract

Objectives/Goals

This project attempted to show that an optical guitar pickup could be built using inexpensive, and would produce clean sounding music. The problem with existing magnetic pickups is that they pull on guitar strings to detect vibrations. In doing this, they decrease the guitar's sustain, and this is not desirable. If an optical pickup could be constructed, then it could eliminate the dampening effect of ordinary magnetic pickups. This would increase sustain, so the sound quality would improve. If the components of the pickup could be built inexpensively, then the pickup would have a great chance of being marketed.

Methods/Materials

Initially, a Michelson interferometer was used to detect the vibrations of teh guitar strings. The interference pattern from the interferometer was shown onto a photodiode, which sensed changes in the interference pattern. The diode converted the changes into an electrical signal which was played over an audio amplifier. This approach produced poor quality sound. A new approach using onlu a laser, a mirror, a lens, and a photodiode was attempted. The laser bounced off the guitar-mounted mirror at a 45-degree angle, and went through a lens, and was shown onto a photodiode.

Results

The Michelson interferometer based optical pickup was very sensitive. However, the sound quality was poor, and the guitar notes had a scratchy, "techno" sound. the author speculated that the mirror moving more than one wavelength of laser light caused this. The second approach, produced good quality sound, and was simpler and less expensive.

Conclusions/Discussion

The Michelson interferometer based pickup produced poor quality sound possibly because the pattern was too sensitive. The new idea, using a laser, a mirror, a lens, and a photodiode produced good quality sound. To further improve the quality of the sound, higher quality optics could have been used.

Summary Statement

I began this project by constructing a Michelson interferometer for use as an optica guitar pickup, which was unsuccessful, wo i constructed a successful optical guitar pickup using a laser, a mirror, a lens, and a photodiode.

Help Received

Dad supervised and bought optical components; Mother helped edit report; Mrs. Hunker got the project started

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Quinn E. Proffer

Project Number
J0730

Project Title
Testing the Effect of Dust on a Photovoltaic Cell's Output

Abstract

Objectives/Goals
In this project the goal was to determine if dust in our atmosphere could reduce a solar panels effectiveness. The experiment was designed to demonstrate that dust could adversely affect the usefulness of residential and commercial solar panels.

Methods/Materials
First a box was constructed which housed a solar panel, light source, and fan. The box was designed to keep dust in and allow for a controlled air circulation. The fan was used to circulate talcum powder which was injected into the testing chamber. Air circulation in the box was designed to keep the dust moving until the fan was turned off and the dust allowed to settle. The light acted as the sun and was mounted on the side of the container. The solar panel which was placed in the dead center of the box was a one square foot photovoltaic cell panel. Twelve hours after the dust was inserted the light would be turned on and would register readings. These readings were compared to readings with different amounts of dust.

Results
The results showed that as dust was added the solar panel lost power, but when the dust had created several layers the power dropped in smaller intervals.

Conclusions/Discussion
Therefore we can conclude that a solar panel exposed to more dusty area like the desert are more likely to lose power and require regular cleanings. What this means for solar panel owners is that they can lose up to 10% power with only a small amount of dust. This is a major loss when it can take six or more years to see a profit with a residential solar panel.

Summary Statement
In this project the goal was to determine if dust in our atmosphere could reduce a solar panel#s effectiveness

Help Received
Father painted experimental box. Mother helped glue display.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Christopher M. Roberts

Project Number
J0731

Project Title
A New Spin on Hydroelectricity

Abstract

Objectives/Goals
The purpose of this project is to generate electricity by harnessing some of the kinetic energy of water flowing through a 1 1/4 inch pipe. This will be done with a small-scale hydroelectric device.

Methods/Materials
The device was made out of multiple sizes of PVC and copper pipes and fittings, size 10 all thread, 4 mm by 8 mm bearings, 2 ft. by 3 ft. piece of plywood, 4 1 1/2 in. bolts and nuts. It was tested with a multimeter, a hose, and a pressure gauge. It was tested 500 times under the setting DCV 20 on the multimeter to test consistency. It was then tested 50 more times on the same setting and 50 times under the setting DCA 200 on the multimeter. The water pressure was recorded before and after the testing.

Results
The device produced an average volt output of 1.80 volts, a maximum volt output of 1.84 volts, an average amp output of 162.82 milliamps, a maximum amp output of 167 milliamps, and an average watt output of 0.29 watts. The flow was not drastically affected. The flow in gallons per second with the device was 0.535 gallons per second, and the flow without the device was 0.5528 gallons per second.

Conclusions/Discussion
The engineering goal, to create electricity by harnessing some of the kinetic energy of water flowing through a 1 1/4 inch pipe, was achieved. This device has many possible uses for the future. It could be used on any pipeline with any fluid that wouldn't clog the turbine.

Summary Statement
This project was to try to generate electricity by harnessing the kinetic energy of the water flowing through a pipe.

Help Received
Father and Mother recorded data, Teacher helped with various aspects

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

Zachary S. Seaton

Project Number

J0732

Project Title

Changing Antennas for Strength

Abstract

Objectives/Goals

The purpose of this experiment was to find out how different antennas varying in type, height, and location, can change the strength of the FM signals received by an FM stereo.

Methods/Materials

Three different antennas were installed onto the stereo and put at three different heights (.30, 1.37, and 2.43) one at a time both inside and outside of a house. The resulted signal strength was then recorded. This was done three times for each different antenna.The materials used in this experiment are 1 Sony FM/AM stereo, 2 Klipsh speakers, 2 KLH speakers, 1 115v electrical outlet, 1 roll of measuring tape,1 screw driver, 1 roll of duct tape, 1 ladder,1 Radio Shack Rabbit Ears antenna, 1 Radio Shack Rabbit Ears antenna converted to a Whip antenna, 1 Radio Shack Di-Pole antenna, 1 Radio Shack 25 foot 75-Ohm to 300-Ohm singal transformer, and 1 Radio Shack coaxial cable coupling.

Results

The reception of the Single Whip antenna at all heights was better inside than outside, the reception of the Rabbit Ear antenna at all heights was better outside than inside, and the reception of the Di-Pole at all heights was better outside than inside. The data also showed that the Whip antenna was the best antenna inside and was the second best antenna outside. That the Rabbit Ear antenna was the best antenna outside and was the second best antenna inside. Lastly, that the Di-Pole antenna was the weakest antenna inside and was the weakest antenna outside.

Conclusions/Discussion

In conclusion, the data shows that with all antennas placed in a horizontal position that the Single Whip antenna was the best antenna to use inside a house at all the tested heights where there are some electrical wiring within the walls and ceiling. Also that the Rabbit Ear antenna was the best antenna to use outside a house were there may be some electrical wires and bushes that can obstruct or interfere with the signal. If the antennas used were placed in different positions/angles the overall results could be different. In this situation the Di-Pole could pull in a stronger signal.

Summary Statement

This experiment is about testing three different antennas varying in type, height, and location to determine how much they will affect the overall signal strength of a FM stereo.

Help Received

My dad helped me to set up the antennas at the three different heights both inside and outside the house.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Matthew P. Terze

Project Number
J0733

Project Title
Linear Accelerator

Abstract

Objectives/Goals
The object is to find if I can make a model of a linear accelerator that shows the basic principals of a linear accelerator.

Methods/Materials
Tape four 12mm ceramic cube magnets 7 cm apart on a ruler in a straight line from left to right. To the right of each magnet place two steel marbles. From the left side roll one marble towards the first magnet. Watch and record.

Results
The model worked by using chain reaction to demonstrate how a linear accelerator accelerates particles.

Conclusions/Discussion
My conclusion is that I can make a model that demonstrates how a linear accelerator works. I also was able to research linear accelerators.

Summary Statement
I made a model of a linear accelerator.

Help Received
My father purchased the ceramic magnets I used in my model.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Lauren M. Turner

Project Number
J0734

Project Title
More Power to You: Increasing Wireless Signal Reception

Abstract

Objectives/Goals
The objective is to determine if a homemade wire mesh parabolic reflector will improve the signal strength from my downstairs wireless router to my laptop computer in my upstairs room.

Methods/Materials
I constructed the reflector from 1/4-inch iron wire mesh cloth and attached it to a plastic cutting board in the shape of a parabola. A large hole was drilled through the plastic board at the focus of the parabola to place over the antenna of the wireless router. I tested and recorded the reception measured in dBm in several locations in my house, both with and without the reflector attached to the router. Materials used were: galvanized iron wire mesh cloth (1/4 in grid), one plastic cutting board, duct tape, picture hanging wire (19 gauge), electric drill, assorted drill bits (1/16 in. up to 5/8 in.), wire cutters, tin snips, Linksys wireless router, laptop with Linksys wireless adaptor and software, and tape measure.

Results
In general the signal strength of wireless router was increased in the direction that the reflector was focused or pointed and decreased the signal strength in other areas. Specifically the signal strength in my room was increased by 7 dBm, which is greater than a four times improvement compared to the original signal strength.

Conclusions/Discussion
I concluded that putting a wire mesh parabolic reflector on the transmit antenna of a Linksys wireless router was very successful in increasing the signal strength received by my laptop computer in my bedroom. It increased the measured signal strength by 7 dBm in my bedroom, which is an increase of greater than four times the original signal strength received. All of the measured signals strengths increased in all of the locations that were positioned in the areas that the reflector was focused.

Summary Statement
I built a wire mesh parabolic reflector and tested to see if it improved the wireless signal strength reception on my laptop computer located in my upstairs room from a wireless router located downstairs.

Help Received
My dad helped me understand the subject matter and answered my questions. He also operated the drill. My mother bought books and materials.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Dennis B. Wassem

Project Number
J0735

Project Title
How Does Coil Shape and Magnet Placement Affect the Rotations of a Simple Motor?

Abstract

Objectives/Goals
This experiment investigates how electromagnet coil shape and stator magnet placement affects the rotations per fifteen seconds of a simple motor.

Methods/Materials
I built a simple motor using a six-volt battery, two thick wires, a magnet and five electromagnetic coils of different shapes. I tested a circle, square, rectangle, diamond, and triangle coil. In a second experiment, I used the circle coil to test the affect of stator magnet placement directly below the coil, one cm away from the coil, and two cm away from the coil. I measured my results by filming the spinning coil and a stopwatch with a DVD camera and played back the disc at a slower speed so I could accurately count the rotations.

Results
Through experiment one, I learned that in a fifteen second period, the motor's electromagnetic coil rotated the most times with these shapes in the following order: circle, square, rectangle, diamond, and triangle. Through experiment two, I have learned that as the distance from the coil to the stator magnet increased, the number of roations per fifteen seconds decreased.

Conclusions/Discussion
I believe that coil shapes with greater surface area are more exposed to the stator magnet and so rotate faster. I also believe that the stator magnet's effect was weakened as it was moved further away from the electromagnetic coil.

Summary Statement
I investigated how electromagnet coil shape and stator magnet placement affects the rotations of a simple motor.

Help Received
Jeff Wassem helped me bend the thick wires.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Jeffrey T. Wilfong

Project Number
J0736

Project Title
Attraction Action

Abstract

Objectives/Goals
I will test what variables of an electromagnet affect the magnet's strength. I predict that the battery voltage will affect the electromagnet's strength the most. The voltage controls the electrons that go through the wire. Higher voltage will create a stronger magnetic field.

Methods/Materials
I built seven electromagnets and changed one variable on each. I created a control electromagnet to establish a base electromagnet strength. I measured the strength of the control by suspending weight from the energized magnet, and added more weight, until the electromagnet was unable to hold the weight. I then changed variables to determine how each would affect the strength of the electromagnet.

Results
Voltage, wire length, and core diameter all affect the strength of the electromagnet.

Conclusions/Discussion
I concluded that my hypothesis was wrong. Voltage did change the strength positively the most, but the core diameter had more of a negative effect on strength than the positive effect of the voltage.

Summary Statement
What variables affect the strength of an electromagnet?

Help Received
My father helped me make the magnets and the power source. My mother helped me type my report and helped me with my graphs.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Christopher R. Wilson

Project Number
J0737

Project Title
What Blocks My Signal?

Abstract

Objectives/Goals
The objective of my experiment was to determine what household materials cause the most interference for wireless networking signals.

Methods/Materials
I started with a wireless network consisting of a base computer, a router, and a laptop. I built five-sided boxes out of different materials (metal, wood, glass, plastic, drywall, foam core, and cardboard) to place over the router to potentially interfere with the wireless signal. I also filled a glass container with water to place between the router and the laptop. I placed the laptop 23 feet from the base computer and router, with nothing in between, sent 25 packets of data from the laptop through the router to the base computer and back to the laptop, and recorded how long it took each packet to return to the laptop. I repeated this test for each source of interference by putting the box over the router, or by putting the glass container between the laptop and the router. These tests were repeated at different dates and times, and the results were recorded and summarized.

Results
Without any external source of interference, 69% of the packets were returned within 2 milliseconds, and none were lost. When using water as the source of interference, about 30% of the packets were returned within 2 milliseconds, but about 40% of the packets were not returned at all. When using metal as the source of interference, just 2% of packets were returned within 2 milliseconds, and 14% of the packets were not returned. For all other materials, more than 50% of the packets were returned within 2 milliseconds, and none were lost.

Conclusions/Discussion
Of the materials tested, water creates the most interference with wireless networking signals, and metal creates the next most interference. No other material created any noticeable interference with the signal.

Summary Statement
My project determines what household materials cause the most interference for wireless networking signals.

Help Received
My Mom helped me to design and build boxes out of various materials to create the needed interference. My Dad gave me research suggestions, and once I found a possible test method on the Internet, he helped me adapt that test for use in my project.

CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Erik W. Young

Project Number
J0738

Project Title
Magic Magnets: Construction and Testing of a Homopolar Motor

Abstract

Objectives/Goals
Make a rail gun using a homopolar motor move on its own and do different tests to see what factors affect its performance.
If the current and number of magnets are increased, then the speed will increase; if the slope is increased, then the speed will decrease.

Methods/Materials
I made the track by taping two strips of foil down on a piece of wood. I made the car by putting four disk magnets on either end of a steel rod. Then I hooked up the two strips of foil to the + and minus of a power source. I hooked up different amounts of resistors to test current, I raised one end of the track to test slope, and I put different amounts of magnets on the axel to test the number of magnets.

Results
My tests on current were very accurate, which is surprising because there are other factors like friction and human error that I didnt account for. I came to this conclusion by picking one of my measured data points and putting it into the formula and then solving so that I could see if the shape of the line was right. My tests on slope revealed that with 2 ohms of resistance, the railgun could only go up a 2.8% slope. My tests on number of magnets showed that to get the best speed, it has to be a compromise of mass and flux.

Conclusions/Discussion
I can conclude that two out of three of my hypotheses were correct: When more current was added, the cars speed did increase, when the slope of the track was increased, the cars speed decreased. But, when more magnets were added, the speed of the car did not necessarily increase. This was because it needed to be a compromise between mass and magnetic flux. The more magnets, the higher the magnetic flux, but the higher the mass, causing the axel to accelerate more slowly.

Summary Statement
I constructed a homopolar railgun and tested current, slope and number of magnets to see how they effected it's performance

Help Received
Dad helped understand some formulas and format my graphs on the computer; Mom helped design my diplay board.