CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Michael H.H. Beitman

Project Number
J0701

Project Title
Potential Batteries for the Developing World

Abstract

Objectives/Goals
Is it possible to develop potential batteries for the developing world consisting of inexpensive, commonly available materials useful in powering radios, cell phones, small motors, and other basic devices?

Methods/Materials
(1) Create a simple battery using commonly found materials. Each battery requires two different types of metal (anode and cathode), and another material as an electrolyte, which helps electrons travel between the different metals. This movement of electrons creates an electric circuit, converting chemical energy into electricity. (2) Measure the voltage and current with a voltmeter (which measures volts and current) and compare the amounts of energy gathered by each combination of materials. Materials that produce the most current and voltage will be tested to see how long the different combinations last before the chemical reaction is used up. The most promising combinations will be tested in real life situations to see if they can power lights, radios, small motors, etc. (3) Record the data in tables and duplicates will be inserted in my Log Book. (4) Draw conclusions and support them with data.

Aluminum, Ash, Brass, Charcoal, Copper, Dirt, Galvanized Steel (steel coated in Zinc), Iron, Lead, Salt Water, Sand, Stainless Steel, Steel, Tin, and Water.

Results
After finishing my experiments, I ordered and graphed results from highest to lowest. Salt Water is the best electrolyte for current and Charcoal is the best electrolyte for voltage. Galvanized Steel and Lead together are the best producers of current, and Aluminum and Copper are the best for creating voltage. Current appears more critical. The one consisting of Galvanized Steel, Lead, and Salt Water ran the radio for days, while the other one could barely light an LED, even with multiple cells.

Conclusions/Discussion
I conclude that it is actually quite simple to generate a surprisingly large amount of power with common resources. I believe that my project can improve the lives of poor people in Third World countries. Lead currently trades for $0.21 a lb., and Zinc trades for $0.35 a lb. I estimate that my battery would cost less than $1 in volume. A poor developing nation (with U.N. financial help) could easily gain access to small amounts of local electrical power.

Summary Statement
Creating Inexpensive Batteries for the Developing World

Help Received
Parents drove me to stores, helped cut metals, allowed me to use workbench

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
L. Austen Bradley

Project Number
J0702

Project Title
Jumping Through Hoops

Abstract

Objectives/Goals
Mass drivers move objects with electromagnetism. My project was designed to determine the relationship between voltage sent to electromagnetic coils and the frequency of coil energizing required to move metallic objects of different weights. I predicted that increasing the coil voltage and pulsing the energy faster would cause faster object movement.

Methods/Materials
My mass driver uses coils of wire wrapped around a plastic straw and the coils are energized sequentially by a homemade distributor. Electricity flows to the coils when hacksaw wipers on a rotating CD disk make contact with guitar string brushes. For my experiment the disk turned at a set speed or frequency and the coil voltage was independently varied to cause movement of a metal rod in the straw. I used rods of three different weights.

Results
Voltage required to cause movement of a metal rod varied as an exponential function with frequency. With heavier rods, more voltage was required to cause movement and the relationship between coil voltage and frequency of coil energizing became more linear.

Conclusions/Discussion
My experiment showed that a mass driver is able to pull or push a mass through a tube using electromagnetic force. The greater the object's weight, the more voltage is required for movement at a given frequency. My experiment implies that to move objects quickly using electromagnetism higher frequencies and more energy are required as the object's weight increases.

Summary Statement
My project involves moving a metal rod in a plastic straw using electromagnetism and varying the voltage and frequency of energy pulsing.

Help Received
My father helped me build the distributor and wire the project. My science teacher, Mr. Long, guided and encouraged me. My mother helped me to assemble the project board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Zahabiya H. Chithiwala

Project Number
J0703

Project Title
Silicon vs. DNA: The Battle Has Begun

Abstract

Objectives/Goals
Determine if DNA has the ability to solve complex problems which cannot be solved by present day silicon based computers due to technology limitations.

Methods/Materials
This experiment will demonstrate how DNA can be used to solve a combinatorial problem such as the Hamilton Path Problem.
Step 1:This step was to hand draw the Hamilton Path Problem on a piece of paper & to create a DNA sequence for each city on the path (20 bases long). A complimentary strand was created for each sequence. Then a DNA strand was created for the path between each city, by taking the 3# end of the first number and the 5# end of the second number and combining them. The oligos; the DNA sequence blueprint were then sent to be made. After receiving the oligos they were combined for the five path problem, then the ten path problem in test tubes according to the path drawing.
Step 2: Used the PCR machine to run 35 cycles at 94C for 15 sec. & 30 degrees Celsius for 60 sec. to amplify the samples(create reactions to help the separate strand to bond.)
Step 3: Running a gel electrophoresis with the samples. This step shows the length (base pairs) of the Oligos, to see if they are long enough for the next step then used the gel protocol kit to extract the DNA from the gel.
Step 4:Amplify the samples from step 3 using PCR machine again is to purify the DNA for sequencing.
Step 5:After DNA is sequenced, compare the sequences to ones done by hand. If the sequences match ,it can be determined that DNA can solve mathematical problems.

Results
This experiment was repeated numerous times and failed in step 3 possibly caused by external variables or materials. If all the steps went correctly the experiment would have turned out as expected and showed the DNA sequence for the path between each city. Each sequence would have matched the ones that were created when solving the Hamilton Path Problem by hand on paper.

Conclusions/Discussion
ALthough the results did not come out as expected through numerous tries , it can still be proven that DNA can solve a complex combinatorial problem, as seen in previous experiments conducted by other scientists. This experiment will be repeated several times before the state fair this May. DNA has a lot of potential, it is already being used to solve crimes and in the future will be used for many other things, one being computing.

Summary Statement
DNA is one of many possible alternatives to silicon- based computers to overcome the limitation faced by current computers in the near future.

Help Received
Sybil Smith was my mentor for this project, used Cal Lutheran University Lab.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Kasie Clark; Kelly Clark

Project Number
J0704

Project Title
Does Storage Temperature Affect Battery Life?

Abstract

Objectives/Goals
The objective of this science project is to determine if the temperature of household AA alkaline batteries are stored at will affect their life when tested in a low resistence battery draining mechanism.

Methods/Materials
40 Duracell AA Alkaline batteries were divided into three groups (room temperature, freezer, and refrigerator) for 43 days. After 24 hours were allowed for them to come to room temperature they were tested in a battery draining mechanism especially designed for this project. A stopwatch was used to test the time it took for the fan on the mechanism to stop rotating. The times of all 20 trials of each temperature group were analized.

Results
Our results show that the Duracell batteries stored at room temperature (average 68 F and 20.43 C) lasted an average of 11.75 minutes; much longer than either the freezer or the freezer groups. Refrigerator batteries were stored at an average temperature of 38 F or 3.33 C and the freezer batteries were stored at an average temperature of 18.6 F or -7.44 C.

Conclusions/Discussion
Our conclusion is that room temperature is the best place to store Duracell AA Alkaline batteries of the three temperatures we tested. The batteries were stored for a period of forty three days. We were surprised to have conclusive data with this time period. We tested only Duracell batteries to control variables but we would find it interesting to test other brands!

Summary Statement
Our project was to determine if it is better to store AA Alkaline batteries at room temperature, refrigerator, or in the freezer.

Help Received
Hyatt Baker and Gene McGuire helped design and build the battery draining mechanism used to measure battery life (on the display table).

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Jeff W. Clyne

Project Number
J0705

Project Title
Can Light Energy Accurately Measure Surface Area?

Abstract

Objectives/Goals
The objective was to construct a machine that could harness light energy to measure surface area. The hypothesis was that it could be accurately and dependably measured.

Methods/Materials
The first step was to construct the machine that could harness the light energy into a tool of measurement. After thinking it through, the researcher generated some designs and began construction of the machine. The machine was constructed. The principle was simple. At the top, there was a light; in the middle, a glass shelf; and at the bottom, a photocell. The light would be turned on, and the photocell would generate a voltage output. If an object was placed on the glass, the voltage would be less, as some of the light would be blocked.
The researcher had several two-dimensional surfaces of known surface area, that were used to calibrate the machines accuracy. A conversion graph was constructed that would convert the voltage output to surface area. Then, random objects such as a triangle or a rhombus of known surface area were placed on the glass shelf, and the researcher took note of whether there was correspondence between the voltage and the surface area based on the graph.

Results
The data proved to vary only slightly, and measured the surface area accurately and dependably

Conclusions/Discussion
The data proved to vary only slightly, and measured the surface area very accurately. From the data, the researcher concluded that his hypothesis was right, and the variance of the data could be decreased even further if the socket in which the machine was plugged into gave out a steady current, as the voltage may vary, perhaps very much so, depending on the load on the socket.

Summary Statement
Can I construct a machine that will measure surface area using light energy?

Help Received
Mr. Resovsky and Father helped with proofreading; Father helped with construction of machine

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Nicole L. Corlett

Project Number
J0706

Project Title
How Does the Intensity of Light Affect Output of Solar Cells?

Abstract

Objectives/Goals
The objective of this experiment is to determine if changes in intensity of light affect the output of solar cells.

Methods/Materials
I used: a single solar cell, a volt meter, an LED(light emitting diode),a switch, a reflector light socket, and 5 light bulbs(15 watts, 40 watts, 60 watts, 75 watts, and 100 watts). I wired the volt meter and the LED together. Those were then wired to a solar cell. A light bulb was then placed in a reflector lamp and shone on the solar cell. From there I measured volts and tryed but could not succeed in measuring amps.

Results
With the greater intensity of light, the LED was brighter and voltage was higher. With the lower intensity, the LED was less bright than before and voltage was low. Some of the voltages ranged from 0.00 volts to 9.00 volts.

Conclusions/Discussion
From my experiment, you can conclude that as the intensity of light gets higher, the voltage also gets higher. My experiment shows that the output voltage of the solar cells is related to the intensity of the light source. Based on this, the best location to position a solar cell would be where it gets the highest intensity of light.

Summary Statement
My project is to determine how the intensity of light affects the output of solar cells.

Help Received
Father helped wire board and taught me how to solder and use a drill press. Dale Ritter gave suggestions on components to use.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
James L. Creech

Project Number
J0707

Project Title
Building Basic Batteries: The Effects of Different Metal Combinations on Battery Voltages

Abstract

Objectives/Goals
The objective of this experiment is to determine which battery between zinc and copper, zinc and lead, or copper and lead gives off a higher voltage. The hypothesis is zinc and copper battery will give off the highest voltage reading because copper conducts heat very easily and zinc is a good material for plates in batteries and it is a good conductor.

Methods/Materials
After the three batteries were assembled in a plastic container (the metals were separated by sponges on a nylon screw), one cup of lemon juice was poured on the batteries and their voltages were recorded with the voltmeter. This process was repeated three times.

Results
The copper and lead battery had the highest average voltage reading of 0.93 volts. This is because the copper gave off a positive voltage reading and the lead gave off a negative voltage reading (this allowed them to make a strong battery). Although the zinc also gave off a negative voltage reading, it did not give off as strong a reading as the lead (this is because the lead conducts better, therefore making a better battery with the copper than the zinc did). The lead and zinc battery gave off low voltage readings because the lead and zinc both give off negative voltage readings and therefore making a weaker battery.

Conclusions/Discussion
In conclusion, the hypothesis was incorrect because the copper and lead battery gave off the highest voltage reading instead of the copper and zinc battery. If commercial batteries today were made from copper and lead instead of copper and zinc, less of the metals would be needed to provide the needed voltage keeping costs low for the company, saving money for consumers, and preserving more of the earth's natural resources.

Summary Statement
The objective of this experiment is to determine which battery between zinc and copper, zinc and lead, or copper and lead gives off a higher voltage.

Help Received
Father helped cut metals; Parents helped do display board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Brendan C. Cummings

Project Number
J0708

Project Title
The Photoelectric Effect

Abstract

Objectives/Goals
This experiment involves solar cells and how they produce electricity. Two important questions are: How is the output power affected by the input power and by distance from the light source? Secondly, what is the efficiency, or percent of light converted into electricity, of the solar cell?

Methods/Materials
To answer these questions, I set up a light bulb in a completely darkened room, and placed the solar cell at different distances of three, six, nine, twelve, fifteen, and eighteen inches from the light bulb. I then recorded the amount of volts produced at each distance using a voltmeter. I then calculated the efficiency by dividing the total output power by the total input power.

Results
I found that the results followed the inverse square law: when the distance of the solar cell from the light source is halved, the amount of electricity produced will be quadrupled. Also, the efficiency of the solar cell was 8.5%, that only 8.5% of the total energy is converted into electricity.

Conclusions/Discussion
It was hypothesized that the efficiency of the solar array would be approximately 11%, however, only 8.5% efficiency was achieved on this solar array. The cause of the reduced efficiency is probably due to the use of cheaper, polycrystalline solar cells vs. the higher qulaity, single crystal cells. Solar cell output power compared to the distance from the light source proved the inverse square law; that is, when the distance of the solar cell from the light source is halved, the amount of electricity produced will be quadrupled. This occurs because the light disperses and has to fill a much larger area , so less light is able to hit a single point on the solar array.

Summary Statement
This experiment involves solar cells and how they produce electricity.

Help Received
Materials and resources provided by Dr. Barry L. Butler.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Kelsey M. DeVries

Project Number
J0709

Project Title
Electromagnets and How They Work

Abstract

Objectives/Goals
I wanted to see the relationship between voltage, resistance, and the force created in an electromagnet.

Methods/Materials
I constructed two electromagnets of varying wire size. I varied the voltage between three and six volts. With varied voltage I measured how many paperclips each electromagnet would lift.

Results
I found a direct relationship between higher voltage applied and the amount of weight an electromagnet could lift. I also found that as resistance increased for the repective voltages, the strength of the magnetic field decreased.

Conclusions/Discussion
Increasing voltage increases the strength of a magnetic field, but resistance in varying wire size can increase or reduce that same magnetic field.

Summary Statement
I am studying the relationship between varying voltage and resistance in electromagnetic field strength.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Bryce W. Fender

Project Number
J0710

Project Title
Ocean Wave Energy Converted to Electricity

Abstract

Objectives/Goals
The capitalization of wave motion through the use of a pendulum, a ratchet device, a gearbox, and a motor/ generator can produce electricity. Continuous on going renewable force 24 hours a day, 7 days a week, 52 weeks a year, and on and on. Waves come from the moon tides, wind, and reefs. A flotation device will have securely anchored braces/ gussets attached with freely moving ball bearings to a horizontal drive shaft with a series of multi toothed gears. Through the gearbox the rotational movement of the drive shaft will be accelerated to rotate an electrical motor/ generator. The electrical motor/ generator in turn will convert the rolling wave motion into electricity.

Methods/Materials
The parts of a wave are, Wave crest, Wave trough, Wave height, Wave Amplitude, Wavelength, and Wave period. Water molecules move in an orbital motion as the wave passes. There are three types of waves defined by water depth: Deep-water wave, Intermediate-water wave, and Shallow-water wave. The celerity is the velocity of the waveform, not the water.
A machine that converts mechanical energy into electrical energy is called a generator, alternator, or dynamo. A simple motor has six parts: Armature or rotor, Commutator, Brushes, Axle, Field magnet, DC power supply of some sort.
Gears are generally used for one of four different reasons: To reverse the direction of rotation, To increase or decrease the speed of rotation, To move rotational motion to a different axis, to keep the rotation of two axes synchronized. The gear ratio is controlled by the number of teeth the gear has even if the diameters are a bit off.

Results
KINETIC ENERGY OF RELATION
E=WK N#ft.LBS./5878=.0017943ft.LBS.
INTERTIA=I=WK=(3)(.15625)=.07324 LBS.-ft
TORQUE=T=(3(.15625)(12)/(308)(1)=.002854 ft.LBS.
WORK AND POWER
HP=P2rN=(T)(N)=(.002854)(12)=.00000652ft.LBS.33,000 5252 min.
1HP= 745.7 WATTS,.00000652x745.7=.00486 WATTS
GEARS
Pitch line velocity=V=mTpnp/60=(3.14159265)(.5)(25.4)(30)(12)/30=2.54 mm/s 60
Tooth bending stress=st=P/(vKvfmY)=.00000486=3.9638x10=12.261

Summary Statement
Converts the up and down and sideways motion of oceanwaves into electricity through gears, pendilum, and a generator.

Help Received
My Mom and Dad helped with the boards. My Dad helped me with the construction of my project. My Grandfather helped me with my Generator / measuring device (volt meter).

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Roy B. Flake

Project Number
J0711

Project Title
What Is the Optimum Power of a Solenoid?

Abstract

Objectives/Goals
The objective is to find the optimum solenoid that will be more powerful and last just as long as the ordinary solenoid.

Methods/Materials
I took 10 feet each trial of the solenoid then put it into the ramp and tested it to see if it decreased or increased the power of the solenoid.
Materials- solenoids,pinballs,wood,plexy glass,wire(hot,common,ground)

Results
The optimum power was trial #13. 130 feet was removed from the solenoid.

Conclusions/Discussion
The trials went very smooth . Trials 15-23 kept on going up and down for a while, but on trial 23, it burned out.

Summary Statement
My project is to amplify a solenoid so that it is strong and can last long.

Help Received
My Dad guided me when I built the ramp.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Jake Friedman; Daniel Moyer

Project Number
J0712

Project Title
What's in a Tesla Coil?

Abstract

Objectives/Goals
To build a functional Tesla coil and to understand how a Tesla coil works.

Methods/Materials
Using a design found on the internet (http://privat.schlund.de/s/skluge/sub1.htm # Stefan's Tesla-pages), we constructed our Tesla coil (originally invented by Nikola Tesla) using a commercially available transformer, a configuration of capacitors individually rated for 7.5 kV, a primary coil of 3/8 and ¼ inch copper tubing, a secondary coil hand wound with 29awg magnet wire, a spark gap constructed using 1 inch diameter copper pipe, a drain cover, and a muffin fan, a toroid constructed using aluminum duct pipe, and a control board designed by a parent experienced in high voltage design.

Results
Tuning and adjusting the Tesla coil were the most difficult components of this project. We were able to tune the coil with one active gap (in the spark gap) and generate sparks and other phenomena characteristic to Tesla coils. Reconfiguration and replacement of some parts was required for the coil to run with two active gaps. Attempting to add additional gaps and subsequently increase the input voltage resulted in an arc-over in the capacitor bank.

Conclusions/Discussion
Once the primary coil was correctly tuned, the Tesla coil produced sparks up to ten centimeters long and cause a nearby fluorescent light to glow due to the coil's inductive field.

Summary Statement
In this project, we built and tuned a Tesla coil, which produced sparks and other electromagnetic effects.

Help Received
Father (Geoff Moyer) designed and built Control board and supervised test-run of the Tesla coil

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Lauren I. Grazier

Project Number
J0713

Project Title
Measuring Harmful Electromagnetic Waves Emitted from Various Brands of Cellular Phones

Abstract

Objectives/Goals
I wanted to find out how many electromagnetic waves go through different types of cell phones to determine which cellular phones are most harmful and least harmful for people's health.

Methods/Materials
electromagnetic field meter 7 different cellular phones landline phone
First I placed a cellular phone and the Electromagnetic (EM) Field Meter together on a table top: then I called the cell phone with a landline phone; I then viewed the readings on the EM field meter; recorded the highest meter reading for test one; repeated these steps ten times; crossed out the highest and lowest readings, and found the average for that particular phone. I did this for each cellular phone.

Results
The results of my investigation on testing EM waves on cellular phones indicated that some phones emitted more electromagnetic waves than others. I discuss the results of each phone on my project board.

Conclusions/Discussion
After completing my investigation, I found that my hypothesis was correct. It stated that some cellular phones will emit a greater amount of harmful EM waves than others, resulting in greater health risk to the user. The least harmful was the Sanyo 4900 and the most harmful was the Nokia 3360. People should be more aware of which brand of cellular phone they are buying.

Summary Statement
My project tests electromagnetic waves from the ring of a cellular phone to determine which brands of phone are more harmful than others.

Help Received
Mr. Carl Gong provided the Electromagnetic Field Meter; My teacher, Mr. Russell was my coach; Dr. Carolyn Chooljian provided articles from medical journals; Mr. R. Zamora from Radio Shack provided the use of some phones.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Arman A. Hamamah

Project Number
J0714

Project Title
How to Generate Electricity Using Michael Faraday's Law

Abstract

Objectives/Goals
The objective of my experiment is to generate electricity by moving a magnet inside a wire coil. This changes the magnetic flux inside the wire coil. Faraday law states that EMF= N delta phi/delta t. EMF is the electromotive force in volts, N is the number of wire loops in the wire coil, delta phi is the change in magnetic flux in Weber, and delta t is the time it takes for the change in the magnetic flux to occur in seconds. My hypothesis is: If the magnetic flux is changed faster, then more electricity will be generated. My independent variable is the time (seconds) it takes for the magnet to move through the wire coil. This indicates the rate of change of magnetic flux. My dependent variable is the generated electromotive force (volts).

Methods/Materials
Three wire coils (200,300,400 loops) were constructed. I moved the magnet through each coil using different speeds. This generated electric sine waves on the oscilloscope. For each wave, I measured the amplitude (volts) which is the dependent variable, and the period (seconds) which is the independent variable. Two orientations of the magnet (vertical and horizontal) were used.

Results
1)When the magnet moved faster in the wire coil, more electricity was generated. There was a linear relationship between EMF and the frequency of the alternating current generated.2) The electricity generated increased as the number of wire loops in the coils increased. For the vertical orientation, the ratio of the slope of the 400 coil graph to that of the 200 coil was 2.1(5% error). The ratio of the slope of the 300 coil graph to the 200 coil was 1.45(3.3% error). 3) The electricity generated in the vertical magnet orientation was consistently higher than the horizontal orientation. The above results are consistent with Michael Faraday law. 4) The direction of the current generated when the magnet was moving towards the wire coil was opposite to when the magnet was moving away from the coil.

Conclusions/Discussion
The electricity generated is 1)directly proportional to the rate of change of magnetic flux. This supports my hypothesis; 2)directly proportional to the number of wire loops in the wire coil; 3)directly proportional to the number of magnetic field lines that are perpendicular to the plain of the wire coil. 4) The direction of the current generated depends on whether the magnetic flux is increasing or decreasing.

Summary Statement
Generating electricity by moving a magnet inside a wire coil

Help Received
Parents helped with guidance and computer. Advisor lent me the oscilloscope and gave me ideas.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Lee A. Hewitt

Project Number
J0715

Project Title
How Does Cold Affect Hearing Aid Battery Life?

Abstract

Objectives/Goals
The objective of these experiements was to determine if patients' reports that cold negatively impacts the life of a hearing aid battery are accurate

Methods/Materials
The life of a hearing aid battery was measured at room temperature, a cool temperature, and a freezing temperature. The cool temperature was obtained by placing the hearing aid in a refrigerator, the freezing temperature by placing the hearing aid in a freezer. The battery was checked three times a day to verify that it and the hearing aid were still functioning. After each trial, a Dry and Store Global was used to remove moisture from the hearing aid.

Materials included: a Phonak hearing aid, size 13 batteries, a refrigerator/freezer, two refrigerator/freezer thermometers, a battery tester, a hearing aid stethoscope, earmold tubing filled with nail polish, a Dry and Store Global, and recording sheets.

Results
When comparing the manufacturer's estimated battery life with my test situations, I found that the battery lost an average of 31 hours of life when run at cool temperatures and 151 hours of life when run below freezing. When compared with my baseline, I found that the battery lost an average of 109 hours of life when tested at cool temperatures and an average of 229 hours of life when tested below freezing.

Another pattern also appeared in my test results. Each test in the refrigerator and freezer resulted in a decrease in battery life, even though the hearing aid completed a cycle in the Dry and Store Global after each test.

Conclusions/Discussion
I concluded that patients' reports of shortened battery life in cooler temperatures are valid and that those who live in colder climates will have to change their hearing aid batteries more often. However, the tests also showed a decrease in battery life from one trial to the next, even though the hearing aid was conditioned in the Dry and Store Global after every trial. This may indicate that another variable, in addition to temperature, can cause battery life to decrease over time.

Summary Statement
This project demonstrated the negative effect of cold on hearing aid battery life.

Help Received
Mother helped type report and provided hearing aid equipment and patient testimony.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Gregory D. Livengood

Project Number
J0716

Project Title
Lightning in a Jar

Abstract

Objectives/Goals
My objective was to find what Leyden jar can capture the most voltage. I believed the liquid Leyden jar would outperform the Foil and Hybrid in storage of voltage due to early testing.

Methods/Materials
I conducted my experiment using a ruler, insulated test wire, a Van de Graff generator, and a Leyden jar. The Leyden jar acted as a capacitor, storing the static discharge of the Van de Graff generator. I then measured the energy stored by jar with a test wire and a scientific equation that stated the voltage needed to send a spark of electricity one centimeter: 35,000xLength(cm)=Total voltage

Results
After testing each jar several times, I graphed the results and noticed a trend that caught me by surprise. The results came out with the Hybrid jar being the most successful, with a storage capacity of up to 70,000 volts. The Foil jar was close behind, averaging around 30,000 volts of storage capacity. The Water jar proved to be more consistent but less effective than the other two, with a consistent discharge of 17,500 volts.

Conclusions/Discussion
My hypothesis was proven incorrect, with a paradox occurring that I could hardly believe. The hybrid jar proved to be the most effective, and the water jar proved to be the least effective. From the results of my experiment I could recommend power companies utilize capacitors with foil and water interiors to capture and harness high energy static discharges, such as lightning.

Summary Statement
My project is about the capture of static discharge

Help Received
Dad helped build jars; Used lab equipment from Atascadero Junior High School with permission from Mr. Librizzi; Sister helped design board and edit project content.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Elizabeth L. Llanes

Project Number
J0717

Project Title
A Random Walk Down Chaos Street

Abstract

Objectives/Goals
This project shows that it is possible to predict the onset of chaos in an electrical circuit, an example of a nonlinear dynamic system. It was hypothesized that if the first and second period doublings (or bifurcations) were measured, then it would be possible to predict the onset of chaos in an electrical circuit.

Methods/Materials
To conduct the experiment, a resistor, an inductor, and a diode were connected in series on a breadboard. Then, a waveform function generator was connected across the resistor and the diode as the input for the circuit. An oscilloscope was connected across the inductor and diode to monitor the output of the circuit. The waveform function generator was set to produce sine waves at 1.75 MHz, at a peak-to-peak voltage swing of 0.1 Volts. The peak-to-peak voltage was increased until the first and second bifurcations and chaos were achieved, and those voltage values were recorded. The above procedure was repeated for 3 different types of diodes.

Results
The measured versus the predicted voltage value for the onset of chaos for the 1N4004 diode had a 5.45% error and for the 1N4005 diode had a 3.99% error. The 1N4004 and 1N4005 diodes had a high enough capacitance to produce chaos in the electrical circuit. Capacitance, in combination with inductance, contributes to the generation of chaos in the electrical circuit. The values of capacitance and inductance define the critical frequency of the circuit. If the critical period (the reciprocal of the critical frequency) of the circuit is about the same value as the reverse recovery period of the diode, the diode will cause bifurcations and, eventually, chaos to occur in the circuit. The 1N4001 diode, however, only produced the first bifurcation. The reason that this diode did not produce further bifurcations or chaos was because the capacitance of the diode was low.

Conclusions/Discussion
The predicted versus the actual voltage value for the point of chaos in the electrical circuit had a small error for the 1N4004 and 1N4005 diodes. Due to a low capacitance, the 1N4001 diode did not produce a second bifurcation or chaos. Because the percentage error between the predicted versus the measured value for the onset of chaos was small, the results prove the hypothesis. It is possible to predict the onset of chaos in an electrical circuit if the first and second bifurcations are measured.

Summary Statement
This project shows that it is possible to predict the onset of chaos in an electrical circuit (an example of a nonlinear dynamic system) if the first and second period doublings (or bifurcations) are measured.

Help Received
My father helped me understand some of the math used in chaos theory. Teradyne Inc. allowed me to use an oscilloscope.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Oliver H. Lorenz

Project Number
J0718

Project Title
The Power of the Force: An Investigation of Electromagnetic Field Forces

Abstract

Objectives/Goals
My project was to learn how electromagnets work and to determine if the number of wraps in an electromagnetic coil proportionally affects the strength of the electromagnetic field.

Methods/Materials
Copper wire was wrapped around iron nails to create coils with 50,100, 150, and 200 wraps. Electromagnets were created when each coil was attached to a 12-volt battery. Each magnet was tested fifteen times to see how many washers it could lift.

Results
The more wire wraps on the magnet the more washers it lifted. The average washer lifted per wrap was consistent except for the 50-wrap electromagnet, and the nail with 200 wraps lifted the most washers. For some reason the magnet with fifty wraps averaged only 0.04 washers per wrap. The others more than doubled this average and averaged 0.09 washer per wrap, which indicates that it is proportional. The charge of the battery may have had an impact but I think it is unlikely. The electromagnets didn't pick up large amounts but adding more wraps made the electromagnet stronger.

Conclusions/Discussion
Increasing the number of wire wraps around an iron core proportionally increases the strength of the electromagnet's power.

Summary Statement
My project was to determine whether the number of wraps in an electromagnetic coil proportionally affects the strength of the electromagnetic field.

Help Received
Father and Grandfather helped with electromagetic concepts, Stepmother proofed board and report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ken L.M. Lozano

Project Number
J0719

Project Title
Electrical Conductivity of Three Types of Fruit Groups

Abstract

Objectives/Goals
The objective was to determine if there is a difference in the electrical conductivity of sweet fruits, subacid fruits, and acid fruits.

Methods/Materials
The materials and equipment used are Bananas, Dates, Papayas, Prunes, Apples, Guavas, Nectarines, Peaches, Pears, Kiwis, Lemons, Oranges, Plums, Strawberries, Ascorbic Acid , Citric Acid, Multimeter, pH Checker & buffer solutions, Cell kit with Copper(Cu), Zinc(Zn), Aluminum(Al), Iron(Fe), and Lead(Pb) electrodes, beakers, test tubes, glass plates, graduated cylinder, wash bottle, distilled water, knife, chopping board, & triple beam balance. The steps followed are Calibration of pH Checker, Assembly of the Electrical Cell kit and Multimeter, Preparation of fruit samples and standard organic acid solutions, & Measurement of pH and voltage using varying electrode pairs: Cu&Zn; Cu&Al; Cu&Fe; and Cu&Pb. Three experimental trials were conducted to determine the pH and voltage readings. The pH and conductivity readings were averaged and later used for the correlation and graphical analysis.

Results
The average pH readings showed that the acid fruits had the lowest value and the sweet fruits had the highest one while the average conductivity readings were also relatively higher for the acid fruits compared to the sweet fruits. The average conductivity was highest for the Cu&Zn electrode pair for the three types of fruits and organic acids and lowest for the Cu&Pb electrode pair. The conductivity readings for acid solutions using varying electrode pairs were close to each other for all the different concentrations. The correlation coefficient (r) between the average pH and fruits conductivity showed a weak negative correlation (r = -0.609) for the pH and Cu & Zn while it was not significant for the other electrode pairs. The plots of pH vs. fruits conductivity showed a weak and apparently linear relationship only for the pH and Cu & Zn electrode pair.

Conclusions/Discussion
There was some difference between the electrical conductivity of the sweet fruits, subacid fruits, and acid fruits. The conductivity readings were highest among the fruits and acid solutions using the copper and zinc electrode pair. A negative but weak correlation as well a plot of weak and linear relationship was shown between the pH and fruits conductivity using Cu & Zn electrode pair.

Summary Statement
This project deals with the comparison of the electrical conductivity of three types of fruit groups namely sweet fruits, subacid fruits, and acid fruits.

Help Received
Dr. and Mrs. Reynaldo Villareal of CIMMYT for project planning advice; Mr. Bill Harmon of BJU for project planning and experimental advice; my dad for helping me put together the display board and making the wood stands; and my mom for guiding me through all the steps of making a science project.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Frederick J. Meyer

Project Number
J0720

Project Title
How Inductors and Capacitors Filter Waveforms

Abstract

Objectives/Goals
The purpose of this science project was to explore the fundamental properties of inductors and capacitors and to then show how they can be combined to create useful electronic filters. I used the data gathered to design a combination high-pass / low-pass filter crossover network for a 2-way speaker system. I decided to work with audio frequencies so I could use my ears to measure filter performance instead of using expensive electronic test equipment.

Methods/Materials
I began by winding a number of coils with inductances that have -3dB cutoff frequencies in the audio frequency range. I measured how a number of different inductor-capacitor combinations could change the output frequencies of 'white noise' input signals. And I measured how the filters attenuated the amplitude of sine wave test signals. Then I added different values of capacitors to the circuit to create 2nd order low pass filters. By rearranging the inductors and capacitors I created high-pass 1st and 2nd order filters. With a shareware computer program, I captured spectrum analysis plots for each of my filter designs. Finally, I combined my filters to make bandpass and bandstop filters. I also modeled each of my filters with a circuit analysis program to see how my real circuits compared to simulated ones.

Results
I was surprised at the results when the circuit resistance was higher than expected. In the case of a bandstop filter, even small increases in circuit resistance had a huge effect on the filter shape. My test equipment did not seem to be very accurate in measuring very low or very high frequencies, but this did not affect the overall results. The use of large coils, with their long wire resistance, tended to flatten out the filter plots and decrease their slope. I did not expect this when I started.

Conclusions/Discussion
In all cases, my filters had a dramatic effect on the audio waveforms I was testing. However, I found designing a good crossover network was difficult and challenging. But my passive electronic filters did enable two speakers to sound much better than they would otherwise and the filters protected the speakers from too much power of the wrong frequency. If I continue further on this topic, I plan to explore how active filters and DSP filters work and compare them to my passive designs.

Summary Statement
The goal of this science project was to explore the properties of inductors and capacitors and to use the data gathered to design working electronic filters that improve the sound quality of audio speakers.

Help Received
My Mom helped me do the signs for my display board and printed my photos and my Dad help me type my paper (but I drew all the graphics). Both my parents helped me do my Internet research. My school advisor gave me suggestions how to make my project better. Inspired by Ron Skelton W6WO.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Manoo Moka Murthy

Project Number
J0721

Project Title
What Is the Effect of Temperature on the Output of Semiconductor Diodes?

Abstract

Objectives/Goals
Has one ever wondered why a calculator that has been left in a car out in the sun does not work, whereas the same calculator when cooled to room temperature works again? The conductor of this experiment wanted to get to the root of this question and thus the topic how will temperature affect the output of a semiconductor diode?

Methods/Materials
The apparatus of the experiment was a breadboard with a diode and a voltmeter measuring output. The diode was placed on a heating device, which was connected to a variac which was used to control temperature, a thermocouple was used to moderate temperature. Also the diode was placed on ice, which was also connected to a thermocouple.

Results
This project was exactly as predicted the output of the device decreased in a linear fashion as the temperature varied from room temperature. The average output correlated with the average temperature except for a few exceptions. All four diodes had relatively the same output for a given temperature.

Conclusions/Discussion
The experiment did not proceed entirely without problems. The temperatures of the heating pad were never stable, and the instability grew with the temperature thus making testing difficult. Also twice during the experiment wires were displaced and had to be fixed before testing was resumed.
The hypothesis that the change in temperature will be equivalent to the increase in degradation caused by leakage current, was supported. The higher or lower the temperature the diode was exposed to, the greater degradation was present.

Summary Statement
What is the impact of different temperatures on semiconductor diodes.

Help Received
Father helped with the project, Friend helped donate materials, Mother proofread reports

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Evie S. Pless

Project Number
J0723

Project Title
Laser Microphone: Sensitivity of Two Interferometer Designs

Abstract

Objectives/Goals
To see if I can set up a laser microphone (made from a laser interferometer) sensitive enough to be able to hear someone speaking on the other side of a window. Also, to measure the difference in sensitivity between my design of a laser interferometer and the Michelson interferometer.

Methods/Materials
I built and tested Laser Microphones using Michelson's design and my own design of an interferometer. I tested the difference in sensitivity between the two interferometers in two ways. First, I compared them using an oscilloscope. Then I measured the difference in the volume settings on the amplifier necessary for me to be able to hear the test vibrations. Each laser interferometer was built from the following: 2 front surface mirrors, 1 beam splitter, 1 solar cell (photo detector), 1 laser pointer, 3 fixed mirror holders, and 1 adjustable mirror holder. An amplifier with a speaker was attached to the solar cell to make the laser microphone.

Results
I was able to successfully use the Michelson interferometer in a laser microphone. My design of an interferometer did function but was not sensitive enough to be used in a laser microphone. Using an oscilloscope to compare sensitivity, the Michelson interferometer was 20 times more sensitive. When I tested with the volume setting on the amplifier, the Michelson interferometer was 6 times more sensitive.

Conclusions/Discussion
Using the Michelson's interferometer I was able to build a Laser Microphone that was sensitive enough to pick up vibrations from a window and turn them back into understandable words. Though the my design was not as sensitive as the Michelson interferometer, the sound it produced was more realistic when testing the sensitivity.

Summary Statement
I compared two interferometers for sensitivity, and tested them in a laser microphone.

Help Received
My dad discussed the project with me and helped purchase parts. My mom proofread my poster.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Melissa W. Poon

Project Number
J0724

Project Title
Solar Energy: The DC of Panels at Different Angles

Abstract

Objectives/Goals
To find how the angle between two solar panels and the angle of the light source affects the amount of energy they capture from the sun.

Methods/Materials
Materials: Multimeter, two probes-opposite charges, two sets of solar panels, stiff hinge, two panels of wood, drill with a bit the size of the terminals on the solar panels, and a floodlight.
Methods:
1. Hinge the wood panels together so that they can be moved but do not move on their own.
2. Drill two holes in the wood where the solar panel's terminals would be. Attach a solar panel to the wood and secure in holes. Repeat with other panel.
3. Move the hinge between the solar panels so there is a 30-degree angle between them. The faces of the panels should be facing outwards. This should look like a teepee. Place the floodlight 12 inches from the solar panels at 30 degrees from the midpoint of the panels. Turn the light on and measure the electrical current. Record this.
4. Repeat #3 using 45 degrees instead of 30 for the floodlight. Record. Then use 60 degrees, then 120, 135, and 150 degrees for the floodlight. Record the results each time.
5. Repeat #3 and #4 replacing the 30 degree space in the panels with 60 degrees. Use 90, 120, 150 and 180 degrees. Record current using multimeter and probes.

Results
For more than 70% of the experiment, 180 degrees was the optimum angle. 66% of the time, the panels peaked when the light source was 60 degrees over the "horizon". The lowest current was 0.3 and the highest was 2.85. With the floodlight at 60 degrees, and the solar panels at 180 degrees, the direct current reached its peak. The lowest current was reached with the floodlight at 180 degrees and the panels at 30 degrees.

Conclusions/Discussion
My hypothesis was disproved. The optimum angle was not 150 but 180 degrees. This probably means that when using a solar energy system to supply energy to a home or business, a flat roof is recommended.

Summary Statement
My project investigated solar energy and what roof is the most useful for a solar energy system.

Help Received
My mom and dad helped set up the solar panels.