Name(s)
Sara Anis

Project Number
J0901

Project Title
Series and Parallel Circuits: Comparing Various Parameters

Abstract

Objectives/Goals
The purpose of this experiment is to compare different parameters (Current, Voltage, Power) of the series and parallel circuit by comparing the actual measurement using the Analog Multimeter against the calculated values using Ohm#s Law (V=IR) and also to compare the power in series and parallel circuit.

Methods/Materials
Materials:Plywood, plastic straps, L-shaped metal, alligator clips, 4 bulbs & bulb holders, 2 batteries-6 volts each, screws, Wires, Analog Multimeter, 2 Slide Switch

Method:Using the Multimeter device, I measured the voltage of each individual resistor and the total voltage of both, series & parallel circuit. The values obtained from this measurement, were used to calculate the voltage, current, total resistance using Ohm#s Law and the individual & total power of both the circuits.

Results
The voltage drop across each resistor in the series circuit was verified by taking actual measurement against the calculated ones. The percentage error for voltage was only 1.82%(could be due to loose connection or fluctuation in the Multimeter). Also the current was same in both resistors.
I noted that the total current in the parallel circuit was only off by 4.55% from calculated, due to fluctuation in the probes when measuring voltage. Both series & parallel circuit behaved per my hypothesis & parallel circuit had more power than series circuit as expected.
The power in parallel circuit was almost more than double in the series circuit as one could expect because of twice the voltage of the resistor in parallel circuit compared to series circuit.
This result of mine is already helping the world.

Conclusions/Discussion
In series circuit, when I unscrewed one of the two bulbs, the entire circuit went dark, because in the series circuit the current flows in one path only. Also, that each bulb in series circuit was not glowing brightly compared to the parallel circuit which was expected in the series circuit because of the voltage drop across each resistor.

In parallel circuit, when I unscrewed one of the two bulbs, the flow of electricity was not broken to other branches. The other bulb was still glowing because in parallel circuit, each bulb has its own path of flow of current, & a break in one pathway does not interrupt the flow in the other paths. I also noticed that in

Summary Statement
My project is about comparing the various parameters of series and parallel circuits.

Help Received
Dad helped in cutting the sheets for the display board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Conner R. Bennett

Project Number

J0902

Project Title

Lead Solder Replacement: Comparing the Electrical Resistance of Solder Joints and Electrically Conductive Adhesives

Abstract

Objectives/Goals

My project is to determine which electrically conductive adhesive bond compares favorably to the electrical resistance (ohms) of solder joints. The most environmentally friendly alternative to tin-lead solder are electrically conductive adhesives. I believe Silver Print II, a silver coating adhesive, will have the lowest average resistance reading at the end of the seven days of testing. The hypothesis is based on research that indicates Silver Print II should have an average resistance less than or equal to 0.1 ohms per centimeter.

Methods/Materials

This study will compare solder, the control, with three silver-filled adhesives, one carbon-based electrically conductive glue, and three special formulas. A graphite-filled homemade casein glue was one of the special adhesive formulas. Three identical sample test boards were built with eight sets of tinned copper wire secured ½ inch apart. Solder and the seven conductive adhesives filled the ½ inch gap. Multi-meter readings were recorded two times daily, for seven days in order to observe the resistance in ohms.

Results

The control sample, solder, had the lowest average resistance for the three sample boards at 0.07 ohms after curing for seven days. The silver coating Silver Print II samples produced the lowest average reading of the electrically conductive adhesive samples at 0.08 ohms. At the end of seven days graphite filled Star brite Liquid Electrical Tape had the highest average resistance reading of the samples at 209.81 ohms.

Conclusions/Discussion

The data does support my hypothesis that the silver coating Silver Print II adhesive will have the lowest average resistance reading at the end of the seven days of testing. The data demonstrates that the sample board design challenged the electrically conductive adhesives ability to bridge a ½ inch gap. The transition from soldering to lead-free adhesives is still in its early stages of development. Adding specific fillers to existing adhesive compounds is the most common approach to develop low electrical resistance adhesives. Further research with electrically conductive adhesives is needed to find an environmentally friendly replacement for tin-lead solders.

Summary Statement

The purpose of my project is to present experimental data comparing seven electrically conductive adhesive bonds electrical resistance (ohms) to that of solder joints using a homemade test board design.

Help Received

My parents drove me to purchase supplies; paid for all materials; lent me tools and the multi-meter; answered questions about grammar and word choice, took pictures, and made sure I thought safety first.

Name(s)

Michael C. Binon

Project Number

J0903

Project Title

Portable Antennas

Abstract

Objectives/Goals

My goal to test and select the antenna which represents the best compromise of volume, mass, ease-of-construction, ease-of-erection, and gain when used in portable operation with a backpack HF transceiver.

Methods/Materials

1. Select four antennas for the project, i.e. a ground plane, an end-fed wire with a counterpoise, a ½-wavelength dipole, and a 1-wavelength loop.
2. Fabricate and test 1/10 scale models
3. Fabricate full-scale antennas. Evaluate ease-of-construction.
4. Pack the antennas for weighing and measuring the volume.
5. Erect the antennas and evaluate for ease-of-erection. Measure SWR to calculate correction for SWR and feedline losses.
6. Test the antennas for gain relative to the 1/2 wave dipole.
7. Average the data collected in step 6 to determine relative antenna gain.
8. Do final analysis for best compromise.

Results

The end-fed wire was the easiest to set up but it preformed the worst. The loop was the best preforming, but it was the hardest to set up. The dipole and the ground plane had the same performance but the ground plane only had one wire that needs to be hung. There was a lot of wire when it came to volume so I had to make a few choices. They where all pretty simple to build but the end fed wire did not have to be cut to any certain length.

Conclusions/Discussion

After all of the data I collected, I found out that the end-fed wire with a counterpoise was the easiest to set up, but it also had a 15 db. loss over the dipole which we used as our reference antenna. I also figured out that the loop had a 2.5 db. gain over the dipole, and that the dipole and the ground plane had the exact same gain. I concluded that the dipole best met my criteria.

Summary Statement

My goal to test and select the antenna which represents the best compromise of volume, mass, ease-of-construction, ease-of-erection, and gain when used in portable operation with a backpack HF transceiver.

Help Received

My teacher and fellow students helped erect and test my antennas; Used playground at Granite Bay Montessori school

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Jeffery N. Blaschko

Project Number
J0904

Project Title
How Does the Size of a Battery Affect the Luminosity of a Light Bulb?

Abstract

Objectives/Goals
My hypothesis is that the nichrome filament will illuminate better than the tungsten filament with everyday batteries. The battery voltage or electrical potential and not the size (amount/volume of energy stored counted in joules) directly affects the luminosity of a filament. Joules or the amount of energy used just determines how long a battery lasts to illuminate a filament. I think the nichrome filaments will work better with low voltages then tungsten. The common batteries used in this experiment are of varying low voltages and sizes.

Methods/Materials
1. 2 foot x 2 foot x ½ inch Board, 2. NXT Robotic Brick, 3. 2 NXT Motors, 4. 1 NXT Light Sensor, 5. 2 2½ Inch Rods, 6. 1 4 Inch Rod, 7. 2 Lego Wheels, 8. 1 Hatbox w/ Lid, 9. 4 Alligator Clips, 10. 2 2 Inch Contacting Blocks, 11. 2 Copper Strips, 12. 4 Wooden Ramps, 13. 1 Petri Dish, 14. 1 Empty Ribbon Spool, 15. 4 2½ x ½ x ½ inch blocks.

Results
Nichrome Filament:
21/23 Battery: Average: 2.9% Error Adjusted Average(-2%): 0.9%
AA Battery: Average: 2.0% Error Adjusted Average(-2%): 0.0%
9 Volt: Average: 84.3% Error Adjusted Average(-2%): 82.3%
CR2 Battery: Average: 5.1% Error Adjusted Average(-2%): 3.1%
D Cell: Average: 2.6% Error Adjusted Average(-2%): 0.6%
6 Volt: Average: 71.7% Error Adjusted Average(-2%): 69.7%
Tungston Filament:
21/23 Battery: Average: 2.8% Error Adjusted Average(-2%): 0.8%
Double A: Average: 2.6% Error Adjusted Average(-2%): 0.6%
9 Volt: Average: 35.1% Error Adjusted Average(-2%): 33.1%
CR2 Battery: Average: 3.6% Error Adjusted Average(-2%): 1.6%
D Cell: Average: 2.9% Error Adjusted Average(-2%): 0.9%
6 Volt: Average: 7.8% Error Adjusted Average(-2%): 5.8%

Conclusions/Discussion
The size of the battery does not affect the luminosity of a light filament but how long the filament remains illuminated. Larger size batteries produce longer illuminations. Batteries with high voltages, regardless of size, produce higher or brighter luminosities. Metal resistors of lower electrical resistance will produce

Summary Statement
The purpose of my project is to identify the perfect combination of amps and volts to make the most powerful but longlasting battery for a specific use,

Help Received
My Dad helped with drilling and hammering; Science Teacher provied Nichrome filament; Dad helped purchase Materials

Name(s)

Weston D. Braun

Project Number

J0905

Project Title

Will Changing the Operating Frequency of a Tesla Coil Change Its Ability to Transmit Power Wirelessly?

Abstract

Objectives/Goals

My project was to determine how changing the operating frequency of a tesla coil used as a radio transmitter will affect its ability to transmit energy wirelessly to light up a fluorescent bulb.

Methods/Materials

I made a tesla coil that I used as a simple radio transmitter. I changed the transmitting frequency of the tesla coil by changing the resonate frequency of the primary LC circuit and changing out the secondary coil, which is a quarter length antenna to the transmitting frequency. To test the ability of the tesla coil to transmit energy at different frequencies I used a grounded 12-inch 8 watt florescent bulb. While the transmitter was operating, I touched the non-grounded end of the florescent bulb to the transmitter's top-load. This would cause the gas inside the florescent bulb to ionize, giving a visual indicator. I then pulled the florescent bulb away from the coil until the gas extinguished and measured this distance, which indicated the end of the transmitter's practical range. This test was conducted five times for each of three tested frequencies.

Results

With the radio transmitter was operating at 300 KHz, it transfered power into the florescent bulb from the farthest distance. When the transmitter was operating at 1 MHz it had the shortest range.

Conclusions/Discussion

My conclusion is that lower frequencies allow wireless power transfer over a greater range.

Summary Statement

My project is an investigation of the affect of radio transmitter frequencies on wireless power transfer.

Help Received

My father helped me build the protective Plexiglas shielding and helped me wind two of the three secondary coils.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Brian A. Clark

Project Number

J0906

Project Title

Resistance Is Futile: A Study of Superconductivity and Critical Current Density

Abstract

Objectives/Goals

Scientists have discovered that certain materials can carry electricity with no resistance at cryogenic temperatures. However, as more current is put through a superconductor, it loses its superconducting properties. I hope to discover that a superconductor has a higher density than a copper wire of its same cross section.

Methods/Materials

Superconducting 4 point probe: 1. YBCO, 2. Attached type T thermocouple; Liquid Nitrogen; Small thermos capable of holding superconductor and liquid nitrogen; Thermos for carrying and pouring liquid nitrogen; Gloves, safety glasses, and a smock; 2 multi-meters; 70A room; Power source capable of generating .5 amp of current; 6 alligator clips (3 red and 3 black); 2 banana plugs.

To determine if the hypothesis is correct, the critical current of YBa2Cu3O7 superconductor is obtained experimentally. Then, to obtain the critical current density, the critical current is divided by the cross section of the superconductor. A comparison to a copper wire is necessary to determine if a superconductor has a higher current density than a copper wire of its same cross section. To find the density of the copper wire, divide the maximum rated current by the cross section of the wire. Then, the current density of the superconductor is compared to the current density of the copper wire to test the hypothesis.

Results

Based on my experimental results, I calculated that the copper wire had a density of ~2.8 A/mm^2 and the superconductor had a critical density of .0167 A/mm^2. The experimentâ##s results showed that the superconductor couldnâ##t carry more current than a copper wire, disproving the hypothesis.

Conclusions/Discussion

My results were contrary to my research because the superconductor was a very crude sample with many imperfections. Scientists have high quality superconductors that have much higher critical current densities than what I found. I should have also tried different types of superconductors other than YBCO, and also try to use type 1 superconductors in my experiments because Dr. Hamilton said that they have high critical current densities. I couldnâ##t get either different types of superconductors or type 1 superconductors in my experiment because other types of superconductors are expensive and type 1 superconductors need liquid helium to superconduct, which is expensive and hard to find.

Summary Statement

In my experiment, I attempted to determine if a YBCO superconductor had a higher density than a copper wire of the same cross section.

Help Received

Dad helped with experiment and handling liquid nitrogen; Dr. Clark Hamilton explained anomalies in results.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Bryn E. Cloud

Project Number

J0907

Project Title

Keep Your Distance! The Effect of Different Computer Keyboard Locations on Electromagnetic Field Levels

Abstract

Objectives/Goals

The objective is to compare electromagnetic field levels from different laptop keyboard locations. I believed that the electromagnetic field readings would be greater when the laptop is on your lap than other keyboard locations, and the readings from the lap position would average at least .5 mG. units greater than the other keyboard positions.

Methods/Materials

A Mac Book Pro laptop, 4100 Series ELF Gauss/Tesla Meter, measuring tape, plug-in keyboard, and recording sheets were the materials used for my project. The laptop keyboard locations that were the test variables were: laptop on lap (finger and lap exposure), laptop with plug-in keyboard (six inches away from laptop, laptop on table, and a control (laptop in "off"position). The laptop was placed in test variable position. An electromagnetic field reading (EMF) was take in the "off"mode first. The laptop was then turned on for 5 minutes, and the Microsoft Word Program was opened. EMF readings were taken for each test variable thirty times while simultaneously pressing the "g" key on the keyboard.

Results

The laptop on lap keyboard position had the highest average exposure measuring 2.42mG. The laptop with plug-in keyboard position had the lowest average exposure of .24mG. All of the electromagnetic field readings taken for the laptop on table and the laptop on lap positions exceeded the Swedish safety standard (1mG). None of the electromagnetic field readings exceeded this standard when testing the plug-in keyboard.

Conclusions/Discussion

Overall I learned that the laptop on lap as well as the laptop on table positions had the greatest electromagnetic field readings. These positions are potentially more hazardous to your health than using a plug-in keyboard.

Summary Statement

The purpose of my science project is to compare the electromagnetic field levels from different laptop keyboard locations.

Help Received

mother helped supervise experiment; teacher assisted in proofreading report

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Madison E. East

Project Number

J0908

Project Title

The Effect of Air Molecules and Gravity on the Distance Traveled by a Maglev Train as Its Mass Increases

Abstract

Objectives/Goals

My objective was to determine what affect air molecules and gravity have on a Maglev train as the trains' mass increases. I believe that a Maglev train will travel 5 cm when carrying 12 U.S. quarters when it is affected by a constant force even as gravity and air molecules slow the trains' motion.

Methods/Materials

A Maglev train was made by gluing high force magnetic strips to the bottom of a train model and also placing them as tracks on a wooden base. The magnetic polarity between the train and its' tracks was reversed and the train was levitated. The track sides were made of smooth plastic that did not significantly slow the Maglev (little friction). Firing a Pirates of the Caribbean pistol upside down and stabilized was used as a constant force on the train. The train started from the same Happy Bunny marker for each try. 1 U.S. quarter (average mass of 5.67 grams)was added and taped to the train each try to increase the trains' mass. I measured and graphed the distance traveled by the train in cm after each try.

Results

The Maglev train traveled 5 cm when it carried 14 U.S. quarters. As the train mass increased with each quarter, the distance the train traveled decreased: there is a correlation between the distance the train can go and the weight it carries. The only forces that affected the train model besides the constant force (the pistol hammer) were the force of gravity (9.8 m/s/s) and the air molecules slowing down the train (it created drag).

Conclusions/Discussion

The hypothesis was correct since the train carried 14 U.S. quarters the distance of 5 cm. Gravity (9.8 m/s/s) was pulling the free floating train down and the air molecules were slowing the trains' movement as the train slammed into them creating a drag on the train.

The force of gravity and the drag of air molecules have a large impact on the distance the Maglev train travels as the trains' mass increases. The pistol hammer force is a constant and as the mass of the train is increasing, the acceleration will decrease and the train will not travel as far. Without the force of gravity and air molecules slowing the train, the train would travel forever at the same speed.

Summary Statement

Gravity and air molecules affect the distance traveled by a Maglev train as its' mass increases.

Help Received

My Dad bought supplies for me and let me use the family computer.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Mason E. Fordham

Project Number

J0909

Project Title

Effect of Coil Current on Velocity of a Model Maglev Train

Abstract

Objectives/Goals

The objective of this experiment was to determine the dependence of a magnetically levitated train's velocity on the current applied to propulsion coils.

Methods/Materials

The method I used to record the velocity was that I videotaped a stopwatch. Then I checked the videotape for how many frames were in 1 sec. Thirty frames were in 1 second. Then I videotaped the train 5 times for each level of current. I hooked the videotape up to the television and watched the playback. I recorded the frame that the videotape was at when the train passed each mark. If the train passed the mark at a time between two frames, I interpolated. I then recorded the time, frames, and distance on an Excel spreadsheet and calculated the velocity.

Results

My results showed that the higher current (3 amps) caused the maglev train to go a greater distance and have a greater velocity than when lower current (2 amps) was used.

Conclusions/Discussion

From my graphs I determined that velocity is proportional to current, provided the current was above a threshold necessary to sustain motion past the final coil. However, more comprehensive testing is required to establish this.

Summary Statement

The effect of current in coils on the velocity of a model maglev train

Help Received

Supervision from my parents. Help from parents when I needed help carrying things or an extra set of hands. Instructions on soldering. Intructions on Excel and Power Point.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Joshua R. Fournier

Project Number
J0910

Project Title
HF Backpack Station

Abstract

Objectives/Goals

My engineering problem was to develop a backpack that would be able to supply emergency support and communications for an indefinite period of time, as well as supply shelter, and other necessities.

This project was designed for emergency relief and emergency communications during a natural disaster and would be able to run independent of an outside power source and other telecommunication devices using a solar panel, battery, and QRP (low power) radio for use on the amateur radio bands. As a result of some research and debate, I designed my first prototype and tested it. This emergency communications device proved itself out in the field as a viable QRP emergency communications device that would run independently of an outside power source.

Methods/Materials

Steps for construction of the solar panel mounting apparatus:
1.First, I found my power budget.
2.I next found out how to construct a solar panel mounting system.
3.I determined what type of battery I needed.
4.Next, I got a suitable solar panel and a suitable battery.
5.Then, I found materials I needed online and locally.
6.Finally, I built the mounting frame.

Steps for determining the solar panel/battery combo would work:
1.I discharged my 12.6v and 12 amp hour battery into the QRP radio (low power radio).
2.After mounting the solar panel onto the backpack, I charged the battery from the solar panel.
3.I then tested it in the field.
All tests were recorded accurately and can be answered for if you have questions.

Results

I successfully transmitted emergency communications from my prototype. I successfully ran my station for 20 hours off of the battery.

Conclusions/Discussion

With the information that I recorded from that trip, I determined that more of the weight should be put lower on my back so that I could balance out my pack. I may try some of the other mounting techniques. I'll definitely try new radios and different equipment.

Summary Statement

My engineering problem was to develop a backpack that would be able to supply emergency support and communications for an indefinite period of time, as well as supply shelter, and other necessities.

Help Received

Grandpa helped build solar mounting device. Science teacher helped with designs. Dale helped with antennas and morse code.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ezra J. Graber

Project Number

J0911

Project Title

Electromagnets: Is Bigger Better?

Abstract

Objectives/Goals

My objective was to see which size drillstock would produce the strongest electromagnet.

Methods/Materials

I used six drillstock cores with three different sizes. The sizes were 5/16#, 3/8#, and ½#. Out of those sizes, one from each size had thirty wraps of 22 gauge wire, and on my other three sizes, I had sixty wraps of 22 gauge wire. I then hooked them up to my battery pack which held six volts. For my experiment I put each electromagnet into a container of scientific metal filings the same way each time and held it in there for two seconds to the count of "one thousand and one,one thousand and two.". I would do that five times for each electromagnet and then weigh how much filings it held on a triple beam balance scale.

Results

My data was confusing. For the 30 wraps series, (Chart A), A1 was inconsistent and had a wide range of measurements. B1 started out strong, but became weaker. C1 showed the most consistent data.
For the 60 wrap series, (Chart B), A2 was strong and got stronger. B2 was moderately strong. C2 was the strongest overall.
When I took the averages, (Chart C), the data showed that the biggest core, ½ inches, with sixty wraps was the strongest electromagnet. However, the smaller core with sixty wraps was the next strongest on this chart. I then found out that drillstock can easily become a permanent magnet. At the end of my experiment, only the smaller cores were still being magnetized. So I think the data for the larger cores were true.

Conclusions/Discussion

Bigger is better because the largest magnet with sixty wraps did the best out of all the electromagnets. But the smallest core on Chart C did better than the medium. I think that was because the magnets were still being magnetized which made them stronger. If I did this again, I would try using a single D cell battery in hopes of avoiding magnetization of the drillstck.

Summary Statement

Controlling the variables to test the strength of an electromagnet.

Help Received

Mother helped with photographs.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Douglas G. Johnston

Project Number

J0912

Project Title

Diodes: I Prefer Mine Over-Easy, Not "Fried"

Abstract

Objectives/Goals

The objective of this experiment was to determine a relationship between the voltage drop across a diode as temperature increases. My hypothesis was that as temperature increases, the voltage would increase. Ohm's Law states that voltage is directly related to current and resistance. I found that resistance increases as temperature increases. Voltage should then increase.

Methods/Materials

I built a circuit using a 9-volt battery, 1 Mega-Ohm resistor, and a diode. The diode and its connecting wires were placed in an oven. Positive and negative leads from a digital voltmeter were connected to the respective leads of the diode to monitor voltage drop. A digital thermometer probe was used to monitor the oven temperature. The oven was heated to a temperature of 170 degF (wire lead limit). As temperature increased, the diode voltage drop was noted until 170 degF was reached. The experiment was repeated 3 times for 3 diodes. To see higher temperatures a soldering iron was used. The same electrical circuit was used except that the diode was placed on the counter. The soldering iron and digital thermometer probe were placed at one lead of the diode and allowed to heat up. Temperature and voltage changes were noted until the diode failed. The soldering iron was unplugged and allowed to cool down. The experiment was tested 3 separate times for each diode. Voltage vs. temperature plots were created for each experiment.

Results

Excel plots show that voltage drops as temperature increases which is opposite of my initial hypothesis. In all three diodes there was small voltage drop to a certain temperature followed by a sharp voltage drop. In all cases though, a second order polynomial best fit line was able to be produced for each diode with a regression greater than 90% in all cases.

Conclusions/Discussion

Diodes have different resistances at each lead allowing current to flow. What I conclude is that as the temperature increased, the differences in resistances between the two leads became less. This smaller difference and a constant current source from the battery and resistor, accounts for the decrease in voltage drop across the diode. The small voltage decreases to a certain temperature can probably be described as the diode's operating range and the sharp voltage drop is where you might expect the diode to become unstable and fail.

Summary Statement

This projects explores whether or not I could determine a relationship between the voltage drop across a diode as temperature increases.

Help Received

My father helped me connect the circuit and hold the soldering iron and temperature probe during the second phase of testing. My father showed me how to use Excel and produce the X-Y plots shown. My mother helped me assemble the board.

Name(s)
Adeline M. Longstreth

Project Number
J0913

Project Title
Zoom Zoom: Which LEV Is the Best Spark for You?

Abstract

Objectives/Goals
With gas prices at an all-time high this past summer, many people want to be green and reduce their transportation cost. This project is testing whether an electric bike can be built for the same cost as anelectric scooter and be more energy efficient.

Methods/Materials
Materials for making an electric bike included a bike with 26 inch wheels, steel forks, and at least 3 3/4 inch dropouts, a go hub front wheel motor, speed controller, thumb throttle, split lock washers, Velcro belts, two 16 gage wire series connectors, and three seal lead acid 12 volt batteries. Materials for testing included a Digital Volt Meter, radar detector gun, plastic cones, measuring tape, and an I-ZIP 650 electric scooter. Riders of the same weight rode the electric bike or electric scooter the same distance uphill, downhill, around the block, and around two cones in a figure eight pattern. After each test the battery capacity was measured with a Digital Volt Meter and the results were recorded. Ten trials were done for each type of test.

Results
The electric bike was more energy efficient in the Downhill Test, Around the Block Test, and Turning Test. The electric scooter was more energy efficient in the Uphill Test. On average the electric bike used 0.078 volts for the Around the Block Test, 0.006 volts for the Downhill Test, and +0.003 volts were gained for the Turning Test. The electric scooter used 0.104 volts for the Around the Block Test, 0.043 volts for the Downhill Test, and 0.006 volts for the Turning Test. The electric scooter only used 0.016 volts for the Uphill Test while the electric bike used 0.045 volts.

Conclusions/Discussion
My project could be used for everyday commuting needs. The electric bike is better for turning, going around the block and downhill, but the electric scooter is better for going uphill. The electric bike has more mass because it is heavier therefore making it harder to go uphill. Use of an LEV may depend on the type of commute. The reason the electric bike was more efficient could have been because the electric go hub motor is brushless, which is more energy efficient. While the electric scooter has a brushed motor that is also on a chain drive which uses energy too. The researcher found the cost of both Light Electric Vehicles "LEVs" were close to each other, therefore more people should build electric bikes.

Summary Statement
This project is testing whether an electric bike can be built for the same cost as an electric scooter and be more energy efficient.

Help Received
Mother drove me to pick up parts; Neighbor taught me how to crimp battery wires and attach connectors; Danny Ray, the founder of Ampedbikes, lent me his wife's electric bike as a model, and answered my email questions;Users on ampedbikes.com forum helped me in problem solving.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Roshn Marwah

Project Number

J0914

Project Title

Stop My iPod from Drowning

Abstract

Objectives/Goals

The objective of this project was to come up with a solution that will help prevent electronic or other personal items being washed in a washing machine. I came up with this idea after my mom washed three iPODs at home.

Methods/Materials

I choose RFID as it provided the best solution to this problem. RFID contains two parts, interrogators and tags. Passive tags get all their power from the signal sent by the interrogator. The RFID tags were stuck on two electronic devices an iPOD and cell phone. An RFID reader was set up near the washing machine and connected to a laptop computer with a USB cable. A buzzer was connected to the RFID board to set of an alarm if the reader found a tag. I have also written a small program to play a music file on the computer when a passive tag was within reading distance of the RFID reader. The tags were chosen because they are thin, without batteries and easy to stick on an iPOD or cell phone. Also they do not look bad or make the iPOD/cell phone hard to carry. Electronic devices were put in various types of clothes and brought near the RFID reader, various combinations were tried; with the electronic devices turned off and on, with the washing machine off and on, different kinds of clothes and with a radio playing music in same room.

Results

My results were that within the range of the reader (about 4 inches) I was able to detect the tags and set off an alarm irrespective of the room#s environmental conditions. Therefore, my conclusion is that my project was a success. I have found a low cost solution using passive RFID (Radio Frequency Identification) tags that are light and durable can be used for the detection of electronic and other objects near a washing machine. However, to make this useful and easy to use by most people the range of the reader needs to be increased and the connection between the computer and RFID reader made wireless. The reader could also be built into the washing machine.

Conclusions/Discussion

I considered five different options i.e. Plastic covers, Magnets, Infrared communication, Blue tooth communication, and RFID. I choose RFID as it provided the best solution to this problem. RFID contains two parts, interrogators and tags. Passive tags get all their power from the signal sent by the interrogator. The RFID tags were stuck on two electronic devices an iPOD and cell phone. The project was a success but needs some improvements for general use.

Summary Statement

Determine whether a solution is possible for the detection of electronic objects near a washing machine and set of an alarm if required.

Help Received

Mrs. Makhijani (Science Teacher); Jim at Radio Shack; Kishor to help with program; Parents for funding and other advice

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Jacob R. Moe

Project Number

J0915

Project Title

Super-Duper Magnets: Transporting Us into the Future

Abstract

Objectives/Goals

My project is to determine if perpetual motion can be achieved by using the repelling sides of magnets. I believe that perpetual motion can be achieved when stationary magnets are used against a rotating disk of magnets, thus defying the law of conservation of energy.

Methods/Materials

An engine was designed that consisted of a plastic disk that held 33 individual rectangle magnets with a pull force of 30# each and mounted on an axle in a vertical position. 4 larger, square stationary magnets of 40# of pull force each were spaced and position around the disk in an arc formation with their repelling sides facing outward towards the magnets on the disk. For the test, an electrical pull starter was used to begin the disk spinning. The spinning time of the disk was measured as soon as the starter began until the disk stopped spinning. The test was repeated multiple times with the repelling stationary magnets positioned at varying distances from the disk of magnets.

Results

The repelling stationary magnets positioned around the disk of magnets failed to keep the disk in motion at any of the tested distances. The magnets changed their polarity and went from repulsion to attraction, causing a braking action and thereby stopping the rotation of the disk.

Conclusions/Discussion

In conclusion, changing the distances of the repelling stationary magnets to the magnets on the disk could not overcome the changing of the polarity of the magnetic forces from repulsion to attraction nor could it overcome the law of conservation of energy.

Summary Statement

Producing perpetual motion using the repeling forces of magnets

Help Received

My parents helped me shop for the materials and supervised me when I used power tools and equipment

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Franklin C. Moirao

Project Number

J0916

Project Title

Radio Data Link

Abstract

Objectives/Goals

My Goal is to construct a reliable radio data link operating in the 70cm Amateur Radio band to be used to send commands and telemetry for a range up to 50m. The data link will allow the transmission of fixed-length messages of up to 32 bytes with error detection but no error correction (other than retransmission). Primary use will be to control a future robot project. Messages will be displayed on a 32-character LCD.

Methods/Materials

1. Construct transmitter and receiver.
2. Test ability to turn TX on/off and detect carrier at the RX.
3. Transmit and detect a fixed bit-stream.
4. Transmit and detect a multi-character message.
5. Test framing..
6. Test checksum algorithm.
7. Transmit arbitrary messages.
8. Demonstrate simple robot control.

Materials:

1. One Boe-Bot with a propeller chip on it
2. One small 3"x2" LCD display
3. One eight pin receiver
4. One six pin transmitter
5. 11 small 3" wires
6. One display cable

Results

Demonstrated the ability to send messages reliably for a range of 50m (the limits of my test area # more range is likely possible). Verified all functions including error-detection.

Conclusions/Discussion

The radio data link was successful and met the design goals.

Summary Statement

My Goal is to construct a reliable radio data link operating in the 70cm Amateur Radio band to be used to send commands and telemetry for a range up to 50m.

Help Received

Brian Lloyd, my science teacher, helped me learn the programming language and introduced the concepts of packet radio systems.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

John R. Niblick

Project Number

J0917

Project Title

RAM vs. CPU: A Study on the Effects of RAM and CPU on Computer Speed and Performance

Abstract

Objectives/Goals

The objective of my projects was to determine if the main modifier on computer speed and performance was random access memory of the computer processor unit and how much of an effect these two components had.

Methods/Materials

I tested this by obtaining three computers with similar ram and differing processor speeds. I installed one copy of my two test programs on each of these computers and then ran these programs twenty times. I used these times as my data by averaging them. To preform these tests I used three computers with similar amounts of ram, three cpus with three different speeds, three copies of RPG Maker 2003, three copies of t@b video editor, and one stopwatch.

Results

I found that the cpu had more of an effect on speed and performance of an operating computer than the ram in all instances except for when I was running a more complex program.

Conclusions/Discussion

The results I attained did not prove my hypothesis correct. I had stated that the ram would have more of an effect however it was the cpu that triumphed. This project has furthered my knowledge in this field by disproving my previous theories about ram and educating me on the effects of faster processors.

Summary Statement

The effects of ram and cpu on computer speed and performance.

Help Received

Mother help assemble display

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Matthew A. Nickell

Project Number

J0918

Project Title

The Leyden Jar

Abstract

Objectives/Goals

My project was to see if static electricity could be stored in a Leyden jar capacitor made out of common household materials, and if so, can the charge held inside the Leyden jar be measured.

Methods/Materials

An electrophorus was assembled using a disposable aluminum pie pan, a Styrofoam cup, and tape. A Leyden jar was then assembled using a small plastic jar with a lid, a hammer, a nail slightly longer than the jar, aluminum foil, and tap water. Then, for charging the electrophorus, I used an 11x14 acrylic sheet, wool cloth, and the electrophorus. For measuring the charge in the Leyden jar, I used a piece of aluminum sheet, a large, flat piece of Styrofoam, a plastic travel soap dish, scissors, insulated wire: 6# long, wire strippers, a metric ruler, and tape.

Results

What I found out was that if you charge the Leyden jar once, you don#t get a spark, which leaves you with an undeterminable voltage. If you charge the Leyden jar 5 times, you get a 3 mm spark, which is 9,000 volts. If you charge it 10 times, you get a 1 cm spark, which is 30,000 volts.

Conclusions/Discussion

My results support my hypothesis. I found out that static electricity can be stored in a Leyden jar capacitor made out of common household materials. Next time, I might make the Leyden jar a little bigger, so it could hold more charge. If I were to further investigate my experiment under a new question, it would be: #How much voltage does one charge cycle give the Leyden jar#.

Summary Statement

My project is to see if static electricity can be stored in a Leyden jar capacitor made out of common household materials.

Help Received

My father helped me assemble my experiment. My mother took me to the store to buy the materials for my experiment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Sierra J. Rupnow

Project Number

J0919

Project Title

Electroma... What?

Abstract

Objectives/Goals

My experiment is designed to find how much electromagnetic radiation is emitted by each of four ways (using the phone directly, on speakerphone, with a plug-in headset, or with a wireless headset) of talking on a cellular phone.

Methods/Materials

To perform my experiment, I used an electromagnetic radiation sensor, a radiation-free room, three cell phones, a plug-in headset, three wireless headsets, a ruler, a flat surface, and an accessible landline. To answer my objective, I placed a call from a cellular phone and, using the electromagnetic radiation sensor, found from which area the phone gave off the most electromagnetic radiation. I then placed five more calls and used the sensor to record the amount of radiation given off throughout each call. I repeated the process placing the sensor 22 centimeters away from the phone during the calls to simulate the distance the phone would be from the head if the user were talking on speakerphone or with a headset. I performed this test with each phone. Subsequently, I repeated these tests using speakerphone, a plug-in headset, and a wireless headset for each phone.

Results

From my experiment, I found that each tested phone gave off the same amount of radiation independent of the method used to talk on it, but neither the plug-in headset nor the wireless headset gave off any radiation while in use.

Conclusions/Discussion

In conclusion, the method that keeps the phone itself farthest from the speaker's head will result in the lowest amount of radiation going into the speaker's head.

Summary Statement

For my experiment, I tested which method of talking on a cellular phone (directly, on speakerphone, with a plug-in headset, or with a wireless headset) emits the lowest amount of electromagnetic radiation.

Help Received

Name(s)

Alexander T. Ryan

Project Number

J0920

Project Title

Web-Controlled Mobile Video-Enabled Collection Device

Abstract

Objectives/Goals

Litter is a big problem in today's world. In addition to its unappealing look, litter may actually harm animals and pollute the environment. Unfortunately, there are not really any good methods of collecting litter and removing it. Removing litter by hand is expensive, time-consuming, and inefficient. I wanted to see if it was possible to create a remotely controlled robot that could clean up efficiently and inexpensively.

Methods/Materials

I used an RC car as the wheelbase of the robot, and used a DLP-I08 USB I/O cable and relays to interface a laptop running Ubuntu and the radio control for the car. I purchased and assembled an advanced robotic arm kit, and interfaced it, using two DLP-I08s and relays, to a miniature computer (called a fit-PC) running Ubuntu. I created a webpage, running off Apache on the laptop, that linked to a shell script on both the laptop and the fit-PC. Each shell script controlled its respective DLP-I08s based on input from the webpage. I purchased a wireless webcam and attached its power cable to a battery. I attached wires from another battery to the miniature computer. I mounted both batteries, the fit-PC, its DLP-I08s, and the robotic arm on the RC car. I also cut and spray-painted an aluminum L-bar, mounted a trash receptacle and the webcam on it, then attached that assembly to the robot.

Results

The remotely controlled vehicle I built was able to pick up litter that weighed from 0.05 grams to up to 100 grams. The device could be controlled over the world wide web through any ordinary computer.

Conclusions/Discussion

I found that it was possible to create a litter-cleaning robot from readily available technology. A similar machine to the one I constructed could be mass produced fairly cheaply. The robots could be used to clean city parks, theme parks, parking lots, highways, or other places with large amounts of litter. Developing certain software could even eliminate the need for human control, allowing for a completely autonomous and efficient robot.

Summary Statement

In this project I attempted to create a wireless, remotely controlled device, capable of picking up litter, by creating circuit boards, a web page, and cgi scripts that controlled a vehicle and robotic arm.

Help Received

Parents paid for supplies; father supervised safety procedures and provided guidance; uncle helped me resolve software bugs.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Daniel S. Sakakini

Project Number

J0921

Project Title

Can a Remote-Controlled Vehicle Create a FIrebreak?

Abstract

Objectives/Goals

As people move out to more remote areas and naturally dry regions, fires become more and more devastating to humans and their property. The fire department has been using the same fire fighting techniques for a long time. I have personally experienced three major wildfires in my lifetime in San Diego County. If the fire department were able reduce the number of firemen needed to fight large fires, it could be very beneficial. My question was: #Could a remote-controlled vehicle create a fire break?# My hypothesis was that, yes, this vehicle could be built, even if I myself could not build a complete, full-scale operational model.

Methods/Materials

In my experiment, I used an M41 Walker Bulldog model tank as my concept vehicle. I mounted my blade arm and SPYKEE camera onto my vehicle. I used an Erector motor for my original blade motor. I used a full water bottle as a counterweight, which could also be used to wet down the surrounding area. I tested my tank at a canyon much like the terrain of a real fire zone.

Results

My results supported my hypothesis. My tank was able to cut down small brush, and worked much like a weed whacker. Although I could not get the camera to work, a camera would be a critical feature in a real-life operation.

Conclusions/Discussion

I was able to move the plants out of the way, but I realize a very powerful vehicle would be needed to remove dense or woody brush. Still, based upon my results, the vehicle I designed performed well, and I believe there is potential a full-scale model could be utilized in wildfire situations

Summary Statement

The goal of my profject was to construct a remote-controlled vehicle prototype thatt could create a firebreak in the event of a wildfire.

Help Received

Thanks to Mr. William Metcalf, for his prelimary help; Grandfather helped find parts; Mother for keeping me on taskThanks to my science teacher for her support

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Aaron G. See

Project Number
J0922

Project Title
What Type of Antenna Works the Best?

Abstract

Objectives/Goals
To find which type of DTV antenna works the best.

Methods/Materials
Compound bowtie antenna, Telephone wire antenna, Loop antenna, Single bowtie antenna, Can antenna, Analog TV, DTV converter box, Coaxial cable, Twin lead cable

Results
The loop antenna is the best; the compound bowtie came in second; the bowtie antenna is third; the telephone wire antenna came in fourth, and the can antenna came in last.

Conclusions/Discussion
The loop antenna was the best and the compound bowtie antenna was the second best. Both of these antennas were made with multiple recievers. There is also a variable that is introduced because of the direction of the antenna and the environment of the testing area.

Summary Statement
My project focuses on testing what type of antenna will get the best DTV signal reception.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Brandon R. Sepulveda

Project Number
J0923

Project Title

Transfer Your Data, Save Your Dollars: A Cost Analysis of Transfer Speeds on Various Network Switches and Cables

Abstract

Objectives/Goals
The objective of this project is to determine if the cost of converting category 5 cable (running 10 100 switch) to category 6 cable(gigabit switch) correlates to the amount of speed gained when transferring data.

Methods/Materials
Using two identical Windows based computers, I created a network by connecting one end of a Category 5 cable to an Ethernet port on Computer A and the other end to a port on the 10/100 switch. I connected a second cable to computer B's Ethernet port and again to the 10/100 switch. I then downloaded a 594 MB, 361 MB, and 104 MB file to the network and I transferred each file from computer A to computer B. I timed the transfer speed of each file by using a stopwatch and recorded the estimated and the actual transfer times. I repeated this same process for a total of 25 trials of Cat 5 on the 10/100 switch, Cat 5 on the gigabit switch, Cat 6 on the 10/100 switch, and Cat 6 on the gigabit switch.

Results
After completing my project, I found out that my hypothesis was correct. I had hypothesized that it would NOT be cost effective to convert from Category 5 (10/100) to Category 6 (gigabit). My results showed that, on average, Category 5 cable cost $4 while Category 6 cost $12 (200% increase); network switches increased in price an average of 900% ($25 on10/100 and $250 gigabit). The average transfer speed on Category 5 (10/100) was 8.3 seconds faster than Cat 6on 10/100; average Cat 5 gig was 1.19 seconds SLOWER than Cat 6 (gig). Cat 6 gig did average out with a faster transfer speed when compared to the Cat 5 10/100.

Conclusions/Discussion
Although Cat 6 on gig did transfer faster than Cat 5 10/100, a home network cannot justify the speed gained to the correlating upgrade costs.

Summary Statement
This project determines if the cost of converting category 5 cable (running 10 100 switch) to category 6 cable (gigabit switch) correlates to the amount of speed gained when transferring data.

Help Received
Mother helped glue papers to board

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Christipher L. Sercel

Project Number

J0924

Project Title

Boxed Lightning: The Effect of Run Time on the Electrical Resistance of an Alternating Current (AC) Carbon Arc

Abstract

Objectives/Goals

This experiment explores the topic of how the run time of a carbon arc would affect its resistance. My approach was to build a carbon arc and measure the resistance at different intervals of time. I hypothesized that over time, resistance would decrease. This was based on the principle that when a carbon arc is running, the carbon in the tips of the rods sublimates and ionizes, creating a more conductive environment.

Methods/Materials

The first thing I did was build two rod holders out of 2x2's. To do this I had two long pieces and two small. I glued the small on top of the large. I drilled holes through the top block. The rods would go through these holes. Next I took two pieces of molding and glued them parallel to each other just wide enough for the two rod holders to fit in. One rod holder I glued down so that it would be stationary. I would move the other so that I could adjust the gap between the rods. Next I built my circuit using two space heater wired in parallel as resistors. In order to take data, I used one ammeter and one voltmeter. Since Ohm's law states that R=V/I, I could divide the measured voltage by the measured current to find resistance. I set up my meters next to each other. I set up a camera on a tripod so that it could take pictures of the two meters and put it on a setting where it would take successive pictures of the same spot. Before running the arc I had to put on welding goggles to protect my eyes. SAFETY FIRST! I also built a shield box with a window of the same glass to use for demonstrational purposes. I turned on the arc and at the same moment held the button on the camera down to take pictures of my meters. I did this 7 times. I uploaded the pictures onto my computer and put the data from the pictures into a spreadsheet.

Results

I found that in almost every instance, electrical resistance increased greatly over time. This answered my research question,"How does run time affect electrical resistance of a carbon arc?".

Conclusions/Discussion

Resistance increased over time. I have two possible reasons for this. The first idea I had was that over time, more and more carbon sublimated. This would cause a larger and larger gap between the rods, making it harder for the electricity to jump between the rods. The other idea I had was that the more volatile carbon sublimated first. This would leave behind harder carbon more reluctant to sublimate.

Summary Statement

My project is about how the run time of a carbon arc affects the electrical resistance it causes.

Help Received

Mother helped proofread report; Father helped by teaching my about electricity and approving/disapproving circuit designs as well as reviewing safety procedures; Aunt reviewed safety procedures; Uncle reviewed safety procedures; Science teacher helped give ideas so as to better test

Name(s)

Nicholas Vanhecke

Project Number

J0925

Project Title

Solar Powered Electromagnetic Propulsion: Eco-Friendly Solution for the Existing Rail Infrastructure

Abstract

Objectives/Goals

The purpose of my science project is to find out if the existing rail infrastructure in the United States could be changed into a rail system powered by electromagnets rather than diesel engines. The rail system would then replicate a simpler version of the Maglev train in Japan. The rail infrastructure could be made into a completely eco-friendly transport system.

Methods/Materials

I have built a 1:43 scale replica of a train and the track it is running on. The electromagnets are controlled by my computer through an electronic relay board. The electromagnets are powered by a deep cycle battery that is charged by an Ultraviolet Light Panel. The train was tested by how far the electromagnets were spaced apart and by how many electromagnets were turned on at the same time.

Results

The train reacted differently to all my tests and was definitely affected by the number of electromagnets on and how far they were spaced apart. The Ultraviolet Light Panel was able to charge the battery efficiently.

Conclusions/Discussion

My conclusion is that this system of rail transport is very effective and could one day become reality through more research and further development.

Summary Statement

My project is about alternative eco-friendly transportation systems that could eventually replace the existing modes of mass public transport.

Help Received

Father helped with the use of power tools and some assembly of Solar Panel Mount.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Jackson L. Wopat

Project Number

J0926

Project Title

The Effect of Wire Spacing on an Electromagnet

Abstract

Objectives/Goals

To find out if spacing wire wraps on an electromagnet strengthens or weakens the electromagnet.

Methods/Materials

12 inch iron nail; Insulated copper wire; 6-volt battery; Duct tape; Wire cutters and strippers; 250 small paperclips; 2 small alligator clips.

Wrap as many loops of wire around the nail in an area of 2 inches, at the front of the nail going back. Attach the alligator clips on both ends of the wire and clamp the clips onto the terminals of the 6-volt battery. Then determine how many paperclips the electromagnet can pick up by dipping the tip of the nail into the container with the paperclips and swirl it around. Count how many paperclips the electromagnet picks up and repeat nine more times so you have picked up paperclips a total of ten times. Average the numbers, then spread the wire so the ends are at a distance of 3 inches without adding or taking any wraps off the wire. Then pick up paperclips ten more times and average the number. Spread it out over 4 inches and repeat the steps for 4 inches, 5 inches, 6 inches, and so on until you average the numbers for 11 inches. Then graph the data.

Results

2"- average of 15 paperclips picked up
3"- average of 13.3 paperclips picked up
4"- average of 10.5 paperclips picked up
5"- average of 10 paperclips picked up
6"- average of 7.4 paperclips picked up
7"- average of 5.1 paperclips picked up
8"- average of 4.8 paperclips picked up
9"- average of 3.7 paperclips picked up
10"- average of 1.9 paperclips picked up
11"- average of 1.5 paperclips picked up

Conclusions/Discussion

My results support my hypothesis. The more space in between the wraps of a wire on an electromagnet, the weaker the magnetic pull from the electromagnet. If you look at my results, you will notice that the number of paperclips picked up steadily decreased, as more space was added in between the wires. If the space was increased even more, it would eventually pickup no paperclips and finally have no magnetism

Summary Statement

The effect of wire spacing on an electromagnet.

Help Received

Dad revised typed parts; Mom helped with poster board set up.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

RoShawn J.J. Yehle

Project Number

J0927

Project Title

Sniff, Sniff

Abstract

Objectives/Goals

My project is to see if I can turn a plug in air freshener into a battery powered air freshener. I will also make homemade batteries to compare.

Methods/Materials

My test objects are three different kinds of air fresheners.I'm making a portable air freshener that runs off of a battery. I will also need batteries, an inverter, wire, alligator clips, a volt meter, and a small light bulb.

Results

I accomplished turning direct current into alternating current by using an inverter and adapter. I was also successful turning volts into amps.

Conclusions/Discussion

My conclusion is that my project was successful because I was able to hook up an electric air freshener to a battery. However, homemade batteries don't generate enough voltage.

Summary Statement

Can plug in air fresheners be made portable to make the world smell better.

Help Received

Mother helped organize project.