CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Sneha S. Bhetanabhotla

Project Number
J0201

Project Title
Energy Generation Using Reverse Electrowetting

Abstract

Objectives/Goals

Reverse electrowetting is the process in which conductive fluid drops generate electric potential when made to flow between electrodes. The purpose of this research is to generate electricity using reverse electrowetting and study how this is affected by these variables - the speed of solution drops, the electrode materials and solutes, and the channel lengths. My hypotheses were as follows:

- The faster the conductive fluid drops move, the more energy will be generated.
- If the conductivity of the fluid is more, then the amount of energy generated will be more.
- If the electrode material has a higher conductivity, then the amount of energy generated will be more.
- If the channel between the electrodes is longer, then the amount of energy generated will be more.

Methods/Materials

In this project, water, sodium chloride, and potassium chloride solutions were used as conductive fluids, and brass and steel plates as electrodes. Plastic rods were kept between the electrodes to make a fluid channel for the solution to flow. The solution was poured into a balloon, and an NXT robot was used to compress the balloon at different speeds to make the solution flow into the channel. Voltage readings were taken as soon as the solution began flowing through the electrodes.

Results

My analyses for my hypotheses were as follows:

- Less energy was produced when the speed of the conductive fluid drops increased, as at higher speeds, the fluid might have moved as a stream instead of as drops.
- The energy generated was more when the conductivity of the fluid was more. The energy generated is higher for the Sodium Chloride and Potassium Chloride solutions than for water as those are electrolytic solutions with higher conductivity.
- The electrode material with the higher conductivity, brass, produced lower voltages than the electrode material with the lower conductivity, steel, because electric charge accumulated more on less conductive material.
- The energy generated became more when the length of the channel between the electrodes became more, because more drops could be present on the electrodes at one time.

Conclusions/Discussion

Thus, my research proves that energy can be generated using reverse electrowetting, and more energy can be generated using more conductive fluids like metallic fluids and more number of drops in thin, long, fluid channels.

Summary Statement

Using reverse electrowetting for generating electricity which can be used as energy source for portable electronic devices.

Help Received

My father helped in acquiring all the needed materials for the experimental set up. My mother reviewed my presentation and the project board.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Joy E. Brown

Project Number
J0202

Project Title
Sol-Lunch

Abstract

Objectives/Goals
My Objective was to built a solar oven in a form of a lunchbox that I can carry to school with my lunch inside of it and use it to cook my lunch without the use of electricity.

Methods/Materials
Materials:
1.Two shoe boxes 2.11/2 rigid insulation 3.Metal tape 4.Thin and Thick cardboard 5.Plexiglass 6.Duct tape 7.Black construction paper 8.Spray adhesive 9.Mylar 10.Oven thermometers 11.Metal handle 12.Timer 13.Camera 14.Pencils 15.Box cutter 16.Drill with 2" circle bit 17.Table saw 18.Record book
Methods:
I created two single panel solar oven lunchbox using a Shoebox. I kept one oven as a control oven and slowly added panels to the second oven for experimenting. Slowly adding panel by panel allowed my to create a portable solar oven lunchbox.

Results
I created a portable solar oven lunchbox that not only caries your food but also heats up and cooks food.

Conclusions/Discussion
My results supported my hypothesis in that I made a lunchbox that can cook food without the use of the electricity. Infact I surpassed my Hypothesis because Sol-Lunch lunchbox actually cooks meat and eggs and I did not think that was possible.

Summary Statement
My project is about creating a portable solar oven lunchbox.

Help Received
Mother helped separate variables, Father helped cut rigid insulation on table saw and hole drill.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Semaj A. Davis

Project Number

J0203

Project Title

Waste Not, Want Not: Use the Microbial Fuel Cell to Create Electricity from Waste

Abstract

Objectives/Goals

My objective was to find an alternative method for creating electricity, the (MFC) which is a system in which bacteria converts organic material into power. The goal was to build a (MFC)using a benthic mud sample from a stream and determine if this device can harvest the electrons that the anaerobic bacteria create.

Methods/Materials

In this project I had 4 main parts the anode, cathode, proton-exchange membrane, and external circuit. For the anode and cathode I used two medium sized acrylic containers as a basin for the salt water solution and anaerobic mud. For the proton-exchange membrane I used a compression fitting as the tube that inserts between the anode and cathode. Then inside of it I had boiled water with salt and unflavored gelatin in as a way for the protons to pass through from the anaerobic mud to the salt water solution. Next, I used carbon cloth and insulated copper wire as my electrical circuits so that the voltage can pass through them so that I can read them through the digital multi-meter. For the actual benthic mud; I obtained it from a lower order stream and for the salt water solution I obtained river water and put salt into it so it can become a conductive solution so electrons can pass through it. Lastly, I used an aquarium air pump to oxidize the salt water solution and a digital multi-meter to measure the voltage.

Results

For my results I did 2 tests, one with the aquarium pump on and one without it to see if the oxidation was necessary. So with the oxidation process going through the chamber the voltage read .011,.020,.016,.023,.033,.030,.050,.057 and with these readings the voltage would fluctuate at certain times and decrease mainly in the beginning due to it needing to run longer but over a certain period of time it would stop at around a stand still of about .057. Next, when I tested it without the oxygen all the voltage readings went below zero due to the fact that the (MFC) needed that oxygen to produce voltage.

Conclusions/Discussion

All in all, I created this project as a way to benefit the world because I enjoy creating something that can make the planet a better place and not a bad one. Furthermore, I can actually power something like a small fan or battery but the problem is being that the mud I came across wasn#t as good as I hoped. But I will try to come across a more beneficial product so that I can actually show the full extent of my work and not make it a failure.

Summary Statement

The main purpose of this (MFC) is to produce electricity by using a natural element to benefit the world.

Help Received

I had assistance from my dad dealing with strong chemicals that were used to bond the wire to the carbon cloth and drilling in the containers.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Lucca F. DeBiaso

Project Number
J0204

Project Title
Cooking with Solar Power

Abstract

Objectives/Goals
My project was to test three different green house containers in a solar oven. My hypothesis was that the plastic container will hold the most heat in the solar oven.

Methods/Materials
Materials: 4 5-gallon buckets,several large rocks, 12 2 foot long stakes, 4 windshield sun shades, Duct tape: silver and black, 2 quart plastic container with lid, 2 quart glass container with lid, oven bag (specifically for cooking), 2 #beer can# cooking racks, 4 digital thermometers, water, 1 cup measuring cup, 4 small Dutch oven cooking pots, apple crisp.

Results
The glass container held and gained the heat in the most.

Conclusions/Discussion
While my results demonstrated that the glass container was the most efficient greenhouse container - achieving and retaining the highest temperature out of all the containers - they are not, however, 100% conclusive. The test needs futher repetition as well as for other factors - time of year/angle of the sun/ longer exposure/multiple-day tests - to be in play for more conclusive results.

Summary Statement
My project is about testing the efficiency of different greenhouse containers in a solar oven.

Help Received
Mom helped type report, dad helped make ovens and showed me how to make graphs using Exel, teacher (Mrs. Kelley) helped with registration as well as general support.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Travis P. Doran

Project Number

J0205

Project Title

Hydrogen Hotrod: Can Adding Hydrogen Increase Your Car's Fuel Efficiency?

Abstract

Objectives/Goals

My objective in doing this project was to determine if adding Hydrogen, produced by electrolysis, can positively affect a vehicle#s fuel efficiency.

Methods/Materials

Determine design for Hydrogen generator. Locate, purchase parts, assemble generator.
Fill the generator reservoir with distilled water and catalyst. Install the generator.
Record MPG on 2 tanks of gas WITHOUT generator. Record MPG on 2 tanks of gas WITH generator.
Alternate subsequent tanks of gas with AND without the generator to assist in qualifying results.
Calculate MPG for EACH tank of gas, then compare.

Glass #Ball# jar. Plastic canning lid. Drip line elbows, bubbler. Aquarium pressure check valves. Plexiglas tower. Stainless steel positive and negative wires. 4 inch tube with plastic wall anchor. Wing nuts, bolts, washers. Waterproof plumbers #goop#. Baking soda. Distilled water. Red and black insulated wire, connectors. ¼ inch clear tubing.
Relay. In-line fuse holder. 2006 Toyota Corolla.

Results

G=gallons of gasoline used. MD=miles driven. MPG=miles per gallon
Without using the Hydrogen generator
Test 1 # 11.048G, 357MD = 32.31MPG. Test 2 # 6.825G, 202.8MD = 29.71MPG
Test 3 # 9.325G, 269.3MD = 28.88MPG. Test 4 # 11.667G, 367.6MD = 31.51MPG
With using the Hydrogen generator
Test 1 # 3.762G, 129MD = 34.29MPG. Test 2 # 4.931G, 165.5MD = 33.56MPG
Test 3 # 9.967G, 336.9MD = 33.80MPG. Test 4 # 9.574G, 330.6MD = 34.53MPG
Test 5 # 10.772G, 356.9MD = 33.13MPG. Test 6 # 10.719G, 359.4MD = 33.53MPG
Test 7 # 8.681G, 285.6MD = 32.90MPG
Please see Method and Journal for details on alternating the use of the generator between tests.

Conclusions/Discussion

My hypothesis was correct. Fuel efficiency was improved by 2.83 MPG. This is a 9.20% increase. My dad drives an average of 18,000 miles yearly consuming approximately 585 gallons of gasoline. Using the Hydrogen generator would save him 54 gallons of gasoline per year. With the current average price of gasoline at $4.10 per gallon, this would equal a savings of $221.40 annually.

Summary Statement

Using electrolysis, my Hydrogen generator will positively affect the fuel efficiency of a vehicle.

Help Received

My dad monitored every step of the generator building and installation process. My mom assisted me in arranging the content of my project board and journal.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
William W. Follett, V

Project Number
J0206

Project Title
Microbes + Wastewater = Free Electricity

Abstract

Objectives/Goals
The objective is to determine if a polycarbonate proton exchange membrane (PEM) can produce more power and cost less than a Nafion PEM that is usually used in university research on microbial fuel cells (MFCs).

Methods/Materials
I developed a unique MFC design that allows proton exchange devices to be easily compared while controlling for changes in the microbe community. I spent a very long time searching for MFC designs, and as far as I know mine is the only MFC to control for the microbes. I was recognized by Penn State University and my MFC is on their website.

The PEMs and the salt bridge separate the anode and cathode chambers, and allow only hydrogen to pass through. The PEM or salt bridge to be tested is selected by opening and closing the correct valves. To determine the power output, the electrodes are connected to various resistances and the voltage is measured. The power is calculated at each resistance by using the formula V^2/R to find the maximum power. The maximum power is divided by the cost of the membrane, which gives watts per dollar. This is repeated for the various proton exchange devices.

Results
The Millipore polycarbonate membrane clearly performed the best out of all of the membranes and delivered 13.1 - 15.8 microwatts per dollar compared to 6.9 microwatts per dollar for the Nafion membrane. The tests showed good repeatability, even though the second test had nearly twice the power output. The tests are repeatable because the results scaled very well. The relative performance ranks of the proton exchange devices (PED) stayed the same for both tests. The significant changes in power show the importance of controlling for the microbes.

Conclusions/Discussion
The hypothesis that the Millipore polycarbonate membrane will provide more power output at a lower cost than the Nafion membrane is partially true. The Millipore membranes performed about the same as the Nafion membrane in terms of peak power but provided over twice as much power per dollar.

The real world application of MFCs is to generate electricity from wastewater treatment plants. The potential energy in U.S. wastewater today is equivalent to 15-20 nuclear power plants. Besides wastewater treatment, MFCs are also good for applications where batteries are hard to replace such as underwater sensors, space rovers and heart pacemakers.

Summary Statement
This project investigates the effect of different proton exchange membranes on microbial fuel cell performance while controlling for the microbe community.

Help Received
My father mentored me, and my mother taught me how to use a bread board for last year's science fair project.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kylie D. Freitas

Project Number
J0207

Project Title
Wired Up for Powerful Results

Abstract

Objectives/Goals
My science project was to determine whether a solar panel or a wind generator would produce the most sustainable energy for Escondido, in Southern California, to daily charge a cell phone, computer, and Bluetooth device. My objective was to create an automatic, alternative generating and power storage system to deliver sufficient daily recharging. My hypothesis was that A solar panel will produce the most efficient energy to charge my daily electronic devices for Escondido, Southern California weather.

Methods/Materials
I setup and measured test results from my solar panel and wind generator at coordinates 33degrees N, 117degrees W. I measure both renewable sources of energy from 10:00 a.m. to 5:00 p.m. I used a 5 watt, 24 volt, solar panel facing 180degrees south. The solar panel produced an average of 5.24 watts. I also tested my wind generator, which I built, at the same location. The average power produced by the wind generator was 2.68 watts.

Results
The results of my project are that the solar panel did produce the most effective and stable energy to charge my daily technologies in Escondido weather. At the coordinates of 33degrees N, 117degrees W with the solar panel facing 180degrees south it was able to sustain a sufficient amount of power to charge all three technologies that I tested. The wind generator was not consistent or stable enough to charge all my daily electronic devices consistently throughout the day.

Conclusions/Discussion
My testing revealed that as an alternative source of energy, a solar panel is the most realistic solution to harness energy in Escondido to charge my electronic devices. My hypothesis was proven correct. The average wind speed in Escondido is not strong or consistent enough to rotate the wind generator during the time periods I tested, to produce the 36 watts needed to charge the technologies.

Summary Statement
Which renewable power source could produce the most effective energy to charge my daily electronic devices?

Help Received
Dad gave me instructions so I could execute them, Technology teacher help me trouble-shoot my electronic controller, Neighbor helped me put together my controller, Friend donated motor for wind generator, Mom helped design board, Grandpa supplied tools.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Ishani A. Karmarkar

Project Number
J0208

Project Title
Unlocking Nature's Secret to Green and Efficient Solar Energy

Abstract

Objectives/Goals
The objective of this experiment is to find the most efficient tree pattern for generating solar energy compared to flat panels using photovoltaic (PV) cells. In addition, this experiment studies the effect of the trees' natural habitats and seasonal changes on the energy generated by PV cells.

Methods/Materials
Tab the PV cells using solder and tabbing wire. Test the PV cells using a multimeter. Attach ten PV cells onto each tree model using double- sided tape. Record the voltages and current for each cell on all the five tree models (palm, plantain, evergreen, conifer, and flat panel at fifteen degrees incline), three times a day (9AM, Noon, 3PM) for ten days each in winter and early spring. Note the weather conditions (sunny, partly cloudy, cloudy) every time. Calculate the power (P=Voltage x Current) for each cell. Calculate the average power generated by each tree. Analyze the data to study the effects of season, weather condition, and time of day for each tree.

Results
This experiment was performed in the months of December, and late February. In December, the pattern of a conifer generated the most electricity. Palm and plantain followed the conifer, while flat panel was least efficient. However, the second set in the month of February the palm tree generated the most electricity. This change in results was due to change in the sun's angle to the horizon. The amount of power generated at 9 AM and 3 PM was almost same. The most power was generated at noon.

Conclusions/Discussion
The conifer tree's pattern allows PV cells to generate the most electricity in December, followed by palm and plantain. In the month of February, the palm/plantain generates the most energy. The flat panel generates the least energy in both the months.

In the tropics the sun's angle to the horizon is above sixty degrees for most of the year, the palm/ plantain pattern would generate more energy. At high latitudes, where the sun stays close to the horizon, PV cells arranged in conifer pattern, are able to absorb direct, indirect, and diffused sunlight.

The natural structure of the plant in its habitat absorbs the most solar energy. Arranging solar cells in the structure of trees' according to the habitat, will eliminate the cost of sun tracking technology. A solar tree that changes its structure automatically according to the season will be the ideal source for green and efficient solar energy.

Summary Statement
This experiment gives us an insight into nature's secret and demonstrates a way to customize the most efficient solar tree structure, according to the geographic location and seasons.

Help Received
I would like to thank my parents for teaching me how to solder the cells. I would like to thank Mr. Vikas Dabeer (Director: Global project management, Applied Solar) for helping me understand the working of the PV cells.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Dhuvarakesh Karthikeyan

Project Number
J0209

Project Title
Microbial Fuel Cells: A Feasible Source of Clean Energy, Water, and Waste Management

Abstract

Objectives/Goals
My objective was to make a simple, cost-efficient, and effective microbial fuel cell that feeds on waste and produces electricity to address global problems such as: clean energy, sanitation, water, and waste-management. My goal in mind that I wished to achieve in this preliminary stage was a power production of 75mW, if any practicality in the future is to be met.

Methods/Materials
I used cost-efficient and readily available equipment in order to create a two-chamber microbial fuel cell. I built the microbial fuel cell (MFC) by epoxying the proton exchange membrane (PEM) to the airtight anode and cathode reactors. After this, I installed the inoculum of benthic mud samples and the fuel of my simulation of municipal solid waste (MSW) and sewage waste. Next, I tested to see which resistor yielded the highest power production in the MFC and used that resistor throughout the duration of the experiment. I let the microbial fuel cell run for five days, taking voltage and amperage readings using a digital multimeter every 12 hours, at 6:00 AM and 6:00 PM.

Results
The results recorded using the digital multimeter showed the microbial fuel cell produced averages for mW, mV, and mA of: 250.173 mW, 308.78 mV, and .73 mA, respectively.

Conclusions/Discussion
My conclusion is that the complex organic compounds in waste can be broken down to release meaningful amounts of electrical energy through the incorporation of a microbial fuel cell. This is shown through the actual MFC producing over 3 times as much power, 2 times as much voltage, and about 1.5 times as much amperage as the prediction that I previously made.

Summary Statement
In my project, I used a microbial fuel cell to digest the organic compounds found in waste and generate electricity and clean water as products of the bacteria's metabolic activity.

Help Received
Mother and Father helped collect the benthic mud samples; Science Teacher collaborated with me regarding the project

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Mathew Kiyama; Maya Kyathsandra; Resya Sastry

Project Number
J0210

Project Title
Power Sandwich: Combine and Store Renewable and Reusable Energy

Abstract

Objectives/Goals
We can generate and combine Solar power, Wind power and hydro power through energy re-use and store the energy in a rechargable lithium ion battery. Energy stored in the battery can then be used from simple uses like charging a cell phone, car battery or an entire house. The benefit would be that we can increase the total amount of renewable energy usage and have this energy available for use throughout the year, irrespective of weather conditions.

Methods/Materials
Our method included charging a 3.7 polymer lithium ion battery using three independant sources -a) Solar power - using a 3 W Photovoltaic solar panel, connected to the lithium battery thru a lipo board that enables battery and charge management; b) Hydropower - we connected a mini hydro generator to a garden house, dishwasher and washing machine to generate power and store in the battery, thru a lipo board; c) Wind power - we had two different wind turbines that we used to generate power using external air and also using an external fan motor to generate power since there was not enough wind. After completing the three independent experiments, we then connected each of the experiments using the lipo boards output in a series and one lithium battery. We generated electricity and measured the flow of current from each of the sources - solar, hydro and wind to the lipo board. Then tested flow of current from the lipo board to the battery. We also connected a model house with lights to turn the lights on and tested flow of current directly from the each of the power source or from the lithium battery (when the source is turned off).

Results
We were able to successfully generate power; a) Solar Power - Generated 4 W of solar power over a week in winter where average temperature was 57 F; b) Wind power - generated 7 W c) Hydropower - generated 11 W from three different sources of water in the house. We were able to generate a total of 22 W and store it in a lithium ion battery. We were also able to demonstrate that we could combine all the three power sources, charge one battery and turn the lights of a model house directly from the power source or from the battery.

Conclusions/Discussion
Thru this experiment, we proved that we could combine multiple renewable energy sources and store it a battery for several usages thrughout the year, even if the weather is bad. ..Yes We Can!

Summary Statement
Combine and store - renewable energy and through energy re use - Save fossil fuels and protect the environment

Help Received
Father helped with soldering, ordering parts and education on measuring voltage and calculating power

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Hunter A. Listwin

Project Number
J0211

Project Title
Sol-Air Efficiency

Abstract

Objectives/Goals
The goal is the test the affect of the haze layer and temperature at altitude on the efficiency of solar panels.

Methods/Materials
I used a weather ballon with various measuring devices along with a solar panel to conduct my experiment. I filled the ballon with helium and released it into the atmosphere. While in the air, the measuring devices took reading of the power output of the solar panel and the outside temperature. After getting to 20,000 feet, the balloon popped and returned to earth safely via a parachute. The onboard GPS then started receiving its current location and transmitting it to my phone via GMS.

Results
There was a 35% increase in solar panel efficiency after it surpassed the haze layer. Although the haze layer had a significant impact on the efficiency of the panel the temperature change did not. Unfortunately, the amperage measuring device did not function, but the volage did, which was enough for an accurate reading. With an exception of the amperage device, all systems worked as I predicted and the mission was a success.

Conclusions/Discussion
We can conclude that solar panels will be more efficient when functioning in an area that has less pollutants, like cars, adding to the haze layer. Solar panels will be more efficient in a dessert where there is less city activity that can pollute the air.

Summary Statement
Sol-Air Efficiency is an exploration of the affects of the haze layer on solar panels.

Help Received
My father help drive on launch day and with the math for the circuit. He also funded the project. Other than those contributions, I did the project by myself.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Aniruddh Mandalapu

Project Number
J0212

Project Title
Dye-Sensitized Solar Cells: Lighting the Path to Our Future

Abstract

Objectives/Goals
Dye sensitized solar cells are solar cells made of a nanocrystalline titanium dioxide layer that is soaked in dye and sandwiched by two conductive pieces of glass. The goal of this project was to find out what fruit or vegetable dye allowed a dye sensitized solar cell to operate the most efficiently. I hypothesized that cranberry dye would work the best. In addition to this, I also wanted to learn about some of the advantages of this new, interesting solar cell.

Methods/Materials
Multiple solar cells were built using simple lab materials and multiple fruit and vegetable dyes. The materials I used were raspberries, a pomegranate, blueberries, blackberries, beets, and cranberries, nanocrystalline TiO2 powder, dilute acetic acid, iodide solution, ethanol, deionized water, a mortar and pestle,a dropper, conductive glass, a multimeter, alligator clips, wires, a pencil, transparent tape, a heat source, a watch, water, binder clips, a strong light source, gloves, a paper towel, goggles, a plastic stirring rod,and a strainer. After I constructed the cell out of these materials, I measured the voltage and ampere output of each cell while I left each one under a flashlight for 1 minute.

Results
The trials using red bell pepper dye generated the most voltage and amperes, with 0.44 volts and 0.003 milliamps. It beat raspberry, pomegranate, blueberry, blackberry, beets, and cranberry. Pomagranate finished second overall with 0.25 volts, and 0.001 mA. The results did not support my hypothesis. Cranberry did not generate significant amounts of electricity. It generated 0.14 volts of output, and too small a current to measure.

Conclusions/Discussion
I believed raspberry dye would be the most successful due to its anthocyanin rich juice (I believed it would absorb the most sunlight). However, there are other factors that play into the dye#s success such as viscosity of a dye, and how well the dye can stick to the titanium dioxide coating. Further research into this project may include testing different mediators rather than just iodide solution. This project can significantly affect the solar cell industry. Some of its advantages include flexibility and eco-friendliness. If these cells can be improved a bit more in energy efficiency, it can take over the oil and gasoline industry in the energy business.

Summary Statement
This project tests the effectiveness of different fruit and vegetable dyes on a dye-sensitized solar cell.

Help Received
My mother supervised the project as I performed my experiment.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kate A. Miller

Project Number
J0213

Project Title
Sun While You Run

Abstract

Objectives/Goals
My objective was to design a portable USB solar power charger that could be used while "on the go." If you out running errands, running for exercise, sightseeing, hiking, or are in a remote area away from electrical plugs and power sources, the portable solar charger could be worn all day, collecting power, and able to charge any USB electronic device, such as a cell phone or an ipod while you are "on the go." You would also be able to use your phone, or device, while it is charging. The design of the portable solar charger would include a practical and easily worn case and elastic band that can be worn on your upper arm or around a hat. Many other designs could be incorporated to hold the case and allow the user to "wear" the portable device while collecting power and keeping your hands free.

Methods/Materials
The items used to make the Solar USB portable charger were: wire, a USB charging circuit, a AA battery holder, a small metal tin for housing the unit, re-chargable AA2600 1.2 V/R6 nickel metal hydride batteries, a 4V solar panel, 1N914 Diode, soldering iron, solder, tin snips, glue gun with glue, electrical tape and a battery tester. The items used to make the wearable case were: wetsuit material, elastic bands, thread, sewing machine, scissors and a hook/eye closure. The portable charger was put together using the soldering iron and then tested to make sure it was collecting power into the re-chargable batteries. The case was designed to be worn and made using the most secure but easiest to wear design.

Results
The portable solar charger worked very well and I was able to charge my cell phone while I was on the go and "out and about." I was even able to charge additional batteries which could be used as backups when power is needed at night. I also tested it with a Verilux natural light bulb which is used to simulate sunlight and this was also successful.

Conclusions/Discussion
The ease of use and efficiency of the portable USB solar charger I designed was even better than I had expected. Dead cell phone batteries will no longer be a problem when a power source isn't nearby. By simply wearing the portable USB solar charger and collecting power throughout the day, a source will always be available to recharge a phone or other small USB electrical device.

Summary Statement
A wearable, USB solar charger provides a constant, renewable source of power for a cell phone.

Help Received
My parents purchased the supplies I needed for my project.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Tessarra M. Parrish

Project Number
J0214

Project Title
How Dust Layer Affects the Absorption Rate of a Solar Panel

Abstract

Objectives/Goals
My hypothesis was that dust layer will affect the absorption rate of a solar panel because the dust layer will block the sun from hitting the solar panel, therefore making it so the solar panel is less effective.

Methods/Materials
12 volt , 1.5 watt solar panel

Voltage meter

Results
The results of my investigation on how dust layer effects the absorption rate of a solar panel shows more dust layer applied to the solar panel, the less the solar panel is going to absorb.

Average volts for week 1, control: 16.63 volts

Average volts for week 6: 14.08 volts

Conclusions/Discussion
I found that my hypothesis was correct. Dust layer did effect the absorption rate of a solar panel because the dust blocked the photovoltaic cells from producing energy from the sun, therefore making the solar panel less efficient. The average result for week 1, no dust layer as 16.63 volts. After 5 more weeks of testing, week 6 had a result of 14.08 volts. This helped me come to conclusion the more dust on the solar panel the less the solar panel is going to absorb from the sun.

Summary Statement
My project is testing whether a solar panel can produce energy if dust layer is blocking the photovoltaic cells from the sun.

Help Received
I did this project by myself, no help was received.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Gyan Prayaga

Project Number
J0215

Project Title
Piezoelectric Energy Harvesting

Abstract

Objectives/Goals

Renewable energies such as solar, wind, hydroelectric and geothermal could potentially help to reduce our dependence on fossil fuels, but are expensive and not always available. Also, developing countries do not have the resources to build energy grids. Capturing energy from footsteps could be an economical and efficient solution to the global energy crisis that faces us today. I wondered if a shoe could be modified to harness energy from footsteps with only a few dollars and a basic knowledge of wiring and circuitry.

My goal in this project was to build a small piezoelectric device to harness pounding energy from walking/running and then store it for later use.

Methods/Materials

METHODS

1. Tested energy output of 1 piezo disc using multimeter. 2. Tested energy output of 3 piezo discs in parallel array. 3. Inserted discs under insole of shoe and tested energy output. 4. Tested storage capacity of NiMH/Li-Ion batteries when using parallel array. 5. Experimented with capacitor as alternative to battery. 6. Built circuit to step-up voltage produced by discs and store it. 7. Attached breadboard with circuitry to shoe.

MATERIALS

piezoceramic discs; running shoes; 9V battery; NPN switching transistor; Hex Schmitt Trigger Inverter IC; 4.7KO, 560KO & 1KO resistors; pencil coiled with non-insulated wrapping wire; Li-Ion & NiMH rechargeable batteries; 47 uF & 1000 uF electrolytic and 27 pF ceramic capacitors; yellow & red LEDs; 2 breadboards; jumper wires; mini toggle switch.

Results

When stepped on, a piezoceramic disc produces enough energy to flash an LED (approximately 6 mA). A parallel series of three discs yields approximately 18 mA (milliamps). When I tried to store energy generated from 250 steps (1/6 mile) only 0.045% of the energy produced could be stored in a NiMH or Li-Ion battery. By integrating a 47 uF capacitor into the circuit, results improved to 0.06% - but still not enough to light an LED. I used a transformer circuit to increase the voltage of the disc and replaced the battery with a 1000 uF capacitor. I was unable to store the energy produced from stamping in a battery/capacitor for later use, but I was able to use the piezoelectric effect to make self-illuminating shoes.

Summary Statement

My goal in this project was to build a small piezoelectric device to harness pounding energy from walking/running and then store it for later use.

Help Received

Father gave guidance about the scientific process; Uncle helped with advanced circuitry; Brother and Mother helped with testing

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Laura E. Ratliff

Project Number
J0216

Project Title
The Effects of Dust Buildup on Solar Panels

Abstract

Objectives/Goals
The objective of this experiment was to measure the decrease in efficiency of solar panels over several weeks or months due to dust buildup, in order to determine how often solar panels need to be washed.

Methods/Materials
My house has two arrays of solar panels, installed in 2009. There is an array of 12 panels on the shade structure in back of the house, and 16 on the garage. The panels naturally collect dust over time and my experiment was to clean the panels in a controlled way to measure the effect of dust buildup on the energy produced by each array. My father climbed on the roof to clean the solar panels while I took pictures from the ground. The output of the solar panels was recorded by the solar company, Sunpower, by a monitor that sends the data from the solar panel inverters to the Sunpower website through our wireless network. We cleaned the arrays three times between November 2011 and January 2012. I downloaded the hourly data from the website and supplemented it with additional data from the past two years. To calculate the efficiency lost, I used the ratio of the energy of the garage array to the shade structure array in order to remove other variables such as season and weather conditions.

Results
The first finding in this experiment was that the effects of dust buildup were not measurable in the winter months due to rapid and frequent changes in shading. Looking at older data from the summer showed that the average efficiency of the panels lost to dust each day was 0.000332606.

Conclusions/Discussion
This data is important because it provides us with proof that it is important to wash your solar panels. This data also gives us another reason to develop self-cleaning panels.

Summary Statement
I measured the effects of dust buildup on solar panels and found that the efficiency loss over a month is about 1%.

Help Received
My dad climbed on the roof to clean the panels and also helped me figure out the equation and how to use Excel. The Sunpower technical support people supplied me with necessary data that was not readily available on their website. Benjamin Root and #Home Power# magazine was very encouraging and

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alex P. Junge

Project Number
J0299

Project Title
The Effect Temperature Has on the Outcome of a Microbial Fuel Cell

Abstract

Objectives/Goals
The purpose of this experiment was to determine how temperature affects the voltage outcome of a microbial fuel cell. The experiment consisted of 6 fuel cells and three different temperature ranges. The temperature ranges were: an average March temperature (30- 70°F), a very warm temperature (90-95°F), and a mild temperature (50 -60°F). Two fuel cells were tested in each temperature range.

Methods/Materials
Each fuel cell was built the same way and consisted of the same amount of mud and water. The mud was taken from the same place in the pond. The voltage was measured two times a day at 7:00 am and 7:00 pm. The total duration for each experiment was 2 weeks long.

Results
All of the fuel cells created voltage. The fuel cells in the warmest temperature (average of 93°F) range created the most voltage, while the fuel cells in the mild (average of 54° F) and average March temperature range created almost the same amount.

Conclusions/Discussion
Like my hypothesis stated, the fuel cells placed in the warmest temperature (average of 93 °F) created the most voltage. B1 made an average of 359.2 mv while B2 made an average of 436.5 mv. The data from my experiment supported my hypothesis. The fuel cells placed in the mild and average outdoor March temperatures were very close. The lowest range of #A# produced an average of 211 mv while #C# produced 215 mv. The highest range of #A# produced 353 mv while #C# produced 296 mv.

Summary Statement
By testing multiple microbial fuel cells in a very warm temperature range (controlled), a mild temperature range (controlled), and a variable temperature range (outdoor), this project showed which range generated the most electricity.

Help Received
Father helped in construction of fuel cells.