CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Addison Mia Ahlstrom

Project Number

J0201

Project Title

Solar Power for a Bright Future

Abstract

Objectives/Goals

The objective of this experiment is to determine which natural dye is the most effective in allowing the dye-sensitized solar cell to capture light energy. This determination will allow scientists who construct dye-sensitized solar cells to be aware of the ideal natural dye, and maximize the potential of their cell. In the last decade, dye-sensitized cells have been exposed to lots of attention due to their unorthodox yet effective way of obtaining light energy. Due to the fact that these types of cells are increasingly popular today, the natural dye chosen in extremely important in maximizing the cell#s performance.

Methods/Materials

In this experiment, I constructed five different solar cells using the identical procedure, but changing the natural dye. The five dyes examined were the berry mix, which consisted of raspberries, black, and strawberries, the onion skin solution, the hibiscus tea solvent, the turmeric powder solution, and the black tea solvent. After constructing the cells, I tested the voltage produced by each cell. By connecting the cell to the multimeter via an alligator clip, and exposing it to a strong light source, in my case a flood light, I was able to record the voltages produced by each cell.

Results

The voltages varied for each naturally-dyed cell. The onion-skin dye was clearly the most effective however, producing 24-26 minivolts. The hibiscus was also generally successful, with a voltage of 14-16 minivolts. Both the turmeric powder-based cell and black tea cell ranged from 12-15 minivolts. The berry mix was especially disappointing, only producing 10-11 minivolts. This was surprising due to the fact that berry mix is usually the most recommended of the natural dyes.

Conclusions/Discussion

In conclusion, the onion-skin natural dye proved to be the most successful out of the five dyes tested in this experiment in allowing the cell to obtain the energy. I would like to acknowledge my grandfather, Mr. Everett Mckeen, for his guidance and help throughout the experiment and for providing myself with the flood light. I would also like to thank my parents for being so flexible throughout the entire experiment despite constant changes.

Summary Statement

My experiment focuses on finding the ideal natural photo sensitizer in order to maximize the performance of one's dye sensitized solar cell.

Help Received

Ms. Bowdoin, Michelle Mckeen Ahlstrom, Everett Mckeen, Lars Ahlstrom, Marilyn Mckeen

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Khadeeja Baqui

Project Number
J0202

Project Title
Converting Dirt into Fuel Using Bacteria

Abstract

Objectives/Goals
Scientists have been greatly plagued by the idea of dependence on nonrenewable resources and the resources# disappearance. In the last decade, they have increasingly researched on possible renewable resources to replace our dwindling supply of coal, oil, and other nonrenewable resources. The microbial fuel cell, which runs on tiny anaerobic bacteria that live almost everywhere around the globe in the topsoil layer, is a fairly new research topic. Very few scientists paid attention to it until recently. However, the ideas that it is based on date to earlier times. Scientists discovered the ideas, but people gave it little attention. It was largely forgotten. Now, though, microbial fuel cells, or MFCs, are thought to be important players in the future of our fuel and electricity.

Methods/Materials
Microbial fuel cell kit (from sciencebuddies.com) I did not modify the kit.

Results
I found that the 5 g of salt microbial fuel cell had a greater power output and better soil conductivity than both the 1 g and 10 g of salt microbial fuel cells. I also found that adding too much salt or too little would not maximize the bacteria's efficiency.

Conclusions/Discussion
The LED did not blink at all while testing with the potting soil because of low power output. However, with topsoil, before adding salt to the MFC, the attached LED began to blink after 2-3 days. Throughout the experiment, the temperature was kept at a constant 72℉. After adding salt, however, the LED attached to the MFC with 1 g of salt started to rapidly blink, faster than it had without salt. The voltage increased, causing the power output to increase as well. However, the 5 g of salt did not begin to blink until a few weeks after adding salt. The internal resistance for 5 g of salt lowered considerably, compared to 1 g of salt. After adding 10 g of salt to the MFC, the power output decreased. Compared to the other two MFCs, the one containing 5 g of salt had the highest power output. After adding salt, the soil conductivity of the 5 g of salt MFC is higher than that of the 1 g of salt microbial fuel cell.

Summary Statement
My project is about generating electricity from electrogenic, anaerobic bacteria.

Help Received
I received some assistance from my mentor.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Remy S. Campbell

Project Number
J0203

Project Title
Gasification: The Future of Renewable Energy

Abstract

Objectives/Goals
With increasing concerns about clean energy sources, clean water supplies and degraded farmland soils, recycling biomass waste products through the process of gasification may be a perfect solution to all of these environmental concerns.

Inspired by my family's search for a clean and economical way to dispose of the wood waste from their manufacturing business, my first science fair project in 2015 compared combustion temperatures in varying density hardwoods and softwoods. In 2016 my project compared the British Thermal Units released by different types of wood waste at a conventional biomass power plant. This year I explored gasification, which is a carbon-neutral process that creates syngas (synthesis gas) and biochar (carbon byproduct) from biomass waste products. Syngas can be converted into energy and biochar has many uses such as water filtration and soil amendment. I tested different types of biomass to compare the amount of biochar output from each product.

Methods/Materials
I worked with Greg Stangl, the owner of Phoenix Energy, a gasification plant in Merced, to test different biomass waste products to determine which produced the most biochar in weight per hour. I utilized 4 different types of biomass - peach pits, oak chips, soft wood waste (pallet stock), and walnut shells.

Results
After running my tests, I found that peach pits produced a larger amount of biochar than the other biomass materials. This was consistent with my hypothesis that the denser material would yield more biochar.

Conclusions/Discussion
Based on my research and experiment, I found the use of gasification to produce energy and valuable byproducts while recycling biomass waste products from agriculture and wood manufacturing industries may be a solution to many environmental concerns.

Summary Statement
I tested different types of biomass materials at a .5 megawatt gasification plant to determine which material produced the most biochar by weight.

Help Received
I was assisted by Greg Stangl, owner, Todd Machado, plant supervisor and Milan Alex, engineer, of Phoenix Energy. I was also helped by my parents, Travis and Patti Campbell.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Ky A. Duong

Project Number
J0204

Project Title
Microbial Fuel Cells: The Power of Mud!

Abstract

Objectives/Goals
The objective of this study is to determine which kind of mud sample will produce the greatest amount of voltage from using a microbial fuel cell.

Methods/Materials
Three pairs of containers, three various mud samples, saltwater solutions, salt bridges, electrodes, air pumps, alligator clips, resistors. Tested each of the three mud samples with a multi meter and air pump over 20 days twice a day.

Results
The fuel cells were tested twice a day and the amount of voltage produced from each was compared. I found that the fuel cell containing lake mud was the most efficient in producing voltage with an average of about 12 mV in comparison to the canal and river mud with averages of 0.3 and 3 mV.

Conclusions/Discussion
The microbial fuel cell that contained the lake mud was much more efficient in generating voltage than the canal and river fuel cells. This, all in all, shows that mud can be used as an alternative energy source in harnessing electricity, in which lake mud is the most effective in doing so.

Summary Statement
I discovered that lake mud is able to produce more voltage in a microbial fuel cell than the canal and river mud, and mud microbial fuel cells can be used as an alternative energy source.

Help Received
My parents helped me build the device and collect mud and water samples. I designed the fuel cell after researching different designs and did the rest of the experiment by myself. My science teacher helped me determine whether my project was restricted and helped me understand what was going on in my fuel

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Ximena E. Greatorex

Project Number
J0205

Project Title
Compressed Air Energy Storage

Abstract

Objectives/Goals
The objective of this project is to design a compressed air energy storage system that could replace batteries in a more environmentally responsible way.

Methods/Materials
3D printed fan blades, shaft with bearings, electric motor (to be used as a generator), and tested with air compressor.

Results
By increasing the pressure on the air source, my output voltage of the turbine generator also increased.

Conclusions/Discussion
Based on my data I realized that the idea of Compressed Air Energy Storage is feasible. The problems with efficiency will need to be fixed before it can be used on a larger scale, particularly with the design of the turbine blades and the electric motor.

Summary Statement
I showed that a compressed air turbine can be used to regain energy stored as compressed air.

Help Received
My father helped me with knowledge of engineering and purchasing materials.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Bradley P. Gribas

Project Number
J0206

Project Title
Can a Bicycle Generate Electricity?

Abstract

Objectives/Goals
I wanted to see if I pedaled a bicycle powered generator if it would produce enough electricity to power small electronics and appliances. If successful, this would prove to be an alternative source of energy.

Methods/Materials
A bicycle was put on a stand, and a motor (generator) was rigged to the bicycle (this will charge a 12 volt battery). An inverter was added to convert the battery's DC current to AC current. This was needed to power items that would normally plug into a wall outlet. A belt was attached to the pulley on the motor shaft and connected to the battery with wires. A diode was inserted between the motor and battery to insure that the current flows in only one direction. The various items were plugged into the inverter to see if they would operate.

Results
While pedaling at a constant speed of 5 to 6 mph, the charge of the battery was maintained and most electronics and appliances being tested ran for 5 minutes. The voltmeter registered between 11 to 13 volts on the radio, laptop computer, blender and light, but would not register at all on the hair dryer and popcorn maker. I think the reason the hair dryer and popcorn maker wouldn't work is they kept blowing a breaker in the AC to DC converter. This would shut them off because they tried to pull more electricity than I could produce.

Conclusions/Discussion
The hypothesis that a bicycle can generate enough electricity to power small electronics and appliances proved to be true for some items, but not all. Enough electricity was not produced to power the hair dryer and popcorn maker. This alternative energy source required human physical exertion, and therefore is not practical. However, for short term use, as in an emergency loss of power, it is a readily available source of clean energy. This project helped me develop engineering skills and made me want to further investigate the bicycle powered generator to make it more powerful and able to operate other appliances.

Summary Statement
Can a pedal powered bicycle generate enough electricity to power small electronics and appliances?

Help Received

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Sadie R. Howard

Project Number
J0207

Project Title
Pee Is for Power

Abstract

Objectives/Goals
The objective of this study is to measure the affect of human urine on the energy output of a microbial fuel cell.

Methods/Materials
Microbial fuel cells were constructed using fuel cell vessels, soil, anodes, cathodes, hacker boards, capacitors, and LEDs. Human urine was added in varied quantities to the fuel cells. The energy output of each fuel cell was measured using a multimeter and seven resistors in several trials both before and after adding the urine.

Results
The addition of human urine increased the energy output of the microbial fuel cells. In the fuel cell where 1ml of urine was added, the peak power occurred at 470 ohms with an increase of 40.01 micro watts after adding urine. In the microbial fuel cell where 5ml of urine was added, the peak power occurred at 47 ohms with an increase of 896.81 micro watts after adding the urine.

Conclusions/Discussion
I was able to build microbial fuel cells that convert human urine into electricity using microorganisms. I determined that using human urine in microbial fuel cells increases the energy output of the fuel cell. I hope to expand this idea by making a septic tank into a microbial fuel cell that could possibly power a house. This idea could create a single solution to solve the problems of human waste and generating electricity.

Summary Statement
I showed that human urine increases the energy output of a microbial fuel cell.

Help Received
None, I built the microbial fuel cells and conducted the tests myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Kayden Hung

Project Number
J0208

Project Title
Electricity Production of a Crystal Power Cell

Abstract

Objectives/Goals
The experiment was to see if changing the amount of potassium chloride(a compound mostly found in salt substitutes) and oxidane(water) would change the ampere and voltage a crystal power cell would produce. Increasing potassium chloride was expected to increase the amperage and voltage since it contained electrolytes. Increasing oxidane would dilute the crystals of the power cells reducing the amperage and voltage.

Methods/Materials
The experiment consisted of 5 groups of 5 crystal cells with each group having a different amount of potassium chloride and oxidane. All groups were 5 2.5cm copper pipe caps containing 3 mL of sodium tetraborate(borax), magnesium sulfate(epsom salt), and hydrated potassium aluminium sulfate(alum). After each cell was full of materials it was assigned, it would be cooked on a stove until the materials boiled, then would be cooled to start measurements.

Results
The group that contained more potassium chloride actually created a high voltage, yet a low amperage. The group that contained less potassium chloride created a very low amperage and low voltage. Cells containing oxidane actually created the highest voltage and amperage, which was surprising due to the crystals barely solidifying.

Conclusions/Discussion
The results of this experiment does not conclude if extra potassium chloride increases a power cell#s energy production or decreases since production is similar to the control group. A conclusion can be made that the more oxidane a cell contains, the more energy is created due to the small amounts of water reacting with the electrolytes. However, there is no conclusion that too much oxidane could prevent a power cell from producing electricity.

Summary Statement
My project is about the production of energy from crystal power cells and how adding different amounts of materials into each changes the electric production.

Help Received
The project was done by myself yet the presentation board was helped by my parents. Emily Hoffman helped proof read the report.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Davin Jeong

Project Number
J0209

Project Title
Hydrogen: The Best Renewable Energy

Abstract

Objectives/Goals
Through this project I tried (and succeeded) in finding out the best type of renewable energy and how to store, harvest, and use it so that we can use it more in the future.

Methods/Materials
My project was mostly conducted through research on my computer. I used various sources (websites) to find out what I did and they can all be found on my project. I also used tools, wood, and common materials to make my hydrogen generator, my (failed) attempt at a home-made hydrogen-to-electricity converter, and the demonstration motor set up.

Results
Through my project, I found out that hydrogen was the best type of renewable energy. I also found out how to store, harvest, and use this hydrogen as an energy source.

Conclusions/Discussion
My project expanded our knowledge by finding out that hydrogen is the best type of renewable energy.It also found out how to store, harvest, and use this hydrogen as an energy source in the future.

Summary Statement
I showed how hydrogen is the best type of renewable energy and how it can be used through constant research.

Help Received
I wrote down and made everything on the board myself. I also designed and performed the demonstrations myself. I also got help from my dad whom helped me build the demonstration.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Izzah Kamran

Project Number
J0210

Project Title
Solar Roller: An Efficient Solar Device

Abstract

Objectives/Goals
The purpose of this project is to test whether a rotating solar device (Solar Roller) will absorb more energy than a stationary solar panel or a solar tracker. I became very interested in solar energy since I found out that solar energy is the newest and most abundant supply of energy. I wanted to find a way to maximize the amount of energy from the sun absorbed and to reduce the footprint.

Methods/Materials
After building the stationary solar panels, the solar tracker, and the Solar Roller and connecting the wires with the battery holders, place the structures in a spot that allows them to absorb the sun#s energy. Measure, record, and place the batteries in the holders and turn on all structures. After leaving the structures in the sun for 9 hours, measure and record the energy in the batteries.

Results
The Solar Roller collected an average of 29.38% more energy than the initial energy in the batteries before the experiment. The stationary solar panels and the solar tracker collected an average of 3.29% and 7.76%, respectively.
After subtracting the energy used by the solar tracker and the Roller, they collected -0.09% and 17.67%, respectively.

Conclusions/Discussion
The Roller collected about 6x the stationary solar panel did. The Roller collected more energy because the kinetic energy from the spinning produced heat which warmed up the wires. Since the wires were hotter, the electrons moved faster, allowing more energy to be absorbed.

Summary Statement
The purpose of this project is to test whether a rotating solar device (Solar Roller) will absorb more energy than a stationary solar panel or a solar tracker.

Help Received
I got help from my teacher for building the devices.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Sanya C. Khattar

Project Number
J0211

Project Title
Accessible Solar Cells: Creating an Anthocyanin Powered Solar Cell

Abstract

Objectives/Goals
The objective of creating an anthocyanin-based solar cell is to realize the efficacy of using fruits containing this specific pigment. Utilizing several fruits with this pigment also adds depth to the understanding of how voltage generation may be impacted by different fruits.

Methods/Materials
Microscope slides, sunscreen, blueberries and blackberries, iodine, soda can, sandpaper, glass glue, candle. Used two glass slides for the two electrodes in the cell, with one side containing the sunscreen and fruit juice. The other side had carbon deposit from the candle, along with iodine, and aluminum strips from the soda can were present on both electrodes. The cell efficiency was tested with blueberry and blackberry juice separately. The solar cells were tested in both ambient light and sunlight.

Results
The efficiency of implementing blueberry juice versus blackberry juice as the anthocyanin source was tested, with the voltage generated generally being exhibited as higher for the blueberry juice on a shorter scale of time, whereas the blackberry juice proved to sustain longer in generation. Sunlight and ambient light impacted the generation of voltage in the cells differently.

Conclusions/Discussion
Testing the generation of voltage in different sizes and materials in accessible solar cells proved that even fruits may be viable candidates for creating energy, and that the juice of certain fruits containing anthocyanin pigment may prove to be of greater use in different circumstances.

Summary Statement
I proved that using fruits containing anthocyanin pigment as the main component of a solar cell can efficiently generate voltage, even with several types of fruits.

Help Received
I designed and created multiple solar cells on my own with guidance from my science teacher, who advised me in the execution of the project.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Jaden A. Luna

Project Number
J0212

Project Title
How Weather Affects a Photovoltaic Polycrystalline Solar Panel and Researching Various Methods to Increase Efficiency

Abstract

Objectives/Goals
The purpose of my project was to find what weather patterns affect a solar panel the most and how to increase the panel in negative and positive patterns.

Methods/Materials
Small PV (photovoltaic) Polycrystalline solar panel, large PV Polycrystalline panel, voltmeter, colored acrylic sheeting, Fresnel lens, prismatic light distributor, apple watch, and a foil reflector.

Results
I found that temperatures ranging between 55-60 degrees Fahrenheit with cloudy skies, but direct sun was optimal weather. The Fresnel lens when concaved forming an enhanced ray, was the best modifier.

Conclusions/Discussion
My project elaborates on how humidity effects a solar panel positively and it also shows how the Fresnel Lens, when concaved forming an enhanced ray, increases the voltage and amperage output of a solar panel.

Summary Statement
My project was designed to show how weather effects a solar panel and how to increase the efficiency.

Help Received
I had assistance from my parents with supplying my materials that were needed. I received advice on how to graph my data from Rick Spurlock, IHI Power Services West Region Director.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Avanti S. Martinez

Project Number
J0213

Project Title
Heat Up a Cold Room with a Solar Air Heater

Abstract

Objectives/Goals
Can I build a Homemade solar heater to heat up a room at 28 degrees Celsius without burning any fossil fuels?From my research, I formulate that my homemade solar air heater will increase the temperature of the room by 10 degrees C and be successful. I believe this heater will not only save money, but it will also decrease the usage of fossil fuels and will help the environment dramatically

Methods/Materials
The most important materials in this project include: a window, pieces of cardboard,a thermometer, tape measure, and tape

Results
According to the data I collected, within five days, the average of the outtake temperature demonstrated a higher temperature than the average of the intake temperature. Each table represents the average of the heater#s daily temperature. I did this for both the intake and the outtake. I learned that the outtake temperature was higher because the energy from the sun transfer hit the absorber allowing it to consume heat and transfer this heat into the room. The outtake is where the hot air comes out and the intake is when the cool air goes out. Due to this, the temperature for the outtake vent will be sufficiently higher than the intake temperature.The heater worked the best on day 3 and 5 and heated up the room and changed temperature of the room by 10-12 degrees Celsius

Conclusions/Discussion
I proved my hypothesis correct. I was capable of building a solar air heater and increase the temperature of a room by 10 degrees Celsius and was successful. Instead of heating it up to 10, I was successful of heating the room by 12 degrees Celsius. According to the data I collected, within five days, the average of the outtake temperature demonstrated a higher temperature than the average of the intake temperature. I learned that the outtake temperature was higher because the energy from the sun transfer hit the absorber allowing it to consume heat and transfer this heat into the room.The heater worked the best on day 3 and 5 and heated up the room and changed temperature of the room by 10-12 degrees Celsius. This project helps humanity because if people were to use solar energy, we would not only save a lot of money, but it will help protect the climate,health, and help with pollution. Instead of burning fossil fuels you can do your everyday things and be warm inside your house just by using energy from the sun.

Summary Statement
My project is about energy from the sun, and the heat collected, being transferred into a room using different techniques and materials.

Help Received
During the days i was at school, my mom, Ruth Martinez, helped test the intake and outtake's temperature of my heater.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Pranav S. Moudgalya

Project Number

J0214

Project Title

Energy of the Future: Using a Microbial Fuel Cell to Harness Bacterial Power Production

Abstract

Objectives/Goals

How does the feeding source of the nonpathogenic bacteria Shewanella oneidensis affect its ability to generate usable power through bioelectrogenesis?

Methods/Materials

Major materials in my research included Microbial Fuel Cells (and their related components), potting soil, and the sugar substrates used to enhance the power output of the fuel cells. To calculate the power being produced, a multimeter was used in assisting the process. To get an accurate measurement of bacterial colonies inside of my fuel cell, I modified the research used to establish a calculator provided online by Mohamed Y. El-Naggar.

Results

My research showed overall, arabinogalactan was indeed the most effective substrate producing an average of 131,240,179 colonies, 5.66 microwatts, and a peak power of 32.41 microwatts per trial . However, the second most effective was actually dextrose, and in large numbers ahead of fructose. While fructose was only able to produce an average of 48,157,289 colonies, 2.3 microwatts, and a peak power of roughly 23.79 microwatts per trial, dextrose proved to be a lot more effective. The MFCs using dextrose as a substrate produced on average about 83,333,367 colonies, 4.2 microwatts, and a peak power output of about 35.98 microwatts per trial.

Conclusions/Discussion

In conclusion, the power of microbial fuel cells will be greatly enhanced through my research as we now have a proven method regarding how to enhance their power output. In specific, arabinogalactan will prove to be a efficient substrate to create energy, however, by using sugar-based substrates, we will be able to optimize power production that won't require complex materials or heavy funding.

Summary Statement

I researched methods to optimize the potential of bacteria derived energy through the use of Microbial Fuel Cells.

Help Received

This research project was designed to be effective and impactful without the use of laboratory grade instruments. My mother (Dr. Rajini Moudgalya) also helped in providing me an understanding of basic principles regarding microbiology and the phases of bacterial growth.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Marrin G. Nerenberg

Project Number

J0215

Project Title

Active vs. Passive: Which Sun Tracking Solar Panel System Is More Efficient?

Abstract

Objectives/Goals

The objective of this experiment is to determine whether a solar panel which follows the sun using a passive mechanism can compare favorably to a solar panel with active sun tracking when the energy used by the active tracking process is taken into account.

Methods/Materials

One solar panel rotated by stepper motor with single board computer (Raspberry Pi) running Python program, one solar panel rotated by two glass tubes of volatile liquid (dichloromethane) interconnected by copper tubing, one solar panel in a fixed position, 3D printed mounting hardware. Measured power produced by each panel at frequent intervals from sunrise to sunset for several consecutive days.

Results

The active panel tracked the sun accurately and produced the most power, but consumed some as well. The passive panel failed to track accurately and produced the least power. The power production of the fixed panel (non-tracking) was intermediate.

Conclusions/Discussion

The efficiency gained by the passive system not requiring electrical energy to operate was more than offset by its failure to track reliably. It may have performed better in warmer weather, improving the effectiveness of the volatile fluid. The active tracking solar panel system did not produce enough power compared to the fixed (non-tracking) panel to make up for the power required to operate it and the cost for and anticipated maintenance requirements of the tracking mechanism. It appears that the fixed panel may be the most efficient in the long run with its simplicity, low operating and maintenance costs, and dependability at various temperatures.

Summary Statement

I compared active to passive solar panel tracking and found no convincing advantage over a fixed panel.

Help Received

I wired and programmed the computer for both controlling the stepper motor and collecting data, and designed and 3D printed the mounting hardware. I received informal instruction on the use of copper tubing and fittings.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Anirudh N. Pai

Project Number
J0216

Project Title
Feasibility Study of Electricity Generation Using Piezoelectric Strips inside a Bicycle Tire

Abstract

Objectives/Goals
How much electricity can be produced by putting different amounts of PZT on the inside of bicycle wheels?

Methods/Materials
6 PZT strips, Wire Coil, Capacitor, 4 diodes, Bicycle, Multimeter, Breadboard

Procedure
Connect the components on the breadboard as per the circuit diagram.
Glue 6 PZT strips on the inside of the tire.
Connect the wire from each PZT strip to the input of the circuit.
Discharge the capacitor before starting each round of the experiment.
Bike 5 laps around the field. Record the voltage accumulated in the capacitor with a multimeter.
Repeat steps 3 - 5 for 4 and 1 PZT strip respectively.

Results
The piezoelectric strips were able to produce some electrical after the bicycle was ridden for 5 minutes. The amount of electrical charge generated was more when more piezoelectric strips were used.

Electricity Generated (Volts)

PZT Strips	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Total	Average (Volts)
1	0.01	0.012	0.009	0.016	0.02	0.067	0.0134
4	0.03	0.026	0.032	0.017	0.051	0.156	0.031
6	0.081	0.072	0.068	0.07	0.065	0.356	0.0712

Conclusions/Discussion
The amount of electrical charge was lower than what I had expected. Experimenting with more strips, the placements of the strips on the back tire, placing them inside the tire wall may help in better efficiency.

Summary Statement
Project is about using piezoelectric strips attached to the inside of a bicycle tire to generate electricity.

Help Received
My dad helped with the soldering of wires to piezoelectric strips

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Olivia G. Petty

Project Number
J0217

Project Title
The Effect of Water Cooling on Solar Panels

Abstract

Objectives/Goals
The objective of this experiment was to see if cooling the surface of a solar panel with water would increase its energy output.

Methods/Materials
I used two solar panels, two volt meters, and two 60 watt lights. Tubing, a glass pane, a water container and a water pump were used to build the water system. The water is pumped over the surface of the panel between it and the glass pane affixed on top of it. I cooled one solar panel with the water system and measured the energy output compared to the uncooled panel.

Results
The solar panels were placed under the lights and their energy outputs measured at 5 minute intervals. The results showed that as time passed, the energy output of the uncooled solar panel decreased from 19 volts to 17 volts while the energy output of the cooled solar panel increased from 19 volts to almost 20 volts after 15 minutes.

Conclusions/Discussion
After several trials of testing the energy outputs of the cooled and uncooled solar panels, I concluded that using water to cool solar panels does increase its energy output while the uncooled solar panel's energy output decreased as the surface temperature increased. This experiment demonstrated that using water on the surface of a solar panel to keep it cool will help it create more energy.

Summary Statement
For this project I developed a surface water cooling system for solar panels and found that it increased the panel's energy output.

Help Received
I designed the water system and conducted the experiment by myself and my dad helped me to build it.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Anna T. Rioux

Project Number
J0218

Project Title
Improving Energy Production of a Microbial Fuel Cell: Testing Surface-to-Area Ratio Variations

Abstract

Objectives/Goals
The purpose of this experiment was to improve the energy production of a Microbial Fuel Cell (M.F.C.). I did this by testing the energy output of different surface-to-area ratios of electrodes and chambers, to use the best combination design in a series connected circuit for application and scale use on a dairy. I hypothesized the large electrode/small chamber (21 cm per 1L ratio) combination would produce the most usable energy.

Methods/Materials
I designed and built four mediator-less M.F.C. combinations: sml electrode/sml chambers (9.5 cm/1L); lrg electrode/sml chamber (21 cm/1L); sml electrode/lrg chamber (2 cm/1L); lrg electrode/lrg chamber (4.5 cm/1L). Twice daily voltage and amperage reading were taken to calculate wattage. Plastic storage containers (3.785 L & 17.98 L) were used as anode/cathode chambers. Carbon cloth sized 6x6 cm and 9x9 cm, and copper wire were used as electrodes. An agar solution, cording and compression fitting were used for the salt bridge, and an air pump was used to aerate the cathode. Cow manure was used as the waste material for the fuel cells.
Then the fuel cells were connected in series to test for further increase in electrical output.

Results
The results showed that the sml electrode/sml chamber produced 525 mV; 232 mA, and a usable energy of the 0.056 watts. The lrg electrode/sml chamber produced 669 mV; 200 mA, and had the second best usable energy output of 0.066 watts. The sml electrode/lrg chamber produced 105 mV; 28 mA and had the least usable energy output of 0.001. The lrg electrode/lrg chamber had 545 mV; 272 mA, and the greatest usable energy output of 0.071 watts. Distilled water (control) did not produce any usable electricity.

Conclusions/Discussion
My hypothesis was proven incorrect. The lrg electrode/lrg chamber with a 4.5 cm/L ratio had the best performance. However, the lrg electrode/sml chamber had the best voltage output. These results indicate that the electrode size is as important as the size of the container to increase the output of the fuel cell. Continuing testing is being conducted by connecting the lrg electrode/lrg chamber fuel cells in a series circuit to further improve electrical output of the fuel cell. Initial result of this series testing is promising, with the goal of transferring the energy produced from the series to a rechargable battery for future use, and eventually for application to power a dairy.

Summary Statement
This project looks to improve the energy production of a microbial fuel cell by testing the energy output of different surface-to-area ratios of electrodes and chambers, to use the best combination design in a series connected circuit.

Help Received
My dad helped me drill holes in the chambers, my mom helped with editing my paper, and technical electrical advice was provided by Dr. Zhao, of West Hills Community College.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Nathan A. Smith

Project Number
J0219

Project Title
What Is the Best Wind Turbine for a Consumer in an Urban Environment?

Abstract

Objectives/Goals
My goal of this project was to determine the best consumer wind turbine for the urban environment.

Methods/Materials
To make this project very reliable I decided to test 4 turbines that cover the main classes. The first one is from the horizontal axis wind turbine (HAWT) category. This is the standard four rotor design that is used a lot in wind farms. The second from that same category is the HAWT with an augmentor. These are experimental wind turbines that, according to their independent tests, produce 2 to 5 times the electricity as the standard ones. The next set of turbines are from the vertical axis wind turbine (VAWT) family. These are the Savonius turbines and the Giromill turbines. With all of the turbines I have chosen, they should cover all of the main families and groups of turbines. To test these, I made an artificial wind tunnel out of my hallway. This would allow me to precisely control the amount of wind being produced and eliminate any unwanted variables. The variables that I was attempting to address was not only the types of turbines, but the angles the wind was blowing at them from, as well as different speeds. This would allow me to stimulate an urban environment in order to find the best turbine for that specific situation. In order to find the best turbine I would average all of the scores.

Results
Out of all the wind turbines that I tested the HAWT with an augmentor performed far better than any of the other competitors. The only down fall to this turbine was that it couldn't perform nearly as well when it was exposed to different wind directions. The one turbine that was able to do this was the Savonius turbine. The reason this one wasn't able to perform the best is because it was not able to get rotating fast enough to come close to the highest output of the horizontal axis turbine with the augmentor meaning that it's average was lower.

Conclusions/Discussion
keeping in mind that the horizontal axis turbine with the augmentor performed the best I think that the turbine that has the most potential is the Savonius turbine. The main reason for this is that any HAWT has a very difficult time making up for wind in other directions, somthing that doesn't effect the VAWT turbines. In an urban environment this could be expessually meaningful. As a result I believe that with slight modifications the Savonius could be the best for an urban setting.

Summary Statement
In this project I built turbines in order test and see which type would be the best in an urban environment

Help Received
I received no help during this project. I built, tested, and made the improved design all by myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Isabela S. Sugden

Project Number
J0220

Project Title
The Bright Side of Bacteria

Abstract

Objectives/Goals
The objective was to find and test an alternative source of electricity from an unlikely source

Methods/Materials
￼- 2 mud samples
- 2 pieces of thin felt
- 2 pieces of thick felt
- 2 microbial fuel cells
- 2 gloves

Results
The bacteria in both microbial fuel cells produced measurable electricity. The plant mud was able to produce a significantly greater amount of microwatts then the creek mud.

Conclusions/Discussion
I learned that it is possible to make alternative forms of electricity, ultimately proving that my hypothesis was correct. Electricity can be produced from bacteria growing/reproducing in an anaerobic environment, like a microbial fuel cell. Overall this experiment went very well. Ultimately it made me realize that, although generating electricity from a bacterial source is possible, probability is low due to any usable quantity of energy would require large fuel cell farms. This would probably also require enormous changes to our current infrastructure, but may be useful to how we might use something as unpleasant as bacteria to our benefit for future colonizations..ie. in Mars for example where the likelihood of an anaerobic environment might be high. So although it is a cleaner alternative to burning fossil fuels it is also a more labor intensive way to produce electricity.

Summary Statement
My project is about creating alternative forms of electricity, I did this by growing bacteria in an anaerobic environment (microbial fuel cell).

Help Received
My mom helped me by driving me to the creek and by taking pictures of me while I was doing the experiment. My dad helped me edit my final conclusion and analysis for grammatical errors.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Misbah M. Syed

Project Number

J0221

Project Title

Efficient Design of Oscillating Water Column to Maximize Power Generated from Ocean Waves

Abstract

Objectives/Goals

The objective of my project is to find the effect of change in diameter on the amount of power generated by an oscillating water column.

Methods/Materials

My project method is to use a digital multi meter to measure the voltage and the current readings for the different oscillating water column designs to determine the peak power output. The materials I used were 2in., 3in., 4in. diameter ABS pipes, ABS cap hubs, rubber packing, 80mm computer cooling fan, digital multi meter, electrical color tapes with varying colors, and alligator clip cables.

Results

The 4-inch diameter oscillating water column produced more power than the 3-inch diameter oscillating water column. The modified 4-inch diameter oscillating water column (which has a short length of 2-inch diameter on the top closer to the fan) was the most efficient.

Conclusions/Discussion

The conclusion I reached was that diameter plays an important role in the efficiency of an oscillating water column. The modified 4-inch diameter oscillating water column produced the most energy because the waves force the air from 4-inch diameter pipe into a narrower 2-inch diameter space and the pressurized air exits through the fan causing it to spin faster thereby generating more power.

Summary Statement

I found that the diameter and design of the oscillating water column plays a critical role in the amount of power generated.

Help Received

I conceptualized and designed the oscillating water column models by myself. I took some assistance from my parents in building the model and while conducting the experiments

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
John R. Teel

Project Number
J0222

Project Title
Valley Velocity

Abstract

Objectives/Goals
As fossil fuel is starting to become non-renewable, alternate energies such as wind power are being considered as a possible way to run our nation. The purpose of my experiment is to determine where to place America's wind farms.

Methods/Materials
I tested two different geological features (in a valley, and up a mountain) to see which would create the fastest wind speed. I used a hand-held anemometer, a large fan, a yard stick; as well as glue, newspaper, and tinfoil to create my two paper mache mountains.

Results
I used the fan to simulate a wind and I took measurements in the valley and on the mountain. Through testing my hypothesis was proven correct as the valley is more efficient at creating faster wind speeds.

Conclusions/Discussion
After my testing, I figured that I could use my results to determine the cost savings possible. As the valley was proven to produce the fastest wind speeds, I used its data to find a cost reduction when a windmill is moved to a valley. I have learned through this experiment how to analyze data and display results.

Summary Statement
I searched for what geological feature would create the fastest wind speed, and I found that the valley compressed the air, creating a high pressure zone.

Help Received
I was helped with designing my experiment with Dr. Dunne and Dr. Manalis at University of California Santa Barbara.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Ian G. Weiss

Project Number
J0223

Project Title
Our Roads, A Large Thermoelectric Power Generator

Abstract

Objectives/Goals
The objective of this study proves that heat from pavement can be converted into energy based on the Seebeck Effect. Solar radiation can heat water in pipes within the pavement, which then in turn can be harvested into useable energy by converting heat energy into electric energy.

Methods/Materials
I tested the useable energy with four thermoelectric plates by measuring the energy output with a multimeter. A pavement box with a pipe system was built and a solar pump system installed to circulate the heated water through a metal holding tank. The thermoelectric plates were attached to the tank.

Results
The testing was done over an 8 month period and all reading were taken during Solar noon. The setup produced consistent energy even during the lower temperature times and high production during peak hours on hot days.

Conclusions/Discussion
Maximizing the efficiency of a thermoelectric power generation system requires extensive engineering design. Trade-offs between total heat flow through the thermoelectric modules and maximizing the temperature gradient across them must be balanced. The design of heat exchanger technologies to accomplish this is one of the most important aspects of engineering of a thermoelectric generator. This results in electricity from otherwise wasted heat. Allowing this heat to be used this way also lowers the heat island effect.

Summary Statement
I engineered a thermoelectric energy system which can be installed under any pavement to harvest heat energy and reduce the heat island effect.

Help Received
None. I built the system by myself and tested the data as well as analyzed it alone.