CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Andreas Allende; Owen Schuster

Project Number

J0201

Project Title

Making a Change for People Who Can't Afford Electricity

Abstract

Objectives

We learned from research that wind turbines have different blade types and our objective was to determine the type of wind turbine that produces the most energy: 2-blade, or 3-blade.

Methods

Using some of our toys, Legos and a Circuit Cube motor, we built a mini-wind turbine that could generate electricity and make light.

We built two model turbines, 2-blade and 3-blade, to see what blade would make the most energy. We used our Legos and Circuit Cubes to build the turbine base, and we 3-D printed blades to attach to the windmills. The blades were the same length and width. The only difference was the number of blades. [We ended up using all Lego parts because we were worried our 3-D printed blades would break apart.]

Next we connected alligator clips to the Circuit Cube and to a voltmeter to determine the volts produced by the blade types.

Then we generated wind with a leaf blower! We aimed the blower at each of the turbines (3-blade and 2-blade), at the same wind speed for the same time period, and measured the volts. We repeated this three times.

Results

The 3-blade mini-turbine generated the much more energy when compared to the 2-blade turbine. The average volts generated by the 3-blade turbine was 2.31 volts; the average generated by the 2-blade turbine was 1.63 volts.

Conclusions

Our hypothesis that the 3-blade wind turbine would make more energy than the 2-blade wind turbine was correct. We believe this is because the 3-blade propeller has more surface and angles to catch the wind so it spins faster and produces more electricity.

Summary Statement

We showed how wind turbines generate electricity and that a 3-blade turbine generates much more energy than a 2-blade model.

Help Received

We designed the project while building toy windmills. We got advice from the project sponsor on how to measure the electricity generated when the turbines spin, and Owen s father s business donated use of its 3-D printer for making our blades.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Breann Amarante; Jacqueline Rocha

Project Number

J0202

Project Title

Biodegradable Energy: Anaerobic Bacteria to Produce Renewable Energy from Compostables

Abstract

Objectives

Our project is based on the California landfill regulations. To do this we used biodegradable items in a sealed system to allow anaerobic bacteria to turn trash into CH4 or methane that could be siphoned off and used for the production of energy.

Methods

The methods used was to assemble each system with the same amount of soil and compostables. We then took readings every Monday and Thursdays to allow methane to build up in the system. We could then calculate the percentage of methane into usable BTUs to determine energy potential.

Results

Our project did exceed our expectations, the highest production of methane came out of the all food buckets and stayed constant through most of the test periods. The lawn-clippings did produce a measurable amount but not as much as the food did. We also found that is does matter what kind of compost-ables are put into the sealed systems as the food systems produces a higher energy potential than the lawn waste.

Conclusions

My partner and I concluded that our hypothesis was correct and that the food compostables did produce the higher amount of methane and it was also concluded that it does matter what kind of food is contained in the sealed systems. We hope to experiment further with the contents of the systems.

Summary Statement

This project is about trying to turn different types of compost-ables into usable renewable energy, methane, that could potentially be siphoned and turned into energy .

Help Received

During this project we had help from our science fair coach, engineers from local waste disposal sights, and other teacher from different subjects.

Name(s)

Vincent Doan

Project Number

J0203

Project Title

Waste Heat Recovery Utilizing Bismuth-Telluride Thermoelectric Generators and Lauric Acid Phase Change Material

Abstract

Objectives

The purpose is to measure the effects of a phase change material (PCM) unit on efficiency of a thermoelectric generator (TEG) waste heat recovery system and determine the appropriate applications of the unit.

Methods

TEG tabs, heatsink with fan, and a thermal interface plate are used to simulate thermoelectric waste heat recovery system. The system is placed on electric stove and wattage measured by multimeters. System efficiency will be compared with and without lauric acid PCM unit. Constant and intermittent operation of stove used to determine appropriate applications of lauric acid unit. Intermittent will test at 2 intervals; 5 minute and 15 minute intervals. Cool-down time is additionally included.

Results

Under constant heat, system with lauric acid unit produced average 227.8 milliwatts and a total of 273 joules as compared to system without lauric acid unit producing average 214 milliwatts and a total of 257 joules. Both were over 20 minutes.

Under intermittent heat (5 minute intervals), system with lauric acid unit produced average 4 milliwatts over 140 minutes and total 34 joules as compared to system without lauric acid unit producing average 49 milliwatts over 49 minutes and total 145 joules (time variance due to accounting for cool-down).

Under intermittent heat (15 minute intervals), system with lauric acid unit produced average 42 milliwatts over 170 minutes and total 428 joules as compared to system without lauric acid unit producing average 84 milliwatts over 78 minutes and total 393 joules.

It was noted that the lauric acid took 8 minutes to melt, compared to the intermittent heat at 5 minute intervals.

Conclusions

Analysis of why the PCM unit enhanced or reduced efficiency finds that the heat source being constant or intermittent is not the key factor that determines efficacy of the PCM unit. The key factor is if heat generated by the waste heat source is sufficient to melt and transfer through the PCM unit. If it is insufficient, PCM s should not be used; if it is, PCM s should be used. This study provides an alternative method of increasing efficiency of TEG s outside of the TEG s themselves, furthering knowledge on how efficiency of thermoelectrics may be improved in the future.

Summary Statement

I used thermoelectrics to recover waste heat, and determined appropriate applications of phase change material units to effectively enhance efficiency, which brings thermoelectrics closer to practical efficiency.

Help Received

My science teacher assisted during preliminary tests and explained key properties of thermodynamics. During the construction of thermoelectric waste heat recovery system and the real tests, my mother supervised. I did my own research on thermoelectrics, phase change materials, and for construction.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Aryah Hubbard

Project Number

J0204

Project Title

From Trash to Gas

Abstract

Objectives

The objective of this project is to see which types of biomass produce the most biogas.

Methods

The materials used for this project include cow manure mixed with banana peels, cow manure with vegetable peels, and just plain cow manure. Balloons attached to the bottles that these items were in were measured to see how much biogas was produced from each of the items.

Results

The results of this experiment indicated that cow manure and banana peels produced the most biogas. With this combination, the balloon attached to the bottle filled with a circumference of 14 centimeters. The cow manure and vegetables bottles had a circumference of 10 centimeters. The bottles with cow manure only had a circumference of 3.5 centimeters and had no change.

Conclusions

In conclusion, the bottles with cow manure and mashed banana produced the most biogas. The balloon at the top of the bottle with cow manure and mashed banana ended with a circumference of 14 centimeters and two of the three balloons stood upright. The cow manure and vegetables bottles had a circumference of 10 centimeters and the balloons stayed leaning to the side except for one of the bottles. The bottles with cow manure only had a circumference of 3.5 centimeters and had no change. This shows that bananas could potentially be a source of renewable energy. Biogas can be produced from food waste and manure. I could go further into this project by testing different kinds of fruits, vegetables, and manure from different animals and also different ways of producing the gas and turning it into energy.

Summary Statement

I showed that biogas could be produced from biomass.

Help Received

I performed my experiment myself but my science teacher, Mrs. Antonio, emphasized validity and the scientific method.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Catalina Interiano; Johanna Perez

Project Number

J0205

Project Title

Urine's Potential as a Biofuel

Abstract

Objectives

The objective of this project was to determine if the components of urine could be utilized by bacteria to aid in the production of electricity in a microbial fuel cell.

Methods

In order to test this hypothesis, 2 microbial fuel cells were prepared with an anode and cathode, a hacker board, an led light, a capacitor, soil, and water. A digital multimeter was used and the power of the microbial fuel cells was measured and recorded with 7 different resistors. Once the microbial fuel cells demonstrated stable power production with water, which served as our control, urine was added to each vessel. The first microbial fuel cell was given 1 mL of urine and the second was given 5 mL of urine. The microbial fuel cell's energy production was recorded over the course of 25 days. The idea to conduct this experiment came about after research on alternate forms of energy and a review of www.sciencebuddies.org, which outlined how to go about such an investigation.

Results

It was observed that both microbial fuel cells had significant increases in power. When the data was analyzed, the results showed that the microbial fuel cell with 1 mL of urine increased in the production of power by 52% and the microbial fuel cell with 5 mL increased in production by 313%.

Conclusions

The conclusion was drawn that adding urine to a microbial fuel cell does improve its electricity production. This study contributes to the field of knowledge in alternate and sustainable fuel which will benefit all of humanity.

Summary Statement

We demonstrated that urine can be utilized in a microbial fuel cell to generate electricity.

Help Received

Mr. Robert Perez, an engineer, gave us guidance on how to analyze our data.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Aditya Kakarla

Project Number

J0206

Project Title

Using Phosphorescence to Increase Solar Panel Output

Abstract

Objectives

The objective of this project was to observe if phosphorescence can increase the amount of energy we receive from solar panels.

Methods

In this project, we used a polycrystalline solar panel, glow sticks, a shoebox, a multimeter, and a lamp. We tested the effect of phosphorescence on a solar panel in 4 different situation inside a room. We used a multimeter to track our results.

Results

The project was tested over multiple days to ensure proper accuracy. Voltages of our 4 different situations was tracked and recorded. Phosphorescence was shown to increase the energy received from the solar panels when the day and night energy outputs were combined.

Conclusions

Repeated trials of our experiment showed that phosphorescence increased the voltage of the solar panel. When combining the day and night results of the tests, there is a constant pattern in the results. The solar panel with the phosphorescence initially has less energy, but gains voltage over time. This results in us determining phosphorescence is a viable source for improved solar panel efficiency.

Summary Statement

This project shows phosphorescence can be used to increase solar panel output.

Help Received

My parents helped me acquire the materials needed for the project.

Name(s)

Muhammed Qaanith Kamal

Project Number

J0207

Project Title

Enabler: Power Generation Re-Imagined

Abstract

Objectives

As per the 2010 Census, there are more than 55 million people in the United States that are disabled. Out of which 3.6 million people use a wheelchair to assist with mobility.One of the common problems people who use wheelchairs face is that they run out of power on the wheelchair when they use their wheelchair device charging station for charging their electronic devices. This becomes an issue if they happen to visit hospitals or places where they have to wait for a long time, or if they have to travel and realize that they didn t charge their device before departure. Enabler solves this problem for people with disabilities who use wheelchairs for charging their electronic devices on the go without depleting the power in their built-in wheelchair charging station. My hypothesis is to determine that electricity can be generated by using a piezoelectric module attached to a wheelchair through the spins of the wheel to power the portable devices of a wheelchair user while they are in motion.

Methods

The materials I used are - Piezoelectric Module, LED, Switch, Rechargeable Battery, Diodes, Wooden Wheelchair Model, and a Multimeter. For my model, I used a piezoelectric module and connected that to a couple of diodes. After that I attached a LED to the circuit to see if the electricity would flow through the circuit. It successfully lit the LED. Next, I removed a wheel from an old bike and attached pieces of plastic to the spokes of the wheel. I tried a variation of objects to use in place of the plastic but they all never actually powered the LED so this was one of my only options! Lastly, I put the piezoelectric piece in the way of the plastic so that whenever it touches the piezoelectric piece it will generate electricity. The factors that I considered for my hypothesis were the number of Piezoelectric modules and the volts generated. I tested my model 5 times and all of the 5 trials were successful. However I had to redesign my circuit around 3-4 times because it wasn t letting the electricity to flow through the circuit. The issue was either due to short circuited components or the Diodes had come apart from the leads. Often times the LED kept fusing. I used a multimeter to measure the volts because that is one of the most common form of measuring electricity. This electricity can be used for a variety of purposes from using it to charge electronic devices to powering the wheel chair as a whole in the future!

Results

The independent variable that I used in this project is the number of Piezoelectric modules and the dependent variable is the number of volts generated. The trials were conducted to determine how many spins the model could generate in 60 seconds. The model generated 17 spins in 60 seconds. So with one

Summary Statement

I showed that electricity can be generated by using a piezoelectric module attached to the wheels of the wheelchair to power their portable gadgets while the wheelchair is in motion.

Help Received

None, I made and tested the project myself. I got inspired by a friend on a wheelchair at a disability event.

Name(s)

Riya Kumar

Project Number

J0208

Project Title

How Poop Can Power the Planet: Microbial Fuel Cells

Abstract

Objectives

The purpose of this study was to find which less conventional, yet prevalent, organic waste fuels would produce the most electricity in a standard two chamber microbial fuel cell. It was hypothesized that out of sewer sludge, horse manure, and compost, sewer sludge would produce the most electricity in a microbial fuel cell left running for 72 hours.

Methods

This experiment involved getting sewer sludge from the Contra Costa County Sanitary District, horse manure from a local farm, and home grown compost. These were then utilized in three microbial fuel cells which were constructed by the scientist.

Results

The results were that sewer sludge produced the most electricity in the fuel cell, with a high of 282 millivolts, and horse manure produced the second highest amount, with an average of 122.7 millivolts. Compost generated no electricity.

Conclusions

It was found that sewer sludge is the best type of fuel to use as it produced the most electricity, likely because it contains a larger amount of anaerobic bacteria. Sewer sludge can be found anywhere in the world, and can help power villages in developing countries.

Summary Statement

I built three microbial fuel cells to see whether different types of prevalent, yet not typically used wastes would be an effective fuel to generate electricity.

Help Received

I constructed the fuel cells and did research on my own, but did so under the supervision of a qualified nurse, Gena Howarter, and my father.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Lillian Lawrenz

Project Number

J0209

Project Title

Temperature: The Impact on Windmill Power Output

Abstract

Objectives

Measure the electrical power output of a wind-driven generator at various temperatures. Compare the power output of the generator at the same windspeed for various temperatures.

Methods

Wind-driven generator, digital multimeter, handheld anemometer, weather app on a smartphone, and spreadsheet. At various temperature and windspeed combinations, measure the voltage and amperage output of a wind-driven generator. Use a spreadsheet to analyze and plot the data to interpret the results.

Results

Plotting the power output (milliWatts) versus windspeed (meters / second) and grouping similar temperatures shows that a generator will produce more power in a cooler temperature compared to a warmer temperature at the same windspeed.

Conclusions

Cooler weather will produce more power. For example, a 16 degree cooler temperature can produce over twice the power output for the same windspeed. Capturing the most possible clean energy from the wind is important in planning new wind farms and new communities. The size, location, and typical weather will all influence the future use of wind farms.

Summary Statement

I found that wind mills will generate more power in cooler temperatures compared to warmer temperatures.

Help Received

I built the test equipment and conducted the experiment myself with some help from my dad.

Name(s)

Brian Li; Emma Li

Project Number

J0210

Project Title

Designing and Implementing a Novel Solar Panel Tracker System Leveraging Reinforcement Learning Technique

Abstract

Objectives

As of today, the average efficiency of household solar panels is around 20%, which means only around 20% of solar energy is converted into household electricity. Our objective is to explore various techniques that not only enhance this efficiency but also are scalable for thousands of households.

Methods

Designed and constructed an intelligent solar panel tracker that adjusts the solar panel s orientations to maximize the sun ray receptance throughout a day, intelligence offered by a reinforcement learning technique that explores an optimal orientation, taking into account of the variations in the environmental factors. Placed two identical solar panels side-by-side, one mounted on our solar panel tracker; the other has a fixed position. Collected voltage measurements from both solar panels at identical time intervals between 8 AM to 5 PM each day. Repeated the same benchmark testing for several days.

Tracker system mainly consists of servo motors, Arduino board, rotational platform, and solar panel.

Results

Five trials were conducted. Daily Voltage Output Percentage Gains: 1st trial-11% ; 2nd trial-16% ; 3rd trial-22% ; 4th trial-16% ; 5th trial-21%. Average percentage gain is 17%. The positive voltage output gains show that this approach is effective.

Conclusions

This is the first ever solar tracking system that leverages a reinforcement learning technique. Our experiment data consistently shows positive voltage output percentage gains from the smart solar tracker throughout our trials. With on average nearly 20% of efficiency gain, it clearly shows that our novel approach is effective. Based on the data charts, the efficiency percentage gains in the morning and evening are greater than the daily peak temperature time window, usually centered around noontime. Also, on a warmer day, the daily efficiency percentage gain tends to be lower. This is because the fixed solar panel is positioned facing up vertically, thus likely to output close to optimal voltages during peak temperature hours. In addition, a warmer day also tends to have longer peak temperature time window. As the temperature or light intensity goes higher, both smart and baseline solar panel voltage outputs are higher, so should expect the percentage gain from tracker be lower.

Summary Statement

Our project is an intelligent solar panel tracker controlled by a centralized software based on reinforcement learning techniques for household use.

Help Received

Vina Sethi is our science teacher. My parents, Hui Li and Min Chen, helped us buy parts and taught us how to do things like C programming and building the device.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Selena Macias

Project Number

J0211

Project Title

Solar Energy to the Test

Abstract

Objectives

The objective of this project is the determine how different environmental factors affect the productivity of solar cells.

Methods

4 Solar Panels, water, ash, dirt samples, infrared thermometer were used as my major materials.
Solar panels were treated with different environmental factors: just sunlight (control), freezed the panels, covered panels with ash, and panels heated to 98 degrees fahrenheit. I used a voltmeter to read the solar panel energy production.

Results

The result of my investigation on does the condition/cleanliness of the solar panels affect how much energy is produced, is that the solar panel with ash pollution created the most energy. I determined this by repeating multiple trials of each solar panel treated with different treatments and calculated the average. Average amount of volts produced (with ash pollution) was 4.86 volts.

Conclusions

After completing my investigation on does the cleanliness of the solar panel affect the amount of energy produced. I have concluded that the variable ash produced the most energy. After my trials I learned that having water on your solar panels will decrease the amount of energy produced by approximately 0.5 times less energy. The water variable created the least amount of voltage. I also learned that the pollution (ash) produced the most amount of voltage it increases the energy by 1.04. So I do think that it is worth it to have someone clean your solar panels even though it will cost you a bite of money it will be worth it in the long run.

Summary Statement

Different environmental factors affect solar panel energy production.

Help Received

Joseph Linares, Glenn Kinney

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Samira Mehrinfar

Project Number

J0212

Project Title

A Healthier Way to Fuel

Abstract

Objectives

The objective of this project is determine the visual effect when adding different levels of methoxide solution on algae oil to create a biodiesel .

Methods

Lye, Rubbing alcohol, Bunsen burner, safety googles, lab coat, gloves, test tubes, algae oil, thermometer, supervisor, electronic weight, timer, and measurement cup.

Results

The different levels of methoxide solution was compared through the visual outcome of the biodiesel. When observing the results, the higher the amount of solution the substance would sultified.

Conclusions

After performing this experiment, I realize the importance of each and every factor when making biodiesel, especially molar ratio. Based of my results, the more amount of a substance needed will create wild results. With this in mind, I can have a better understanding about biodiesel.

Summary Statement

I created different levels of a methoxide solution, tested it on algae oil, and observed the visual outcome of the biodeisel when putting too much and too little.

Help Received

I was supervised by my science teacher, Mr. Briner. He watched me do my experiment, as well let me use his lab as well.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Jordan Prawira

Project Number

J0213

Project Title

Spira Mirabilis: Improving the Performance of Archimedes Wind Turbine with Logarithmic Spiral Concept

Abstract

Objectives

To develop higher efficiency of Archimedes Wind Turbines (AWT) by applying the logarithmic spiral concept for small-scale wind turbines below 30m.

Methods

AWT curvatures were remixed to incorporate different logarithmic spiral formulas from Desmos (2 Blades, 3 Blades A/B/C). Prototypes were 3D-printed, with a stand and generator connected for testing in three wind speeds and different latitudes/longitudes. Power is calculated by measuring the voltage and current using the multimeter. Efficiency is calculated by comparing AWT power to the wind power available in the sweep area and also compared to HAWT and VAWT from my prior science projects.

Results

Power generated is affected consistently by wind speed. However, a higher power doesn't always translate to higher efficiency. Efficiency increases by 17%-174% in 3.8 m/s compared to 2.6 m/s wind speeds in various turbines. 2 Blades outperforms 3 Blades in low wind speed. Latitude/longitude of the wind affects the power generated. The highest power is at 0,0; producing 83%-93% within 45 degrees and 15%-23% within 90 degrees, except 45 S and 90 S. The stand blocks some airflow and reduced the power by 20%-46% in 45 S. Logarithmic spiral wind turbine prototype (3 Blades B) efficiency is up to 27.4% at 3.8m/s wind speed, exceeding my HAWT, VAWT designs and one commercial AWT at 12m/s wind speed. Based on logarithmic regression prediction, 3 Blades B has the potential to reach up to 38% efficiency at 6-8m/s and up to 44% efficiency at 12 m/s; 10-20 percentage points higher than commercial AWTs.

Conclusions

My hypothesis was proven correct, as different blade curvatures produce different powers in the same wind speed and in different latitudes/longitudes of wind direction. Since the logarithmic spiral is a growth spiral, an increase in curvature results in more surface area to capture the wind energy spiraling from high-to-low pressure. However, an optimal point is reached as tighter curvature adds weight, diminishes the Coanda effect and power is reduced. Implementing a Logarithmic spiral in AWT is proven to generate higher efficiency and meets stated design criteria.

Summary Statement

I developed Logarithmic-spiral based wind turbine prototypes with high efficiency in relatively low wind speeds and in various latitude/longitude wind directions for urban settings.

Help Received

Thanks to Mr. Nager Shareghi, Director of Public Work Department at Mountain House Community Services District; Mrs. Gillmore, Mr. States, Ms. Nora for feedback and support; My parents for providing materials and assisting me in Excel and board.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Caroline Schmidt; Scarlett Streitman

Project Number

J0214

Project Title

WAVE Goodbye to Fossil Fuels: It's Time to SEA Energy Differently!

Abstract

Objectives

Our goal was to create a self-sustaining energy source that relied on natural occurrences. We decided to make a wave powered generator, after researching several alternative energy sources. We strived to use recycled materials in a purposeful manner in order to reduce non-biodegradable waste in the ocean. Based on research, we believed that the amount of energy would increase as the waves grew in size and speed, due to the magnet s larger and faster movements. Today, fossil fuels are used for energy because of their convenience. Due to using greater quantities of fossil fuels, changes have occurred in the environment; the solution could be wave energy.

Methods

We created a generator using a plastic bottle, copper wire, magnets, and electrical tape. We recorded 100 results with 17 varying wave heights, and 29 varying outcomes. The wave heights varied from 3 to 23 cm. Before testing, we assembled the generator by using the water container as a buoy. We attached the magnets, and wrapped a water bottle in copper wire. While testing, the waves carried the buoy to different heights, resulting in varying amounts of energy being produced.

Results

After recording 100 results, we calculated the mean, median, mode, and range of the data. After several days of testing, there was an outlier of 14.1 V, which we did not include into our calculations. The average amount of energy produced was 1.71 V and the average wave height was 11.05 cm. The median number of volts generated was 1.1 V, and the median wave height was 10 cm. The most common wave height was 8 cm, and the most common voltage was 0.9 V. Overall, the greatest amount of energy produced was 6.2 V, which occurred at 9 cm. The lowest recorded voltage was 0.4 V, which occurred at 3 cm, which was also the lowest wave height recorded.

Conclusions

In general, our hypothesis was supported. We documented that as the wave heights and speeds increased, the energy generated also increased. There were a few setbacks along the way, such as weather conditions. We would recommend performing more tests, in order to confirm the findings. The outcomes of the experiment seemed to reinforce the belief that wave energy could greatly improve how society produces electricity.

Summary Statement

In our project we constructed a wave-powered generator and correlated energy output to wave height.

Help Received

We would like to acknowledge our parents and our teacher for helping us obtain necessary materials.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Alison Togami

Project Number

J0215

Project Title

Dye-Sensitized Solar Cells Made with Fruits

Abstract

Objectives

The objective of this experiment was to see if using different fruits to make dye-sensitized solar cells affected the amount of voltage the solar cells produced.

Methods

A Nanocrystalline Solar Cell Kit from the Institute for Chemical Education provided the basic parts of the solar cells. Commercial raspberries, blueberries, and cherries were purchased to obtain the dyes used in the fabrication of the solar cells. Three solar cells were made for each fruit. Using a digital multimeter measured voltage of different cells under the light source.

Results

Each solar cell was tested three times. The solar cells made with raspberry dye consistently had the highest voltage output, while the solar cells made with the blueberry dye consistently had the lowest voltage output.

Conclusions

Solar cells dyed with raspberries produce the highest voltage and significantly produced more voltage than cells dyed with cherries or blueberries. While all of the solar cells produced measurable amounts of electricity, the type of fruit used has a major role in how much electricity they produce.

Summary Statement

I tested dye-sensitized solar cells made with three different fruits and found they produced varying amounts of electricity.

Help Received

Based on internet research I modified the fabrication of the Nanocrystalline Solar Cells from Institute for Chemical Education Naoncrystalline Solar Cell Kit.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Marcus Yoo

Project Number

J0216

Project Title

Gravity Battery

Abstract

Objectives

In our society, there are still those who don t have access to electricity and light. I saw a need for a device that would be able to provide light and energy to those who needed it. I wanted to utilize the power of gravity to fuel my device, which would allow the device to be used by anyone, anywhere. I hypothesized that I would be able to use Computer Aided Design software to calculate and design a planetary gearbox, that would be able to translate the kinetic energy stored in weights into electricity. Despite encountering difficulties related to the low-melting point of the plastic used by the 3-dimensional printer, I found that I was able to use weights to produce energy and successfully power a Light Emitting Diode.

Methods

Calculate gear reduction weight ratio, please see explanation below of the mathematics required.
Design and adapt 3D parts with Computer Aided Design software
Print 3D parts
Assemble prototype and make necessary adaptations
Make final print
File parts
Lubricate parts
Add weights
Attach LED
Affix to framing material to secure device
Conduct tests to find the weight at which the LED would light up.

Results

During my experiment I discovered that it is indeed possible to produce energy using gravity. I experimented with different weights and the output they produced. The smallest weight that I could get to produce energy was at 16 pounds. I was able to produce 1.2 volts consistently. That is a small amount considering that an average battery has an output with a constant current of 1.5 volts. When scaling the weight up to 19 pounds I was able to attain 2.45 volts of electricity. The Light Emitting Diode that I am using requires a minimum of 3 volts to light up. When I raised the weight to 21 pounds I was able to produce 3.1 volts at a constant rate thus powering the LED. One problem that I encountered is that the plastic was melting due to the high friction. I am assuming that this was a result of the PLA plastic that was used to print the parts, being able to melt at such low temperatures.

Summary Statement

My project converts gravitational potential into electricity that can be used to power a light.

Help Received

Bing Liu was my teacher who supported me with my research, Terri Rodriguez is the Maker-space Teacher that provided me with 3d printing utilities Adella Pyo Mom that helped me put my board together.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Luca Younes

Project Number

J0217

Project Title

Wave Energy Optimization

Abstract

Objectives

The goal of this project is to determine what mechanisms work best for capturing energy from certain wave shapes, sizes, and speeds.

This is important because wave energy could be a significant source of renewable power; there are 620,000 km of coastline on Earth. Most previous research provides information on size, aesthetics, or efficiency of a method. What has been missing is situational efficiency information. I hope to fill in some of these gaps with my data.

Methods

I performed a series of constructive tests. I analyzed data from some initial tests, then I ran more tests to verify my preliminary conclusions.

I built a wave tank, using an Arduino microprocessor to create different wave types/patterns. I also built two different wave energy capture mechanisms:

- Pulley Apparatus: Uses the up and down motion of the waves with a buoy to move a dynamo.
- Bar Apparatus: Uses a rotating paddle and the linear motion of the waves to generate electricity.

Results

I collected a total of 10,158 data points for the series of 6 tests that I ran.

Analyzing the results led me to believe that the pulley apparatus performs better with most wave types and sizes.

In my final set of tests, I used my intermediate results to design a condition that would allow me to verify my initial ideas. I found that the pulley apparatus does better on three quarters of the tests, but when the bar apparatus does do better, it is significant.

Conclusions

In this project I looked into two different ways of capturing wave energy. I proved with my data that the pulley apparatus is better overall, but that the bar apparatus is better for more balanced waves. This is the exact data that I can't find online because most articles say the bar apparatus is better. But they fail to realize that for more balanced waves the pulley apparatus is better. Therefore, this project has done something useful!

Summary Statement

The goal of this project is to determine what it takes to capture wave energy and what types of models work best for converting energy from certain wave shapes, sizes, and speeds to electricity.

Help Received

I discussed the project with my parents, and they helped me purchase some of the materials.