CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Forbes H. Bainou

Project Number
J1001

Project Title
Go with the Flow: An Exploration of the Benefits of Hydropower Technology

Abstract

Objectives/Goals
My objective was to develop alternative energy sources to fuel our growing world demand for energy and to reduce fossil fuel emission, by utilizing hydropower. My goal was to design a propeller that would produce the greatest amount of rotations per minute.

Methods/Materials
I first created my propellers to be unique and very different from each other. From there, I tested each propeller individually five times. I then recorded my results and averaged the data.

Results
From the data, I concluded that propeller A cut through the water the most efficiently because of its hydrodynamic shape. It rotated on average 105%+ more quickly than Propeller B, C, and D.

Conclusions/Discussion
I can accept my hypothesis because my data shows that I was correct in stating that propeller A would create the most rotations per minute. I can conclude that propeller A was able to cut through the water the most consistently. I belive this is true because the surface area of the blades of propeller A as well as the angle of the blades proved to be optimal for creating the maximum rotations per minute.

Summary Statement
My project investigates the possible benefits of hydropower technolgy by testing diffrent propellers.

Help Received
My math tutour Blaine Rhodes helped me brainstorm ways of testing hydropower technology accurately.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Aymin Bedri

Project Number
J1002

Project Title
Space Solar Cells

Abstract

Objectives/Goals
My objective is to increase the power efficiency of solar cells by changing the alloys of the solar cells. Based on my research, the hypothesis I formed, the solar cell efficiency generated energy can be improved by changing the alloys of the solar cells elements. This improves the generated energy efficiency for the solar cells.

Methods/Materials
I exposed different solar cell types such as Silicon, Indium Nitride, and Indium Galium Nitide to different LED light types, and measured the output voltage and current from the solar cells. The materials I used were solar cells, light source, LED, and a voltmeter.

Results
The measurement results show that Indium Gallium Nitride produced the most power efficiency.

Conclusions/Discussion
I concluded that, more efficient solar cells can be produced and built by a mixture of semiconductor alloys of semiconductor elements from group III (Gallium, Indium) and V (Nitrogen). This is very suitable for space solar cells by improving the efficieny up to 40%. A good spectral match to sunlight, with a growth of multiple layers with different band gaps, makes the material InGaN suitable fo satellites space solar cells.

Summary Statement
How to increase the power efficiency of solar cells by changing the alloys of the solar cells?

Help Received
Father helped in putting equipment together

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Nathan G. Behrens

Project Number

J1003

Project Title

Increasing Efficiency of Existing Air Conditioners by Only Changing the Timing of Operation

Abstract

Objectives/Goals

The purpose of this project was to determine whether it is more efficient to run an air conditioner in the day or night and in long or short time blocks.

Methods/Materials

More than 200 cycles of a home air conditioning system was analyzed over the period of a month. Eighteen data loggers, some with internal and some with external temperature probes, were placed outside, in the attic, before and after the evaporator and below return and outlet air vents. Relative efficiencies were calculated by comparing average temperature differences between inlet and outlet air vents (delta T) at differing times of day and lengths of air conditioner run. To ensure that the temperature measurement devices responded quicker than the air conditioner transients, a transient test was conducted by comparing the characteristic times of the data loggers against the air conditioners response. Winter data from the heater was used as a complementary data because it used the same duct system and supplemented the summer A/C data in looking at impact of run length.

Results

The measurement device transient tests on the main data logger type showed a six minute response time to reflect 80% of a 12°C step change. After device modification, the response time was one minute. Typical A/C run lengths were five minutes.

On long runs, the delta T dropped from 12°C to 8°C as the attic temperature rose from 25°C to 35°C. On short runs, typical delta T's were as low as 4°C when the attic temperature was ~40°C. As the attic temperature started dropping below ~35°C the temperature differences rose to 6-8°C. Winter heater delta T's were 15°C for long runs and only 5-8°C for short runs.

Conclusions/Discussion

Daytime vs. nighttime attic temperatures reduce the air conditioner cooling capacity by approximately a third. Long runs show greater cooling capacity but also drop with higher attic temperature; the winter heating analysis is consistent showing twice the heating delta T at longer run times. Heat conduction into the ducts and leakage on the inlet side taking attic air into the ducts both reduce the delta T that cools or heats a house.

Summary Statement

Relative efficiencies were calculated by measuring temperatures throughout a house to increase efficiency of the existing air conditioner by only changing the timing of operation.

Help Received

Discussions with parents. Dad showed how to run the data loggers and wrote some VBA used to catalogue and retrieve the data quickly.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ian J. Bennett

Project Number

J1004

Project Title

Microbial Fuel Cell, Year Two: Comparing Ten Anode Electrode Materials' Average Power Density in an Air-Cathode Design

Abstract

Objectives/Goals

Last year my project was a broad investigation about the possibility of generating power with a simple microbial fuel cell. This year, I seek to determine which anode electrode material will produce the highest average power density using secondary (biological) treatment water, while keeping the single-chamber air-cathode microbial fuel cell configuration the same. I believe the Duocel Aluminum Foam Metal, 40 Pores Per Inch, 6-8 percent Density (Non-Compressed) anode electrode will produce the highest average power density reading over seven days. The hypothesis is based on literature that indicates Duocel Foam Metal Aluminum is a good conductor, does well in harsh environments, and provides good access for the bacteria to attach.

Methods/Materials

Designed and built ten identical single-chamber air-cathode microbial fuel cells. Telephoned suppliers and obtained free carbon, aluminum, and copper anode electrode materials; secondary (biological) treatment wastewater; and supplies. Built a homemade carbon fiber brush anode electrode and assembled the other nine anode electrode materials. Poured 1 Liter of secondary treatment water into ten air-cathode systems and sealed airtight. Connected the external circuit to a 1000 ohm resistor and a multi-meter. Recorded millivolt and milliamp readings three times daily for seven days.

Results

The anode electrode made from Aluminum Foam Metal, 40 PPI, 6-8 percent Density (Non-Compressed) had the highest average power density at 9.2367 x 10-2 mW/m² while processing secondary (biological) treatment water.

Conclusions/Discussion

The data does support my hypothesis that the Duocel Aluminum Foam Metal, 40 Pores Per Inch, 6-8 percent Density (Non-Compressed) anode electrode will produce the highest average power density reading. The medium density and non-compressed aluminum anode was a good conductor, biocompatible in the secondary treatment wastewater, and had enough surface area available for the bacteria to colonize. The data demonstrates that the type of anode electrode material is important when measuring the average power density in this homemade single-chamber air-cathode microbial fuel cell configuration.

Summary Statement

My project purpose is to present experimental data comparing the average power density of ten different anode electrode materials using secondary treatment water, in a homemade single-chamber air-cathode microbial fuel cell configuration.

Help Received

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

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Khajag Bornazyan

Project Number
J1005

Project Title
Enhancement of Solar Pond Performance

Abstract

Objectives/Goals
My 2008 #Energy Trap# project studied solar ponds as an energy collector and storage system combined. I effectively proved that by creating salinity gradient body of water we could store and reuse solar energy for our needs. One of the unanswered questions was the effect of bottom reflectivity on solar pond performance. My 2009 project experimentally investigates this subject. After researching, I hypothesize that decreased reflectivity of the bottom surface of the salinity gradient container will result in the greatest thermal storage efficiency.

Methods/Materials
Solar pond-like vertical salinity gradient was created in the container and exposed to halogen lamplight (sunlight simulator). High absorptive, medium absorptive and high reflective bottom cases were observed. Effects were evaluated by measuring and calculating difference in temperature between bottom and top layers of water as function of light exposure time.

Results
In the high absorptive case, the bottom temperature increased and exceeded top about 6 hours sooner than in the medium case and about 12 hours sooner than in the high reflective case. In the high reflective case bottom temperature never exceeded top.

Conclusions/Discussion
In the high absorptive case, the temperature increased more efficiently than in the medium and high reflective cases, indicating high thermal conversion efficiency for the first case. The data supported the hypothesis and findings agree with the information that is found in the literature and the El Paso Solar Pond research and development project results.

Summary Statement
By creating high absorptive surface at the bottom of solar pond-like environment, it was shown that the sunlight, a renewable energy source, could be more effectively converted into thermal energy and stored for future needs.

Help Received
Father helped me to choose the topic and with transportation to obtain necessary materials and literature. Mother helped me with the display board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Macallan Brown; Elias Dykaar

Project Number
J1006

Project Title
Smoked Out Power

Abstract

Objectives/Goals
Determine how smoke from a forest fire affects the power output of solar cells and if either amorphous or crystalline solar cells perform better in a smoky environment.

Methods/Materials
The Plexiglas box (30 cm x 30 cm x 30 cm) is constructed and placed over the amorphous and crystalline solar cells. A 150 watt light bulb is mounted above box for the light source. Smoke is put into the box by burning a stick of incense inside the box. The output of the solar cells is measured before smoke is introduced and after every two cm of incense is burned. The output of the solar cells is determined by measuring the voltage drop across a 100 ohm resistor and a 220 ohm resistor. The power is calculated using the equation P=V2/R where P=power, V=voltage, and R=resistance.

Results
We found that smoke decreases the power output of both types of solar cell 60 to 70 percent. The amorphous solar cell transformed 25 percent more power than the crystalline solar cell at 10 cm of incense burned.

Conclusions/Discussion
Our data shows that smoke from forest fires will significantly affect the power output of solar cells. Amorphous solar cells will work better in a smoky atmosphere than crystalline solar cells. Since the climate is steadily growing warmer and dryer, forest fires are becoming more frequent as evidenced by the numerous forest fires in California during the summer of 2008. Solar cells are a great way to obtain renewable energy however forest fires will substantially reduce their power output.

Summary Statement
To measure the affect of smoke on the power output of solar cells.

Help Received
Dad helped build box, and monitored the report process, Mom helped edit report, Mr. Steely gave instructions

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
John E. Carrion

Project Number
J1007

Project Title
Solar Panels with Reflectors

Abstract

Objectives/Goals
The purpose of my science project is to determine if light reflected onto a solar panel is an efficient way to produce electricity. Last year I tested at which angle to the light source does a solar panel create the most voltage. That project made me wonder what would happen if I put two solar panels back to back, one in direct light and one getting light from a reflective surface? That is this year's project.

Methods/Materials
2 Solar panels, a 1000 watt spot light, black foam board (control background), white cardboard (white reflector), 2 mirrors, a voltmeter. I compared two different reflective surfaces shining light onto a solar panel and measured the voltage output of a solar panel. I also measured the voltage output of another solar panel in direct light. I tested the panels with the light source at 90 degrees to the face of the solar panels, then moved in 10 degree increments, all the way down to 0 degrees.

Results
Overall, white reflectors worked better than mirrors at all angles except from 70 degrees down to 50 degrees. The white reflectors consistently and more evenly produced light at most angles. The mirrors were the best at 70 degrees(almost producing the same amount of light as the solar panel in direct light), but dropped off at all other angles, due to the law of specular reflection.

Conclusions/Discussion
White Reflectors are the reflectors that produced light, and therefore electricity the most consistently. As reflectors, the mirrors are actually better than the white reflectors, but only when the sun is at a specific place in the sky. If you can somehow get the mirrors to track the movement of the sun, the mirrors would be the best reflector.

Summary Statement
Which reflective surface, white cardboard or mirrors, will most efficiently produce more electricity on a solar panel?

Help Received
My Mom proof read docs, my Dad helped build the display board and was a second set of hands when needed.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Alex Chen

Project Number
J1008

Project Title
V-Groove Solar Cell and Mirror Arrangement for Efficiency Enhancement

Abstract

Objectives/Goals
The objective is to determine if a novel V-groove solar panel using solar cells on one sidewall of the V-grooves and mirrors on the other sidewall can generate electricity more efficiently than a conventional planar solar panel.

Methods/Materials
A V-groove solar panel using solar cells and mirrors and a conventional planar solar panel were designed, assembled, and measured. In the V-groove configuration, solar cells of size 1cm x 1.1cm were attached to one sidewall of the V-grooves and flexible paper mirrors were attached to the opposite sidewall to reflect photons to the solar cells. In the planar solar panel, all solar cells were arranged on the same plane. The V-groove panel used 396 individual solar cells and 22 mirror stripes while the planar panel used 432 cells. Both panels had the same size of 20.5cm x 28.5cm x 2cm and the same light receiving area. Current-voltage characteristics were measured to compare their fill factor and maximum power capability.

Results
Measured fill factor was 0.74 for the V-groove panel and 0.70 for the planar panel, indicating that the V-groove panel had better efficiency. Open circuit voltages and short circuit currents of both panels were measured outdoors for two consecutive days to determine their maximum output power. In average, the maximum power capability of the V-groove panel was 10% higher than that of the planar panel.

Conclusions/Discussion
A V-groove solar panel using solar cells and flexible paper mirrors was demonstrated for the first time. It outperformed a conventional planar panel in terms of fill factor and maximum power capability. The improved performance of the V-groove panel was attributed to enhanced light trapping and reduced internal resistance. Separated measurements on an individual solar cell indicated that the antireflection coating of the solar cells seemed to work better at a slanted angle. The V-groove panel also had lower internal resistance due to less number of solar cells connected in series.

Summary Statement
A V-groove solar panel using solar cells and flexible paper mirrors was demonstrated for the first time and it outperformed a conventional planar solar panel.

Help Received
Mrs. Andrea Acres, my science teacher at Ridgecrest Intermediate School, guided me throughout the entire scientific research project. My parents provided financial support, transportation, and encouragement, and supervised my experimentation. Belps Manufacturing machined solar panel frames.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Marisa A. Christensen

Project Number
J1009

Project Title
Can We Use Solar Energy When Our Air Is Dense with Pollutants?

Abstract

Objectives/Goals
The objective of this science fair project is to determine if atmospheric pollution affects the efficiency of solar panels.

Methods/Materials
Six Miniature Photovoltaic Panels; One Model House or Board; One Large, Clear Container; Two Cans; One Package of Mosquito Repellent Coils; One Standing Floodlight; One Reflection Density Guide; One 10.4 Ohm Resistor; One Copper Board to Connect Wires; Two Meters; Duct Tape.
Attach the six solar panels to each other, wires connected positive to negative.
Mount panels to the board or roof of the model house. Attach the panels to two meters, one measuring electrical current, one measuring voltage. Power is calculated by multiplying the volts by the amps. Place the large, clear container over the model with the meters pulled out under the container where they can be easily read. Turn the standing floodlight on, light focused directly on the solar panels. Record data from the panels after three minutes. Divide three mosquito repellent coils evenly between two cans. Break each coil into small pieces about one inch long. Light one end of each small piece and place into the cans. Place cans under container in the two front corners facing the floodlight. Duct tape around the bottom of the container as to not let the majority of the smoke emitted from the coils out. Record voltage and current simultaneously from panels every three minutes for fifteen minutes total. Compare the atmospheric pollution within the container with the reflection density guide each time the voltage and current is recorded. Record the results.

Conclusions/Discussion
My hypothesis was correct, atmospheric pollution does affect the efficiency of solar panels as to not allowing light to penetrate completely. As the smoke accumulated in the container, the solar panels could not absorb as much light as when fully exposed to the floodlight, hence the voltage and current both steadily decreased. The smoke from the coils also left behind much particulate matter on the model house and the panels itself, which was a variable to whether the solar panels would be able to absorb the light at full efficiency. As the sediment accumulated on the panels, the panels were obstructed and could not take in the radial energy.

Summary Statement
The purpose of this project is to test whether atmospheric pollution affects the efficiency of solar panels.

Help Received
Father helped build model house; Used lab equipment from Santa Catalina Upper School with aid from Mrs. Paulette Struckman; Reflection Density Guide provided by Dr. Edward Wong; Research Interview of Mrs. Suzette DelBono

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Madeline C. Cowan

Project Number
J1010

Project Title
Reflecting on Renewable Energy

Abstract

Objectives/Goals
The goal of this project was to discover if the use of reflective materials would increase the output of a solar panel.

Methods/Materials
In my experiment, I used a variety of reflective materials including:aluminum foil, a small mirror, white ceramic tiles, yellow ceramic tiles,black ceramic tiles, and glass tiles to reflect light onto a 6 volt solar panel. To minimize reflection from other sources, I constructed a box to hold the solar panel and the reflective materials and spray-painted it matte black. I also used a 100 watt light bulb as a light source instead of the sun to eliminate variables in weather conditions. During the experiment , I tested all materials for one minute, three times each and measured the output using a multimeter. Between tests, I would let the bulb and solar module cool for two minutes. For my control group, I measured the output of the solar panel without any reflective materials. I recorded the data in a journal.

Results
The reflective material definitely increased the output of the solar panel. The aluminum foil and the mirror produced the greatest output with an average of 4.17 volts followed by the white tiles (4.10 volts), the glass tiles (4.07 volts), the yellow tiles (4.06 volts) and the control group (4.04 volts). The black tiles produced the lowest average voltage with 3.98 volts.

Conclusions/Discussion
My hypothesis stated that by using reflective materials, the output of a solar panel would increase. My hypothesis was proven correct. I was surprised, however, that the average output of the solar panel was the same with both the mirror and the aluminum foil. I had thought that the panel's output would be greater using the mirror since to my eyes it was the most reflective of the materials I tested. The data also suggests that lighter colored materials were better reflectors because they resulted in more output than the darker materials.

Summary Statement
The goal of my project was to determine if the use of reflective materials would increase the output of a solar panel.

Help Received
My parents purchased the materials. Mom helped with my display board. Dad helped with the graphs.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Sara K. Davis

Project Number
J1011

Project Title
Garden Science: Wonders of Plant Juices

Abstract

Objectives/Goals
The main purpose of my science project was to see if juices from plants native to Humboldt County, when used as base materials in Graetzel photovoltaic solar cells, could generate electrical power.

Methods/Materials
I made several Graetzel solar cells using a number of simple items, chemicals, and filtered juices from flowers and berries. Next I conducted a series of experiments using artificial light. After I learned that only two of the four plant juice-based solar cells generated measurable electricity with artificial light, I conducted separate experiments using only dark red flower petal juice-based solar cells exposed to artificial light, and then to sunlight. Then I did experiments using 4-5 solar cells in a series to see if more electricity was generated compared to a single solar cell.

Results
I discovered that single solar cells based on darker colored plant juices under artificial light generated 10-20 times more electricity than single Graetzel cells using lighter colored plant juices, and 4-5 times more electricity under sunlight. Also, I learned that single solar cells based on dark red petal juice produced slightly more electrical energy than single photovoltaic cells based on blackberry juice. Then with further experimentation using only dark red petal juice-based solar cells, I discovered that 4-5 solar cells connected in series, and under artificial light, generated 2-3 times more electricity than a single solar cell, and 7-29% more power under sunlight.

Conclusions/Discussion
From my project experiments I found out that berry and /or flower petal juices can be used in simple photovoltaic cells to generate electricity; that more electricity is generated from solar cells using juices of darker pigmented plants than from Graetzel cells using lighter colored ones; that photovoltaic cells using juice from dark-pigmented flower petals generated slightly more electricity than solar cells using juice from dark-colored berries; that sunlight as a light source resulted in more electrical power generation in a Graetzel solar cell than artificial light; and that solar cells operating in a series generated more electricity than individual solar cells. The results of my experiments showed me that electricity can be reliably and cheaply generated by use of simple, inexpensive photovoltaic cells using a combination of relatively cheap materials, including very abundant plant juices.

Summary Statement
Solar generation of electricity from simple photovoltaitc (Graetzel) solar cells using plant juices.

Help Received
Father proofread logbook; Mother supervised experiments and helped construct backboard.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Taylor S. Davis

Project Number
J1012

Project Title
Pond Drool to Biofuel: What Factors Increase the Growth of Oil-producing Microalgae Cultivated in Photo Bioreactors?

Abstract

Objectives/Goals
My project was to determine which nutrients would be most effective in increasing the density of oil-producing algae when grown in a photo bioreactor.

Methods/Materials
Five different solutions were tested to determine which nutrients would increase the production of microalgae. I grew an unknown species of Nannochloropsis microalgae in a system of photo bioreactors made from 2-liter soda bottles. The control contained 1600 ml of distilled salt water with 16 drops of Micro Algae Grow (similar to Guillard's F/2). Four other bottles contained varying amounts of additives. One bottle had only half the algae grow and another bottle had twice as much algae grow required for proper growth. A third bottle added sucrose. A fourth bottle substituted the 1600 ml of distilled water with 1600 ml of carbonated water. During a 17-day period of growth, density was tested each day using a secchi stick. Density readings were recorded and compared to the control.

Results
Out of the 5 methods I tested, the photo bioreactor with the carbonated water showed the most consistent growth and produced the most algae with a density reading of 13.3 million cells/ml. This reading was 3.6 million cells/ml over the control, which resulted with the second highest growth. The method of feeding algae with twice the amount of food resulted in the lowest growth of all the methods.

Conclusions/Discussion
I conclude that the best method for increasing growth of microalgae is to use carbonated water because it has a presence of CO(2), which is needed for photosynthesis. I can also conclude that overfeeding microalgae can be detrimental to its growth.

Summary Statement
My project was to determine which nutrients would increase algae growth, thereby increasing the oil produced for use in biofuels.

Help Received
Mother helped me build my board and read densities; Father helped construct framework for photo bioreactors; Professor Alan McHughen, from UC Riverside, answered a few questions for me twice on e-mail

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Jennifer A. Disanto; Ashley Utz

Project Number

J1013

Project Title

The Power Tower: Producing Electricity Using a Solar Chimney

Abstract

Objectives/Goals

The goal of this experiment was to create a device that would harness solar radiation and convert it into electricity. Our hypothesis was that the temperature of the air exiting the solar chimney must reach a minimum of 212 degrees Fahrenheit for the propeller to rotate.

Methods/Materials

We constructed a metal chimney containing a propeller and generator attached to a wooden base and surrounded by a plastic greenhouse. This device, The Power Tower, uses a combination of the greenhouse effect and the chimney effect. We took readings over a 7 hour period using the Lab Quest instrument, which graphed the temperature of the air as it exited the chimney. We also recorded outside temperature, revolutions per minute (RPM), sun position, shadows, clouds, and other observations every fifteen minutes. On a different day, we graphed the electricity the tower produced.

Results

We observed that the propeller started turning at 11:30 a.m. when the temperature of the exiting air was 68.9 degrees Fahrenheit and the outside temperature was 61.3 degrees Fahrenheit. At this time half of the greenhouse was shaded. The propeller stopped rotating at 4:30 p.m., thirty minutes after the sun had gone down. The exiting air temperature was 62.5 degrees Fahrenheit and the outside temperature was 66.7 degrees Fahrenheit. Exiting air temperature and the propeller RPM reached their highest point of 101.1 degrees Fahrenheit and 209 RPM, respectively, at 3:00 p.m.

Conclusions/Discussion

Our hypothesis was proven incorrect. However, we learned from our data that when the exiting and outside air temperatures are the same, the propeller does not rotate. Therefore, the greater the difference between the exiting and outside air temperature, the greater the rate of rotation of the propeller. Our data proved that the minimum difference between the exiting and outside air temperature required to spin the propellers was approximately 7.6 degrees Fahrenheit. Future experiments will include improving the chimney design and testing it with different variables.

Summary Statement

We created a solar chimney that harnesses solar radiation and converts it into electricity.

Help Received

Mothers supplied materials and assisted with editing; Fathers helped with brainstorming, using powertools, and scientific writing; Mr Akers provided the Lab Quest instrument and generator.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Thien T. Doan

Project Number
J1014

Project Title
How Do Different Chimney Heights Affect the Amount of Energy a Solar Updraft Tower Can Produce?

Abstract

Objectives/Goals
This experiment's objective was to determine the effects of different chimney heights on the solar updraft tower in generating energy.

Methods/Materials
The solar updraft tower was constructed based on "The Driving Force for the Stack Effect" and "The Flow induced by the Stack Effect" equations. A 56 x 56 inches wooden base collector area was constructed with three 1 x 10 inches input air vents on each side. At the center lies a wooden chimney base measuring five inches in height and connected to a three inches diameter aluminum chimney with adjustable height. A miniature DC generator was mounted at the collar of the chimney base. The collector area's floor was painted with a flat black color. Inside the wooden collector area lie approximately two hundred Mexican Beach pebbles evenly spread at the bottom. The collector area was enclosed with one sixteenth of an inch thick clear plastic sheet.

The sun heated the rocks, which heated the air in the collector area and created the stack effect (the warm air to rise and rush through the chimney). This air flow causes the propeller to turn and generate energy.

The experiments were conducted and data was recorded for three different chimney heights (28.5, 49.5 and 57.5 inches) with the digital multimeter connected to the DC generator and three temperature probes were placed to collect the data (in the chimney area, in the collector area and outside of the project).

Results
The data shows that the tallest chimney height generated greater stack effect, but not enough to turn the generator.

Conclusions/Discussion
My hypothesis is correct. There were a few unexpected issues encountered during the design and experimental phases. The materials that were required were unobtainable due to budget issues. The ¼" thick steel base collector area along with a special design metal construct steel/mirror formation was replaced with ¼" wooden base and Mexican Beach pebbles rock. The two inches diameter ceramic chimney was replaced with three inches diameter aluminum chimney. The miniature low torque RPM DC generator was replaced with a used high RPM motor. The outside air temperature was below the minimum required temperature of 90°F.
Due to these undesired modifications, the results were not as efficient as expected.

Summary Statement
My project is about a homemade solar updraft tower that generates energy by incorporating three fundamental concepts: the greenhouse effect, the stack effect, and the wind turbine.

Help Received
My father assisted me in buying materials and using electric equipment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Sarah M. Douglas

Project Number
J1015

Project Title
Electrical Oceans: The Power of the Future

Abstract

Objectives/Goals
The objective of this experiment is to find out if sea water can be used in a water drop electrostatic generator to create electricity, therefore providing an alternate energy source.

Methods/Materials
Firstly, a generator was built. Then, testing was done by recording the time it took for the generator to produce 5 sparks for different amounts of salt added to water, starting with distilled water and tap water,then increasing the salinity by increments of 1/4 teaspoon up through 2 1/4 teaspoons, which is the salinity of ocean water. Then, 5 different ocean waters were tested. During each test, the humidities were also recorded, as it was found from previous research that humidity has an affect on the efficiency of the generator.

Results
It was found that the generator is capable of producing energy using ocean water. Also, ocean water is more efficient than plain salt water at the same salinity. However, any salinity (above distilled water) was found to have little to no effect on the generator, whereas humidity was found to have an enormous effect.

Conclusions/Discussion
The main conclusion is that weather affects the generator more than the salinity of water does. Secondly, it was concluded that the hypothesis was incorrect. This was concluded because the hypothesis stated that as the salinity of water increases, the effectiveness of the electrostatic generator will first increase then become ineffective. However, the results show that the generator worked until the saturation point of water with salt, so it did not become ineffective. Lastly, it was concluded that the generator is not reliable as an alternate energy source because, although the generator is capable of producing energy using sea water, it is unpredictable due to other factors.

Summary Statement
My project is testing to find whether a waterdrop electrostatic generator can produce electricity with sea water.

Help Received
Mother helped mix water; Father supervised building; Richard Morrow (mentor) advised during project.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Daniel (D.J.) R. Freeman, Jr.

Project Number
J1016

Project Title
The Power of the Wave: Which Area in a Wave's Development Will Yield the Most Energy?

Abstract

Objectives/Goals
The purpose of my project was to determine what section of a wave will produce the most electrical energy. The reason I did this project is to see if wave power is a credible source of renewable energy. If so, than what phase should we look to? My hypothesis was that the breaking wave would produce the most energy. The reason behind my hypothesis is that I knew a breaking wave is incredibly strong. I chose this project because our source of electrical power is diminishing and due to our heavy use we will soon run out. This renewable energy will provide an alternative source of power for homes and businesses around the world.

Methods/Materials
For this project I built my own wave tank. I also built my own wave energy apparatus with an aluminum pie pan, wooden dowels, nylon spacers, fishing wire, and two half ounce metal washers. The tank consisted of a 4ft long, 1ft wide, and 1.6 deep glass aquarium with pieces of Plexiglas and dowel holders glued with industrial strength adhesive. I created a wave by pushing a Plexiglas paddle with the relatively same amount of strength and counted by thousands to make sure the movement was even. This process was repeated five times and the movement was repeated until the washer completely wound around the dowel. This was repeated for three different wave locations. The locations were swell, breaking, and whitewater.

Results
The overall results for the least amount of winds it took for the weights to reach the top of the dowel was the swell wave with 20 movements. The next lowest amount of winds was the breaking wave with 28.5 movements. The highest amount of winds came with the whitewater wave and took 35.5 movements.

Conclusions/Discussion
After completing my investigation I found out that my hypothesis was incorrect. I thought that the breaking wave would create the most energy, but the undertow kept turning the waterwheel in the opposite direction. The swell proved to be the best method of capturing a waves energy because it was the most consistent. The whitewater was absolutely impractical because the undertow was too strong. I learned from my experiment that the swell period is the best place to extract from a wave. In further projects, in order to collect renewable energy it should be set in the open ocean where swells are at their most potential. I did prove that the swell wave could be used as a source of renewable energy, thus providing power for our world.

Summary Statement
The pupose of my project is to prove which area of a wave's development will yield the most energy.

Help Received
Mother and Father, supervised; Mr. Carl Gong coached; Precision Plastics cut materials for wave tank.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Ricky J. Galliani

Project Number

J1017

Project Title

Dam Science: Testing the Energy Efficiency of Varying Reservoir Dimensions behind a Hydroelectric Dam

Abstract

Objectives/Goals

The objective of my Science Fair experiment was to discover how the depth and length of a reservoir behind a dam impacts the force on a turbine, and ultimatley the amount of generated electricity.

Methods/Materials

First, I constructed a wooden box to simulate the conditions of a hydroelectric dam. The dam simulation had three different adjustable widths, which was made possible by a wooden partition. Next, I built a micro-hydroelectric generator. To conduct the experiment, I placed the micro-hydroelectric generator adjacent to the hole where water would flow out of the "dam". The water force would spin the turbine and generate electricity. The varied range in electrical output occurred because of the varied shape and water pressure of the reservoirs behind the dam.

Results

The reservoir with large horizontal and vertical water pressure (reservoir 9) produced the most electricity. A reservoir with large horizontal force and medium vertical force (reservoir 6) produced less electrical output than the reservoir with medium horizontal force and large vertical force (reservoir 8). The reservoir with small vertical and medium horizontal force (reservoir 2) produced no electricity. A small vertical force and large horizontal force (reservoir 3) produced an average of five mili-volts. The reservoir with small horizontal and vertical pressure (reservoir 1) produced the least amount of electricity.

Conclusions/Discussion

Horizontal and vertical water pressure are very important to the efficiency of a hydroelectric dam. However, vertical water pressure appears to be more crucial as long as there is at leat a medium horizontal force. This is particularly demonstrated in reservoirs 8 and 6. Reservoir 8 yields significantly more electricity compared to reservoir 6 with its large horizontal force and medium force. These results make me question the efficiency of some of todays hydroelectric dams. For example, Buchanan Dam has a reservoir length of 31 miles, while its height is only 1025 feet. The height is disproportionably small, and its long length is unneeded. This dam would be more effective if its length was cut down and the dam was made deeper.

Summary Statement

This project explores the impact of depth and length of the reservoir behind a hydroelectric dam on the the water flow exiting the dam, the force on the turbine, and the electricity generated by the hydroelectric generator.

Help Received

My mother and father helped during the construction and testing processes, which required several sets of hands.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Talia Gnessin

Project Number
J1018

Project Title
The Effect of Simulated Winter and Summer Sunlight Intensities on a Solar Panel's Performance

Abstract

Objectives/Goals
The objective of the experiment was to investigate and test how sunlight intensity effects solar panel performance. The hypothesis was that during the summer, the solar panel would receive more energy from the sun's rays than in the winter, because the light intensity is affected by the sun's rays angle.

Methods/Materials
The tests consisted of recording the electrical current that is generated by the solar panel each hour of the day during winter and summer, making sure the angle of the light was simulating the angle of the sun's rays. The angle of the sun's rays is defined by two angles. The latitude angle determines how high the sun is in the sky, while the azimuth angle is the direction of the sun east to west, as it moves in the sky between morning and evening.

Materials: I used a lightbulb to simulate the sun's rays, and a circular rail to simulate the suns position in the sky throughout the day. I purchased a small photovoltaic type solar panel that is used to charge batteries. I also used a current meter and electrical wires.

Results
When repeating the experiment in three different trials, the results were generally the same. The solar panel produced more electric current in the sumer compared to the winter, however during the "early morning" and "sundown" hours, the solar panel produced more current in the winter compared to the summer.

Conclusions/Discussion
In general, the results supported the hypothesis because the solar panel generated more current in the summer compared to the winter. However, I expected to get consistent results along the course of a day, and that did not occur in the experiment. In the early morning hours and at sundown, the winter current was higher than the sun current. I believe that this was caused by the fact that the rail did not simulate accurately the movement of the sun in the sky. The hinges that were used for tilting the rail were fixed, therefor the height of the sun was the same in winter and summer. I know that the latitude and azimuth were very accurate around noon time (Zenith point), but the results towards the ends of the rail were not accurate. If I had to repeat the experiment, I would make the hinge height adjustable.

Summary Statement
The Effect of Simulated Winter and Summer Sunlight Intensities on a Solar Panel's Performance.

Help Received
Dad helped with the sawing of plywood and purchasing of materials; Science teacher Mr.Hueyopa helped with report and preparations.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Rachael S. Green

Project Number
J1019

Project Title
Wave Energy

Abstract

Objectives/Goals
My purpose was to invent and build a device that can harness the kinetic energy of the ocean waves to create an ecologically friendly, renewable source of electricity.

Methods/Materials
A surfboard was reshaped into a buoy which was anchored in the ocean. Due to its shape, it dives through the waves and repetitively moves through a 90 degree arc. This rocking motion causes a magnet to slide through a copper coil creating electricity. The generators in my prototype were waterproof, shakable flashlights. The location of the trials was the Humboldt Bay entrance, due to non-breaking, ocean type waves, easily accessible to shore. Test times were standardized to 1 hour. Wave data at the time of the tests was obtained from the NOAA buoy, Humboldt Bay. The electricity produced was measured in a darkroom. A stopwatch measured the length of time each flashlight's disc of light was visible from a standardized viewing distance.

Results
The ocean wave tests proved the hypothesis to be correct by generating electricity on multiple trials. First, larger waves generated more electricity than smaller waves. Second, flashlight #1 was more efficient than flashlight #2; however, both were able to generate, store, and provide usable light from the kinetic energy of the ocean.

Conclusions/Discussion
I have proven that it is possible for a 7th grader to design and build a device which can generate small amounts of electricity from the ocean waves.
The design of my buoy was based on observations and experiences in my life. The buoy had to ride the waves, which is why I used a surfboard for the body. The repeating motion that I needed to charge the flashlights reminded me of the feeding motion of ducks. The diving motion of the "Duckie" is a key innovation because it eliminates moving parts which are vulnerable in the harsh marine environment. Background research showed that even universities with large budgets have been frustrated by breakages to their complex prototypes in the ocean waves.
My next step in this project will be to create a more powerful generator and maximize the electricity produced from this small buoy. I plan to build my next buoy from more ecologically friendly materials.
In conclusion, I hope my idea is part of a future where humans use their science to have a less detrimental impact on the planet. Perhaps the largest untapped source of energy in that future is the ocean.

Summary Statement
The purpose of my project was to invent a device that can harness the energy of the ocean waves to create usable electricity.

Help Received
Father assisted with fiberglass application to buoy, ocean testing of buoy, and transportation to beach.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Sean S. Haas

Project Number
J1020

Project Title
Solar Powered Water Purification and Distillation through Evaporation

Abstract

Objectives/Goals
Not all areas of the world have access to a source of clean water. In some countries people have to drink contaminated water and risk their health to stay hydrated. In nature water is constantly being recycled by evaporation, so I thought of a way to use this process on a smaller scale to purify water. As a second year study this project improves upon previous attempts to purify water with a solar still by observing the effects of different backing materials on overall distillation efficiency. I believed that a still with a reflective backing would produce more water than one with a black or clear backing because it would reflect any light and heat that was not originally absorbed by the water tray back into the water. This causing a double trough parabola effect, which would make the water hotter and cause more evaporation.

Methods/Materials
A glass cylinder was used for a condenser unit. Inside was a black metal tray used to hold the dirty water. This was placed on a frame which held a trough parabola underneath it. The parabola would collect the light and bounce it back onto the tray full of water. This was then placed under heat lamps for 12 hours. The heat lamps were then turned off for another 12 hours. This alternating cycle represented a day of solar radiation. This was repeated a total of 12 times, 4 trials for each variable. I had two variables, a black background and a reflective Mylar background. My control was a clear still with no background.

Results
In each trial the reflective-backed still proved to be far more efficient in heating and distilling the water. Both my control and the black-backed still were incapable of creating as much water as my reflective-backed trials.
Changing my parabola to a more reflective material substantially increased the energy density of my focal point causing an increase in temperature resulting in a higher clean water yield.

Conclusions/Discussion
My hypothesis was proven correct: the reflective-backed still produced more water than my black-backed or clear control still. I believe this has proven to be a viable means of water purification for Third World countries or for clean water anywhere. I plan on this being an ongoing study, I would like to perfect this still so it could be easily and effectively used to help create clean water that is vital to all life.

Summary Statement
To create a simple and efficient means of solar water purification this could benefit people the world over.

Help Received
My mother helped as inspiration and as my trusty assistant. My father helped proof read papers. John Davis was my solar adviser.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Tim O. Hamersly

Project Number
J1021

Project Title
Ratchet Up the Efficiency

Abstract

Objectives/Goals

Question: By decreasing the distance traveled and therefore decreasing the input force, can I make a more efficient human power generation machine?

Hypothesis: By using a ratchet and pawl pedaling system, I can make human pedal-power more efficient.

Purpose: To improve the generic pedaling system by using more efficient, human power generation with zero carbon emissions while running.

Methods/Materials

Materials:

Sheets of metal and wood. Copper wire and alligator clips. 12 electromagnets. 24 neodymium rare earth ½ in. disk magnets. A used bike frame with back wheel and good bearings. Fix-it-all (quick drying and setting cement). (2) 1 ft-long threaded shafts. 1 hinge. A wooden dowel (7/8 in.). A voltmeter. Welder

Method

Weld a bike frame (seat down) with a back wheel onto 2 metal plates. Bolt the metal plates onto a 4.5 X 3.5 ft. wooden platform. Mount a 2.5 foot long pedal onto the platform. Attach the end of the pedal to the bike pedal and attach the other end of the pedal to a spring on the platform. Fill the back wheel rim with cement and place 12 magnets on each side of the wheel. Cut 2 square wooden panels as large as the wheel and place them on either side. Firmly attach 6 electromagnets to each panel. Wire the electromagnets + to - and make the magnets alternating poles (N, S, N, S). Make a base piece for the panals and place them in. With 2 large threaded shafts with washers, bind the 2 panels together.

Results

Results: I got a maximum of 1.5 amps and 10 volts pedalling in parallel. In series I got .75 amps and 20 volts. Say, I pedaled in the "Far Position" of my pedal twice, I would get 4.5 volts.

Conclusions/Discussion

Conclusion: I found that by increasing the mechanical advantage of the pedal, making the wheel into the flywheel itself, and by using the wheel as the generator, one can create an efficient power generation machine. There are many modifications that can be made to improve it#s performance including: A wooden bike frame to lessen magnetic friction when the magnets spin, electromagnets without an iron core to further lessen magnetic friction, and more coils to increase the voltage made.

Summary Statement

My project is about making an alternating current human powered generator more efficient by using simple machines and kinetic energy storage

Help Received

Neighbor helped inspire ideas, helped with technical support, and lent out equiptment; Father helped solder, and assisted with constructing the apparatus.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Zoe R. Harness

Project Number

J1022

Project Title

Potential Effectiveness of Solar vs. Wind Energy in Private Generation Systems

Abstract

Objectives/Goals

My objective was to determine weather solar or wind is a more dependable energy source for private generating systems in Riverside,California, over a specific period. My hypothesis stated that for the period of November 10, 2008-January 31, 2009, solar power would be more dependable in this area because our climate is more sunny than windy.

Methods/Materials

To test the dependabilty of solar versus wind for residential power, this experiment used VLDPE solar panels and a Windmonitor II device. First, an appropriate location was identified. For wind the location had to be 30 ft above natural or manmade obstructions; for solar the location had to have clear exposure of the southweast sky. the VLDPE panels were already in place on our roof and were connected to a Jandy Aqualink pool moniitor which displayed the water, ambiant, and solar temperatures. the Wind Monitor II was placed on my roof near the panels.The solar panels heated the 188,908 pounds of pool water each day and i calculated the solar energy produced using the daily rise in the pool water temperature The Windmonitor data (windspeed) was reported via download to an Excell program on my desktopcomputer Windspeed was recorded each half hour. To calculate the potiential wind energy, I used this formula: (the radius of the windmill blade) squared X the(windspeed) to the 3rd power = kW. The solar calculation was: (weight of water) X (pm pool temp.-am. pool temp.)=Btu. To compare the Btu's to kW, I used the following formula: Btu X .002931=kW.

Results

Solar: The average, the daily pool temperature rise (using solar heating)was 5.2 degrees F daily over my data period. 68 daily power generation was a total of 6,469,524 Btu or 18,960 kW.

Wind- Daily average speed was 2.3 M.P.H. over the data period. 68 day power generation was 0.590 kW.

Conclusions/Discussion

Riverside,California is a better location for utilizing solar than wind. Wind speed was insufficient to drive a turbine capable of producing a usuable amount of kW. This is because of the very limited range(6-38 MPH for private towers) when wind will produce usable power. Sunlight can always produce some power.

Summary Statement

My project compares the potential of solar versus wind energy generation for private residences, and further indicates the currently limited capabitlies of these alternative generation systems, especially when they are retrofit.

Help Received

My father mounted my Windmonitor II on roof of my house. My uncle helpeed me solder the light system for my dislay board marquee.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Khush M. Kharidia

Project Number
J1023

Project Title
Converting Human Energy into Electrical Energy

Abstract

Objectives/Goals
Energy and health care are two important issues facing our nation. I am motivated to address both issues simultaneously. My project is about Converting Human Energy into Electrical Energy. It demonstrates that you can exercise and charge your small electronic gadgets at the same time. In my project, I wanted to find out how much cell phone talk time I can get if I ride my bicycle for 15 minutes. I guessed I would get 15 minutes of talk time for fifteen minutes of riding time.

Methods/Materials
A bicycle is often used to exercise in fitness centers. Attaching a dynamo generator to a bicycle will convert human energy into electrical energy. An AC to DC converter circuit can convert the AC voltage from the dynamo into a 5V DC. The 5V DC can be used to operate many small electronic gadgets. I charged my cell phone by connecting it to a 5V DC output from the AD/DC converter circuit. First I measured dynamo output for different riding speed. Then I selected a proper speed that will operate the AC/DC converter. At a constant bicycle speed, I measured the cell phone talk time for different bicycle riding times.

Results
The AC voltage generated by the dynamo is proportional to the speed of the wheel. This followed Faraday's law of induction. It took me fifteen minutes of riding time to get 13:30 minutes of talk time. I observed that the cell phone charges more when the bike is ridden longer. My circuit gave 0.5W of output power to charge the cell phone. A 1.0W of output power should be sufficient enough to get 15 minutes of talk time for 15 minutes of riding.

Conclusions/Discussion
We can take advantage of calories burned during exercise to operate electronic gadgets. More importantly, the energy generated through my project is clean. It is a way forward towards environmental friendly energy called "Green Energy". My hypothesis did not come out to be exactly true but it was very close. In addition, I also learned about AC/DC converter circuits, a dynamo, and Faraday's Law of induction during my project.

Summary Statement
Ride a bicycle to exercise and create clean energy while riding to charge low powered gadgets.

Help Received
Mr. Ben Guansing for guidence, Ms. Meera Datta for correcting report, Mehul Kharidia for collecting materials

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Renee B. Krieger

Project Number
J1024

Project Title
Wave Energy

Abstract

Objectives/Goals
My project is determining which kind of ocean waves, short and frequent, or long and less frequent, will generate a greater measurable amount of electricity. I hypothesized that shorter and more frequent waves would create more electricity.

Methods/Materials
I built a device to harness the energy and connected it to a buoy. The buoy then went into the water and was pulled down at different speeds and lengths to simulate waves. This generated electricity which was then measured and recorded.

Results
Both types of waves seem to generate about the same amount of energy. The smaller, more frequent waves had the single highest average, but it was inconsistent. The longer, less frequent waves had slightly lower averages, but they were more consistent.

Conclusions/Discussion
My conclusion is that both types of waves generated about the same amount of electricity, but more testing will be needed to come to a solid conclusion.

Summary Statement
My project is about which kind of ocean waves, short and frequent, or long and less frequent, would generate a greater amount of electricity.

Help Received
Dr. Tom O'Neil of Oxanard College helped me design the device to harness the wave energy.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Emma LaPorte; Raina Wuthmann

Project Number
J1025

Project Title
When Is 10%, Not 10%?

Abstract

Objectives/Goals
One of our main goals for our science fair project, was that our project should relate to everyday life. One day our science teacher told us how his neighbor was getting a second story to his house. This seemed fine to us, but when he told us how this could affect his solar panels, we understood why he was concerned. He was worried because he wasn't sure if when part of his solar panel was shaded, no energy could be produced. We thought this would be an interesting idea for our science project, and definitely interesting to find out the answer! Also it relates to many people with second story houses around them or living in cloudy areas.

Methods/Materials
For our project we used a solar panel, construction paper, camera, energy meter that measures how much energy is produced, tape, a dark room (garage), data table to record results, and three lights.
For our science project we had a repeating method that we used. After finding and cutting out 10%-100% horizontally and vertically of the solar panel on construction paper, we began this repeating process. First we would find the power produced by the solar panel, when it is not covered. After we would find the power produced by the solar panel when 10% is covered horizontally. Then we would continue shading the solar panel horizontally and finding the power produced continuing up to 100%. After we did this, we did the same exact process, except we shaded the solar panel vertically.

Results
When we first found all our data, we were extremely surprised. But as we researched further of why this could have happened, it all made sense. When we shaded the panel horizontally, the panel's power began decreasing right away, as we had expected. But then later when we shaded the panel 10% vertically, and it did not decrease until 70% of the solar panel was covered!

Conclusions/Discussion
After more research, we found that all our data actually made sense! We learned about the wiring in a solar panel, and about solar cells. Our data then seemed right when we discovered that when you cover one cell in a string of solar cells, the entire string is knocked out. So basically when shading 10% horizontally, all three strings were unable to produce power. So that's why when we shaded horizontally it decreased. But when we shaded the solar panel vertically it did not decrease until 70% because even after one string was knocked out, the other two strings were still working.

Summary Statement
Our science project, "When is 10%, Not 10%" is all about the wiring and shading of solar panels.

Help Received
Father helped set up resistor and get the solar panel.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Olivia M. Lipco

Project Number
J1026

Project Title
Our Life and the Battery

Abstract

Objectives/Goals
The objective of this project was to see if a battery would last longer being turned off and on or staying on continuously.

Methods/Materials
I used six flashlights, three on continuously and three being turned on and off hourly. Once each flashlight turned off and the batteries had run out, I recorded the time it lasted. When all the flashlights were recorded I rotated them, since I was doing more than one trial. All the batteries were Rayovac.

Results
The information that I compiled shows that in trial one the on/off flashlights had lasted a total average of fifteen hours and thirty-three minutes. The continuous flashlights in trial one averaged a total of twenty-six hours and eight minutes. On the second trial the on/off flashlights averaged a total of twenty-three hours and the continuous flashlights averaged a total of ten hours and twenty-six minutes. In the third trial the on/off flashlights lasted an average of twelve hours and thirty-three minutes, while the continuous flashlights lasted on average twenty-two hours.

Conclusions/Discussion
In conclusion leaving a flashlight on continuously saves more energy and you get better life out of your batteries. My observations lead me to conclude that my hypothesis was wrong.

Summary Statement
My science project examines if a battery has more life if it's allowed to rest.

Help Received
My mother helped me by taking pictures of my experiment.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Victor H. Liu

Project Number
J1027

Project Title
Are Solar Panels Right for You?

Abstract

Objectives/Goals
My goal was to test solar panels to see how they acted under different conditions, since most sources of information assume that the conditions are sunny. On sunny days in the northern hemisphere, south is the best direction for a solar panel to face. However, what if the sky is overcast? Would other directions than south be more efficient?

Methods/Materials
The materials used in this experiment were a ruler, a protractor, some pieces from a solar car kit, a miniature solar panel, a foam board, a compass, a digital clock, masking tape, a small table, a multimeter, and probes. I took a solar car and removed all wheels and motors. Also, I drew all eight directions of the compass rose on a board. For several days, I set up the board and the solar panel, which was at approximately 63.2 degrees. This experiment took place from 9 am to 4 pm. Every hour, I would set the solar panel on each direction and measured the amount of current produced.

Results
On the first day, it was sunny. This data made complete sense, with the current producing as hypothesized. It also appeared that the eastward and westward directions produced different amounts of current. On the second day, no sun shined through the overcast. The solar panel facing south was the top current producer, but the differnce was insignificant. On the third day, clouds were in the sky and continually moved and the data was inconsistent. On the sixth day, the weather was sunny again and was similar to the results of day one.

Conclusions/Discussion
Like many of my sources stated, south was the best direction on sunny days. I found out that in other conditions, south is the optimal direction for a solar panel. However, in days with heavy overcast, the difference between south and the other directions is very slight. Also, I found out the eastward and westward didn't produce the same amounts of current. I hypothesized that this was because the sunlight weakens as it sets. In addition, I discovered that the sunnier the weather is, the farther apart the highest and lowest current productions are. The opposite is true as well. Also, I discovered that sunny days do not differ in the strength of sunlight. This was discovered when the two sunny days' current productions had very similar milliamp levels. Ultimately, in order of best current producer to worst, the order is south, southeast, southwest, east, west, northeast, northwest, and north.

Summary Statement
This project is about testing if a solar panel facing a suboptimal direction under different conditions will produce more current than a solar panel facing the optimal direction.

Help Received
Father helped with buying materials.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Akshay P. Madhani

Project Number
J1028

Project Title
Solar Mirrors: An Economical Design to Increase the Power Output of Silicon Photovoltaic Solar Cells

Abstract

Objectives/Goals
Current solar concentrator systems are either too expensive or too complicated to build and therefore are not used by the common man. My objective was to design an economical solar concentrator using ordinary mirrors to enhance power output of silicon photovoltaic solar cells.

Methods/Materials
I experimented with different sizes of mirrors and angles with respect to the solar cell to figure out the combination which will give the maximum power output. I first attached two modified hinges to a Styrofoam board, followed by a solar cell on top of the hinges. The hinges helped control the angle of the mirror. I put the Styrofoam board on an easel so the hinges were to the top and bottom of the solar cell. I experimented with three mirror sizes: 1 times the width and 1 times the length of the solar cell, 2 width x 1 length, and 1 width x 2 length. I measured the solar cell power output with the 1 width x 1 length mirrors when they were at 100, 110, 120, and 140 degree angle with respect to the solar cell. I did this with not only with both the top and the bottom mirrors but also with only the bottom mirror. I repeated the experiment with the other mirror sizes. The readings were taken every 2 hours from 9 a.m. to 3 p.m. Materials: 1. Solar cell, 2. 2 mirrors of size 1 Length x 1 Width of solar cell, 3. 2 mirrors of size 2 Length x 1 Width, 4. 2 mirrors or size 1 Length x 2 Width, 5. 2 hinges, 6. Digital multimeter, 7. Styrofoam board

Results
Mirrors at a 140 degree angle did not really help increase the power output as the angle was too wide. The top mirror at a 100 degree angle blocked light coming to the solar cell and sometimes created a loss in efficiency. Mirrors at a 110 degree angle performed the best, followed by a 120 degree angle. 2 length x 1 width mirrors performed the best, followed by 2 width x 1 length mirrors, followed by 1 width x 1 length mirrors.

Conclusions/Discussion
By using only one 2 length x 1 width mirror at a 110 degree angle with respect to the bottom of the solar cell, you can increase the maximum efficiency of the solar cell by 27.9% and average efficiency by 17.25% for less than 3% increase in the cost. This is a very economical way of boosting the output from the solar cells using an innovative design with ordinary mirrors. You can increase efficiency even more using both the top and the bottom mirrors; however, efficiency increase created by adding the top mirror is marginal.

Summary Statement
The purpose of my project was to create an economical solar concentrator system using simple, inexpensive mirrors which would increase the power output of solar cells.

Help Received
Mother helped me with the board. Father helped me with obtaining the materials. Mrs. Nguyen guided me in the project.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
David Mariscal

Project Number
J1029

Project Title
How Temperature, Angle, and Distance Affect Solar Cell Wattage

Abstract

Objectives/Goals
The goal of this project is to investigate how changes in temperature, angle and exposure to the sun affect the wattage output of a solar cell.

Methods/Materials
This project involved three tests: 1) Solar Cell Temperature Test, 2) Distance/Cloud Cover Test, and 3) Angle/Sun Position Test. All three tests required the use of a 150 watt portable lamp, solar cell panel, and multimeter that measured voltage and current. The Solar Cell Temperature Test included a digital thermometer and a temperature-controlled enclosure. Measurements of voltage and current were taken at "cool", "warm" and "hot" temperature levels (Test 1), different distances between the solar cell and lamp (Test 2), and at various solar cell angles (Test 3). The voltage and current readings were multiplied to calculate solar cell wattage produced for each test.

Results
The Solar Cell Temperature Test findings followed Ohm's Law - as the temperature rose by 10.5 C, the solar cell wattage decreased by almost 50% due to increased resistance. The Distance/Cloud Cover Test findings followed Newton's Inverse-Square Law - the solar cell wattage decreased inversely proportional as the distance (proxy for cloud cover) increased between the solar panel and the lamp. The Angle/Sun Position Test demonstrated that the production of solar cell wattage is directly tied to the solar cell's angle to the lamp.

Conclusions/Discussion
My conclusion is that the best place to locate an efficient solar photovoltaic generation plant would be near Denver, Colorado because it is about a mile above sea level, has cool temperatures, and gets reasonable amounts of sunshine. I would recommend that any photovoltaic solar system have a tracking device that follows the sun's angle/position in order to maximize solar cell wattage production.

Summary Statement
My project investigates how temperature, angle and distance affects solar cell wattage.

Help Received
Parents helped type report and organize board; used Ribet science department lab equipment under supervision of Mr. Shirajian.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
S. Kennedy Placek

Project Number
J1030

Project Title
How Much Energy Can a Residential Hydroelectric System Generate?

Abstract

Objectives/Goals
To determine if the run off from rain on residential rooftops can be harnessed to the degree that rooftop hydroelectric systems can be developed to contribute to energy production and have a positive impact on environmental issues.

Methods/Materials
A loop wing wind generator set, including a model test car (I converted it into a water wheel but maintained the ability to generate and measure the electricity created). Balsa wood for the water wheel, a hot glue gun and 1/8" plywood made into v-shaped slews (water flows and increases velocity). A measuring tape to measure the head of the flow, wood glue and duct tape. A stop watch to time the model car run time and a garden hose to replicate rainwater. Copper pipes for Concept 2 and a hair dryer for the wind generator. Wind meter.

Results
The actual loop wing wind generator was the most efficient at generating power. The light weight blades were hard to match with the balsa wood constructed water wheel. In two minutes of rotation (using hair dryer of 15 knots of wind), it generated 45 seconds of run time for the test vehicle. This run time was compared to just 18 seconds of run time for the Concept 1 system using 126 liters of water over a two minute period of time. Concept 1 is the invention of V shaped micro slews to channel rainfall into a single spout on each side of the house to generate maximum velocity and volume as the water hits. Concept 2 uses micro water wheels at the base of every V shaped channel. Concept 2 did not generate electricity in the 2 minute test.

Conclusions/Discussion
Each year millions of gallons of rain water run off roof tops in the United States. Concept 1 proved that a water wheel can be used to create a micro hydroelectric plant on residential roofs using the V-shaped channels that I invented. While the second concept did not generate electricity during the same time period, I believe that with the use of lighter materials and a more efficient design, this system has great potential to out perform both the wind loop and Concept 1.

Summary Statement
Creating a residential rooftop hydroelectric system using rainwater.

Help Received
My father helped assemble the gears and body of the model car and assisted me in cutting pieces of wood for the water wheel.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Megan R. Ruckstuhl

Project Number
J1031

Project Title
Here Comes the Sun

Abstract

Objectives/Goals
My topic was to study the effects of intensity, temperature, and angle on a solar cell#s power output. I chose this topic because I am interested in how solar cells work. I expected the solar cells to produce more power as the intensity of light shining on them increased, and as the light shines more directly on the cell. I also expected the solar cell to produce less power as temperature increased.

Methods/Materials
First, I bought two solar cells. My dad and I soldered them together to make one big solar cell. I also bought three different light bulbs. They were 205, 570, and 1050 lumens. I tested each light bulb in a 65 degree environment, 68 degree environment, and an 85 degree environment. For each light bulb and temperature environment I recorded the current and voltage at fifteen degree intervals starting at zero and advancing to one hundred eighty degrees. I multiplied the current and voltage together, to determine the wattage. I used the wattage to make my graphs.

Results
My results were that if I used the brightest light bulb, the most power was recorded. If I placed a light bulb at a 90 degree angle, then the most power was also recorded. The most power was recorded when I conducted the experiment in the 85 degree environment. My research stated that if the cell got hotter, the power should decrease. Therefore, my results on the temperature portion of my experiment were inconclusive. My results did show that if a cell is exposed to a major temperature difference, then the power output will change.

Conclusions/Discussion
My 1st hypothesis was that if I used the 1050 lumens light bulb, then the most power would be recorded. I was right. The least power came out of the 205 lumens light bulb. My 2nd hypothesis was that if I angled the light at a 90 degree angle, then the most power would be produced. I was right. When the light is at 0 degrees or at 180 degrees, the least power was recorded. My 3rd hypothesis was that if I performed the experiment in a cool environment, then the cell would perform the best. The cell put out more power in the hotter environment. My research stated that the hotter a solar cell gets, the power output should decrease. Temperature does have an effect on the power output of a solar cell. The results did not match my research. To further my study, I could use a different setup to study temperature effects and use a wider range of temperatures

Summary Statement
My project tested how angle, intensity, and temperature affected the power output of solar cells.

Help Received
Mother proof read report. Father helped solder solar cells together and collect data.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Bryon E. Scott

Project Number
J1032

Project Title
Sun Power

Abstract

Objectives/Goals
My goal was to determine if the angle a solar cell is mounted at would affect the amount of energy the cell would produce.

Methods/Materials
Materials: multimeter, solar cells, protractor, velcro, screws, screw driver, metal brackets, vise, hammer, jumper wires with alligator clips, wood, compass, data chart.

Methods: A solar cell was mounted on each of four metal brackets bent to varying angles. These solar cells were placed in the sun facing South. Voltage readings were taken with a multimeter each hour. Research indicated that the most voltage or electric energy would be produced by the solar cell mounted at the latitude of my area, approximately 33 degrees.

Results
In 156 out of 160 readings, 97.5 percent of the time, the solar cell mounted at the angle of 30 degrees produced the most voltage or electric energy.

Conclusions/Discussion
The results showed that my hypothesis was correct. To get the most effecient energy production from solar cells they must be mounted at the optimal angle which is the latitude of the area. Using solar energy is important because it saves our primary natural resources and is better for our environment. Just one 100kw solar energy system can, in one year, save 18,700 pounds of carbon dioxide emissions and 420 barrels of oil. Because solar energy does not pollute the environment with carbon dioxide, sulfur dioxide or mercury like many traditional forms of electrical generation do, it does not contribute to global warming, acid rain or smog.

Summary Statement
I found the optimal angle to mount solar cells to produce the most electric energy (voltage).

Help Received
Neighbor helped bend brackets; Dad helped build test board and make graphs; Mom helped design the board layout.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Christopher R. Swenson

Project Number
J1033

Project Title
The Effect of Different Electrolytes on Solar Fuel Cell Efficiency

Abstract

Objectives/Goals
This project investigates the use of solar power to generate hydrogen through electrolysis and measures the amount of electricity generated when that hydrogen is reabsorbed in a fuel cell. Sulfuric acid, hydrochloric acid, table salt, and baking soda are used as electrolytes in this experiment, which attempts to predict which one will provide the highest electrical output for the longest amount of time. My hypothesis is that sulfuric acid will perform the best because it is the strongest of the electrolytes chosen and will probably increase the electrical conductivity of the water the most.

Methods/Materials
Solar power is applied to electrodes inserted into a solution of water and one of the electrolytes in a standard electrolysis setup. After a charging period, where hydrogen is formed on the electrodes, the solar cell is disconnected, and the setup becomes a primitive fuel cell. The amount of electricity generated during the fuel cell operation is recorded over a 10 minute time period.

Results
The results show that baking soda, not sulfuric acid, generates the highest voltage for the longest period of time. Surprisingly, the order of effectiveness of electrolytes is: baking soda, table salt, sulfuric acid, and lastly hydrochloric acid.

Summary Statement
This project investigates the use of solar power to generate hydrogen through electrolysis and measures the amount of electricity generated when that hydrogen is reabsorbed in a fuel cell.

Help Received
My father paid for the materials and supervised the use of sulfuric acid and hydrochloric acid, ensuring that I wore gloves, goggles, and a mask.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Lucas E. Swyden

Project Number
J1034

Project Title
Solar Energy Output Lab

Abstract

Objectives/Goals
Conventional solar energy usually means dozens of expensive solar panels pointed at the sun. A alternative form of solar energy is to use mirrors to focus more light onto a solar cell; another is to use large lenses to focus the light. Which of these methods is most cost effective to use on a large scale? HYPOTHESIS: The method of mirrors will be the cheapestto produce solar energy because it is cheaper to polish pieces of glass than to shape plastic or glass into lenses.

Methods/Materials
One: Ordered solar cells from Edmund; bought mirrors from Michael's; bought a Fresnel lens from Office Depot. Two: Recieved the solar cells and had to find out how to assemble them. Three: With the solar cells assembled, I need to set up the mirrors and lens. Will use parts from a Vex Robotics Kit. Four: With the mirrors and lens set up, I need a method of measuring the output of the solar cells. I found a way on the internet, but need a load resistor and two multi-meters (borrowed from my father). Five: On a sunny day, I took 10 readings each of: 1) Solar Cell alone; 2) Solar Cell with Lens; 3) Solar Cell with 8 mirrors. Had to use a Neutral Density Filter to keep the solar cells from overloading.

Materials: Fresnel lens, 2 solar cells, 8 mirrors, a wooden pole, 8 clamps, 16 small nuts and bolts, 2 multi-meters, 4 bendable pieces of metal, wire, a 4.8 ohm resistor, and a 1.0 ND Filter.

Results
In Power/Dollar my results were: 160 microwatts/$ for the solar cell alone; 733 microwatts/$ for the solar cell with lens; 951 microwatts/$ for the solar cell with mirrors.

Conclusions/Discussion
My experimentation confirmed my hypothosis that a solar cell with mirrors would put out the most energy per dollar. Even though the lens system put out a higher average of 10,265.74 microwatts compared to the mirror system's 6657.8743 microwatts, because mirrors are cheaper than lenses, the mirror system was more cost effective.

Summary Statement
I am studying the cost effectiveness of using mirrors and lenses with solar cells versus using solar cells alone.

Help Received
Mother proof read report and display text; Father helped assemble the solar cells and build the test circuit; Father lent me his multimeters and camera tripod.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Luke A. Thompson

Project Number
J1035

Project Title
Water Down the Drain ... or Is It? Converting Water Waste into Usable Energy

Abstract

Objectives/Goals
My objective was to determine if energy could be produced from water run off through a household drain and, if so, what factors influence the energy output.

Methods/Materials
I constructed a stand to hold a generator and impeller, a pipe to direct the water flow, and used a voltmeter to measure the peak energy output. First I poured water directly onto the impeller using 3 different water containers (2-quart container without holes, 2-quart container with holes and a 5-gallon bucket). Then I poured water onto the impeller through a pipe, to simulate a drain, using the same water containers. Each time I poured water, I measured the peak energy output. I performed this test with each water container five times without the pipe and repeated the procedure five times with the pipe.

Results
Energy was produced in each trial. The water poured through the pipe consistently produced greater energy. The highest energy output was achieved using a two quart container with holes in the bottom.

Conclusions/Discussion
My hypothesis was partially correct. Energy was able to be produced in a household drain. I believe this was due to the fact that the kinetic energy of the falling water was transferred to the motor, thus producing energy. The pipe helped produce more energy because it focused the kinetic energy onto the impeller. The higher speed of the water also effected the energy output in a positive way. One aspect that surprised me was that the 5-gallon bucket produced a lower peak voltage than the 2-quart container with holes. I thought that the 5-gallon bucket would produce a higher peak energy because of it's greater volume. This may be due to a design error. The water from the 5-gallon bucket was poured into the pipe through a funnel whereas the 2-quart containers were poured directly into the pipe. This may have caused it to lose some of it's kinetic energy.

I believe this experiment has the potential to revolutionize the future of green technology. This project could be improved by using an impeller specifically designed for water applications and a gear system to increase the revolutions of the generator. It could be engineered and mass produced to fit into any standard household drain pipe.

Summary Statement
The goal of my project was to utilize wasted water in a household drain and to convert it into usable energy.

Help Received
My father helped pour the water while I recorded data. He also helped me find the parts for the pipe and stand.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Seth N. Thompson

Project Number
J1036

Project Title
Reflect the Rays: Aluminum Foil and Solar Power Production

Abstract

Objectives/Goals
The purpose of my project was to determine if placing aluminum foil reflective panels on a photovoltaic cell would have an effect on the current produced by the solar panel. The test variable angles that were tested: 30°, 60°, 90° and 180°. I believed that the aluminum foil would give the solar panel the most power if the aluminum foil is positioned at a 90° angle, relative to the solar panel.

Methods/Materials
A moveable reflective panel that could be moved to the angles tested was constructed. The solar panel was tested once without the reflective panel and four other times with the reflective panel placed at the various test variables. I tested the solar panel 15 times for each variable using a multimeter to measure the current.

Results
The 60° angle provided the greatest current output while the control (absence of reflective panels) provided the least current output.

Conclusions/Discussion
My conclusion is that aluminum foil can increase the power of a solar panel. Amongst the angles tested, a 60° angle would provide the greatest current output.

Summary Statement
The purpose of my project was to determine if placing aluminum foil reflective panels on a photovoltaic cell would have an effect on the current produced by the solar panel.

Help Received
Thank you to my mother and science teacher for helping me with my project, thank you to the school for providing my board materials, thank you to Mr. Matthew Potter from Unlimited Energy for providing me with information about solar panels.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Jissa A. Vennat

Project Number
J1037

Project Title
A Novel Method of Improving the Efficiency of a Photovoltaic Solar Panel using Flexible Thin-Film Solar Cells

Abstract

Objectives/Goals
The objective is to determine if a flexible photovoltaic solar panel made to a wavy geometry can increase the amount of electric energy generated per projected area.

Methods/Materials
The project involved various materials such as 2 flexible thin film solar panels, multi-meter, resistor, bread board, wires with alligator clip ends, soldering iron, solder, wire stripper, wood stapler, mounting tape, curved wood pieces, and ply wood board. I measured both the current and voltage of Panel #1(curved panel) and Panel#2(flat) using a multi-meter. Measurements were taken at three different angles, 0°, 13°, and 29°, and at four different times of day.

Results
Many calculations were obtained in my experiment. The maximum measured value of open circuit voltage was about 4.8 volts, which was close to the stated manufacturer#s value of 4.6 volts. Power was also calculated, using current and resistance. The higher the angle, the panel generated more power within the range of angles used. Also, the amount of power generated was higher around noon. The maximum power calculated was 0.29 watts, which compares to the manufacturer#s specification of 0.36 watts. By dividing the power by the projected area for each panel, power per square meter was calculated. Finally, I calculated the ratio of power per square meter, for the curved panel to flat panel, which varied between 2-40%.

Conclusions/Discussion
The observed data in my project proves my hypothesis correct; showing the adjusted power for the curved panel per projected area was higher than that of the flat panel. The power ratio of the curved panel to the flat panel ranged from 2-40%. This may be due to the fact that the curved panel had more surface area for a given roof area. The higher ratio of 10-40% occurred at zero degree angle. At a zero degree angle, some portions of the curved panel have a more favorable angle to the sunlight, causing the overall effect to be much better compared to the flat panel. However, in practical uses panels are always kept at an angle close to the latitude. This means that the improvement using curved panels may be in the lower range of the power ratio stated (2-9%). Nonetheless, my experiment proved ideal in improving the efficiency of solar energy conversion, and can be advantageously used in practical applications such as in PV (photovoltaic) solar panels installed in homes, commercial buildings, and PV solar power plants.

Summary Statement
My project demonstrates a novel method of using flexible solar film to make high-efficiency photovoltaic solar panels, which is likely to reduce the cost of power generation.

Help Received
My dad helped me decide how to conduct my experiment. He soldered wires and sawed woods for use in my experiment. Ms. Julia Stone from Power Film Inc., supplied me with free solar panels. My science teacher, Mr. Lobato, reviewed my topic and report, and guided in general.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Gareth C. Wang

Project Number
J1038

Project Title
Constructing and Testing a Practical Solar Powered Vehicle

Abstract

Objectives/Goals
The objective of this project was to determine if it is possible to build a practical solar powered vehicle that can be used for everyday errands and tasks. This vehicle needs to be affordable, have a long enough range and a suitable speed to be used as a delivery, shopping, and transportation vehicle. In rural countries, bicycle ambulances are used and a solar vehicle could be a quicker way of getting someone to the hospital. I wanted to do this project because I am very interested in cars, but also want to help the environment.

Methods/Materials
First, selected key parts including the electric motor, batteries, solar panels, a base vehicle, and a Maximum Power Point Tracking Charge Controller. Parts were chosen based on affordability and performance. Next, design the vehicle. But problems kept cropping up at each stage of the design, such as when the solar panels were too big to fit on the base vehicle. Two tests were performed: a practicality test, which included solar panel charging time, average speed, all electric range, and top speed, and a performance test (time to speed and time to distance). The procedure was: 1. Record date and time 2. Perform test drives or charge batteries. 3. Record results.

Results
The average speed of the solar vehicle was 12.1 km/h, the top speed of the vehicle was 35.2 km/h, and the solar panels charged the batteries in 4 hours. Fastest times for 54.5 kg person in time to speed test: 0-25 km/h: 13.03 sec. 0-25 km/h with pedaling: 10.09 sec.Fastest time for 54.5 kg person in time to distance test: 0.5 km in 1.27 minutes. Fastest time for 77.3 kg person in time to speed test: 0-25: 15.6 sec. Fastest time for 77.3 kg person in time to distance test: 0.5 km in 1.1 minutes.

Conclusions/Discussion
The hypothesis was correct; it is possible to build a practical solar powered vehicle. This vehicle has lots of luggage space, the solar panels charge quickly, and the speed and range are suitable for local errands. The more experience I had with the vehicle, the better the performance I was able to get out of it. This vehicle will also pay itself back in saved gas money and it is a lot better value than similar vehicles on the market.

Summary Statement
My project is about designing, building, and testing a solar powered vehicle.

Help Received
Godfather operated dangerous woodworking tools and allowed access to other tools; Father taught me about hardware tools and basic electrical concepts.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Elisabeth R. White

Project Number
J1039

Project Title
Comparison of the Efficiency of a Photovoltaic and a Solar Hot Water System

Abstract

Objectives/Goals
The objective was to measure the efficiency of our family's photovoltaic (PV) and solar hot water (SHW) systems in order to determine which technology does a better job of turning the sun's energy into an alternate form. The cost effectiveness of each technology was examined.

Methods/Materials
For the solar hot water panels, the efficiency was found by measuring the temperature of the water flowing into and out of the panels, the flow rate, the solar irradiance, and the area of the panels. Data from the temperature sensors and a pyranometer was taken once per minute and logged by two computers. The efficiency of the photovoltaic panels was found using the output power of the photovoltaic inverter and the pyranometer. A third computer was used to log the output of the pyranometer once per minute. Data from the text files was put into Excel for calculations and plotting.

Results
Data was taken over a three day period from 1/31/09 to 2/2/09. All three days were clear and sunny. The data from each day was similar. In the morning, the solar irradiance (W/m2) rose gradually dropped and reached a maximum around noon. The solar irradiance fell off suddenly at 3:15 pm each day as shade from our neighbor#s tree fell across the meter. The efficiency of the solar hot water panels was determined to be about 20% for most of the day. The efficiency of the photovoltaic panels was 12%.

Conclusions/Discussion
It was found that a solar hot water panel is more efficient at turning the Sun#s energy into an alternate form than a photovoltaic system. The solar hot water system was also less expensive than the photovoltaic system by a factor of about two. Since the SHW system is about twice as efficient as the PV system at about half the cost, the SHW is about four times as cost effective as the PV system.

Summary Statement
I measured the efficiency (output/input x 100 %) for our photovoltaic and solar hot water systems.

Help Received
My dad built both the PV and SHW systems. I helped to get the SHW system working. Dad also helped me to set up the three computers to take the data.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
William T. Whitehead

Project Number
J1040

Project Title
Got Wind?

Abstract

Objectives/Goals
The objective of my project was to investigate whether McKinleyville, California has enough wind to generate the electricity needed to power a house using a household wind turbine.

Methods/Materials
I bought a Speedtech SM-18 Skymate Wind Meter to measure the wind, a 10-foot PVC pipe to attach the wind meter to, along with the necessary fittings. I acquired the daily average wind speed for the year 2008 using the Preliminary Climate Data from the National Oceanic and Atmospheric Administration (NOAA) website, whose weather station is located at the airport. This is very close to one of the houses I used to measure the wind. The other house is near the ocean, about one mile to the west. I measured the wind at the same time of day, at both houses. I recorded the max speed, time and date. I graphed the data to compare it to the cut-in speeds of the wind turbines: Bergey XL.1 and South West Skystream 3.7. I used the PG&E bills form the house near the airport to find the average kW used per month during 2008.

Results
I found that the house near the ocean consistently had almost twice as much wind as the house near the airport. I also found that the Bergey would make about 1.2 kW and the Skystream would make about 1.7 kW in the windiest month. That's only 1/468 to 1/330 of the kW needed for the monthly average.

Conclusions/Discussion
My data shows that McKinleyville does not have enough wind to power a house using a household wind turbine. More research is needed to discover if a hybrid wind/solar system would generate the electricity needed to power a house in McKinleyville.

Summary Statement
My project is to investigate the feasibility of a household wind turbine in McKinleyville, California.

Help Received
My mom helped obtain the materials, provided guidance and support. My grandmother bought supplies for my backboard.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Stephen W. Wolfe

Project Number
J1041

Project Title
Converting Tidal Energy into Electricity

Abstract

Objectives/Goals
The goal of this project is to prove that energy can be made through the tides that are all around us. A tidal energy converter will be made and tested in several areas around San Diego in hope to find the prime location if one were to be Installed. The first goal is to construct a successful tidal energy converter prototype that can be used to test. The second goal is to test and recover accurate results.

Methods/Materials
Stepper motors, wood, sprockets, silicon cement glue, pipe, LED lights, a volt meter, acrylic paint, rope, Styrofoam, and a weight are the primary pieces to construct a successful tidal energy converter. Countless tools were used in the process to piece everything together into a finished product. When the wake of the water meets the tidal energy converter it causes the arm to move up and down on the axle of a stepper motor creating surges of electricity.

Results
Coronado island produced 3.498 volts on average. Mission bay produced 2.822 volts on average. Miramar lake gave off 1.508 volts on average. Finally the Scripps Ranch pond only produced .0408 volts on average. Coronado island produced the most because an ocean has the most gravitational pull between the moon and the sun creating stronger tides. Scripps Ranch pond produced the least amount of volts because its gravitational pull was very weak and only ripples formed.

Conclusions/Discussion
The hypothesis proved to be near perfect because the average of each locations trials were in the same range as the hypothesis. If a small tidal energy converter prototype a 14 year old boy made can produce electricity imagine what large investment and many high quality prototypes could create. The future Is at today#s youth#s fingertips it is their decision what happens to it.

Summary Statement
The project is about taking a tidal energy converter and placing it in different bodies of water to compare the amounts of electricity each place creates creates.

Help Received
Recieved help from handyman with tools, Grandpa helped with construction, parents helped with support.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Thomas O. Yaeger, Jr.

Project Number
J1042

Project Title
Magnet Madness: Using Transverse Wave Motion to Propel Electromagnetic Induction

Abstract

Objectives/Goals
Can a windbelt, an alternative wind powered device using a ribbon belt instead of blades, generate enough wave energy to oscillate a magnet and coil induction circuit to power a 1.5 volt lamp and how do the position of the fan, coil and magnet affect the amount of wave motion needed to produce measurable power?

Methods/Materials
First I designed and built a windbelt structure to suspend a taut Mylar ribbon. I conducted multiple trials on the device to test the fan angle and magnet placement in different positions along the belt for determining the best placement to generate a rapid wave motion to move the magnets in an electromagnetic induction circuit. I then switched the coils position along the ribbon belt and tested by using a voltmeter to see if there is any difference in current output. After each trail I connected the 1.5 volt lamp to the coils.

Results
I found that a homemade windbelt could power a 1.5 volt light bulb. The best angle generating the most consistent wave motion was at a 90 degree angle. I found that the bottom portion of the ribbon belt near the securing tower was the most consistent wave. The fan did produce a wave motion in the ribbon belt sufficient to create a current in electromagnetic induction circuit. The ribbon belt tension had a great influence on the amount and "quality" of the motion.

Conclusions/Discussion
A Windbelt converts wind energy into movement (waves) of a ribbon that can be used to move a magnet past a set of coils to generate enough power to light a small light bulb. The amount of flutter and current is dependent on the amount of wind, the tension of the ribbon belt, the position of the magnets, the weight of the magnets, and the angle of the air flow. My windbelt was simple to prove the concept. Further work would need to be done to maintain the ribbon belt at the optimal angle relative to wind direction

Summary Statement
I tested the affects of wave motion and magnet placement on a ribbon belt to power an electromagnetic induction circuit.

Help Received
My mother helped me with the graphs and proofreading. My Father helped buy the materials. Richard Remillard of Fuel Solutions Inc. helped me with understanding the bridge rectifier solution.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

David M. Zimmerman

Project Number

J1043

Project Title

The Relative Impact of Anode and Cathode Composition on the Performance of a Two-Chambered Microbial Fuel Cell

Abstract

Objectives/Goals

Microbial fuel cell (MFC) performance is dependent upon many complex microbe-electrode interactions. To attain commercial viability, researchers must better understand the effect of electrode composition on MFC performance. My objective was to use a two-chamber MFC to assess the impact of electrode materials on electrical output in order to determine the relative importance of anode and cathode composition. My specific hypotheses were: 1) anode composition would have a greater effect on electrical output than cathode composition because of its contact with the microbes and 2) Pt anodes would be superior to Au or Cu.

Methods/Materials

Anode and cathode chambers were constructed from converted reagent bottles. Agar/saltpeter solution was poured into a plastic mold to serve as a salt bridge interposed between the chambers of the MFC. Anode chamber contained organic sediment from a stagnant stream; cathode chamber contained saline solution. Multimeter measurements of V(OC) and I(SC) with different anode/cathode materials (Cu, Pt, Au) were used to estimate electrical output as a figure of merit (V(OC)*I(SC)) to facilitate comparisons.

Results

Anode composition had a greater effect on electrical output than did cathode composition. Electrical output was significantly different between anode groups; Cu anodes yielded a significantly greater mean wattage than either Pt ($p = 0.03$) or Au ($p = 0.01$). In contrast, there were no statistically significant differences between the mean wattages of groups sorted by cathode type.

Conclusions/Discussion

My data support my hypothesis that anode composition has a greater effect on electrical output than cathode composition, probably due to the complexity of the microbial interactions at the anode during initial electron transfer. These data suggest that future MFC development efforts should prioritize anode material selection. Contrary to my second hypothesis, Pt anodes were not superior to either Au or Cu. The small surface area of my electrodes might have been insufficient for Pt's catalytic properties to overcome its poor electrical conductivity. Cu's superior performance might be due to its excellent conductivity, the absence of bactericidal Cu compounds, and suitability for the specific bacteria in my system. This finding underscores the value of testing anode performance under system-specific conditions, especially when mixed-cultures of bacteria are utilized.

Summary Statement

A two-chambered organic sediment microbial fuel cell was used to estimate electrical output resulting from different combinations of electrode materials in order to demonstrate the effect of anode/cathode composition on MFC performance.

Help Received

Mr. Robert Kahn guided me through the planning and logistical stages of my project; My mother advised me on statistical analysis; My father helped me to obtain my project materials; My uncle inspired my interest in the use of living organisms as a source of power.