CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
J1009

Project Title
Solar Concentrators for Battery Chargers

Abstract

Objectives/Goals
While many people in poor countries don't have electricity, the fuels in wealthy countries produce pollutants. Solar power is a clean alternative but is unreliable due to cloudy days or nighttime. We can solve this problem by storing solar energy in batteries. However, solar cells are still expensive, and the solar battery chargers below $80 are inefficient. I want to create efficient concentrators for solar battery chargers that can keep the cost down by reducing the area of solar cells. Eventually, I want to achieve a voltage >1.5V and a current >100mA under $15 for charging one AA battery.

Methods/Materials
My research question was: which design would be the cheapest and most efficient? First, I built 4 systems: (1) a control, (2) a big metal bowl with a suspended cube of solar cells, (3) lenses over solar cells, and (4) small mirrored cups with cells inside. They were put on a table at noon and aimed at the sun. Then, over 3 days from 9:00 AM to 4:00 PM, 3 repeated measurements of the current and voltage were taken each hour. Next, I tested the winner(s) by attaching an AA battery. My materials were: 24 of 1 x 1 sq cm 20 mA cells, a fruit container, spray paint, a metal bowl, Fresnel lenses, a multimeter, NiMH rechargeable batteries, 8 of 100 mA cells, and supplies.

Results
The control provided the highest energy output at 850 Joules a day and was the cheapest at $6.23. The bowl was the worst performer. The lenses produced a little more energy than the cups, but were twice as expensive as the cups. However, I could not put much charge in a battery with the control; the current and voltage dropped substantially when the battery was attached. Therefore, I decided to switch to larger 100 mA solar cells and learned that about 2 volts were needed to charge one AA battery. Furthermore, it took 8 solar cells to reach the maximum charging current of 100 mA, many more than I had expected.

Conclusions/Discussion
I have learned how to achieve my objectives. Though the control performed the best, the cups are very promising. The cups' peak current was higher than the control's. The cups' poor performance at the end of the day was because the sun couldn't reach the cells well. I plan to improve the cups in the future. In addition, I learned the solar cell voltage must be quite a bit higher than the battery's for it to charge efficiently.

Summary Statement
My project is about how to use novel, low-cost solar concentrators to enhance the performance of solar cells when charging batteries.

Help Received
Dad taught me how to use Excel, a soldering iron, and some electrical equations. Mom helped with editing and taking photos. My science teachers Mrs. Amsden and Mrs. Sterne reviewed my notebook and application.