# CALIFORNIA STATE SCIENCE FAIR
## 2011 PROJECT SUMMARY

**Name(s)**
Paul A. Dennig, Jr.

**Project Number**
**J0211**

**Project Title**
# From Concentrator to Tracker: An Innovative Solution for Maximizing Electric Power from Solar Photovoltaic Cells

**Abstract**

**Objectives/Goals**
With the awful BP oil spill in the back of my mind, I feel a sense of urgency to make green energy accessible to all. Solar trackers can increase power output by close to 40%, but even a simple tracker for doing science fair experiments costs $100. My goal is to build an affordable tracker with real-world applications at half the cost. After 10 prototypes, I created three trackers and my research question was which design would be the cheapest and most efficient. My hypothesis was that my focal-point tracker would be superior in both cost and power output performance, because it does not use expensive circuitry and it is the only one that receives concentrated light.

**Methods/Materials**
The three trackers that I built are: (1) a shaded solar-powered tracker, (2) a micro-controlled servo tracker, and (3) the novel focal-point tracker. The first two trackers use electric motor drives to follow the sun at a rate of 15 degrees per hour. My focal-point tracker consists of a circular solar concentrator and a tubular collector that moves inside it along a path determined through simulation by ray tracing software. The collector is moved by a clock at 20 degrees per hour. A flexible 60 mm x 150 mm solar cell and a load resistor are attached to each setup and the control. On a large table outdoors, I oriented all four configurations perpendicular to the rays of sun during solar noon. Then I let them track the sun and measured the voltage of each setup's resistor with a digital multi-meter every 15 to 30 minutes for 5 to 7 hours a day over 8 days.

**Results**
I calculated the current (mA) and power (W) and estimated the future cost ($) for each tracker and the control. Among the trackers, the focal-point tracker was the cheapest one which can be made for about $27 and it always had the highest power output with about 55% more than the control, while the other two trackers outperformed the control only by roughly half.

**Conclusions/Discussion**
My hypothesis was correct! My focal-point tracker was the winner by having the lowest cost and highest output. I know I can greatly improve the novel tracker's performance. My ray-tracing simulation suggests I can boost the power output by around 7 times. The plastic solar cell can only make about 100 mA without a load and melts in intense heat. I will look for a more powerful one that won't melt.

**Summary Statement**
I designed and built three solar trackers and found that my novel concentrating-type design performed the best in making electricity from sunlight.

**Help Received**
Mom helped me with my writing. Dad introduced me to Arduino microcontroller and servo motor and showed me how to do difficult math.