Wisconsin Energy Institute
UNIVERSITY OF WISCONSIN–MADISON

SOLAR ROVER EXPLORATION STATION

Overview

This Exploration Station is designed to introduce learners to solar energy and how electrical output, or power, of solar photovoltaic panels changes relative to the distance of the light source. "Exploration Stations" are educational activities at public events that invite learners to interact with materials in a hands-on manner, and at their own pace. Learners will discover the relationship between power and distance of the light source using a solar rover. The facilitators' role is to take cues from the learner to encourage inquiry-based scientific reasoning and experimentation.

Materials Needed

- Solar Rover[1]
- LabQuest Interface, by Vernier
- Energy Sensor, by Vernier
- 1 K ohm potentiometer (variable resistor)[2]
- Electrical wire, light weight (14-18 gauge)
- Alligator clips, 2 Red and 2 black
- Electrical tape
- Light source (LED lamp) with tall stand[3]
- Measuring Tape
- Large (flip-chart size) graph paper
- Darker area with minimal overhead light to interfere with readings

Notes

1. The Solar Rover is made up of a solar photovoltaic panel approximately 1.5' by 2.5' attached to a low cart or wagon, with the panel facing up at an angle of approximately 45 degrees. The Energy Sensor and the potentiometer are mounted and wired under the panel, and the LabQuest interface is mounted on top of the Rover next to the panel.
2. This is used as a higher resistance alternative to the Variable Load unit by Vernier.
3. The LED bulb that is used is 36 amps which provides high intensity light. Due to the fact that it is an LED, the unit does not emit heat, and therefore it is not a potential burning hazard. The bulb is screwed into a utility lamp and clamped onto a photography tripod, or similar.

Setup

The Solar Rover is modeled off of the "Effect of Load on Solar Panel Output" activity, by Vernier. Details can be found in their book Renewable Energy with Vernier, or at https://www.vernier.com/experiments/rev/18/effect_of_load_on_solar_panel_output/).

Due to the larger size of the panel, a 1 K ohm potentiometer is used as a replacement for the Vernier Variable Load unit (6 – 225 Ohms). If a smaller panel is used, the Vernier Unit may be sufficient.

With the Solar Rover at its closest point to the light source, adjust the potentiometer to the maximum power (Watts) output. Doing this will provide the greatest range of power output for different distances between the Rover and the light source.

Facilitators Needed

- Minimum 2: 1 for managing rover and lamp, and 1 for leading discussion and helping participants mark their data point on the flip-chart graph.

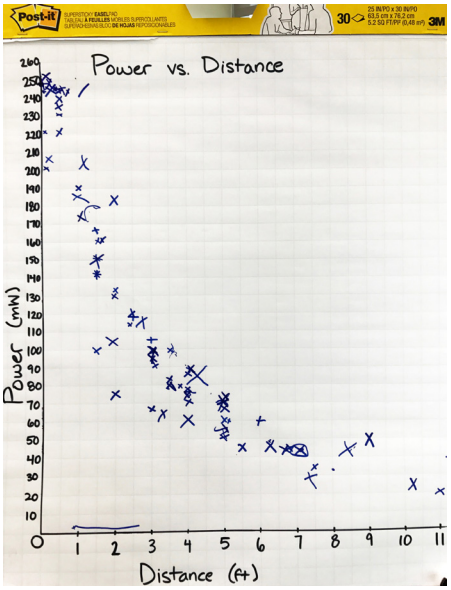
Guiding the Activity

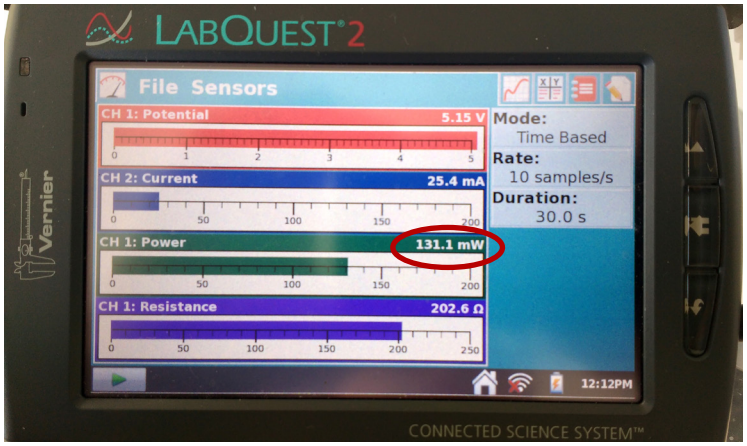
Introducing the Concepts: Sample Questions

- Do you want to help us with an experiment?
- Do you know what a solar panel is?
- What do solar panels do?
- Why are solar panels good for the environment?

Make sure to mark a base point (distance zero) from the front of the rover where all measurements will be compared to this. This point should also be where the solar panel is producing the most power (Watts) from the light source.

Have learners move the solar rover closer or farther away from the light source and make sure the light source is shifted to center on the solar panel. Take note of the power reading on the Vernier Interface and measure the distance using a measuring tape from the marked base point to the front of the rover. Using the found data, the point should be plotted on a large sheet of graph paper as "Power vs. Distance" to show the relationship between the two.





Note: Number circled is the power that is measured

Additional Resources

Energy 101: Solar PV video by the U.S. Department of Energy: https://energy.gov/eere/videos/energy-101-solar-pv