PRELIMINARY ACTIVITY FOR

Solar Energy: Photovoltaic Cells

Energy produced by the sun is called *solar energy*. It is produced during nuclear reactions that take place throughout the volume of the sun. The energy travels to Earth in the form of light. *Photovoltaic (PV) cells*, or solar cells, change the light energy to electrical energy that can be used to power calculators, cars or even satellites. A photovoltaic cell is usually made of a semiconducting material such as silicon. When light strikes the cell, it provides enough energy to move electrons through the cell producing an electric current. A single photovoltaic cell is approximately the size of a fingernail and puts out a very small current when struck by the light. Objects requiring higher currents to operate can be powered by wiring large numbers of photovoltaic cells together.

Items powered by solar energy are said to be using *solar power*. Streetlights that must operate in the dark store the energy in a battery while the sun is shining and then use the energy at night. Scientists working in remote places rely on solar power to operate their computers and equipment. What things can you think of that are powered by solar energy?

In the Preliminary Activity, you will measure the current and voltage produced by a photovoltaic cell when exposed to sunlight. You will calculate the power output of the cell using the relationship

$$P = V I$$

Power = voltage × current

Where power has units of watts (W), voltage has units of volts (V), and current has units of amperes (A).

After completing the Preliminary Activity, you will first use reference sources to find out more about photovoltaic cells before you then choose and investigate a researchable question. Some topics to consider in your reference search are:

- photovoltaic cells
- solar energy
- renewable energy
- properties of light

PROCEDURE

1. Connect a Current Probe and a Voltage Probe to the data-collection interface.
2. Connect the two voltage leads (red and black) of the Voltage Probe together. Zero both probes. This sets the zero for both probes with no current flowing and no voltage applied.
3. Connect the series circuit shown in Figure 1. The red terminal of the Current Probe should be toward the + terminal of the photovoltaic cell. Look at the bottom of the PV cell to determine polarity. Connect the red lead of the Voltage probe to the wire coming from the + terminal of the PV cell and the black lead to the wire leading to the - terminal.

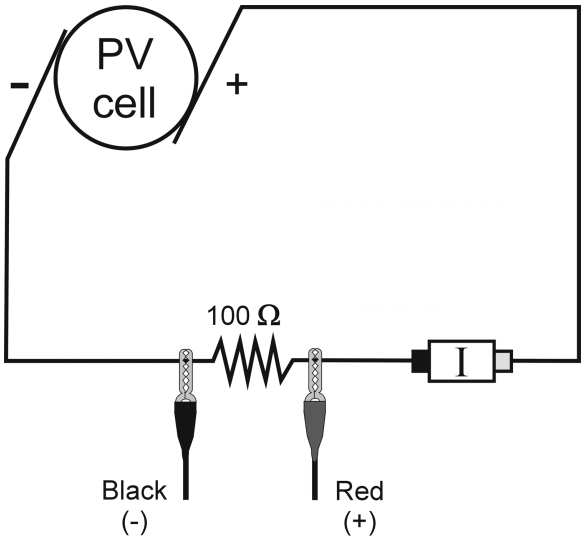

Figure 1

4. Tilt the PV cell so that it is perpendicular to the sun's rays and start data collection.
5. Stop data collection after about 30 seconds.
6. Use the Statistics function to determine the mean current and mean voltage readings. Record these values.

QUESTIONS

1. Calculate the average current and voltage values for the Preliminary Activity.

2. Calculate the power output of the photovoltaic cell (in W) using the equation given in the introduction above.

3. Examine the open PV cell and record the number of cells on the panel. Determine the area of one cell in cm^2. Remember, the area of a rectangle is length × width and the area of a triangle is ½ base × height. Draw a diagram of one cell and label any measurements that will help when calculating the area.

4. Calculate the total area of the cells in m^2 using the equation

$$\frac{\text{Number of cells on panel} \times \text{Area of one cell}}{10{,}000\ cm^2/m^2}$$

5. Determine the power per square meter (W/m^2) output of the PV cell by dividing the power output by the total area of the cell.

6. List at least one researchable question for this experiment.