# The Power of the Sun

Basic Experiment

Student Name_____**Date** _____

Introduction
In this experiment you will study the power output of a small silicon solar cell, about 10 to 200 cm^2, in a load resistance R (see diagram). (In residential applications these might be the resistances of a kitchen stove or washing machine) With the cell facing the sun you will measure the voltage across several load resistances R with a voltmeter. The power output, appearing as heat in the resistor, is given by the equation $P = V^2/R$. (P will be in watts if V is in volts and R is in ohms)
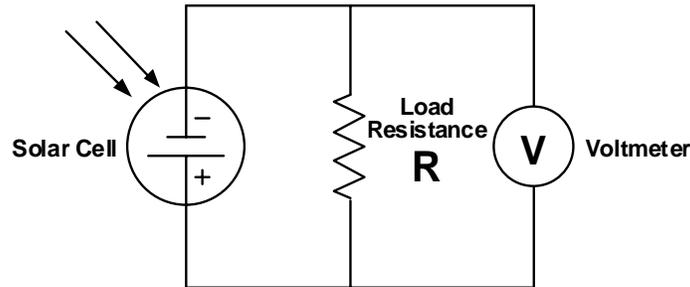
The greatest possible power output from the solar cell under given conditions (such as full sunshine, partially overcast, etc.), is obtained when the load resistance is "matched" to the solar cell and under these conditions. The optimum resistance can be found experimentally by performing the experiment with different load resistances and determining which delivers the most power to the load resistance.

Measurements and Calculations
1. Measure and record the "open circuit voltage" of the cell. This is voltage across the cell with no load resistance attached. (equivalent to an infinite load resistance)

2. Using different load resistances measure and record the voltage for each. Use resistances ranging in value of 0.1 ohms up to 20 ohms. (Resistance wire can be used for small resistances)

3. Calculate in watts the power produced in the load resistance for each of the load resistance values you used.

4. Which load resistance produced the most power and what is that maximum power?

5. Estimate the front surface area of the solar cell by measuring the outside dimensions of the cell, in square cm and then convert to square meters.

6. By dividing the maximum power output, expressed in watts, by the area, expressed in square meters, you will obtain the power output of an identically made cell with an area of one square meter.

7. The full power of the sun on a sunny day at the surface of the earth is on average about 1,000 watts/m^2. This value is called the "Standard Sun" by solar scientists and engineers. Using this value, what fraction of the power of the sun is your cell capturing? This fraction is called the efficiency of the cell.

Follow up questions
1. Calculate the area of a solar panel of a similar manufacture, which would produce enough power to run a 500 watt water pump in a remote village.

2. Estimate the area of the roof of your school and the power that could be produced if the roof were covered with such silicon solar cells.