

3-9) INSTRUCTOR'S GUIDE TO PHOTOVOLTAIC CELL DYNAMICS

Overview: Occasional clouds will change the rate at which the solar cell generates electricity, so choose a cloudless day for taking the apparatus outside.

Answers to Questions: *based on data collected in 2010:*

1-2) Based on a 40-minute trial on a sunny day the photovoltaic cell in the picture which measures about 0.0013 square meters and produced an average of **0.10 watts** (watt-hours per hour). Therefore: $0.10 \text{ watts} \div 0.0013 \text{ m}^2 = \mathbf{77 \text{ watts per m}^2}$

3) $790 \text{ watts} \div 77 \text{ watts generated per m}^2 = \mathbf{10 \text{ m}^2}$

4) $(\$300 / \text{m}^2) \times (10 \text{ m}^2) = \mathbf{\$3,000}$

5) $(6 \text{ hours per day}) \times (0.790 \text{ kW consumed}) \times (\$0.18 \text{ per kWh}) = \mathbf{\$0.85 \text{ per day}}$

6) $(\$3,000) \div (\$0.85 \text{ saved per day}) \approx \mathbf{\cancel{2,600} 3,500 \text{ total 6-hour sunny days needed}}$
 $\div (365 \text{ days per year}) \approx \mathbf{\cancel{7 \text{ years}} 10 \text{ years}}$

Logistics: This lab only requires two people, but if you have only one set of equipment for the whole class, students who do not set it up can take turns recording voltage and amp-hour readings.

Degree of Difficulty: 1—This lab does not require any form of rehearsal. Just make sure the solar cell works before your students try it.

Product Guidelines: Most items in the lab (including the motor and solar cell) are available at Radio Shack. The DC wattmeter used in this lab is called “Watts Up[®]” and was purchased online from Battery Junction for \$55. The auxiliary power connector cable called “Watt-AuxCable[®]” was purchased online from Powerwerx for \$9. *A more complete description of how to set up the auxiliary cable can be found in the Instructor’s Guide to Lab 3-5.*