NAME PERIOD DATE

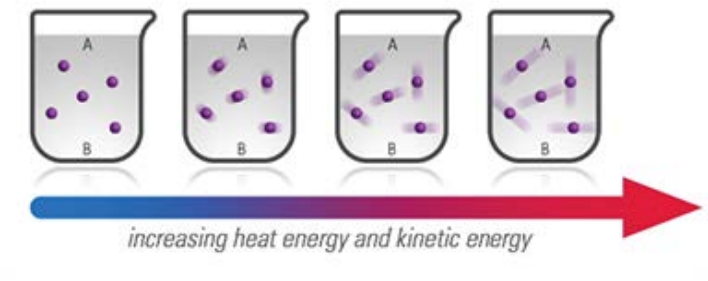
HEAT AND SOLAR PANELS

Driving Question | Objective

How does temperature affect solar panel current output?

When matter heats up, particles including electrons begin to move faster. How might particle motion affect electric current produced in a solar panel?

Photons that make up light knock electrons off atoms. The loose electrons are drawn into a stream of electric current. As more light hits the panel, more electrons are available to increase current, but every other particle in the panel also moves faster when heat increases. If you are trying to maximize current, what is the best balance between amount of light and heat if electrons are trying to flow from Point A to Point B?



Materials

- Temperature sensor
- Current sensor with red and black banana plugs
- Solar panel with toothpicks behind center line, in cold storage (Chilled in a refrigerator or ice bath for at least 30 minutes; if using an ice bath, do not allow panel to directly contact water. Do not use a freezer.)
- Adjustable lamp with 60-W or higher incandescent bulb (A CFL bulb is not appropriate for this activity)
- Solar panel holder from a previous activity
- Ruler or meter stick
- Tape

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Caution: The bulb may become hot.

Consider

1. The solar panel will generate the most current in ____ temperatures.

   a) Colder

   b) Warmer

2. Explain the basis of your prediction.

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3. Is it possible to have high solar intensity with low temperatures? Why or why not?

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4. List several factors that could affect the temperature of a rooftop solar panel.

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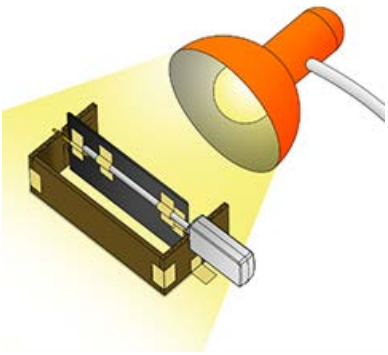
Investigate

1. Connect the temperature and current sensors. Use Help (?) if necessary.

2. Insert banana plug leads into the current sensor if necessary. Use red for (+) and black for (-).

3. Build a graph with Temperature on the x-axis and Current (in milliamps, mA) on the y-axis. Use **Help (?)** if necessary.

4. Tape the solar panel holder to the table.



5. Set the lamp horizontally on the table 20 cm from the panel holder. Turn the lamp on.

6. Prepare two 5-cm pieces of tape. Complete Steps 7-9 as quickly as possible.

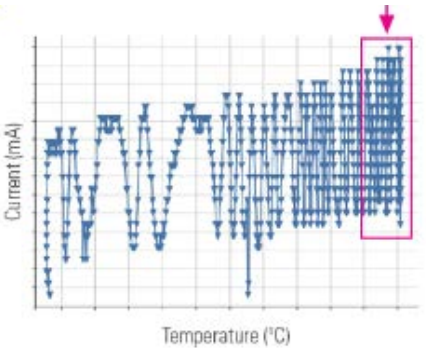
7. Remove the panel from cold storage. Attach the panel alligator clips to the current sensor leads. Match wire colors.

8. Set the panel in the holder at 90^0. Firmly tape the temperature sensor directly to the back of the panel as shown. Allow the sensor to rest on the panel holder.

9. Start recording data.

11. Scale the graph. Use **Help (?)** if necessary.

12. Continue collecting data for 10-20 minutes, or until either temperature stops increasing or current shows at least 8 stable minimum-maximum cycles, as shown. Answer the following questions while you collect data.



13. A. Describe how electron motion changes as the solar panel warms up.

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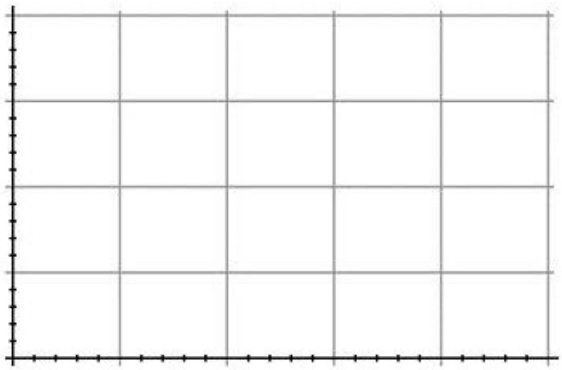
14. Why are horizontal (side to side) gaps between minimum and maximum data points along the x-axis getting closer together?

15. After data collection has stopped, scale the graph. Sketch your results in the graph below. Remember to add labels and numbers to the axes.



Analyze

1. Describe how electron motion changes as the solar panel warms up.

2. Why are horizontal (side to side) gaps between minimum and maximum data points along the x-axis getting closer together?

3. Explain the relationship between current and temperature.

4. When solar panels get extremely hot, current decreases. Use electron motion and resistance to explain why.

Extend

Write a testable question to explore the effects of higher levels of heat on solar panel current output. Design and conduct an experiment to answer your testable question. Remember to keep light intensity constant in your experimental design and use a safe source of heat. Get approval from your instructor before conducting your experiment.