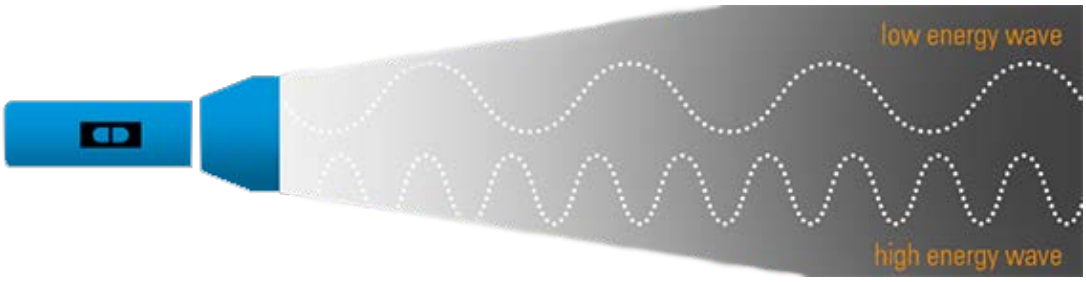
NAME PERIOD DATE

LIGHT AND SOLAR PANELS

Driving Question | Objective

How does light power and distance affect solar panel output?

If you could zoom in on a beam of light to see what it is made of, you would see many lines of tiny, evenly-spaced particles moving in a wave pattern.



Light is made of tiny particles called photons. Photons carry light (electromagnetic) energy from place to place. When they have enough energy, photons can push electrons off atoms in a solar cell. The loose electrons can be collected together in a circuit to produce electric current. We can send electricity from the solar cell directly into our homes or we can store the electricity in batteries. When the electricity is used to do work, we call it power.

Power is the amount of work done over a period of time, measured in watts (W). Work done slowly is said to have a low power rate while work done quickly has a high power rate. The difference between low power and high power is how fast energy is used when work is being done.

Materials

- Voltage sensor with red and black banana plug leads
- Solar panel with toothpicks taped behind center line
- Meter stick
- Pencil
- Tape
- Solar panel holder from previous activity
- Adjustable lamp with bulb of any wattage*

*At least two different wattage bulbs must be available for student use. Bulbs must be the same type; either use all CFL or all incandescent bulbs

Safety

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

- Caution: Lamp may become very hot.

Consider

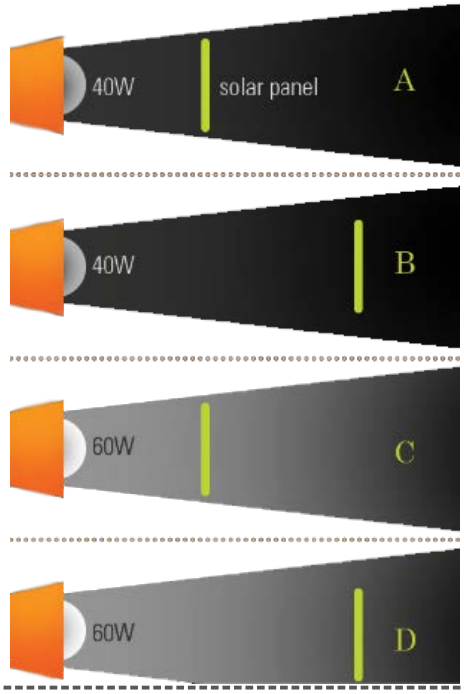
1. Which position will result in the greatest number of photons reaching the solar panel?

   a) Picture A

   b) Picture B

   c) Picture C

   d) Picture D



2. Predict the change in voltage produced when a light source moves farther away from the panel:

   a) Voltage will increase

   b) Voltage will decrease

   c) Voltage will not change

3. Which allows the highest number of photons to reach you?

   a) A walk in a forest

   b) A day at the movies

   c) A day in a museum

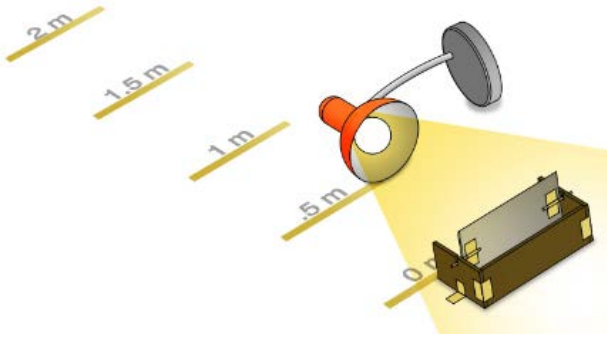
   d) A nap on a beach

4. Predict the relationship between light power (bulb wattage) and panel voltage produced:

   a) Higher light power = higher panel voltage

   b) Higher light power = higher panel voltage

   c) Light power has no effect on panel voltage



Investigate

1. Connect the voltage sensor. Build a digits display for voltage. Use **Help (?)** if necessary.

2. Work in a minimum 3 m x 3 m space.

3. Mark the following distances in a straight line: 0 m, 0.5 m, 1 m, 1.5 m, 2 m.

4. Place the solar panel in the holder you built in a previous activity. Rotate the cell to 90^0. Line up the cell at 0 m as shown.

5. Place the lamp at 0.5 m, shining towards the panel as shown.

6. Insert banana plug leads into the sensor if necessary. Use red for (+) and black for (-). Use the alligator clips to attach the solar panel wires to the voltage sensor. Match colors.

7. Enter the bulb wattage for Run 1 in Table 1.

Table 1: Bulb Power

Run #	Bulb Power (W)
1	
2	

8. Turn on the lamp. Turn off all classroom lights, close doors, and cover windows if possible. Let the lamp warm up for 1 minute.

9. Start collecting data. Measure voltage at each distance for Run 1. Record results in Table 2. Avoid touching the hot bulb.

Table 2: Voltage at Increasing Light Distance

Distance (m)	Run 1 Voltage (V)	Run 2 Voltage (V)
0.5		
1.0		
1.5		
2.0		

10. Stop collecting data after recording voltage at 2 m. Turn off the lamp and let it cool for a few minutes.

11. Trade your lamp with a group that used a different bulb wattage. Enter wattage for Run 2 in Table 1.

12. Turn on the new lamp. Let it warm up for 1 minute.

13. Start collecting data. Measure voltage at each distance for Run 2. Record results in Table 2.

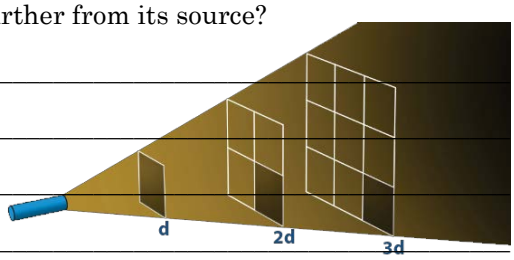
14. Stop collecting data.

Analyze

1. How does light distance affect voltage produced? Does this match your prediction? Support your answer with data.

2. How does bulb wattage affect voltage produced? Does this match your prediction? Support your answer with data.

3. Study the picture. What happens to light as it moves farther from its source?



4. What happens to the number of photons that land on the solar panel as you move the light farther away from the solar panel?

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5. Why is it important to maximize the number of photons that land on a solar panel?

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Extend

The sun is on average 149,600,000,000 meters from Earth. To give you an idea of how big that number is, you would need to eat over 450 pieces of candy every second of every day for over 10 years to eat a total of 149,600,000,000 pieces of candy. Write a testable question to determine if changing solar panel distance from the sun has an impact on voltage produced. Design and conduct an experiment to answer your testable question.