

The Effect of Shade on a Solar Panel

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**Educational Goals:**

• Students will use the Scientific Process to perform the experiment.

• Students will collect and analyze data.

• Students will observe the photovoltaic effect of sunlight and artificial light producing electricity.

• Students will learn how both overcast and shade affect solar panels.

• Students will use the Internet to research lesson related topics.

**Learning outcomes:**

Students are shown that shade from trees, clouds and man-made objects can cause a disproportionate decrease in power output and can even cause physical damage to a solar panel.

Students come to understand that:

1. Shade is like turning off an internal power switch that shuts off most of the power to the rest of the solar panel.

2. Solar panels can be damaged by shade if they do not have the appropriate internal protection.

3. Solar panels on space satellites must always be repositioned to face the sun at all times regardless of satellite orientation.

**Time**: about 1 hour.

**Materials Needed:**

1 - Solar panel

1 - Goose neck table lamp

1 - 100 ohm potentiometer

2 – Red hookup lead

2 – Black hookup lead

1 – Circuit Board Module Base

1 – Translucent sheet of paper

1 – Kleenex or Tissue

**Directions:**

1. Set the potentiometer to 10 ohms.

2. Set the multimeter dial to DC Volts with a range of at least 5 VDC.

3. Set the table lamp above the solar panel and turn on the light – or place the panel in direct sunlight which is best.

4. Record the voltage.

5. Place a single sheet of facial tissue between the light source and the solar panel in order to shade the entire panel but have enough low light shining on the panel as if it were an overcast day.

6. Record the voltage.

7. Remove the facial tissue.

8. Apply a regular piece of paper directly over one fourth ( ¼ ) of the solar panel to cover that portion completely. Refer to Figure 1.

9. Record the voltage.

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| --- | --- | --- | --- |
| **Steps** | **Volts** | **Amps** | **Watts** |
| **Full light** |  |  |  |
| **Overcast** |  |  |  |
| **Shading** |  |  |  |

**Analyzing the Results**

Have the students use the power data in the table to compute the percentage of power loss due to normal overcast and then to partial shading. Here is an example of how to do this:

% Power Loss = (Overcast / Full Light) \* 100%

% Power Loss = (Shading / Full Light) \* 100%

**Interpretation:**

Tell students to think of the solar panel as made up of several solar cells wired in series (which it is). When one solar cell is shaded it cuts off power to the other cells. This is like the lights on a Holiday Tree; when one light goes out, the entire string of lights go out. Here is an illustration of what the inside of a solar panel looks like. Each yellow star represents a solar cell with light shining on it. When all the cells are illuminated it’s like having an uninterrupted circuit with all the switches ON.



Here is an illustration of what happens when just one solar cell is shaded. The entire circuit is broken and no electricity can flow. What’s worse is the solar cells that are illuminated get hot trying to find a path for their built-up energy. This damages the solar cells that are illuminated and eventually damages the entire solar panel.



**Reflection: What If ?**

Have students speculate on the following hypothetical questions.

What if you were a spacecraft engineer and you had to make sure that the solar panels on the satellite you were designing would always face the sun as the satellite orbited around the Earth. This would provide the satellite electronics with full power at all times and not damage the solar panel. You can assume that the solar panels can be moved with motors. Look at the satellite in the photo below and notice that half of the solar panels are illuminated and half are shaded. Can you figure out a way to make them all face the sun?



What if you had a solar panel on your house or apartment and it snowed on it. What do you think will happen to the power output when the sun comes out again? How about when the sun melts some of the snow but not all of it?

 