

The Effect of TILT Angle on Solar Panels

**By Zai Vang (zaivang@live.com)**

­­­­­­­­­­­­­­­­­

**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 tilt angle affects solar panel power output.

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

**Learning outcomes:**

Students are shown that the angle at which a solar panel is oriented towards its light source is directly proportional to its ability to produce usable power.

Students come to understand that:

1. Solar panels must be oriented at the proper angle to the light source for maximum electrical output.

2. Orienting large commercial solar panels outdoors is based on both geographical location and the season of the year.

3. A device called a Sun Tracker can keep solar panels correctly oriented at the sun all day long in order to generate the most power.

**Time:** about 1 hour

**Materials Needed:**

1 - Solar panel

1 – Goose neck table lamp

1 - 100 ohm potentiometer

1 – Protractor (for measuring tilt angle)

2 – Red hookup lead

2 – Black hookup lead

1 – Circuit Board Module Base

**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. Students adjust the solar panel tilt angle in seven positions from 90 angular degrees to 0 degrees in 15 degree steps. At each setting the voltage is recorded.

4. Set the table lamp at about a 45 degree tilt as it shines on the solar panel when the solar panel is vertical. Do not move the table lamp for the other solar panel settings.

5. Use the protractor to set the solar panel at a 90 degree angle (vertical to the table) and record the voltage.

6. Change the angle of the solar panel to each of the next settings of 75, 60, 45, 30, 15 and 0 degrees and record the voltage and amps at each setting. Derive Watts by multiplying volts and amps together.

|  |  |  |  |
| --- | --- | --- | --- |
| Angles | Volts | Amps | Watts |
| 90 |  |  |  |
| 75 |  |  |  |
| 60 |  |  |  |
| 45 |  |  |  |
| 30 |  |  |  |
| 15 |  |  |  |
| 0 |  |  |  |

**Analyzing the Results**

Using the data in the table, have the students make a graph that plots the voltage, current and power (vertical axis) against the tilt angle (horizontal axis).

As expected the maximum voltage, current and power are generated when the angle of the solar panel matches the angle of the light source.

**Reflection: What IF?**

Have students speculate on the following hypothetical questions.

1. What if your class decided to mount a large solar panel on your school property? What “fixed” tilt angle would be best for getting the most power from the sun? The answer depends on two things:

 - the geographical location of your school

 (To find your school’s latitude (and longitude) go to the following web link

 <http://itouchmap.com/latlong.html> and enter your school’s address.)

 - the time of year.

2- To absorb the maximum amount of energy from the sun throughout the day, what do engineers have to make sure of?

**Remember:** The graph below shows the sun angle on the Earth for September (Autumnal Equinox), December (Winter Solstice), March (Vernal Equinox) and June (Summer Solstice). This would mean a different tilt angle at different times of the year.

