

**Background:** We learned in the tilt and azimuth lab that indeed, that at all tilts (except a zero degree tilt) more energy is converted to volts when a solar panel is south facing. We also learned from True South Solar that a 32 degree tilt is ideal to average annual solar gains.

**Question:** How is the amount of electricity harvested from a solar panel affected by the intensity of the sun hitting the solar panel?

**Hypothesis:**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Materials Per Group:**

Heat lamp 1 volt solar panel Multimeter Tape

12” Ruler Graph paper Colored pencils (for graphing)

4” sq. cardboard 4” sq. card stock 4” sq. clear bubble wrap

4” sq. copy paper 4” sq. waxed paper 4” sq. tissue paper

**Procedure:**

1) Set the heat lamp up so that it is 12” off the ground (or table) and is perpendicular with the floor (or table). The heat lamp represents the sun.

2) Place the solar panel flat on the ground or table so that it is centered on the heat lamp bulb.

3) Attach the red clip on the multimeter to the red wire on the solar panel and the black clip on the multimeter to the black wire on the solar panel. Turn the multimeter to the setting V$∼$ 200. Keeping the solar panel flat. (Note: This is your baseline reading.) Record the reading on Table 1.

4) Place the screen over ¼ of the solar panel. (Use the markings on the solar panel to control the quantity of the solar panel covered each time - see diagram below.) Record the voltage reading on Table 1.

5) Place the screen over 1/2 of the solar panel. (Use the markings on the solar panel to control the quantity of the solar panel covered each time - see diagram below.) Record the voltage reading on Table 1.

6) Place the screen over 3/4 of the solar panel. (Use the markings on the solar panel to control the quantity of the solar panel covered each time - see diagram below.) Record the voltage reading on Table 1.

7) Place the screen over all of the solar panel. (Use the markings on the solar panel to control the quantity of the solar panel covered each time - see diagram below.) Record the voltage reading on Table 1.

8) Repeat steps 5-7 with the tissue paper, waxed paper, copy paper, and paperboard.

**Data Collection:**

Table 1. Voltage at various shade intensities.

|  |  |
| --- | --- |
|  | **Volts Per Paper Type and Coverage** |
| **No paper (baseline)** |  |
|  | **1/4** |  **1/2** | **3/4** | **4/4** |
| **Tissue Paper** |  |  |  |  |
| **Waxed Paper** |  |  |  |  |
| **Clear Bubble Wrap** |  |  |  |  |
| **Copy Paper** |  |  |  |  |
| **Card stock** |  |  |  |  |
| **Cardboard** |  |  |  |  |

**On a seperate piece of graph paper:**

1. **Create a bar graph that represents the relationship between the volts and material at each coverage. (Volts should be on the *y*-axis and paper type and coverage should be along the *x*-axis.)**

What do you notice about the data?

**Conclusion:**

***Remember to include the question in your answer, use complete thoughts and descriptions, and to punctuate.***

1) What was the overall purpose of this experiment?

2) Overall, how is voltage output affected by coverage?

3) Describe how voltage output is affected by each type and quantity of shade.

 Tissue Paper:

 Waxed Paper:

 Bubble Wrap:

 Copy paper:

 Card Stock:

Cardboard:

4) Based on the data, is there a change in sun exposure that has a greater impact on output than another? Explain.

5) Describe what environmental (weather, shade from vegetation or buildings, etc. that each of these materials could represent. (Bullet points / brief descriptions are acceptable.)

 Tissue Paper: Waxed Paper:

 Bubble Wrap: Copy paper:

 Card Stock: Cardboard:

8) Was your hypothesis supported by data? Why or why not?

10) Where could errors in your data collection occurred?

11) How could this experiment be improved?

12) What could be studied next (related to variables that impact voltage output)?