



# Watts On Your Mind?

Solar energy educational activities for schools

## Activity Overview

Grade Level: Varies

Activity: WOS-7

## General Description

Students will look at graphs of the power output of a solar energy system and will make inferences about the weather.

## Learning Outcome

Students will learn how to read a line graph and will understand that solar energy production is dependent upon the weather.

## Subjects

Science, math

## Process Skills

Observation, inference

## Duration

30 minutes

## Key Vocabulary

Overcast, partly cloudy, sunny

## Curriculum Standards Addressed

Texas (TEKS)

112.2.a.4

Louisiana (LSCS)

ESS-E-B5

Arkansas (ASCF)

3.1.4

National (AAAS Project 2061)

The Physical Setting – 2<sup>nd</sup>

## Exploring Solar Energy Data

### Materials

- Computer with Internet access or Watts On Schools Data Acquisition System (DAS) to obtain 15-minute or hourly graphs of solar energy system power over several days

### Method

1. The teacher will conduct a discussion about the solar energy system at the school, asking students to discuss what would happen on a sunny day, a partly cloudy day, and an overcast day.
2. The teacher instructs students in how to make a chart of solar energy production over time.
3. The teacher obtains and presents to students a time-series plot of the power produced by the school's solar energy system over 3-7 days (this can be obtained from the DAS or the Watts On Schools website—[www.wattsonschoools.com](http://www.wattsonschoools.com)).
4. Students are asked to make inferences about the weather during each day. The following questions can be used to guide students' thinking:
  - Was the day sunny, partly cloudy, or overcast?
  - Did the weather change at some point during the day? If so, how?
5. Directed by the teacher, students discuss their findings with the class.

### Discussion

The performance of the school's solar energy system at any given time depends primarily on the amount of sunlight available to it. On bright, sunny days, the



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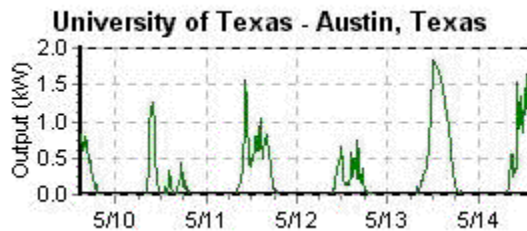
system gradually produces more and more energy throughout the day until the sun is directly overhead. A graph showing the energy production of the solar system (y-axis) over time (x-axis) on a sunny day will resemble a smooth, tall, bell shaped curve.

On consistently overcast days, the curve will have the same width but will be much lower, showing that the system produced less energy throughout the day.

And on partly cloudy days, with patches of clouds intermingled with bright sun, the curve will no longer be smooth, but instead will tend to be bumpy or spiky, showing that the system produces more energy during sunny periods and less energy during cloudy periods.

This exercise is intended to give both teachers and students experience with connecting to the solar energy system with the DAS or with the Watts On Schools website. Graphs of the system's power output over the past several days (like the one shown in the example below) are available by either method.

## **Example 1. Solar energy production graph available from website ([www.wattsonschoools.com](http://www.wattsonschoools.com)).**



Using current graphs from the DAS or website, students can make inferences about the weather conditions on that day. In Example 1, above, the only day that appears to have been consistently sunny was 5/13, and even then the morning looks like it may have been overcast for a while before the sun came out. Energy production peaked at about 1.8 kW on this day. 5/10 had some bright sunshine in the early morning, and then became very overcast, resulting in almost no energy production for the rest of the day (though it appears there were two times when the sun poked through the clouds for a short while). 5/11 was a brighter day overall, but energy production still appeared spiky throughout the day, indicating a partly cloudy day. The highest energy output on 5/12 was only about 0.75 kW; given that on the very next day energy production reached about 1.8 kW, we can assume that the sun never really came out at all on 5/12, even though there were some periods when it was brighter than others.

Students should be encouraged to discuss or write about each day on the plot in small groups. Students should be reminded that the graph is not a graph of weather or sunlight, but of the power production of the solar energy system. Although a plot of sunlight would look very much the same, an important lesson is that we are able to gain knowledge about something we are interested in (in this case, the weather) by observing other easily observable phenomena (solar energy output) that are related to what we are interested in (again, the weather).



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When encouraged to make observations about the weather, students often will try to relate temperature to the energy production of the solar system. Although there is a relationship between temperature and energy production, it is not strong, and in fact the relationship is inverse (when other variables are controlled, the colder the temperature, the higher the energy production). It should at least be pointed out to students that graphs of energy output tell us far more about the amount of sunlight falling on the system than they tell us about the temperature (after all, there can be lots of sunlight on very cold days, too).

A variation on this activity is to assign different groups of students a chart from a different school (obtained from the website), and have each group find the needed chart on the website.

## **Assessment**

Student performance on this activity can be assessed in a number of ways, depending on how the activity is implemented. Students can be evaluated on their ability to work with others in small groups.

Source: This activity created by CSGServices.