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SCHOOLGEN ACTIVITIES **LEVELS 3-4**

HOW THE SUN'S POSITION AFFECTS SOLAR ELECTRICITY GENERATION

Teacher-led Activity

In this activity, the students will process and interpret the electricity generation data from the PV panels. They will then use a model to explore the correlations between the generation of solar electricity and the position of the Earth in relation to the sun.

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1. LEARNING AREAS: Science

2. CURRICULUM LEVELS: 3–4

3. AIM OF THE ACTIVITY

When interpreting electricity generation data from the PV panels, students will identify a consistently high level of electricity generated around midday, when the sun reaches meridian. This activity gives students an opportunity to process and interpret the electricity generation data from the Schoolgen website (http://www.schoolgen.co.nz/ss/default.aspx) and suggest explanations for this pattern. Students will then use a model to explore the correlations between the generation of solar electricity through the PV panels and the position of the Earth in relation to the sun at specific times during the day. Students will also reflect on the impact of the greater intensity of solar energy at this time and how this relates to Sun Safety messages.

4. INTENDED LEARNING OUTCOMES

The students will be able to:

- Interpret graphs and data to identify trends in solar electricity generation
- Explain the reason for recurring increases and decreases in electricity generation throughout the day, and the peak in generation around meridian
- Use the term 'meridian', demonstrating their understanding that meridian is the point at which the sun reaches its highest altitude in the sky
- Demonstrate their understanding that the consistent increase in solar electricity generation during meridian is due to the sun's energy being at its highest level of intensity.

5. CURRICULUM ACHIEVEMENT OBJECTIVES

- Science Levels 3–4 (PEB): Investigate the cause, rate, and signs of change of natural features
- Science Levels 3–4 (PW): Use some scientific ideas to explain physical phenomena, such as light and heat
- Science Levels 3–4 (PW): Consider, describe and represent patterns and trends in physical phenomena and use simple scientific models
- Maths Measurement: 3.1, 4.1, 4.3; Statistics: 3.4, 3.2, 4.4, 4.5.

6. WHAT YOU NEED

- A computer with an internet connection
- Printed copies of the Data Chart at the end of this activity
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- A container with pump spray nozzle
- Dye
- A large sheet of paper or card, at least 1 m^2
- A measuring tape
- Two 1 m lengths of string

HOW THE SUN'S POSITION AFFECTS SOLAR ELECTRICITY GENERATION

7. FOCUS

Ask the students questions like:

- Is electricity generation constant throughout the day?
- What could affect how quickly solar panels generate power?
- What time of day would you expect the highest generation and why?
- How could we measure this?
- Could we graph how much electricity is generated at different times of the day – what might this look like?

8. MANAGING THE ACTIVITIES

Experiment 1: Processing and Interpreting Electricity Generation Data

Level 4 students could be presented with the task of designing this data gathering process themselves.

(i) Over the period of a week, at the conclusion of each day, arrange for a small group of students to download the data from the Schoolgen website (http://www.schoolgen.co.nz/ss/default.aspx) showing the hourly record of electricity generated from your or another school's PV panel. This data should then be entered into the Data Chart.

(ii) At the beginning of the next week, divide the students into small groups and distribute copies of the completed Data Chart to each group

(iii) Ask the students in each group to add up the total electricity generated for each hour over the week, and ask them to record this on their Data Chart (Level 4 students could create their own chart)

(iv) Ask the students to calculate the average amount of electricity generated at these hourly intervals over the week

(v) Ask the students to draw a graph showing the week's hourly averages (students could use the Data Graph)

(vi) To help the students analyse the data, the following questions could be asked:
  (a) On average, what time of the day is more electricity generated?
  (b) Why do you think this is?

(vii) Draw the students' attention to the term 'meridian'. Discuss its meaning, drawing upon their knowledge of p.m. and a.m. (ante meridian and post meridiem).

Experiment 2: Correlation Between Solar Electricity and the Position of the Earth

Either working with the whole class or dividing the students into groups, conduct the following investigation. It may be wise to protect floors with newspaper or to conduct this demonstration outside. Ensure all the students are standing behind the direction of the spray. Ask the students to:

(i) Fill the container with a dark coloured dye and secure the spray nozzle

(ii) Spread two large sheets of paper on the floor

(iii) On each sheet draw a large circle 1 m in diameter

(iv) Pin one end of each 1 m string to the centre point of each circle

HOW THE SUN'S POSITION AFFECTS SOLAR ELECTRICITY GENERATION

(v) With one piece of string, hold the loose end so the string is tight and on a 30 degree angle from the centre of the circle (it should be about 50 cm off the floor – see Figure 1). Hold the nozzle of the container next to the end of the string. The nozzle represents the sun's position at approximately 8:30 am in September.

(vi) Point the nozzle towards the centre of the circle and give one spray of the dye. The result is that the dye should look dispersed but light on the paper.

(vii) Repeat this exercise on the second sheet of paper. This time hold the loose string end straight up from the centre of the circle. Hold the nozzle of the container next to the end of the string. The nozzle represents the sun's position at meridian in September (see Figure 2). Point the nozzle straight down towards the centre of the circle, and spray once. The result is that the dye should cover a smaller area but look heavier.

(viii) Consider what can be inferred about the intensity of the sun's rays at these times of the day by comparing the intensity of the dye's dispersion over the paper

(ix) Consider what correlations can be made between the generation of solar electricity through the PV panels and the position of the Earth (at the location of the PV panel) in relation to the sun during the day.

Figure 1

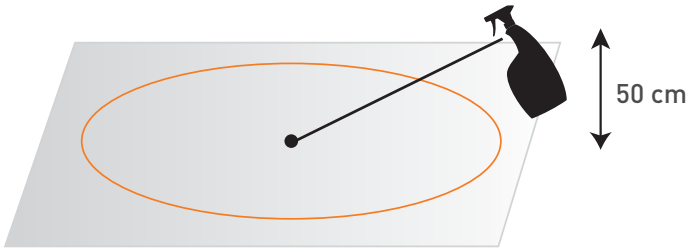
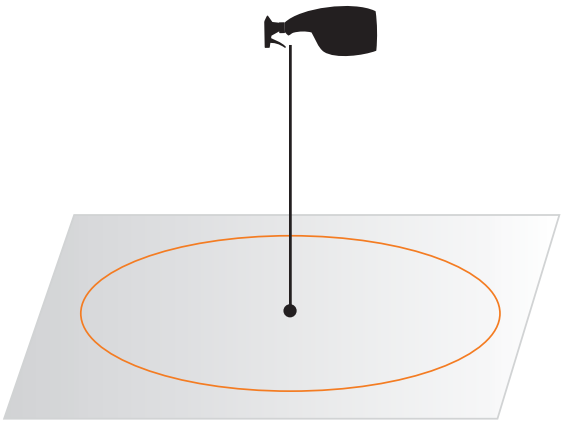


Figure 2



HOW THE SUN'S POSITION AFFECTS SOLAR ELECTRICITY GENERATION

9. REFLECTION

- Can the students account for factors, such as weather, that may contribute to inconsistency in electricity generation on some days, when compared to other days in the week?
- How might daylight saving shift New Zealand's midday from true meridian?

10. EXTENSION

- Arrange for the class to keep a record of the daily burn time warnings published in the newspaper or on the internet (go to http://www.sunsmart.org.nz/uv-radiation--index/ultraviolet-radiation-(uvr).aspx)
- Compare the burn time information with your electricity generation data. Reflect on how the two may relate. (Note: PV cells are not powered by UV radiation.)

11. SAFETY GUIDE

Ensure the students wear adequate sun-protection if conducting the exploration outdoors.

12. RESOURCES

Ministry of Education, *Building Science Concepts Book 29: Solar Energy – Sun Power on Earth*, Learning Media, Wellington, 2003

HOW THE SUN'S POSITION AFFECTS SOLAR ELECTRICITY GENERATION

DATA CHART: ELECTRICITY GENERATED BY SCHOOLGEN PV SOLAR PANELS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	TOTALS	AVERAGE
DATE							
6am							
7am							
8am							
9am							
10am							
11am							
12pm							
1pm							
2pm							
3pm							
4pm							
5pm							
6pm							
7pm							
8pm							

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DATA GRAPH: AVERAGE WEEKDAY ELECTRICITY GENERATION DATA

For: _____

(name of school)