

## LESSON INQUIRY QUESTION

# How alike are plants and solar panels?

## LESSON CHALLENGE

Select the most important similarities and differences between plants and solar panels.

### Broad understanding

Students will understand that plants and solar panels are similar and different in how they transform energy from the sun.

### THINKING TOOLS



#### Background knowledge

- photovoltaic (PV) cells
- photosynthesis



#### Critical thinking vocabulary

- similarity and difference
- criteria



#### Criteria for judgment

- criteria for an important similarity or difference



#### Thinking strategies

- organizing information
- supporting ideas with evidence



#### Habits of mind

- attentive to detail

### SUMMARY

In this lesson, students learn how a solar panel turns energy from the sun into electricity. To begin the lesson, students identify possible similarities and differences between plants and solar panels. Students use their initial ideas to develop the criteria for judging similarities and differences. Students then use the criteria to compare how plants and solar panels transform energy from the sun. Students then select the three most important similarities and differences between plants and solar panels. To conclude the lesson, students rate the degree to which plants and solar panels are alike.

### MATERIALS

#### Activity sheets

- Thinking About Plants and Solar Panels (Activity sheet A)
- Comparing Plants and Solar Panels (Activity sheet B)

#### Briefing sheets

- How Do Plants and Solar Panels Use Energy from the Sun? (Briefing sheet A)

#### Image sets

- Plant and Solar Panel (Image set A)

#### Assessment materials

- Assessing My Ability to Select Important Similarities and Differences (Assessment materials A)

## LEARNING ACTIVITIES

**Introduce the criteria**

1. Organize students into pairs and display *Plant and Solar Panel* (Image set A). Invite students to suggest how plants and solar panels might be similar and how they might be different.
2. Prompt groups to share their ideas with the class. At this point, encourage students to share all their suggestions, even if the ideas are inaccurate or very general. Note students' suggestions on chart paper or whiteboard for use later in the lesson.
3. Review the suggestions with students. Ask groups to select the three most important similarities and the three most important differences.
4. Invite groups to share their decisions and thinking with the class. As students share, ask them to reflect on their decisions: what made an important similarity? What made an important difference? Use students' ideas to co-develop or present the criteria for an important similarity and difference:
  - *Important similarity*: a main part, function, or effect that both objects have
  - *Important difference*: a main part, function, or effect that only one object has
5. Provide each student with *Thinking About Plants and Solar Panels* (Activity sheet A). Prompt students to note the criteria in the "Criteria for judging similarities and differences" section. Note the criteria on chart paper or a whiteboard for use later in this lesson.
6. Direct students' attention to the "My first thoughts" section of the activity sheet. Encourage students to now work on their own and to use the criteria to select the three most important similarities and the three most important differences. Again, encourage students to note their decisions on their activity sheet, even if their ideas are inaccurate or very general.
7. Share the lesson inquiry question, "How alike are plants and solar panels?" and the challenge, "Select the most important similarities and differences between plants and solar panels." Explain that they will use the criteria to select the three most important differences and similarities between plants and solar panels.

**Compare plants and solar panels**

1. Direct students' attention back to the lists of similarities and difference developed at the beginning of the lesson. Work with students to group common ideas and create categories. Examine the categories with students, inviting them to suggest what categories might be used to compare plants and solar panels. For example, groups might suggest that the structure of plants and solar panels could be compared. Other suggestions might include function of plants and solar panels, energy created, by-products/waste created.
2. Provide each student with a copy of *Comparing Plants and Solar Panels* (Activity sheet B). Draw students' attention to the horizontal lines on the Venn diagram; instruct students to note one category in each section of the diagram.
3. Guide students in using the diagram and the categories by selecting one of the similarities and one of the differences, then noting them in the correct section of the diagram. For example, "both use energy from the sun" could be noted as a similarity in the "function" category. "Plants are green" could be noted as a difference in the "appearance" category. If students require additional practice using the Venn diagram, considering sorting some of

## Compare plants and solar panels (Cont'd)

the similarities and differences noted at the beginning of the lesson.

**Identifying similarities and differences**

1. Organize students into small groups (2-4 students) and provide each group with a copy of *How Do Plants and Solar Panels Use Energy from the Sun?* (Briefing sheet A). Inform groups that their challenge is to identify similarities and differences between how solar panels and plants use energy from the sun.
2. Prompt students to note details from the briefing sheet in the appropriate section of the Venn diagram on their activity sheets.
3. Encourage groups to share the similarities and differences that they identified and noted. Invite groups to suggest which similarities and differences are the most important, reminding them to use the criteria to guide their thinking. Student responses might include:
  - Important similarities
    - » Plants and solar panels use chemical reactions to transform or change energy from the sun.
  - Important differences
    - » Plants require water and nutrients to use energy from the sun; solar panels do not require any other fuels.
    - » Plants can store the energy that they make from the sun; solar panels cannot store energy.
    - » Plants release or give off oxygen as part of photosynthesis; solar panels do not release or give off any waste when they convert energy from the sun into electricity.
4. Direct students to refer back to their copy of *Thinking About Plants and Solar Panels* (Activity sheet A), drawing their attention to the “My second thoughts” section of the activity sheet. Ask students to select the three most important similarities and the three most important differences. Remind them to use the criteria to guide their decision-making.

**Compare plants and solar panels**

1. Draw students’ attention to the “My final thoughts” section of *Thinking About Plants and Solar Panels* (Activity sheet A). Explain that their final task is to decide how similar or different plants and solar panels might be.
2. Invite students to work individually to note their decision on the scale found on the activity sheet. Prompt students to note any evidence that supports their decision at the bottom of the activity sheet. Remind them that evidence could come from the briefing sheet or from their Venn diagram.
3. Invite students to share their decisions and thinking with the class.

**Reflect on the learning**

1. Encourage students to reflect on the inquiry question: “How alike are plants and solar

## LEARNING ACTIVITIES

Reflect on the learning (Cont'd)

panels?” Consider inviting students to suggest how understanding how plants use energy from the sun can also help them understand how solar panels function.

### Assess the learning

1. Encourage students to use *Assessing My Ability to Select Important Similarities and Differences* (Assessment materials A) to self-assess their ability to identify important similarities and differences between plants and PV systems.

## Thinking About Plants and Solar Panels

### Criteria for judging similarities and differences

#### My first thoughts

Most important similarities

- 1.
- 2.
- 3.

Most important differences

- 1.
- 2.
- 3.

#### My second thoughts

Most important similarities

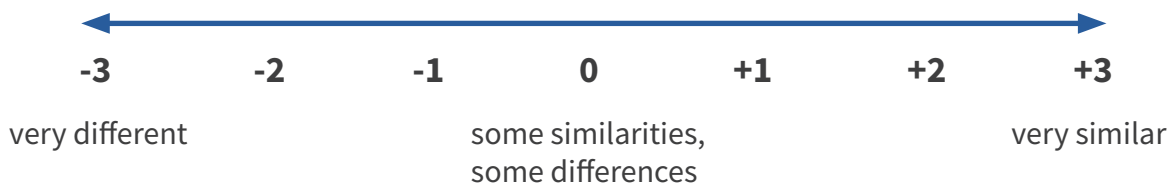
- 1.
- 2.
- 3.

Most important differences

- 1.
- 2.
- 3.

#### My final thoughts

Plants and solar panels are...



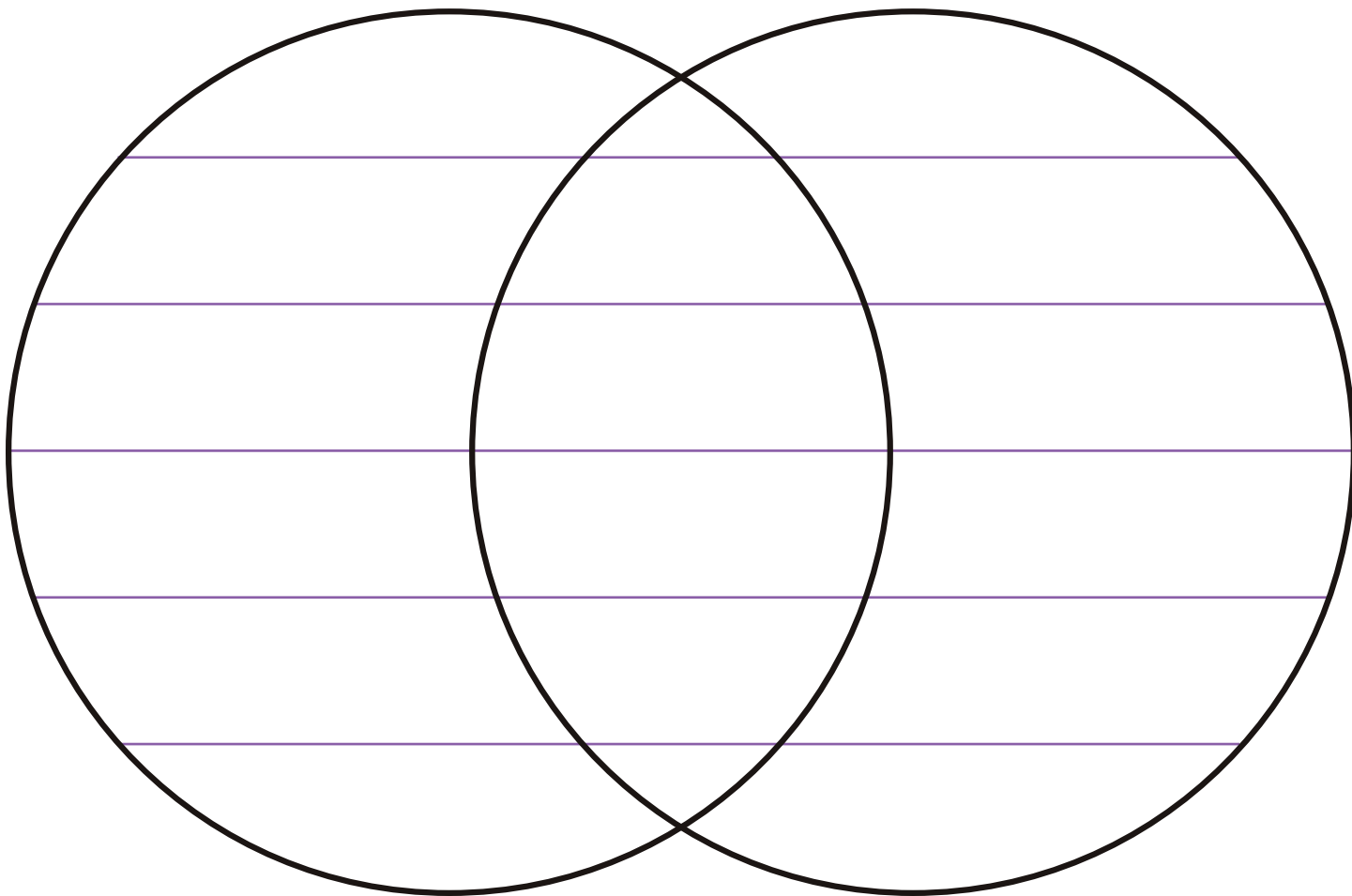
#### Reasons for my decision

- 1.
- 2.
- 3.

## Comparing Plants and Solar Panels

Plants

Solar panels



## How Do Plants and Solar Panels Use Energy from the Sun?

Plants and solar panels both use light from the sun to create energy. What are the most important similarities and differences?

### Converting energy from the sun

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Plants use sunlight to create the energy they need to grow and live. This process is called photosynthesis.</li> <li>• Photosynthesis is the process that green plants and some bacteria use to convert or change light energy into chemical energy.</li> <li>• Photosynthesis begins when a plant absorbs light from the sun.</li> <li>• Photosynthesis requires light, either from the sun or electric lights. Plants also need carbon dioxide and water for photosynthesis.</li> <li>• The leaves of plants are made up of many small cells. These cells contain many small structures that each have special functions that help the plant live. Chloroplasts in the plant cell contain chlorophyll. This is where photosynthesis occurs.</li> <li>• Photons, or particles of energy in sunlight, are absorbed by chlorophyll. The photons then cause a chemical reaction with molecules from the water and carbon dioxide. This reaction changes the water and carbon dioxide into glucose, a sugar the plant uses for food, and oxygen.</li> <li>• The glucose created by photosynthesis is then used by plant cells as energy for growing.</li> <li>• Plants produce oxygen as a byproduct of photosynthesis. This oxygen is used by other creatures to live.</li> </ul> | <ul style="list-style-type: none"> <li>• Solar panels use sunlight to create electricity. This process is called the photovoltaic effect.</li> <li>• The photovoltaic effect occurs when light energy is converted or changed into electrical energy.</li> <li>• The photovoltaic effect begins when light from the sun strikes a solar panel. Other than energy from the sun, solar panels do not need water or any other fuel to create electricity.</li> <li>• Most solar panels are made from silicon, a material that's found in sand and rock. Every solar panel is made up of many small photovoltaic (PV) cells.</li> <li>• Photons, or particles of energy in sunlight, react with electrons inside the PV cells. Electrons are very small particles with a negative charge of electricity. During the reaction between photons and electrons, photons give energy to the electrons. When electrons receive the energy, they move very quickly and create electric energy.</li> <li>• Solar panels do not emit or release any byproducts or pollution when they convert energy from the sun into electrical energy.</li> </ul> |
|--|---|

## How Do Plants and Solar Panels Use Energy from the Sun? (Cont'd)

Energy Output	
<ul style="list-style-type: none"> <li>Plants and organisms use photosynthesis to convert solar energy into chemical energy.</li> <li>In addition to using the oxygen created during photosynthesis, humans and other creatures use the energy in plants to grow and live. Whenever a person or animal eats a plant, they are actually consuming energy from the sun.</li> </ul>	<ul style="list-style-type: none"> <li>All the PV cells of a solar panel work together to produce larger amounts of electricity.</li> <li>The electricity generated by a solar panel is sent through wires to a solar energy system. The solar energy system changes the electricity into a form that can be used to power lights and other appliances.</li> <li>Whenever a person uses electricity generated by solar panel, they are actually using energy from the sun.</li> </ul>
Energy Storage	
<ul style="list-style-type: none"> <li>Plants can use the energy created by photosynthesis immediately, or store the energy and use it later.</li> </ul>	<ul style="list-style-type: none"> <li>The electricity made by solar panels must be used right away or stored in batteries.</li> </ul>



## Plant and Solar Panel



By 7834351/Pixabay

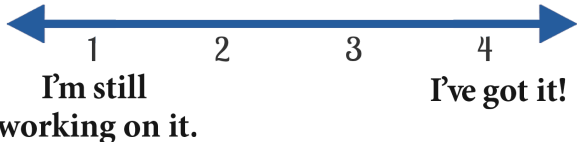
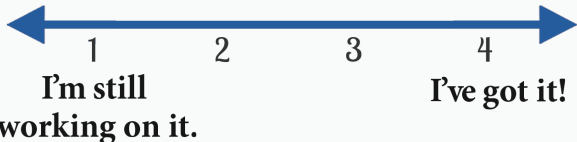


By skeeze/Pixabay

## Assessing My Ability to Select Important Similarities and Differences

Name: \_\_\_\_\_

1. Provide examples that show how you have met the success criteria.
2. Use the rating scale to indicate how well you have met the success criteria.
3. Describe the next steps in your learning.

Success criteria	How am I doing?
<p>I can describe important similarities and differences between plants and solar panels.</p> <p>Examples:</p>	 <p>Next steps (e.g., use criteria, ask for help):</p>
<p>I can decide how alike or different plants and solar panels are and support my ideas with evidence.</p> <p>Examples:</p>	 <p>Next steps (e.g., add more evidence, use criteria, ask for help):</p>