

Science Assessment Grounded in Equity: Unit 6.1 Lesson 6 Check and Connect Assessment



Task Table of Contents

- [About this Task](#)
- [Standards Emphasis](#)
- [Task Worksheet](#)
- [Teacher Instructions](#)
- [Feedback and Scoring Guidance](#)

About This Task

Task Name	How could a pyramid shaped solar cell produce 90% more solar energy than a traditional solar panel?	Grade Level or Course	6th grade
Phenomenon or Phenomenon Based Problem Description	The shape of solar panels affects how much light energy is captured.	Type of Phenomenon Everyday, Societally Relevant, Culturally Significant, Contemporary Scientific	Societally Relevant ▾
Task Description (from the learner perspective)	Learners are figuring out why the amount of light energy in a pyramid shaped solar panel would be higher than a flat solar panel.	Time Required & Materials	15 minutes
Profile of Identified Learner Population(s)	This task was written with Washington state teachers for a general population of middle school learners across Washington	Special Considerations Characteristics of the culturally and linguistically diverse groups that may introduce differential performance	This task requires learners to be able to make sense of schematics.



	experiencing OpenSciEd instructional materials.		
How is this task meant to be used? Mid Unit, instructionally embedded, End of Unit	Check and Connect ▾	What instruction or experiences should learners have before completing this task?	Learners should have opportunities to investigate light passing through magnifying glasses. They will be most successful if they participate in the lab in Lesson 3 of the OpenSciEd 6.1 unit, or at least analyze the results of the investigations.
Note(s)	Prompt #3 could be removed, or offered to those learners who are ready for extensions or enrichment.		
Adaptation Suggestion(s)	For learners who would like to investigate further renewable resources, there is an extension included with this check and connect.		

Standards Emphasis

Assessment is a balancing act involving multiple tradeoffs. No one task can do everything, and often good design carefully considers what *not* to assess. The targeted NGSS Performance Expectation and supporting dimensions are shown below. The parts of the standard not addressed in the task are ~~struck through~~. Each item in the task may target one or more of the dimensions - not every item has to assess every dimension. What matters is that the task as a whole addresses all three dimensions.

NGSS PE(s) Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. * (MS-PS 4-2)		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a model to describe unobservable mechanisms.	PS4.B: Electromagnetic Radiation The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.	Structure and Function Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.

Key Equity Feature(s)

Support Learning: Opportunity to Learn

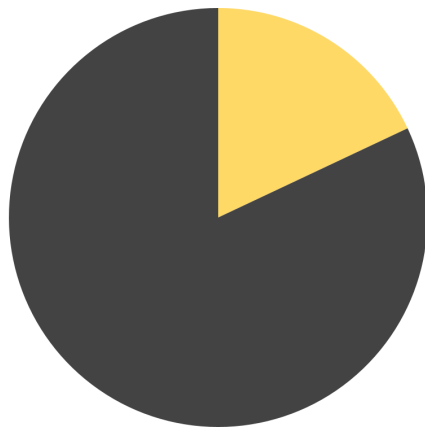
Task Worksheet

In 2022, a new clean energy law was passed for states in the Pacific Northwest, including Washington, Oregon and California. The new law requires that electricity is supplied using clean energy free from greenhouse gases by the year 2045. This means electricity must be supplied using cleaner sources like wind, water, geothermal, and solar.

Solar energy is already the clean energy source of electricity for many homes and businesses. Current solar panels are only 15-22% efficient. This means only 15-22% of the energy from the sun is captured and used to produce electricity.

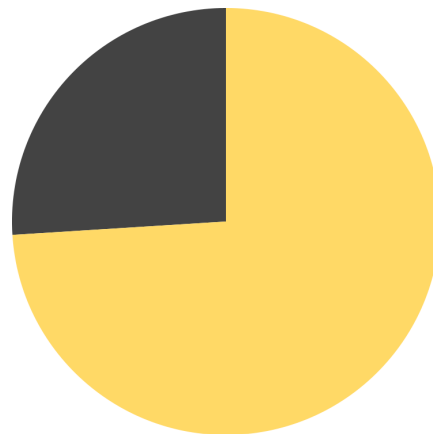
Researchers at Stanford University in California used their understanding of the relationship between structure and function and their understanding of properties of light to design a new 3 dimensional, pyramid-shaped solar panel. This new design can collect up to 90% more energy from the sun than current flat solar panels.

Solar Panel Efficiency: Flat



- Amount of Energy Captured
- Amount of Energy Not Captured

Solar Panel Efficiency: Pyramid

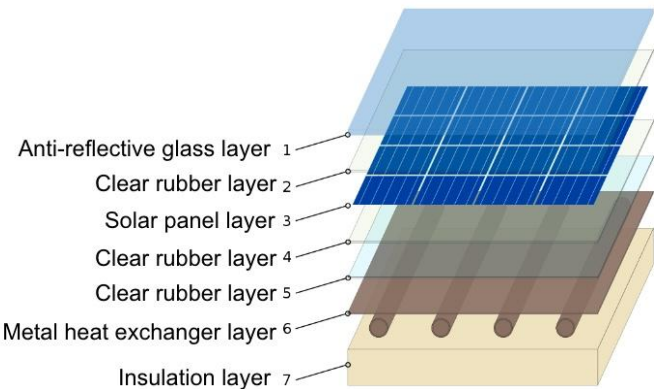


- Amount of Energy Captured
- Amount of Energy Not Captured

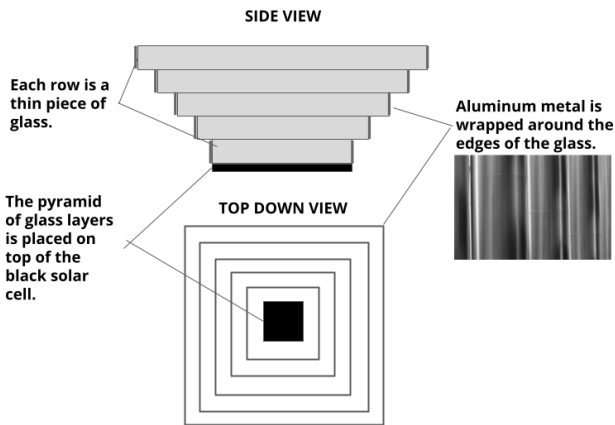
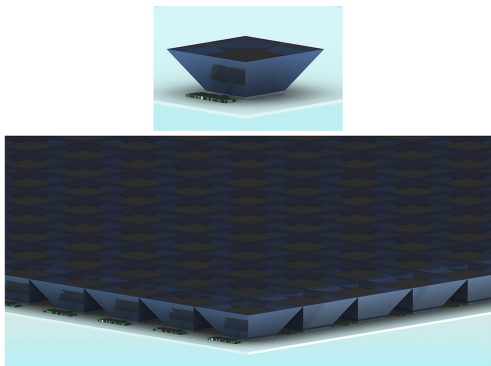
In this task, you will figure out how a pyramid shaped solar panel produces 90% more solar energy than a traditional solar panel.

Analyze the images below of the two types of solar panels.

Current 2-D Flat Solar Panel



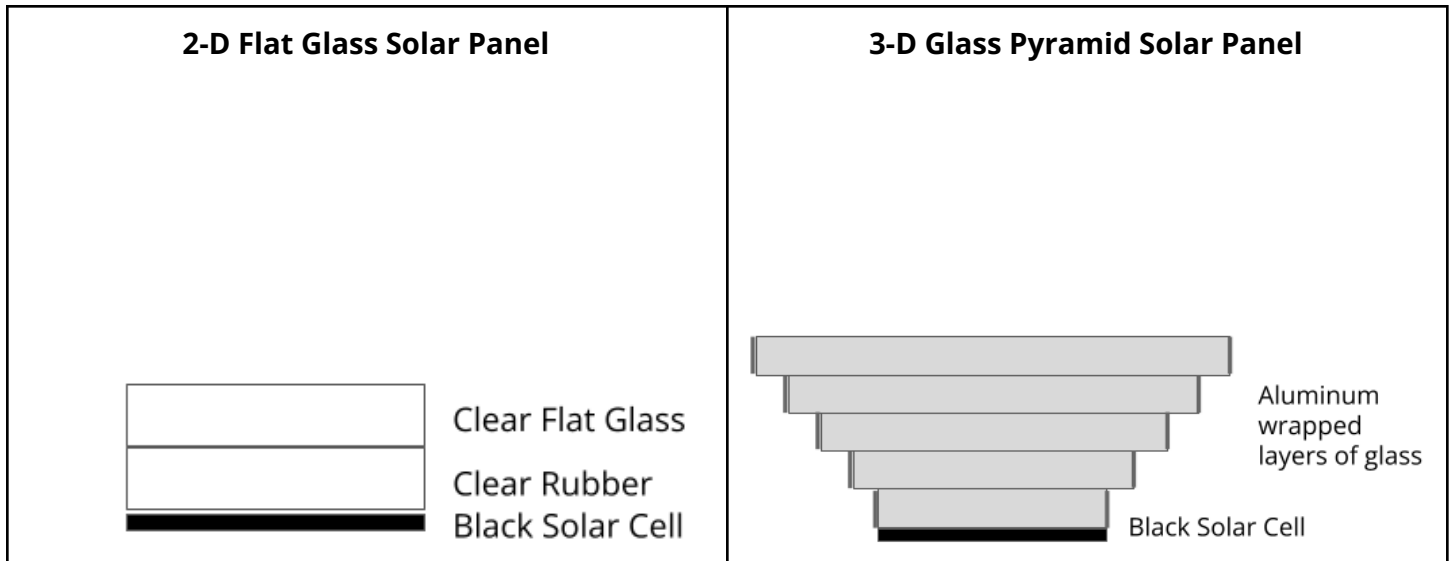
New 3-D Pyramid Solar Panel



1. What are some things you notice and wonder about these two different designs?

Notice	Wonder

2. **Why does the new pyramid solar panel collect more light rays than the current flat solar panel?** Develop a model to explain what happens when light interacts with the two solar panels. Your model should show how light rays reach the black solar cell.



3. **How would you describe the relationship between the structure of the two solar panels and how efficiently they function?**
4. **What type of data would you want to collect to determine if your model is correct?**
(lux readings at different times of day, temperature readings, etc.)

Extension:

The map to the right shows four places that get 99% or more of their energy from renewable sources.

- solar
- wind
- water
- geothermal (heat from inside earth)



Image by [andreas160578](#) from [Pixabay](#)



Image by [Hans](#) from [Pixabay](#)



Image by [Jan Tuomi](#) from [Pixabay](#)



Image by [soukmang](#) from [Pixabay](#)



Analyze the types of renewable energy sources used by the four places identified on the map. Then answer the questions below.

5. Think about where you live...**Have you seen any renewable energy resources used for energy? What are they?**
6. If your town wants to get more power from renewable resources, **which type of renewable source do you think would work best for where you are located? Why do you think this?**

7. What data would you collect or investigations would you do to determine whether this type of renewable source would be best for where your town is located?
8. What questions do you have that would help you figure out more about renewable resources that would work best for your location?

Teacher Instructions

This Check And Connect has been created as a way to collect evidence of learner’s sensemaking about reflection and refraction. Prior to this assessment opportunity, learners will have figured out that in addition to transmitting and reflecting, light refracts through different materials at different amounts. They will have collected evidence that light refracts through a magnifying glass at different amounts depending on the intensity of the light and the distance of the light from the magnifying glass. This check and connect can be used to see if they can apply what they have figured out to a new, somewhat similar phenomenon.

Feedback and Scoring Guidance

The **highlighted responses** below are the ideal expected responses from learners.

1. What are some things you notice and wonder about these two different designs?

Notice	Wonder
Accept all responses.	Accept all responses.

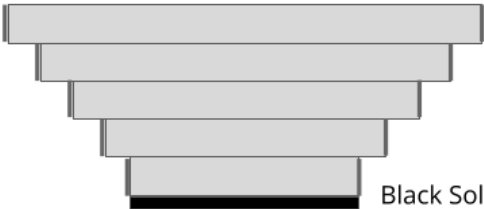
2. Why does the new pyramid solar panel collect more light rays than the current flat solar panel? Develop a model to explain what happens when light interacts with the two solar panels. Your model should show how light rays reach the black solar cell.

2-D Flat Glass Solar Panel

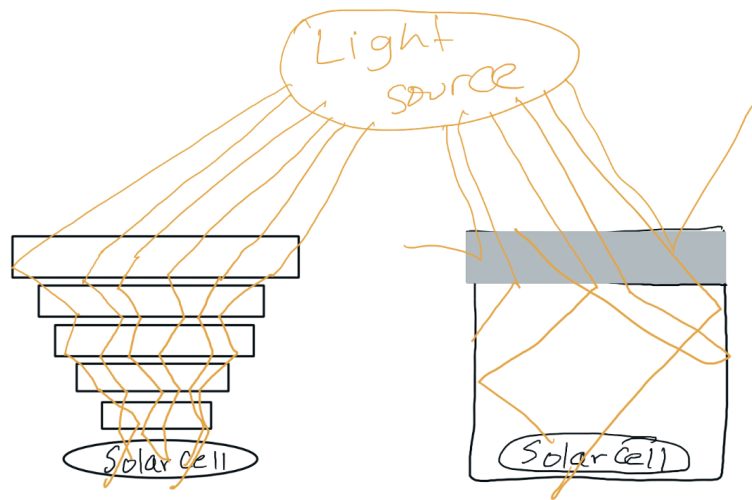


Clear Flat Glass
Clear Rubber
Black Solar Cell

3-D Glass Pyramid Solar Panel



Aluminum wrapped layers of glass
Black Solar Cell



3. How would you describe the relationship between the structure of the two solar panels and how efficiently they function?

The pyramid shape of the glass allows more light to be reflected and refracted towards the solar cell. The more light that reaches the solar cell, the more energy. The flat solar panel reflects away a lot of the solar light. When this happens, the light doesn't reach the solar cell. If the light doesn't reach the solar cell, then there will not be any energy for electricity. Since the pyramid shaped solar cell has many glass pieces for light to be reflected and refracted towards the center of the shape, more energy reaches the solar cell.

4. What type of data would you want to collect to determine if your model is correct?
(lux readings at different times of day, temperature readings, etc.)

Some possible responses might include:

- The lux reading of light at the solar cell for each type of solar panel.
- Comparisons of the lux readings at different times of the day, and the year.
- Data about how long places with these different types of solar panels had electricity and if they ran out ever.

Extension:

The map to the right shows four places that get 99% or more of their energy from renewable sources.

- solar
- wind
- water
- geothermal (heat from inside earth)



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Analyze the types of renewable energy sources used by the four places identified on the map. Then answer the questions below.

5. Think about where you live...**Have you seen any renewable energy resources used for energy? What are they?**

Accept any answers here.

6. If your town wants to get more power from renewable resources, **which type of renewable source do you think would work best for where you are located? Why do you think this?**

Accept any answers here. Look for learners to suggest renewable resources connected to the types of experiences they have had with local land/weather. For example if they have a lot of windy days, they may suggest wind power. Or if there are a lot of water locations near them, they may suggest water power.

7. What data would you collect or investigations would you do to determine whether this type of renewable source would be best for where your town is located?

Look for learners to want data about:

Number of windy days
Strength of the wind in their area
Strength of the moving water near them
Number of sunny days
Angle of the sun over time in their area
Temperature underground in their area

8. What questions do you have that would help you figure out more about renewable resources that would work best for your location?

Accept all answers here.

Resources:

<https://www.commerce.wa.gov/growing-the-economy/energy/ceta/>

<https://www.pacificorp.com/energy/washington-clean-energy-transformation-act-equity.html>

<https://worldsmartcities.org/5-places-running-on-100-renewable-energy/#:~:text=Iceland%20is%20a%20country%20running%20on%20100%25%20renewable%20energy>