

An NGSS-Aligned Engineering Design Lesson on Solar Energy and Human Sustainability (Resource Exchange)

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Jenny Valdez is a Geoscience H and AP Environmental Science teacher at the Las Vegas Academy of the Arts in Nevada. She has a bachelor's degree in Secondary Education with an Emphasis in General Science from the University of Nevada, Las Vegas. She also has a master's degree in School Counseling from Touro University, Nevada.

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Target Grade: 10-12

Overview

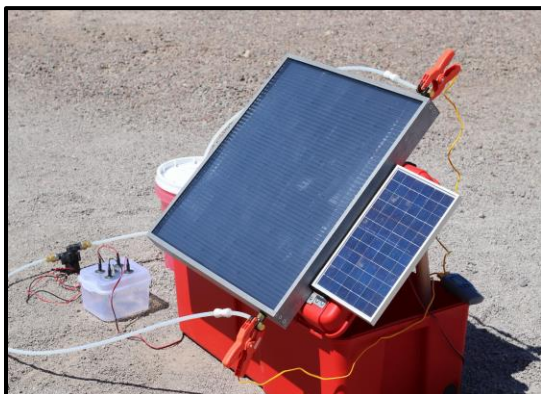
This Next Generation Science Standard (NGSS) aligned lesson helps high school geoscience teachers meet performance expectations on human sustainability while incorporating the engineering design process into their curriculum. Over the course of 8 days, students learn about solar energy, learn how to operate a solar thermal water heater, and then work in teams to design, build and test their own thermal panels. This lesson also includes an introductory engineering design lesson for students and teachers who are not yet familiar with the engineering design process. Working with a solar thermal water heater exposes students to technology that is often not part of a traditional science curriculum.

Featured Activity	Question	Student's Task
<i>Designing a Solar Thermal Collector</i>	How can we use the engineering design process to design a solar thermal collector?	Your team's thermal collector was destroyed in a windstorm. Using the materials provided, create a low-cost replacement. Be mindful to consider if the materials selected are conductive or insulative. You have 2 class periods.

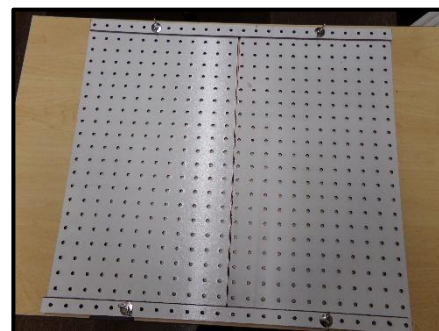
Lesson Summary

Students are asked to restate the problem and brainstorm criteria and constraints. In their group, students must create a matrix showing their criteria for evaluating the thermal panel designs. They also consider how much to weight each criterion based on its importance. Next, students are given a list of materials and their associated cost. Teams must come up with several different solutions and then evaluate the solutions. After selecting the best design, the group constructs it. A pegboard base serves as the platform for constructing the thermal panel. Once built, the team tests its performance. Finally, the group optimizes the design and tests it again.

Solar Water Heater with Commercial Thermal Panel



Pegboard Base for Thermal Panel Construction



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Example Criteria Matrix

Weights		3 points	2 points	1 point
Criteria				

Materials

Item	Cost (\$)	Size / length / number
Foil	10	6" x 6"
Black tubing	30	3'
White tubing	15	3'
Copper tubing	100	3'
Zip ties	5	5
Trash bag (white)	10	1
Trash bag (black)	20	1
Plastic wrap	5	6" x 6"

Evaluation or Decision Matrix

Criteria					Total
Weights					
Solutions	1				
	2				
	3				
	4				
	5				
	6				

Analysis Questions

1. Describe how the solar thermal water heater works.
2. Distinguish between the role of the photovoltaic panel and the thermal panel. How do they use the energy from the Sun differently?
3. What materials were the best conductors? Insulators?
4. How does the speed of water flow affect temperature?
5. How effective was your team's initial solution? What did your team do to optimize its solution?

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