THE SOLAR POWER CHALLENGE

GRADE LEVEL

3rd-5th grade

OBJECTIVE

Students will identify photovoltaic solar power as a source of energy. Students will explain what happens when a photovoltaic cell is shaded. Students will understand why we can't rely solely on this resource for energy.

PURPOSE OF ACTIVITY

Read or Listen, Identify Details, Apply Skills

21st CENTURY SKILLS

Critical Thinking, Collaboration

COGNITIVE LEVEL

Strategic Thinking, Extended Thinking, Skills and Concepts

CLASS TIME

Four class periods of 45 – 60 minutess

- Day 1: Introduction and research
- Day 2: Building the prototype
- Day 3: Testing prototype and redesign
- Day 4: Testing of redesign and interpretation

MATERIALS

- Cardboard, poster board or stiff paper to construct the house
- House design templates –find templates at this website: https://www.template.net/business/paper-templates/paper-house-template/
- Protractors – two per group
- Small solar panel
- One voltmeter per group
- Two sunny days to test the prototypes three times (at the start of the day, during lunch, near the end of the school day)
- Student Sheet

PROCEDURE

Divide the students into groups of three or four. Allow students to design their houses based on the templates. Make sure you have stiff paper that will be able to hold the weight of the solar panel. The students will also need a square of poster board to place their house on as a base.

Day one: Introduction and Research

Have students discuss their knowledge of solar panels – where they have seen them and how they work. After the discussion, let the students come up with some questions they may need to know before they create a house that will hold a solar panel. Have them write down their questions. As a class, look at the questions the groups came up with.

Research: On the student worksheet, there are links that the students can click on and watch to learn how solar panels work and how they create energy. Students will need to take notes. Have the students work quietly on their own notes and designs.

Bring the students together in their groups. Ask them if there is something they would add or change to their model. As a group, determine which house design will provide the best solar solution. Where should the solar panels go?

(continued on next page)

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THE SOLAR POWER CHALLENGE

PROCEDURE (cont.)

Day one *(cont.)*

Have the groups use their research to create a model that will meet the criteria and constraints. Make sure they realize that they only have a limited time to build their prototype. The students will also need to have a look at what supplies are available for use. Groups must make a list of supplies. They will also need to have a detailed model with notes of the height of the house, the angle of the roof, where they are putting the solar panel and their prediction on how many watts of energy they will get.

Note: Some students may want to place their solar panel on the ground. If so, make sure they indicate at what angle the panel will be set.

Day two: Building your Prototype

Students build their prototype.

Day three: Testing, Analyzing and Redesign

Teacher prep: Set up an area outside where the students can test their prototype. Make sure that each group has access to the voltmeters. The students will need ten minutes to test their prototype at least three times throughout the day. Suggested times would be first thing in the morning, around lunchtime and at the end of the day. The students will need time to redesign their prototypes and retest them.

Video on How to read a voltmeter: The Best Multimeter Tutorial (4:35 minutes)
https://www.youtube.com/watch?v=bF3OyQ3HwfU

Student groups can test their prototype, writing down the amount of energy they have created using solar energy. They will record the volts on the voltmeter. They will also need to record any observations they may see (example: angle is off, roof is too steep, roof is too weak, etc.)

Once the group has tested their prototype, the students need to answer the analysis questions. Students will then get an opportunity to redesign and update their prototype. Explain that this is not a time to start over from the beginning. This is the time to look at the problems and use different ideas to come up with a solution. Allow time for the students to make the changes to their prototype and test again. Record their data and observations on data table.

Day four: Testing Redesign and analyzing data

Allow students to test their redesigns and analyze the data.

CRITICAL THINKING QUESTIONS

What are some constraints to homeowners that wish to use solar energy?

Cost of solar panels, amount of electricity the panels can produce, number of days of adequate sunlight, the size of the homeowner's roof.

Why is solar energy attractive to homeowners?

The energy source is free, solar energy produces little or no emissions, current energy sources do produce emissions, solar energy costs less than other sources.

Adapted from: https://energy.utah.gov/energy-education/curriculum/

Student Sheet Name _____

THE SOLAR POWER CHALLENGE

The mayor of a small town is in need of your help. The town will be growing quickly in the next few years. The city council would like to see this growing city use renewable energy as an energy source. Your job is to create a prototype using the sun as energy to generate electricity. The mayor has assigned you and your partners to find the best way to generate the most electricity from one panel efficiently.

Together with your group discuss what three main questions you will need to research before you can start building.

1.

2.

3.

Research: Research is important to the engineering process. Watch the following videos and summarize what you learned in them.

What is Solar Energy? https://www.nrel.gov/research/re-solar.html (5:07 min)

Summarize this video

Solar Energy 101, https://www.energy.gov/eere/articles/energy-101-solar-pv (1:58 min)

Summarize this video

Engineering projects have criteria and constraints. In this activity they are:

Criteria: Develop a prototype of a house that can gather 1.0 volts of solar energy as shown on a voltmeter.

Constraints: Limited supplies – one sheet of cardboard or very stiff paper, solar panel, voltmeter and sun.

Time: You will have one hour to complete your prototype.

Design: Draw your house design and show where the solar panel will be placed and the angle it will have. Show where the sunlight will be coming from.

Testing: Take your prototype outside at least three times throughout the day to gather data. You must place it in the same location each time. Once outside, give your solar panel time to gather the sun's energy. Then take a measurement of the amount of energy the sun generated by using the voltmeter.

Record your observations:

Day 1 Weather:

Angle of solar panel:

	TRIAL 1	TRIAL 2	TRIAL 3
Time			
Volts			
Observation			

Analysis: Answer the following questions.

1) How did your solar panel perform? Give some examples from your observations.

2) What changes do you need to make with the solar panel to make it more efficient or fix issues during testing?

Redesign: Redesign your house by making changes to improve or reach the criteria. Is there a new angle? What adjustments did the group make? Redraw your prototype showing the changes made.

Retest your design and record the results in the table below:

Day 2 Weather:

Angle of solar panel:

	TRIAL 1	TRIAL 2	TRIAL 3
Time			
Volts			
Observation			

Analysis: Answer the questions below.

1) Did your redesign help meet the criteria? Why or why not? Describe your observations.

2) What other changes do you need to make to the prototype to make it more efficient or fix issues during testing? Use the space below to show any redesigns.