

Solar Oven

4th Grade

Science Unit 3 - Energy

Design Challenge Summary

Challenge: What will the students be required to do?

Your family is going camping this weekend. You are in charge of planning for and providing a snack for your family (s'mores). There's a burn ban so you can't use fire for heat. You need to work collaboratively with your group to create a solar oven that will cook your family's snack (s'mores) efficiently.

Standards: What standards are addressed?

Science:

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Math:

4.MD.2 Represent and interpret data.

3.MD.1 Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes.

3.MD.3 Draw scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

ELA:

W.4.2 Write explanatory texts to convey ideas and information correctly.

SL.4.1 Engage effectively in collaborative discussions. Pose and respond to specific questions. Review ideas and explain their own ideas.

Result: What will students know, value, and be able to do as a result of the lesson? What's the big idea?

Know and apply the engineering design loop.

Thermal energy is transferred as heat, moving from warmer objects to cooler objects.

Sunlight can be transformed into usable heat. Sunlight is a clean, inexhaustible energy source.

Students will know how the thermal energy from the sun can be utilized to cook their food.

Reason about insulation, heat and light absorption – properties of matter.

The big idea is that the students can develop a way to harness energy from the sun to cook food without using modern technology.

Assessment: What evidence will be used to determine student learning?

Did their food cook?

Did their oven's temperature increase?

Did they modify their design to cook their food?

Did they follow the design loop process?

Did they work collaboratively?

Does their writing show evidence of understanding?

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Prior Knowledge/Experiences: What prior content knowledge and skills will the students need?

Experience with the Engineering Design Loop process (Introduction lesson to STEM & working as a team)

Connections to the Mathematical Practices

Investigations/inquiry in Science

Solar energy is energy from the sun.

Research Solar Oven Images to give students background on what some designs may look like.

(Vary images used so they see a variety of images and designs.)

How to read a thermometer.

How to create a bar graph and collect data.

Tell time and calculate elapsed time.

Vocabulary: Thermal Energy, Solar Energy

Summary/Connections: How will this design challenge connect with new/future learning, other content areas, real world experiences, etc.?

This lesson will help students develop problem solving skills and collaboration skills that are essential in succeeding in the 21st century. It will allow students the opportunity to transfer and apply skills from various content areas within one task.

As summary activities, you can:

Create a bar graph about temperatures measured over a time period. **3.MD.3, 4.MD.2**

Calculate elapsed time for cooking food. **3.MD.1**

Write an informational essay about constructing the solar oven. **W.3.10, W.4.2**

Materials/Equipment/Preparation: What materials and equipment will students need to successfully complete this design challenge?

Thermometers (1 per group)

Cardboard pizza box

Pen / pencil

Aluminum foil

Plastic wrap

Black construction paper (other colors as well if you want students to reason about light absorption)

Newspaper

Scissors

Electrical Tape, glue

Ruler or Stick

Paper Plate

Graham crackers, marshmallows, chocolate bars

Solar Oven

Additional Information

Suggested Sequence to facilitate the task:

Day 1: Present Challenge and allow students time to collaborate and build their Solar Oven
Research Ovens with students and look at pictures for ideas.

Day 2: (11:00-3:00 best time for ovens to cook) Place Ovens outside (they should not have any food in them, this is simply for students to monitor and track the oven's temperatures) periodically take students outside to measure temperature and record their data to create a bar graph of the oven's temperatures over the course of the day. This is simply for the students to test their ovens before they are to cook their snacks. (If no students chose black construction paper, the teacher should make an oven with black paper.) The students will need to compare and contrast the temperatures of other colors so that they can reason about light absorption and heat.

Day 3: Using data from previous day's experiments students will modify and adjust their ovens, they may change paper colors materials, add insulation etc. (This is the design loop happening!!!)

Day 4: (11:00-3:00 best time for ovens to cook) Place Ovens outside and students may place the food they are "cooking" into the oven. They will monitor their ovens and calculate the elapsed time required to cook their food.

Related Resources:

http://www.solarcooker-at-cantinawest.com/pizza_box_solar_oven.html

<http://www.hometrainingtools.com/a/build-a-solar-oven-project>

<https://www.scientificamerican.com/article/sunny-science-build-a-pizza-box-solar-oven/>

Name: _____

Date: _____

#: _____

Making a Solar Oven

On your own, list the materials you would choose to make your solar oven and why:

Draw a picture of what your solar oven would look like:

Name: _____

Date: _____

#: _____

Making a Solar Oven

As a team, decide on what materials you have decided to use and make a list of the materials your group chose to make your solar oven and why:

Draw a picture of what your solar oven will look like:

Name: _____

Date: _____

#: _____

Making a Solar Oven

We will be graphing the temperature inside of your box each time we go outside. Please record the time that you graphed the temperature.

Date	Time	Temperature	Changes (+ or -)

Attempt Number ONE

What was the highest temperature that your oven reached? _____

Whose oven got to the highest temperature? _____

Why do you think their oven got the hottest? _____

Whose oven melted the marshmallows and the chocolate? _____

What could you have done to make your solar oven work better?

Name: _____

Date: _____

#: _____

Making a Solar Oven

You are now going to get the chance to add or take away two things from your oven. As a team, decide on what materials you have decided to use and make a list of the materials your group chose to make your solar oven and why:

Draw a picture of what your solar oven will look like now:

Name: _____

Date: _____

#: _____

Making a Solar Oven

We will be graphing the temperature inside of your box each time we go outside. Please record the time that you graphed the temperature.

Date	Time	Temperature	Changes (+ or -)

Attempt Number TWO

What was the highest temperature that your oven reached? _____

Whose oven got to the highest temperature? _____

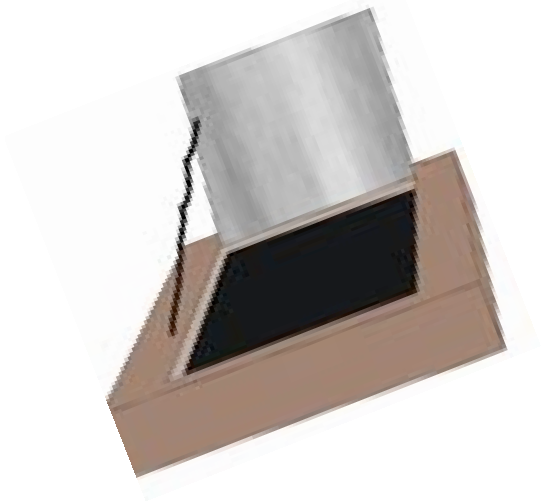
Why do you think their oven got the hottest? _____

Whose oven melted the marshmallows and the chocolate? _____

What could you have done to make your solar oven work better?

Graphing Your Data

120								
110								
100								
90								
80								
70								
60								
50								
40								
30								
20								
10								



Solar Oven

During your weekend camping trip, you will be responsible for cooking a snack for your family! There's a burn ban so you can't use fire for heat. You need to work collaboratively with your group, to create a solar oven that will cook your family's snack efficiently.

Group Supplies:

cardboard pizza box, aluminum foil, plastic wrap, construction paper, newspaper, scissors, tape, ruler or stick, plate, graham cracker, marshmallow, chocolate square