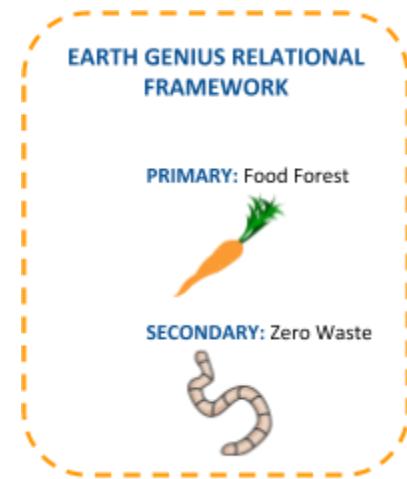


Solar Pizza Box Oven

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Lesson Overview:

In this lesson students will learn about different forms of energy and will engineer a solar oven out of a pizza box! Students will then experiment with the structure and function of their ovens by making quesadillas in the garden utilizing garden produce.



Diggin' To Topics:

Energy, Solar, Biomimicry, Greenhouse Effect, Photosynthesis, Engineering, Cooking

Grade Level:

This activity is designed for elementary students and is best suited to support 4th grade NGSS. Content can be adjusted for different grade and comprehension levels. See bottom of activity guide for easy adaptations that can be done to make this activity more appropriate for K-2nd grade students.

Inside or Outside:

Table space is needed for Part 1 of this activity, Constructing the Oven. If there is ample table space in the garden, this activity can be completed 100% outside! Alternative options: check out tables from the custodian to use outside or complete part 1 inside the classroom. Part 2, Setting up Oven and Cooking in Garden, must be completed outside. It is best to schedule this between 11-3, when the sun rays are hottest.

Suggested Time Allowance:

Part 1 - Energy and Constructing the Oven (1 hour)

Optional Seasonal Offering: Part 2 - Setting up Oven and Cooking in Garden (1 hour)

Learning Objectives:

- To understand that energy is derived from natural sources that humans harness
- To construct a model that can convert the sun's energy into heat energy, and to understand how the structure affects the system's function.
- To identify edible produce in the school garden and utilize it as apart of their oven experiment
- Make connections to biomimicry and patterns; the greenhouse effect and photosynthesis are two scales of how nature operates that can be scaled down to create these ovens

Essential Question(s) that Connect CCCs and SEPs:

- Does this structure serve as a model for any other systems we can think of? (ex. Plants store energy like solar panels; greenhouse and atmosphere trap heat) Can I use this pattern as evidence to support my argument that the structure will work? ([Patterns](#); [Engage in Argument from Evidence](#); [Developing and Using Models](#))

- How does energy work in this solar oven? (ex. Light enters the box through the saran wrap, converted to heat energy inside the box, air inside the box can't escape and is hotter than air outside of the box; in other words, the solar oven is like a super greenhouse!) How can I make this more energy efficient? How can the materials be improved? ([Energy and Matter](#); [Asking Questions and Defining Problems](#))
- What does our solar oven do? (It cooks!) How does the function depend on the structure? How can we design the structure to absorb the most heat? ([Structure and Function](#); [Asking questions and Defining Problems](#))
- What variables about this structure can we change to find out how the function is affected? (angle of the reflector, black vs. white paper, etc). ([Structure and Function](#); [Planning and Carrying out Investigations](#))

Materials:

Part 1 - Energy and Constructing the Oven

- Printout of [How to Make a Pizza Box Solar Oven](#) to guide GEM in leading construction
- Small pizza boxes for every two kids (work in teams)
- Saran wrap
- Tin Foil
- Black paper
- Tape
- Scissors
- Kabob sticks
- Paper Plates
- Laminated pictures:
 - [Greenhouse](#)
 - [Plant Photosynthesizing](#)
 - [Giant Sun Oven](#)

Part 2 - Setting up the Oven and Cooking

- Pizza box solar ovens
- Tables to prep quesadillas on
- Giant Sun Run solar oven *Optional but awesome visual to see how we are mimicking in our designs
- Corn tortillas and cheese for every partner pair to share a quesadilla
- Cutting boards
- Kid Safe Knives
- Collanders
- Bowls to put cheese, produce, etc. inside of

EG Team Support Needed:

- Donations of pizza boxes

Prep:

- Gather pizza box donations and all materials.
- Walk through garden to know what is available for harvesting! Supplement from farmers market, the district culinary kitchen, the food bank, or a grocery store.

- For part 2, setup cooking station. Wash cooking surfaces well with soap and warm water, rinse, and dry.

Activity Procedure:

Engage:

Have a classroom discussion about energy. *Energy* is the ability to do work, to make things happen, and to cause changes. **Energy cannot be made or destroyed**; it can only be changed into different forms.



Comprehension Check

Write the following underlined questions on the board, record answers, and discuss with the class:

What is energy? The ability to do work or cause change. Can you name a form of energy? (Examples: Light, heat, electricity, sound).

From where does energy come? (Possible answers: Power plant, the outlet in the wall, food) As animals, we get our energy from food. Where do plants get their energy from? (The sun!) What is this process called? (Photosynthesis!) Energy flows from the sun, to plants, to animals, and then to people as we eat plants and animals for food. Can you think of an example in which energy is changed from one form to another? How about a light bulb? We turn it on by plugging it into the wall. What happens when you leave a light bulb on for a while? It gets hot! Well, that is an example of electrical energy changing into heat energy. There are natural energy sources such as food, water, plants, trees, gravity, sun, fossil fuels. However, we can't just put our TV in the sun to power it. What are some ways **humans have harnessed these natural energy sources into usable energy?** How about wind turbines? (Other possible answers: bike powered TV, hydroelectric dams, nuclear power plants, solar panels).

How do we use energy? (Possible answers: TV, radio, cars, ovens, to heat houses, to break down food in our bodies.)

Explore:

Today we are going to engineer a solar oven out of a pizza box. What do you think I mean when I say a solar oven? Display laminated photos of plants absorbing sunlight, a greenhouse, and different solar oven technologies. A solar oven is a box that traps some of the Sun's energy to make the air inside the box hotter than the air outside the box. In other words, the solar oven is like a super greenhouse. Our solar oven is going to **model** how photosynthesis and the greenhouse effect works (**Structure and Function; Developing and Using Models**). **Why might cooking in a solar oven be good for the environment?**

Action:

1. Have students work with a partner. Refer to the think-pair-share document for ideas on pairing up students, or simply have them work with the person sitting next to them.
2. Give each partner pair their unfolded pizza box and have them work together to figure out how to fold it into a finished box. Once students have had 5 minutes to try, sample how you fold one in front of the class to model the process to any stuck groups.
3. Show students all of the materials they will be working with to create their solar oven, and give them a couple minutes to brainstorm how they might construct their solar oven if they were to

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have no direction. Do not pass out the materials yet! What is the purpose of the tin foil? The saran wrap?

Explain:

Remind students what the callback will be for this project (give me 5, silent coyote, chime, etc). Explain that we are going to walk through all of the steps together and will wait for every group to finish each step before moving on. You should be constructing an oven in front of the class as an example!

Action: Follow this link for [How to Make a Pizza Box Solar Oven](#)

Elaborate:

Optional Seasonal Offering - Part 2: Take the classroom to the garden to try out their pizza ovens!



Comprehension Check

Start with a class discussion: What factors/variables affect temperature - both on our planet and in our ovens? (Possible answers: season, cloud coverage, sun's angle, insulation, surface color). Think about the structure of your solar oven. How does the **function (cooking) depend on the structure?** (Possible answers: angle the reflector towards the sun, make sure the saran wrap is fully insulating the oven, use a black paper plate) In other words, how can we set up our solar oven to maximize temperature keeping the factors from above in mind?

Action:

1. Have partner pairs set up their solar ovens. Encourage them to [experiment with angling the reflector](#) and oven in different ways.
2. Review what is available to harvest in the garden. Take kids on an edible walking tour, pointing out all of the yummy additions they can cook with. Partners may harvest produce that they want to use.
3. Assist kids in assembling quesadillas, helping them to cut and rip produce. Place in solar oven and bake! It is a general rule that food in a solar oven can take twice as long to bake than in a normal oven, but they are not prone to burning.
4. Enjoy as a class! Give thanks to the sun, soil, water, and air for helping us to have this quesadilla party.

Evaluation:



Comprehension Check

Take a hand raising survey of whose quesadilla was fully cooked or not. How can the **materials and structure be improved for energy efficiency?** (ex. sealing the saran wrap tighter or using a different material, angling the reflector to capture the sun's light, etc.)

Write on your graphic organizer and fill out as a class:

Structure: Function:

Tin foil reflector _____

Saran wrap _____

Black paper _____

Extension Activities:

- Write a story about cooking your quesadilla in the solar oven. How can I explain how the structure of my solar oven is related to the function of cooking? What did you put inside of the quesadilla? Use your 5 senses to describe your quesadilla.
- Send a small group of students to cook quesadillas in solar ovens with kindergarten buddies.

Tips and Caveats:

Adaptations for K

K will be a 1 part lesson.

Rather than K building a solar oven, have them **draw a design**. Come back together as a class and have students share designs (use Think, Pair, Share for ideas).

Show the giant solar oven and discuss **what the different parts are doing (structure and function)**. Who drew something similar to this part?

Make quesadillas in giant solar oven or pizza box solar ovens made by older kids using garden produce.

Cited Curriculum:

teachengineering.org - [Lesson: What is Energy?](#)