



Lesson Extension

Engineering 3: (Re)-Building a Bridge

This week, we learned about engineers and how they work through a problem to develop a solution, using bridge building as an example.

Engineering a Solar Oven

Now we will build something entirely different: our own solar oven, capable of heating marshmallows and chocolate for s'mores, cooking a quesadilla, or preparing some other delicious creation. In the process, you will harness the energy of the sun while learning that engineering is fun AND rewarding!



Materials:

- Empty pizza box
- Ruler
- Pencil or marker
- Scissors
- Craft knife (parent's job)
- Black construction paper
- Clear plastic wrap
- Aluminum foil
- Glue or clear tape
- Stick, bamboo skewer, or chopstick
- Graham crackers, chocolate bar, and marshmallows or flour tortilla and shredded cheese.

Procedure:

While the solar oven can be created at any time, wait for a sunny day to cook in your solar oven.

1. Using a ruler and a pencil, measure a window in the top of the pizza box with a one-inch margin on each side.
2. Have a parent cut along 3 sides of your window with a craft knife. Be sure to leave one side connected to the box.
3. Carefully pry open the flap you have made. Fold the flap up along the uncut line. This is your solar window.
4. Glue or tape aluminum foil smoothly to the underside of your flap.
5. Line the rest of the box with aluminum foil, inside and out.
6. Tape a black piece of construction paper on the inside bottom of the box on top of that piece of foil.
7. Glue or tape the plastic wrap to the underside of the lid forming an airtight seal.
8. Prepare your food:
 - a. For each s'more, center two graham crackers on the construction paper. Top one with chocolate and the other with a marshmallow.
 - b. For a quesadilla, lay a flour tortilla on the construction paper. Top with shredded cheese.



9. Close the lid of the box.
10. Use a bamboo skewer to prop the flap open.
11. Angle your box and the flap so that the flap reflects the most light into the solar oven as possible.
12. Start cooking. Check your food every 10 minutes. Cooking can take anywhere from 20 minutes to 2 hours depending on the amount of sun and time of year.
13. Taking it further: Now that you know how to design a simple solar oven, think about how you might improve your oven prototype to cook faster or redesign its shape to cook another type of food. (Hint: Pringles cans and hot dogs!)

What's Happening In There?

The foil flap gathers sunlight and reflects it through the plastic and into the oven, doubling the amount of incoming light. The black paper absorbs the light and converts it to heat, and the clear plastic allows the sun to shine in while keeping all that heat from escaping. As more light hits the black paper, more heat is created and trapped. After an hour or so on a sunny day, the oven can be as hot as 275°F—hot enough to melt chocolate and marshmallows or the cheese.

Additional Resources:

- University of Arizona Engineering Department--Solar Oven Throwdown: <https://www.youtube.com/watch?v=C4cP06Gmcgg>
- Solar Cooking with a Parabolic Mirror: <https://www.youtube.com/watch?v=wyXsYkumHcw>