

Activity #4 - Sun S'mores (90 minutes)

Objective:

- To follow simple instructions to build a box solar oven and to learn about sunlight as a source of energy.

Materials:

- Cardboard box with attached lid. Lid should have flaps so that the box can be closed tightly. Box should be at least 3 inches deep and big enough to set a pie tin inside.
- Aluminum foil
- Clear plastic wrap
- Glue stick
- Tape (transparent tape, duct tape, masking tape, or whatever you have)
- Stick (about 30 cm) to prop open reflector flap
- Ruler or straight-edge
- Box cutter or X-acto knife (with adult help)

Instructions:

Part I- Make the solar oven

1. Using the straight edge as a guide, cut a three-sided flap out of the top of the box, leaving at least a 1-inch border around the three sides (with adult assistance).
2. Cover the bottom (inside) of the flap with aluminum foil, spreading a coat of glue from the glue stick onto the cardboard first and making the foil as smooth as possible.
3. Line the inside of the box with aluminum foil, again gluing it down and making it as smooth as possible.
4. Tape two layers of plastic wrap across the opening you cut in the lid—one layer on the top and one layer on the bottom side of the lid.
 - Test the stick you will use to prop the lid up. You may have to use tape or figure another way to make the stick stay put.

Cut here, 1 inch from the edge of the box top.

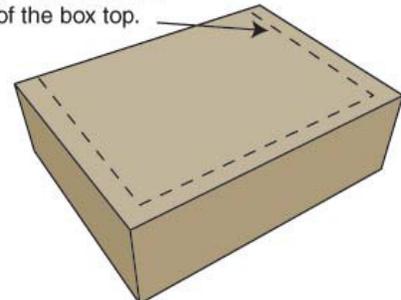


Image Credit: <http://climatekids.nasa.gov/smares/>

Part II- Make the S'mores

NOTE: Start cooking at the beginning of the meeting to ensure there is enough time. The time of day is also critical- this activity will have to be done when you have full sun.

Materials:

- Graham crackers
- Large marshmallows
- Plain chocolate bars (thin)
- Aluminum pie pan
- Napkins

Instructions:

1. Break graham crackers in half to make squares. Place four squares in the pie pan. Place a marshmallow on each.
2. **Note:** Unlike most recipes, these s'mores have the marshmallow UNDER the chocolate. That's because, in the solar oven, it takes the marshmallow longer to melt than the chocolate.
3. Place the pan in the preheated solar oven.
4. Close the oven lid (the part with the plastic wrap on it) tightly, and prop up the flap to reflect the sunlight into the box.
5. Depending on how hot the day is, and how directly the sunlight shines on the oven, the marshmallows will take 30 to 60 minutes to get squishy when you poke them.
6. Then, open the oven lid and place a piece of chocolate (about half the size of the graham cracker square) on top of each marshmallow. Place another graham cracker square on top of the chocolate and press down gently to squash the marshmallow.
7. Close the lid of the solar oven and let the Sun heat it up for a few minutes more, just to melt the chocolate a bit.

Discussion:

- What is the basic principle that is powering the solar cooker?
- Does the colour of the surface matter in terms of how hot it can get?

Most solar cookers work on basic principles: sunlight is converted to heat energy that is retained for cooking. Sunlight is the "fuel." A solar cooker needs an outdoor spot that is sunny for several hours and protected from strong wind, and where food will be safe. Solar cookers don't work at night or on cloudy days. Dark surfaces get very hot in sunlight, but light surfaces don't. Food cooks best in dark, shallow, thin metal pots with dark, tight-fitting lids to hold in heat and moisture. One or more shiny surfaces reflect extra sunlight onto the pot, increasing its heat potential.

- When sunlight enters the box through the glass top, the light waves strike the bottom, making it scorching hot. Dark colours are better at absorbing heat, that's why the inside is black. The molecules that make up the box get excited and generate more heat. The box traps the heat, and the oven gets hotter and hotter. The effect is the same as what goes on in a standard oven: The food cooks.

MEETING 1

- Some people think solar cooking can help poorer countries around the world, but there are challenges- what do you think are the drawbacks of solar cooking?
 - Solar cooking is really only possible for countries that have a dry, sunny climate for at least half the year. Areas of India, Brazil, Kenya and Ethiopia are some of the ideal locations for this cooking method.
 - The bigger problem is that even in places like India, the sun isn't always shining. Solar cookers won't work at all in nighttime or on cloudy days.

Open-Ended Inquiry Questions:

Experiment S'more with these variables:

- Test with and without a reflector.
- Try different types of heat-absorbing materials for the oven shelf/heat sink.
- Try different types of insulation between the inner and outer boxes.
- Why is it necessary to paint the shelf black and to use black cooking pots? See for yourself! Try black vs. shiny shelf and cooking pots.
- Try re-orienting the oven towards the sun once or twice an hour, vs. leaving the oven stationary.

FUN FACT!

Cool (or should we say "hot") Facts about Solar Energy

Though the sun is 90 million miles (149.6 million km) from the earth, it takes less than 10 minutes for light to travel from that much of distance. If we add the amount of solar energy that is absorbed by the Earth's atmosphere, land and oceans every year, we end up with approximately 3,850,000 EJ (exajoules) or 2.7 million earthquakes!

Source: Conserve Energy Future <http://www.conserve-energy-future.com/various-solar-energy-facts.php> and Energy Informative <http://energyinformative.org/solar-energy-facts/>

Activity #5 - Bake a Chemistry Cake (60-90 minutes) *

* Length of time depends if the cakes can be baked simultaneously or one at a time.

Objective:

- To witness how heat creates a chemical reaction and changes things; and to experiment how different ingredients can change the final product.

Materials:

- Small bowl
- Several sheets of aluminum foil
- Pie pan