S'more Heat [ME]

Adapted from Climate Kids

Grades: K-2
Time: 45 minutes to 1 hour

Goals: To understand how solar energy works and how heat is being trapped in our atmosphere.

Objectives:
Students will be able to: define solar heat; explain how the atmosphere is trapping heat; correlate the trapped heat to changes in coastal ecosystems; and use a solar oven to demonstrate solar energy.

Materials:

- Cardboard boxes with lids
- Aluminum foil
- Clear plastic wrap
- Glue stick
- Tape
- Stick (used as a prop for the "oven lid")
- Ruler
- Box cutter
- S'mores: graham crackers, marshmallows, chocolate bars
- Aluminum pie pan
- Napkins/paper towels

Preparation: Older students can make their solar ovens, but for younger students, it is best to prepare several solar ovens before beginning the lesson. Solar ovens also need to "preheat" in the sun for up to 30 minutes, so this can be done in a two-part lesson. The cardboard box lids should have tabs so that the box can be closed tightly (e.g. computer boxes) and the boxes should be deep enough to place a pie pan inside. Using the box cutter, cut along three edges of the top of the box, approximately one inch from the edge, and create a flap. Glue a layer of aluminum foil to the inside of the box as well as the inside of the flap, making the foil as smooth as possible. Take two pieces of clear plastic wrap and cover over the opening in the box (tape one to the underside of the opening; tape another along the outside edge). Use the stick (can be a skewer or even a real stick) to prop open the flap. You may need to use tape to hold it in place. Your solar ovens are now ready to be placed in the sun to reflect light and "preheat" for the lesson.

Procedures:

1. Pre-Activity (introduction): Begin by starting a discussion about heat. Ask the students to describe where heat comes from. Discuss with them different places where they felt that the ground was hotter, like going barefoot on the sidewalk or asphalt and on beach sand and explain why that happens. Ask the students if they've ever been outside during the summer when it was very hot and during the winter when the sun was shining bright but it didn't feel so hot. Explain how the greenhouse effect and reflection works.

2. Activity: For the younger students, they will put their s'mores together in the pre-made solar ovens. For the older students, if you choose to allow them to create their own solar ovens, they can also decorate them before "preheating" them in the sun. Divide the class into groups of 4-5 students (depending on how many s'mores will fit on the pie pans and how many ovens you have). Each group will be in charge of their own s'mores. Ask the students if they've ever made s'mores over a campfire and what was the first ingredient they needed (they will most likely say marshmallows before graham crackers). Inquire what type of heat they used to cook the marshmallows to make them nice and gooey. Explain that they will be using solar heat instead of an open fire to do the same thing.

   For each student, place one half-sheet of graham crackers in the pie pan and a marshmallow on top. Opening the lid using the tabs, place the pie pan into the box and secure the plastic wrap tight before setting the ovens in the sun again. Allow approximately 30 minutes for the marshmallows to get soft and gooey (depending on the direct sunlight). During this time, you can discuss with students what has caused temperatures to rise and how it affects coastal ecosystems. When the marshmallows are done, add a piece of chocolate and another graham cracker to each s'more, pressing down lightly to spread out the softened marshmallow. Cook in the sun for another few minutes to melt the chocolate.

3. Post-Activity (review): As students are eating their solar oven snacks, remind them that it was the sun that gave them the energy to cook their food. Explain that the solar oven acted like the earth's atmosphere and reflected the sun's heat with the foil. The plastic wrap acted as a clear insulator, trapping the sun's heat inside the oven and making it warmer inside than outside, just like the atmosphere does as we continue to burn fossil fuels. You can discuss alternative methods of energy use like solar energy so that fossil fuels don't have to be burned and so that the atmosphere can again reflect energy out.

Key Words:

Solar energy	Climate change	Atmosphere
Heat	Greenhouse effect	Reflection

Background Information:

Adapted from Climate Kids

If you've ever been inside a greenhouse, you would notice that it is a bit warmer and more humid than outside its glass walls. This is because the glass acts as an insulator for heat. As the sun shines through the glass, the room heats up. As the heat and energy from the sun bounces off of the ground and plants, it is reflected back up. The glass keeps the heat trapped inside. This keeps the inside of the greenhouse warmer even when the sun isn't shining bright.

Our atmosphere acts in a similar way to the greenhouse. It is made up of gases, such as nitrogen, oxygen, and carbon dioxide, and these all allow heat and energy to come through during the day. When this happens, the surface of the earth heats up, making things like sand, concrete, and asphalt very hot because they are absorbing the heat instead of reflecting it. In the evening, without the sun's direct light, the surface of the earth can cool down and reflect the heat back up into the atmosphere. The gases act like the glass of the greenhouse, keeping the heat from being released into space.

This is what is known as the greenhouse effect. When the gases prevent sunlight, heat, and energy from reflecting out into the universe, they are trapped on earth's surface, making it warmer than it should be. This is being exacerbated by excess gases and compounds being emitted into the atmosphere by human waste. When we burn fossil fuels, use aerosol cans, pump petroleum from wells, etc., we are emitting waste in the form of gases into the atmosphere, creating a greenhouse around the earth. When we cut trees down to build homes and shops and factories, we are losing the plants that could turn the excess carbon dioxide into oxygen.

For marine species, the effect also changes the chemistry of the water. When carbon dioxide is mixed with saltwater, it decreases the amount of carbonate ion in the water and creates carbonic acid. This changes the pH of the water. Most life in marine ecosystems cannot survive in acidic water, so the increase in carbon dioxide also makes marine ecosystems unhealthy and uninhabitable.