OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION **Activity**

S'mores Solar Oven

Target Grade: K-12th Grade

Time Required: 15 minutes to prepare and 90 minutes to cook

Standards/Topics Covered:

Next Generation Science Standards:

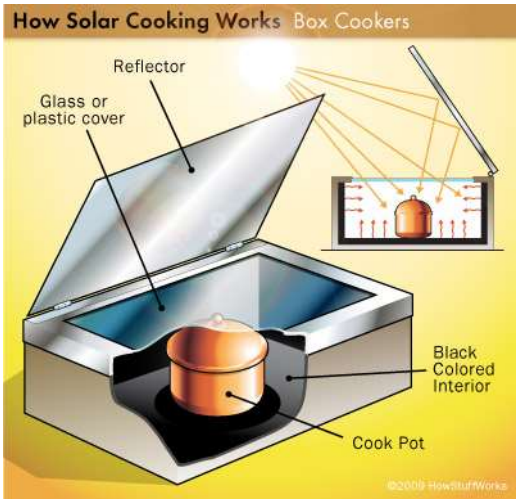
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Central Focus:

Cook up student engagement with this solar oven activity! In this activity, students will make s'mores using their knowledge of solar radiation to transfer thermal energy through the system. As the energy flows through the device, the temperature rises and the s'mores cook! This activity using solar energy as a renewable resource, will leave your students wanting s'more!

Key terms: heat, flow, design, nonrenewable, resources, radiate, systems, greenhouse effect

Background Information:



https://science.howstuffworks.com/environmental/green-science/solar-cooking1.htm

Heat can be transferred three ways: conduction, convection, and radiation. In the solar oven made in this activity, radiation is used to cook the s'mores. Radiation occurs when heat is transferred without the direct contact between the two objects (the sun and the s'mores). The heat is transferred through electromagnetic waves traveling through the air. The emission and absorption of high energy electrons leads to the changing temperatures between objects.

A solar oven works by trapping heat from the sun to cook the food inside. A solar oven is comprised of a cardboard box with a black inside, a transparent cover, and a reflective surface that directs sunlight into the box. The nuclear energy that occurs on the sun (in the form of light and infrared rays) changes to

into solar radiation. The solar radiation hits the reflective surface and the light is reflected into the box through the transparent cover. The solar radiation hits the items inside the box, mainly the black construction paper. The solar radiation heats the construction paper through thermal energy. As the black paper heats up, it heats the surrounding air in the box through conduction. Through convection, the warm air circulates throughout the box and cannot escape through the box with the plastic film over the opening. This heats and cooks the s'mores. A similar effect is observed in a car on a hot day. The sun enters through the car's windows, warming the inside of the car, but the heat is unable to escape causing the car to become very hot. This process is called "the greenhouse effect".

A solar oven is a form of renewable energy, as it harnesses the renewable energy of the sun to cook s'mores in the oven. A renewable resource has an endless supply, such as solar energy or hydropower. Renewable resources generally produce fewer greenhouse gas emissions and pollution than nonrenewable resources; however, renewable resources can often be affected by seasonal or daily changes which can cause an inconsistent energy production. Alternatively, nonrenewable resources are sources of energy that have a finite supply, such as fossil fuels and coal. These resources contribute pollution and greenhouse gases to the atmosphere.

Materials

- Cardboard box with lid (i.e. pizza box or shoe box)
- Aluminum foil
- Plastic wrap
- Black construction paper
- Tape
- Glue stick
- Pencil or wooden skewer
- Scissors or utility knife
- S'mores supplies:
    - Chocolate
    - Graham crackers
    - Marshmallows

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Instructions

1. On the opening side of the pizza box, cut a flap for an “oven door” leaving 1-2 inches of border around the edge of the pizza box. Be careful not to cut the bottom edge of the flap. (Photo 1)
2. Glue aluminum foil to the inside of the flap that was cut. (Photos 2a and 2b)
3. Glue the black construction paper to the bottom of the box. (Photo 3)
4. Tape plastic wrap to completely cover the opening to create the best greenhouse effect possible. (Photo 4)
5. Tape a wooden skewer or pencil to prop the lid open at an angle. (Photo 5)
6. Add a graham cracker, marshmallow, and chocolate inside the oven.
7. Place in the sun so the sun directly hits the foil and reflects down into the box and wait until the marshmallow has puffed up. Enjoy!

1.

2a.

2b.

3.

4.

5.

Closure

1. What is the purpose of the plastic wrap in the solar oven?
   The purpose of the plastic wrap is to trap the heat in the box. In the solar oven, sunlight is reflected into the box by the reflective surface created by the aluminum foil. The sunlight goes through the plastic wrap and warms the s'mores. As the s'mores heat up, the heat is not able to escape through the plastic wrap, causing the entire inside of the box to warm and the s'mores to cook.

2. If there were clouds would it increase or decrease the length of time required to cook the s'mores?
   If there were clouds in the sky, it would increase the length of time required to cook the s'mores because they are cooked using sunlight. Without sunlight, the light would not be reflected through the plastic wrap into the box and would not heat up the s'mores.