Solar Oven

Overview

One of the biggest challenges in establishing a lunar base is to supply it with adequate power. Although various power sources have been proposed and are under consideration, there is no question that solar power will play a significant role.

Purpose

Through the construction and testing of a solar oven, students will:

- Understand the importance of solar energy to the establishment of a lunar base.
- Develop methods to maximize solar power efficiency.
- Develop skills in teamwork, communication, and problem solving.

Preparation

1. Gather all materials and make copies of the Solar Oven Challenge Student Sheets.
2. Research indicates that cooperative learning methods – having students work in small groups – can help them learn concepts and skills. Using official engineering job titles will enhance the experience. Teams of three or four will work best. If you have three students per team, one will have the combined role of facilities engineer and developmental engineer (see role cards).

Materials

Per team:

- Student Data Sheets
- One 3.79-liter plastic milk container
- Scissors and/or razor knives
- Aluminum foil
- Wire coat hanger (untwisted)
- Plastic wrap
- Food item suitable for cooking such as marshmallows or raw apple slices
- Cotton balls
- Cotton batting
- Construction paper (assorted colors with plenty of black available)
- Cardboard
- Wire cutters
- Masking tape
- Books or other objects that can be used to prop up the oven at the proper angle
- Role cards
- Watch or clock with second hand

Note: With the exception of the milk container, aluminum foil, wire coat hanger, plastic wrap, and food item, specific construction items can vary as long as all teams have equal access to materials.

Procedure

1. Introduce the challenge. The object is to use the available materials to build the most efficient solar oven, able to cook a food item in the least amount of time.
2. Divide the class into teams.
3. Distribute role badges and explain the responsibilities of each team.
4. Distribute Student Sheets and discuss the steps of the design process.
5. Students should use the Student Sheets to guide the design process.
6. Provide students with directions to build a basic solar oven and encourage them to modify and expand upon the basic plan as they see fit (these directions are included in the Student Sheets).

Basic Solar Oven Instructions

1. Using scissors and leaving the mouth of the container intact, cut away the side of the milk container with the handle.
2. Line the inside of the milk container with aluminum foil. Try to keep the foil as smooth as possible and avoid wrinkles.
3. Untwist the coat hanger and cut a section approximately 30.48 cm in length.
4. Push one end of the wire through the bottom of the milk container using the scissors to cut a hole if necessary.
5. Skewer the food item with the wire and pass the wire through the mouth of the container.
6. Cover the open part of the oven with plastic wrap.
7. Remind students that these are only the directions to build a basic solar oven and they are free to alter and expand upon these plans to make the most efficient solar oven possible.
8. Allow teams a predetermined amount of time to construct their ovens (approximately 30 minutes should be sufficient).
9. After construction is complete, have all teams bring their oven to a designated area in the sun. Teams should use books and other objects to prop the ovens at an angle that allows them to receive direct sunlight.
10. Teams may adjust their ovens during cooking.
11. The instructor will determine when the food items are completely cooked. The team whose oven completely cooks the food item in the shortest time wins. Depending on the weather, where you live, and the time of year, cooking times may range from 10 minutes to 30 minutes. Obviously, this activity works better on hot, sunny days.
12. Points will be awarded as follows:
    a. Food cooked in shortest time = 5 points
    b. Food cooked in next shortest time = 4 points
    c. Food cooked in next shortest time = 3 points
    d. Food cooked in next shortest time = 2 points
    e. Food cooked in next shortest time = 1 points
13. Discuss the results as a class.

Questions

1. What role did the aluminum foil play in the solar oven?
2. What modifications from the basic design increased the efficiency of the oven?
3. What modifications did not prove effective?
4. How would you redesign your oven based on the lessons you have learned?

Answer Key/What is Happening?

As the rays of the sun hit the reflective surfaces inside the oven, they will be concentrated on the food item.

The plastic wrap traps some of the heat inside the oven.

Additional insulation around the outside of the oven, but not blocking the sun, can increase the efficiency of the oven.