TRB 6:6 - Activity 2 - Solar Oven

Summary

Students will design two different solar ovens to learn about heat transfer.

Materials

- mixing bowl or salad bowl (wooden bowls are good because they are often rounded without the flat bottom usually found in plastic or glass bowls)
- aluminum foil
- doubled-sided tape
- 20 cm x 35 cm sheet of flexible cardboard
- 1 m of string
- scissors
- marshmallows
- long forks or skewers

Background for Teachers

It's possible to fry an egg on a sidewalk, but you need a very hot, sunny day and the cooking process takes a while. Using a solar oven is more efficient. You've probably taken a magnifying glass and focused sunlight through it to burn paper. The curved reflector in a solar oven does about the same thing, concentrating all the sunlight that strikes it into a very hot spot near the center of the oven. The efficiency of an oven made from a bowl is affected by the size and shape of the bowl; a continuous curve shape will focus the parallel rays of sunlight better. Both homemade solar ovens will be affected by how smoothly you're able to apply the aluminum foil. Be aware of things you can't control, like the movement of the sun. (You can tell the sun is moving by watching the oven's shadow.) As the sun moves, so does the oven's "hot spot", so adjust the oven accordingly. Ideally, the reflector should point directly at the sun at all times.

Intended Learning Outcomes

1-Use science process and thinking skills
2-Manifest scientific attitudes and interests
4-Communicate effectively using science language and reasoning

Instructional Procedures

Never look directly at the sun or at reflected, focused sunlight. It can damage your eyes permanently.

Design One: Line the inside of a large bowl with aluminum foil, shiny side up. Use several small pieces of double-sided tape to secure the foil. Press the foil close to the bowl and make it as smooth as possible.

Design Two: Cover one side of a sheet of cardboard with aluminum foil, shiny side up, securing the foil with double-sided tape. Bend the cardboard into a semicircle, with the foil on the inside of the curve. Wrap a length of string twice around the cardboard semicircle and knot the string at the back.

Face both ovens into the sun. You may want to prop up and angle the cookers by making a base with Plasticine. Find each oven's "hot spot", the spot where the sun's reflected rays crisscross. Different ovens have different hot spots. To find the bowl oven's hot spot, slowly put you open hand into the bowl until you feel the hot spot; don't hold your hand in the hot spot! You'll probably find the cardboard oven's hot spot near the middle of the string, closer to the foil.

Put marshmallows on the end of long skewers and hold a marshmallow in each oven's hot spot. Which oven cooks a marshmallow the fastest? Can you alter an oven to make it work better (e.g. change curve of cardboard)?

Extensions

Have students go home and recreate their own solar oven. Retest their new ovens and compare results with ovens made in class.

Assessment Plan

The following rubric could be used or adapted for grading this activity.
Teacher Note:
You will be assessing each student's progress on an ongoing basis. Use the response levels to help you evaluate the student's growth toward the Key Scientific Concepts, the Communication Characteristics and Learning Dispositions.
Response Levels:

- Accomplishes the purposes of the question, task or concept.
- Partially accomplishes the purposes of the question, task or concept.
- Shows fragmented understanding; uses vague scientific communication.

Key Scientific Concepts to Discover:

- Heat travels across space from the sun to Earth by radiation.
- Heat energy transfers through Earth's atmosphere.

Communication Characteristics:

- How complete were the student's recordings?
- Did the student's drawings make sense?
- Did the student's recordings reflect awareness of Key Scientific Concepts?

Learning Dispositions:

- Did the student show perseverance and attention to detail when working on the tasks?
- Did the student show awareness of science process as they worked on the tasks?

Bibliography

This lesson is part of the Sixth Grade Science Teacher Resource Book (TRB3) http://www.usoe.org/curr/science/core/6th/TRB6/. The TRB3 is designed to be your textbook in teaching science curriculum to your students. This book covers all the objectives of each standard and benchmark. If taught efficiently, a student should do well on the End-of-Level (CRT) tests. The TRB3 is designed for teachers who know very little about science, as well as for teachers who have a broad understanding of science.

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