Educator Guide: Solar Oven Construction

This guide provides step-by-step instructions for conducting the 'Solar Oven Construction' experiment. The goal is to help students to build a simple solar oven using cardboard and aluminum foil, teach about renewable energy, heat transfer, and practical cooking applications without fuel.

1. Course Objectives

By the end of this course, educators will:

- Demonstrate how solar energy, reflection, insulation, and heat absorption contribute to cooking food in a solar oven.
- Use solar oven activities to teach students about renewable energy, sustainability, and reducing carbon footprints.
- Guide students in testing and refining their solar ovens to enhance efficiency and performance using the experiment.

2. Learning Outcomes

By the end of the experiment, students should be able to:

- Explain how solar ovens can help people around the world by saving energy and reducing pollution.
- Notice what worked or didn’t and suggest ways to improve the oven’s design.
- Evaluate the solar oven's potential applications and limitations.

3. Materials Checklist

- Ruler
- Aluminum foil (from food packaging)
- Cardboard (from old boxes)
- Knife that can cut a box or scissors
- Plastic wrap or clear plastic bag
- Black construction paper
- Newspaper or paper scraps (for insulation)
- Tape

4. Icebreaker Preliminary Questions Session

Teachers ask “thought provoking” questions and students are encouraged to ask their “curiosity questions”, to make kids excited or expectant about class.

- Have you ever felt the sun heat something up—like a seatbelt, a rock, or your skin? What did that feel like?
- Do you think we could use sunlight to cook food? How might that work?
- Why might someone want to cook using the sun instead of electricity?

Encourage students to give their perspective on what they know on solar oven construction.
Present a “story” that serves as an example of introduction to the topic - a story that merges science and folklore - can be dynamically spread along the experiment.

Story:
Jane and the Sun-Cooking Secret

Once upon a time, in a small village surrounded by trees and hills, lived a clever and curious girl named **Jane**. Jane loved helping her grandmother in the kitchen. But one day, the firewood was all wet from the rain. “Hmm,” Jane said, looking up at the big, bright sun. “I wonder... Can the sun cook our food instead of fire?” Her sister laughed. “The sun can’t cook! It’s just for light and keeping us warm!” But Jane smiled. “Let’s see.” Jane used what she could find: an **old box** from her uncle’s shop, some **foil paper** her grandmother had saved, a piece of **clear plastic** from a food wrapper and some **black paper** she found at school. She said, “The foil will help the sunlight bounce into the box. The plastic will keep the heat inside. And the black paper will soak up the sun’s warmth.” She placed a small piece of bread and some butter inside. Then she waited… and waited… and waited. After a little while, her sister smelled something yummy. “Hey! The butter is melting!”“The bread is warm!” They stared at the little box. “It’s working! The sun is cooking!” From that day on, Jane showed everyone how to build a **sun-oven**. She even helped her school cook a treat using just sunshine!

5. Experimental Setup

- Use a box knife or sharp scissors to cut a flap in the lid of the old box. Cut along three sides. Fold this flap out so that it stands up when the box lid is closed.
- Cover the inner side of the flap with aluminum foil so that it will reflect rays from the sun. To do this, tightly wrap foil around the flap, then tape it to the back, or outer side of the flap.
- Use clear plastic wrap to create an airtight window for sunlight to enter the box. Do this by opening the box and taping a double layer of plastic wrap over the opening you made when you cut the flap in the lid. Leave about an inch of plastic overlap around the sides and tape each side down securely, sealing

out air. If you use a plastic bag, cut out a square big enough to cover the opening and tape one layer over the opening.

- Line the bottom of the box with black construction paper. Black absorbs all known wavelengths of light and converts them to thermal energy (heat). The black surface is where your food will be set to cook. How much you need will depend on the size of the box you're using to make your solar oven.
- To insulate your oven so it holds in more heat, roll up sheets of newspaper and place them on the bottom of the box. Tape them down so that they form a border around the cooking area. It may be helpful to also tape the rolls closed first. The newspaper rolls should make it so that the lid can still close, but there is a seal inside of the box, so air cannot escape.
- The best hours to set up your solar oven are when the Sun is high overhead—from 11 am to 3 pm. Take it outside to a sunny spot and adjust the flap until the most sunlight possible is reflecting off the aluminum foil and onto the plastic-covered window. Use a ruler to prop the flap at the right angle.
- You can make toast by buttering a slice of bread then letting the Sun do the rest.It would also work great to heat up leftovers. So the paper at the bottom doesn't get dirty, put what you would like to cook on a clear plastic or glass plate.

What to Expect - What kids should focus on:

- Learning how sunlight can be harnessed to generate heat.
- Understand basic scientific principles (reflection, insulation, heat)
- Discover the potential of solar energy.

Additional References or Material

https://youtu.be/wSzFkpe_5yk?si=5cWHeelYUToefeDP

6. Facilitation Tips

- Provide clear instructions and demonstrations.
- Offer guidance without giving away answers.
- Ask questions like "What do you think will happen?" or "Why do you think this works?"
- Encourage analysis of results.

7. Class Conclusion and Takeaway

As “assessment evaluation” kids can be divided in groups, given time and space and asked to come out with a “skit” summarizing what they learned.
Ask kids to come up with a story themselves about the topic of the lesson.

8. Instructor’s Theoretical Background

- Solar Energy: Energy generated from the sun's rays.
- Heat Transfer: Conduction, convection, and radiation.
- Insulation: Reducing heat loss through materials.
- Reflection: Using surfaces to direct sunlight.
- Greenhouse Effect: Trapping heat inside the oven.
- Thermal Mass: Absorbing and releasing heat.
- Angle of Incidence: Optimizing sunlight reflection.
- Oven Design: Maximizing heat retention.
- Thermodynamics: Understanding heat and energy.

9. Illustrations

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