Build a Solar Oven

Re-Energy
Activity
Grade Level 3-12

Main Objective

In the first class, learners will work in small groups to build a solar oven. During the second class, learners will test the efficiency of the oven using two baking pans, each of a different color, over a series of five-minute intervals. They will record the temperature changes on their worksheet. Learners will also identify aspects of the solar oven construction, record steps of the construction and identify building plan modifications.

Learning Outcomes

By the end of this activity, learners will:

- Identify the purpose of and specific requirements for making a solar oven.
- List the steps needed to construct a solar oven.
- Record necessary design modifications to maximize the solar collection capacity and thus achieve a higher oven temperature.
- Evaluate the effectiveness of using different colours in the baking chamber to collect heat energy.

Length of Activity: 2 hours (2 Periods)

Period 1: Building a Solar Oven (1 hour)
Period 2: Data Collection and Observation (1 hour)

Materials List: Period 1

- Solar Heat Backgrounder
- Solar Oven Construction Plan
- Materials listed in the Solar Oven Construction Plan
- Approximately ten additional large aluminium foil cake tins (one per group)

Materials List: Period 2

- Building and Testing a Solar Oven Worksheet, class set
- Completed solar oven (one per three learners is recommended)
- One oven thermometer per solar oven
- White tempera paint
- Paint brush 3-5 cm wide

Activity

Before you begin:

Paint the ten additional aluminium foil cake tins white **before** class begins. The aluminium cake tins need to be dry before the second period.

Period 1: Building a Solar Oven

Step 1: Set Up

1. Set up stations of complete materials to build a solar oven in different areas of the room. Set up enough stations to accommodate groups of three learners each.
2. Explain to the learners that they will be building a solar oven during the class. Describe the materials given and explain the purpose of each item.

Step 2: Build it!

1. Review the Solar Oven Construction Plan as a class.
   a. Watch an instructional video on **How to Build A Solar Oven (4:06 minutes)**
   b. Then, build your Solar Oven! Pay close attention to the steps on pages two to five.

Period 2: Data Collection and Observation

Step 1: Worksheet Introduction

1. Explain to the learners that they will test their solar ovens. They will also record their work and observations from the last class on the Learner Worksheet.

Step 2: Data Collection and Fill Out Worksheet

1. Instruct the learners how to record temperature data in five-minute intervals - once with the black cooking chamber and once with the white cooking chamber.
2. Have learners record with observations for each temperature interval on the Learner Worksheet.

Tips and Extension Activities

- As learners need to use sharp knives to cut items in the construction of their ovens, you may wish to wait to distribute the knives until they are needed.
- To help the learners understand what the solar oven looks like, you may want to build a demonstration model to which you can refer as you review the steps of how to build it. Do not tape the top and bottom of the oven; this will allow you to take off the reflector and reveal the shredded paper inside.
- Learners can use the "Home Heating" section in the Solar Heat Backgrounder to build a model of a solar home. Discuss how a home can be built to capture the sun's energy. List the ideas on a whiteboard/smartboard or on chart paper. Give learners some time to research passive solar heating. Using the list, add or revise the original ideas based on their research findings. In small groups, have learners build a model of a solar home and test its efficiency by placing it near a window. By comparing the design features of their models, learners can learn how passive solar heating works.
- Have learners record the temperature in the solar oven at different times of the day. Pool and compare the data collected by the learners and calculate the average temperature reached.
- Have the learners monitor and record the weather for a period of time. Learners can also describe loud cover and temperature. Discuss how many of the days would provide enough sunlight to power a solar fuelled item.
- A solar collector captures the sun's visible light to utilize heat energy. Discuss other items that convert the sun's energy into other forms of useable energy (e.g., photovoltaics). Discuss the ways that solar collectors and solar panels use the sun's energy – one converts the sun's energy to useable heat energy and the other converts the sun's energy into electricity.

Comprehension

- How could you increase the efficiency of this solar oven? Describe two or three design changes that would help the oven become hotter faster, and store heat longer.
- What is the purpose of having insulation (shredded paper) around the baking chamber?
- What are some advantages of using sunlight as a source of energy compared to other sources, such as coal or nuclear energy?
- What two forms of energy are most commonly produced using sunlight?
- How does a solar home work? What are some design features of a solar home?
- What is the difference between active and passive solar energy? Which type of energy does the solar oven use?

Answer Key to Worksheet

1. Describe how a solar oven works. The purpose of the solar oven is to capture the sun's light energy and convert it into heat energy.
2. List specific materials needed to make a solar oven. See materials list in the solar oven construction plan.
3. List the steps involved in making a solar oven.
    a. Prepare the reflective panels.
    b. Join the panels together.
    c. Add the insulating box.
    d. Prepare the baking chamber.
    e. Test the oven.
4. How does the design of the solar oven allow the sun's visible light energy to be collected? The solar oven has reflectors that funnel the light energy and concentrate it towards the baking chamber. The backing chamber has a black coating that will attract heat. The insulated box traps more heat in the oven.
5. How does the design of the solar oven allow collected heat energy to be insulated? Shredded paper in the box helps to insulate the heat collected. The plastic cooking bad over the backing chamber also helps to retain the heat.
6. What angle or position is the most effective for generating heat in this solar oven? Because the sun's rays are essentially parallel, any position (vertical to horizontal) will work. The critical aspect of positioning the collector is the "axis of symmetry" of the parabola to point directly at the sun.
7. What aspects of this design would you change to make an oven that cooked faster or hotter? The two most important variables are the area of the reflector, and the shininess or reflectivity of its surface. A larger reflector will concentrate more light and generate more heat, while a smoother, shinier surface will concentrate more of the light at the focus, also creating more heat.
8. Besides preparing food, how might a solar oven like this one be used around the home? One of the most practical applications is for heating water. Most homes use a lot of energy to provide hot water for cooking, washing, and bathing. A solar collector could provide this hot water without using fossil fuels.
9. What are limitations of a solar oven? Describe some ways to overcome these limitations. A solar oven does not work at night, or on cloudy days. Changing the placement of a solar oven over the course of a day can serve to maximize the amount of the sun's energy that is collected