

Building and Testing a Solar Oven

Brief description

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

Learning objectives

Students 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 Time

Two class periods

Materials

Period 1: Building a solar oven

- materials listed in the Solar Oven construction plans (from re-energy.ca Web site)
- Solar Heat backgrounder (from re-energy.ca Web site), class set
- Solar Oven construction plans (from re-energy.ca Web site), class set
- approximately 10 additional large aluminum foil cake tins (one per group)

Period 2: Building a solar oven

- Building and Testing a Solar Oven student worksheet, class set
- completed solar oven (one per three students is recommended)
- one oven thermometer per solar oven
- sunglasses (one pair for each student)
- white tempera paint
- paint brush 3–5 cm wide

Procedure

Period 1: Building a solar oven

- Paint the 10 additional aluminum foil cake tins white before class begins. The aluminum cake tins need to be dry before the second period.
- 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 students each.



- Explain to the students that they will be building a solar oven during the class. Describe the materials given and explain the purpose of each item.
- Review the steps listed on page three to five of the Solar Oven construction plans.

Period 2: Answering questions and testing the solar oven

- Explain to the students that they will test their solar ovens. They will also record their work and observations from the last class.
- Instruct the students on how to record temperature data in five-minute intervals — once with the black cooking chamber and once with the white cooking chamber.
- Have students complete their worksheet questions while they are waiting between intervals.

Tips and Extension Activities

- As students 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 students 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.
- Students 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 chalk/whiteboard or on chart paper. Give students some time to research passive solar heating. Using the list, add or revise the original ideas base on their research findings. In small groups, have students build a model of a solar home and test its efficiency by placing it near to a window. By comparing the design features of their models, students can learn how passive solar heating works.
- Have students record the temperature in the solar oven at different times of the day. Pool and compare the data collected by the students and calculate the average temperature reached.
- Have students monitor and record the weather for a period of time. Students can also describe cloud 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 both 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 of the 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

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 the specific materials needed to make a solar oven.

See materials list on page 2 of the construction plans, Building a solar oven.

3. List the steps involved in making a solar oven.

- *Prepare the reflective panels.*
- *Join the panels together.*
- *Add the insulating box.*
- *Prepare the baking chamber*
- *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 baking 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 bag over the baking 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 the 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.



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Student Worksheet

Name: _____

What To Do

- Record your observations and the temperature indicated on the oven thermometer. Make sure you place the thermometer inside the plastic oven bag.
- While you are waiting to record your temperature data, continue to answer the questions listed below the data and observation chart.

Data and Observations Chart

Record your observations for each temperature interval.

	Temperature at 5 minutes	Temperature at 10 minutes	Temperature at 15 minutes	Temperature at 20 minutes
Black aluminum baking tin				
White aluminum baking tin				

Questions

Use the solar oven and the background information to determine the answers to the following questions. You may need to do additional research after constructing and testing the solar oven.

1. Describe the purpose of the solar oven.
2. List the specific materials needed to make the solar oven.
3. List the steps involved in making a solar oven.



4. How does the design of the solar oven allow the sun's visible light energy to be collected?

5. How does the design of the solar oven allow collected heat energy to be insulated?

6. What angle or position is the most effective for generating heat in this solar oven?

7. What aspects of this design would you change to make an oven that cooked faster or hotter?

8. Besides preparing food, how might a solar oven like this one be used around the home?

9. What are the limitations of a solar oven? Describe some ways to overcome these limitations.

