SOLAR ENERGY FOR THE CLASSROOM

Pierce Cedar Creek Institute
for ecological education

Provided by Pierce Cedar Creek Institute
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Activity Overview
Grade Level: 6-8

General Description
Students will construct a solar air heater and learn how solar energy can be used to heat the air and water in buildings.

Learning Outcome
Students will learn about the technologies used to capture the sun's energy for heating our homes.

Science Content Standards
Content Area: Constructing New Scientific Knowledge (C) I.1.1
Standard: All students will generate scientific questions about the world based on observation.

Content Area: Constructing New Scientific Knowledge (C) I.1.2
Standard: All students will design and conduct scientific investigations.

Content Area: Constructing New Scientific Knowledge (C) I.1.3
Standard: All students will use tools and equipment appropriate to scientific investigations.

Content Area: Constructing New Scientific Knowledge (C) I.1.6
Standard: All students will write and follow procedures in the form of step-by-step instructions, formulas, flow diagrams, and sketches.

Content Area: Reflecting on Scientific Knowledge (R) II.1.4
Standard: All students will describe the advantages and risks of new technologies

Heating Our Homes With Solar Energy

Background

Solar air heaters, also called solar collectors, trap the sun's rays to produce heat. They are mostly used to heat homes and water. Most solar collectors are boxes, frames, or rooms that contain these parts:

- Clear covers that let in solar energy
- Dark surfaces inside, called absorber plates, that soak up heat
- Insulation materials to prevent heat from escaping
- Vents or pipes that carry the heated air or liquid from inside the collector to where it can be used

Covers
Many clear materials can be used as covers for solar collectors, but glass is the most common material. Glass can be made quickly and easily. The special glass used in solar collectors resists breaking and scratching.

When sunlight passes through glass and hits a surface inside a solar collector, it changes into heat. Although glass allows sunlight to pass through, it also traps the heat produced inside the collector.

Absorbers
The heat produced inside a solar collector is soaked up by metal sheets or containers filled with water, rocks, or bricks that have been painted black or another dark color. These dark-colored objects that soak up heat are called absorbers. Without absorbers, solar heating systems would not produce enough heat to warm rooms inside your house.

Science Content Standards

Content Area: Reflecting on Scientific Knowledge (R) II.1.5
Standard: All students will develop an awareness of and sensitivity to the natural world.

Content Area: Ecosystems (LEC) III.5.6
Standard: All students will describe ways in which humans alter the environment.

Content Area: Changes in Matter (PCM) IV.2.4
Standard: All students will describe common energy transformations in every day situations.

Content Area: Waves and Vibrations (PWV) IV.4.4
Standard: All students will describe ways in which light interacts with matter.

Content Area: Geosphere (EG) V.1.5
Standard: All students will explain how technology changes the surface of the earth.

Insulation

Heat always tries to move from a hotter object to a colder one. *Insulation* is what prevents or slows down the movement of heat. Because insulation prevents the heat inside a solar collector from moving to the outside where the temperature is lower, it is an important part of any solar collector.

Vents and Pipes

When a solar collector is working properly, the heat that it produces moves from the collector to an area where that heat can be used. If the collector's job is to heat air, then vents, ducts (air tubes), and fans carry the heated air from the collector to another part of the house. If the collector's job is to heat water, then pipes, tubes, and pumps move water from the collector to water heating or space heating equipment.

When fans or pumps are required to move heated air or water, the heater is called an active solar heater. If the heated air or water from the collector moves to another part of the house naturally without fans or pumps, then the heater is called a *passive solar heater*.

Why Use Solar Heating Systems?

Today, solar heating is becoming more important than ever before. Natural gas and oil, which are burned to heat our homes and water, are limited. As reserves of gas and oil shrink, these fuels become more expensive. If more people began using solar heating systems, fossil fuels such as oil and gas would become less expensive and last longer.

Burning natural gas and oil in our heating systems also causes air pollution. Even electric water and space heaters cause air pollution indirectly, because coal and natural gas are burned to produce electricity in large power plants. So if more people used solar energy to heat the air and water in their homes, our environment would be cleaner.

Materials (per student work group)

- 1 large piece of cardboard
- measuring tape
- scissors
- acrylic gesso paste
- flat black acrylic paint
- paint brush
- thumb tacks (not pushpins)
- duct tape
- thin string
- plastic wrap
- masking tape
- thermometer
- 1 piece of graph paper

Methods

1. Find a south-facing window and measure its width and height inside the frame.
2. Cut out a piece of cardboard that is 10 inches (25 cm) wider and taller than the window.
3. Cut a 5-inch (13 cm) square out of each corner to make four 5-ince flaps that extend from the top, bottom, and sides of the cardboard. Fold the flaps inward. The area inside the folds should be the same size as the window area.
4. Apply a coat of gesso paste to the inward side of the cardboard. Allow the paste to dry for 10 minutes.
5. After the paste has dried, paint the same side of the cardboard with flat black acrylic paint. Allow the paint to dry.
6. Cut vent holes 3 inches (8 cm) wide by 3 inches high at about 1 inch (2.5 cm) from the top and bottom folds of the cardboard.
7. Push thumbtacks into the unpainted side of the cardboard around the vent holes on the inside surface.
8. Weave string around the thumbtacks and across the vent holes. This keeps the plastic wrap from blowing through the vent holes.

Methods (cont'd.)

9. Cover the thumbtacks with thin strips of duct tape to prevent them from falling out of the cardboard.
10. Cut enough plastic wrap to cover the vent holes. Decide which is the top and bottom of the cardboard. Tape the plastic to the top of the bottom vent holes on the black side so the plastic hangs as a flap. Do not completely seal the vent holes. Do the same to the top vent holes on the string side.
11. Fold the cardboard flaps toward the black side, and place the cardboard inside the window frame. The plastic flap on top should be facing the inside of the room. Tape the cardboard to the window frame using masking tape. You should have air space between the window and the cardboard.
12. To perform the experiment, draw lines on the graph paper to make a three-columned chart.
13. On a sunny day and a cloudy day, take temperature readings every hour for several hours. To do this, hold the thermometer under the plastic flaps covering the vent holes for 2 minutes to measure the collector's air intake (bottom) and output (top) temperatures. Mark your temperature readings on the graph paper.

Discussion/Assessment

- During what time of the day was the collector's output temperature the highest? Lowest?
- What was the highest output temperature of the collector on a cloudy day? On a sunny day?
- Which car would be a better example of a solar collector? Why?
    - A car that has:
        - a. black seats and open windows?
        - b. dark blue seats and closed windows?
        - c. white seats and open windows?

Source: This activity was adapted from a *Solar Heating and You—For Young Scholars activity* http://www.eere.energy.gov/kids/solar_heating_and_you.html