612-0003 (05-040) Solar Furnace

Introduction:
What is a solar furnace? Methods of concentrating solar energy have existed for millennia, but it was not until 1949 that the first modern solar furnace was constructed in the Pyrenees. Basically, the purpose of a solar furnace is to generate large amounts of heat without fuel. This is possible by using heat generated by the sun and concentrating it. Solar furnaces are generally used for industrial or experimental purposes; some of the largest can generate heat in excess of 3,000° C. These can be used for disposing of hazardous waste, testing thermal properties of materials, power generation, or possibly weaponry. The primary advantages of solar furnaces are the huge heat capabilities, lack of required fuel, and ease of use. Some disadvantages are high cost, and unreliable sunshine.

Description:
There are two methods usually used for this: parabolic mirrors with a collector at the focal point, or semicircular troughs of mirrors arranged around a central point.

Our solar furnace is the former type. It features a plastic parabolic mirror 30cm in diameter, connected to a plastic base by a support shaft. A property of parabolic mirrors is their ability to focus light or other radiation onto a single point, called the focus. This focus is directly over the center of the mirror, and the distance between this point and the center of the mirror is called the focal length. If one were to place an object directly above the center of the mirror at a distance equal to the focal length, it would be subject to much greater radiation than elsewhere.

A solar furnace makes use of this by putting a collector at the focus of the mirror. Our collector is a small, black copper cup supported by a shaft. Copper is used because of its high heat conductivity. It is painted black to absorb the most amount of heat possible.

Suggested Experiments:
Converting sunlight to heat: place your solar furnace in bright sunlight. The copper receiver is adjustable; loosen the bolt holding it in place and move it until bright sunlight is focused on the bottom. Place a thermometer in the cup. Measure the temperature and compare it to the ambient air temperature. A variant is to place an ice cube in the copper receiver and another in a tray next to the solar furnace, in direct sunlight. Observe which melts first.

Storing heat: fill the receiver with water, and let it be heated until it is near boiling. Cover the mirror with a cloth, and measure the temperature of the water. How long does it take to cool down to room temperature? Would other liquids hold the heat better?

If you wish to improve the performance of the above experiment, cover the copper cup with glass, saran wrap or other clear cover. Measure the temperature of the water. How long does it take to cool down with the cover in place?

For a more explosive demonstration of the power of the solar furnace, place a few kernels of popcorn in the receiver and stand back. How long does it take for the kernels to pop?

Generating electricity: there are a few ways you can use the solar furnace to generate electricity.

Steam: use the furnace to boil water and drive a steam turbine. Attach a dynamo to the turbine and measure the current.

If you have a model of a Stirling engine, place it at the focal point. You can use it to produce mechanical work, or attach it to a generator for electrical production.

Place a small photovoltaic cell at the focal point. The concentrated sunlight will generate more electricity. Do not use a plastic coated cell, as it may melt.

Warning: this device is used to generate high temperatures. Take care not to burn yourself on the hot receiver. Wear sunglasses when operating the device, as the concentrated sunlight can damage your vision. Take care not to perform experiments involving materials that could explode or melt when subjected to heat, such as sealed containers or plastics.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

Other Science First Products:

652-1025 Wind Electric Generator: A good way to study aerodynamic transfers, this new version of an old favorite has 12 colorful plastic vanes and a balanced tail. Connect it to a DC generator and light bulb to indicate electrical output with the included leads.

652-1010 Anemometer: This colorful working model is sensitive to breezes as slight as 2 mph. Since it rotates at speeds 1/6 that of the wind velocity, wind speeds can be determined quantitatively by counting the rotations. Includes four plastic molded cups, 3 black, 1 red for contrast; low friction axle; sturdy plastic base; instructions with sample problem and wind speed chart.

652-1020 Wind Vane: The wind may not always be at your back - but at least you'll know its direction with our economical, attractive wind vane. The heavy cast base and sturdy post support a sensitive cone bearing assembly that responds to the slightest wind. Place the "N" in the northern position and read off the direction shown by the pointer.