Hand Boiler

P3-5005

BACKGROUND:

The liquid inside the Hand Boiler does not actually boil. The "boiling" is caused by the relationship between the temperature and pressure of a gas. As the temperature of a gas in a closed container rises, the pressure also rises. The molecules are moving faster in the warmer gas. There must be a temperature (and pressure) difference between the two large chambers for the liquid to move. When held upright (with the smaller bulb on top), the liquid will move from the bulb with the higher pressure to the bulb with lower pressure. As the gas continues to expand, the gas will then bubble through the liquid, making it appear to boil. The fact that the liquid is volatile (easily vaporized) makes the hand boiler more effective. Adding heat to the liquid produces more gas, also increasing pressure in the closed container.

A sample of relevant national and state science education standards: Heating and cooling cause changes in the properties of matter. Atoms and molecules are perpetually in motion. Increased temperature means greater average energy of motion, so most substances expand when heated. Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.

SAFETY INFORMATION:

Caution! Contains flammable liquid! The hand boilers contain ethyl alcohol. Keep away from heat or flame. Flush with water if contact with eyes. Do not drink.

ACTIVITIES:

Have the students hold the boiler upright by the larger bulb. How long does it take for the liquid to "boil"? Is there a student in class whose hand does not make it "boil"? Take the temperature of the students' hands. Notice the difference. How do you make the liquid go down again? Hold onto the top bulb only. What happens if you hold both bulbs? Why? Can you make the liquid move by using cooling instead of heating? Try putting ice on the bulbs and see what happens. After several uses, the boiler won't work for a while. Why not? Will the boiler work if upside down? Why not?

RELATED PRODUCTS:

The **Drinking Bird** (P3-5001) uses evaporative cooling to move a liquid to his head. He tips, allowing the liquid to flow back, and starts over again.

The **Cartesian Diver** (P1-2000) shows the relationship of pressure to volume of a gas. It also demonstrates the concept of buoyancy.

Use the **Pressure Pumper** (P1-2050) and a soda bottle, and the **Student Vacuum Pumper and Chamber** (P1-2140) to explore volume, pressure, and temperature of gases.