

CONCEPTUAL PHYSICS**Experiment**

23.4 Change of Phase: Boiling

COOLING BY BOILING

Purpose

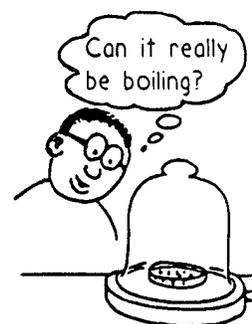
In this activity, you will see that water will boil when pressure is lowered.

Required Equipment and Supplies

400-mL beaker
thermometer
vacuum pump with bell jar

Discussion

Whereas evaporation is a change of phase from liquid to gas at the surface of a liquid, boiling is a rapid change of phase at and below the surface of a liquid. The temperature at which water boils depends on atmospheric pressure. Have you ever noticed that water reaches its boiling point in a *shorter* time when camping up in the mountains? And have you noticed that at high altitude it takes *longer* to cook potatoes or other food in boiling water? That's because water boils at a lower temperature when the pressure of the atmosphere on its surface is reduced. Let's see!

**Procedure**

Warm 200 mL of water in a 400-mL beaker to a temperature above 60°C. Record the temperature. Then place the beaker under and within the bell jar of a vacuum pump. If a thermometer will fit underneath the bell jar, place a thermometer in the beaker. Turn on the pump. What happens to the water?

T = _____

Was the water *really* boiling?

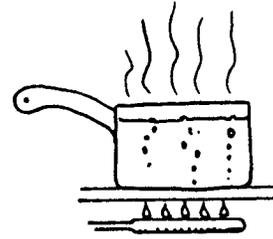
Stop the pump and remove the bell jar. What is the temperature of the water now?

T = _____

As time permits, repeat the procedure, starting with other temperatures, such as 80°C, 40°C and 20°C, recording the time it takes for boiling to begin.

Summing Up

1. In terms of energy transfer, what does it mean to say that boiling is a cooling process? What cools?



2. Name two ways to cause water to boil.

3. Boiling water on a hot stove remains at a constant 100°C temperature. How is this observation evidence that boiling is a cooling process?
