Pressure and Temperature Teacher's Notes

Main Topic	Pressure & Fluids
Subtopic	Gas Laws
Learning Level	Middle
Technology Level	Low
Activity Type	Student

Description: Measure the temperature change caused by an increase in pressure in air-filled container.

Required Equipment	Pressure Pumper, Strip Thermometer, Empty 20oz or half-liter soda bottle
Optional Equipment	

Educational Objectives

- Measure the temperature change caused by an increase in pressure in air-filled container.

Key Question

- How does a change in the pressure of a gas affect its temperature?

Concept Overview

According to Charles' Law, the pressure of a gas and its temperature are directly proportional. If the pressure increases (with volume staying constant), the temperature increases, and vice versa.

The strip thermometer allows students to observe a slight increase in temperature as they pressurize a plastic bottle. The most dramatic observation is the rapid decrease in temperature when the pressure is released.

This concept can be tied to several real-life experiences including refrigeration and why cans of compressed air (used for dusting electronics) carry freeze warnings.

Lab Tips

Soda bottles are designed to withstand very high pressure; however, students should wear safety glasses during this activity.

Caution students to reduce the contact their hands have with the bottle in this experiment, to reduce the temperature changed caused by body heat.

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Pressure and Temperature

1. Put a temperature strip (58-88 °F) in a clean dry 20 oz. pop bottle.
2. Record the temperature in the bottle: _____
3. Put the Pressure Pumper on top of the bottle.
4. Pump the Pressure Pumper 100 times. What is happening to the pressure in the bottle?

5. Record the temperature in the bottle: _____
6. What happened to the temperature in the bottle?

7. While watching the temperature strip, unscrew the Pressure Pumper. What happens to the temperature as the pressure is released?

8. State the relationship between the pressure of a gas and its temperature.

9. A student got a large balloon at the store. She walked home with the balloon on a very cold day. What do you think happened to the balloon as she walked? Explain your reasoning.

Pressure and Temperature Name: _____
Class: _____

Extension Activity:

1. Repeat steps 1-4 from the previous activity. Record the unpressurized and pressurized temperatures.

   Unpressurized temperature: _____

   Pressurized temperature: _____

2. Let the pressurized bottle sit until it returns to the unpressurized temperature. What is happening to the heat energy that was in the bottle?

3. When the bottle has returned to the previous temperature, release the pressure. Record the new temperature. _____

Theory:

This is the principle behind refrigeration. A gas is compressed. It heats up, and that heat energy is released into the environment (out of the air conditioning unit, or out of the back of the refrigerator). The cooled, compressed gas is allowed to decompress, and it cools to an even lower temperature. The expanding gas absorbs heat from the area being refrigerated. As demonstrated here, air works for this process, but it cannot carry much heat at a time. Special refrigerant gases are used in air conditioners because they are more efficient in moving heat through this process.

If you ever let air out of your car tires, feel the air that is escaping. It feels cold!

4. If you left the door open on the refrigerator, would the whole room get cooler? Explain.