

Main Topic	Pressure & Fluids
Subtopic	Adiabatic Expansion
Learning Level	Middle
Technology Level	Low
Activity Type	Student

Description: Observe cloud formation when a gas is allowed to expand quickly in volume.

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

Educational Objectives

- Observe an adiabatic process, specifically cloud formation when a gas quickly expands in volume.

Key Question

- How do clouds form?

Concept Overview

Students introduce water vapor and smoke into a bottle, pressurize it, and quickly release the pressure. The rapid depressurization decreases the temperature of the water vapor, which encourages it to condense around the smoke particles. A cloud forms.

Lab Tips

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

Caution students to keep hair and clothing away from the flame.

Cloud Machine

1. Add a little water to a 20-oz. pop bottle.
2. Light a match and blow it out. Hold it inside the mouth of the bottle and let some of the smoke go 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 inside the bottle?
5. Release the pressure by slowly unscrewing the Pressure Pumper. Carefully watch the air inside the bottle. What happens?

Theory:

As you increased the pressure in the bottle, you also increased the temperature. When the pressure was released, the temperature decreased. The water vapor in the air in the bottle, when cooled suddenly, condensed into water droplets. These water droplets could be seen as a cloud.

The smoke in the bottle acts as a condensation point, something for the water molecules to stick to. Small particles such as those in smoke are called aerosols. An aerosol is about 1000 times larger than a water molecule. A water droplet (like in a cloud or fog) is 20 times larger than an aerosol and a raindrop is composed of about 100 droplets.

Questions:

1. What happens to water vapor as it cools?
2. What is the purpose of the smoke?
3. Why does fog form more often in the early morning than any other time?