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## A Cloud in the Hand . . .

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### Introduction

An exquisitely simple demonstration in which you literally form a cloud with your own two hands. The thunder and lightning are up to you.

### Concepts

- Condensation
- Cloud formation
- Gas laws

### Materials

Clear plastic soda bottle, 2-liter

Matches

Water, 10 mL

### Procedure

1. Remove the label and the base from a clear two-liter soda bottle.
2. Add approximately 10 mL of water (room temperature) to the bottle and replace the cap.
3. Shake the bottle to distribute the water on the interior surface and let it stand for at least a few minutes. This will allow time for some of the water to evaporate.
4. Uncap the bottle and light a match. Allow the match to burn for a few moments. Extinguish the match and immediately toss it into the bottle. Quickly cap the bottle very tightly, trapping some of the smoke from the extinguished match.
5. Using both hands, squeeze the bottle. The pressure in the bottle will increase significantly.
6. Quickly release your grip and observe the bottle interior. A cloud will form. Repeat as often as desired.

### Discussion

This demonstration is loosely analogous to cloud formation in the atmosphere. Squeezing the bottle dramatically increases the pressure (and slightly increases the temperature) inside the bottle. At this higher pressure some of the water that was in the

vapor phase returns to the liquid phase until a new equilibrium state is reached. When the pressure on the bottle is released the pressure (and temperature) within the bottle drops suddenly, creating a partial vacuum. To reattain equilibrium, water now goes from the liquid phase to the vapor phase. At this point the area above the liquid becomes saturated with water vapor which condenses on the “airborne” smoke particles (condensation nuclei) to form the cloud. This saturation is caused by unequal pressures of the liquid and vapor phases upon expansion of the bottle. Think of the inequality of pressure as an instantaneous partial vacuum.

As an interesting aside, while going through a few squeeze and release cycles hold the bottle up to a fluorescent (overhead) light. By releasing and applying the pressure slowly, various colors may be evident (primarily purple and orange). One might suppose that light passing through the bottle is differentially scattered by the smoke particles as the pressure varies. Perhaps similar to the atmospheric effects seen at sunset!

## Disposal

The soda bottle may be saved and used for future demonstrations.

## Acknowledgment

Adapted from an item written by Bruce Parks that appeared in *Connect*, January/February 1995 issue. *Connect* is a publication of the Teachers Laboratory, Inc., Brattleboro, VT.

**An *Ultimate Cloud-Forming Apparatus Kit* is available from Flinn Scientific, Inc.**

Catalog No.	Description	Price/Each
AP5302	Ultimate Cloud-Forming Apparatus	Consult Your Current <i>Flinn Catalog/Reference Manual</i> .