

## Cloud in a Bottle

*This experiment illustrates the effect of pressure change and aerosols on cloud formation.*

*Before beginning this lab activity, watch the short video about condensation nuclei and cloud formation. It will help you understand this lab much better.*

<https://www.youtube.com/watch?v=z6B3YMzPu2c>

### Materials:

- 1) Two clear, empty, plastic water bottles with lids. Remove labels.



- 2) Matches.

### Directions:

- For the first bottle, add about 1 inch of hot tap water and put the lid on. Shake vigorously.
  - Look through the bottle. It is best viewed in good lighting against a dark background.
  - Squeeze the bottle as hard as you can, then release it. Repeat this 5 or 6 times.
  - You are trying to see if there is any change in the air inside the bottle. To get a clear view, swirl the water around to remove condensation from the inside walls of the bottle.
- 
- For the second bottle, again add about 1 inch of hot tap water, put the lid on, and shake.
  - Take the lid off, light a match, blow it out, drop it into the bottle while it is still smoking, then immediately put the lid back on the bottle.
  - Again look through the bottle, squeeze the bottle as hard as you can, then release it. Repeat this several times. Swirl the water as needed to remove condensation from the inside walls of the bottle.
  - Safety precautions are always important "in the lab". Take a moment to put the matches away, out of reach of children. Thanks!

Which bottle had better cloud formation, the one with smoke in it, or the one without?

Did the cloud appear when you caused high pressure on the air in the bottle (by squeezing), or when you caused low pressure (by releasing)?

### **What is happening?**

The warm moist air in the bottle is close to saturation. Squeezing the bottle increases the air pressure which also causes an adiabatic temperature increase. This increased temperature allows more water to evaporate. Releasing the bottle decreases the pressure and temperature slightly and causes the excess water vapor to condense. The smoke particles are condensation nuclei which improve cloud formation.

The formation of the cloud when the pressure decreases is analagous to what happens to a parcel of air rising in the atmosphere.

**Answer the following questions, based on the experiment and these sections in your textbook:**

Dew-Point Temperature, pages 449-451

Adiabatic Temperature Changes, page 452

Condensation and Cloud Formation, pages 444-447

The amount of vapor needed for saturation \_\_\_\_\_ with increasing temperature.

- increases
- decreases

Saturation occurs when sufficient water vapor is added to the air, or when air is cooled to its dew point.

- True
- False

Cooling below the \_\_\_\_\_ causes water vapor to condense.

Air that is allowed to expand \_\_\_\_\_; air that is compressed \_\_\_\_\_.

- cools; warms
- warms; cools

When a parcel of air moves upward, it expands and cools.

True  
False

In order for a cloud to form, air must be cooled below it's \_\_\_\_\_ point.

In the experiment, squeezing the bottle causes pressure and temperature to \_\_\_\_\_; releasing the bottle causes pressure and temperature to \_\_\_\_\_.

increase; decrease  
decrease; increase

Tiny bits of particulate matter known as \_\_\_\_\_ serve as surfaces for water vapor condensation.

Give two examples of condensation nuclei.

Explain why the cloud appeared when you released the bottle.

After you have completed your own experiment, you can watch the video below which will hopefully, duplicate what you have done and seen. I chose this video specifically since the guy is very entertaining and thought it would be interesting to watch. Let me preface, that during the video the guy keeps talking about "smoke" but actually this is not smoke, but condensation of moisture using the particles in the air inside the bottle to form against to form a cloud.

<https://www.youtube.com/watch?v=VMt7mAUSdBM>