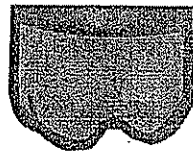




## Cloud in a bottle



Ingredients: One soda bottle (with cap), water, matches  
cotton string, muscle

### Background info:

When a parcel (certain volume) of air is **compressed**, the molecules are forced closer together. This compression warms the parcel, and is called **adiabatic warming**. This occurs to air that is put under higher pressure than it was before.

When a parcel of air **expands**, the molecules spread out. This expansion cools the parcel of air, and is called **adiabatic cooling**. This occurs to air that is under less pressure than it was before.

In this activity we will model the compression and expansion of air, a process that causes condensation or evaporation in our bottle.

### Procedure:

1. Add some water to the very bottom of the bottle (about 2-3 cm deep and no more.)
2. Let the bottle (cap on!) sit for a minute or two undisturbed.
3. Light the cotton string with a match, let burn for a few seconds, then extinguish.
4. Carefully open the cap of the bottle (don't let water spill out!) Quickly place the **smoking end** of the string in the bottle and cap the bottle. Lower the string a few centimeters. Let it sit for a minute while some smoke enters the bottle.
5. Take the cap off and remove string. Quickly place the cap back on and **screw the cap on tightly**.
6. Experiment with the bottle by squeezing it (compression of air) and releasing it (expansion of air.) Note what happens.
7. Answer the questions below.

## Questions:

1. What happens inside the bottle when you compress the air inside? \_\_\_\_\_  
\_\_\_\_\_
2. When you compress the air in the bottle is pressure increasing or decreasing? \_\_\_\_\_
3. When you compress the air in the bottle is the temperature of the air inside increasing or decreasing? (see background information) \_\_\_\_\_
4. What happens when you release the bottle and let the air expand again? \_\_\_\_\_  
\_\_\_\_\_
5. When the air expands is the pressure increasing or decreasing? \_\_\_\_\_
6. When the air expands in the bottle is the temperature of the air increasing or decreasing? (see background information.) \_\_\_\_\_
7. Why do we need to add water to the bottom of the bottle? \_\_\_\_\_  
\_\_\_\_\_
8. Why do we need to add some smoke to the bottle? \_\_\_\_\_  
\_\_\_\_\_
9. When the cloud disappears, the liquid droplets of water making up the cloud are evaporating. What do we need to do to make the cloud evaporate and why does it cause evaporation? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
10. When the cloud forms, the water vapor inside the bottle condenses to form liquid droplets. The cloud forms because we \_\_\_\_\_ (cooled or warmed?) the air to the \_\_\_\_\_ point temperature. This happens because the air inside the bottle \_\_\_\_\_ (compressed or expanded?) Relative humidity is at or near \_\_\_\_\_ %
11. In real life, air expands when it \_\_\_\_\_ (rises or sinks?) and the pressure on it \_\_\_\_\_ (decreases or increases?)  
In real life, air compresses when it \_\_\_\_\_ (rises or sinks?) and the pressure on it \_\_\_\_\_ (decreases or increases?)
12. Clouds (and condensation) tend to form when air is \_\_\_\_\_ (rising or sinking?) because this \_\_\_\_\_ (cools or warms) the air to the dew point temperature.
13. Clouds tend to dry up (evaporate) when air is \_\_\_\_\_ (rising or sinking?) because this \_\_\_\_\_ (cools or warms) the air above the dew point temperature.