

CLOUD IN A BOTTLE OR BOTTLING UP THE GAS LAWS

STUDENT EXPECTATIONS

Upon completion of this activity, students will be expected to know or have a better understanding of:

- How clouds form
- Boyle's gas law
- Charles' gas law
- The strength of a plastic bottle

TEACHER NOTES

This activity came from Project Atmosphere training. The gas law information was added. People weighing well over 250 pounds have stood on 2 and 3 liter soda pop bottles without them bursting.

Boyle's law – there is an inverse proportion between volume and pressure if the amount of gas remains the same. (If volume is decreased, pressure is increased.)

Charles' law – there is a direct proportion between pressure and temperature if the amount of gas remains the same. (Increased pressure causes an increase in temperature.)

By standing on the bottle, the students decrease the volume, and increase the pressure which causes the temperature to go up. When your students get off the bottle, pressure decreases and temperature goes back down.

The reason we used a 3 x 5 note card to tape the thermometer to is to make certain we are taking the inside air temperature and not the temperature of the floor.

When the drops of water (humidity) are added to the bottle and then temperature and pressure released, a cloud will form in the bottle, just as when an air pocket rises in the atmosphere with humid air and temperature and pressure are released, condensation must occur. The smoke particles from the match are condensation nuclei for the water to condense on, much like dust, smoke, or salt in the atmosphere.

Even the atmosphere must obey the gas laws!

ACTIVITY DESCRIPTION

In this activity, students should work in pairs so as one is standing on the bottle (which is lying on its side) the other can read the temperature inside the bottle.

MATERIALS

- Dry, clear, (no labels) 2 or 3 liter bottle with lid. (3 liter bottles are best because they have a larger opening.)
- Liquid crystal aquarium thermometer
- 3 x 5 note card
- match
- few drops of water
- tape

METHODS/PROCEDURES

- Fold the note card in 3 equal lengthwise sections to make a triangle
- Tape the ends of the triangle together.
- Tape the liquid crystal aquarium thermometer to the triangle
- While the bottle is still DRY, put the triangle into the bottle and put the lid on tightly.
- Lay the bottle on its side and stand on it while your partner watches the thermometer. You might want to put your hand on a desk or something to help you balance.
- Observe what happens to the thermometer.
- Now, get off the bottle, take the lid off, and put a few drops of water in the bottle and shake the bottle making humidity in the bottle.
- Strike a match and immediately blow it out causing the smoke from the match to go inside the bottle.
- Screw the lid back on and repeat the procedure.
- After you have stood on the bottle for 30 to 60 seconds, step off and see what happens!

RESULTS/CONCLUSIONS

1. How was Boyle's gas law demonstrated by this exercise?
2. How was Charles' law demonstrated by this exercise?
3. What happened to the temperature inside the bottle when you stood on it?
4. What was the purpose of blowing smoke into the bottle?
5. Describe how this would be similar to cloud formation.
6. What type of precipitation may be formed if the humid air rises very high in the atmosphere and the updrafts are very strong?