

The Atmosphere

Learning Activity 2

Objective:

Demonstrate the effect of heat on pressure.

Overview:

A plastic 2-liter bottle will be crushed by the normal atmospheric pressure in the room.

Total Time:

10 – 15 minutes

Supplies:

Two empty 2-liter bottles, hot tap water.

Background:

Pressure is not only a matter of altitude but also is dependent upon the temperature. As the temperature increases so does the pressure. The atoms that comprise the air we breathe gain energy as they absorb heat. That increase in energy results in faster moving atoms which we observe as an increase in energy. The opposite occurs when the temperature decreases. As the atoms lose energy, their motion is decreased and we observe a decrease in pressure.

Procedure:

1. Place two cups of hot tap water into each two 2-liter bottle.
2. Place your thumb over each bottle opening and shake. This ensures the air inside the bottle is warmed.
3. Pour the water out of each bottle and screw a bottle cap on only one of the two bottles.
4. Stand both bottles side-by-side and observe over the next five minutes.

Discussion:

The bottle that was capped will eventually begin to collapse. This is a result of the cooling air inside that bottle. The air cools because the atoms inside the bottle lose energy as they collide with the bottle side that is exposed to the cooler surrounding air. As their energy decreases so does their velocity and therefore the pressure decreases. Since the pressure inside the bottle decreases the weight of the air outside the bottle begins to crush the bottle.

However the uncapped bottle remains unchanged. As the air cools inside, outside air moves in to take up the space thereby keeping the pressure the same both inside and outside of the bottle.