

Purpose:

Students will follow these instructions to investigate the effects of changes in pressure, volume and temperature on common objects in the laboratory.

Materials:

empty aluminum can	water
graduated cylinder	hot plate
crucible tongs	bucket of ice water
juice glass with smooth lip	half sheet of paper or 3 x 5 index card
empty 2-liter soda bottle	plastic pipette or medicine dropper
water with food coloring	small plastic jar or film canister (with hole drilled in the side)

Safety:

When performing these investigations, students must wear eye goggles and must follow instructions to avoid burns.

Procedure:

- Place about 10 mL of water in an empty soda can. Heat the can on a hot plate so the water starts to boil. After 60 seconds of vigorous boiling, use the tongs to turn the can over in one quick motion and immediately place the mouth of the can into a bucket of ice water.
 - When the water starts boiling, the air in the can is forced out and replaced by what?

 - Placing the can in ice water causes the water to condense. Does decreasing the temperature of the gas cause the pressure inside the can to increase or decrease?

 - Does decreasing the temperature of the gas cause the volume of the gas inside the can to increase or decrease?

- PERFORM THIS DEMONSTRATION OVER THE SINK IN THE CLASSROOM.** Pour water into the glass container until it overflows. Place the provided piece of paper over the mouth of the glass container. Hold the paper in place while you invert the glass. Remove your hand from the paper. The water should stay in the glass... but you are welcome to try again if it did not work the first time!
 - Why did water not fall out when you inverted the glass?

3. Fill a 2-liter soft drink bottle to within 4 cm from the top. Half-fill a pipette or medicine dropper with water that has food color added. Drop the pipette into the bottle and tighten the lid to make the bottle airtight. Firmly squeeze the soda bottle with both hands until the pipette “diver” descends.
- Look at the level of the color liquid in the pipette. As the pipette moves down in the bottle, does the volume of the color liquid increase or decrease?

 - Does the volume of AIR in the pipette increase or decrease as pressure increases?

 - The water enters the dropper to take the place of the compressed air. Does the pipette now have more or less mass?

 - When you release pressure on the soft drink bottle, the volume of air in the pipette increases, forcing the extra water from the pipette. The pipette is now buoyant and moves upward in the bottle. Does the pipette have more or less mass?

4. Obtain a small plastic container (like a juice bottle or film canister). Notice that it has a small hole drilled in the side. Fill the container with water and place your hand firmly over the top of the canister. (You may have to practice this because you have to move your hand quickly before the water leaks out of the hole!)
- What happened to the water when you placed your hand over the top of the can?

 - Explain why this happened.

5. When Joseph Kittinger piloted a balloon to an altitude of 29.7 km (18.5 miles) in the atmosphere, he ran into trouble. At a height of 13.1 km (43,000 feet), the pressure glove on his right hand developed a leak. Based on your knowledge of atmospheric pressure and gas laws, EXPLAIN IN WORDS what happened to his hand.

6. Calculate the pressure (in pounds per square inch) exerted by the left heel of a person walking on a wooden floor. The person has a weight of 120 pounds and has a left shoe with a heel surface area of 0.02 square inches.

