

Punctured Plastic Bottle

GENERAL INFORMATION

This experiment demonstrates how air pressure controls the flow of water. When the bottle is filled with water and then capped, the weight of the air around the bottle is exerting a force or pressure on it. As the tape over a hole in the side of the bottle is removed, a small amount of water might leak from the bottle. This would be caused by some air trapped between the water level inside the bottle and the cap.

The force of air against the hole will “push” against the water and prevent it from flowing out. When the cap is removed, the air pressure exerts a pressure on the surface of the water equal to the force being exerted against the water in the hole on the side of the bottle. Gravity will then “pull” the water from the bottle.

Air pressure at sea level is approximately 14.7 pounds per square inch (PSI). Air pressure decreases with elevation. At 10,000 feet the air pressure is about 10.2 pounds per square inch. Below sea level air pressure increases. For example, Death Valley, California is as much as 282 feet below sea level. At that point the air pressure is greater than 14.7 pounds per square inch.

MATERIALS

The experiment can also be demonstrated using an empty paint thinner.

PROCEDURE

When presenting this experiment to the class, you could poke the hole, place the masking tape and then fill and cap the bottle, before showing it to the students. After removing the tape, show the bottle to the class and carefully unscrew the cap while holding it over a wastepaper basket. Get the students to think at the analysis/synthesis level by asking them to indicate why the water flows from the hole when the cap is removed and why it stops when the cap is replaced.

POSSIBLE ANSWERS

1. When the masking tape was removed, none, or very little, of the water leaked from the bottle.
2. When the lid was removed, the water flowed from the hole because of the air pressure pushing on the water through the opening at the top of the bottle and the pull of gravity.
3. Replacing the lid, or covering the hole with the hand, cuts off the air pressure on the surface of the water and the flow stops.
4. Air is all around the bottle.
5. This experiment proves that air controls the flow of water.

EXTENSION ACTIVITIES

Ask students to suggest ways that air pressure is used in everyday life to control the flow of liquids. Answers will vary, but some responses might include:

1. Using a wedge type can opener to make two holes at the top of a large fruit juice can, tomato sauce can, etc. before pouring it. If only one hole is used, the liquid will dribble out.
2. Picnic jugs have an opening at the top that has to be adjusted before the liquid can be “pushed” out of the spigot.
3. Using a narrow neck vinegar bottle that has the plastic insert in the opening. Fill with either water or vinegar. Hold the bottle upside down and slowly unscrew the cap. The water or vinegar will be held in the bottle by the upward force of the air pressure against the opening.

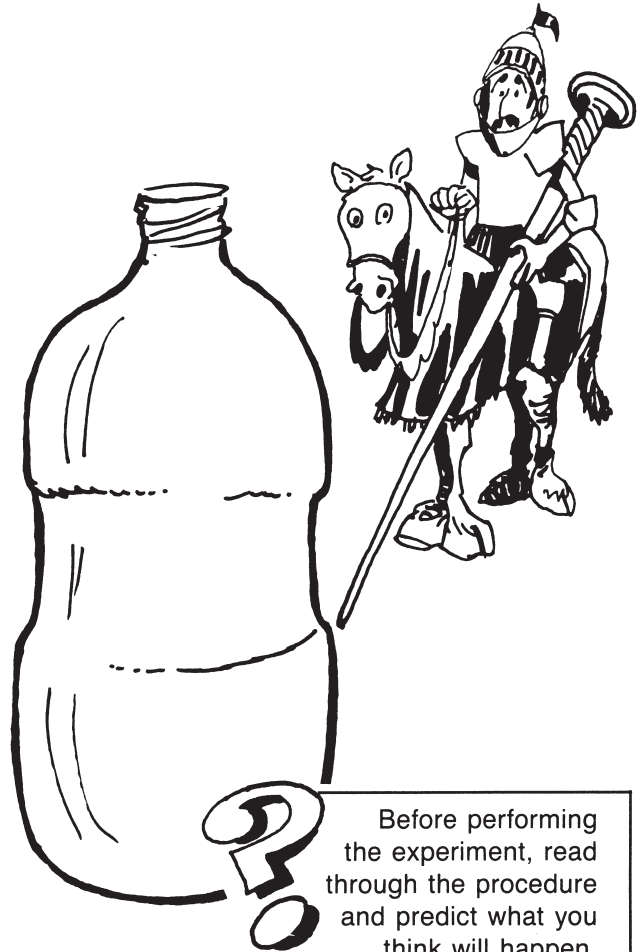
Punctured Plastic Bottle

You Will Need

- plastic soda pop, shampoo, or detergent bottle with screw on lid
- nail • water • masking tape

Procedure

1. Using a nail or ice pick, make a hole in the side of the bottle about 2" from the bottom.
2. Cover the hole with a piece of masking tape and fill the bottle with water.
3. Screw the lid onto the bottle.
4. Remove the masking tape that covers the hole. Observe for several seconds.
5. Unscrew the lid and remove it from the bottle. After five seconds, replace the lid or cover the top of the bottle with your hand.



Before performing the experiment, read through the procedure and predict what you think will happen.

Questions

1. What happened when the masking tape was removed?
2. Was there a change when the lid was removed? What caused this to happen?
3. Did a change take place when the lid was replaced or the opening was covered by your hand? Describe.
4. What is all around the outside of the bottle?
5. Tell what this experiment proves.

CAUTION: This activity should be conducted with adult supervision.

