# Cartesian Diver

SECONDARY

## Materials

Large paper clips (The vinyl-covered multi-colored ones work best)

Small rubber bands

A clear two-liter soda bottle with lid

Clear plastic straws

## Activity

**1.** Fold straw in half and pinch it in the middle to make it easier to bend. Wrap a rubber band several times around the bottom to secure the ends. To add weight to the diver, hook the outside ends of both large paper clips on the rubber band between the front and back of the straw, placing one paper clip on each side of the diver.

**2.** Fill the bottle with water, put the diver in, and twist the cap on. It is best to avoid extremes in water temperature.

**3.** Squeeze the bottle to make the Cartesian diver sink, and release to make it rise. Vary how hard you squeeze the bottle. You will find that the harder you squeeze, the faster the diver will sink to the bottom.

## Explanation

The experiment illustrates that compressing material while increasing the material's density (gas molecules, in our industry), and, therefore increases buoyancy. When pressure is released, the gas molecules expand, producing more surface area and reducing gas density. The result is that they become more buoyant and rise to the top of the fluid. This is what happens in a solution gas drive reservoir as the pressure declines and a gas cap is created. It also applies to oil and gas separation technology. The best illustration is what happens when you open a carbonated soft drink and the gas fizzes out as the pressure is released.

Ideally, the diver will sink when you squeeze, and rise when you let go. Often, however, the diver benefits from some fine tuning. If the bottle gets dropped on the floor, the diver will stay sunk. The pressure shock has allowed too much water to get into the diver. You must remove the diver from the bottle and shake out the water.

If the diver does not dive, try squeezing the bottle harder. If that doesn't work, add more paper clips for weight. If the diver sinks but does not rise, try removing one paper clip or replacing it with a smaller paper clip. Also, do not use any straws that could be cracked and leaking air.