

# How do scuba divers sink?



Explore how an object's density will affect its buoyancy.

**Setting:** Indoors

**Time:** < 30 minutes

**Concepts:** pressure, buoyancy, density

**Skills:** predicting, observing

## Subject(s):

- ✓ Physics
- ✓ Earth Sciences

## Ages:

- ✓ 9-11
- ✓ 12-14

## Materials:

- 2mm disposable pipettes (or eye droppers)
- Large vinyl-covered paper clips (about twice the size of the common paper clip)
- Normal sized vinyl-covered paper clips
- Permanent markers
- 500ml water bottles with lids
- Blue food colouring
- Water

## What to do!

1. Decorate the bulb part of the pipette (or eyedropper) with permanent ink. It can be a diver's face, a sea creature or anything you want!
2. Attach the large paper clip vertically to the bottom (tube part) of the pipette by sliding the pipette through it snugly. Attach the small paper clip underneath in the same way. Make sure that the clips stay below the bulb part. This is now your diver.
3. Fill your water bottle almost to the top. Carefully place your diver inside.
4. Add 2-3 drops of blue food colouring and put the lid back on (make sure it's VERY tight).
5. Give your bottle a squeeze and watch your diver go!
6. Troubleshooting: If your diver sinks and does not come back up, that means the water has forced the air OUT of the pipette. Dump out the contents of the water bottle, empty the water from the pipette, refill the bottle and put the diver back in. Try it again!



Squeeze!  
→



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Video – [Cartesian Diver - Sick Science! #138](#) (Video – 1:37min)

## What's happening?

Density is the amount of weight in a specific volume. An object is buoyant (floats) if its relative density is less than that of the fluid it rests in. That means that in order for something to float on water, it needs to be less dense than water.

In the experiment, by squeezing the sides of the bottle, all of the matter ("stuff") in the bottle is under increased pressure. As you squeeze, the air molecules are compressed into a smaller space and water moves up inside the pipette, taking up the space that the air once occupied. When this water goes up inside the pipette, its mass is then added to the diver's mass, increasing the relative density of the diver. Due to this increase in relative density, the diver is no longer less dense than water and sinks to the bottom of the bottle. When you release the pressure on the bottle, the air is able to expand again, forcing the water back out of the pipette. This decreases the relative density of the diver and allows it to float once again.

## Why does it matter?

People float because the human body is less dense than water. Scuba divers, however, are able to stay under water and control their depth. They do this by using two pieces of equipment that help them stay underwater: a weight belt and a buoyancy compensator. Properly adjusted, the weight belt allows the diver to increase his density enough to descend. Not enough weights are put on the belt to sink the diver, but to give him the freedom to descend. The buoyancy compensator is a vest that can be inflated with air to increase buoyancy or deflated to reduce buoyancy. Understanding the relationship between density and buoyancy allows the diver to practice safely!



## Investigate further!

- Try using different sized bottles. Do you need to squeeze more with a bigger bottle or a smaller bottle?
- Does the temperature of the water affect the density of the diver? Try using both ice cold water and hot tap water.
- What happens if you add salt to the water?