

Questacon at HOME

Activity sheet

Water Density

Background

Density describes how much mass an object has relative to how much space it occupies. A kilogram of feathers takes up much more space than a kilogram of rocks; this tells us that rocks are denser than feathers! The density of a substance can also be affected by its temperature. In this experiment, we are going to explore how temperature affects the density of water.

Materials

- 2 identical small, wide mouthed bottles (i.e. baby food jars)
- A rigid plastic card that is larger than the opening of
- the bottles, such as an old rewards card
- Cold and hot (not boiling!) water
- Two different colours of food dye



Procedure

Set up the water bottles: Fill one bottles all the way to the top with warm water, and fill the other all the way to the top with cold water. Put a few drops of food dye into the warm bottle, and a few drops of a different coloured food dye into the cold bottle.

Stack the bottles: Place the plastic card over the opening of the warm bottle, making sure that it's completely sealed. While holding the plastic card in place, flip the warm bottle upside down and stack it on top of the cold bottle so that the rims line up exactly.

Observe what happens: Carefully slip the plastic card out from between the bottles and observe what happens! Try the experiment again, but this time, put the cold bottle on top. Compare the results of the two experiments.

Safety

This activity uses water, which can become a slipping hazard. Adult supervision is recommended for young experimenters.



Tips & tricks

- Bottles with narrow necks are easier to stack on top of each other.
- If you're having trouble flipping the container without spilling lots of water, try using a more rigid waterproof card.
- Do this experiment in an area where you can spill a lot of water, like a bathtub or backyard.

What's the Science?

Density is a measurement of mass divided by volume – that is, how much 'stuff' is contained within a certain space. Consider a brick and a block of wood that are the same size. The brick is heavier than the wood, because the molecules it is made out of are more tightly compacted together. This means it is denser than the block of wood.

Density is affected by a substance's temperature. When the temperature of a substance increases, the density decreases because the atoms inside the substance are moving around more and take up more space. This increase in volume results in a decrease in density. The opposite happens when a substance cools down; the molecules slow down and take up less space. This decrease in volume results in an increase in density.

A substance that is less dense than the liquid or gas it is placed in will float to the top! This is why helium balloons float upwards in the sky and why surfboards float in the ocean. In this experiment, when the containers are stacked carefully, less dense warm water can float on top of cold water. If the containers are stacked so that the cold water is on top, it will sink to the bottom, causing the water to mix.

What questions could I ask?

- What do you think will happen when we remove the waterproof sheet?
- Why do you think that happened?
- Where could you see this effect in the real world?
- How different do you think the water temperatures have to be for separation to occur?



What's next?

- **Temperature challenge:** Instead of using warm and cold water, try filling two bottles with water of the same temperature. Do you get the same result?
- **Salt challenge:** Instead of warm and cold water, try using fresh water and salty water. What happens? Which type of water is denser?
- **Time challenge:** After you've stacked your bottles and removed the plastic card, leave the bottles until the water cools down. What happens over time? Make sure you leave the jars in a safe place where they won't be knocked over.

