

Lava lamp

Lava lamp demonstration: A demonstration video can be viewed at rsc.li/3ehzJKJ

This investigation looks at what proportion of a fizzy drink is gas and how much is liquid.

Age group: 7–9

Learning objectives

- To show understanding of solids, liquids and gases.
- To understand that gases have mass.

Enquiry skills:

- To take accurate measurements.
- To apply maths skills in science.

Background science

Learners are likely to have experienced drinking fizzy drinks, and the burps that come after doing so! In this investigation, learners will explore how much of their fizzy drink is liquid and how much is carbon dioxide gas that has been added to make it fizzy.

The lesson will help them to understand that a gas has mass, as they will be able to see how the mass shown on the scales changes as the gas escapes, as well as having a discussion about why drinking fizzy drinks leads to burping, which they will have experienced first-hand.

Prior learning

Learners should already know that there are three states of matter: solids, liquids and gases. They should have a basic understanding of the properties of each state of matter.

Links

The investigations [Bath bombs](#) and [Intriguing ice](#) also involve the generation of carbon dioxide. In [Fire extinguisher](#) this carbon dioxide is used to put out lit tea lights.

Key words and definitions

Solid – A material that has a fixed volume and holds its shape. Ice, wood and chocolate (at room temperature) are examples of solids.

Liquid – A material with a fixed volume that can flow and that takes the shape of its container. Water, juice and lava are examples of liquids.

Gas – A material that spreads out in all directions, filling its container. Gases can be compressed (squashed). Oxygen, carbon dioxide and nitrogen are examples of gases.

Mass – The amount of matter, or 'stuff', that makes up an object. Mass is measured in grams and kilograms [avoid using the term 'weight'].

Carbon dioxide – A material that is a gas at room temperature and is added to drinks to make them fizz.

Teachers may wish to hide the meanings/examples on the PowerPoint slide and discuss the learners' ideas first.

Equipment list

Each group of learners should have:

- A set of electronic scales
- A 500 ml bottle of fizzy drink
- Measuring jug (with a capacity of at least 500 ml)
- Spoons, straws or something else to stir the drinks with

Try to gather a range of different brands and types of fizzy drink, including some budget brands.

You might not have enough sets of electronic scales in school to give one to each group. The best way to gather these is to ask colleagues to bring in theirs from home. Alternatively, you may be able to borrow more accurate electronic scales from local secondary schools.

Method

Recap the terms *solid*, *liquid* and *gas* and ask learners to identify familiar examples.

Demonstrate the activity from the video and ask learners to identify the solids (container, effervescent tablet), liquids (oil, water) and gases (air, carbon dioxide bubbles). Notice how the gas is produced when the tablet is added to water.

1. Show a bottle of fizzy drink and ask learners to identify which materials are solid (the bottle and lid), liquid (the drink) and gas (carbon dioxide). Explain that the drink is fizzy because carbon dioxide gas has been dissolved in the liquid. Discuss how we can tell that there is a gas in the drink – what clues are there? (*We can see bubbles; hissing sound on opening; tingles on the tongue; and it makes us burp!*) Challenge them to explain why burps occur, using what we have talked about in this lesson.

Explain that we are going to explore how much solid, liquid and gas there is in the bottle of fizzy drink. To do this, we need to find the total mass of the bottle and drink and then the masses of the bottle, liquid and gas separately.

2. Ask learners to measure the mass of their group's full bottle using the scales. Ask them to estimate how much is solid, liquid and gas. Discuss whether different drinks will contain the same amount of gas in and why.
3. Discuss learners' ideas for how they could find the masses of the different materials, then support them in planning their investigation. To prevent a big mess, suggest ways in which learners could agitate the liquid to release the gas without shaking up the bottle (eg pouring the liquid out into a container and stirring until it is flat). Consider learners' other suggestions.
4. When the drink is flat, measure the mass of the remaining liquid. Learners may need help understanding that they need to find the mass of the container to calculate the mass of the liquid. If they subtract the mass of the bottle and the mass of the liquid from their original total, they will have the mass of the gas in the unopened drink.



Discuss any differences that were found between each group's results.

Question prompts

1. Why do you think fizzy drinks make us burp?
You burp when gas moves from the stomach, up the oesophagus and out of the mouth. Often, this gas comes from the air around you, which you swallow when you eat or drink. When extra gas gets into your stomach, your body forces it back out in a burp. This is more likely to happen if you eat or drink very quickly or talk a lot while you are eating. Carbonated (fizzy) drinks can also increase burping because you swallow the carbon dioxide in the bubbles.
2. What can you see change in the drink as you open the bottle?
Before you open the bottle, the carbon dioxide is dissolved in the liquid and is under pressure. When you open the bottle, the pressure decreases and the gas escapes quickly, making a hissing sound. The bubbles appear as the carbon dioxide turns into gas.
3. Do you think the mass of drink will be more or less after we have loosened the top?
The mass will start to decrease as some of the carbon dioxide escapes.
4. What happens when you leave a bottle of fizzy drink open for a long time?
The longer you leave the bottle open, the more chance the carbon dioxide has to escape. When the carbon dioxide leaves the fizzy drink, the drink will become flat.
5. How could we find out the mass of the solid bottle?
Pour out all of the drink and find the mass of the bottle.
6. How could we make sure that we are only measuring the mass of the liquid and not the gas too?
Wait until the drink is completely flat.
7. How will you know when all the gas has left the liquid?
The bubbles will disappear completely from the drink.
8. Does the gas make the drink lighter or heavier? (Many learners have a misconception that adding gas makes things lighter).

The gas makes the drink heavier as gases have mass.

9. Do you think that all fizzy drinks will contain the same amount of gas?
You can test this by putting a balloon over the top of the bottle when you first opened. How much the balloon inflates will tell you how much carbon dioxide you have managed to collect.

FAQs

1. Why can't we see the gas inside the liquid?
The gas is invisible. We 'see' it as a bubble when it is surrounded by liquid. The gas has dissolved in the liquid, like when salt dissolves in water – it is still there but you can't see it anymore.
2. Where does the gas go when the drink becomes flat?
The gas spreads out to fill whatever space it is in, so it has been unleashed into the room! When someone opens a door or window, it will continue spreading out.
3. Is carbon dioxide bad for us?
We breathe out carbon dioxide. The amounts in fizzy drinks are very small and will not harm us if we drink them, but carbon dioxide makes the liquid acidic and along with sugar, this can damage our teeth if drunk too often. Carbon dioxide is one of the gases that contributes to global warming. In fact, some manufacturers of fizzy drinks use 'captured' carbon dioxide for their fizzy drinks that has been produced by power stations and then cleaned. This puts energy-generation waste to good use.

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