Heavy sugar

Heavy sugar demonstration: A demonstration video can be viewed at rsc.li/3wCi3PZ

The investigation allows learners to explore how much sugar is in ordinary cola.

Age group: 9–11

Learning objectives

- To recognise that objects float at different levels in relationship to their mass/density.
- To know that mass is the measure of the amount of matter from which the object is formed and is measured in grams.
- To understand that density is a measure of the amount of mass in a certain volume.
- To understand the role of sugar in health.

Enquiry skills:

- To predict, observe, and evaluate an investigation giving reasons for any explanations.

Background science

Learners will investigate the amount of sugar in a soft drink by comparing its mass with a comparable diet drink. This relates to healthy living and allows learners to visually see the effects of the choices they make regarding the drinks they consume. The visual impact of the investigation should serve as a reminder to consider the implications on their lifestyle when they choose the drinks they consume regularly.

Learners will know that some objects float, whilst others sink. They will probably relate this to the mass of the object. It is important to point out that it is not just the mass that matters, but the volume too. We link these two quantities, mass and volume, in a measure called density. Put simply, if you have two objects of the same size (volume) the denser material has more mass.

Prior learning

Learners should understand that objects float or sink depending on their density (how much material mass is found in a certain volume) and whether this is less than the surrounding liquid (it will float) or greater than the surrounding liquid (it will sink).

They should be familiar with states of matter – the basic properties of solids, liquids and gases.

Links

Here learners explore the mass of a dissolved solid. In The leaky bottle they look at the mass of a dissolved gas.

Key words and definitions

Dissolve – to mix a substance with a liquid so that this substance is no longer visible.

Solvent – a liquid, such as water, that can dissolve another material.

Solute – a material that can be dissolved, eg in cola, a solute is sugar, and the solvent is water.

Soluble – a substance that can be dissolved in a solvent, eg sugar is soluble in water. When a substance dissolves, it might look like it has disappeared, but in fact it has just mixed with the solvent to make a transparent (see-through) liquid called a solution.

Density – a measure of how much mass there is in a given volume.

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

Equipment list

- Can of diet cola
- Can of cola (preferably same brand as the diet)
- Plastic transparent cup
- Teaspoon
- Granulated sugar
- Balance for weighing (optional)
- Tank two-thirds full of water
- Other types of soft drinks

Method

1. Prepare the tank, place where all the learners can see it.
2. Show the learners two cans of cola, stating that one is diet and the other 'ordinary' but they have the same *volume* (you can show them the volume in millilitres on the side).
3. Ask if anyone drinks these and tally their answers.
4. Ask the learners to predict what will happen if they place the two cans in the water and explain their ideas.
5. Place the two cans in the water and ask the learners to talk about what they observe, suggesting reasons. Record a selection of responses.

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Learners may suggest that the cans have different masses, contain different types of liquid, are made of different types of metal or they may understand about the sugar inside. Explain that the cans are the same, so it is the content that has changed. One can has more mass (it is heavier) for its size (volume) and denser than the other.

6. Pour out the contents of the 'ordinary' cola and ask the learners to look at it carefully. Can they see the sugar? No. Why not? It is dissolved in the liquid. Take time to explain dissolving.

7. Ask them to observe closely and count cubes or add granular sugar to a plastic cup balanced on the can of diet cola until it sinks like the 'ordinary' can. You may need someone to support the cup as you add the sugar.

Learners could further investigate sugar content in a variety of soft drinks. Looking at the nutrition labels, they should measure out (onto scales) and bag the same amount of sugar in each drink. This can be displayed to appreciate, visually, the amount of sugar in each drink.

Learners could tally consumption of drinks for a week and create a graph or create information posters offering healthy alternatives or guidance to others. Discuss the implications of excessive sugar on a healthy lifestyle.

Question prompts

1. What did you predict might happen when the cans are placed in the water?
2. What are the differences between the two cans of cola?
   The ingredients in the cola – one has no sugar but does contain sweeteners.
3. How do we know they are different?
   Look at the ingredients list.
4. What are the similarities between the two cans of cola?
   Volume of liquid, type of can.
5. Why do you think the 'ordinary' cola sinks lower in the water?
   It is heaver/denser than the diet can.
6. Can you explain why the diet cola floats higher in the water?
   Without sugar, the overall mass is less (therefore the density is less than for a similar volume of 'ordinary' cola).
7. Why is it important for us to know how much sugar is in the drinks we consume?
   Too much sugar is bad for health/causes tooth decay.
8. What impact might drinking large quantities of cola or other sugary drinks have on our health?
   Drinking too many sugary drinks can contribute to obesity, diabetes, and tooth decay.

FAQs

1. Does this happen with all diet and non-diet drinks?
   We could collect samples and find out!
2. What makes the drinks sweet if it is not sugar?
   They are sweetened with artificial sweeteners like aspartame, saccharin, or sucralose.
3. What are artificial sweeteners?
   These are 'low-calorie' or calorie-free (they don't provide the body with any energy) chemical substances used instead of sugar to sweeten foods and drinks.
4. How do we know which drinks have the most sugar?
   You can read the information on the can before you buy it. The contents must be listed by law – the highest are at the beginning of the list.
5. Do all cans float, even baked beans?
   You could investigate at home and share your findings.