

Fizzy drinks

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Acknowledgements

This resource was originally developed by the University of Reading to support outreach work delivered as part of the Chemistry for All project.

To find out more about the project, and get more resources to help widen participation, visit our Outreach resources hub: rsc.li/3CJX7M3.

Fizzy drinks: teacher notes

Available from rsc.li/3o5OV1P

Guidance notes

This resource should take approximately one hour to complete in full. It was initially created for 11–14 year-old learners but can be adapted for other age groups.

The learners should understand the idea of the pH scale but may need a reminder.

Download the PowerPoint presentation, technician notes and student workbook that accompany this resource at rsc.li/3o5OV1P.

Read our health & safety guidance, available from rsc.li/3IAmFA0, and carry out a risk assessment before running any live practical.

Find specific safety advice for the chemicals used in this project in the technician notes.

The safety equipment suggested is in line with CLEAPSS requirements. For non-hazardous substances, wearing lab coats can help to protect clothes. The safety rules might be different where you live so it is worth checking local and school guidance.

Learning objectives

- Compare the sugar content and pH of a range of fizzy drinks.
- Discuss the health implications of sugar and acidity.

Career link

Senior science manager

Between Activities 2 and 3, introduce learners to Paul, a senior science manager. He works for British Sugar and manages the scientific services, developing and implementing process improvements. Watch his video job profile, available on **slide 10** of the PowerPoint and also from rsc.li/3lpJleT, to show your learners how chemistry careers are making a difference.

Activity 1: cola and milk (10 minutes)

In this activity the learners will make observations about the change in the appearance of cola over time following the addition of whole milk.

Show the video of the experiment and expected observations from bit.ly/3Z6804w (Home Science channel), which is also available on **slide 4** of the PowerPoint. Ask learners to record their observations in the table included in their workbook.

Once the learners have watched the video and recorded their observations, they should answer questions (a) and (b) in their workbook.

Answers

- (a) A white precipitate settles out, leaving a clear solution behind.
- (b) This is a reaction between phosphoric acid and calcium and the protein in the milk. The milk 'curdles' as the protein changes shape – the protein changes from being soluble to insoluble in water. The reaction equation is shown on **slide 5** of the PowerPoint.

As an alternative to the video, you could demonstrate this reaction, with learners making observations of the contents of the bottle throughout the lesson.

If time were available, and you had sufficient resources, the learners could do this activity themselves but you would have to provide the instructions below.

To do

1. Open the cola bottle and add milk slowly so the liquid gets close to the lid area.
2. Reseal the bottle and gently rotate the bottle to mix the ingredients.
3. Every 10 minutes gently rotate the bottle to mix the contents.
4. Record your observations in the table throughout the session.
5. Use your observations to answer questions (a) and (b) at the end of the session.

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Available from [rsc.li/3o5OV1P](https://www.rsc.li/3o5OV1P)

Before moving on to **slide 6**, give the learners two minutes to answer the following questions in pairs:

- What is the pH scale?
- What is it used for in modern life?
- Can you give some examples of different acids and bases?

Go through the content of **slide 6** to answer these questions.

Activity 2: pH of soft drinks (20 minutes)

Learners find out how acidic soft drinks can be.

Learners can work in groups of three or four to encourage discussion. The method is given in the student workbook. Provide the six different soft drinks in six 250 ml beakers. Each beaker will have two labelled syringes that learners will use to transfer the soft drink to their 50 ml beaker. Tell learners these syringes must be kept with the labelled beakers at all times to avoid getting them mixed up.

Slide 8 of the PowerPoint provides a pH scale for learners to use to interpret colour changes with universal indicator. This slide can be printed out if preferred.

Once learners have collected their results table, they should use their observations to answer questions (a) and (b).

The answers can vary depending on the soft drinks used, but the suggested answers are shown on **slide 9** of the PowerPoint.

Answers

- (a) The drinks with pH values lower than 3 were the most acidic.
- (b) The more acidic the drinks are, the more likely they are to do damage to the enamel of the teeth.

What is sugar?

Use **slide 11** of the PowerPoint to provide some background on sugar.

Demonstration: sugar in soft drinks

Set this up in front of learners, then return to it once the drinks have evaporated. While the liquid is evaporating, discuss with the learners what is happening and why. You should notice that in the evaporating dish containing the Coca-Cola®, there is a brown residue left behind as the liquid evaporates. This brown residue is the sugar in Coca-Cola®.

The evaporating dish containing the Coca-Cola® zero sugar should not produce residue during the heating because it does not have sugar present.

Encourage learners to think about why the amount of sugar could be an issue and how it may cause harm to our health. Encourage them to use their observations to answer questions (a) and (b) in their student workbook.

Equipment

- 100 ml Coca-Cola®
- 100 ml Coca-Cola® zero sugar
- 2 × evaporating basins
- 2 × Bunsen burners
- 2 × heat mats
- Spatulas
- Tripod and gauze for resting the evaporating basins

Method

1. Pour out the 100 ml Coca-Cola® and 100 ml Coca-Cola® zero sugar into separate evaporating basins.
2. Apply heat to boil the water off.
3. Keep stirring the contents of the evaporating dishes throughout the demonstration.
4. Show the learners the end result and allow them to compare the differences.

If the demonstration cannot be performed in class, you could show learners a video of the same experiment from bit.ly/3lQ5pgJ (Home Science channel).

Answers

- (a) The cola zero sugar drink has almost no residue after evaporation, but learners may be surprised by the amount of sugar remaining from the cola.
- (b) Encourage students to think about dental care as well as obesity and diabetes.

Activity 3: sugar or no sugar? (15 minutes)

Learners investigate the sugar content of different soft drinks (these will be the same drinks that learners tested the pH of in Activity 2). They can work in groups of three or four to encourage discussion.

Before learners start, demonstrate how to transfer 5 ml of each drink from the labelled beaker to a 50 ml beaker, label and apply the test stick into the liquid and how to take a reading of sugar concentration. (Take a glucose test strip, dip it into a liquid for 1 second, remove it, then leave for 30 seconds for colour to develop.)

Learners can use the sugar scale shown on **slide 14** of the PowerPoint to interpret the results shown on the test strips. This slide can be printed out if preferred.

The learners should then use their results to identify the sugar and zero versions of each soft drink from the list provided on **slide 15** of the PowerPoint. (Note: amend this list depending on the types of soft drinks you have available.)

Discuss the results as a class.

The test is based on the enzymatic reaction that occurs between glucose oxidase, peroxidase and chromogen. Glucose is first oxidised to produce gluconic acid and hydrogen peroxide in the presence of glucose oxidase. The hydrogen peroxide reacts with potassium iodide chromogen in the presence of peroxidase. The extent to which the chromogen is oxidised determines the colour produced.

Answers

Note: the answers to these questions will vary depending on the learners' results. Find the general guidance to aid class discussion below. You will need to tailor the answers for (a) and (b) depending on your choices of soft drinks as guided below.

- Provide the list of drinks matched with their letter labels – discuss who got the correct answers.
- Provide the name of the drink containing the most sugar.
- The test strips only measure glucose so are not necessarily a useful tool for comparing sugar content in drinks. Sucrose and fructose, for example, will not be detected. The strips are used to test blood glucose. As sucrose is broken down to glucose and fructose during digestion, sucrose in the diet will affect blood glucose levels.

Plenary

Use **slide 17** to ask learners to think about the potential health issues of sugary drinks.

Give them three minutes to consider their answers in pairs.

Show **slide 18** to encourage learners to think particularly about the damage caused to their teeth and link this to the importance of good dental hygiene and teeth brushing before moving on to the next slide.

Slide 19 shows some pH values of a variety of fizzy drinks. The notes on the slide give the reference website to provide more examples. Ask learners to identify the drinks that could cause their teeth to dissolve if they drank too much of them.

Slide 20 gives the answers.