Bath bombs

Bath bombs demonstration: A demonstration video can be viewed at rsc.li/3hCBqnW

The investigation will enable learners to identify the materials needed to make an irreversible reaction. After the investigation learners could make bath bombs (risk assessments/ allergy checks needed). This may require several lessons, depending on the time available.

Age group: 9–11

Learning objectives

- To understand that chemical changes produce new materials and are irreversible.

Enquiry skills:
- To take measurements.
- To record data and results using scientific diagrams and labels.
- To use test results to make predictions.

Background science

Learners are likely to have eaten fizzy foods (sherbet), drunk fizzy drinks and be aware of fizzy bath bombs.

This investigation will explain the science behind the ‘fizzing’. Acids and alkalis are chemicals that react together to form new materials. Some examples of these chemicals are edible (eg citric acid and bicarbonate of soda) and when they react, one of the products is carbon dioxide gas. Learners will already have been introduced to three states of matter and to mixing/separating materials (reversible changes such as melting and freezing); by investigating changes that lead to new materials being formed, they will learn that chemical changes are not reversible. Formation of a gas is an indication that an irreversible change has occurred.

Prior learning

Learners should already be familiar with:

- States of matter (materials as solids liquids and gases).
- Melting and freezing as reversible changes.
- Dissolving as a reversible change.
- Powders, which are solids in granular form.

Links

The creation of carbon dioxide using these ingredients is also used in the investigations Freaky hand and Lava lamp. Extinguishing a flame using carbon dioxide can be done in Fire extinguisher.

Key words and definitions

Reversible change – a change where no new materials are created and the original material can be recovered. Examples include melting, evaporating, freezing, dissolving and mixing (creating a mixture).

Irreversible change – a chemical change or reaction where new materials are formed.

Gas – a 'state of matter' where particles have high energy and large spaces between them. A gas takes the shape of the container it is in and will flow.

Variable – a condition or object that is observed or measured that could change during a science experiment, eg temperature, amount of substance.

Carbon dioxide – a type of material usually found as a gas (it does not generally form a liquid and becomes solid at –78°C).

Acids and alkalis – chemicals with specific properties that may be thought of as 'chemical opposites' and that react together to form new substances.

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

Equipment list

Per pair/group

- Beakers/containers
- Spoons/mixing implements of appropriate size or pre-measured amounts in cake cases
- Pipettes (optional)/fine paintbrushes
- Citric acid
- Bicarbonate of soda
- Water
- Oil (rapeseed/baby oil) *allergies
- Food colouring/essential oil for colour and scent *allergies
- Salt
- Stopwatches

NOTE: citric acid is not found in all supermarkets. It may be easier to source online or where home brewing materials are sold.

Method

Ask if learners have ever eaten fizzy foods (eg sherbet, popping candy). Why are they fizzy? What makes the fizz? Explain that the fizz is actually carbon dioxide and that we are going to investigate how this is made.

Provide learners with citric acid and bicarbonate of soda. Ask what they know about these materials already. [This could lead onto a further lesson on acidity using red cabbage indicator/litmus paper.] Citric acid is added to homemade cordials and sherbet, so some learners will be familiar with it. It is the same acid as you find in lemons, which will be familiar to most learners.

Explain that they will be investigating what happens when they mix these materials and add water.

Ask learners to prepare, in advance, a table to record their results, or provide one for them to fill out as they complete each test.

It is helpful for the initial amount of product to be used to be clearly written next to the substances, so the learners use the right amount. Once water has been added to the powders, no further testing is possible, so consider retaining larger amounts for further investigation until these are needed and providing small amounts for each test.

You should guide learners to think about variables – anything that could be changed in the experiment that might have an effect on the outcome. It is useful to start by asking learners to identify *everything* that they think could be **changed** (eg amount of bicarbonate of soda, amount of citric acid, amount of water, type of liquid) and *everything* that could be **measured** (eg how long the reaction continues, the mass of the reactants, the temperature of the water).

In this experiment, learners **will change** the ratio of bicarbonate of soda to citric acid – this is the **independent** variable.

Learners will measure the time it takes for the fizzing to stop – this is the **dependent** variable.

All other variables [the amount (volume) of water, the temperature of the water] must be **controlled** (ie must remain the same each time). This makes it a fair test.

Older learners should be introduced to these terms (but it is more important that they understand the process than remember the names of the variables!).

Younger learners should simply be introduced to the term variable as anything that can be changed and shown how these are changed, measured and controlled.

Take time to explore variables that could be changed.

1. Learners should work in pairs to mix and observe these materials. A good starting point is 2 tsp bicarb and ½ tsp citric acid. They should mix the materials and record their observations.

What do they observe? *Nothing happens.* What do they think would need to be added to cause a reaction? Prompt with sherbet – is it fizzing in the packet? What do you think makes it start to pop?

2. Next, add water a drop at a time, using pipettes if available, and observe. If no pipettes, use the end of a spoon to add one drop at a time or use a paintbrush to add drops.

Learners could complete a table to show how much water can be added before the fizzing stops.

3. Investigate changing the amounts of materials (dependant on how much you have).

MATHS LINK: Explore ratios using bicarbonate : citric acid. The suggested ratio is 4 : 1, but learners can try 1 : 1, 2 : 1, 3 : 1, 1 : 2, 1 : 3 and 1 : 4. Learners can investigate how much water is added before it stops fizzing, or they can add a set amount of water and time how long it fizzes for. Encourage learners to choose their own question to test.

4. Learners can make bath bombs to take home and share their learning.

NOTE: If using dye/herbs/essential oils, you will need to be aware of allergies.

Question prompts

1. What happens when you keep adding water? Does it keep fizzing? Why not?
   Water provides conditions to cause a chemical reaction. When the initial chemicals are used up, no more gas can be made, at that point the reaction will stop.
2. Carbon dioxide is invisible. How do we know that a gas has been created?
   You can see bubbles of liquid that surround the gas.
3. What else might make this fizz? Oil?
   Only water will react.
4. What happens if you use sugar/salt in place of bicarb/citric acid?
   Sugar or salt don't react. This reaction requires an acid and an alkali to create carbon dioxide. You might use sugar or salt in food to flavour it or in a bath bomb to soften the water.
5. Can you get the original substances back again?
   A chemical reaction is irreversible and makes new substances.
6. Why doesn't a fizzy drink go flat in the shops?
   The carbon dioxide gas is pumped into the liquid under a lot of pressure, so there's a lot of gas in the drink! Particles of gas are tiny – eventually they can get out through the tiniest of gaps between the lid and the bottle, but this can take a very long time.

FAQs

1. Why doesn't anything happen when I mix the two solids?
   These materials need to be wet before they can react. If they were left out in a damp room they would react slowly – moisture in the air would wet the chemicals so they can react.

2. Why do we see it fizz?
The substances react to create a new substance – a gas called carbon dioxide – this bubbles through the liquid and 'pops' at the surface, creating the 'fizz'.
3. Why does it stop fizzing?
Fizzing stops when the reactants have been used up (converted into new materials).
4. Why doesn't another liquid like oil make it fizz? *The chemicals will not dissolve in the oil as they do in water to enable them to react.*
5. What happens if I try a different acid?
Vinegar could be tested. This contains acetic acid in water so the reaction would start straight away. However, it would be smelly and not suitable for a bath bomb!
6. What if I change the temperature of the water?
Heat speeds up reactions as there is more energy, which causes the particles to move around more quickly and therefore react more quickly.
7. What is the gas – how can I tell?
Carbon dioxide, which is colourless and odourless. It could be collected with a syringe/pipette and bubbled through limewater; it could be carefully poured over a lit tea light and it would extinguish the candle. [Note: this links with the Fire Extinguisher investigation.]