

Fight fire! Fill up with foam

This resource accompanies the article **Chemicals that play with fire** in *Education in Chemistry* which can be viewed at: rsc.li/44gGuU2.

Learning objectives

- 1 Plan an investigation to identify the reagent that produces the largest quantity of carbon dioxide foam.
- 2 Record the investigation results and make a conclusion.
- 3 Design a 'foam launcher' suitable for delivering the foam to a fire.

The aim of this experiment is to produce the largest quantity of carbon dioxide foam possible.

Each group is provided with these starting reagents:

- Sodium hydrogen carbonate (6 spatulas) x 3
- Sulfuric acid, 1.4 mol dm^{-3} (20 cm^3) x 3

Learners then investigate which **one** extra reagent produces the largest quantity of foam. The reagents to investigate are:

- Washing detergent powder (6 spatulas)
- Washing up liquid solution (20 cm^3)
- Water (20 cm^3)

The reagents can be added in any order but must not be shaken or stirred. Once learners have decided the order of the reagents, they must keep this the same in each reaction to make it a fair test.

Equipment

Per group

- One litre plastic measuring cylinder **or**
- One litre drinks bottle with the top cut off
- Measuring cylinder (25 cm^3)
- Spatula
- Non-permanent marker pen and ruler

Reagents per group (with quantities to be used in each experiment)

- Sodium hydrogen carbonate powder (6 spatulas)
- Sulfuric acid, 1.4 mol dm^{-3} (20 cm^3)
- Washing detergent powder (6 spatulas)
- Washing up liquid solution (20 cm^3)
- Water (20 cm^3)

Preparation

- Refer to SSERC/CLEAPSS Hazcards and recipe sheets.
- Hazard classification may vary depending on the supplier.

Chemical supplied for the practical	Preparation
Sodium hydrogen carbonate solid NaHCO_3 (s) Currently not classified as hazardous	N/A
Washing up liquid solution, 1:5 dilution (1 part washing up liquid mixed with 5 parts water) Not considered as hazardous	Washing up liquid, non-diluted  WARNING Irritant to eyes and skin
Washing detergent powder  WARNING Irritant to eyes and skin	N/A
Sulfuric(VI) acid, 1.4 mol dm^{-3} H_2SO_4 (aq)  WARNING Irritant to eyes and skin.	Sulfuric(VI) acid, concentrated H_2SO_4 (l) MW = 98.07 g mol^{-1}  Danger Corrosive to eyes and skin. Wear splash-proof goggles and a face shield and chemical resistant gloves.

Safety, hazards and additional notes

[Read our standard health and safety guidance](#) and carry out a risk assessment before running any live practical.

- Wear safety glasses.
- Learners can carry out their tests in plastic drinks bottles with the top removed to avoid a jet of chemicals being projected. Care should be taken to avoid cuts as the plastic might be sharp. Learners can use a non-permanent marker pen to draw lines on the outside of the bottle and then measure the height of the foam using a ruler. They can calculate the volume of foam generated.
- Do not use biological detergents as they contain enzymes and may cause an allergic reaction. Check the hazard warnings on containers of washing powder and washing up liquid – most washing powders and detergents are irritant to the eyes and will have a warning sign. Detailed safety data sheets are also available online. Learners with sensitive skin will need to wear gloves.
- As the amount of foam produced by detergents differs between brands, the dilution will need to be determined by the technician.
- Check learners' planning before they start their investigation and throughout their tests.
- If possible, supply all chemicals in closed containers.
- Wash hands at the end of the lesson.

Disposal

- Supply buckets filled with 1 litre of 1 mol dm⁻³ sodium carbonate solution and a few drops of universal indicator solution and ask learners to empty their bottles into the bucket. Stir, check that the solution is alkaline, then add water and pour down a foul-water drain.