5: Foam Fire Extinguisher

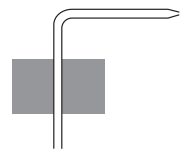
● Basic level ● 30 minutes total

Requirements

2 x 50 cm^3 beakers
50 cm^3 measuring cylinder
100 cm^3 conical flask
bung with delivery tube drawn out into a fine nozzle
(this will make it easier to control the jet)
spatulas
stirring rods
dropping pipette

aluminium sulphate powder, $Al_2(SO_4)_3$
sodium hydrogencarbonate, $NaHCO_3$
washing up liquid or liquid detergent

eye protection
protective clothing (e.g. lab coats)



Method

See pupils' sheet.

Safety advice

Avoid foam in the eye.

The foam will make the floor slippery; ensure that pupils direct their foam jets at a sink.

Chemical background

The sodium hydrogencarbonate releases carbon dioxide when it reacts with the acidic aluminium sulphate solution. The detergent is a foaming agent.

The carbon dioxide acts as a blanket which excludes air from the fire. The foam traps the carbon dioxide and slows down the rate at which it diffuses away.

6: Floating Soap Bubbles

● Basic level ● 30 minutes

Requirements

a wand for blowing soap bubbles (you can make one from wire)
a large transparent container with an open top (an empty 45 dm^3 aquarium works well)
shallow glass dish to fit inside the large container (glass baking dish)
straws and string for the large wand

soap solution: 10% liquid detergent
85% distilled or deionised water
5% glycerine
stir the mixture, do not shake.

20 g sodium hydrogencarbonate, $NaHCO_3$
250 cm^3 colourless vinegar or 0.1 mol dm^{-3} ethanoic acid

• Butterfingers (0117 986 6690) supply bubble making accessories.

Method

See pupils' sheet.

Safety advice

Wear eye protection when blowing large bubbles.
The floor may be become slippery.

Chemical background

A soap molecule has a long tail which is water-insoluble (hydrophobic) and a small electrically charged head which is water soluble (hydrophilic). When soap molecules are added to water, they tend to migrate to the surface and orient themselves so that their water soluble end points towards the water and the long tail sticks out of the water. When a wand is placed in the solution and then withdrawn, the water tends to drain from the inside of the film, making the surface begin to collapse on itself forming a multilayered spherical film.

A soap bubble is round since the surface of the soap film which forms tends to contract to take up the smallest possible surface area. In the walls of the bubble, the water drains to the bottom of the bubbles producing a small bump on the bottom. When the top of the bubble becomes too thin to support the total mass of the bubble, it breaks.

The colour of the bubbles is due to the interference of the light being reflected from the inner and outer surfaces of the film. The film is of varying thickness and so different areas of the bubbles will have different colours.

The floating bubbles become larger as carbon dioxide moves through the soap film.
The bubble becomes heavier and sinks lower into the CO_2 in which it is floating.


wear gloves to avoid staining hands


avoid skin or eye contact

7: pH Painting at Home

● Basic level ● 30 minutes

Requirements

TO MAKE THE PURPLE pH PAPER:
1 small red cabbage
white blotting paper
cheese grater and bowl
sieve
a large bowl
eye dropper (or similar) if available
access to a warm oven or hair dryer (optional)

TO MAKE THE pH 'PAINTS':
concentrated lemon juice
baking soda
washing powder
some water-tight containers
paint brushes
protective clothing and household gloves to prevent staining of gloves and hands
eye protection if available

Method

See pupils' sheet.

Safety advice

The work must be carried out under adult supervision, after written permission has been obtained (see page 13).
Wear rubber household gloves.
Work on a stainless sink surface near a tap.
Although the chemicals involved are household items, if you do spill anything on your skin, wash it off with water and thoroughly rinse your eyes should you splash anything in them.

Chemical background

The purple colour of the red cabbage is due to a mixture of natural dyes present. Under different conditions of pH, the dyes have different structures and therefore absorb different wavelengths of light.

You will find that the paints often dry to a different colour.
This is because pH is a measure of the **concentration** of acid or alkali. As the 'paint' dries the water evaporates, and the concentration of the acid or alkali effectively increases.
This means that a 'paint' which is blue when wet may dry to a green colour.
Similarly, a 'paint' which is green when wet may dry to a yellow.