Science at home

The Science of Soap Bubbles

THE SCIENCE

Soap bubbles are difficult to examine because of their fragility and short life. However, because they are very light, soap bubbles will float on a gas that is only slightly denser than the air that fills them. Such a gas is carbon dioxide. When soap bubbles settle into a container of carbon dioxide, the bubbles float on the carbon dioxide and can be examined closely.

MATERIALS

You will need:

- soap bubble solution with blowing wand;
- a large transparent container with an open top such as an empty fish tank;
- 125 ml (½ cup) of baking soda (sodium bicarbonate);
- 50 ml (1 cup) vinegar
- shallow glass dish to fit inside the large container such as a glass baking dish.

HEALTH & SAFETY

Soap can make hard floors slippery.

METHOD

Place the glass dish inside on the bottom of the large transparent container. Put 125 ml of baking soda in the glass dish. Pour 250 ml of vinegar into the dish with the baking soda. The mixture of soda and vinegar will immediately start to fizz as they react and form carbon dioxide gas. Carbon dioxide is denser than air and so it will be held in the large container as long as it is not disturbed by draughts of air over the container.

After the fizzing in the dish has subsided (about a minute), gently blow several soap bubbles over the opening of the large container, so that they settle into the container. This may take a bit of practice. Do not blow directly into the container, you will blow the carbon dioxide out of it. When a soap bubble settles into the container it will not sink to the bottom, as it would in air. Instead, it will float on the surface of the invisible carbon dioxide in the container.

While the bubble is floating on the carbon dioxide in the container, you can observe the soap bubble closely. Note what the bubble looks like.

NOTE:

- the bubble colour(s)
- bubble size and any change
- the position of the bubble, does it rise or sink?

When you have finished observing the bubbles, dispose of the mixture in the glass dish by rinsing it down the drain with water.

The colours of a soap bubble come from reflections of the white light that falls on the bubble. White light, such as from the sun or from a light bulb, contains light of all colours.

Light has waves, and the length of the wave, from crest to crest, determines the colour of the light. When light reflects from a bubble, some of each wave reflects at the outside surface of the soap film. Some light travels through the soap film, and reflects from the inside surface of the film.

Waves of light reflected from the inner and outer surfaces of the film of a soap bubble can interfere with each other. Where the crests of the light waves reflected from the inner and outer surfaces of the film meet, the intensity of the light increases. If the crest of a wave reflected from the inner surface meets the trough of a wave from the outer surface, the intensity of the light is diminished. Whether the crest of a wave meets another crest or a trough is determined by the length of the wave and by thickness of the film. If the film thickness is a multiple of the wavelength of the light, the crests of waves reflected from the inner surface will meet the crests of waves reflected from the outer surfaces. If the thickness of the film is an odd multiple of half the wavelength, the crests of the waves reflected from the inner surface will meet the troughs of the waves reflected from the outer surface. Because the thickness of the film varies and the wavelength of the light determines its colour, different areas of the bubble will have different colours.

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