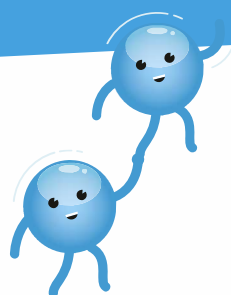


5. Boiling nitrogen

Showing the rapid expansion of nitrogen changing from liquid to gas



Overview

Building on 'Liquid air', this demonstration prepares a large balloon of gaseous nitrogen from boiling liquid nitrogen in a tube, and capturing the gas in a balloon.

What's happening?

Pouring liquid nitrogen from a dewar into a boiling tube at room temperature will immediately start the nitrogen boiling into a gas, as the boiling point of nitrogen ($-196\text{ }^{\circ}\text{C}$) is much lower than the ambient temperature of the boiling tube and its surroundings. When a balloon is attached to the end of the tube, it will rapidly fill with gaseous nitrogen, which can then be used in further activities. The liquid-gas expansion ratio of nitrogen is 1:694 at standard room temperature, and it's useful for audiences to see this difference in action.

Why is this important?

A small amount of liquid nitrogen will produce a large amount of gaseous nitrogen, and it's interesting to demonstrate the reverse effect of 'Liquid

air'. The difference with this experiment is that because a closed system is used, it should produce pure nitrogen, which can be used in the 'Keeping food fresh activity later'.

The Activity

Before the show:

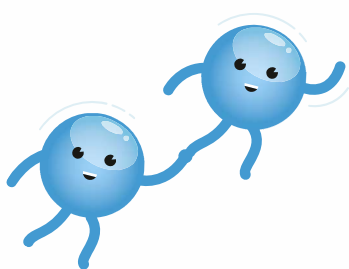
1. Attach the balloon to the glass adapter and quick-fit clip, ready to be attached to the boiling tube. Use an elastic band for extra security.

During the show:

1. Pour a small amount (around 5-10 mL) of liquid nitrogen into a boiling tube.
2. Attach the balloon, adaptor and clip to the boiling tube.
3. The balloon will start filling up with gaseous nitrogen quite quickly, take care not to over-inflate.

Troubleshooting

1. See Troubleshooting section from 'Shrinking balloons' and 'Liquid air' for recommendations on the type of balloon used.
2. The cold borosilicate boiling tube will cause the air around the tube to condense and form a frost on the surface of the tube. This may need to be wiped away to ensure the audience can view the liquid inside.



SECRET GAS FACT

Nitrogen was originally named 'azote' by the French chemist Antoine Laurent Lavoisier, the word translates as 'without life' which is ironic given its role in growth and reproduction in both plants and animals.



Health and Safety



Every delivery centre must undertake their own risk assessments for the specific audiences, locations and conditions they are presenting in. Sample assessments are available on The Secret World of Gases website. Below is a guide to the key risks and hazards:

1. Please see all the risks listed under 'Liquid air' activity.
2. Please see risks associated with handling liquid nitrogen in 'Additional Resources'.
3. The borosilicate boiling tube will get very cold during this process. It is recommended that the demonstrator wears cryogenic gloves during this activity.

