Organiser's Notes

Small Fog Effects

Everyone loves this one!

Points: Rate of sublimation is dependent on temperature. Why are clouds white?

Things you need

Safety Gloves (provided in dry ice kit) Or thin latex gloves, which are suitable For picking up a few pieces of dry ice for a few seconds

Plastic Container (1.5 litre plastic jug provided with kit) or large pyrex container 200ml-1litre)

Scales (accurate to 1 gram (optional)

Scoop (ceramic coffee mug with handle is ideal

time

20 minutes

Instructions

Add a small quantity of dry ice (4-5 pieces of ice, around 10-15g) to the container and then add around 100ml of ice cold water (no more than 5°C). You will immediately see bubbles as the dry ice sublimates and the formation of a very faint cloud of mist at the surface of the liquid.

Challenge the students to explain what is happening and ask them to speculate on what would happen with warmer water.

Repeat this experiment using progressively warmer water; we suggest around 20°C and again at around 50°C. The last demonstration will produce a very impressive 'cotton wool' cloud. As the water gets hotter the students should observe that the amount of fog is increasing. You can repeat the last demonstration with around 50g of dry ice and 250ml of hot water (scale down a little if your container is smaller).

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Ask the students to see if they can make coloured fog. For example by adding food colouring.

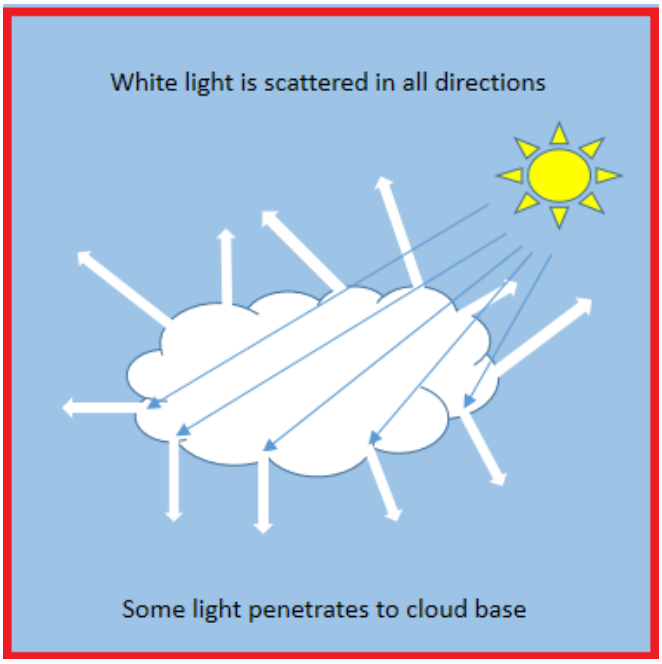
Discussion Topics

- **What is happening here?**

  The bubbles of CO_2 gas leaving the dry ice are very cold, (around –79°C). As they hit the surface of the liquid they carry some of the moisture into the air above the liquid as a vapour. The cold CO_2 gas makes the nearby air very cold. The air can't hold as much water vapour when it's colder, so some of the water vapour condenses into small water droplets that we see as fog. This creates an aerosol of tiny water droplets that scatter light and look like mist, which is what it is! The hotter the liquid the greater the formation rate of white mist. The white fog is caused only by the water droplets and not by CO_2 gas, which is invisible.

- **Can you make the fog different colours?**

  The white colour of the fog is due to the size of the water droplets not the colour of the liquid. It's always white (unless you shine coloured light at the fog).



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If anyone can make a coloured fog please let us know and we will provide you with a place of honour on our website!

A water droplet or ice crystal inside clouds is sufficiently large to strongly scatter light of all colours (different wavelengths). Since light undergoes multiple scattering between numerous water droplets or ice crystals in all direction and they are weakly absorbing to visible light of all wavelengths, the scattered light of all wavelengths constitutes the white colour of clouds that we observe.

How do you know that CO_2 gas is invisible?

Our breathe contains CO_2 gas and is invisible (but see next question). Also in the **Crystal Growth** experiment the students were asked to see if they could observe CO_2 gas leaving dry ice.

Most gases are invisible - ask the students if they can think of gases that can be seen, (this is limited to the halogens and their compounds: chlorine, bromine and iodine).

Would any gas cause the formation of the mist?

Only cold gases! Ask the students to think of an experiment to test this. One answer is to state what happens when they open a can or bottle of soda drink that has CO_2 gas dissolved into the liquid - they will see bubbles coming to the surface but no mist. This is because CO_2 gas in this case is not cold enough. On a cold day you can see your breath - this is because we breathe out warm humid air and this is chilled and condensed by the ambient cold air causing the formation of the water aerosol, which scatters light to provide a white mist.

Further Reading and Resources

Chillistick have a range of different experiments which are free to download at www.chillistick.com. 10% discount is available for all schools during National Science Week. Quote "NSEW" when you phone us.

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Curriculum Links

- KS1
- KS2
- KS3
- KS4

Safety Warning: Using dry ice can be potentially dangerous and the demonstrator must prepare their own hazard assessment and satisfy themselves that the experiments are safe. Information on dry ice can be found on our website at www.chillistick.com

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