DRY ICE EXPERIMENTS

TEACHERS NOTES

Recommended year levels: 5-10

OBJECTIVES

1. Understand the properties of Carbon dioxide as a solid and a gas
2. Understand and demonstrate the process of sublimation

BACKGROUND INFORMATION

Dry ice is frozen carbon dioxide, as a gas carbon dioxide makes up about 0.04% of the earth's atmosphere. It is the gas that we exhale during breathing and the gas that plants use in photosynthesis. It is also the same gas added to water to make soft drink. Dry ice is commonly used for freezing or keeping things froze as it maintains a very cold temperature of -78.5°C. Instead of melting, dry ice turns directly into carbon dioxide gas but does not melt like common ice.

The vapour released from dry ice falls down, unlike hot steam you see from a boiling kettle which moves rises. This is due both to the temperature difference, and the density of CO2 gas.

PRECAUTIONS: Please read information sheet on precautions of handling dry ice.

EXPERIMENT 1: DRY ICE TURNING INTO A GAS

As the dry ice sublimes CO_2 will be released. By covering the cup with gladwrap students will see the plastic swell as the concentration of CO_2 within the cup increases. This sublimation can be accelerated by adding water to the cup as the warmer temperature of the water speeds up the sublimation process. This experiment also demonstrates the use of CO_2 to extinguish fires as it starves the fire of oxygen.

WHAT YOU NEED

- Styrofoam cup
- Chunk of dry ice
- Water
- Gladwrap
- Rubber band
- Candle
- Match

WHAT TO DO

1. Using metal tongs or appropriate material gloves to place a chunk of dry ice into the cup.
2. Place gladwrap over the top of the cup securing tightly with a rubber band.
3. Observe what happens.
4. Now take off the gladwrap for a moment and add ~ 2 tablespoons of water. If the gladwrap is broken use another piece of gladwrap.
5. Replace the gladwrap and tightly seal with the rubber band.
6. Observe what happens.
7. Now light the candle
8. **Carefully** pour the air from your cup onto the flame. Do not let any dry ice fall out.
9. Observe what happens.

QUESTIONS

1. What happened to the gladwrap when you covered the cup with it? *It swelled up*.
2. Can you explain why this happened? *The solid* CO_2 *sublimed to release* CO_2 *which could not escape due to the plastic so pushed up against it.*
3. What happened when you added water to the cup? *The dry ice released a white vapour. This is the dry ice vaporizing into a clear, colourless gas.*
4. Do you think dry ice is a good name for this material? Why/why not?

EXPERIMENT 2: FLOATING BUBBLES

This experiment helps students understand that Dry ice sublimes to CO_2. The bubbles float above the dry ice as the CO_2 forms a layer for the bubbles to bounce off.

WHAT YOU NEED

- Dry Ice
- Gloves, tongs
- Bubble solution and wand
- Ice cream container

WHAT TO DO

1. Using gloves and tongs, place some dry ice into a rectangular container.
2. Blow bubbles on top on the dry ice and observe what happens.

EXPERIMENT 3: BUBBLING OVER

BACKGROUND INFORMATION

In this experiment students see the Dry Ice turning into CO_2 gas and forming bubbles as they explode from the cylinder. The warm water increases the rate of sublimation of conversion of CO_2 to gas. The soap in the water traps the carbon dioxide to form an explosion of bubbles.

WHAT YOU NEED

- Dry Ice
- Gloves, tongs
- Tall glass or plastic cylinder
- Liquid detergent 5-10mL
- Food colouring
- Warm water

WHAT TO DO

1. Fill the tall cylinder with warm water and add ~5-10mL of liquid detergent and your choice of food colouring.
2. Using gloves or tongs place pellets of dry ice into the plastic cylinder with the soapy water
3. Observe what happens.

QUESTIONS

1. Can you explain how the bubbles floated above the dry ice? *Layer of* CO_2.

EXPERIMENT 4: SUPER COLD SOLUTION

BACKGROUND INFORMATION

This super cold solution is made using alcohol and dry ice to freeze things in seconds. Alcohol is used as its freezing point is much lower than that of water (-114°C).

WHAT YOU NEED

- Dry Ice
- Gloves, tongs
- Beaker or plastic cup
- Alcohol
- Water
- Flowers or leaves

WHAT TO DO

1. Fill the cup half way with alcohol.
2. Add 3 to 5 pellets of dry ice to the cup.
3. Using tongs hold the flowers or leaves in the cup for about 30 secs.
4. Remove the flower from the cup and observe what has happened.

QUESTIONS

1. What happened to the flower after you put it in the dry ice/alcohol mixture? *The flower became hard very quickly as if it had been in the freezer overnight.*
2. How do you think this happened? *The dry ice was so cold that it froze the flower.*
3. What is the freezing point of water? *0°C*
4. Why do you think you used alcohol instead of water to make this super cold solution? *Alcohol has a freezing point of -114°C whereas water has a freezing point of 0°C. Dry ice temperature is -78.5°C and therefore when added to the alcohol the alcohol does not freeze, whereas the water would start to freeze.*

REAL WORLD APPLICATIONS OF DRY ICE

Packaging: Dry ice is commonly used as packaging for items that need to remain cold or frozen, such as ice cream.
Medicine: In medicine it is used to freeze warts and sunspots to help remove them.
Construction industry: Used in the construction industry to loosen floor tiles by shrinking and cracking them, as well as to freeze water in valveless pipes to allow repair.
Fire extinguishers: Fire extinguishers use CO_2 to douse the flames of an electrical fire. The CO_2 "starves" the fire of its oxygen.

CURRICULUM CONCEPTS ADDRESSED

Essential Learnings: Natural and processed materials
End of year 5
-Properties of materials are affected by processes of change.
End of year 7
-Physical change produces no new substances.
End of year 9
-Changes in physical properties of substances can be explained using the particle model.
Year 10 Syllabus Learning outcomes Natural and Processed Materials
-6.2 Students use identified patterns of change to predict interactions between materials.

RESOURCES USED TO DEVELOP THIS ACTIVITY

1. Wikipedia Encyclopedea. (2008). *Dry Ice*. Retrieved October 30, 2008, from http://en.wikipedia.org/wiki/Dry_ice#Applications
2. *Dry Ice Info.com*. (2004). Retrieved October 30, 2008, from http://www.dryiceinfo.com/science.htm

Image courtesy of: Ice factory online. Retrieved October 30, 2008, from www.icefactoryonline.com.