6. Separation

2.5 hours

Using different techniques to separate solids, liquids and gases from each other.

OBJECTIVES

- To know how to separate a mixture of solids, liquids and gases.
- To select and use appropriate equipment to carry out an investigation.
- To know how to represent data in a table and a pie chart.

RESOURCES

(Per group of 4 children unless otherwise stated)

- 330ml pop bottle containing:
  - 50-75ml sand
  - 50-75ml cooking oil
  - 50-75ml water
- Funnel
- Paper towels or filter paper
- A selection of 50-150ml measuring cylinders
- 1 litre measuring jug
- Bottle with a one way valve, e.g. from shower gel or tomato sauce Pipette
- 3 plastic cups
- Tea light candle
- Heating stand
- Wooden/metal box containing sand
- Individual foil cake case or similar
- Safety lighter (teacher only)
- Optional resources:
- Computer with graphing or spreadsheet package
- Protractor
- Compasses
- Calculator

ADVANCE PREPARATION

Prepare a bottle containing a mixture of sand, water, oil and air for the introductory activity.

INTRODUCING THE ACTIVITY

Prior to this activity, the children will have discussed how gas is stored and transported. Explain to the class that during storage and transportation the gas picks up debris such as small pieces of rock from the reservoir. Gas companies add ingredients (additives) which prevent corrosion and ice forming in the pipes. See background information below for further details.

A prepared bottle containing a mixture of gas (air), sand, water and oil is shown to the children as an example of what is found inside the pipe. Ask the children what they think it contains.

Once they have correctly identified the components of the mixture, the children discuss what effect the sand, water and oil, may have if they were left in the pipes (e.g. blockages which stop the gas getting to its destination and damage to pipes which causes the gas to escape into the atmosphere). Children share their suggestions and form groups for the main investigation. The snowballing discussion strategy could be used for this purpose (Appendix 2). The children put their ideas onto post it notes which can later be displayed with their findings from the main activity. The children go on to discuss the following questions:

- Could the oil, water and sand be removed from the gas?
- Which techniques could you use?
- Can you measure the quantities of each material after separation?

You may wish to support the discussion by reminding the children of previous work they have carried out, or by showing resources that could be used.

MAIN ACTIVITY

Children plan and investigate how to separate and measure the amounts of each component in the mixture. The following are examples which could be used by groups struggling to formulate their own ideas.

Separating and measuring the gas

The volume of gas is calculated by subtracting the amount of solids and liquids present from the known volume of the container. Mark the level in the bottle where the gas and liquid meet, before separating the remaining components. The volume of gas present can be calculated once the bottle has been emptied by refilling the bottle with water and decanting the quantity above the marked level into a measuring cylinder.

Alternatively, the gas could be collected in a bottle of liquid, using a similar technique to that in Activity 2.

Separating the two liquids

The water and sand can be separated using filter ! paper and a funnel. The sand could be dried using the tea light candle, heating stand and metal container, placed inside the sand tray for safety.

Separating the sand and water

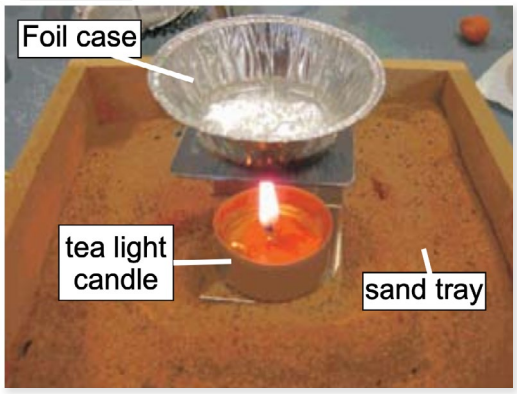
The water and sand can be separated using filter paper and a funnel. The sand could be dried using the tea light candle, heating stand and metal container, placed inside the sand tray for safety.

The weight of the wet sand and filter paper can be measured before and after drying. The difference can then be added to the amount of water already reclaimed.

Once all volumes have been measured, the class can decide whether this information is best represented in a bar chart or a pie chart. Pie charts can be constructed using protractors and compasses or appropriate software.

Safety note

Be aware of naked flames.



PLENARY

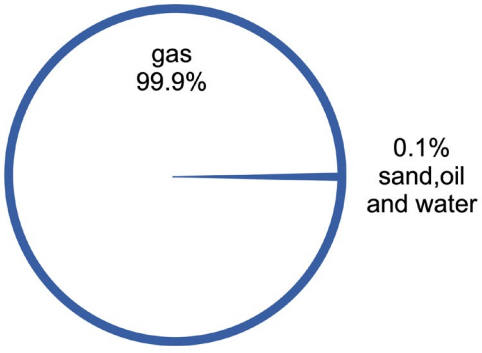
The children report their findings, describing any difficulties they had with the separation techniques. The measuring of gas may be seen as the most difficult as it is more theoretical than practical. The most time consuming is the sand and water separation as it takes time for the sand to dry.

Explain that the amount of liquid and solids they had in their bottles is significantly higher than they would find in gas extracted from the reservoir, which is approximately 0.1% sand, oil and water.

Pose the questions:

- Why are such low levels of unwanted materials still so important to the company?
- Could you use the actual amounts of gas and other materials to create another pie chart? Would it be easy to read and use?

The pie chart below can be enlarged to show to the class:



BACKGROUND INFORMATION

Before the gas is moved from the reservoir to the mainland for processing, a corrosion inhibitor is added to reduce the rusting of the pipes. A 'hydrate inhibitor' is added to stop a type of ice forming (above 'normal' freezing temperatures when you have water and high pressured gas together). The ice and the rust can block pipes and damage instruments if not controlled by these additives.

Companies use equipment called 'pigs' to clean the pipes and remove the debris. Pigs vary in shape, size and material. It can be a large metal ball, a sponge cylinder or a metal and rubber corkscrew style device which fits snugly inside a pipe. The choice of pig will depend on the type of pipe and debris. It is pushed through the pipe and forces any unwanted obstructions out of the pipe into a special trap where it is removed safely. Children can take up the challenge of controlling one of these pigs at www.roughguidetogas.org.uk.

AMBASSADOR ROLE

The ambassador can discuss methods industry use to remove and dispose of the sand, oil and water found in the gas. Relevant portable equipment can be brought in to the classroom, or photographs of larger equipment used to aid discussion. Photographs of company personnel carrying out work related to the laying and 'cleaning' of the pipelines, particularly the scientific and technical aspects, will be welcomed by the children. The ambassador can then engage the children in discussions about the kind of work each job entails.

Appendix 2: Discussion Strategies

The following strategies are used extensively as part of the Discussions in Primary Science (DiPS[1]) project, and have been proven to be successful when developing children's independent thinking and discussion skills.

Use of these strategies is strongly recommended during the activities in this resource. A description of each strategy is provided below, suggesting the type of discussions best suited to each activity.

Talk cards

Talk cards support the teacher in facilitating these discussions, with the letters, numbers, pictures and shapes enabling the teacher to group children in a variety of ways. The role badges described in Appendix 1 can also be used for this purpose.

The example provided here shows one set for use with four children. The set can be copied onto a different colour of card and talk groups are formed by children joining with others who have the same coloured card.

Children can then pair up by finding a partner with the same animal or a different letter eg. elephant, rhino or a + b pair. Each TALK pair would then have a card with a different number or shape.

The numbers or shapes may then similarly be used to form alternative groupings and pairings.

ITT (Individual Think Time)

Each child is given time to think about the task individually before moving into paired or group work.

Talk Partners

Each child has a partner with whom she/he can share ideas and express opinions or plan. This increases confidence and is particularly useful where children have had little experience of talk in groups.

1 For more information go to www.azteachscience.co.uk