Rough Guide to Gas

Science and technology activities
for 9-11 year olds

Promoting science

centrica storage

Rough Guide To Gas

A science investigation pack for teachers of 9-11 year olds

This package was developed by CIEC *Promoting science* at the

Department of Chemistry
University of York
Heslington
York, YO10 5DD

Telephone: 01904 322523
Facsimile: 01904 324460
E-mail: ciec@york.ac.uk
Website: www.ciec.org.uk

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Debbie Hamilton, Process Engineer

Terry Jackson, Assistant Management Accountant

Nikki Lister, Learning and Development Assistant

Rebecca Sunshine, Communications Advisor

Martin Wright, Operations Advisor.

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Michele Smale and Mike Dunn, Authors

Gayle Pook and Joy Parvin, Editors

Centrica Storage is responsible for running the largest gas storage facility in the UK. The storage facility is connected to the mainland via a pipeline to Easington gas terminal, on the east coast, where it is processed and prepared for transfer into the gas supply network and on to your homes. The gas storage facility is known as Rough, hence the name of the resource, and was once an offshore field before its reserves were depleted. The field's locality made it ideal for use as a storage facility and it was converted in 1985.

Contents

Introduction

Age range

The materials in this resource are aimed at teachers of 9-11 year olds. The activities link with units of work on rocks and soils, solids liquids and gases, and separating materials.

The suggested activities can be adapted to suit the needs of the children, staff and the planning requirements of the school.

Approximate duration

The timings for each activity are given as a guide and will vary from class to class. They range in length from 1½ to 2½ hours.

Context

The activities are set in the context of natural gas, and how it is prepared for commercial and domestic markets. In the first activity the children create a display of the route natural gas follows from underground extraction and storage in a reservoir, to treatment for use in heating and electricity production. Subsequent activities focus on each part of this route, identifying the scientific features of the different phases.

Classroom discussions

Discussion is an important way for the teacher and children to identify understanding of concepts in science, and many opportunities are therefore provided for such talk to take place. The discussion tools described can be used in all areas of the curriculum, and some may already be familiar as they formed part of the Literacy Strategy.

Website

Further activities and information on gas storage can be found at www.roughguidetogas.org.uk . The website provides teachers with some of the resources suggested for managing discussion, and questions to stimulate children's ideas suggested within this resource.

Curriculum coverage

At the time of publication, the English National Curriculum and assessment processes were undergoing review. For updated information related to the 2013 curriculum and assessment, please visit www.roughguidetogas.co.uk.

The resource covers substantial areas of Scientific Enquiry (Sc1) and Materials and their properties (Sc3) in the current National Curriculum for Science, as well as contributing to the Breadth of Study.

The activities can be used to support levels 3-5 of each assessment focus for Assessing Pupils' Progress.

Coverage of Scotland's Curriculum for Excellence is predominantly in the technology strand.

Activities

Activity One sets the scene for subsequent activities, as shown in the table below. Activity Seven is standalone and could be carried out at any point in the sequence, or completely independently.

In some activities a structured approach has been offered which follows

Title and description	Page	Timing (hours)
1 How do we get gas? **Children create a wall display showing how natural gas is stored and piped to the mainland for domestic use.**	3	1½
2 What is a gas? **Identifying gases in everyday settings and the creation of canister rockets to understand how gas expands when it is produced.**	6	2
3 Reservoirs **Investigating the absorbency and the porous nature of different materials which could be used to store natural gas in the reservoir.**	10	1½
4 Pipeline shapes **Investigating the effects of pressure on a range of pipe shapes.**	14	1½
5 Sinking pipelines **Exploration of materials which could be used to keep a pipe on the sea bed.**	16	1½
6 Separation **Using different techniques to separate solids, liquids and gases from each other.**	19	2½
7 Designing safety wear **Investigating types of protective equipment, and collecting data using data loggers. Designing new equipment using appropriate materials.**	23	2½

Activity 1 How do we get gas?

$1\frac{1}{2}$ hours

Objectives

- To produce a wall display, using information provided and further research; showing where gas is stored, treated and transported for end users.
- To work cooperatively.
- To begin to understand the gas storage process.

Resources

per group of four children

Display materials, e.g. coloured paper, adhesive tape, drawing pins, blu-tak

Activity sheets 1-4 (colour version of sheet 2 at www.roughguidetogas.org.uk)

Access to the internet

Role badges - see Appendix 1

Advance preparation

Prepare role badges before the lesson. Activity sheets 3-4 copied on to card and cut in to individual prompt cards.

Introducing the activity

Give the children Activity sheet 1 to read and discuss the news articles. Ask them:

What are the articles about?

What information can you gather from the articles?

Why do you think it is important to collect the gas then store it?

Do you understand all the terms used? If not, does anyone in your group have any ideas about what they mean?

Make a list of words you are still not sure about.

The children may put together a KWL grid (what they know, what they want to learn and what they have learned) of information about natural gas. This can then be referred to throughout the activities in this resource.

Using the energy source diagram and photographs of industry on Activity sheet 2, show the children how gas is stored, where it travels from, and the sequence of events required to transport it to domestic markets.

Main activity

Organise the children into groups of four and decide on job roles, as described in Appendix 1. Each group then researches a particular aspect of the process shown on the diagram, e.g. the storage facility, gas terminal plant, power generation, etc. They then create a class display, by ‘joining’ sections together to represent the whole process.

Plenary

Each group explains the purpose of their part of the process, providing opportunities for others to pose questions, and promoting discussion about how all parts of the process interact.

Revisit the list of words collated when discussing the news articles, to find out how much the children now understand.

After each activity during the project, the children can reflect on the accuracy of their display and consider how it can be improved and what information they would like to add. For example, as an activity is completed, an information sheet could be written, photographs taken or diagrams drawn, and added to the display. The prompts on Activity sheets 3-4 can be copied on to card and used as prompts during discussion. Those on Activity sheet 4 are for use at the end of the project.

Ambassador role

There are several ways in which an ambassador could work with a school on this activity:

1. The ambassador could be invited into school to introduce the project, using large photographs (perhaps on a PowerPoint presentation) or a DVD showing the gas storage process.

2. The ambassador may want to support the teacher by offering the children ‘expert’ information which will help the children complete the task they have been given.

3. Encourage the ambassador to bring resources into the classroom to aid understanding. These could include small pieces of equipment, such as ‘core’ and other samples, photographs and models.

4. Where time allows, and the ambassador has experience and confidence, they could lead the whole activity; introduce the project, organise the children (with teacher support) and work with the groups as they develop their display.

Background information

Centrica Storage operates the largest gas storage facility in the UK. The Rough gas field is 18 miles off the coast of Yorkshire and is connected to the mainland via a pipeline to Centrica Storage Easington Gas terminal. Once gas is received at the terminal it is processed and prepared for transfer into the National Transmission System (at high pressure), before entering Gas Supply Networks (at lower pressure) for use in homes and industry.

Rough was previously a gas-producing field, and it was converted into a storage facility, commencing operations in 1985. It is able to store gas in the rock strata known as Rotliegendes sandstones.

Gas storage is important to ensure security of UK gas supplies. Rough currently provides 10% of the gas required on a peak winter day.

At times of low gas demand, gas is taken from the National Transmission System and stored in the Rough reservoir. When demand for gas is high, gas is withdrawn from Rough and enters the National Transition system.

Natural gas has many uses. A commonly known use is heating, but it is also used to produce electricity and to power cooling systems.

Activity 2 What is gas?

2 hours

Objectives

- To understand that, although we cannot see most gases, their presence can be demonstrated.
- To recognise the differences between solids, liquids and gases.
- To observe and explore the production of a gas when a drinks bottle is opened, or certain materials are mixed.

Resources

per group of four children

Balloon
Adhesive tape
Pin
Film canister with lid (available from TTS) or similar
Effervescent vitamin C tablets, Alka-Seltzer tablets* or similar
Pipette
Spoon
Funnel
Timer
Shallow tray e.g. baking tray
Post it notes or white board and marker
Safety glasses (per child)
Activity sheet 5
For teacher demonstrations only:
Tea light candle
Matches or safety lighter
2 litre plastic container, e.g. ice cream tub, transparent fish tank
Coffee lid or small saucer
Clear plastic pop bottle
Plalstic bottle of any fizzy drink
Tubing which will fit tightly over the funnel
Bung
Plasticine or blu-tac

Use safety glasses whenever there may be risk of injury to eyes. Children should not swallow tablets used during this investigation.

*For further information regarding classroom use of Alka-Seltzer see Be Safe – Health and Safety in School Science and Technology, available from the Association for Science Education.

Advance preparation

Try the experiment in advance, as some lidded pots do not provide a strong enough seal for the pressure to build up inside.

Introducing the activity

Referring to the display from the previous lesson, discuss the finding and storing of gas. Continue by asking:

What is a gas?

Where do we find gases?

How do gases differ from solids and liquids?
What are gases used for?

Talk cards (see Appendix 2) may help to organise discussion groups. Ask different groups to focus on different questions which can then be shared via *jigsawing*.

Using their previous knowledge and earlier discussion, the children collate their ideas and descriptions of gases (e.g. gas will fill a container of any shape or size; the vapour that comes from a kettle is a gas; gases are all around us; gases can be found everywhere including in our bodies as we breathe in and out).

Pose the questions:

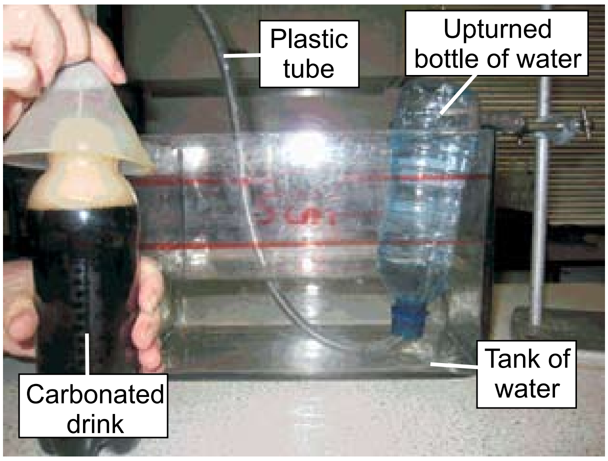
How do we know gas is around us?
Can we see it?
Can we feel it?

The Administration Officer writes the group responses on a white board or post it note and the Communications Manager shares these with the class. Practical ideas suggested by the children can be tried, in addition to those outlined below.

By blowing a balloon up, the children can observe that gas fills the balloon evenly and changes the shape of the balloon. By sticking a piece of adhesive tape to the balloon and then piercing the tape carefully with a sharp point, the air will be released in a controlled manner. The children will be able to feel the gas leaving the balloon and see the balloon change shape.

Teacher demonstation

To show how much gas is in a fizzy drink, set up the demonstration resources as shown in the photograph below.



An opened bottle of carbonated drink is attached firmly to a tube and funnel with blu-tac. The tube leads to a bottle filled with water held upside down in a tank of water. Ask the children to observe closely when you shake the fizzy drink, and tell you what they see. They should see bubbles appearing in the upturned bottle of water, as the released gas is collected. If left in the classroom for several hours or days the gas from the fizzy drink will slowly displace the water contained in the other bottle. This activity could be photographed over a period of time (stop frame animation) to show how the water and drink levels change.

Main activity

In order to explore the production and properties of gases for themselves, challenge the children to make a timer using a film canister, Alka-Seltzer or other effervescent tablet, and water.

The children begin by observing the effervescence of the tablets added to water. If these are put into a closed container such as a film canister, after a while the lid will pop off as the pressure increases and more and more gas is produced.

Direct the shaken film canister away from everyone.

Varying the ratios of material that are combined will result in differing amounts of gases being produced. This will result in the lid popping off the canister after varying lengths of time. Measuring the amounts of the tablet and water, and the resulting popping times, will allow children to calculate the quantities of each ingredient to create a 30 second or 1-minute timer.

The children's exploration may include:

- Ratios and quantities of materials required (larger containers may require more of the tablet)
- Ways to measure the amount of water and tablet

- Effect of using crushed or ‘chopped’ tablets
- Creating a fair test and controlling variables.

Ensure that the children consider the risks there may be in carrying out this investigation, and precautions they should take to reduce the risks. For example, as the canister lid may come off with some force, an open area with a high ceiling should be used. If the weather conditions allow, this activity may be carried out outside. The children may also consider using a shallow tray to carry out the investigations, to prevent spillages becoming a slip hazard.

Activity sheet 5 can be used to record results. A sample data set is provided below as a guide. Results will vary with the equipment and tablets used:

Quantity of tablet	Quantity of water (ml)	Time taken to ‘pop’ (secs)
1	5	10
½	5	28
¼	5	59

Plenary

A class set of results is tabulated using all the group data. This can then be presented as a bar chart (using the mean data) or scatter graph. The results are discussed using some of the following questions:

What does the information tell us?

Is there any information that doesn’t fit with the rest? Why?

How much water and tablet do you think we’d need for a 45 second or 2 minute timer?

Is there anything we could do to improve our investigations?

What could the next investigation be?

Discuss the idea of repeating measurements to find out whether the test is reliable (i.e. are the results always similar, regardless of how often we carry out the test).

Background information

The focus for this resource is natural gas which is formed by the decomposition of sea animals and plants. The remains of the plants and animals are covered in layers of silt and sand. As the plants and animals are buried deeper and deeper and over thousands of years, the heat and pressure changes the plant and animal material into oil and gas. The gas is then released via drilling through the sand, silt and rock.

Activity 3 Reservoirs

1½ hours

Objectives

- To understand that reservoirs store liquids/gases.
- To understand porosity and that rock can be porous.
- To carry out a fair test, changing one factor.
- To measure a volume by reading a scale.

Resources

per group of four children

Green and brown floral foam (oasis)
Pumice (size of soap bar)
Sponge (size of soap bar)
Cork (size of soap bar, if available)
Cup of sand
Pop sock
Shallow bowl or tray/ margarine tub
250ml measuring cylinder
Timer
Pair of disposable gloves
Funnel
Activity sheet 6
For teacher demonstration:
Large jar or small mixing bowl
Marbles (enough to fill jar)
Cup full of sand
500ml water

Floral foam may cause irritation to the skin so disposable gloves should be worn when handling.

Note: Rock collections containing samples such as sandstone, marble, granite, flint, or gritstone, can also be used. More time will be required to observe measurable amounts of absorbed water.

Advance preparation

Due to inhalation risk from the floral foam, this should be cut prior to the lesson.

Introducing the activity

Using the display made in Activity 1, the children discuss what the reservoir does. Ask the children if they have seen and/or can describe a reservoir. Children may be aware of reservoirs through studying the water cycle, visiting one, or from news reports during periods of drought.

Ask the children to create a description of a reservoir which can be used to explain the appropriate area of their display.

Introduce the children to the idea that the undersea reservoir, where the natural gas is stored, is made from rock. Tell the children that the natural gas is stored as a compressed (squeezed) gas.

Ask the children if they can think of any solids that will store liquids, reminding them of how we mop up spilled water, etc. Create a list of 'solids' that will hold liquids, e.g. paper towels, dish cloths, etc. Show the children the cork, sponge, floral foam, etc. and ask them to plan a test to find out whether any of them will hold liquids. Other materials of the children's choice can be included in their investigations.

Main activity

The children are given the task to plan and carry out an investigation to find out which is the most porous material to store water. This can be carried out as a fair test by considering the size of the material, the amount of water, and the time allowed for absorption. For example; the children measure and pour 250ml of water into a shallow bowl, tray or margarine tub. The material being tested is put into the water and left for 5 minutes. The amount of water absorbed is calculated by measuring the amount of water remaining in the bowl or tray and subtracting it from the original quantity used. Activity sheet 6 can be used to record results and prompt discussion. The experiment could be extended over a longer period of time, over lunch time or overnight, to see if this makes any significant difference to the amount absorbed.

Plenary

The children should be given the opportunity to report their findings. Each group investigates a different material; jigsawing can be used for the children to share their findings, e.g. all the Communications Officers, Resource Managers, etc. They then return to their own groups and compare information. This is a good way of checking shared information and for further discussion to take place. During these discussions, they could be asked to consider the following questions:

What do the results show us?

How could the investigation be improved?

Which material would they recommend?

Teacher demonstation

Show how much an apparently ‘full’ container can hold to develop an understanding of the porous nature of different materials. Start with an empty container and ask if it is full. Add marbles followed by sand, then water. Ask the children at each stage if the container is full. The children should observe that the sand fills spaces between the marbles, and the water fills even smaller spaces between the grains of sand. Explain that many materials, either naturally occurring or manmade, have small spaces between the particles. These spaces can be used to hold other materials or used as a filter.

Remind the children of the gas leaving the bottle of fizzy drink in the previous activity. The level of drink did not go down because the particles of gas were between the particles of water.

Background information

Water is used in this activity, as it is easier to handle than gas.

The two different kinds of floral foam behave in different ways. Brown foam is manufactured to hold dried or artificial flowers so does not need to absorb water, whereas green foam is manufactured to hold fresh flowers so must be able to absorb water to keep the plants alive for as long as possible.

Natural gas is a mixture of hydrocarbons (molecules that contain only carbon and hydrogen) that exist naturally in rocks beneath the surface of the earth. It is widely used as a heating source, for power generation, and as starting materials in industrial processes. For a gas reservoir to form, the ‘source rock’ containing the organic matter needs to be covered by a porous rock (the reservoir rock) for the gas to accumulate in, and then a non porous layer (the cap rock) that traps the gas thousands of feet below the earth’s surface. This gas is at very high pressure as it is squashed by the weight of the thousands of metres of rock above the reservoir.

The natural gas is extracted for use by drilling wells into the reservoir to pipe the gas to the surface. Once the gas has been extracted, and the reservoir depleted, a small number of reservoirs are converted into storage facilities. Here gas from other fields is pumped back into the reservoir at times of low user demand so that it can be re-extracted when demand is high. Storage facilities have large numbers of wells so they can extract large quantities of gas very rapidly to meet peak demand requirements when there is insufficient production available from producing fields.

For further information and activities on how reservoirs are found and used, visit www.roughguidetogas.org.uk.

Ambassador role

An ambassador could introduce this activity, and work with the class throughout. During the plenary they could add to the discussion by explaining the similarities and differences between this process and what industry does in practice to measure porosity.

If available, take rock cores into the classroom to show the children. Explain how the cores are obtained, what they are made from, and why they are taken from the seabed.

Activity 4 Pipeline shapes

$1\frac{1}{2}$ hours

Objectives

- To understand that pipes are cylindrical because the forces applied by gases under pressure are more evenly distributed than in other shapes.
- To be able to use observations to draw conclusions.

Resources

per group of four children

Adhesive tape
3 long balloons
Balloon pump
A4 paper
Activity sheet 7
Camera (optional)

Introducing the activity

Refer to the display to discuss what the children have learned so far. Ask the children how they think the gas gets to shore when we need to use it. Ideas may include use of ships and pipelines. Discuss their ideas by comparing efficiency, cost, time, etc.

Explain that long pipes are laid along the seabed to transfer the gas efficiently. Visit www.roughguidetogas.org.uk for activities exploring how pipes are laid on the sea floor.

Ask the children what shape pipes are, ensuring the term cylindrical is used rather than ‘round’. Tell the children they are now going to explore other shapes of pipes, to find out if they might be better than cylinders.

Main activity

The children test three or more different shapes of ‘pipes’. Children can be given Activity Sheet 7 that offers a guide to the three nets required to produce their paper pipes. Approximate dimensions are given, but this will vary with the size of balloons used, so some exploration of ‘pipe-size’ may be needed.

Explain that the gas is ‘under pressure’ or ‘squeezed’ inside the pipe. Therefore, when testing their own pipes, the children use long balloons to represent the pressurised gas inside the pipe.

The children should observe what happens to their ‘pipes’ as they blow the balloon up inside each one. They can record their observations in drawings, photographs and/or writing.

The cylinderical pipes should not really change but those with a triangular or square section should distort and become more cylindrical.

Plenary

Once the children have completed their investigations, they report their findings by using envoying or A-B Talk discussion strategies, as outlined in Appendix 2. They should be able to explain which shape would be the best for a pipe and why, using their findings as evidence.

This is a good opportunity to assess the children’s ability to use their observations to draw conclusions.

Background information

Storage containers for gases are cylindrical or spherical as gas under pressure is naturally trying to expand and push out in all directions. Corners on a container are weak points. The same principles apply to pipes; the pressure pushing outwards is evenly distributed around a cylinder.

Activity 5 Sinking pipelines

1½ hours

Objectives

- To investigate a range of materials that could be used to hold down a pipeline.
- To know that the greater the mass of the material, the lower the pipe will be in the water.

Resources

per group of four children

Pair of pop socks (or tights)
Funnel
Scissors
100g (approx.) of each of sand, gravel and salt
10g masses* in a variety of materials
500g (approx.) compost
50-100ml measuring cylinders
Scales
330-500ml plastic bottle and lid
3-5 litre tank or similar container
Activity sheet 8
Camera (optional)

**These are not used as measuring equipment, but as alternative materials to fill the pop socks.*

Introducing the activity

Remind the children of the previous activity looking at the shape of the pipes. Use Activity sheet 8 to introduce the email from a company explaining they are having problems with their pipeline; it is floating up from the sea bed.

Ask the children in their groups to discuss how solutions to this problem could be investigated in the classroom. Each Communications Manager (Appendix 1) reports their group's ideas to the class.

Main activity

This activity offers children the opportunity to investigate materials that could be used to hold the pipe on the seabed. Other solutions suggested by the children can also be explored. Note: The children may suggest that they use something inside the pipe to hold it down. However, debris inside the pipe can cause damage, so is not a solution the company would consider. Activity 6 looks at this problem in more detail.

Pop socks are filled with the test material (e.g. 10g or 10ml), and placed over the horizontal 'pipe' (sealed plastic bottle) on a table. Adjust the length of the pop socks so they do not touch the table on either side. The loaded pipe is placed in a tank of water to observe whether it sinks or floats. If it does not sink, the amount of material in the pop socks is increased incrementally.

The children can record both mass and volume to appreciate the relationship between the two when evaluating successful quantities.

Each group tabulates their results, and decides whether the data could also be represented in a bar chart or line graph. Additional evidence can be provided in photographs and/or diagrams.

Plenary

The class data are collated on the whiteboard to produce a set of repeated results, looking for patterns in the data, and identifying and discussing anomalous results. Each group can also prepare an email response to the company, which could include a PowerPoint or photo story presentation of their investigation, results and conclusions.

The children should appreciate that the greater the mass of the material added to the pipe, the lower in the water the pipe will be. The volume of some materials (e.g. compost) needed to achieve this will be very high. Some children may be able to understand that the materials that have the greatest mass in the smallest volume (e.g. sand) will be the most appropriate for the task.

Visit www.roughguidetogas.org.uk for interactive learning about gas pipe laying on the seabed.

Ambassador role

The pipelines that transport natural gas are covered in concrete, and an ambassador could bring photographs showing these pipes in construction and on the seabed.

An ambassador could describe the construction of the longest undersea pipeline, which is over 725 miles long and runs through the North Sea from Norway to Easington Gas Terminal in the UK. Construction started in 2004, and took three years to complete. The annual capacity of the pipeline is 25.5 billion cubic metres, which is 20% of Britain's peak gas demand.

An ambassador could provide details and photographs of sea life living on and around the gas pipes which can interfere with their operation, e.g. crustaceans inside the pipes, corals living on the structures. The pipelines are checked regularly for damage.

Activity 6 Separation

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 four children

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

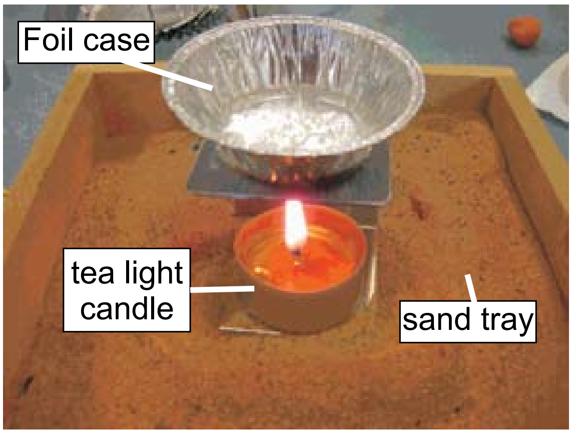
The water and sand can be separated using filter paper and a funnel. The sand could be dried using the tea light candle, heating stand and metal container, placed inside the sand tray for safety.

Be aware of naked flames.

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.

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.

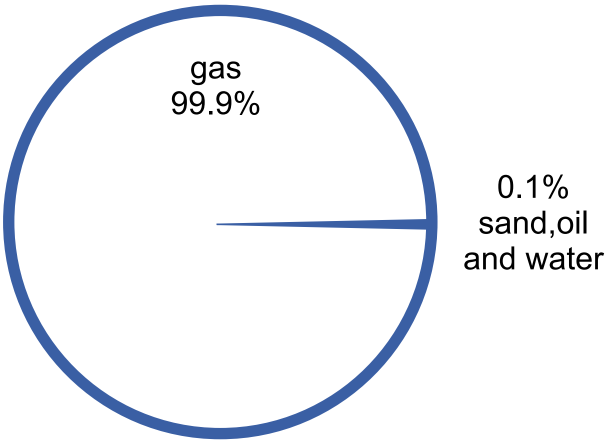
Explain that the amount of liquid and solids they had in their bottles is significantly higher than they would find in gas extracted from the reservoir, which is approximately 0.1% sand, oil and water.

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.

Activity 7 Designing safety wear

2½ hours

Objectives

- To investigate materials for potential use in protective equipment.
- To collect sound, light and temperature data.
- To gather visual and other information to help develop ideas.
- To communicate design ideas effectively.

Resources

per group of four children

Activity sheet 9
4-5 of one of the following:
  Water proof and non-waterproof fabrics
  Sound insulating materials
  Thermal insulating materials
  Range of coloured films (e.g. Quality Street wrappers)
Sound source (e.g. a buzzer in a simple circuit)
Light source (e.g. torch, angle poise lamp)
Tray (e.g. Gratnell shallow tray or similar)
Shoe box
Cup of hot water (50-60°C)
330-500ml bottle filled with ice
10-100ml measuring cylinders
Range of 4-5 colour shade cards (e.g. paint cards from DIY shops)
Data loggers
Thermometer (optional)
Digital Camera

Water should be below 60°C.

Note: If data loggers are not available, only subjective data can be collected for the sound insulation and light activities.

Introducing the activity

Using Activity sheet 9, introduce the brief from the company asking for help to design new equipment for people flying to an offshore platform. The criteria include:

- New flight suit which needs to be waterproof
- Recommended materials for ear defenders, to protect against the noise during the flight

- Lens colour and design for sunglasses
- Recommended materials for insulated gloves.

Main activity

Each group working in job roles decides which part of the design brief they will investigate. After exploring the materials available and planning an investigation, the groups find possible ways to solve the problems.

Investigations could include:

- Testing a range of fabrics to find one that is waterproof and durable, and using the chosen fabric to design a flight suit.
- Wrapping a sound source (e.g. buzzer in a simple circuit) in different materials in a shoe box to identify which is most effective in dampening the sound. Data loggers are used to measure the sound travelling through a material.
- Using a light sensor to record the amount of light travelling from a light source through different coloured films. Layers of films could be combined to make new colours (e.g. red and yellow) or to stop more light from coming through. If the eye protection is for the pilot, they will still need to be able to see the lights on the instrument panel.
- Exploring which materials slow down either the rate of hot water cooling or ice melting. This would lead to the design of insulated gloves. Data loggers or thermometers are used to measure temperature changes. The volume of melted ice over time can also be measured.

Results could be collected either electronically or on paper and displayed alongside their designs and samples of chosen materials.

Plenary

Each group shows and explains their findings and designs to the rest of the class, including reasons for their chosen materials.

Background information

Flight suits are specially designed for use in helicopters, military planes and space travel. Historically these flight suits consisted of many pieces but modern suits are a single piece like a jump suit.

The first suits designed for World War 1 needed to keep their pilots warm so were heavily padded. At one point they were electrically heated as the cockpits were open and very cold. Gradually as airplane design changed, the suit design changed. The heavy padded fabrics have been replaced with lightweight fabrics, which are less bulky and can be tailored to allow ease of movement. These fabrics are nylon based with blended cottons and polyesters. This combination results in a durable and flexible fabric. Zippered pockets are often featured in these suits.

Ambassador role

An ambassador can attend the children's presentations of their findings, and offer constructive feedback on their ideas. They can bring a variety of protective equipment currently used on helicopter flights and industrial sites to highlight some of the important design features, and to reinforce some of the children's design ideas.

Cold snap bites

People turning up the heating during this year's cold snap is worrying the gas market.

When the Met Office sent out a severe weather warning in the north of the country, gas storage companies were put under pressure to top up the supplies which come from the North Sea.

The North Sea supplies 40% of Britain's needs which means the rest of the gas needed has to be piped in from other areas of Europe. Some gas is shipped in from Qatar and Algeria.

Gas isn't going to run out

Politicians called for more space to store natural gas in the UK, as they claimed that the UK has only eight days' supply left in storage.

A spokesman for the National Grid reassured the public, "We've got supplies coming into the UK that are able to meet these high levels of demand. I would always encourage people to use their energy efficiently but, rest assured, the gas isn't going to run out."

Risk of gas supply cuts

Recent winters have recorded the coldest temperatures in decades. People in Britain were left shivering and there were concerns about shortages in supplies of gas.

As prolonged spells of freezing weather continued, industry was warned that they may have to cut their fuel consumption to save supplies.

The National Grid was left with much less gas than they had expected when users increased the amount of gas they were using.

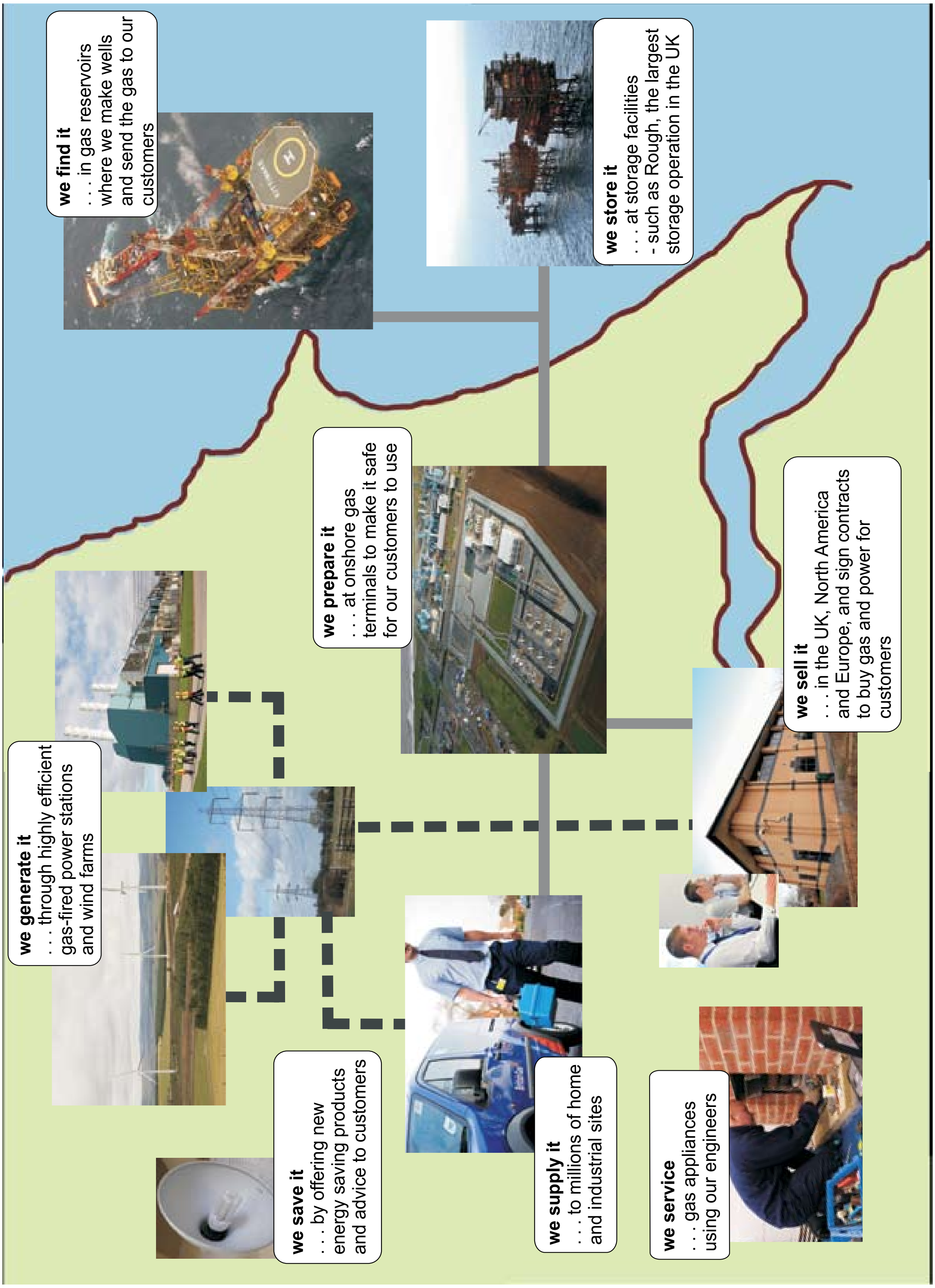
East Yorkshire meets Middle East

An engineer from Qatar has joined local gas storage company for nine months. She is one of three engineers who will gain new skills and knowledge for their return to Qatar Petroleum.

Centrica has a strong partnership with Qatar, which has the world's third largest gas reserves, and a new contract with Qatargas will deliver 2.4 million tonnes per year of gas to the UK.

This will meet about 10% of UK annual residential gas demand, enough for around 2.5 million households.

Energy source diagram



What did you learn from the news articles?

Why is it important to store gas?

Where is gas found and what do we use it for?

Can you describe what a gas is?

How can gas be transported?

How is gas stored?

What shape are pipes? Why

How is gas found?

How are pipes laid on the sea floor?

What materials are used to weigh the pipes down?

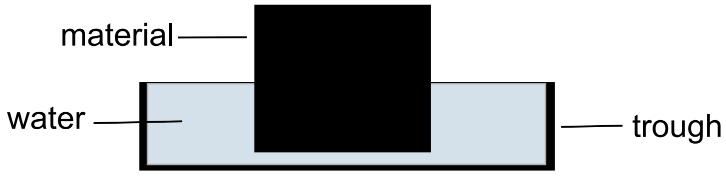
What methods were used to separate materials?

In industry how are the pipes cleaned?

Popping timers

Mixture	Amount of tablet	Amount of water (ml)	Time (secs)	Comments
1				
2				
3				
4				
5				
6				

Water absorption



Quantity of water used: _____ ml

Material				
Quantity of water (ml) after (mins/hours/days)				

The data above tell us ____

____

____

____

If we had left the experiment longer ________________________________

____

____

____

____

If we had used a gas instead of a liquid ____________________________

____

____

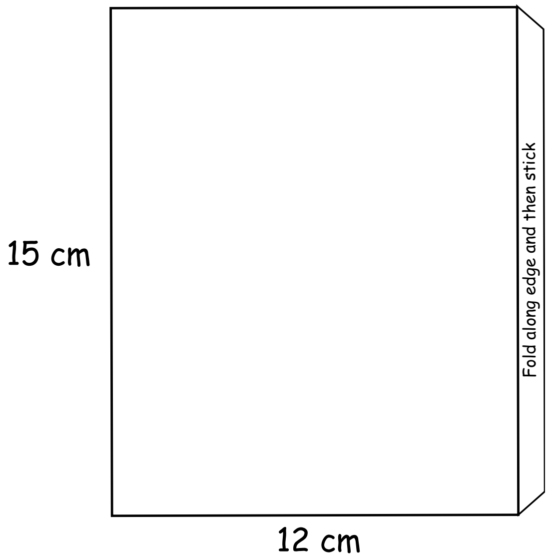
____

____

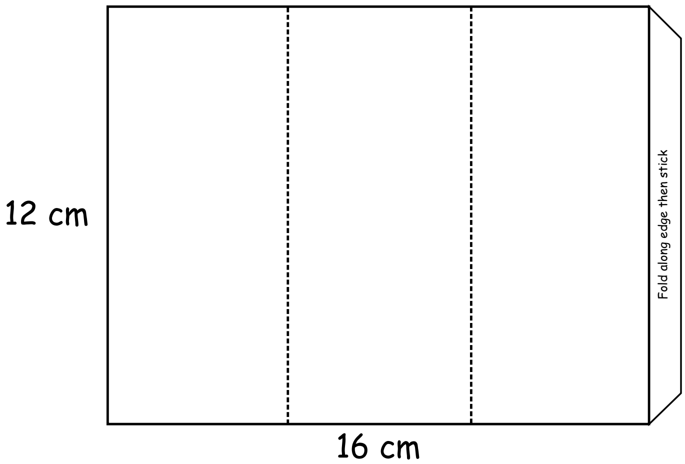
Scale templates for pipes

These sizes are an approximate guide, and actual sizes required will vary with the balloons used.

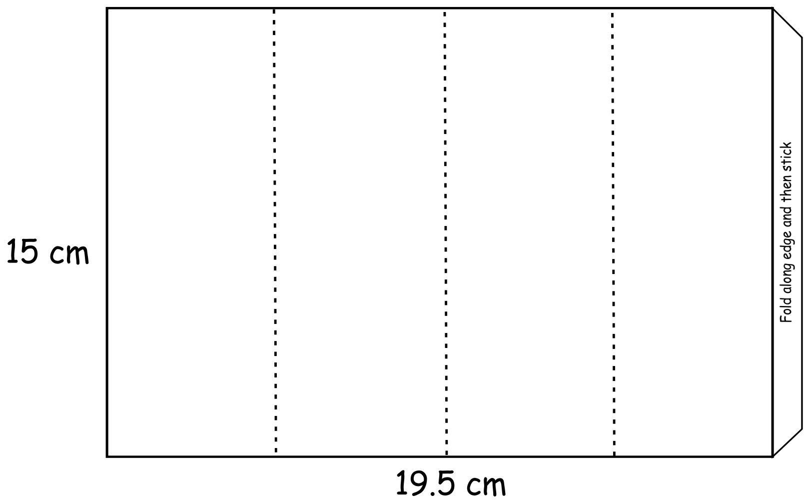
Scale template for a cylinder-shaped pipe



Scale template for a prism-shaped pipe



Scale template for a cuboid-shaped pipe



E-mail

From: Pippa Long [pippalong@seabedengineering.com]
Sent: 28 April 13:34
To: Science Consultants
Subject: Floating pipes

Dear Science Consultants,

We are a company that lays pipelines on the sea bed for gas companies. Recently we have become aware of a problem which we would like you help to solve.

Although our pipes are made of steel and are heavy, they are floating away from the seabed. We cannot attach the pipes to the seabed and they are moving and getting damaged.

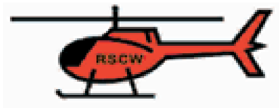
We would like your help to find a suitable material to keep our pipes on the seabed.

The material used must not harm the wildlife around the pipeline and also be long lasting as it is expensive to change any pipeline which has been damaged.

We look forward to hearing your recommendations.

Pippa Long
Senior engineer

Safety Wear Design Brief



Project Title

New flight outfit for people being transported to offshore platforms.

Company Name

Rough Sea Copter Wear.

Company Profile

We are a small company that makes and supplies protective equipment for companies transporting workers from the mainland to offshore platforms.

Target Audience

The people who need our products travel by helicopter and are required to wear special protective equipment.

Requirements

Each man or woman travelling by helicopter requires the correct safety equipment.

The equipment required comes in several parts and we would be interested in receiving designs for the following:

1. **Flight suit:** Must be close fitting, waterproof and durable (long lasting).
2. **Ear defenders:** Must contain sound-proof material, due to the high levels of noise.
3. **Sunglasses:** Must protect eyes from the sunlight, which is very bright and it reflects off the sea. The pilot's glasses must not be too dark so they can still see their instrument panel.
4. **Gloves:** Hands need to be kept warm during the flight, is it can get very cold. Therefore, materials which act as thermal insulators are required.

We would like to see ideas for the design of each item including colour choices. Please include any results collected during your tests on materials.

Please feel free to experiment with colours!

Role Badges

All of the classroom sessions involve children working together in groups of four.

Each child is responsible for a different job or role within the group and wears a badge to identify this. The images below may be photocopied onto card and made into badges, by slipping them in to plastic badge sleeves. Keep sets of badges in 'group' wallets, to be used on a regular basis in your own science lessons.

Children should be encouraged to swap badges in subsequent lessons; this will enable every child to experience the responsibilities of each role.

Administration Officer - keeps a written and pictorial record for the group.

Resources Manager - collects, sets up and returns all equipment used by the group.

Communications Officer - collects the group's ideas and reports back to the rest of the class.

Health and Safety Manager - takes responsibility for the safety of the group, making sure everyone is working sensibly with the equipment.

Where groups of 5 are necessary, the following role can be used:

Personnel Manager - takes responsibility for resolving disputes within the group and ensuring the team works cooperatively.

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

A > B Talk

Children take turns to speak in their pair in a more structured way, e.g. A speaks while B listens B then responds. B then speaks to A while A listens and then A responds to B.

Snowballing

Pupils first talk in pairs to develop initial ideas. Pairs double up to fours to build on ideas. Fours double up to tell another group about their group's ideas.

Envoying

Once the group have completed the task, individuals from each group are elected as 'envoys', moving on to a new group in order to summarise and explain their group's ideas.

Jigsawing

Assign different numbers, signs or symbols to each child in a group. Reform groups with similar signs, symbols or numbers, e.g. all reds, all 3s, all rabbits and so on. Assign each group with a different task or investigation. Reassemble (jigsaw) the original groups so that each one contains someone who has knowledge from one of the tasks. Discuss to share and collate outcomes.

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