6. Move that water!

A problem-solving approach to moving water from one place to another.

OBJECTIVES

- To use a problem-solving approach to move water from one place to another
- Gathering and recording data to help in answering questions
- Observing closely, using simple equipment

RESOURCES

- Activity sheets 12 - 15
- Large bucket of water
- Jugs
- Plastic cups
- Plastic tubs & lids
- Wheeled trolley (or suitable construction kit, such as Quadro)
- Sponges
- Hose pipe/plastic tubing
- Funnel
- Stop watch or sand timer
- Guttering
- Plasticine

DISCUSSION

The challenge of moving a large amount of water is posed to the class to initiate discussion. The children are given criteria to meet:

- As little water as possible must be spilled.
- The method used must be safe whilst other people are working in the classroom.
- The method must be quick - within reason (e.g. safety).

Brainstorm ideas with the children - accepting all possibilities, as this will give them more confidence to suggest unusual ideas. You may choose to display the resources available to them, to hint at solutions, or you may decide to find out what children can devise without any additional support.

Ask children to try and rank the suggested methods in order of their likelihood for success, reminding them of the different criteria, and discussing reasons for their choices.

TASK

Once the class have agreed a rank order, small groups of children can be responsible for trying each method. This can be done whilst the rest of the class watch and time proceedings, or it can be a rotating group activity.

Some methods are most suitably carried out in a wet area or in the playground in warm, dry weather - such as pouring water from the bucket down some guttering. Other feasible methods include:

- Moving filled sponges, cups or jugs of water from a sink to a water tray.
- Attaching a hose-pipe or length of tubing to the tap of the classroom sink to move a given quantity of water.
- Pouring water down a funnel attached to tubing which feeds a bucket (the funnel and start of the tubing should be higher than the end of the tubing, for the water to move along the tubing).
- Using a trolley to move the large container of water.

"We could not obtain piping, so we used the hose from an old vacuum cleaner."

RECORDING & MEASURING

Timing the activity can be done with either a stop clock or a large sand timer, depending on the ability of the children. If using the sand timer, keep a tally of the number of times it is turned over whilst the water is being moved. The transfer of a fixed volume of water can be timed, e.g. one full bucket.

In addition, the flow rate of water through transparent tubing can be measured. This is done by placing a very small plasticine 'fish' (2-3 mm sphere, in reality) in the tubing and timing how long it takes to reach the other end of the tube. Children can watch the 'fish' as it travels along the tubing.

VARYING THE TASK

With older or more able children, an additional small group discussion can be added to the activity. They divide into groups to rank the suggested methods from best to worst before coming back together to make a class decision.

DISCUSSION

Once all the methods have been tried, the results are collected and ordered from 'fastest' to 'slowest'. Each method can then be discussed according to its safety and the amount of spillage. Methods which resulted in a lot of water being spilled, or were unsafe to other children should be moved to the bottom of the list. Finally, children decide on the most suitable method for moving the water.

Ask the children:

- How do you think large amounts of oil are moved from an oil rig to other places?

Activity sheets 12 - 15 can be used during this discussion, to show that large ships, lorries and pipelines move the oil around the world (Activity sheet 15 shows a stream being diverted, as it crosses the path of a new pipeline).

"The children were fascinated by how the oil gets from under the sea onto the land - this was discussed exhaustively!"

Children can compare the methods they used for moving the water to those used to move oil. The use of cups or tubs with lids is similar to the road tanker - moving fairly small amounts. This method is used to move 'tanker loads' of oil to a variety of final destinations. The pipeline is similar to a hose pipe or guttering - and is used when a large amount of oil is being transported to a fixed destination, usually from sea to shore. Oil tankers (ships) are used to transport oil around the world. For further details of oil transportation, see the Background Information page.

Background Information

Note: *This information is provided as a reference for the teacher. Most of the information is too difficult for 5-7 year olds to understand. Some aspects can be discussed, though these must be carefully selected to provide simple and appropriate discussion points with the children.*

THE FORMATION OF OIL

Oil is formed from the remains of small sea animals and plants from 50 million years ago. Immense pressure and heat over time changes these tissues physically and chemically into crude oil and natural gas.

SEARCHING AND DRILLING FOR OIL

Nobody knows precisely where oil can be found.

Geologists gather information about rock formations to make intelligent deductions about possible locations, often under the sea. Exploratory drilling then takes place, using a drilling rig. This is a tall structure with suspended steel pipes and a strong steel drill bit. Once oil is reached (sometimes as deep as 6000 metres below the sea bed) the drilling rig is replaced with a production platform - a more permanent structure in which the crew will live and work.

The platform must be strong enough to support its community and buildings, and withstand the severest storm conditions at sea. The platform is therefore made from a combination of steel and cement.

The North Sea has many oil rigs and platforms which have been built on the North East coast of Britain, and then towed out to the place where oil production will begin.

Rigs used for exploration are quite different from those erected for long term oil extraction. There are also a variety of platform designs for extracting the oil, which depend on the sea and weather conditions. For example, floating platforms are anchored in very deep seas. Others can sit on the sea bed with the legs of the structure deeply embedded. 'Feet' for a platform can be used on dry land, but the force of the sea water would still move the platform about in the water. For the children's activities, distinctions between different types of platforms are not made.

The rate of drilling depends largely on the hardness of the rock. In ideal conditions up to 60 metres an hour can be achieved; whereas extremely hard rock can reduce this rate to 60 metres in 24 hours. A typical drill bit varies in diameter from 30 to 60 cm, depending on the drill hole and depth. In very deep holes, the diameter of the drill bit can be as small as 12.5 cm. The bit has many individual teeth which are made from steel that has been toughened by adding chips of tungsten carbide. For exceptionally hard rock, the teeth are toughened using diamond.

To weigh down the drill bit, 'collars' are used. These are each 9 metres long and weigh 1.5 tonnes. Up to 20 in a 'string' can be added. Replacement of a worn drill bit can take 24 hours - 12 hours to bring it up, and 12 to take it down again.

WORKING ON A PLATFORM

100-200 people can work on one platform, though small or 'satellite' platforms have less. Due to the difficult travelling to and from work, most staff work 1-2 weeks on the platform, followed by 1-2 weeks on shore. People usually travel by helicopter, whilst supplies can travel by boat or helicopter. One helicopter typically transports 20 people.

The platform functions as a small community, so jobs vary widely, as in a village or town. As well as the production, maintenance and drilling team, there are cooking staff (head chef, baker, cooks, and stewards), cleaning staff, medical staff, radio operators, etc.

A typical weekly 'shopping list' for the platform crew includes:

100 kg butter	500 kg vegetables
350 kg flour	1,000 kg meat
500 kg fruit	2,000 litres milk

In addition to this food, a fresh supply of water must always be available. For this reason, a platform has its own desalination plant which converts sea water into fresh water. A typical demand for fresh water can be 30,000 litres per day!

TRANSPORTING THE OIL

Tankers are used to transport oil around the world. They are categorised according to the quantity of crude oil they carry. Very large crude oil carriers (VLCCs) can carry 300,000 tonnes, whilst the cargo of ultra large crude oil carriers (ULCCs) can be 500,000 tonnes. The largest tankers are 400 metres long - approximately 5 football pitches placed end-to-end. Often the crew use bicycles to travel around the ship.

These ships are too large to travel through the Suez Canal, and so their route from the Middle East to Europe takes them around the Cape of Good Hope. This journey takes 60 days, rather than the 40 days needed to travel through the Suez.

The oil is carried in several compartments in the ship. As a cargo is unloaded (in order to maintain the ship's stability) the compartments are filled with water for the return journey.

Smaller coastal tankers sail between refineries, and usually carry loads of 20,000 tonnes or less.

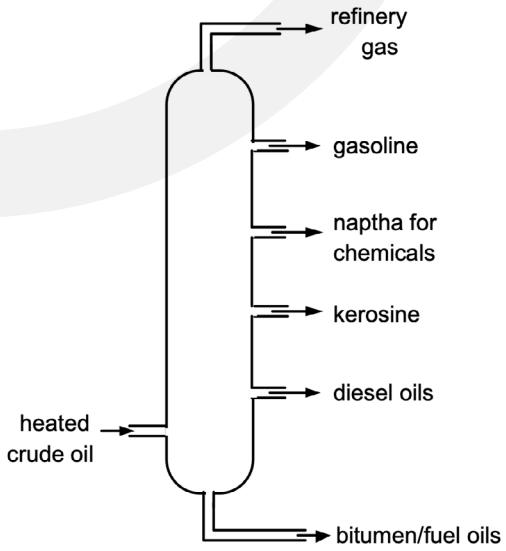
In addition to tankers, pipelines are used to carry crude oil from platforms in the North Sea to shore. Oil can be transported from several platforms to the shore by one pipeline. Pipelines are also used within the UK to transport oil products, such as petrol, to large consumers and distribution centres. For example, nearly 90% of Esso oil and gas products are transported by pipeline. A network of 1100 km of pipelines runs from the Esso refinery near Southampton to centres such as Manchester, London, Birmingham and Gatwick Airport. It is the safest means of transportation, as spillages are rare. It is also environmentally friendly, as pressures on road transport are reduced, and the only visible signs of the pipeline are small markers along its length - similar to those seen on street corners for gas pipelines.

The pipeline consists of sections of steel pipe welded together. When being laid, the newly-welded joints are cleaned, X-rayed, wrapped and waterproofed before the pipeline is covered over. To ensure no leakage occurs, the entire pipeline is regularly tested by running high pressure water through its length.

Road tank vehicles are used to carry oil products to smaller distribution centres, such as petrol stations, and to some customers. These tankers can weigh 38 tonnes and carry 35,000 litres of petrol, though smaller vehicles are used for less accessible places.

SEPARATING CRUDE OIL

Crude oil is a mixture of components which can be separated by heating. This process is called 'distillation'. The process relies on the fact that each component in the mixture changes from a liquid to a gas at a different temperature. The crude oil mixture is heated up to 400°C before being passed into a tall tower (about 80m high). Some of this mixture is now a liquid, but most of it has turned into gases. As the mixture enters the tower, the liquid falls to the bottom, and the gases rise up the tower. As the gases rise they cool down, and one by one they become liquids. As each gas becomes a liquid, it is drawn away from the tower by pipeline. The diagram overleaf shows the main components of the mixture. These components are often further distilled, or refined, to provide a wider range of products.



USES OF OIL

In the 1860s the main use of oil was as a fuel for domestic lighting (paraffin lamps). However, the demands for lubrication grew as industry developed, for lubricating wheels, pulleys and engines. In the 1960s the main use was for producing heat. Today, the main demands on oil are fuels for transportation, a wide range of lubricants, and for the production of chemicals.

A variety of oil products provide fuels, such as aviation fuels, diesel oil and petrol. Each product is tailor-made for its use, be it a heavy grade of fuel oil for use in ships, or kerosene used to heat large buildings such as hospitals, or liquefied petroleum gas (LPG) for camping gas stoves. In many countries these fuels are also used for cooking.

Similarly, products for lubrication vary - from a fine clear liquid to thick grease for the rollers in a steel mill. Paraffin wax is extracted from oil during lubricant manufacture. It is used to make candles and waxed containers for packaging.

Fine oils and greases are used in cosmetics and medicines.

Bitumen is used for road surfacing and for waterproofing roofs, dams and tunnels. This list is not exhaustive, and oil products are found in many applications - such as plastics, ointments, polishes and a wide range of chemicals. In the children's activities the distinction between crude oil and its many products is not made. It is sufficient to say that crude oil is changed in 'factories' (oil refineries) to make many types of oil and products.