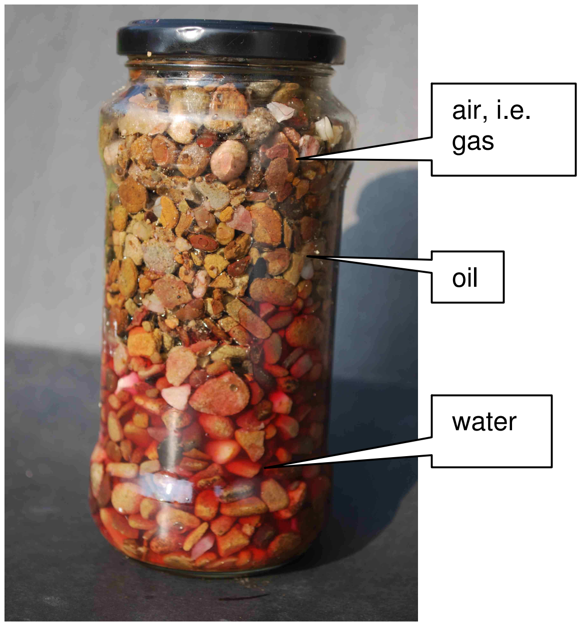
Make your own oil and gas reservoir
Demonstrating how oil and water flow through permeable rocks

Ask pupils how they think that oil and gas are found in their natural state. Do oil and gas deposits lie in great underground lakes; on the sea bed; or within the pore spaces of the rocks? *(A. within the pore spaces of the rocks).*
Show the pupils the prepared sealed jar, containing oil, water and air. Ask them:
- What will happen when the jar is turned upside down?
- What will be the sequence of the oil, water and air, after the jar has been turned upside down and left to settle?

Then turn the jar upside down. Watch as the gas rises rapidly to the top. The oil moves much more slowly, with small globules working their way upwards between the grains of gravel.
Ask the pupils to explain what they have just seen, i.e.
- Why does the oil rise above the water?
- Why does the air always come to the top?
- If the air were replaced with natural gas (which is lighter than air), what would happen if the top of the jar were to be unscrewed?
- Could water, oil and gas be moving like this in the rocks beneath your feet today?



The oil and gas demonstration in a coffee jar (*Photo: Peter Kennett)*

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The back up
Title: Make your own oil and gas reservoir

Subtitle: Demonstrating how oil and water flow through permeable rocks

Topic: A teacher-led demonstration of the migration of oil and water in underground reservoirs

Age range of pupils: 10-16 years

Time needed to complete activity: 15 mins

Pupil learning outcomes: Pupils can:
- explain that oil and gas float on top of water, because of their lower density;
- appreciate that fluids such as oil, water and gas can be contained within the pore spaces of rocks;
- explain that, if the pores spaces are interconnected, the rock is permeable and fluids will be able to move through it.
- explain that if natural gas and oil are not "trapped" below ground, the gas will escape to the atmosphere and the oil will leak out at the surface.

Context: This could form part of a lesson on the world's resources. It is a simple way of demonstrating that oil and gas do not normally occur in underground lakes, but are held within the pore spaces of the rock.
Answers to the questions above are as follows:
- What will happen when the jar is turned upside down? *The layers of oil, water and air will move.*
- What will be the sequence of the oil, water and air, after the jar has been turned upside down? *The water will sink to the bottom, the oil will move to the middle and the air will rise to the top.*
- Why does the oil rise above the water? *The density of oil is less than that of water.*
- Why does the air always come to the top? *Air is of lower density than either the oil or the water.*
- If the air were replaced with natural gas, what would happen if the top of the jar were to be unscrewed? *The gas would escape into the atmosphere.*
- Could water, oil and gas be moving like this in the rocks beneath your feet today? *Water will be flowing through any pores in the rocks beneath your feet, usually downhill; any oil or gas released by source rocks lower down, will be rising, as shown in this model.*

Following up the activity:
Pupils will realise that rock layers are not as loosely compacted as the gravel in the jar. Instead, the grains of the rock are cemented together and the natural cement itself reduces the permeability of the rock (i.e. the rate at which fluids can pass through the rock). They can try dripping water onto a range of sedimentary rocks to see which ones are the most permeable. These would be better reservoir rocks (for oil and gas) or

aquifers (for water) than those with a higher proportion of natural cement in them.
Pupils could be asked to predict what would happen if the jar and its contents were to be heated, to represent higher temperatures at deeper levels in the Earth's crust. They could then try it, by carefully heating the apparatus in a bucket of hot water and then turning it upside down (*The oil would migrate faster, owing to its reduced viscosity).*

Underlying principles:
- Oil and gas do NOT occur in underground lakes but are held within the pore spaces in the rock.
- The porous and permeable rock in which they occur is known as a reservoir rock. [but pupils should not think of a 'reservoir' in the normal sense of the word (i.e. an artificial lake on the surface, built to hold a water supply)].
- Fluids of low density, such as oil and natural gas, will tend to rise through the strata and leak out onto the surface and into the atmosphere, unless an impermeable rock (often called a cap rock) above the reservoir rock forms a suitable trap.

Thinking skill development:
- appreciation of the density pattern of water, oil and gas (construction);
- what will happen if…? (cognitive conflict);
- reasoning behind the answers (metacognition);
- applying the model to real situations in oil exploration and other occurrences where density differences are important (bridging).

Resource list:
- an empty glass coffee jar, drinks bottle, or similar relatively tall, narrow cylindrical container
- clean gravel with a grain size of about 8 to 16 millimetres, enough to fill the jar
- oil, e.g. cooking oil
- water
- colouring agent to colour the water,
- sealant for the lid of the jar

Make up the simple apparatus in advance – fill the jar with the gravel. Fill the pore space with about one third water, followed by one third coloured oil and allow about one third air. Seal the jar, using sealant so that the fluids do not escape and so that pupils do not come into contact with the oil.

Useful links: Try the Earthlearningidea activity *'Trapped! Why can't oil and gas escape from their underground prison?'* and *'The space within: the porosity of rocks'* and *'Where shall we drill for oil? Sorting out the sequence – oil prospect'*.

Source: Earth Science Teachers' Association *Earth Science Experiments for A Level* by Mike Tuke, 2007