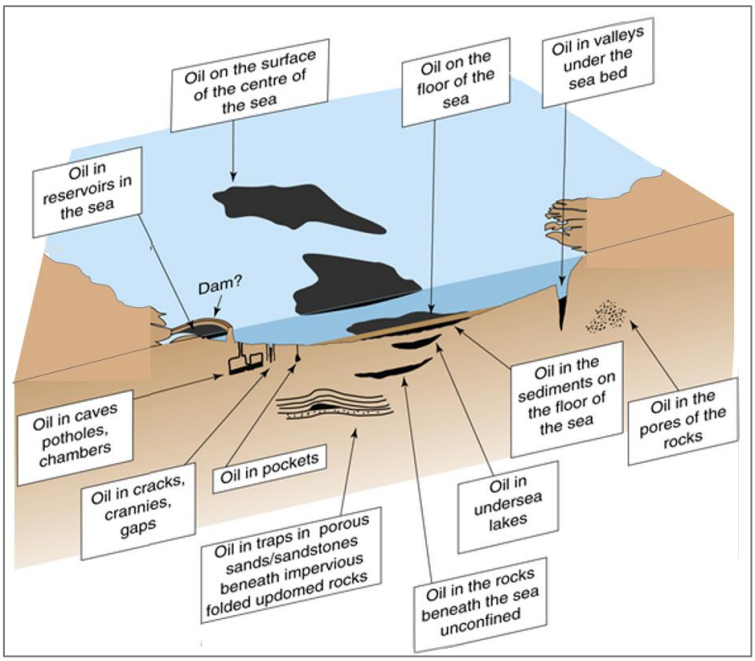
Where does offshore oil come from?
An activity to dispel misconceptions about the source of oil



A cartoon diagram of misconceptions about where oil is found
(*David Thompson, redrawn by ESEU*)

This cartoon block diagram of a coastal area shows many of the misconceptions shown by educational research about where people think oil from offshore areas is actually found.

Ask pupils to tick on the table on page 4 whether the source shown on the diagram is right, partly right or wrong. Then discuss the results with them.

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The back up

Title: Where does offshore oil come from?

Subtitle: An activity to dispel misconceptions about the source of oil

Topic: Pupils are asked to highlight the misconceptions they may have about where offshore oil is found – as a basis for discussion to address these misconceptions.

Age range of pupils: 9 – 18 years

Time needed to complete activity: 10 minutes

Pupil learning outcomes: Pupils can:

- explain that oil is less dense than water and so floats;
- explain how this fact means that the only way in which oil can be trapped in the pore spaces of rocks beneath the sea bed, is if it is covered by an impermeable material such as clay;
- describe how the oil can be recovered by drilling a bore hole through the impermeable material, allowing water pressure to push the oil to the surface.

Context:
As the research shows, a number of pupils can be expected to mark the results incorrectly. The best results are given below, with explanations.

Where does offshore oil come from?	Right	Partly right	Wrong	Explanation
In reservoirs in the sea			√	All offshore oil 'reservoirs' are underground rock masses with oil trapped within them
On the surface of the centre of the sea			√	Any oil found on the surface of the sea is from accidental leakage and is an environmental problem – it cannot be recovered for use
On the floor of the sea			√	Oil is less dense than water and floats – and so cannot be found on the sea bed
In valleys under the sea bed			√	Oil is less dense than water and floats – and so cannot be found in seabed valleys

In the pores of the rocks		√		Oil is found in the pores of rocks, but since oil is less dense than the water in the rocks, it will have leaked out unless the pores are so small (as in clays) that the oil cannot leak
In the sediments on the floor of the sea			√	Oil is less dense than water and floats – and so cannot be found in recent sediments such as gravel, sand or mud, on the sea bed
In undersea lakes			√	There are no spaces at the depths where oil and gas are found big enough to form undersea lakes – even if there were, the oil would have leaked out unless there were leak-proof layers above to trap it
In the rocks beneath the sea unconfined (with nothing impervious/ leak-proof on top)			√	Oil is less dense than water and floats – and so if there is no leak-proof or impervious layers to trap it – it will have leaked out
In traps in porous sands/ sandstones beneath impervious (leak-proof) rocks	√			All oil and gas traps worldwide are of this type. The oil/ gas is trapped in porous reservoir rocks such as sands/sandstones or limestones, trapped beneath impermeable cap rocks and caught in some sort of trap such as formed by the up-doming of the rocks and several other configurations
In pockets			√	Oil is less dense than water and floats – and so will have leaked out of any pockets in the rock
In cracks, crannies, gaps			√	Oil is less dense than water and floats – and so will have leaked out of any cracks, crannies or gaps in the rock
In potholes, chambers (caves)			√	Oil is less dense than water and floats – and so will have leaked out of any cave features in the rock

There are five requirements to form an oil/gas reservoir underground, as follows:

- a source rock – a rock from which the oil or gas originally comes. Most oil source rocks are fine-grained mudstones or shales that contain great quantities of microscopic marine phytoplankton (microscopic plants); these accumulated on a quiet sea bed in the geological past. Most natural gas derives from coal, the dead remains of plants that usually grew and accumulated on deltas in the geological past, and have since become buried.
- enough heat and pressure to break down and release the oil/gas from the source rock; most crude oil is released at a temperature between 60^{o}C and 120^{o}C often at a depth of around 2-4 km; most natural gas is released between temperatures of 120^{o}C and 225^{o}C.
- a reservoir rock – a rock with enough pore spaces (porosity) to store the oil/gas and large enough pore spaces (permeability) to allow the fluids to flow through; these are normally sands, sandstones or limestones.
- a cap rock – a rock that is impervious (impermeable) to seal in the oil/gas; this is usually a fine-grained mudstone, shale or clay; the cap rock prevents the oil and gas from rising vertically to the surface, but it will still rise if a trap-shape is not present to catch it.
- a trap – a shape in the cap rock that traps the oil/gas in the reservoir rock beneath it – this can be formed by folding, faulting or sediment-changes in the rocks.

When a trap containing oil/gas is found by drilling, the fact that oil/gas float on water, and that all the rocks contain water, means that water pressure from beneath forces the oil/gas out of the drill hole towards the surface. In the past this would have caused an oil gusher, but nowadays great precautions are taken against such a dangerous event. If a trap has leaked its oil/gas in the geological past, it will contain only water when it is drilled.

Following up the activity:
Ask pupils to visualise what an underground oil reservoir might look like, and draw and label a picture to show their ideas.

Demonstrate how several of the situations shown in the cartoon diagram and the table could not occur, by, for example, putting a layer of sand in a container (the sea bed), adding cooking oil (an oil 'lake') and then adding water (the sea), to show how the oil floats on the surface of the water, and cannot form a lake at the bottom of the water.

A number of activities relating to oil/gas can be found at the Earthlearningidea website (http://www.earthlearningidea.com), such as 'Trapped! Why can't oil and gas escape from their underground prison?'

Underlying principles: see the 'Context' section above

Thinking skill development:
As a result of discussion, pupils should be able to construct a picture of where offshore oil is actually found, and from where it can be exploited.

Resource list:

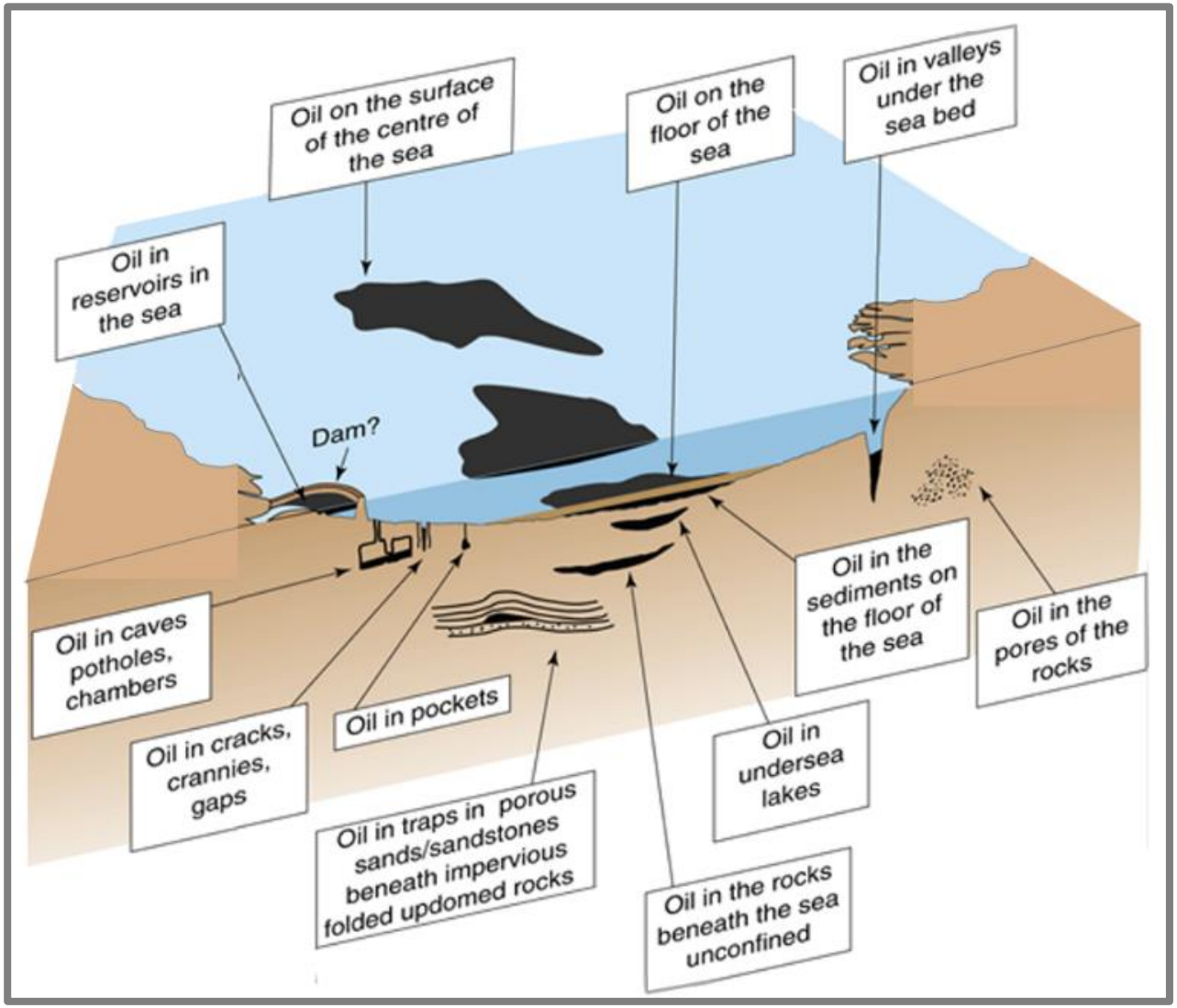
- copies of the 'Where does offshore oil come from?' sheet, one per group of participants
- pens/pencils

Useful links:
A You Tube animation of the formation of an oil/ gas reservoir can be found at:
https://www.youtube.com/watch?v=w9Vj0jjd4ms

Source: Devised by Chris King of the Earthlearningidea Team, based on a drawing drawn from : Thompson, D. B. (1996) Portuguese and English students' ideas on the nature of the Earth, life, volcanoes, earthquakes, oil and soil *in* Stow, D.A.V. & McCall, G.J.H. *Geoscience education and training*, 199-207.

Where does offshore oil come from?

Pupils who were asked where oil from offshore areas came from, gave the answers shown in the cartoon diagram and table below – which is right?
Tick the best boxes.



Where does offshore oil come from?	Right	Partly right	Wrong
In reservoirs in the sea			
On the surface of the centre of the sea			
On the floor of the sea			
In valleys under the sea bed			
In the pores of the rocks (the spaces between the grains)			
In the sediments (gravel/ sand/ mud) on the floor of the sea			
In undersea lakes			
In the rocks beneath the sea unconfined (with nothing impervious/ leak-proof on top)			
In traps in porous sands/ sandstones beneath impervious (leak-proof) rocks			
In pockets			
In cracks, crannies, gaps			
In potholes, chambers (caves)			