Oil and Gas

Sample of crude oil **D**

If you can not get the real thing then used car engine oil is a realistic substitute.

Model of a reservoir **D**

To demonstrate the water-oil-gas order in a reservoir and the slow movement of the oil fill a 200g coffee jar with gravel (8mm to 16mm). Fill the gravel one third with water, one third with a strongly coloured oil (I have used a diesel additive called Redox but sun flower oil would do but would be less visible) and leave the remaining third empty. Put sealant on the thread of the lid and screw it on tightly.

Place the jar on the desk and point out the water, oil and gas layers.

Turn the jar upside down; the gas rises quickly to the top and the oil moves much more slowly, small globules squeezing their way upward between the gravel.

The process is slower if the jar is cooled in a fridge than if warmed on a radiator.

It is possible to make this in a boiling tube using 4mm gravel and a thin oil such as penetrating oil. Make several and then students can watch and describe the processes in pairs.

Effect of temperature on the viscosity of oil ***E P [F](#) 15min***

Three 100ml measuring cylinders have their bases sawn off and gauze placed over one end and then filled with 1mm to 2mm sand. These are

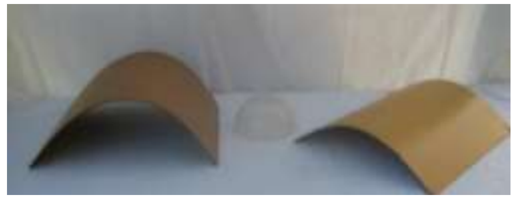
placed on a stand. Sunflower oil at fridge, room and radiator temperature is poured into the tubes to see how fast each flows through.

Porosity of reservoir rocks E P F 10 min per sample
Students find the porosity of typical reservoir rocks: sandstone and oolitic limestone.
Students measure and work out the volume of a rectangular piece of rock. They then weigh it. It is put in water for 24 hours and then weighted again. The difference in weight is the water it has soaked up. The weight of water equals the volume of water in cc. and this divided by the volume of the rock is the porosity. Alternatively students can find the porosity of irregularly shaped samples. First they obtain the volume of the dry sample from the difference of its weight in air and in water. The sample is soaked and the weighed again to find the weight of water in the pores.

Oil and gas traps Pa I F 10 min
Students are given a cross section with many different types of oil traps. They must shade in where oil might be found and name the type of trap.

Location of natural gas in the North Sea Pa I F 10 min
Students locate sites where natural gas might have accumulated in a section through part of the southern North Sea Basin. They must name the types of traps.

Boreholes A P F 30 min
A large container (50cm by 40cm by 20cm) contains a hidden shape which represents the top of an oil reservoir. Students locate and describe the shape of the reservoir by lowering a thin rod through pegboard.



Resistivity of the reservoir rock *E P 10 min*
Small pots of sand saturated with formation water (tap water), oil (sun flower oil), and gas (air) are tested with a damp meter or resistivity meter.
Cubes or sandstone and of oolitic limestone saturated in the same way can also be used. The oil and the gas saturated samples do not conduct electricity.

Oil shale *D*
Place the oil shale in boiling water. Some oil comes out and floats on the water. Heat the oil shale and it gives off smoke.

Compaction of shale with depth *Pa I F 15 min*
Students plot the changing porosity, pore diameter and temperature with depth and comment on the movement of fluids from the source rock into an adjacent sandstone at various depths. They must then comment on what factors are going to make movement of fluids easier (high temperature therefore lower viscosity, high pressure); and more difficult (pore size)

Oil generation Pa I F 10 min

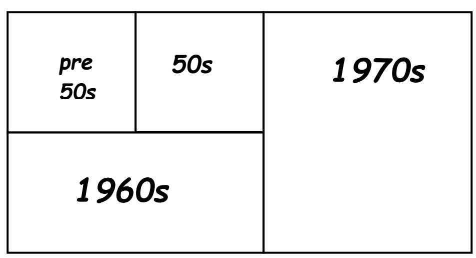
Live plankton may eventually become oil in a reservoir. Students are given a list of the processes and the products that result from each of these processes which happen during the generation of oil from plankton and its movement to a reservoir. They must put the processes in order and match them to the correct product.

Locating natural gas reservoirs in the North Sea Pa I F 10 min

Students overlay maps of the distribution of source rock (coal), reservoir rock (sandstone), cap rock (salt) to find where they all overlap. They then compare this with the location of known gas wells.

Will there be enough Oil? Pa I 10 min

Until recently oil demand was increasing at 7% per year which means it is doubling every 10 years. Students draw a square on graph paper 2cm by 2cm to represent the volume of oil used prior to 1950, and another the same size touching it for use during the 1950s. Below that again touching it a rectangle 2cm by 4cm for the 1960s and then a square on the right for the 1970s and so on for each decade up to 2020. During the 1950s the world used 2200 billion gallons of oil. How much did it use in the 1990s?



Yield of oil from source rock Pa I F 10 min

Students calculate the volume of oil that can be extracted from a volume of source rock.

Volume of oil from a reservoir rock A I 15 minutes

Students work out the porosity of the reservoir rock (see porosity experiments) and the area underlain by oil saturated rock and are given the reservoir thickness. From this they must calculate the volume of oil present. Alternatively they can be given the porosity, area and thickness.

Stretching and thinning of the crust **D**

The North Sea oilfield was caused by the stretching of the crust which formed a sedimentary basin and the thinned crust enable more heat to come through from the mantle. Take a sheet of sponge rubber 5cm by 2cm by 20cm and stretch it. It will thin in the centre.

Fun ***I 1 min***

Type either 7100553 or 71077345 into an ordinary calculator. Turn it upside down to see what it has to do with oil.