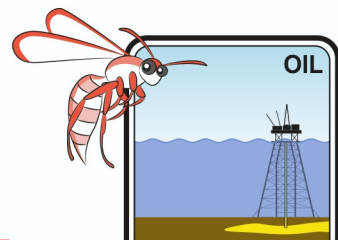


## Pressure, Porosity, & Permeability – Teacher Notes



### 1. **Pressure** (Force per unit area)

Hydrocarbon migration occurs as a response to pressure from overlying rocks, sediment and water.

This demonstration or activity uses a water-filled plastic bottle into which holes have been pierced. When the bottle is held upright, water coming from the lower hole is under greater pressure and spouts further. It is easier if you fill the bottle with water, screw on the lid and lay it on its side to be punctured with a pin or nail before you lift it upright. (This activity or demonstration can precipitate a “run” on students asking to visit the toilet!) Oil is created from the hydrocarbon kerogen (fragments of buried organic material) at depths of about 2 to 4 km. Gas is formed between 4 and 6km. Pressure at these depths of sediment is extreme. Oil and gas will move upwards and laterally through porous rocks and fractures in rock.



**Porous rocks** have pores or voids between their grains, clasts (broken bits of rock) or crystals.

**Permeable rocks** have connections between the pores permitting gasses or liquids to pass through. Many students have problems differentiating between porosity and permeability.

### 2. **Porosity and permeability**

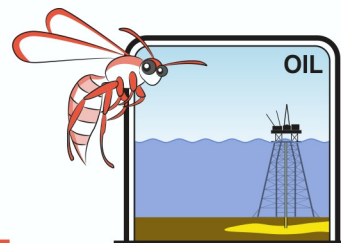


**Materials required per person or group:**

#### Part A

- 1 Filter stand or balance the funnels inside the beakers
- 2 filter funnels (or one used twice)
- 3 beakers
- Small polystyrene balls or marbles, (dry rice or pasta can be used if the funnels are lined with filter paper first)
- Bubble wrap cut large enough to line filter funnels (HINT Use squares one and a half times the diameter of the funnels)
- Water (with food colouring if you prefer)
- A hand lens or magnifying glass

## Pressure, Porosity, & Permeability – Teacher Notes



**Equipment note** Resource challenged schools may cut the tops off 500ml washed cool drink bottles. The base can be used as a beaker and the top inverted to form a funnel. Kitchen paper or Chux can be substituted for filter paper. The filtration section in 'Physical Separation Techniques of Water' may be of use.

1. Mix water with food colouring in one beaker
2. Set the filter funnels on the stand and place the empty beakers below. Students often forget this critical step and wet benches result!
3. Line one filter funnel with bubble wrap and fill the other with polystyrene balls
4. Pour some water slowly into the filter funnels.
5. Clean the equipment and store for further use

Describe what happens and give an explanation

Although both filtering materials had spaces/holes, only the balls had these joined up to allow the water to permeate through.

Materials which have holes or voids are called porous. Which filtering material is porous? Both are porous

Materials where the holes or voids are joined up are called permeable. Which filtering material is permeable? The polystyrene balls/rice/

**Porous rocks** have pores or voids between their grains, clasts (broken bits of rock) or crystals.

**Permeable rocks** have connections between the pores permitting gasses or liquids to pass through.

Which kind of rock would you need to allow oil or gas to migrate through it? Permeable

Igneous rocks are crystalline and unless broken through earth movements are rarely permeable. Sandstones and limestone are permeable but clay and siltstone are not.

### Part B

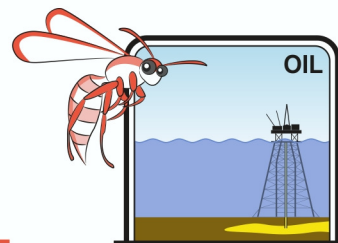
- Specimens of different rocks (E.g. granite, limestone, basalt, limestone, chalk, dolerite - commonly called road metal and slate)
- Pasteur pipette and water

**Equipment Notes** If you don't have pipettes, use a drinking straw. Measure 5cm from bottom of straw and make a mark with a waterproof pen. Place straw in water to the mark and hold finger over the other end. The straw can be lifted out of the water and water will be released when the finger is removed

**Rock specimens** Many garden centres and kitchen/bathroom outfitters sell prepared slabs of slate, sandstone, marble etc. They are often willing to hand over broken pieces for classroom use. Monumental masons (gravestone makers) have impermeable rock but do not often have samples of permeable rock as it weathers more easily. Some blackboard chalk is reconstituted and is impermeable because of the fixative used. Brick is cooked/metamorphosed clay.

**Oil/water** Because of safety considerations water is used to represent oil and gas in their migration from source rock to reservoir. Vegetable oil could also be used. However it is expensive and difficult to clean up afterwards.

## Pressure, Porosity, & Permeability – Teacher Notes



1. Using the hand lens or magnifying glass closely observe each rock to see if it is porous
2. Using a pipette or straw, drop 2 ml water onto the rock specimens.
3. Closely observe water movement using the hand lens to see if the rock is permeable.
4. Write up your observations in the table below.

	Porous	Permeable	Would oil or gas move through this
Granite	No	No	No
Chalk	Yes	Yes/No (see note)	Yes/No
Limestone	Yes	Yes	Yes
Dolerite	No	No	No
Sandstone	Yes	Yes	Yes
Pumice	Yes	No	No
Brick (cooked clay)	Yes	No	No

### **OPTION** Permeability pictures

Ask students to make observations based on the photographs on the following page. 2ml water was dropped on specimens of sandstone, granite and slate at the same time. A 5c coin was placed next to the water drop to act as a control for measurement. Photographs were taken at intervals of five minutes.

What was the **DEPENDENT VARIABLE**? Permeability

What was the **INDEPENDANT VARIABLE**? Rock type

What was the purpose of the 5c pieces? To indicate scale

Which rock or rocks would allow oil or gas to migrate through? Sandstone

Tick the correct boxes

Rock	Permeable	Impermeable
Granite		X
Sandstone	X	
Slate		X

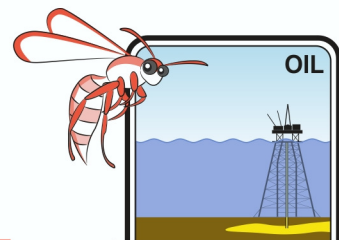
The rock above is pumice. It is a volcanic rock. 2ml of water has been dropped on its surface. Observe what has happened.

Is pumice porous? Yes, it has holes

Is pumice permeable? No, the holes were not joined up so the water ran off of the outside







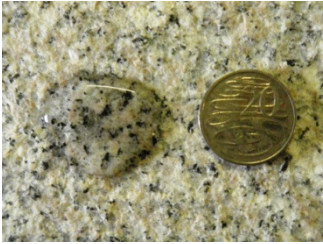


Which rock would be the best to allow oil and gas (hydrocarbons) to migrate through it and why? Sandstone. The hydrocarbons could migrate through the joined up holes or voids.

## Pressure, Porosity, & Permeability – Teacher Notes



### Permeability Experiment pictures

Five ml of water was dropped onto three different rock types. Photographs of what happened to the water were taken at 5 minutes, at 10 minutes and after 1 day.

Time	Granite	Sandstone	Slate
0min.			
5min.			
10min			
1 day	