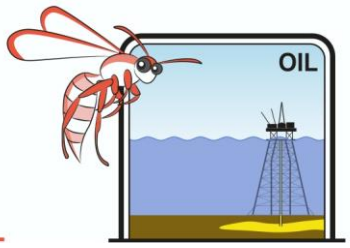
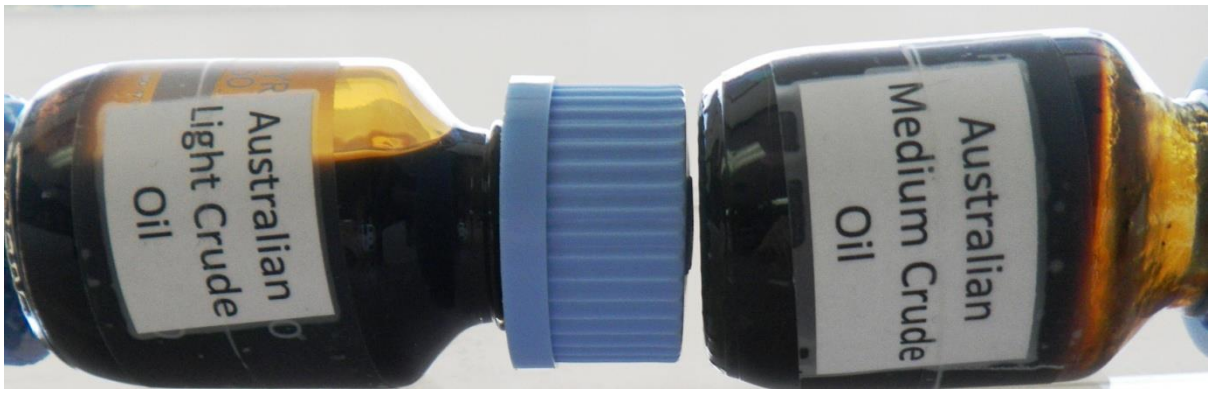



# Viscosity & Raising Raisins - Teacher Notes

Viscosity is a measure of reluctance to flow. Something which flows easily has low viscosity and something which is resistant to flowing has high viscosity. For example, honey is more viscous (i.e. has a higher viscosity) than water. For a visual demonstration of liquids with different viscosities, visit: https://en.wikipedia.org/wiki/Viscosity

When geologists drill a hydrocarbon well, light oils are recovered faster than heavier oils (which are more viscous) because the light oils permeate and flow out of the reservoir rock and into the well more easily and faster than the heavier oils. After a while, the flow of hydrocarbons into the well slows down because of the increased percentage of heavier, more viscous, oils.



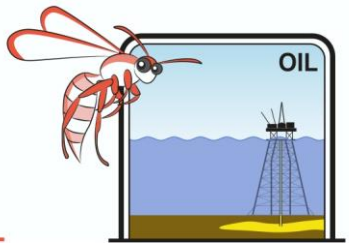

These oils above were sourced from local oil fields. Medium crude oil is more viscous and more reluctant to flow than light oil. It therefore requires more reservoir pressure or gas re-injection to allow it to be recovered. The bottles of oil above were moved from upright to horizontal position and left for 10 minutes. Light oil achieved a level surface almost instantly. The more viscous crude oil had only just started to level out after 10 minutes and took about 30 minutes to achieve a fully level surface.

**Measuring the Flow Rate of Liquids**
This experiment helps introduce the concept of viscosity to students by comparing how fast different liquids flow down an inclined slope.

**Materials per group or teacher**

- A laboratory or student tray (or any washable, flat surface) raised at one end by a pile of books. The surface should be cleaned and dried between repetitions to reduce the effects of contamination by earlier competitors.
- Masking tape and ruler to create a “race track” on the tray
- Transfer pipettes or teaspoons.
- A variety of liquids with different viscosities (e.g. honey, butter/margarine, tomato sauce, mayonnaise, water, oil, vinegar, syrup)
- Stopwatches (or stopwatch in their mobiles)

To make this a ***fair test,*** the same volume of liquid must be used on a surface inclined at the same angle in each trial. ***HINTS:*** Do not make the angle of incline too steep and the difference between the fluids will be more apparent. Honey from the fridge is *VERY* slow to move. A teaspoon usually holds 5mLs of fluid. Students measure the rate of movement of the fluids over the same distance using stopwatches. If data is scientifically acceptable, it must be **Observable, Measureable, and Repeatable before it is Reportable**. The table supplied is for three repetitions.




# Viscosity & Raising Raisins - Teacher Notes

**Estimate Viscosity**

Another simple demonstration of viscosity involves comparing the viscosity of two liquids, in this case blue water on the left and tomato sauce on the right.
Ask students to hypothesise (provide a scientific guess or estimate) which substance will be the most viscous. Expel air from both transfer pipettes and measure water level on the graduated column.
This experiment provides measurable data (comparison of volumes in the barrels of the transfer pipettes), however the amount of air expelled resulting in negative pressure cannot be controlled.
Similarly two transparent drinking straws can be used. Two students suck for two seconds. This experiment is even less controlled but can provide a rough indication of relative viscosity.
Viscosity also affects the rate of recharge in a reservoir. Most depleted oil reservoirs will recharge but it will take geological time.

**Gas Lift**

When either reservoir pressure decreases or oil becomes too viscous, flow from the well can slow or stop. Gas can be pumped into the well to decrease the density and viscosity of the oil and raise it more easily to the surface. Carbon dioxide is a by-product from oil and gas refining and may be pumped back down the hole. This technique is called "***GAS LIFT***".

**Materials per student or group**

- 500ml beaker or clean glass jar. NOTE: The container must be clean and very well-rinsed out; any bit of detergent will ruin the experiment.
- 6 raisins
- Lemonade, soda or clear fizzy drink

**Method**

1. Place some raisins at the bottom of a large, empty glass jar or beaker.
2. Cover well with lemonade or soda water (anything with fizz).
3. Observe for at least 5 minutes.

Raisins will slowly rise to the surface and then drop back down again. They will do this several times. Bubbles from the fizzy drink attach themselves to the surface of the raisin until their density together is less than the drink, and then the bubbly raisins rise up to the surface of the drink. At the surface, the bubbles are lost into the atmosphere; this increases the apparent density of the raisins relative to the liquid, which results in the raisins sinking back to the bottom of the container. The raisins will stop rising when there is insufficient gas left in the drink.

In onshore areas producing little oil, a donkey pump or pump-jack can be used to pump shallow oil to the surface when reservoir pressure falls.