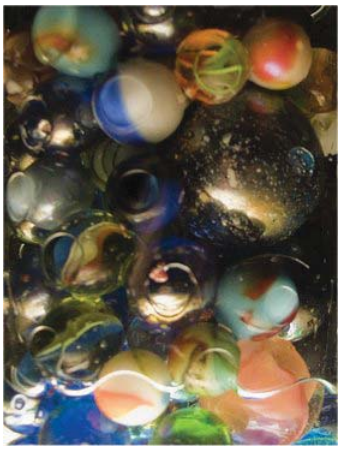
Reluctant Oil Well - Teacher Resource

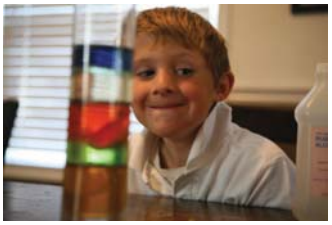
Investigating Density and Viscosity

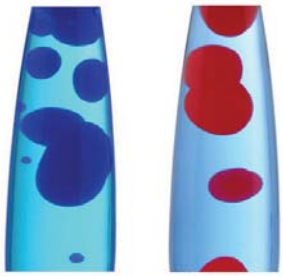
The Reluctant Oil Well experiment gives students the opportunity to explore physical principles such as density, viscosity and pressure. This follow-up resource includes a few suggestions for demonstrations and class activities you might like to run with the students after their visit to Lab in a Lorry.

Activity	Setup Guide and Information
What is Density? Demonstration: Equipment: Salt Small Beaker Marbles Water	Density is a measure of how much "stuff" there is in a certain space. We can calculate the density of an object using the following formula: Density = Mass / Volume Units kg / m^3 All matter is made of tiny particles, the closer the particles are together; the more particles will fit in the same space, and therefore the denser the material. • Fill the beaker with the marbles; ask the students if they think you could fit any more in. Now pour in the salt - the salt will fill in the gaps between the marbles. Ask if they think you can get anything else into the same space. Now pour in the water. There is now much more "stuff" in the same space so we say it is denser.
Floating and Sinking	Why do some objects float whilst others sink? Whether or not an object floats depends on the relative densities of the object and the liquid it is placed in. An object will float in a liquid if the density of the liquid is higher than the density of the object. Oil is less dense than water, this explains why after an oil spill the oil can be seen floating on the surface of the water. We use the density difference of oil and water to help us extract oil from under the sea. Oil rigs pump water underground which pushes the oil through the rock. The oil then rises above the water and towards the surface.
Demonstration: Equipment: An Orange Large Glass Bowl Extension + Class Activity	• Ask the students if they think the orange will float or sink if dropped into the bowl of water. The orange should float • Peel the orange and drop it in again - this time it should sink. Students often get confused by this. *Misconception - light objects float and heavy objects sink.* Why does the peeled orange float? The orange has trapped air under the peel which makes its overall density less than the density of the water - so it floats. Remove the peel and you are left with just the orange, which is denser than water so it sinks • Try adding salt to the water until the orange floats - ask the students what they think is happening. This method could then be used by the students to work out the relative densities of different fruits.

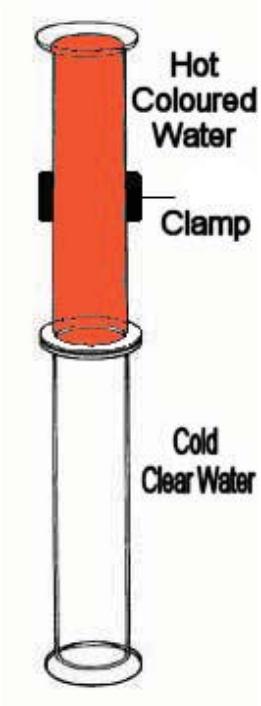


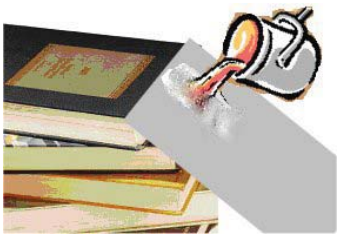
Activity	Setup Guide and Instructions
Class Activity Layering Liquids Equipment: Test-Tubes Glycerol Salt, Water Isopropyl Alcohol Food Dye (4 colours) Pipettes	Preparation: Add different coloured dye to the alcohol and glycerol. Now mix the salt with some water to make a fairly strong salt solution. Add the remaining dyes to the salt water and the plain water, to produce 4 different coloured liquids. • Using what they have learnt about density and floating the students can now have a go at layering some liquids. The densest liquid must be at the bottom and they should decrease in density moving upwards. The students will first need to experiment to find out the relative densities before producing a column of 4 different coloured liquids.
Effect of temperature on density	A lava lamp is a device that relies on the change of density with temperature. When a liquid is heated the particles are given more energy. This causes them to vibrate more and therefore get further apart. Since the particles are further apart, less will fit into the same space so the density decreases. In a lava lamp a wax-like substance is heated by a light bulb. Once this substance melts its density becomes less than the water so it rises up inside the lamp. As the substance rises it also starts to cool and contract, finally becoming denser than the water and therefore sinking back to the bottom again. The process is then repeated.
Demonstration: Make a Lava Lamp Equipment: Lemonade Raisins Water Cooking Oil Salt	• A simple lava lamp can be made in 2 ways; 1) Pour lemonade into a beaker and then add some raisins. The bubbles of carbon dioxide gas (what makes the drink fizzy) are less dense than the liquid and start to rise up. On the way they get trapped in the wrinkled surface of the raisins. When enough bubbles accumulate on a raisin they will lift it to the surface. Once at the surface the gas escapes and the raisin will sink back to the bottom. 2) 4/5^{ths} fill a beaker with water. Pour a layer of oil onto the surface (remember it should float as it's less dense than the water - relate to oils slicks in the sea) Pour a table spoon of salt onto the surface of the oil. The salt will fall through the oil, dragging it down to the bottom. On the way down the salt will dissolve in the water and the oil will then rise back to the surface.





Activity	Setup Guide and Information
Layering liquids using a temperature difference Demonstration: Equipment: 2 Gas Jars Hot water Shiny card / Plastic sheet	This demonstration is best done in a large tray or sink to catch any spillage • Fill one of the gas jars with cold water and the other with hot water, ensure both are filled right to the brim. Add a few drops of food colouring to the hot water • Place the shiny card or plastic sheet on top of the gas jar filled with the hot water and invert it. Keep the card pressed tight against the end to prevent the water running out. • Place the inverted gas jar on top of the one filled with cold water and take care to line them up properly. • Whilst holding the top jar in position carefully pull out the card. The hot coloured water should remain on top of the clear cold water, due to the density difference. As the hot water cools it will begin to mix with the cold water below.
Investigating Viscosity Class Activity Equipment: Tracing paper or teflon baking sheets Variety of different viscous liquids - eg, Honey, Ketchup etc Text Books Sticky tape Stop-watch Ruler Bunsen/heater Meausring Cylinders	Viscosity is a measure of a fluids resistance to flow. In simple terms it's how “thick” a liquid is. A liquid with high viscosity will flow slower than a liquid with low viscosity. Water has a low viscosity while the viscosity of honey is much higher. • Get the students to setup a ramp using a pile of books and the tracing paper. They must secure the tracing paper etc to the books and desk using some sticky tape - ensure it is taut. After measuring out equal amounts of the different liquids they should pour them one at a time onto the slope and measure the distance each one flows in 2 minutes. • Ask how we could get the liquids to flow further. A common answer might be "increase the angle of slope". Another way would be to reduce the viscosity of the liquids. This can be done by either adding water to dilute the liquids (depending on which liquids you're using) or by increasing the temperature. Viscosity normally reduces at higher temperatures so the students could investigate either/both of these ideas depending on the time available. • When drilling for oil engineers use steam to extract very viscous oil - ask the students why this might be - is it dilution? The shape of a volcano depends on the viscosity of the lava it is erupting. Some volcanoes are narrow with steep sides whilst others are much wider with gently sloping sides. See if the students can figure out what causes these differences.





Curriculum Links for the Reluctant Oil Well experiment and follow-up

Planet Earth

Second	Third	Fourth
	I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things. **SCN 3-05b**	Through investigation, I can explain the formation and use of fossil fuels and contribute to discussions on the responsible use and conservation of finite resources. **SCN 4-04b**

Forces, Electricity and Waves

Second	Third	Fourth
By investigating floating and sinking of objects in water, I can apply my understanding of buoyancy to solve a practical challenge. **SCN 2-08b**		Through experimentation, I can explain floating and sinking in terms of the relative densities of different materials. **SCN 4-08b**

Materials

Second	Third	Fourth
I have participated in practical activities to separate simple mixtures of substances and can relate my findings to my everyday experience. **SCN 2-16a**		I have explored how different materials can be derived from crude oil and their uses. I can explain the importance of carbon compounds in our lives. **SCN 4-17a**