

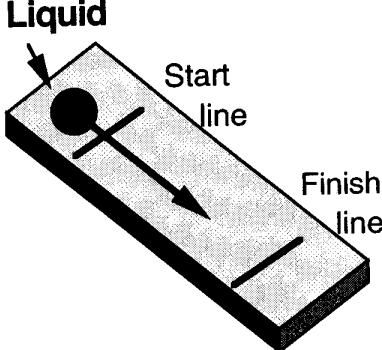
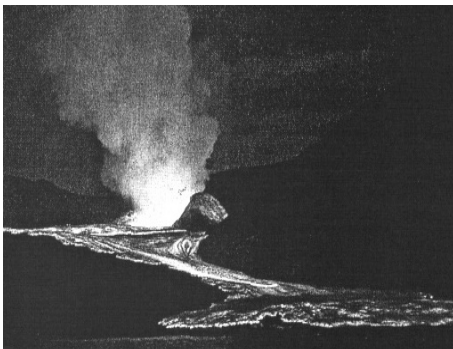
# Fluid flow

One feature of liquids is that they can spread out and flow downhill.

However, they do not all run at the same speed! The “runniness” of a liquid is measured by its **viscosity**.

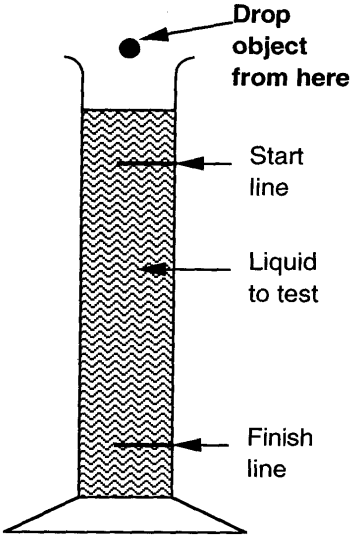
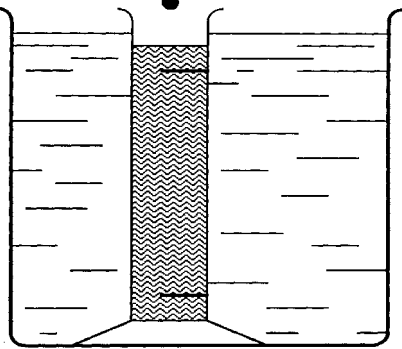
In this mini-project, you will test different ways of comparing viscosities of different liquids, and also find out how the viscosity of a given liquid depends on the conditions under which it is measured.



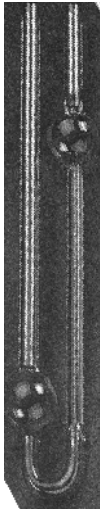
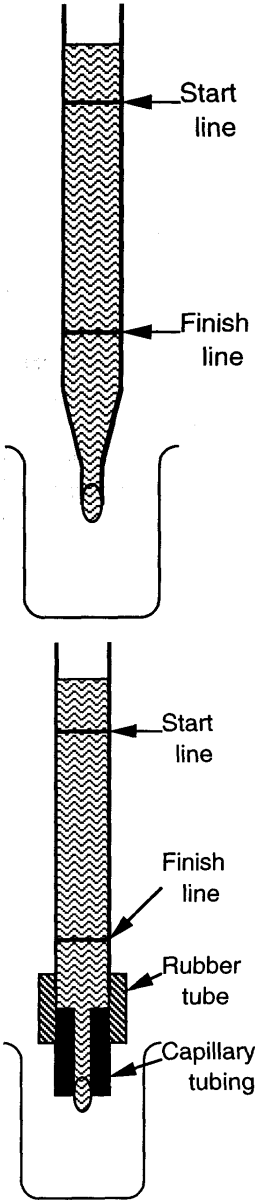
Ideas about how liquids behave:	Some investigations you might try:	
<p>The particles in liquids are held close together by attractions between them, but they are able to move past each other. The viscosity of a liquid is related to how easy or difficult it is for the particles to move.</p> <p>Because of the attraction between the particles, liquids, unlike gases, do not spread out to fill all the space around them.</p> <p>However, because the particles can move, gravity makes liquids flow down slopes to the lowest level they can reach.</p> <p>This movement is useful when scientists are working out what might happen if a liquid is spilt.</p> <p>It is also of interest to drainage engineers, and in flood control.</p>	<p><b><u>The slippery slope</u></b></p> <p>The easiest way to compare the movement of liquids down slopes is to make a “standard slope” and then compare the times for different liquids to flow down it.</p> <p>Set up a clean sheet of glass (e.g. a microscope slide) or a shiny tile at an angle.</p> <p>Mark two lines, or reference points on it.</p> <p>Using a dropper, drop one drop of the test liquids onto the slope, just above the top mark.</p> <p>As the drop runs past the top mark, start a clock. Stop the clock when the liquid reaches the lower mark.</p> <ul style="list-style-type: none"> <li>• How do different liquids (e.g. different motor oils, or different alcohols) compare?</li> <li>• How do skimmed milk, full cream milk, single cream and double cream compare?</li> <li>• Does the amount of dissolved sugar make a difference to the runniness of sugar solutions?</li> </ul>	<ul style="list-style-type: none"> <li>• How can you support the slope?</li> </ul>  <ul style="list-style-type: none"> <li>• How will you catch the liquid that runs off?</li> <li>• What difference does changing the angle of the slope make?</li> </ul> 

**Check all experimental plans with your teacher BEFORE you begin any practical work!**

# Fluid flow

Ideas about how liquids behave:	Some investigations you might try:	
<p>Because the particles in liquids can move, other objects can move through a liquid.</p> <p>For example, you can swim through water, bubbles of gas rise up through water, and objects which are denser can sink down through a liquid.</p>	<p><b><u>Sinking like a stone</u></b></p> <p>This method for comparing viscosities uses an object that is denser than the liquid. You can time how fast the object sinks.</p> <p>This method depends on how easily an object can sink through the liquid.</p> <p>The falling object can be a bead, stone, ball-bearing or marble. The liquid can be contained in a test tube or measuring cylinder. Make two marks on the container, one a little way below the surface of the liquid, the other a little way above the bottom of the container.</p> <p>Hold the object just above the surface of the liquid and let go. Time it from the first mark to the second one.</p> <p>With this method, you could put the container in a water-bath at different temperatures. This would let you test how the viscosity changes if the liquid is at different temperatures. For example, motor oil has to be thin enough to flow round the engine on cold mornings, but remain thick enough to protect the engine when it is hot.</p> <p>A variation of this method is to take a fairly narrow glass tube that can have the ends closed using rubber caps (as used for gas syringes). Fill the tube almost full with the test liquid, close both ends. See how long it takes for the small bubble of air in the tube to move between two marks when the tube is held up straight.</p> <p>Both of these methods work well for thick, sticky liquids. In very thin, runny liquids, the ball or bubble moves so fast it is difficult to time it accurately.</p>	 <ul style="list-style-type: none"> <li>• Does it matter what the ball is made of?</li> <li>• Can you still get reliable results if the object isn't a regular shape?</li> <li>• Does it matter how big the object is, or how wide the container is?</li> <li>• Does it matter how far from the ends the two marks are?</li> <li>• What is the shortest container that gives good results?</li> </ul>  <p>Don't forget, it takes quite a long time for a liquid to come to the same temperature as its surroundings!</p>
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# Fluid flow

Ideas about how liquids behave:	Some investigations you might try:	
<p>The viscosity of a liquid determines how fast it can run through a tube, or escape through a small opening.</p> <p>This is important for piping engineers. They need to know what size pipes and valves will be needed to carry different liquids.</p> <p>A commercial viscometer of this type is called an Ostwald viscometer (named after the person who invented it). It is a U-shaped tube.</p> <p>Perhaps you can invent a new type of viscometer and name it after yourself!</p> 	<p><b><u>“Run-out” viscometers</u></b></p> <p>For this you need a tube with a narrow jet at one end. Two lines should be marked on the tube to show the start and finish levels for timing the liquid as it runs out of the tube.</p> <p>Clamp the tube so that it is vertical. Fill it with liquid to above the top mark. Let the liquid run out freely (catch it in a beaker!).</p> <p>Record the time for the surface of the liquid to fall from the top mark to the bottom mark.</p> <p>This sort of measuring device is less useful for very thick, sticky liquids. It works well with thin runny liquids, especially if the tip of the jet is very narrow.</p> <p>One practical problem for you to solve is how to get the liquid in without any bubbles!</p> <p>Find out how much difference it makes if the tube is not vertical.</p>	
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