4. Viscosity testing

1.5 hour activity

Children investigate the effect of altering the ratios of specific ingredients on the viscosity of the resulting syrups. The aim is to find the best consistency for a cough medicine.

TYPE OF ENQUIRY

- Comparative testing

OBJECTIVES

- Compare and group together everyday materials on the basis of their properties
- Give reasons, based on evidence from comparative and fair tests for the particular uses of everyday materials.
- To report and present findings from enquiries including conclusions, causal relationships and explanation of and degree of trust in results in oral and written forms.

SCIENCE VOCABULARY

Viscosity	Observe	Measure
Investigation	Data	Changes
Compare	Improve	Evaluate
Results	Ingredients	

RESOURCES

(per group of 4 children, unless otherwise stated)

- Activity sheet 5 (1 per child, optional)
- 50 ml liquid glucose (available from most supermarkets or pharmacists)
- 50 ml glycerine
- 50 ml water
- 20 ml measuring cylinder
- Small containers
- Plastic spoons or stirrers
- Measuring spoons
- Pipettes
- Blank sticky labels
- For the viscosity testing (depending on the test chosen)
    - 3-4 marbles
    - 1 plastic funnel

- 1 stop clock
- 1 30 cm length of dowel marked in centimetres
- 1 30 x 20 cm board (or other smooth surface)

PRIOR KNOWLEDGE/EXPERIENCE

Children should have experience of taking and recording measurements. They should have had opportunities to describe and explore a range of mixtures and understand that mixtures of liquids can be made up of different amounts and types of liquids. An understanding of ratio and average is helpful but not essential.

ADVANCE PREPARATION

Consider that children are likely to need three or four identical containers per group plus any measuring cylinders and jugs. The utensils used for measuring the liquids are suggestions and can be substituted with what is available.

When mixing ingredients, containers with firmly fitting lids are ideal as they can be shaken. If lids are not available, make sure containers have a wide enough mouth to allow for vigorous stirring.

Liquid glucose is very difficult to pour and is very sticky. Children may need assistance to pour a measured amount accurately or they may use measuring spoons.

ACTIVITY NOTES

Discuss the meaning of viscosity and explain that it is the correct word to describe the 'runniness' of a liquid.

Encourage discussion about how runny a medicine would need to be, based on children's own experience. Make reference to familiar liquids such as water, oils, shampoo or washing up liquid. Polymers are added to these products to produce the correct consistency.

A cough syrup needs to be of the correct consistency to coat the inside of the throat instead of going straight into the stomach.

Show children the three ingredients that could be used to produce a syrup to carry the active ingredient in the medicine they are producing (liquid glucose, glycerine and water). Make sure children know they have to devise and record a recipe for the syrup they produce in this activity to make the final product. In the pharmaceutical industry, this would form part of the secondary manufacturing stage.

None of the three liquid ingredients individually has the desired viscosity, so the children will need to devise a way of mixing the liquids in different combinations and proportions to achieve the best result. Stress the need to measure accurately and to label and record each combination. Ask children why, in a commercial environment, it is vital that the recipe be systematically recorded and reproduced so that it is identical each time. Relate this to other products they may be familiar with such as tomato ketchup or toothpaste. Ensure that children understand the importance of potential customers knowing that a product will be as they expect each time they buy it.

Discuss with children the need for quality control and constant sampling in all forms of manufacturing. More information about the industrial production of liquids can be found in the CIEC resource Runny Liquids.

Allow each group time to discuss the task and to produce ideas about how the viscosity of a syrup could be tested. Discuss ideas and ask groups to consider any advantages or disadvantages of the suggestions that are put forward.

There are several ways that children may decide to test viscosity.

- They may pour a measured amount of each liquid into a 'bunged' funnel and time how long it takes for all of it to run through, when the bung is removed.
- They may use a 'spoon' test, scooping a measured amount of each liquid and observing or timing how long it takes to pour or drop from the spoon.
- A similar method is to measure and mark a length (between 5 and 10 cm) on to separate pieces of dowel, dip the dowel into the liquid up to the measurement and then transfer it straight to a measuring jug. The run off of liquid can then be measured. The more viscous the liquid, the more will be picked up by the dowel.
- Time how long it takes an object, such as a marble, to sink through a measured amount of each liquid.
- Time how long it takes for a measured amount of the liquid to spread out to fill a circle.
- Measure the length of time it takes the liquid to run down an angled slope.

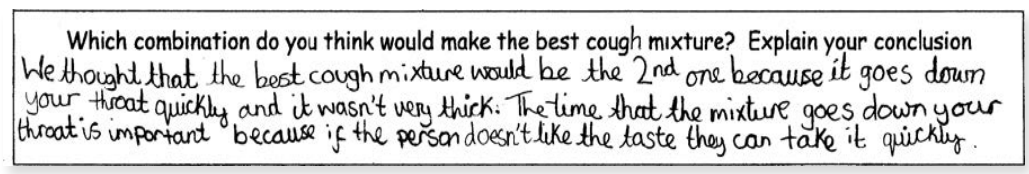
When the merits of each method of investigation have been discussed, each group should decide how to carry out their test and collect their resources. Each group should design a recording sheet and have it approved before beginning their investigation. Alternatively use Activity sheet 5.

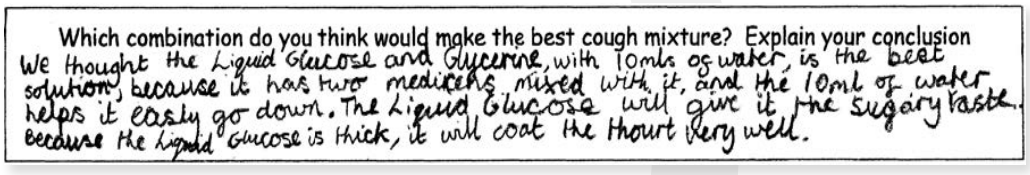
Children do not need to test large quantities. A total of 50 ml of any of the liquids combined is enough to obtain results. This may be measured out using a spoon, a pipette or a measuring cylinder, depending on what the children decide to do and the resources available.

Remind the children that they need to combine two or more of the ingredients in measured amounts, testing and recording each combination until they arrive at what they consider to be the ideal viscosity for their medicine. Once a sample has been tested and recorded it can be changed to dilute or thicken and then retested, as long as the changes are recorded.

Each group should discuss how successful their investigation was.

In the examples below two different groups of children have a completely different perception of what the best liquid will be like. In the first example the focus is on swallowing quickly to avoid the bad taste. In the second example the children understand that the medicine needs to stay in contact with the throat to be most effective.


Which combination do you think would make the best cough mixture? Explain your conclusion
We thought that the best cough mixture would be the 2nd one because it goes down your throat quickly and it wasn't very thick. The time that the mixture goes down your throat is important because if the person doesn't like the taste they can take it quickly.


Which combination do you think would make the best cough mixture? Explain your conclusion
We thought the Liquid Glucose and Glycerine, with 10mls of water, is the best solution, because it has two medicens mixed with it, and the 10ml of water helps it easly go down. The Liquid Glucose will give it the sugary taste. Because the Liquid Glucose is thick, it will coat the throat very well.

An opportunity should then be given to present their findings to the whole class and the outcomes discussed. A comparison could be made between the final syrup that each group has produced. Ask what other ingredients may need to be added before the medicine goes into production. If needed, prompt children to think about flavouring and colouring to make the medicine more palatable and more visually appealing.

This is also an opportunity to discuss the effects of glucose on tooth decay and obesity. They have used glucose (a form of sugar) as one of the ingredients, but many medicines are now sugar free. Introduce the idea that scientists have developed an alternative to glucose to sweeten medicines because of these issues.

EXTENSION

In what other instances is the viscosity of a liquid important?

Ask children to think about, discuss and research this question. Oil for lubrication of machines is an obvious example. On an industrial scale, it is also a consideration for the petrochemical industry and any company that has to move liquid from place to place. Chocolate manufacturers need to move liquid chocolate around a site. Molten glass and metal are moved around while at a very high temperature. Discuss examples that may be familiar to children, for example sucking a milkshake through a straw, squeezing toothpaste from a tube. Why is viscosity important in ice cream sauces or tomato ketchup?

QUESTIONS FOR THINKING

- What problems did they encounter?
- How were they resolved?
- How would a company check that their mixture was always exactly the same?
- Why is it important that the mixture is always exactly the same?

CROSS CURRICULAR LINKS

- **English:** Opportunities to use spoken language to develop understanding through speculating, hypothesising, imagining and exploring ideas. Also, links to writing whereby pupils identify audience and purpose, as well as selecting the appropriate form.
- **Mathematics:** Opportunities to practice taking and recording measurements