

Hot Chocolate

Curriculum links

England and Wales (Key Stage 3 Science Programme of Study)	
key concepts	1.1a
key processes	2.1b and c, 2.3a
range and content	3.2a
curriculum opportunities	4a-c
Northern Ireland (Science Statutory Requirements)	
knowledge, understanding and skills	develop: enquiry skills; critical thinking; practical skills research information learn about: mixtures; solubility
objective 1 – develop as individuals	mutual understanding: team work
objective 3 – as contributors to the economy/ environment	identify skills used in: writing unambiguous instructions
Scotland (SQA Science Outcomes)	
third level	SCN 328Z

Introducing the activity

You may wish to start this activity by discussing what the pupils already know about dissolving:

- some substances (such as salt) will dissolve in water (substances that dissolve are soluble)
- some substances (such as sand) will not dissolve in water (substances that do not dissolve are insoluble)
- heat can make things dissolve more quickly and in greater amounts (in a given volume)
- stirring can help things dissolve more quickly
- when substances dissolve in water they form a solution (for example, a salt solution)

Pupils may also know that there's a limit to how much can dissolve. However, it is unlikely before this stage that the pupils will have encountered the terms solute, solvent and saturated solution.

Show pupils two beakers (or other transparent vessels) containing about 200 cm³ of hot water. Ask the pupils to observe what happens when you add a heaped teaspoon of sugar to one beaker, the same amount of drinking chocolate powder to the other, and stir each briefly for the same length of time. They should be able to tell you that the sugar has dissolved. Ask them how they know. (It has 'disappeared' and the solution has become transparent.)

Some pupils may think the drinking chocolate has also dissolved (or at least some of it has). Ask them why some of the powder has collected at the bottom of the beaker. Establish that the powder has not dissolved, and will not dissolve, even with more stirring. (It has not 'disappeared'; the mixture has not become transparent.) It is not a solution but a suspension.

Describe what has happened in each beaker using the terms soluble, insoluble, solvent, solute and solution - to allow the pupils to complete their extension activity. You may need to remind them of the particle model.

Ask the pupils who they think decides what the instructions on a packet of drinking chocolate are going to be and how this decision is made. Explain that throughout the production of chocolate (and other foods and drinks), constant checks and measurements are being made. The different processes require people, such as chemical engineers, to follow standard procedures.



The practical activity

Safety note: Preparing and tasting the drinking chocolate must be carried out under hygienic conditions e.g. in a food technology room, not a laboratory.

This activity is designed to be carried out in small groups. However, you may wish pupils to write up their standard procedures individually. Discuss the activity with the pupils to ensure they are confident, and you are confident in them, of carrying it out correctly and safely. Explain that they are going to investigate the significance of standard procedures by carrying out a hot chocolate taste test.

Pupils are expected to notice the following vague or ambiguous words, and alter them to produce a set of exact instructions (a standard procedure):

1. heaped – what is the mass of a heaped teaspoon?
2. cup or mug – what is the volume of a cup or mug?
3. hot – what is the required temperature of the milk?
4. stir well – how many times should they stir, and how vigorously?
5. milk – is the milk skimmed, semi-skimmed, whole, organic ...?
6. add – in one go, or gradually?

The groups are unlikely to come up with the same sets of instructions. They may decide on different masses for their 'heaped' teaspoons, different temperatures for 'hot', different types of milk, and choose different sized cups or mugs filled to different levels, giving them different volumes.

When the groups compare the flavour of their drinks, it is likely that at least some of these differences will be apparent. This highlights the need for standard procedures if you want everyone to produce exactly the same thing. It doesn't matter if the instructions on a packet of drinking chocolate are ambiguous. Taste is a personal thing and different people might prefer different amounts of powder, or different types of milk, or different temperatures of drink and so on. However, if you want to conduct a taste test, then you must be sure that everyone tastes exactly the same hot chocolate drink. You need unambiguous instructions.

Note: Although you want the pupils to recognise the ambiguous meaning of 'milk', to focus attention on the other ambiguities, you may wish to restrict choice to whole and/or skimmed milk only.

Heating the milk: If a cooker ring and saucepan (or hotplate) are used, pupils can use a thermometer during heating. However, if a microwave is used, the increase in temperature cannot be monitored. Instructions should stipulate the power of the microwave and the amount of time the milk will be heated for.

Equipment

(Per group)

- 50 g drinking chocolate (powder)
- up to 300 cm³ of milk
- cup or mug
- teaspoon
- measuring jug
- kitchen scales or top-pan balance
- thermometer (to measure up to 100 °C)
- a method of heating the milk (microwave oven, cooker ring and saucepan, or hotplate)

Possible extension activities

- Investigate the misconception that dissolved substances 'disappear'.
 - mass of solute + mass of solvent = mass of solution
 - evaporation shows that the dissolved substance is still there; it has not been lost
- Investigate how temperature affects solubility. Does temperature also affect the ease or difficulty of stirring drinking chocolate powder into water or milk? If so, why?
- Investigate what happens when no more solute can dissolve. How much sugar can be dissolved before the solution becomes saturated?

