Science@School | Book 4D

Solids and liquids

Teacher's Guide

Support material for the pupil book
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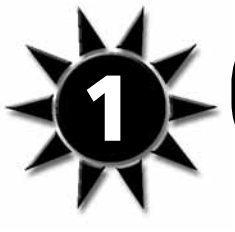


Teacher's sheet: comprehension

See **pages 4 and 5** of *Solids and liquids*

Answers

1. **The square should be filled with 25 circles. They should all be about the same size and each one should touch its neighbours.**
2. **Metal, clay, wood, paper, wool, margarine.**
3. **Flexible solids.**
4. **By pushing and pulling them.**
5. **Some of the particles unstick and this allows them to move past one another.**
6. **Warm it up.**

Complementary work

(a) Give the children some cotton wool, a piece of woollen fabric and a sponge. Tell them that they are made of solid materials and ask them to look at each one with a magnifying glass and draw the solid parts of the material. They should draw fibres of cotton wool, the pattern of yarn in the woollen fabric and the solid material between the holes in the sponge.

Teaching notes

The approach taken here is to introduce solids and liquids separately. This is done to introduce the children gradually to the concept of the three states of matter. These states are solids, liquids and gases. In this unit the aim is to take the children's knowledge of materials from earlier work and show how this relates to the solid state of matter.

In earlier work, the children may have come across the term particle as a tiny piece of solid that they can see. Here the term particle has a different meaning. It means a tiny piece of matter that can only be seen by very powerful microscopes called electron microscopes. Both meanings are correct, and the children should be aware of the distinction. It may help them to think of a particle of sand, that they can see, as being made up of millions of tiny particles that they cannot see.

Some children may be familiar with the words atoms and molecules. These are examples of the tiny unseen particles from which all three states of matter are made.

The children may have difficulty thinking of soft, flexible materials, like wool, as being solid. Make sure that they recognise these materials as solids by letting them try (a) in the complementary work.

Teacher's sheet: activity

Based on **pages 4 and 5** of *Solids and liquids*

Introducing the activity

(a) You could begin by reminding the children that all the materials they have studied in this unit can be put in one group, because they have one property in common. They all keep their shape unless they are pushed or pulled into a new shape. Materials with this property are called solids. Now challenge the children to see if different solids have different properties (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 3 (see note (ii)).

(c) Let the children try tasks 1 to 3.

(d) Go through tasks 4 to 6.

(e) Let the children try tasks 4 to 6 (see note (iii)).

Completing the activity

(f) Let the children complete task 7 and compare their results (see note (iv)).

Conclusion

The metal wire and Plasticine bent because they are flexible. The dry spaghetti and matchstick snapped because they are brittle.

The spaghetti broke at a certain weight. The wire was much stronger and did not break. It bent when the weight became very heavy.

Teaching notes

(i) The purpose of this activity is to help the children see the materials they studied in previous years as belonging to the group called solids. It also allows them to use their knowledge and understanding of the properties of materials for assessment, and will help you plan your future work on this topic.

(ii) The children can record their results in a table or in written form. Look for the words flexible and brittle in their grouping of the materials, and in their explanation.

(iii) The spaghetti and wire should be placed between two blocks in turn and small weights hung from them. The number of weights can be added until the spaghetti snaps and the wire bends. You may wish the children to wear eye protection.

(iv) The accuracy of the results will depend on the size of the weights used. Children who use small weights will have a more accurate record of the strength of the spaghetti than children who use large weights.

Teacher's sheet: comprehension

See **pages 6 and 7** of *Solids and liquids*

Answers

1. **(a) A cube; (b) salt, sugar.**
2. **Ice crystals.**
3. **Room. A liquid which is turning into a solid very, very slowly.**
4. **Molten rock.**
5. **Diamond, emerald, ruby.**
6. **The way the particles inside the crystal are locked together in regular ways.**

Complementary work

(a) Let the children examine a mineral's hardness test set (available from educational suppliers). They can compare the hardness of the minerals and revise the previous year's work on hardness in *3C Properties of materials*.

(b) Let the children use secondary sources to find out about diamonds, emeralds, rubies and sapphires. If they study opal, they will find that it does not have a crystal form.

Teaching notes

Many solids have a crystalline structure. There are seven basic forms of crystal. The cube is one form. The rhombus and hexagon are two other forms. Rocks are made of different crystals which have grown into each other. This often results in the crystal shapes being impossible to see. Sometimes, as in granite, pink crystals of feldspar and black crystals of mica can be seen in a white mass of quartz crystal. If a crystal is broken, it breaks in a special way that is related to its form. Mica, for example, is a thin, flat crystal which splits to form more thin, flat crystals if it is broken.

The crystals seen in geological specimens or in gemstones have their special shapes because there was space for the crystals to form properly.

Metals also have a crystalline form, but often this cannot be seen. 'Fool's gold' is the mineral chalcopyrite. It contains copper, iron and sulphur. The crystal structure of zinc can be seen in its ore, and in the pure metal. Zinc ore is a mineral called sphalerite. It contains zinc and sulphur, and has a cubic form. You can see the boundaries between crystals of zinc on galvanised steel such as farm gates and buckets.

Teacher's sheet: activity

Based on **pages 6 and 7** of *Solids and liquids*

Introducing the activity

(a) Begin by telling the children that they are going to compare sea salt and sugar with Epsom salts. You can also tell them that they will have a chance to try and grow crystals in a few minutes (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 4.

(c) Let the children work through tasks 1 to 4 (see note (ii)).

(d) Go through tasks 5 to 9, then let the children work through them (see note (iii)).

Completing the activity

(e) Let the children compare their descriptions.

Conclusion

Sugar and sea salt have a cubic crystal structure. Sugar crystals are larger than sea salt crystals.

Epsom salt crystals vary much more greatly in size. Some fragments are as small as sea salt crystals, others are larger than sugar crystals. They do not have a cube shape (see note (iv)).

When the water containing Epsom salts dries on the glass a white substance is formed which has lines in it. Some of the lines may form a structure like a fan.

The appearance of the substance on the side of the glass is due to the formation of crystals.

Teaching notes

(i) Epsom salts are made from a mineral called epsomite. This mineral rarely forms crystals naturally, but forms a crust on the walls of caves and mine workings. When Epsom salts are dissolved in water they make crystals readily when the water evaporates.

(ii) Make sure that granulated sugar is used.

(iii) A very small beaker or other container can be used. The brush needs to be painted across the side of a glass about six times. Drops of water can be allowed to flow down the glass. Just half the side of a glass tumbler can be used, or one side of a flat-sided jar (the crystals do not form well on a plastic surface). It may take half an hour for the crystals to form. They are best viewed by holding the jar above a black cloth and using a magnifying glass.

(iv) The crystals have a rhomboid form.

Teacher's sheet: comprehension

See **pages 8 and 9** of *Solids and liquids*

Answers

1. **Sand, rice, wheat.**
2. **Flour.**
3. **Water.**
4. **It has too much water. (The extra water has made the mixture lose its strength.)**
5. **A landslide forms on a hillside when the soil gets very wet. The very wet soil loses its strength and flows like a liquid down the side of the hill.**

Complementary work

(a) If you have used a sand timer in your introduction, you could challenge the children to make one. They could first draw out their design and discuss it with you. If the materials needed are within the resources of the school, and the children are able to handle the materials safely, you may let them make their timers and assess how accurate they are.

Teaching notes

In this unit the children can use the word particle to mean tiny pieces of solid that they can see. This can be used freely as there is no mention of the tiny particles from which all matter is made.

The children may think that a group of particles behaves exactly like a liquid. It does behave like a liquid in that the particles can flow and take up the shape of the container they are put in. However, when grains or powders are poured into a container, they do not form a level surface, but a cone. If the container is gently shaken the cone will be destroyed and the surface will become level. When the container is tipped, the particles will move, but their surface may not form a horizontal surface, as when liquid is tipped in a container. (You may like to leave this property until the next unit, where the tipping of water in a container is featured.) A further difference between groups of solid particles and liquids is that the groups of solid particles do not form drops when they are poured.

Teacher's sheet: activity

Based on **pages 8 and 9** of *Solids and liquids*

Introducing the activity

(a) Introduce this activity to the children after they have studied the section on the effect of water on pages 8 and 9 of the pupil's book.

Using the sheet

(b) Give out the sheet and let the children fill in their name and form, then go through tasks 1 to 4 (see note (i)).

(c) Let the children perform tasks 1 to 4.

(d) Go through tasks 5 and 6 with the children, then let the children try them.

(e) Go through tasks 7 to 10 with the children, then let the children try them (see note (ii)).

Completing the activity

(f) Let the children compare their observations.

Conclusion

All the substances form a cone when they are poured.

Rice grains stick together with a little water, but separate almost completely when more water is added.

Sand grains stick together with a little water and can be made into a wider variety of shapes than rice. When more water is added, the sand grains may flow together at the bottom of the bowl.

When a little water is added to flour, it makes a sticky dough. When more water is added, the dough becomes slimy and breaks up.

When the cornflour is mixed with a little water, it forms a liquid, but if you press the mixture it turns into a solid. When more water is added, the cornflour forms a creamy liquid.

Teaching notes

(i) This activity is potentially messy, so it is important for all the children to perform all the tasks at the same time and to clear up between the examination of each substance. Depending on the ability and attitude of the children, you may like to pour out the grains, powders and water for them.

(ii) If you make a mixture of 20cm^3 of water and four teaspoons of cornflour, you should produce a substance which flows slowly in the bowl but turns into a solid when you put your fingers in it to pick it up. When you pick up a solid lump and hold it in your hand it will turn back to liquid and flows through your fingers. Squeezing and pulling will make the substance turn back to a solid. You may have to add a little more cornflour or water to your mixture to make it exhibit these unusual properties. You should practice making a successful mixture before you make a mixture in class.

Teacher's sheet: comprehension

See **pages 10 and 11** of *Solids and liquids*

Answers

1. **All the lines in the containers should be horizontal.**
2. **By heating it until it melts.**
3. **By cooling it until it freezes.**
4. **Cube-shaped.**
5. **It changes its shape and becomes globe-shaped.**
6. **The water moves from one syringe through the pipe to the other syringe. It does this because a liquid cannot be squashed.**

Complementary work

(a) Let the children use secondary sources to find out about water clocks.

(b) From their research on water clocks, let the children design a water clock. If the materials can be easily provided and the children have the ability, let them make their water clocks and test their accuracy. You could use this activity as part of a technology project or a history project.

Teaching notes

This unit forms the bridge between solids and liquids. You may like to revise the properties of solids at some point in your introduction, then move on to show how liquids are different.

The unit also gives you an opportunity to revise the children's ideas on heating and cooling from earlier in their school work. It will also prepare them for later studies on changes.

Here the main focus is on comparing the solid state and liquid state, so it is sufficient to keep your work to the study of wax and water. In the following unit you can introduce a range of liquids.

You may like to demonstrate the activity in Picture 1, or show the children a candle with wax running down its sides and ask them to explain why the wax has set again lower down the candle.

You may also like the children to tip a container carefully and see how the water surface always stays horizontal. You could compare tipping a container of sand to show how a group of solid particles move when they are tipped.

A weight may be placed on a wooden block, and on a balloon containing water, to show how both give support because they cannot be squashed.

When the study of the unit is almost over, show the children the two balloons you used in the introduction. They should find that they appear and feel the same because the balloon that was frozen has thawed out.

Teacher's sheet: activity

Based on **pages 10 and 11** of *Solids and liquids*

Introducing the activity

(a) Show the children a collection of containers. Pick up two containers (use two that are very different, such as a bottle and a tray) and mime pouring a liquid from one container to the other. Ask the children if they think the volume of the liquid could change when it moves from one container to another. Ask them how they could check.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 and 2 (see note (i)).

(c) Let the children perform tasks 1 and 2.

(d) Go through tasks 3 to 8 with the children.

(e) Let the children perform tasks 3 to 8.

(f) Check that the children have successfully completed tasks 3 to 8, then let them try tasks 9 to 11.

Completing the activity

(g) Let the children complete task 12 (see note (ii)).

(h) Let the children compare their results.

Conclusion

The volume of the water does not change when it is placed in containers with different shapes. The level of the water in the container changes from one container to the next. In a tall, thin container the water level is high. In a broad, shallow container the water level is low.

Teaching notes

(i) The children could stick labels on the containers or write on them in marker pens.

(ii) The volume may appear to fall slightly as the investigation progresses. This could happen if drops of water are left on the insides of the container after the liquid has been poured back into the measuring cylinder. The children could check their results by pouring a certain volume into each container then pouring it back, rather than using the same water throughout the investigation.

You may wish to point out that, although the volume stays the same, the water level may vary widely due to the shape of the containers. This change in water level may lead some children to think that the volume has changed.

Teacher's sheet: comprehension

See **pages 12 and 13** of *Solids and liquids*

Answers

1. **The X should be lower than the marble in jar A.**
2. **The X should be higher than the marble in jar A.**
3. **Ensure all the marbles were the same size. Have the same volume of liquid in each jar.**
4. **Water. It is runnier than oil.**
5. **From under the ground when a volcano erupts.**
6. **It changes from hot to cold, red to black, runny to sticky, liquid to solid.**

Complementary work

(a) The children can use secondary sources to find out which volcanoes are active today.

(b) The children can use secondary sources to find out about large eruptions of volcanoes in the past.

Teaching notes

The runniness or 'stickiness' of a liquid is known as its viscosity. Viscosity is an important property of oil that is used in machinery. If the oil is too viscous, it will not coat the moving parts and protect them from the effects of friction. As different machines work at different temperatures, so oils are designed to provide the correct viscosity for them. You may like to try the activity on the following pages with warm and cold syrup, or treacle.

Teacher's sheet: activity

Based on **pages 12 and 13** of *Solids and liquids*

Introducing the activity

(a) Begin by telling the children that when scientists are trying to make discoveries, they try to find different experiments to test the same thing. The runniness of a liquid, or the speed at which objects sink in it, both test the 'stickiness' of the liquid. Challenge the children to try both tests and see if they produce the same results.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, and go through tasks 1 to 3.

(c) Let the children carry out tasks 1 to 3.

(d) If the children's plans are acceptable, let them try their tests (see note (i)).

(e) Go through tasks 4 to 6, then let the children carry them out.

(f) If the children's plans are acceptable, let them try their tests (see note (ii)).

Completing the activity

(g) Let the children try task 7.

(h) Ask the children how they could make more certain of their conclusion. Look for the answer that they should try more liquids. If time permits let them try two more liquids.

Conclusion

The 'stickiness' of a liquid can be found by testing for runniness, or for testing how quickly objects sink in them. The results of one test are confirmed by the other test.

Teaching notes

(i) A ramp should be made with a board or tray and wooden blocks. The same amount of liquid should be poured from the top of the ramp, and the time taken for it to reach the bottom, or a certain distance, should be recorded. The test could be repeated. The table should have two or more columns. The first column is headed 'Liquids'. The second column is headed 'Time to flow (secs)'. If the test is repeated, the second and subsequent columns may be headed 'Trial 1', 'Trial 2', etc. Some children may need reminding that they need a stop clock.

(ii) The same amount of liquid should be used for both tests. The object should be dropped from the same height above the liquid surface. If there is sufficient equipment, both liquids could be compared at the same time. If there is not enough equipment, one liquid can be tested after the other. The table should have two or more columns. The first column is headed 'Liquids'. The second column is headed 'Time to sink (secs)'. If the test is repeated, the second and subsequent columns may be headed 'Trial 1', 'Trial 2', etc.

Teacher's sheet: comprehension

See **pages 14 and 15** of *Solids and liquids*

Answers

1. **To provide warm water for the home.**
2. **Near the lower pipe should be an arrow pointing to the left. Inside the tank there should be arrows pointing upwards. An arrow pointing to the right should be by the top pipe.**
3. **The bottom of the tank should be shaded.**
4. **A rod-shaped heater.**
5. **(a) When it is warm, (b) when it is cold.**
6. **It rises.**
7. **The water takes up more space, but still weighs the same. This makes it lighter than the surrounding water, so it rises. The particles in the warm water spread out and make the warm water less dense than the surrounding water. The less dense water rises.**

Complementary work

(a) The children could use secondary sources to find out about cold water systems and hot water systems in a home.

Teaching notes

The terms 'less dense' and 'more dense' are introduced in this unit. The children may have already come across the word 'dense' in other contexts. Here it should be clearly linked to the amount of matter in a certain space. When a material swells up, it still has the same amount of matter, but it is spread out over a greater volume. If you were to take a sample of the material in its expanded form you would find that it weighed less than a sample of the same volume in its unexpanded form, simply because it has fewer particles of matter in it.

The density of a material is a measure of the amount of matter in a certain volume of it. The weight of a substance is a measure of its mass. The density of a substance is found by measuring the mass of a substance and dividing it by the volume of the substance. The children do not need to know about density at this level, but you may feel that using the terms less dense and more dense in your explanations may help their vocabulary.

Children may be puzzled that warm water rises to the surface, because it is at the surface where ice forms. Water is an unusual liquid in that its density does not increase as it freezes, at 0°C. Water is densest at 4°C. Below this temperature, the water begins to expand again and become less dense. This explains why ice forms on the surface of pools and not at the bottom of them. When water freezes, it expands more and becomes less dense than the water from which it formed. This means that ice floats on water instead of sinking.

Teacher's sheet: activity

Based on **pages 14 and 15** of *Solids and liquids*

Introducing the activity

(a) Ask the children how they could get some warm water to the bottom of a jar of cold water. Let them try and think of complicated methods, then suggest that they might just lower some warm water in a small jar. Some children may think that this is too simple, so challenge them to try it by doing this activity.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through tasks 1 to 7 with them (see note (i)).

(c) Let the children carry out tasks 1 to 7.

(d) Go through tasks 8 to 11 with the children.

(e) Let the children carry out tasks 8 to 11.

(f) Go through tasks 12 and 13, then let the children carry them out (see note (ii)).

Completing the activity

(g) Let the children compare their observations and explanations.

Conclusion

Warm water that is sunk into cold water in a small jar rises to the surface.

Cold water from an ice cube sinks through warm water. If there are particles in the warm water, the path of the sinking cold water can be seen, from the way it moves the particles.

Teaching notes

(i) This works well if the jars of cold water have been put in a fridge for an hour. If you do this, the children will have to rub the condensation off as they look through the side of the jar. The children should put a piece of white paper behind the jar so that they can see the movement of the dye more clearly.

(ii) Only a tiny amount of talc is needed. It should just make the water cloudy. If too much is used, the ice cube and the sinking current of water will not be seen.

In tasks 8 to 11, the movement of the cold water is seen because of the dye it contains. In this activity, the movement of cold water is seen indirectly through its action on particles suspended in the water.

Teacher's sheet: comprehension

See **pages 16 and 17** of *Solids and liquids*

Answers

1. **It uncurls.**
2. **Steel and brass.**
3. **Water rises up the straw.**
4. **The water in the bottle swells up.**
5. **(a) Expand means become larger, or swell. Materials expand when they become hotter.**

   (b) Contract means become smaller, or shrink. Materials contract when they become cooler.

Complementary work

(a) Let the children use secondary sources to find out how large metal bridges are kept from expanding and buckling in hot weather.

Teaching notes

This unit provides you with a further opportunity to compare solids and liquids. The children may have come across expansion before in their study of rocks and soils (*3D Rocks and soil*). Rocks are made to crumble by the way water expands when it freezes. The water trapped in cracks in rocks forms ice. This presses on the rock and makes it crack.

Water is unusual in that it expands when it freezes. You could also use photographs of milk bottles in winter, which show the frozen milk pushing out of the top of the bottle, to make this point.

The introduction on page 12 of this guide mentions expansion and contraction in thermometers, and relates this to the children's work on weather earlier in their school life. In *4C Keeping warm and cool*, thermometers are studied in much greater detail. You may use this unit as an introduction to the study of thermometers or for revision after thermometers have been studied.

Children are aware of air, but do not study it formally until *5C Gases around us*. Although the main focus of the practical activity is on how water expands when heated, a simple study of air is also included. This study is very striking, as the warm air makes the balloon stand up and helps the children to remember that air is a substance, and prepares them for future work on gases.

7 Teacher's sheet: activity

Based on **pages 16 and 17** of *Solids and liquids*

Introducing the activity

(a) Look at the bottle thermometer on page 16 with the children. Tell them that it is quite difficult to make a hole in a cork for a straw, but there is a very simple way to see if water will expand when it is warm.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 and 2 (see note (i)).

(c) Let the children try tasks 1 and 2.

(d) Go through tasks 3 and 4, then let the children try them (see note (ii)).

(e) Go through tasks 5 to 7, then let the children try them (see note (iii)).

(f) Go through tasks 8 to 11, then let the children try them (see note (iv)).

Completing the activity

(g) Let the children compare their results and explanations.

Conclusion

When a bottle of cold water is placed in hot water, it warms up and the water inside expands. The drop on the Plasticine top of the bottle becomes larger due to the water expanding and pushing out of the hole.

When a bottle of cool air is placed in a bowl of hot water, the air warms up and expands. It pushes its way into the balloon that is attached to the top. The expansion of the air makes the balloon inflate and stand up.

Teaching notes

(i) Check your school policies on the use of glass with children before you include this activity in your plans. This experiment works with glass and not plastic because glass does not expand or soften. It may help if you make a cap to show the children how it is done. The seal should be water tight, but you do not have to test it by turning it upside down. The hole can be made with a paper clip.

(ii) The children should push down very gently so that just a small drop appears. They must not push hard as this will release too much water and probably break the seal around the neck.

(iii) Use hot water in accordance with your school policies. The bottle should be immersed up to its lower neck.

(iv) You may wish to put the balloons on the bottles for the children. The bottles should be immersed to the same depth of water as in the first part of the activity. They will have to be held down in the water, otherwise they will float.

Teacher's sheet: comprehension

See **pages 18 and 19** of *Solids and liquids*

Answers

1. **The particles of sugar should be drawn completely mixed with the particles of coffee and no cube left.**
2. **Water and orange juice, etc.**
3. **By stirring them together.**
4. **Solution.**
5. **Dissolving.**
6. **(i) (a) no; (b) yes. (ii) The undissolved solid stays at the bottom of the liquid.**

Complementary work

(a) The children can use secondary sources to find out about the ingredients in bread, cakes and biscuits. They could look at the ingredients in recipes from around the world.

Teaching notes

This unit introduces the children to the mixing of materials. It is important to stress that the properties of the materials in a mixture do not change just because they are mixed together. You could emphasise this by picking pieces out of the muesli you made earlier, and showing the children that they are just like some other pieces that you have not put in the mixture.

A mixture is a simple combination of materials. It may be made in preparation for making a new material. For example, the mixture in a cake mix can be separated but, after heating, a new material forms and the original materials cannot be separated. The heat has made the materials in the mixture undergo a change, which has bound them together in such a way that a new material is made. The new material has properties that are different from those of the materials in the mixture.

The term solution is introduced here as related to the mixing of liquids. This is done for simplicity, but in the next unit, liquids which do not mix are introduced.

The term dissolving is introduced here in relation to a solid dissolving in a liquid. It is important to remember that all three states of matter – solids, liquids and gases, dissolve in liquids and form solutions. A solution has two parts. They are the solvent and the solute. The solvent is the liquid that dissolves the material, and the solute is the material that is dissolved. The children do not need to know these terms but they may have encountered the word solvent before.

Teacher's sheet: activity

Based on **pages 18 and 19** of *Solids and liquids*

Introducing the activity

(a) Begin by asking how many people like to put sugar in their tea and coffee. Ask them about how much sugar other people in their home use. Ask the children to describe what happens to the sugar when they put it in their drinks (see note (i)).

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 to 5 (see note (ii)).

(c) Let the children perform tasks 1 to 5.

(d) Check that the children have successfully completed tasks 1 to 5, and kept their table tidy, before letting them move on to tasks 6 to 10.

Completing the activity

(e) Let the children try tasks 11 and 12 (see note (iii)).

Conclusion

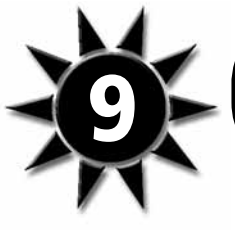
More sugar than salt dissolves in a given volume of water. Sugar is more soluble in water than salt is.

Teaching notes

(i) You may digress to talk about the effect of sugar on health, or remind the children to ask you about it at another time. In the description of sugar dissolving, watch for the children using the word 'melting', and correct this misconception.

(ii) Tell the children to use less than 75cm^3. This will require about four spoonfuls of salt and seven or more of sugar. Ask the children why they must use the black paper, and look for an answer which implies that the white crystals can be seen most easily against a black background.

(iii) The investigation can be made more accurate by making sure that the two samples of water are at the same temperature, and that the experiment is repeated twice more to check the results.



Teacher's sheet: comprehension

See **pages 20 and 21** of *Solids and liquids*

Answers

1. **(i) fat globules; (ii) the neck of the bottle is full of fat globules; (iii) cream.**
2. **Salt, etc.**
3. **Liquid fertiliser.**
4. **Insoluble.**
5. **Soil, fat, metals, pottery, glass, greasy substances.**

Complementary work

(a) The children can use secondary sources to find out how paints are made. They could find out about how early people made paints, and how paints are made today.

Teaching notes

In the previous unit, the concept of mixtures was introduced. This unit examines how solids and liquids may or may not mix, and introduces the terms soluble and insoluble. It is important to note that when insoluble particles are mixed with a liquid they may behave in one of two ways. If the particles are very small, they may remain suspended in the liquid for some time, perhaps up to a day or more. These particles form a suspension in the liquid. When soil is mixed with water, for example, any clay present forms a suspension. If the particles are quite large, they sink to the bottom of the liquid and form a sediment. Sand grains in a soil, for example, form a sediment when the soil is mixed with water.

Teacher's sheet: activity

Based on **pages 20 and 21** of *Solids and liquids*

Introducing the activity

(a) Ask the children to define the terms soluble and insoluble. Ask how they could tell if a substance was soluble or insoluble in water (see note (i)).

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 to 3 (see note (ii)).

(c) Let the children try tasks 4 and 5 (see note (iii)).

Completing the lesson

(d) Let the children compare their results.

(e) You may like to ask the children to test tea leaves and plaster of Paris (see note (iv)).

Conclusion

Some substances are soluble in water and some substances are insoluble in water.

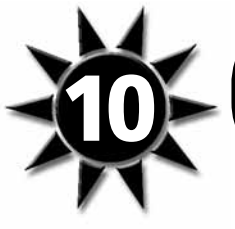
Teaching notes

(i) As soluble and insoluble are new terms, it is important to make sure that the children know what they mean and how to apply them.

(ii) Instead of making a collection on their table, you may want the children to test each one in turn by taking a small sample from your table when they need it. The collection could include these soluble substances: bath salts, bicarbonate of soda, Epsom salts, coffee grains; and these insoluble substances: sand, chalk, aluminium foil, marble chip, metal paper clip, plastic paper clip.

(iii) The plan should mention using the same size sample of each substance. A different sample of water must be used for each test, but the volume of the water sample must be the same in all tests. Each substance must be stirred in the water for the same amount of time.

(iv) The children will discover that part of the tea leaf is soluble – it dissolves in the water and colours it – and part is insoluble. When scientists perform experiments, they sometimes encounter something which does not fit in with their plans or theories, and a new discovery may be made. You could give the children a sense of this by letting them test plaster of Paris. Try the test beforehand so that only a small amount of powder and water are used and a solid can be made. You may feel it is appropriate for the children to wear eye protection. The mixing of water and plaster of Paris is examined again in *6D Changes in materials*.



Teacher's sheet: comprehension

See **pages 22 and 23** of *Solids and liquids*

Answers

1. **X is written in the paper sheet, Y is written in the coarse sieve, Z is written in the fine sieve.**
2. **Small holes.**
3. **A much finer kind of sieve.**
4. **Paper.**
5. **To separate an insoluble solid from water containing a dissolved solid.**
6. **(a) Ground tea leaves from water containing the part of the tea that has dissolved. (b) Whole tea leaves from the water containing the part of the tea that has dissolved.**

Complementary work

(a) Let the children use secondary sources to find out about how white, brown and wholemeal flour are made.

Teaching notes

The children may have encountered sieving before in the Unit 9 practical activity of *3C Rocks and soil*. If they have, revise their work with them then set it in the wider context explored here as a means of separating mixtures and making discoveries about them.

If children watch television programmes on archeology, they may see large sieves being used to separate pieces of pottery, metal and bone from the soil. You may like to use this aspect of sieving in a history project.

The link between the sieve and the filter should be made clearly, so the children can see how a solid and liquid can be separated. The limitation of the sieve, in separating undissolved solids from a liquid, should be emphasised. The filter's inability to separate dissolved solids from their solvent should be discussed. Later, when the children have studied evaporation, they will find that evaporation can be used to separate a dissolved solid from its solvent.

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Teacher's sheet: activity

Based on **pages 22 and 23** of *Solids and liquids*

Introducing the activity

(a) Show the children the sugar, icing sugar and flour. Tell the children that the three white substances are all made of small particles, but challenge the children to find out if they contain any lumps (see note (i)).

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through task 1 (see note (ii)).

(c) Let the children try task 1.

(d) Go through tasks 2 and 3, then let the children try them (see note (iii)).

(e) Go through tasks 4 and 5, then let the children try them (see note (iv)).

(f) Go through tasks 6 to 9, then let the children try them (see note (v)).

Completing the activity

(g) Ask the children to assess the accuracy of their predictions, and to explain their predictions (see note (vi)).

Conclusion

When sugar is sieved, some large lumps with a rough surface may be left behind in the sieve. They are made by crystals sticking together.

When icing sugar is sieved, the large lumps are rounded.

When plain flour is sieved, the large lumps are rounded.

When wholemeal flour is sieved, a large number of broken drown grain coats may be left in the sieve. There may also be some small, rounded lumps of flour.

Teaching notes

(i) The children should respond by saying that they will use a sieve. You may wish to introduce the word sifting as an alternative verb to sieving. You may add that this activity is to test their powers of observation. Ask the children what may help them with their observations, then issue them with magnifying glasses.

(ii) The sieve should be gently shaken side to side.

(iii) The children may predict that it will have lumps with rough surfaces, like the granulated sugar, and may be surprised to find there is a difference.

(iv) The children may predict that the flour will have lumps like the icing sugar because it has similar-sized grains.

(v) The children should estimate that some of the grain coats will not go through the sieve. Some children may also predict that wholemeal flour will contain some lumps, as in plain flour.

(vi) They may show how the results of the earlier tasks helped shape their predictions in later tasks.