Science@School | Book 6C

Dissolving

Teacher's Guide

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The pupil book explained unit by unit

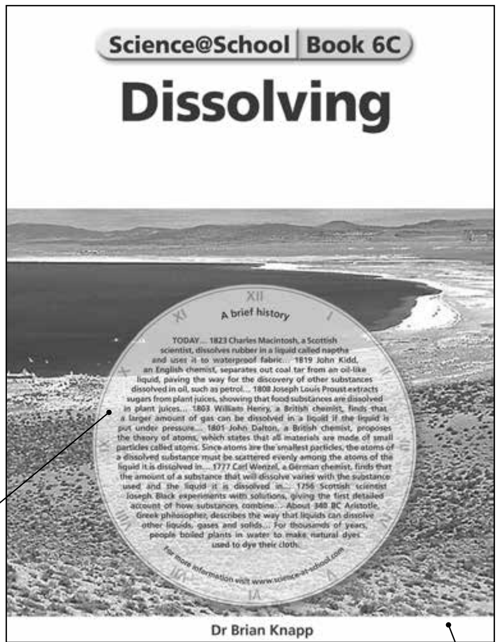
Although the pupil book – *Dissolving* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Dissolving*.

It is possible to use *Dissolving,* and the worksheets and activities, without reading this section, but we would strongly recommend that you take a short time to familiarise yourself with the construction of the pupil book.

The units are arranged in sequence, to help you with your lesson planning. In this section, a brief description of the content of each unit is given, together with hints on how to start or support it. List 1 (Starting a unit with a demonstration) on page 11 sets out the resources that you could use to do the demonstrations where suggested. The activity associated with each unit is also briefly described to help you see how the unit and activity work together.

Title page

The book begins on the title page (page 1). Here you will find information about science and technology in the form of a clock. You may want to use this to set the scene for the study of the book's contents. You may choose to focus on an event which ties in with your work in history, before moving onto the rest of the book. Alternatively, you may wish to skip over this page and return to it later. It is not a core part of the book, but helps the children see how the work they are doing now fits in with the work of scientists and engineers in the past. It may also be used to stimulate more able pupils to research the people and events that are described here.



A time clock giving additional historical information about the topic.

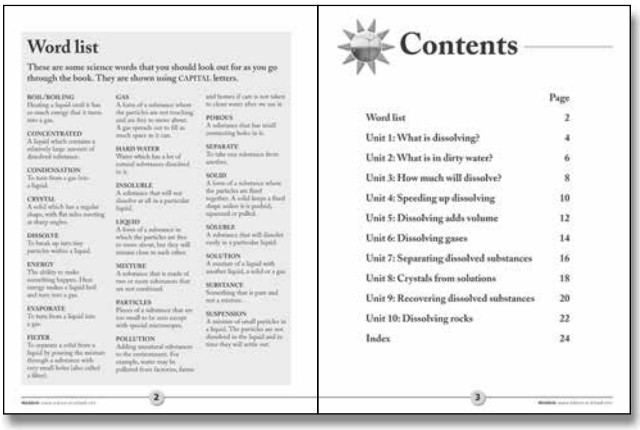
The picture shows evaporation around the margin of Mono Lake, Owens Valley, California.

Word list and contents

The core content of the book begins with a word list on page 2. This is a glossary, brought to the front for the pupils' attention. Pupils could be encouraged to look at the list and see how many of the words they already recognise.

One of the important things about science is the precision with which words are used. However, many scientific words are also common words, often used in a slightly different way from how they would be used in science. The word list presents the opportunity for pupils to consider the words they already know, and the meanings they are familiar with.

When your teaching unit has been completed, you may want to invite pupils to revisit this list and see if their understanding of the words has been enhanced or changed in any way. A visual dictionary is also given on the CD.



Word list

These are some science words that you should look out for as you go through the book. They are shown using CAPITAL letters.

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The entire contents are shown on page 3. It shows that the book is organised into double page spreads. Each double page spread covers one unit.

The units

Heading and introduction

Each unit has a heading, below which is an introductory sentence that sets the scene and draws out the most important theme of the unit.

Body

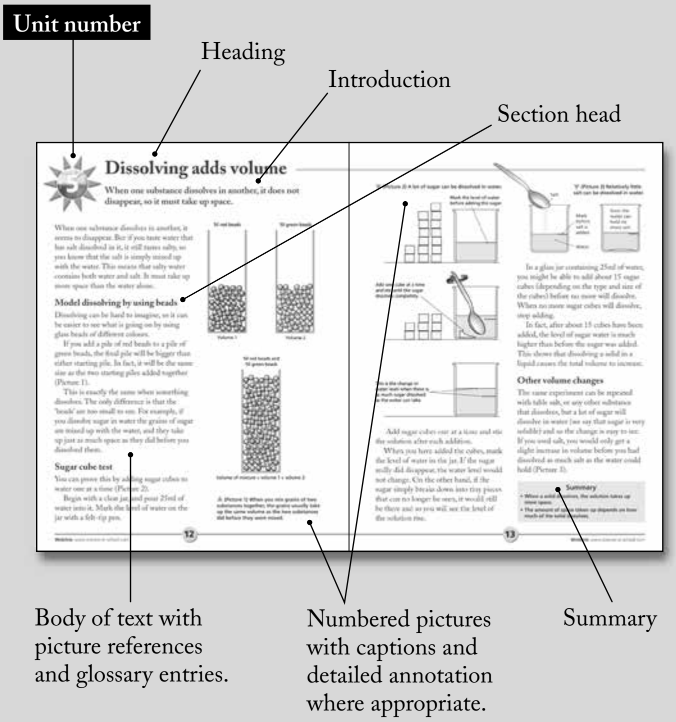
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

Words highlighted in bold capitals in the pupil book are defined in the word list on page 2. A visual dictionary is also given on the CD.

The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

Summary

Each unit concludes with a summary, highlighting and reinforcing the main teaching objectives of the unit.

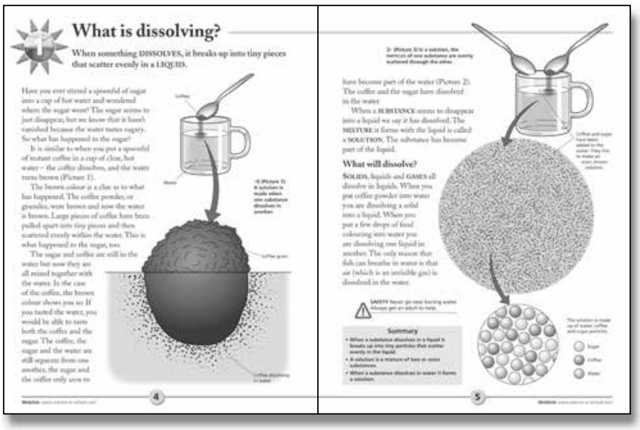


1 What is dissolving?

You may like to introduce this unit by holding up a clear plastic beaker of water and then stirring a large spoonful of sugar into it. Ask the children what they see, and ask them for a name of the process. Let some children look in the water with a magnifying glass to confirm that the sugar has disappeared. Now begin to go through the unit.

The unit begins by considering dissolving sugar in hot water, and takes the introduction a stage further by considering how the sugar can be detected in the water by taste. The dissolving of a coffee grain is featured, to show how some substances that dissolve also colour the water. Care is taken to present the liquid and the dissolved substance as a mixture, which is called a solution. The unit ends by explaining that solids, liquids and gases can dissolve in liquids.

The unit is supported by a complementary activity in which children can make a scientific model to demonstrate how some substances dissolve and others do not. In the supporting practical activity the children collect a range of substances, predict which will dissolve in water and which will not, then design and perform a fair test.

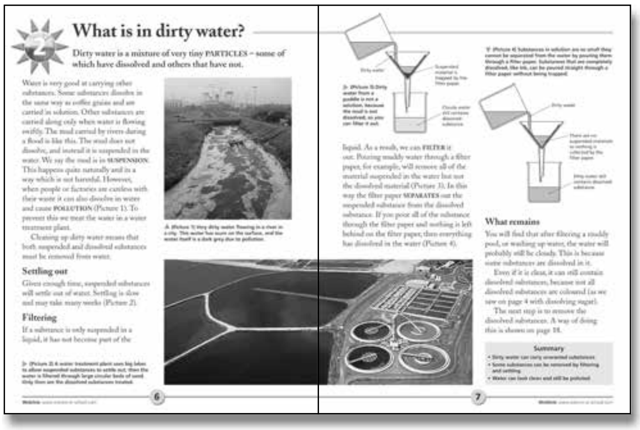


2 What is in dirty water?

You may begin by showing the children a beaker of clean water and a beaker with a soil sample in it. Ask the children to predict what will happen when you add the soil to the water. Mix the water and soil together and hold them up. Ask the children to compare their predictions with the result. Ask the children to describe what they see and look for them describing the floating materials, the cloudy water and the solid material at the bottom of the beaker.

Turn to the unit in the pupil's book and work through it with the children. In this unit the children will learn about suspensions, pollution and how dirty water can be cleaned by settling out and filtering.

In the complementary work, the children can be shown how small suspended particles are by the use of a microscope. The need for using a material with small holes for filtering can also be demonstrated, and the application of filters in water treatment can be examined, along with the problems of supplying clean water in developing countries.

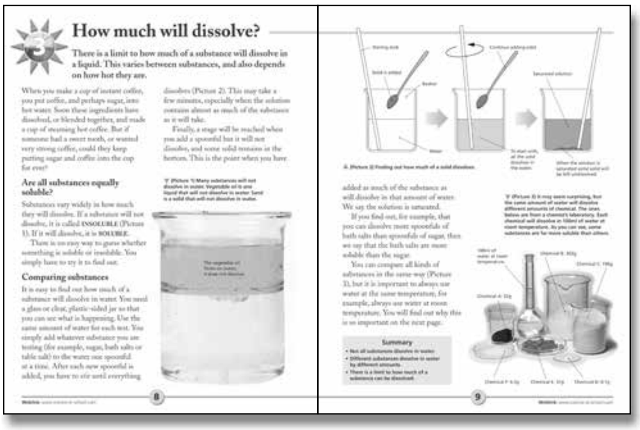


In the practical activity the children make observations on suspensions, learn how to fold a filter paper to fit in a filter funnel and use it to filter dirty water.

3 How much will dissolve?

The unit begins by considering what would happen if someone wanted to make a very strong cup of coffee or a very sweet drink. Could coffee or sugar be added to water for ever? After this introduction, the unit moves on to define insoluble and soluble substances. You may like to add a demonstration here to emphasise the difference. You could shake some gravel and water together in a clear plastic beaker, to show how an insoluble substance behaves when mixed with water. Then you could shake some large lumps of sugar with water to show how a soluble substance behaves. You could further emphasise insolubility by having children stir up oil and water, then leaving the mixture to show how oil settles on water. The way oil and water separate is also shown in a photograph in the pupil's book.

The unit then shows how the solubility of substances can be compared, and presents the results of an investigation quantitatively. In the complementary work, you can ask the children to


How much will dissolve?
There is a limit to how much of a substance will dissolve in a liquid. This varies between substances, and also depends on how hot they are.

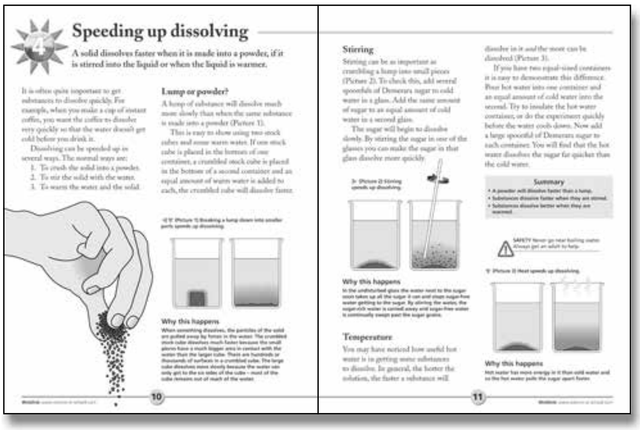
compare these quantities and make a bar graph of some of the results. In the supporting practical activity the children have the opportunity to plan a whole investigation and carry it out. This gives you a chance to see if the children will build more sophisticated elements in to their plan, such as repeating their tests to check for anomalies.

4 Speeding up dissolving

You may wish to begin by holding up a stock cube and saying that you want to make gravy from it. Drop the cube in a beaker of water and let the children look at it. Ask them how they could make it dissolve faster, as the gravy is needed quickly. Look for 'break it up', 'stir it up' and 'use warm water', then go through the unit in the pupil's book to discuss these ideas further.

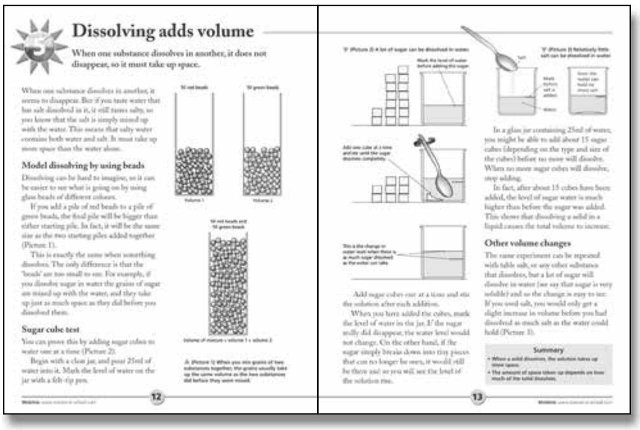
In the unit, the way a lump of substance dissolves is compared with the way a powder dissolves; the way an unstirred substance dissolves is compared with the way a stirred substance dissolves; and the way a substance in cold water dissolves is compared with the way a substance in warm water dissolves. In each case, an explanation is given for the way the different substances dissolve.

In the first complementary activity, the difficult subject of size and surface area is tackled in a way that makes it clear to the children how breaking a lump into particles increases the surface area of the substance. The practical activity provides the children with an opportunity to make a full investigation on


Speeding up dissolving
A solid dissolves faster when it is made into a powder, if it is stirred into the liquid or when the liquid is warmer.

the effect of water temperature on solubility, and to construct line graphs of their results. Advice is given on how to show that averages can produce more reliable results than considering each result separately. Further complementary activities show how the children can conduct more investigations on the effect of particle size and the effect of stirring, and present their findings to the whole class.

5 Dissolving adds volume


Dissolving adds volume

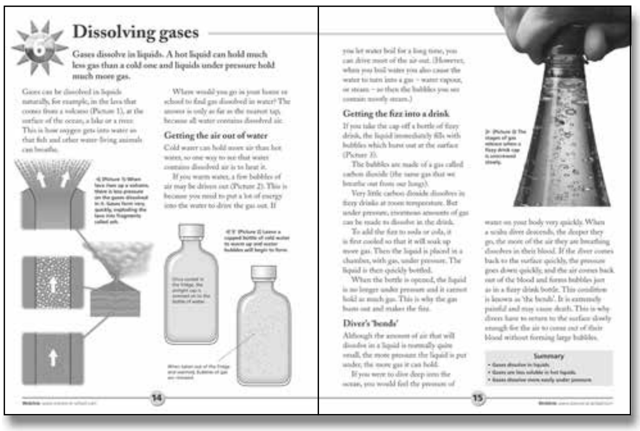
When one substance dissolves in another, it does not disappear, so it must take up space.

If you used the scientific modelling exercise in the complementary activity of unit 1, you may wish to apply scientific modelling to introduce this unit. Ask six children to stand close together and draw a line on the ground, or put a rope circle around them on the floor. These children are water particles. Ask another six children to go between the 'water particles'. These children are particles of a solid that has dissolved in the water. You should find that some of the children no longer fit inside the line or rope, and this suggests that when a substance dissolves the volume of the mixture increases.

The unit addresses the concept of scientific modelling by considering what happens when a volume of sand is mixed with a volume of sugar. The analogy is used to explain why the volume of a liquid increases when a substance is dissolved in it. The text then moves on to describe what happens when a number of sugar lumps are dissolved in water, and the way to measure the change in volume is explained.

The mixing of sand and sugar, which is featured on page 12, can be used as a complementary activity. The unit is supported by an activity in which the children predict the number of sugar cubes which have to be added to water to cause a certain increase in volume. The children then carry out their investigation and assess the accuracy of their predictions.

6 Dissolving gases


Dissolving gases

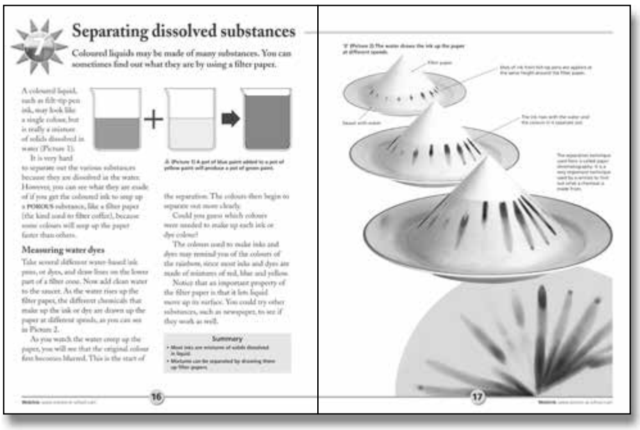
Gases dissolve in liquids. A hot liquid can hold much less gas than a cold one and liquids under pressure hold much more gas.

You may like to introduce this unit by holding up a can or bottle of fizzy drink and asking the children what will happen when you open it. You could make the question more dramatic by shaking the can or bottle first, but do not open it for some time afterwards, or have a sink close by. Ask the children to explain their answer. Some may experience difficulty with this but look for an answer that mentions a gas escaping from a liquid, then move straight into the unit.

The unit begins by explaining that gases can dissolve in water, and shows how you can tell that air is dissolved in water. The way air escapes from boiling water is described in detail, and the making of fizzy drinks is explained.

In the complementary activity, the children make a survey of fizzy and non-fizzy drinks. In this, they consider other substances that are dissolved in the drinks and the type of packaging that is needed to contain them. In the practical activity they investigate the effect of warming up a fizzy drink on the way it releases bubbles.

7 Separating dissolved substances


Separating dissolved substances

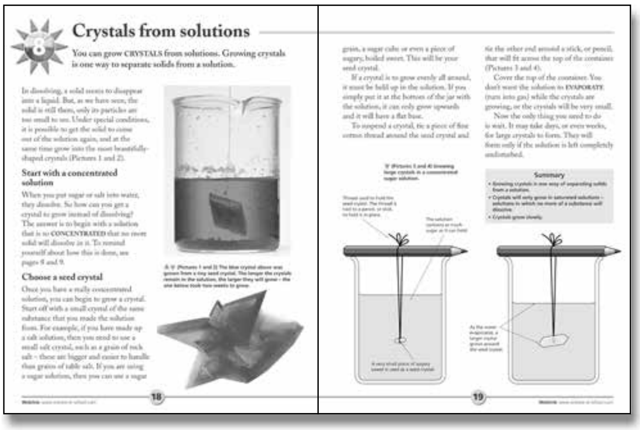
Coloured liquids may be made of many substances. You can sometimes find out what they are by using a filter paper.

You may like to introduce this unit by writing your name in black water-based felt-tip pen on a piece of paper, then dipping the lower edge of the paper in water. As you hold the paper in the water, ask the children what might happen. They may say that the letters will become blotchy. If some children have done chromatography before, they may say that the ink will separate into different colours. If the children do answer in this way, ask them how it happens, then begin reading the unit on page 16 to check their answers.

The unit begins by stating that inks are often made from a mixture of coloured substances, and that the way to separate them is by using filter paper. The pores in the filter paper allow water to creep up it, carrying the coloured substances, which become separated. The substances separate because they travel at different speeds. The unit ends by making suggestions for practical work, including making predictions, and comparing the ability of different papers to separate dissolved substances.

The supporting practical activity shows how to formalise the introductory demonstration into a scientific investigation. The complementary activities extend this work by providing ideas for further investigations.

8 Crystals from solutions


Crystals from solutions

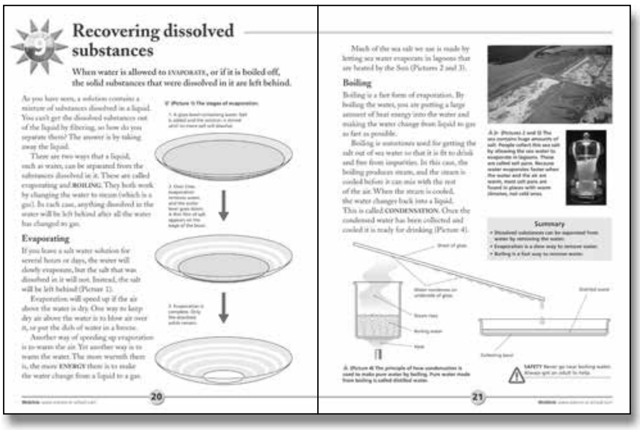
You can grow CRYSTALS from solutions. Growing crystals is one way to separate solids from a solution.

Crystals are fascinating objects and you may wish to introduce this unit by showing the children a few geological crystal specimens, such as quartz and calcite. Tell the children that the crystals formed as liquid rock cooled down, but we can also make crystals from solutions that are slowly drying out.

The unit begins by reminding the children that a liquid will only hold a certain amount of dissolved substance, then goes on to describe how to suspend a small crystal in a saturated solution and watch it grow over the following days and weeks. You can use the instructions here to demonstrate how a crystal can be grown.

The supporting activity allows the children to see crystals form in a few minutes. The activity involves heating a drop of Epsom salts solution in a teaspoon over a night light candle. This gives you an opportunity to discuss safety issues, such as eye protection, and the need to follow instructions carefully. In the complementary activity section you will find a list of substances that you can use to show the children how to grow crystals.

9 Recovering dissolved substances

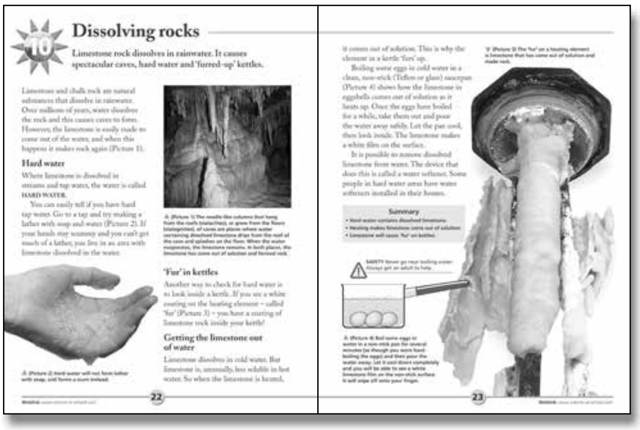


If you used the scientific modelling exercises in the complementary activity of unit 1, and in the introduction to unit 5, you may like to use it again now, to help the children understand what happens when a liquid containing a dissolved substance evaporates. Give six children a large brightly-coloured card each. They are particles of a dissolved substance. Ask them to go and stand in a group of ten other children. These children are particles of water. Ask two of the 'water particles' on the edge of the 'solution' to evaporate. They should move away and sit down. Ask another two 'water particles' to evaporate and continue with your request until only the particles of dissolved substance are left.

Move the class on to the unit. Here they will read about taking away the liquid to recover substances dissolved in it. The unit tackles evaporation first and shows how a substance appears out of the liquid as the water dissolves. The extraction of salt from sea water is illustrated before the text moves on to describe boiling as a second way of recovering dissolved substances. In this account, condensation is also featured as a way of recovering the pure liquid.

In the complementary activity, instructions are given to demonstrate evaporation as a means of separating a liquid from its solution. In the practical activity the children investigate a range of liquids to discover which ones are solutions.

10 Dissolving rocks



You may wish to begin this unit by showing the children some different kinds of rock such as limestone, chalk, granite and sandstone. You could tell the children that water can dissolve limestone and chalk, and then show them a kettle (or a picture of a kettle) which has 'fur' inside it, and say that the stone re-forms when the water is heated.

The opening of the unit will reinforce your introduction, and the text then takes the children further, to consider hard water. The formation of limestone from hot hard water is explained in more detail and a demonstration is described in which limestone is made in a pan from boiling eggs. You may like to prepare this demonstration at home and then bring it into school when the eggs, water and pan have cooled down.

A striking photograph of stalactites is shown, and in the complementary activities it is suggested that the children use secondary sources to find out about large limestone caves and the stalactites and stalagmites they contain. Advice is also given for setting up a stalactite and stalagmite in school and measuring their growth. In the supporting activity the children test a range of still mineral waters for hardness by using a small amount of bath salts.

Index

There is an index on page 24.

Using the pupil book and photocopiable worksheets

Introduction

There is a wealth of material to support the topic of dissolving in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets, and how to integrate them for lesson planning. On the page opposite you will find the resource lists for introductory demonstrations, the complementary work and the activity worksheets. The learning objectives are shown on pages 12 and 13.

Starting a unit

Each unit in the pupil book forms the basis for a lesson. You may like to start by reading it with the class, or begin with a demonstration (see List 1). Always begin the unit by reading the introductory sentences in bold type. This helps focus the class on the content of the unit and to prepare them for the work.

The first part of the main text introduces the content, which is then developed in the headed sections. The illustrations are closely keyed to the main text, and the captions of the illustrations develop the main text content.

With less skilled readers, you may prefer to keep to the main text and discuss the illustrations when they are mentioned. With more skilled readers, you may want to let them read the captions for themselves. Each unit ends with a summary. The children can use this for revision work. They can also use it to test their understanding by trying to explain the points made in the summary.

You can find the learning objectives for each unit here.

The style and content of the unit also make it suitable for use in literacy work, where the needs of both English and science are met. You may wish to use the unit as a topic study in literacy work, or you may want to perform an activity in science time and follow it up with a study of the unit during literacy work.

Using the comprehension worksheets

Each unit in the pupil book has one photocopiable comprehension worksheet in this *Teacher's Guide* to provide a test. The learning objectives are for these comprehension worksheets and relate directly to the knowledge and understanding component of the science curriculum.

The comprehension worksheets begin with simple questions and have harder questions towards the end.

The worksheets may be used singly, after each unit has been studied, or they may be used along with other worksheets to extend the study.

The teacher's sheet, which is opposite the comprehension worksheet, shows the answers and background information to the unit. This teacher's sheet also carries a section on work complementary to the study topic. This work may feature research using other sources. It may also have value in literacy work.

Using the activity worksheets

The activities are designed to develop skills in scientific enquiry. The learning objectives for practical skills associated with each unit are given here. The activities may be small experiments, may focus on data handling or comprise a whole investigation.

Each activity section is a double page spread in this *Teacher's Guide*. On the left hand page is a photocopiable activity worksheet to help the children in practical work, or it may contain data for the children to use or interpret. The page opposite the worksheet is a teacher's sheet providing a step-by-step activity plan to help you organise your work. Each plan has a set of notes which provide hints on teaching or on the use of resources. The activity plan ends with a conclusion, which you may like to read first, to help you focus on the activity in your lesson planning.

Planning to use a unit

The materials in this pack are very flexible and can be used in a variety of ways. First, look at the unit and activity objectives here. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

Safety

The practical activities feature equipment made from everyday materials or available from educational suppliers. However, make sure you carry out a risk assessment, following the guidelines of your employer, before you do any of the practical activities in either the pupil's book or the *Teacher's Guide*.

Resources

The three lists below show the resources needed to support the photocopiable worksheets.

- List 1 shows resources for demonstrations suggested for starting a unit.
- List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.
- List 3 details those resources needed for the 10 activity worksheets.

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. Clear plastic beaker, large spoon, sugar, magnifying glasses.
2. A beaker of clean water, a beaker with a soil sample in it, a spoon.
3. Two clear plastic beakers, some gravel, some large lumps of sugar.
4. Stock cube, beaker of water.
5. Chalk and playground, or rope in classroom.
6. Can or bottle of fizzy drink, sink (optional).
7. Piece of filter paper, felt-tip pen with water-based ink.
8. Geological specimens such as crystals of quartz and calcite.
9. Six, large, coloured cards.
10. Pieces of limestone, chalk, granite and sandstone. A kettle with 'fur' inside it or a photograph of a kettle with 'fur'.

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

1. –
2. A beaker of sand and water, an empty beaker, a sieve; secondary sources about water treatment; secondary sources about water supplies in developing countries.
3. Graph paper.
4. Thermometer, clock, a beaker, stirring rod, sugar, icing sugar (small particles), caster sugar (medium sized particles), brown sugar (large particles), measuring cylinder.
5. Sand, sugar, measuring cylinder, two beakers.
6. Access to a wide range of fizzy and non-fizzy drinks in their containers.
7. Food colourings, filter paper, beakers, pencil, ruler, newspaper, blotting paper, scissors.
8. Beakers, pencils, threads, chrome, alum, copper sulphate, ferrous sulphate, potash alum.
9. Night light candle, sand tray, two metal spoons, salt solution, (oven gloves or metal spoons with wooden handles optional).
10. Secondary sources about limestone caves, stalactites and stalagmites. Washing soda, two beakers, a thick piece of wool and a dish. A secure cupboard with a glass front or other secure area which the children can visit under close supervision.

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. Samples of sugar, salt, sand, clay, instant coffee grains, food colouring, olive oil, sunflower oil, flour, bath salts, measuring cylinder, beaker, spoon (or volume spoon – available from educational suppliers), clock.
2. Clay, three beakers, water, filter paper, filter funnel, a means of supporting the funnel (e.g. clamp, boss and stand from an educational supplier or loaned from a secondary school), soil water, place to leave beakers of clay suspension undisturbed.
3. Table salt, sea salt, bath salts, sugar, beaker, spoon (or volume spoon – available from educational suppliers), stirrer, balance which weighs in grams – optional, clock.
4. Thermometer, clock, two beakers, stirring rod, sugar, spoon or balance, measuring cylinder.
5. Sugar cubes, beaker, measuring cylinder, stirrer, felt-tip pen.
6. Two bowls, two beakers, warm water, cold water, a fizzy drink.
7. Beakers, strips of filter paper (3cm x 12cm or smaller), water-based inks, ruler, pencil, clock (optional).
8. Sand tray, night light candle, matches, eye protection, metal spoon with wooden handle or all metal spoon and oven glove, beaker, Epsom salts, stirrer.
9. Samples of water labelled A to F. A contains tap water, B contains water coloured blue and with added bath salts, C contains salt water, D contains ink, E contains the filtered soil water from Activity 2, F contains distilled water, (obtainable from a secondary school science department or chemist). Shallow dishes, access to a warm place where the dishes may be left for a few days.
10. A measuring cylinder, three beakers, a spoon, bath salts, three types of water which differ in their calcium concentration. One sample must be hard water, either from a hard water area or a still mineral water which has extra calcium (300 mg/l). The second sample must have a calcium concentration of about 80 mg/l, and the third sample must have a calcium concentration of about 10 mg/l.

Learning objectives

Comprehension worksheets

The table below shows the learning objectives for knowledge and understanding associated with each unit in the pupil book, using the comprehension worksheets in this *Teacher's Guide*:

Unit 1

- When a substance dissolves in a liquid it breaks down into tiny particles that cannot be seen.
- Solids, liquids and gases can dissolve in liquid.

Unit 2

- Some solid particles form a suspension when mixed with water.
- Filtering can remove suspended particles from water but cannot remove dissolved substances.

Unit 3

- Some substances dissolve in water and some do not.
- There is a limit to how much of a soluble substance can be dissolved in water.
- Different soluble substances dissolve in water by different amounts.

Unit 4

- A substance can be made to dissolve faster by making it into a powder, by stirring it into the liquid or by heating the liquid.

Unit 5

- A dissolved substance takes up space inside the liquid.
- The volume of the dissolved substance and the liquid is greater than the volume of the liquid on its own.

Unit 6

- A gas is more soluble in a cold liquid than a warm one.
- Fizzy drinks contain a gas which has been forced into the liquid by pressure.

Unit 7

- Coloured liquids may contain many coloured substances.
- If the coloured substances dissolve in water they can be separated by paper chromatography.

Unit 8

- Crystals can be grown from saturated solutions.
- Crystal growing separates a solid from a solution.

Unit 9

- When the liquid in a solution evaporates or boils off, the solid that was dissolved in it is left behind.
- The pure liquid can be recovered by allowing it to condense after it has evaporated or boiled away.

Unit 10

- When water passes over limestone rocks it becomes hard water.
- Hard water does not make a good lather with soap.

Learning objectives

Activity worksheets

The table below shows the learning objectives for practical skills associated with each unit in the pupil book, using the activity worksheets in this *Teacher's Guide*:

Unit 1
- Make predictions and compare with conclusions.
- Design a fair test.
- Use simple equipment appropriately and safely.

Unit 2
- Use simple equipment appropriately and safely.
- Make observations and comparisons.
- Record observations diagrammatically.

Unit 3
- Plan a complete investigation.
- Design a fair test.
- Make systematic observations and measurements.
- Choose equipment for an investigation.

Unit 4
- Design and make a fair test.
- Construct a table and record results in it.
- Present data in the form of a line graph.
- Identify a pattern and describe a relationship.

Unit 5
- Make a prediction and test it.
- Take systematic measurements.

Unit 6
- Make observations and comparisons.
- Explain observations using scientific knowledge and understanding.

Unit 7
- Plan and carry out a fair test.
- Record observations in a table.

Unit 8
- Follow instructions carefully.
- Control risks when performing an investigation.
- Record observations in written form.

Unit 9
- Make predictions and compare them with results.
- Plan a fair test.
- Use knowledge and understanding to explain the scientific reasoning behind the investigation plan.

Unit 10
- Plan a fair test.
- Make careful measurements and observations.
- Relate findings to a bar graph.

1

Name: .... Form: ....

See **pages 4 and 5** of *Dissolving*

What is dissolving?

When something dissolves, it breaks up into tiny pieces that scatter evenly in a liquid.

Q1. What seems to happen to sugar crystals when they dissolve in water?

✎...

Q2. How could you test the water to see if it contained sugar?

✎...

Q3. What happens to the water when coffee grains dissolve in it?

✎...

Q4. The circle shows part of a liquid which has coffee and sugar dissolved in it. Draw how the coffee, sugar and water particles are arranged in the liquid.

Q5. A dissolved substance and the liquid it is dissolved in form a mixture. What is this mixture called?

✎..

Q6. (a) Name a liquid that dissolves in water; (b) name a gas that dissolves in water.

(a) ✎.. (b) ✎..

Teacher's sheet: comprehension

See **pages 4 and 5** of *Dissolving*

Answers

1. **They disappear.**
2. **You could taste it if the sugar had been put in a clean beaker.**
3. **It turns brown.**
4. **The circle should have three kinds of particles arranged at random. There should be a key for the particles such as: w = water, c = coffee and s = sugar.**
5. **A solution.**
6. **(a) food colouring, (b) air.**

Complementary work

(a) If you have talked to the class about the tiny particles being molecules, you may like some of the children to take part in scientific modelling to show how dissolving takes place. Ask four children to hold on to each other. They are four molecules of a solid substance. Ask another four children to form a ring around the group. They are molecules of water. Ask the "water molecules" to pull gently on the "molecules" in the solid. They should not pull them apart. Now ask the solid "molecule" to weaken their hold on each other and ask the "water molecules" to pull again. This time the "molecules" in the solid should be gently separated and gently pulled away from each other by the water molecules.

Teaching notes

When dissolving is first encountered in a science course, some children may confuse it with melting. You may like to refer to this in your introduction to the unit, to make sure the children are aware that dissolving and melting are two different processes. Melting is the change in a solid which results in it turning into a liquid. This occurs at a particular temperature, and solids must be heated for it to occur.

Dissolving is a process in which either a solid, liquid or a gas forms a mixture with a liquid. The mixture is called a solution. This may occur at normal temperatures, such as the temperature of the room. At this stage you do not need to mention the effect of heat on dissolving.

The use of the word 'particle' can cause problems in the study of dissolving and filtering, so it may be useful to explain how the word may be used. In dissolving, the word particle means a piece of matter that is so small that it cannot be seen. By the upper junior stage the children may have come across the words atom or molecule and know that they refer to something that is very small. You can build on this knowledge, if you wish, by saying that the dissolved particles are made up of groups of atoms which make tiny particles called molecules.

In filtering, or in the study of undissolved materials, the tiny pieces of material that can be seen are also called particles. These are made up of large numbers of atoms and molecules that are holding onto each other strongly.

1

Name: .... **Form:** ....

Based on **pages 4 and 5** of *Dissolving*

Which substances dissolve?

Try this...

1. Make a collection of the substances shown in the table.

2. Predict which ones you think will dissolve in water. Record your predictions in the table by ticking the prediction that you think is correct for each substance.

Substance	Prediction: will dissolve	Prediction: will not dissolve	Result: dissolves/ doesn't dissolve
Sugar			
Sand			
Salt			
Clay			
Coffee grains			
Bath salts			
Flour			
Olive oil			
Sunflower oil			
Food colouring			

3. Think how you will make your test fair and write down your plan here.

✎...

✎...

✎...

4. Collect the items you need to make your test.

5. Test each substance in turn, and write either 'dissolves' or 'doesn't dissolve' in the 'Result: dissolves/doesn't dissolve' column.

Looking at the results.

6. How good were your predictions? ✎...

7. On the back of this sheet, write down the names of the substances that dissolved.

1 Teacher’s sheet: activity

Based on **pages 4 and 5** of *Dissolving*

Introducing the activity

(a) If the children have made a model of dissolving in the complementary work, you may like to remind them of how a dissolving liquid pulls the particles of another substance apart. This allows the children to think about dissolving in another way as they make this investigation. You may even ask them which substances they think the water will pull into tiny particles.

Using the sheet

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

(c) Let the children try task 3. If they need help, remind them of how you introduced the unit with a demonstration of dissolving (see note (i)).

(d) When you have checked and approved the children’s work in task 3, let them try tasks 4 and 5.

Completing the activity

(e) Let the children complete tasks 6 and 7 (see note (ii)). In the plenary session let the children discuss the accuracy of their predictions (see note (iii)).

Conclusion

Sugar, salt, coffee grains, bath salts and food colouring all dissolved.

Teaching notes

(i) You may have chosen to introduce the unit by stirring a spoonful of sugar into a clear beaker of water. The children will need to extend this technique a little by measuring out the same volume of liquid for each test. They will also need to use the same volume of solid or liquid substance for dissolving each time. This may be obtained by using a flat spoonful of substance (as opposed to a heaped spoonful, which could be achieved with solid substances, but not liquid substances such as oil and food colouring). The children may also plan to stir each substance a certain number of times in a certain period of time.

(ii) Some children may still need help in extracting data from a table. Task 7 gives all the children an opportunity to do this, so you can identify any who are finding difficulty.

(iii) Look for precision in the answers. Some children may simply say that their prediction skill was “OK”, but a more accurate answer should be encouraged, such as “I got eight out of ten correct”.

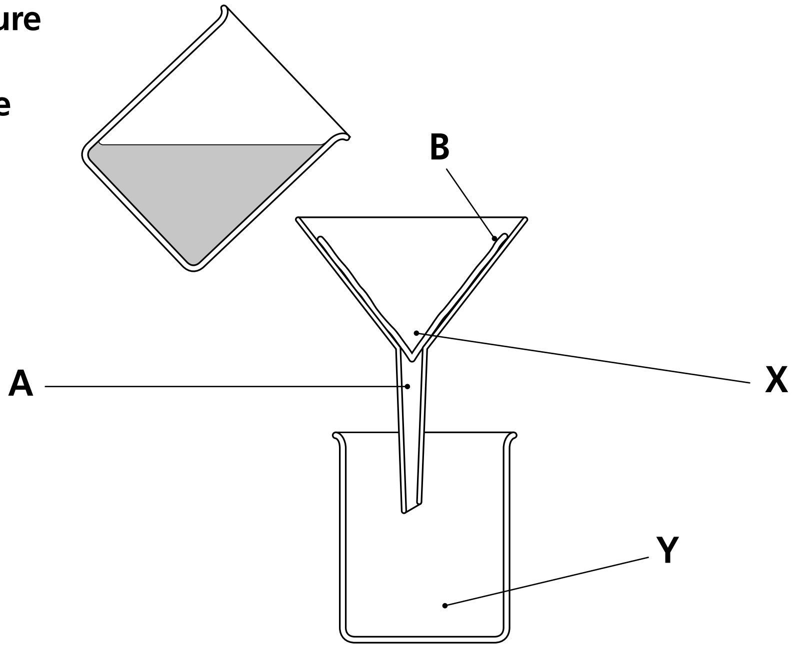
2

Name: .... Form: ....

See **pages 6 and 7** of *Dissolving*

What is in dirty water?

Dirty water is a mixture of very tiny particles – some of which have dissolved and others that have not.



Q1. How does a river carry mud along with it?

✎..

Q2. What do we call particles which do not dissolve in water but are scattered through it?

✎...

Q3. If the undissolved particles scattered in a container of water are left for some time, what happens to them?

✎..

✎..

Q4. In the diagram above, what are A and B.

A ✎... B ✎...

Q5. When the dirty water is poured out of the beaker, what will collect at X and Y?

X ✎.. Y ✎..

Q6. Which of these substances can be removed from water by the process shown in the diagram: (a) sand, (b) sugar, or (c) salt? ✎..........................

Teacher's sheet: comprehension

See **pages 6 and 7** of *Dissolving*

Answers

1. **The mud is suspended in the water.**
2. **A suspension.**
3. **They will settle out at the bottom of the container.**
4. **A = filter funnel, B = filter paper.**
5. **X = suspended material, Y = cloudy water.**
6. **(a) sand.**

Complementary work

(a) You could show that the particles in a suspension are very small by using a microscope (see teaching notes).

(b) Before you begin the filtering section in the unit in the pupil book, you may like to demonstrate the use of a sieve to clean a mixture of water and sand. You could ask the children to predict what may happen, then show them that the sand and water pass through the sieve. Ask the children how the sand could be removed and look for an answer which suggests using a material with smaller holes. Present the children with filter paper and magnifying glasses and ask them to look for holes. When they have identified the holes, turn back to the unit in the pupil's book and read about filtering.

(c) The children could use secondary sources to find out how dirty water is cleaned at a water treatment plant.

(d) The children could use secondary sources to find out about the problems of obtaining clean water in developing countries.

Teaching notes

If you mixed soil and water as a demonstration at the beginning of the unit, the children should have seen that some parts of the soil float, some sink and some make the water cloudy. Emphasise that the water is cloudy due to tiny particles which have not dissolved in the water. It is not a cloudy colour due to substances that have dissolved in it. The particles which make the water cloudy are so small that they take a long time to fall through the water and settle out.

If the school has a microscope you could use it to show that a drop of suspension does actually contain tiny solid particles. Simply put a drop of the suspension on a microscope slide, put the slide on the stage and look down the microscope. You should make sure that light from a table lamp or the window is shining onto the mirror on the microscope, **but never collect light from the Sun as this can cause severe eye damage**.

Make sure that the children realise that the filter paper only removes the solid particles that can be seen. Clear water that passes through the filter may contain dissolved substances and these may be harmful. Later, in Unit 9, you may return to this point and show that water can be made pure by distillation.

2

Name: .... Form: ....

Based on **pages 6 and 7** of *Dissolving*

Making water cleaner

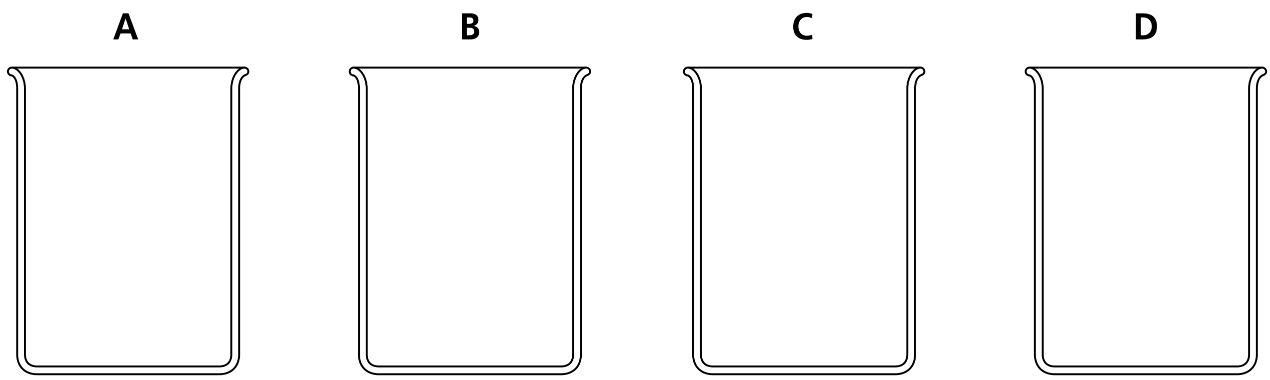
Try this...

1. Mix up some clay and water in a beaker. Stir the mixture well.

2. In beaker A below, draw how your mixture looks after you have stirred it.

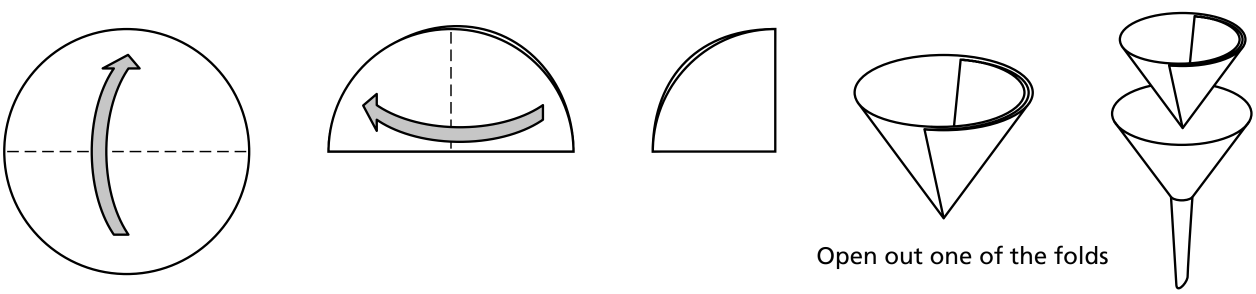
In beaker B below, draw how your mixture looks after one hour.

In beaker C below, draw how your mixture looks after one day.



3. In a second beaker, stir up soil and water and make a drawing of your mixture in beaker D above. Label the suspension.

4. Fold up a filter paper and put it in a filter funnel as the diagram shows.



5. Place the filter paper in a filter funnel and use it to filter your mixture of soil and water.

6. How does the filtered water compare with the water in your diagram in beaker D?

✎...

✎...

Teacher's sheet: activity

Based on **pages 6 and 7** of *Dissolving*

Introducing the activity

(a) Begin by saying that the solid particles that make water dirty can be removed in two ways.

Using the sheet

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

(c) Let the children work through tasks 1 and 2 (see note (i)).

(d) Go through task 3, then let the children work through it (see note (ii)).

(e) Go through task 4 and make sure that the children can fold the filter paper and insert it in the funnel.

(f) Go through tasks 5 and 6, then let the children work through them (see note (iii)).

Completing the activity

(g) Let the children report on how they performed tasks 4 to 6.

(h) On the following day, let the children complete task 2 and discuss their results.

Conclusion

In beaker A, the suspension may be shown with a little sediment. In beaker B, the suspension should be shown with less shading or dots and a little more sediment. In beaker C, there should be even less suspension (or the water is clear) and more sediment. The children should be able to fold a filter paper and insert it in a funnel. They should be able to see that the filtered soil water is much clearer after filtration.

Teaching notes

(i) You will have to make provision for the children to put their beakers in a place where they will not be disturbed, and for the children to visit them one hour, and one day, later.

(ii) The suspension may be shaded, or it may be shown as tiny dots. The particles of suspension should be labelled.

(iii) The filter funnel can be held over a beaker in a variety of ways. It may be supported by a clamp, boss and stand (available from educational suppliers or borrowed from a secondary school), it may be held in a cardboard support made from an empty cereal packet, or it may be simply held over the beaker in the hand. If the beaker is the right size it can simply be placed in the mouth of the beaker.

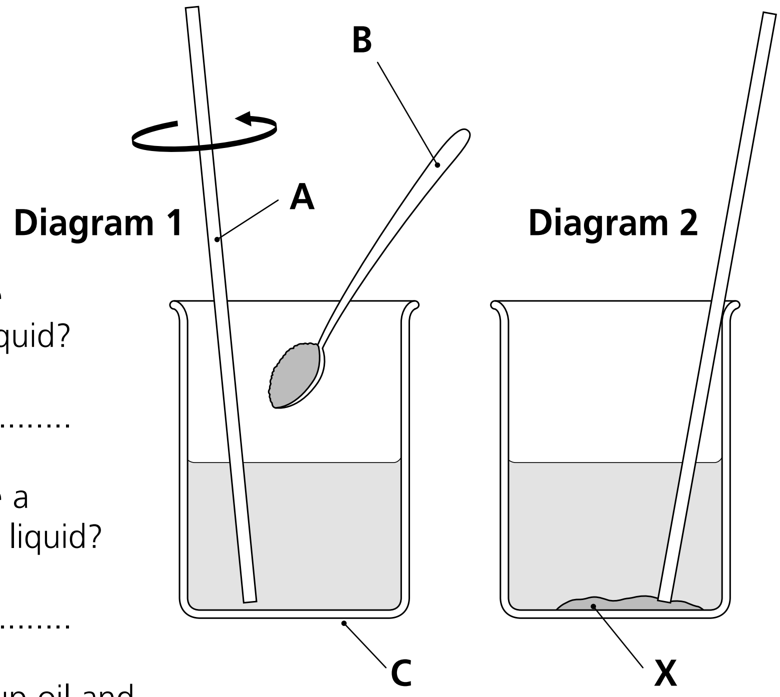
3

Name: .... Form: ....

See **pages 8 and 9** of *Dissolving*

How much will dissolve?

There is a limit to how much of a substance will dissolve in a liquid. This varies between substances, and also depends on how hot they are.



Q1. What word is used to describe a substance that will dissolve in a liquid?

✎...

Q2. What word is used to describe a substance that will not dissolve in a liquid?

✎...

Q3. What happens when you stir up oil and water and then leave them for a minute? Explain your answer.

✎...

✎...

✎...

Q4. Diagram 1 shows how to dissolve a solid in water. Name A, B and C.

A ✎.. B ✎............................. C ✎............................

Q5. Diagram 2 shows what happens after a large amount of solid has been added to the water. What is the substance labelled X?

✎...

Q6. When you are comparing how different substances dissolve in water, how do you make the test fair?

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 8 and 9** of *Dissolving*

Answers

1. **Soluble.**

2. **Insoluble.**

3. **The oil and water separate. The oil forms a layer on top of the water. They separate because oil does not dissolve in water. Oil is lighter than water and floats on top of it.**

4. **A = stirring rod, B = spoon, C = beaker.**

5. **Undissolved solid.**

6. **For each test, use the same amount of water at the same temperature and make the same number of stirs in the same amount of time.**

Complementary work

(a) Ask the children to compare the solubilities of chemical A, B and C in picture 3 and to make a bar graph of the results for chemicals A, E and F.

Teaching notes

Substances vary in their solubility. Some are not soluble at all. These are called insoluble. Others may have a wide range of solubility, as the chemicals in picture 3 show.

The children may wish to know the names of the chemicals in picture 3. Unfortunately, none of them have common names, but some children enjoy hearing or seeing the names of chemicals. The chemicals in the picture are:

A = potassium permanganate

B = potassium perchlorate

C = potassium dichromate

D = calcium hydroxide

E = iron chloride

F = sodium thiosulphate

The chemical names of salt and bath salts are sodium chloride and sodium carbonate respectively.

When a liquid has become saturated with a soluble substance, no more of the substance will dissolve, and the liquid is said to form a saturated solution. Any extra substance which is added to a saturated solution will fall to the bottom of the beaker and remain undissolved.

3

Name: .... Form: ....

Based on **pages 8 and 9** of *Dissolving*

Comparing how substances dissolve

Try this...

1. Select two substances that you know dissolve in water and write down their names here.

✎.. ✎..

2. Write down the equipment you will need for your investigation.

✎...

✎...

3. Write down the plan for your investigation.

✎...

✎...

✎...

✎...

4. Use this space to present your results as a table.

Looking at the results.

5. What do your results show?

✎...

✎...

Teacher's sheet: activity

Introducing the activity

(a) Show the children some sea salt, table salt, sugar and bath salts. Let each group choose two substances to test. If you have moved directly from the unit in the pupil book, continue to step (b) but if it is a few days since you studied unit 3, read the section on comparing substances with the children again, then close the pupil books.

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.

(c) Let the children try tasks 1 to 4 (see note (i)).

Completing the activity

(d) The children should compare the solubility of the two substances (see notes (ii)).

Conclusion

The solubility of solids can be compared by devising and performing a fair test.

Teaching notes

(i) The children will need a beaker, measuring cylinder, thermometer, stirring rod and spoon (you could use volume spoons, which are available from educational suppliers). The plan should include details of a fair test and mention using the same amount of water at the same temperature in both tests. Both substances should be stirred the same number of times in the same amount of time. The results could be presented as a table with a column for substances and a column for amount of substance dissolved. The units should be in spoonfuls. If you have access to an accurate balance, the children could use grams.

In the plan and in the table look for evidence that the children plan to repeat the experiment to test their results. If there is no evidence for this you may suggest it.

(ii) Sugar and bath salts are more soluble than table salt. Both table salt and bath salts have the same solubility.

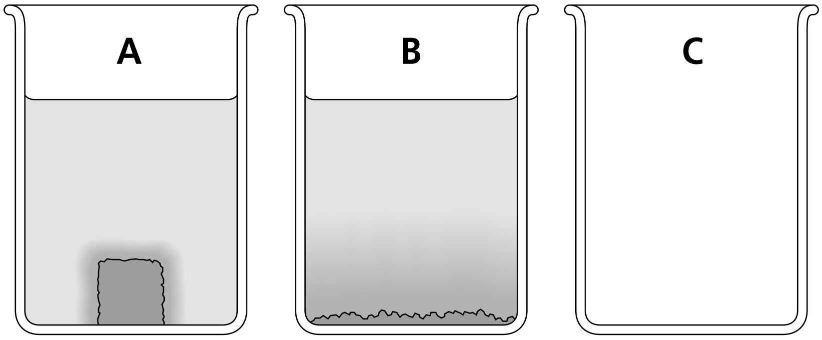
4

Name: .... Form: ....

See **pages 10 and 11** of *Dissolving*

Speeding up dissolving

A solid dissolves faster when it is made into a powder, if it is stirred into the liquid or when the liquid is warmer.



Q1. In the diagram above, beaker A contains a stock cube in water. Beaker B contains a crumbled stock cube in water. The water is coloured in both beakers. Why?

✎...

✎...

Q2. Both cubes were placed in water at the same time. Which one is dissolving faster, and how can you tell?

✎...

✎...

Q3. In which beaker does the cube have a larger surface in contact with the water? ✎............................

Q4. In beaker C above, draw what would happen if you stirred up the crumbled stock cube with water.

Q5. Why does stirring help the cube dissolve?

✎...

✎...

✎...

Q6. Why would using hot water speed up dissolving of the cube?

✎...

✎...

Teacher's sheet: comprehension

See **pages 10 and 11** of *Dissolving*

Answers

1. **Particles of the stock cubes have dissolved in the water.**
2. **B is dissolving faster because more of the water around the cube is coloured.**
3. **B.**
4. **Stirring rod with direction arrow, water level, particles spread about in water.**
5. **It removes the stock-rich water from around the cube particles and lets more water take part in dissolving the cube.**
6. **Hot water has more energy than cold water and can pull the stock cube apart faster.**

Complementary work

(a) Make a large cube of Plasticine and ask the children to measure its surface area. Cut the cube in two and ask the children to measure the surface area now.

Cut the cube into four, six and eight smaller cubes. Each time, ask the children to measure the surface area in contact with the air. They should conclude that as the Plasticine is made into smaller pieces its surface area, which is in contact with the air, increases. Apply this conclusion to the breaking up of the stock cube on page 10 of the pupil book.

(b) After the children have tried the practical activity in this unit, you could ask them to devise investigations to find out about the effect of particle size on speed of dissolving, and the effect of stirring on the speed of dissolving. Each group could present a graph of their work and explain what it shows.

Teaching notes

This topic provides a good opportunity for practical work. If the children have been working through the previous units, they may be able to design a fair test which will give you an opportunity to take them further in considering the results.

The data obtained in investigating the effect of temperature is particularly suitable for presenting as a line graph. When this is done, you can show how a line graph can be used to predict results for investigations which have not been tried. It is also important for the children to see how the results from different groups cluster on a class graph and allow you to make a line of best fit. If possible, show how using averages produces even more reliable results.

You may let the children use the experience they have gained in performing the activity to devise investigations, as suggested in complementary activity (b). Time spent on handling results here will be useful for the children both in other scientific topics at this level, and when they move on to secondary science work.

4

Name: .... Form: ....

Based on **pages 10 and 11** of *Dissolving*

How does temperature affect dissolving?

Try this...

1. Plan a fair test to compare how fast sugar dissolves in water at different temperatures.

✎...

✎...

✎...

✎...

✎...

2. Make a table on the back of this sheet in which to record your results.

3. Take water from the fridge, record its temperature and then find how long it takes for an amount of sugar to dissolve in it.

4. Take water from the cold water tap, record its temperature and then find how long it takes for an amount of sugar to dissolve in it.

5. Make a volume of water 30°C, and then find how long it takes for an amount of sugar to dissolve in it.

6. Make a volume of water 40°C, and then find how long it takes for the same amount of sugar to dissolve in it.

7. Present the data in your table as a line graph.

Looking at the results.

8. Describe how the temperature of the water affects the way sugar dissolves in it.

✎...

✎...

4

Teacher's sheet: activity

Based on **pages 10 and 11** of *Dissolving*

Introducing the activity

(a) You may introduce the work by demonstrating the experiment on page 11 of the pupil book, on the effect of temperature on solubility. You could then challenge the children to think of how they could find out how sugar dissolves at other temperatures (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 6. Return to tasks 1 and 2 to check that the children know what they have to do.

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

(d) When you have checked the plan and the table let the children try tasks 3 to 6.

(e) Give out the graph paper and show the children how to set out the axes for the line graph (see note (ii)).

(f) Let the children make a line graph.

Completing the activity

(g) Draw the axes of the graph on the board. Label the graph A, and plot the results of five groups on it (see note (iii)). Try and work out a line of best fit with the children.

(h) If the children are familiar with the concept of averages, let them calculate the average dissolving time at each temperature for the five groups. Plot the averages on a second graph on the board. Label this graph B. Draw a line of best fit, and show the children how using an average makes the results more reliable (see note (iv)).

Conclusion

The amount of sugar that dissolves in water depends on the temperature of the water. As the temperature of the water rises, its ability to dissolve sugar increases.

Teaching notes

(i) The children may think of putting water in the fridge and they may also suggest using boiling water (which cannot be used for safety reasons). The children may suggest mixing warm and cold water together but if they do not, tell them how this can be done. It is important that, when they have mixed the water to the correct temperature, they use the same volume of it as they have in the tests with water from the fridge and the tap.

(ii) The X axis, or vertical axis, should be used to record the time, in seconds, to dissolve. The Y axis, or horizontal axis, should be used to record the temperature of the water used. You may say that the line graph is more appropriate to use than a bar graph because it can be used to show how the sugar could dissolve at other water temperatures that were not tested.

(iii) Select groups in which there are no anomalous results. Later you could replace one result with an anomalous result to show how it affects graphs A and B. It will show that using an average brings the anomalous result more in line with the other results.

(iv) When using the best fit method in graph A, you may have been able to plot at least two lines, each one at a different angle to the other. In graph B you will have just one line, which may go between the two lines on graph A.

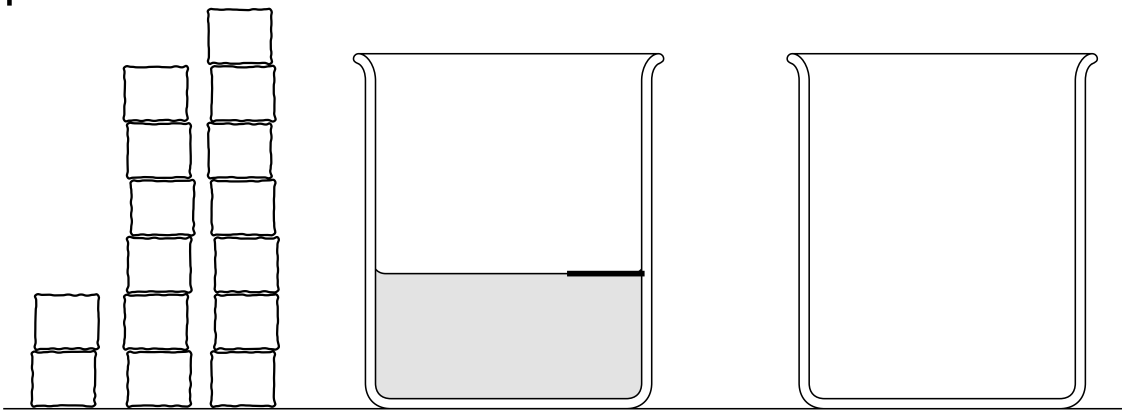
5

Name: .... Form: ....

See **pages 12 and 13** of *Dissolving*

Dissolving adds volume

When one substance dissolves in another, it does not disappear, so it must take up space.



Q1. If you put some marbles in a beaker of water, would the level of the water (a) rise; (b) fall; (c) stay the same? Explain your answer.

✎...

✎...

✎...

Q2. When a crystal dissolves in water, do the particles need (a) the same space as the whole crystal, (b) more space than the whole crystal, (C) less space than the whole crystal?

✎...

Q3. In the diagram above, what was used to mark the level of the water?

✎...

Q4. How can the sugar cubes be made to dissolve quickly in the water?

✎...

Q5. In the empty beaker above, draw the level of the solution when all the sugar cubes have dissolved.

Q6. When a liquid can hold no more sugar, what happens if you add another cube?

✎...

Teacher's sheet: comprehension

See **pages 12 and 13** of *Dissolving*

Answers

1. **(a) rise. The marbles sink to the bottom of the liquid and take up space there. This means that the water must rise above them.**
2. **Same space.**
3. **A felt-tip pen.**
4. **The water is stirred.**
5. **The level is about twice as high as in the beaker on the left.**
6. **It does not dissolve.**

Complementary work

(a) You may wish the children to perform the experiment shown in Picture 3 on page 13.

Teaching notes

Sugar is added to drinks like tea and coffee to sweeten them, and salt is often added to water in cooking. In these two everyday examples of dissolving, people are not usually aware of the increase in volume because it is very small. Sugar is very soluble, and a very large amount has to be added before the volume of liquid changes noticeably, so someone who likes a lot of sugar in their drink, even as much as four spoonfuls, will not see their drink increasing in size. Salt is much less soluble in water, so the liquid does not greatly increase in volume when it is saturated. You may wish to mention these facts if the children seem amazed that dissolving increases volume and they say that they have not seen it.

5

Name: .... Form: ....

Based on **pages 12 and 13** of *Dissolving*

Dissolving sugar cubes

Try this...

1. Measure out a volume of water in a measuring cylinder.

2. Pour the water into a beaker.

3. Mark the level of the water on the outside of the beaker.

4. Make a second mark, less than a centimetre above the first mark.

5. Predict how many sugar cubes you will have to add to raise the level of the liquid to the second mark. Write down your prediction.

✎...

6. Add one cube of sugar and stir it up in the water until it completely dissolves. Check the level of the liquid.

7. Repeat task 6 until the level of the liquid rises to the second mark on the beaker.

8. When the liquid reaches the second mark, write down how many sugar cubes you have dissolved.

✎...

Looking at the results.

9. How good was your prediction?

✎...

Teacher's sheet: activity

Based on **pages 12 and 13** of *Dissolving*

Introducing the activity

(a) Read through the sugar cube test on pages 12 and 13 of the pupil book. Some of the children may be surprised to find that the volume of a liquid increases when a substance dissolves in it and will be keen to test this information. Build on this by asking them to predict how many sugar cubes they think are needed to see that the level of the liquid has risen.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form and go through tasks 1 to 8 (see note (i)).

(c) Let the children carry out tasks 1 to 4 and check their work.

(d) Let the children carry out tasks 5 to 8 (see note (ii)).

Completing the activity

(e) Let the children compare the prediction with the result and assess their accuracy. They may like to compare their predicting ability here with other activities in which they have made predictions and evaluated them.

(f) You may say that when a discovery is made, the scientists who make it write a report and it is published. Other scientists then read the report and repeat the experiment to see if they get the same results. The children have behaved like scientists by reading about the experiment in the pupil book and then repeating it to see if they reach the same conclusion (see note (iii)).

Conclusion

When sugar cubes are added to water the volume of the liquid increases.

Teaching notes

(i) The volume of water is deliberately not specified so that the children can make a choice. In order to prevent huge numbers of sugar cubes being used, you can instruct the children to choose small volumes of less than $50cm^3$.

(ii) It is important to keep particularly vigilant in this activity as sugar cubes can become small missiles. There may also be some over-enthusiastic stirring as the children try to reach their predictions.

(iii) Some children may ask what happens if other scientists get different results from the first group of scientists. When this happens, the first group of scientists may read the results of the others and repeat their own work to try and find why there is a difference. When differences occur, sometimes new discoveries are made, but sometimes the difference is due to the investigation plan not being thorough enough or to mistakes being made when the practical work is being done.

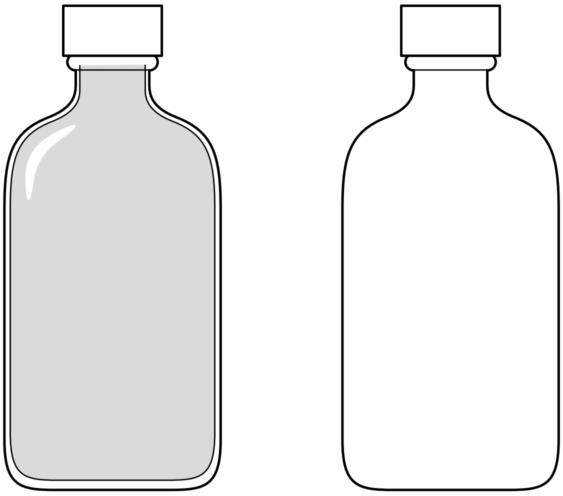
6

Name: .... **Form:** ....

See **pages 14 and 15** of *Dissolving*

Dissolving gases

Gases dissolve in liquids. A hot liquid can hold much less gas than a cold one and liquids under pressure hold much more gas.



Q1. The bottle of water above left has been cooled in a fridge. In the bottle above right, draw how it will look after it has warmed up for some time. Label your diagram.

Q2. Why was there a change when the bottle warmed up?

✎..

✎..

Q3. Where does oxygen enter an ocean, lake or river?

✎..

Q4. When water is boiled does it (a) make bubbles at the same rate all the time; (b) make bubbles faster as time goes on; (c) make bubbles quickly at first and then make bubbles more slowly? Explain your answer.

✎..

✎..

Q5. What is the gas which makes the bubbles in a fizzy drink?

✎..

Q6. A fizzy drink has a large amount of gas pushed (dissolved) into it under pressure and the pressure is maintained by the bottle top. (a) What happens to the pressure on the liquid when you open the bottle? (b) How does the pressure change affect the dissolved gas?

(a) ✎..

(b) ✎..

Teacher's sheet: comprehension

See **pages 14 and 15** of *Dissolving*

Answers

1. **The bottle should have bubbles in it labelled air. The water in the bottle should also be labelled.**
2. **Some of the air that was dissolved in the water came out of the water and formed bubbles.**
3. **At the surfaces of oceans, lakes or rivers.**
4. **(c). Most of the air is driven out when the water first boils, so there is less to escape later. However, if you do this, it appears as though the bubbles form slowly as the water first comes to a boil, then speed up.**
5. **Carbon dioxide.**
6. **(a) It goes down, or decreases;**
   (b) The liquid cannot hold as much dissolved gas, so the gas forms bubbles and escapes.

Complementary work

(a) The children can make a survey of fizzy drinks and find out what other substances are dissolved in them. In the survey, they should mention the flavours of the drinks, and the type of containers used to store the drinks. They should also examine non-fizzy drinks to discover their flavours and packaging.

Teaching notes

As the children spend a great deal of time investigating how solids dissolve, some of them may be surprised that gases also dissolve in liquid and they may ponder how this can happen. Air, which is a mixture of gases, dissolves in water through the water surface. If air did not dissolve in water, then many kinds of water life could not survive. For example, fish have organs called gills which take in oxygen dissolved in the water. In places where the water surface is large, the amount of air entering the water will also be large.

Similarly, as river water splashes over rocks, the surface area of the water is increased and the amount of air entering it is also increased. This means that in streams and rivers high in the hills, the oxygen content of the water is higher than in water lower down, where there are fewer rocks to cause splashing. Also, water higher in the hills is colder than water lower down, and this also helps the water to take in more gas.

You may find it necessary to emphasize that gases dissolve better in a cold liquid than a warm one, and compare this with solids, which dissolve better in a warm liquid than a cold one.

Large amounts of carbon dioxide can be dissolved in water by increasing the pressure on the gas. This forces the gas into the liquid, where it remains dissolved until the pressure is taken off. When a gas is stored under pressure, it is held in a strong metal container. Some children may be aware of this if they have a carbonated drinks maker at home, which uses a canister of carbon dioxide to make the drinks fizzy.

6

Name: .... Form: ....

Based on **pages 14 and 15** of *Dissolving*

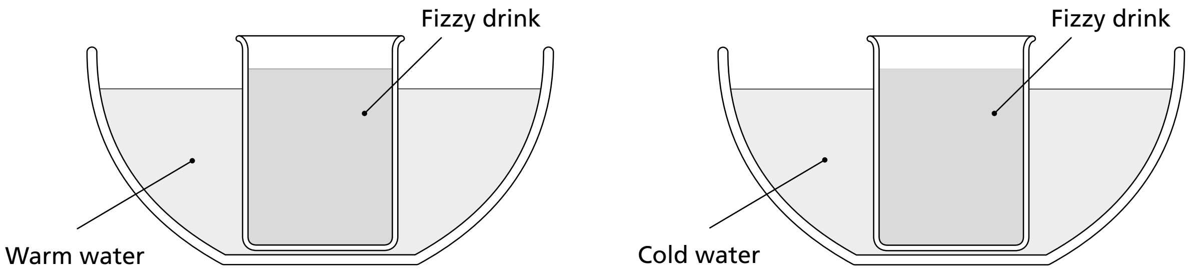
Warming a fizzy drink

Try this…

1. Pour warm water into one bowl and cold water into the other.

2. Pour some fizzy drink into two small beakers.

3. Put one beaker in the bowl of warm water and the other in the bowl of cold water.



4. Look in each beaker and observe the bubbles for a few minutes.

5. Write down your observations here.

✎...

✎...

✎...

✎...

✎...

✎...

Looking at the results.

6. Explain your observations.

✎...

✎...

✎...

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Dissolving*

Introducing the activity

(a) Ask the children to predict what might happen if they warmed up a fizzy drink. Do they think that warming speeds up fizziness or slows it down (see note (i))?

Using the sheet

(b) Give the children the sheet, let them write their names and form on it then go through tasks 1 to 5 with them (see note (ii)).

(c) Let the children carry out tasks 1 to 4 (see note (iii)).

(d) Let the children carry out task 5 (see note (iv)).

(e) Let the children carry out task 6 (see note (v)).

Completing the activity

(f) The children could compare their observations and explanations.

(g) The experiment could be repeated with clean drinking glasses, and each drink could be tasted at the end of the experiment (see note (vi)).

Conclusion

The bubbles escape more quickly from the warm fizzy drink because carbon dioxide dissolves less easily in the warm water than in the cold water.

Teaching notes

(i) As fizzy drinks are usually cooled to make them really refreshing, the children may think that coldness makes them fizzier.

(ii) Take care to offer the children water which is warm but not hot.

(iii) The children should look carefully into the top of each beaker. It may help them if they count the number of bubbles escaping from each water surface over a time period of ten or fifteen seconds. They may also look at the size of the bubbles being formed and escaping.

(iv) The children should see that more bubbles are produced in the fizzy drink in the bowl of warm water, and that many of these bubbles are larger than the bubbles in the fizzy drink in the bowl of cold water. Streams of small bubbles may form in the drink in the bowl of warm water.

(v) The explanation should state that more bubbles escape from the warm drink because the gas does not dissolve as easily in the warm liquid as in the cold.

(vi) The children will find that the drink in the bowl of warm water tastes flat while the other drink is still carbonated.

7

Name: .... **Form:** ....

See **pages 16 and 17** of *Dissolving*

Separating dissolved substances

Coloured liquids may be made of many substances. You can sometimes find out what they are by using a filter paper.

Q1. What is the ink in many felt-tip pens made from?

✎...

Q2. What is a porous substance?

✎...

✎...

Q3. What is the porous substance used to separate the chemicals in inks?

✎...

Q4. In the space above, draw a diagram of the experiment you would set up to investigate the colours in two inks.

Q5. What would you expect to happen to the inks?

✎...

✎...

Q6. What is the name for the technique used to separate the colours in an ink?

✎...

7 Teacher's sheet: comprehension

See **pages 16 and 17** of *Dissolving*

Answers

1. **A mixture of solids dissolved in water.**
2. **A substance that has small connecting holes in it.**
3. **Filter paper.**
4. **The diagram should show an inverted cone in a saucer of water. There should be two ink spots on the paper, both at the same height above the water. The filter paper, saucer, water and ink spots should be labelled.**
5. **The water rises up the filter paper and carries the different coloured particles in the ink to different heights up the paper.**
6. **Paper chromatography.**

Complementary work

(a) The activity on page 44 can be repeated using food colourings instead of inks.

(b) The activity on page 44 can also be repeated with newspaper and blotting paper, as well as filter paper, to compare how the different papers separate the substances in inks and food colourings.

Teaching notes

Paper chromatography is a popular topic and the children may have already used this technique before. If they have, ask them to describe their experiences as you introduce the unit. The chances are that the children will talk about their amazement at how there may be a range of different colours in one ink. You should acknowledge this, then let them focus on making a fair test in the activities associated with this unit.

Paper chromatography works because the different dyes used to make up each colour have different solubilities and different weights. The lighter, more soluble dyes will travel faster up the paper, while the heavier and less soluble dyes travel slower. Over time, the different dyes will separate from each other.

7

Name: .... Form: ....

Based on **pages 16 and 17** of *Dissolving*

Testing coloured inks

Try this…

1. You have some strips of filter paper, coloured inks, a pencil and ruler, beakers and access to water. How could you compare the colours in the inks? Write a plan here.

✎...

✎...

✎...

✎...

✎...

2. Make a table for your results.

3. Let your teacher check your work before you try your investigation.

Looking at the results.

4. What do your results show?

✎...

✎...

Teacher's sheet: activity

Based on **pages 16 and 17** of *Dissolving*

Introducing the activity

(a) Remind the children of your introductory demonstration, in which you wrote a name on filter paper and then dipped the lower end in water. Write a name, using a different coloured ink for each letter. Ask the children what might happen if you dipped the lower edge of the paper in water. Ask the children how you could make this investigation more scientific (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 perform tasks 1 to 3.

(d) Let the children carry out the investigation and then try task 4 (see note (iii)).

Completing the activity

(e) The children can report on their findings to the whole class.

Conclusion

A water-based ink may be made from a number of different coloured substances. They can be separated by water seeping through filter paper. Some of the coloured substances are not the colour of the ink.

Teaching notes

(i) The children may predict that the ink used for each letter may separate into a range of colours. You may dip the paper in the water and let them see their prediction confirmed. The children should say that in order to make the investigation more scientific, one dot of each ink should be used and all the dots should be the same distance from the edge of the paper.

(ii) You may cut the strips up for the children. The strips should be about 3cm wide and 10cm long, depending on the other resources you use. You can make them smaller than this. With more able children you may let them chose the dimensions of their paper strips and let them cut the strips accordingly. The size of the strips can be assessed for their appropriateness for the task.

(iii) A ruler should be used to measure 2cm, or 3cm, from one end of the paper. A line may be made at this distance, and an ink spot made on the line in the middle of the paper strip. The water level in the beaker should be between the bottom of the paper and the spot. This ensures that when the paper is placed in the beaker, the water is below the ink spot and can seep up the paper towards it.

Some children may suggest leaving the paper in the beaker for a certain amount of time. Other children may suggest leaving the paper in the beaker until the water has reached a certain height. Both are acceptable.

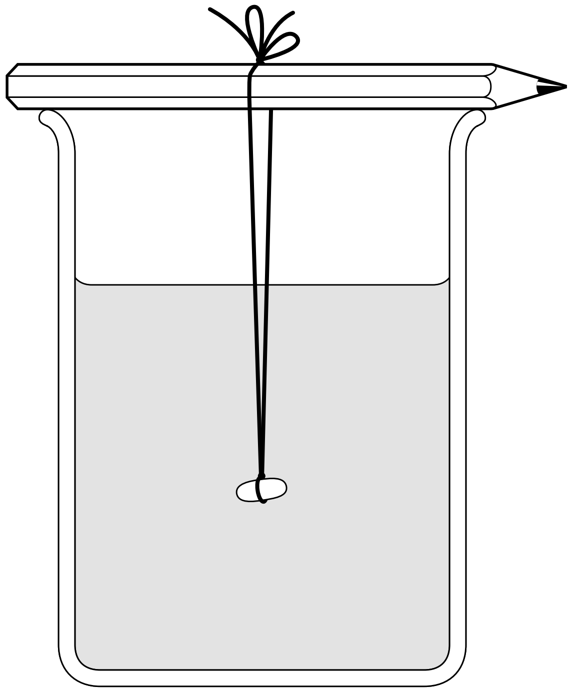
8

Name: .... Form: ....

See **pages 18 and 19** of *Dissolving*

Crystals from solutions

You can grow crystals from solutions. Growing crystals is one way to separate solids from a solution.



Q1. When a solid dissolves in a liquid, why is the solid no longer seen?

✎...

✎...

✎...

Q2. How much solid do you need to dissolve in water to make a crystal?

✎...

✎...

Q3. What is a seed crystal?

✎...

✎...

Q4. On the diagram above, draw a crystal that you might expect to form in the solution.

Q5. What would happen if a crystal was allowed to form at the bottom of the beaker?

✎...

✎...

Q6. What must you do to the beaker of solution after you have set up the experiment?

✎...

✎...

8

Teacher’s sheet: comprehension

See **pages 18 and 19** of *Dissolving*

Answers

1. **The solid breaks up into particles which are too small to be seen.**

2. **As much as the water will take until no more will dissolve.**

3. **The small crystal you use to grow a large one.**

4. **A larger crystal should be drawn around the seed crystal.**

5. **It would have a flat base and would only grow upwards.**

6. **Leave it undisturbed for a few days, or even weeks.**

Complementary work

(a) The following substances can be used for growing crystals. All these substances must be used with care and a risk assessment must be made before use. If the children conduct the experiment, close adult supervision is necessary. The substances are: chrome alum (purple), copper sulphate (blue), ferrous sulphate (green), potash alum (white).

The crystal which is suspended in a saturated solution is called a seed crystal. You can make seed crystals in the following way. Dissolve some of the substance in warm water and make a saturated solution. Let the solution cool and crystals will form. Select the largest crystal, one you can tie a thread around easily. Then follow the instructions on page 19 of the pupil book.

Teaching notes

Children find crystals fascinating, so it can be worth spending some time looking at geological specimens of crystals and talking about how they form. When molten rocks cool down, they form crystals called minerals. Each mineral is made from one or more chemicals.

If you have used scientific modelling earlier, you may like to refer to it again and say that the atoms of the chemicals can arrange themselves in a certain orderly way. When they do this, they form crystals with distinctive shapes. Salt, for example, is made of two chemicals – sodium and chlorine. The atoms of these two substances arrange themselves so that they form crystals which are cube shaped.

When crystals are grown from saturated solutions, the atoms of the chemicals of the dissolved substance arrange themselves in an orderly way around the seed crystal. If you wish to grow a fine crystal, you must select a seed crystal with a good shape on which the atoms of the other substance can settle and organise themselves.

Crystal growing, in both the complementary and supporting activities, gives the children an opportunity to handle chemicals. You must make sure that they know that they must not taste the chemicals and must follow all school policies associated with the handling of chemicals.

8

Name: .... Form: ....

Based on **pages 18 and 19** of *Dissolving*

Growing crystals of Epsom salts

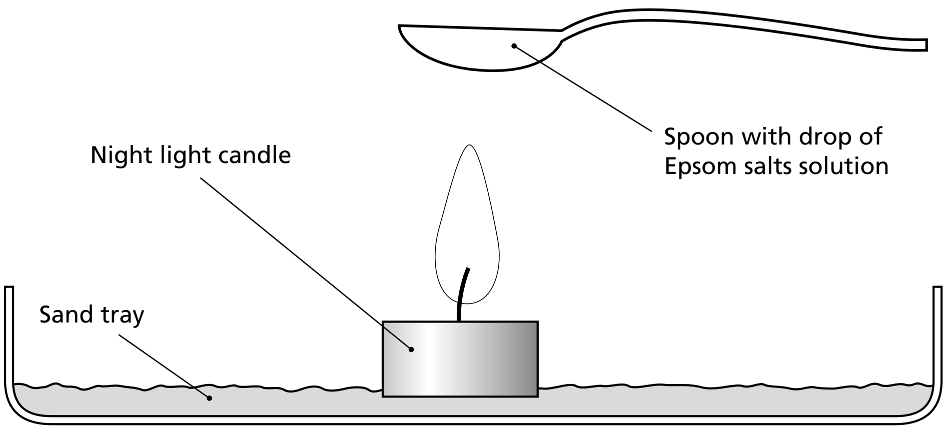
Try this…

1. Put on eye protection.

2. Dissolve Epsom salts in a small volume of water until undissolved crystals remain at the bottom of the solution.

3. Put a drop of solution in a spoon. The drop should be no longer than about 2cm and no wider than about 1cm.

4. Hold the spoon about 1 to 2cm above a candle flame for 1 minute.



5. Remove the spoon from the flame. The drop of liquid should have become smaller. If you tip the spoon slightly, the liquid should flow slowly.

6. Hold the spoon and let it cool down for 2 minutes. Watch the liquid during this time.

7. Write down the changes that you see in the liquid.

✎..

✎..

✎..

✎..

✎..

Teacher's sheet: activity

Based on **pages 18 and 19** of *Dissolving*

Introducing the activity

(a) Tell the children that there are many processes that are used to investigate materials and some of them need special care (see note (i)). The activity they will try here requires the children to take a great deal of care. They are going to heat a substance and observe it while wearing eye protection.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form then go through tasks 1 to 7.

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

(d) Make sure the children wear eye protection that is in accordance with your school policies.

(e) Place a night light candle in a sand tray and light it. Let the children perform tasks 3 and 4 group by group. Stay with each group as they heat their spoon. Make sure that the children are standing up as they heat the spoon (see note (iii)).

(f) Let the children complete tasks 5 to 7 (see note (iv)).

Completing the activity

(g) Let the children report on what they saw.

(h) Ask the children why the crystals formed so quickly (see note (v)).

Conclusion

When a saturated solution of Epsom salts is warmed for a minute, enough water escapes to make it impossible for all the dissolved substance to remain in solution, so some of the substance forms crystals.

Teaching notes

(i) Sometimes older children ask if everything is found out by just making observations or by using only simple processes such as filtering. They may have seen a more complicated process on the television and ask why they cannot try something similar. This activity allows them to use heat. It also gives you an opportunity to discuss safety issues and assess the children's maturity and responsibility in practical work.

(ii) Use only a small volume of water as Epsom salt is quite soluble. You may like to use just one solution for all class groups. It may help the children if they use a ruler to draw on paper an area about 2cm long and 1cm wide.

(iii) Make sure that the night light candle is in the centre of the sand tray, and that the children are standing up so that it is easier for them to move away if an accident happens. The spoon should be a metal teaspoon with a wooden handle or, if the spoon has a metal handle, the child could wear an oven glove.

(iv) Make sure the group can see a clock or timer. They must remove the spoon from above the flame after one minute. The children can move away from the sand tray to complete their observations. They must take care not to let the hot spoon touch their hands. They should find that after two minutes, diamond-shaped crystals begin to form at different places in the liquid. More crystals will then grow very quickly across the surface of the liquid, and soon the whole surface will be covered in crystals. Crystallisation really does take place before their eyes, and many children may want to try the activity again.

(v) Heating the saturated solution removes water and makes the liquid too concentrated to hold all of the Epsom salts in solution, so some salt comes out of solution and forms crystals. If the children are interested in chemical names, you can tell them that Epsom salts are made from the chemical magnesium sulphate.

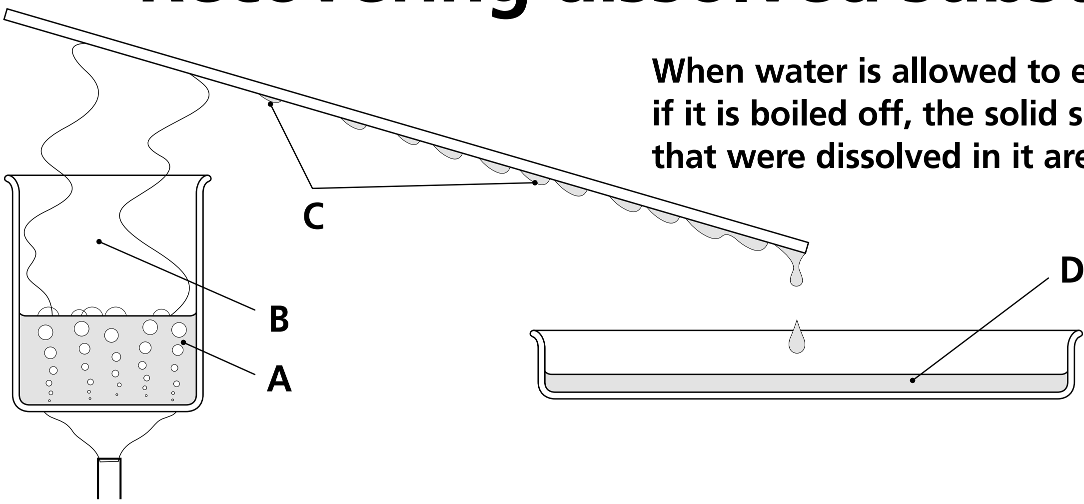
9

Name: .... Form: ....

See **pages 20 and 21** of *Dissolving*

Recovering dissolved substances

When water is allowed to evaporate, or if it is boiled off, the solid substances that were dissolved in it are left behind.



Q1. Why can't you use a filter paper to separate a dissolved solid from water?

✎...

✎...

✎...

Q2. What kind of air makes evaporation take place quickly?

✎...

Q3. How does the temperature of the water affect the way it evaporates?

✎...

✎...

✎...

Q4. Are boiling and evaporating similar? Explain your answer.

✎...

Q5. Name parts A, B, C and D on the diagram above.

A ✎... B ✎...

C ✎... D ✎...

Q6. On the diagram above, put an X at the place where you would find dissolved solids when all the water has boiled away.

9 Teacher's sheet: comprehension

See **pages 20 and 21** of *Dissolving*

Answers

1. **The particles of the dissolved solid are so small that they pass through the holes of the filter paper with the water.**
2. **Warm, dry, moving air.**
3. **The warmer it is, the more energy there is for the water to change from a liquid to a gas.**
4. **Yes. Boiling is a fast form of evaporation.**
5. **A = Boiling water, B = Rising steam, C = Condensed water, D = Distilled water.**
6. **The X should be at the bottom of the container holding the boiling water.**

Complementary work

(a) You could demonstrate how salt and water can be separated by boiling in the following way: Make a salt solution. Put a night light candle in a sand tray and light it. Pour some of the salt solution into a metal soup spoon. Hold the spoon about two centimetres above the candle flame. Hold a second metal soup spoon about three centimetres above the first. Hold the spoons in position for a few minutes then turn over the upper spoon to show the condensation. You may not need to wear oven gloves for this demonstration, instead, you could use metal spoons with wooden handles.

Teaching notes

This unit may be used in sequence, as it appears here, or straight after Unit 2. In Unit 2 water is mixed both with substances that dissolve in water, and with substances that do not dissolve in it. The process of separation is also discussed in Unit 2, and undissolved substances are separated from the water and from the dissolved substances. This unit takes the separation a stage further by showing two techniques for separating a dissolved substance – evaporation and boiling.

You can also use this unit when you are studying the water cycle, as both evaporation and condensation are covered here. The application of evaporation in extracting salt from sea water, as discussed here, can be mentioned when you consider evaporation of water from the sea as part of the water cycle.

9

Name: .... Form: ....

Based on **pages 20 and 21** of *Dissolving*

Which liquids have something dissolved in them?

Try this…

1. Look at the liquids labelled A to F. Predict which ones have something dissolved in them and which ones you think are pure.

2. On the back of this sheet, make a table with three columns and six rows. The headings for the columns are 'Liquid', 'Prediction' and 'Result'. The rows should be labelled A to F.

3. Fill in the first two columns of the table for each liquid.

4. Write down your plan to find out which liquids have something dissolved in them.

✎...

✎...

✎...

✎...

5. Explain why the plan will work.

✎...

✎...

✎...

✎...

6. Let your teacher check your work before you try your investigation.

7. Carry out your investigation and fill in the table.

Looking at the results.

8. How accurate were your predictions? ✎..

Teacher's sheet: activity

Based on **pages 20 and 21** of *Dissolving*

Introducing the activity

(a) Show the children the liquids labelled A to F (see note (i)) and tell them that some liquids contain dissolved substances and others do not.

Using the sheet

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

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

(d) Go through tasks 4 to 6 (see note (ii)) then let the children try them.

(e) Let the children try tasks 7 and 8 (see note (iii)).

Completing the activity

(f) Let the children compare their results.

Conclusion

Substances are left behind when liquids B, C, D and E have evaporated. Liquid A will probably not show any dissolved substances, and liquid F will not show any dissolved substances (see note (iv)).

Teaching notes

(i) A is tap water, B is blue and contains bath salts, C contains salt water, D contains ink, E is the filtered soil water from Activity 2, F is distilled water (obtainable from a secondary school science department or a chemist).

(ii) You may like to ask the children the reason for their predictions. They may say that some dissolved substances colour the water so they are easy to identify.

The plan should state that equal volumes of the liquids are set out on dishes or trays and left in a warm place to speed up evaporation. If a liquid contained something dissolved in it, that substance would be left behind after the water had evaporated and will be easy to see.

The explanation for why the plan will work should include that water evaporates in warm conditions, but the dissolved substance cannot evaporate and will remain behind.

(iii) The investigation will take a few days to complete. The dishes of liquid must be left undisturbed in a warm place during this time.

(iv) Tap water does contain dissolved substances, but these may not be seen due to the small amount of water used in the investigation.

10

Name: .... Form: ....

See **pages 22 and 23** of *Dissolving*

Dissolving rocks

Limestone rock dissolves in rainwater. It causes spectacular caves, hard water and 'furred-up' kettles.

Q1. How long does it take caves to form in limestone rock?

✎..

Q2. How can you use soap to see if water is hard? What happens if water is hard?

✎...

✎...

✎...

Q3. In the box above, draw a cave with stalagmites and stalactites in it. Label each one.

Q4. What are stalagmites and stalactites made from?

✎..

Q5. Why does limestone come out of a limestone solution when you heat it?

✎...

Q6. What is the device which takes limestone out of hard water called?

✎...

Teacher's sheet: comprehension

See **pages 22 and 23** of *Dissolving*

Answers

1. **Millions of years.**
2. **Try and make a soapy lather with the water. The soap does not make much lather with hard water. It may make a scum.**
3. **Stalactites should be labelled and shown growing from the cave roof. The stalagmites should be labelled and shown growing from the cave floor.**
4. **Limestone.**
5. **Limestone is less soluble in hot water than cold water.**
6. **A water softener.**

Complementary work

(a) The children can research, using secondary sources, to find out about limestone caves and large stalactites and stalagmites.

(b) If you can find a secure place to display the growth of washing soda stalactites and stalagmites, then you may wish to set up the following demonstration: Make a saturated solution of washing soda and pour equal amounts into two jars or beakers. Place a length of thick, woollen thread, or yarn, between the beakers, so that each end is in one beaker and the thread dips a little in the middle to form a U-shape between them. Place a deep dish below the U-shaped piece of thread. For more details, see the teaching notes on this page.

Teaching notes

It is customary to describe limestone as dissolved in water. However, although the dissolving property of water is important, the processes are more complex.

Limestone dissolves in water due to the chemical and solvent properties of water. Carbon dioxide in the air dissolves in rainwater. This produces a chemical change in the water that turns the water into a weak acid. This weak acid reacts with the substance from which limestone is made, calcium carbonate. The acid changes calcium carbonate into calcium bicarbonate, which dissolves in water.

When water rich in calcium bicarbonate reaches the roof of a cave, drops fall to the floor. When a drop falls, it releases carbon dioxide back into the air. This causes tiny particles of calcium carbonate to re-form. Those particles which stay on the cave roof stick together and form a stalactite. Those which fall to the cave floor stick together and form stalagmites. If the children have studied chemical change, and have sufficient interest or ability, you may use this information as an example of chemical change, as well as an example of dissolving.

If you plan to try complementary activity (b), you will find that the washing soda solution moves through the wool thread and drips from the bottom of the U-shape. A stalactite will grow at the bottom of the U, and a stalagmite will grow in the dish beneath it. The process may take a few days. You may be able to measure the length of the stalactite and stalagmite each day, and calculate its rate of growth. The growth of real stalactites and stalagmites is much slower.

10

Name: .... Form: ....

Based on **pages 22 and 23** of *Dissolving*

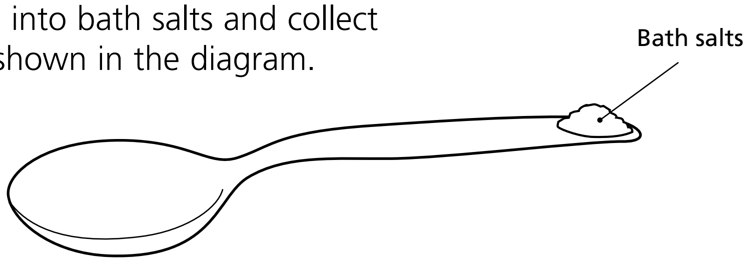
Hard water, soft water

Try this…

1. Measure out a volume of water A and pour it into a beaker.

2. Repeat step 1 with water B and water C.

3. Dip a spoon handle into bath salts and collect as much bath salts as shown in the diagram.



4. Stir the bath salts into water A for 20 seconds, and note the amount of lather and cloudiness.

5. Repeat steps 3 and 4 with water B and water C.

6. Leave each water sample for 5 minutes, then compare the lather and cloudiness again, and enter your comments in the table.

Water	Amount of lather	Water clear/cloudiness after 5 minutes
A		
B		
C		

7. The amount of calcium in the three samples of water were:

A ✎....................... mg/l B ✎....................... mg/l C ✎....................... mg/l

On the back of this sheet, make a bar graph of these readings and work out how much calcium your volume of A, B and C contain.

8. Check your answers with your teacher, then label each column in the bar graph according to the teacher's answers.

Teacher's sheet: activity

Based on **pages 22 and 23** of *Dissolving*

Introducing the activity

(a) Begin by reminding the children that when limestone is dissolved, a substance called calcium is dissolved in the water. This substance makes it difficult for the water to make a lather with soap. It can also make the water produce a cloudy scum. Tell the children that they have three waters to test, and they are going to use bath salts instead of soap to test for hardness (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 6 (see note (ii)).

(c) Let the children try tasks 1 to 6.

(d) Give the children the concentrations of calcium in the three water samples. Do not give them in the order A, B and C.

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

(f) Let the children try tasks 7 and 8.

Completing the activity

(g) Let the children report on their findings and compare results.

Conclusion

Water rich in calcium will not produce a lather with bath salts but may produce a cloudy scum. Water which has only a small amount of calcium in it will produce a lather and no scum. The amount of calcium in the water affects the ability of the water to make a lather. The more calcium the water possesses the less able it is to make a lather and the more likely it is that the water will make scum.

Teaching notes

(i) If you live in a hard water area, you may wish to use the local water and softer, bottled, mineral water. In order to complete the activity, you will need to know the concentration of calcium in mg/l (milligrams per litre) from your local water company. You may, however, prefer to use bottled water as suggested for people who live in soft water areas.

If you live in a soft water area you can obtain hard water from bottled still mineral waters which have added calcium. This can then be used with two other still mineral waters with differing amounts of calcium. For example, when waters with 300, 78 and 9 mg/l of calcium were each tested with bath salts, the first water went cloudy and produced no lather, the second was clear at first with some lather and the third was clear all the time and produced the most. After five minutes the second water sample became cloudy, but not as cloudy as the first water sample.

(ii) Use small amounts of water. For example, about $25cm^3$.

QUESTIONS

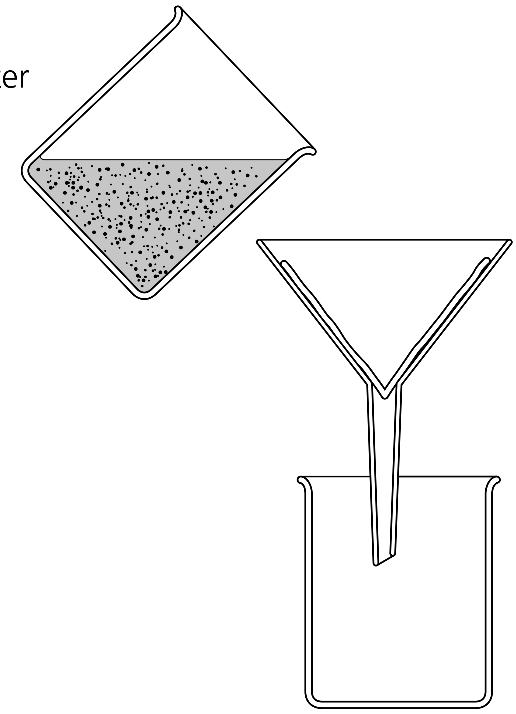
Name: .... **Form:** ....

Q1. Which of these substances dissolves in water?

Tick three boxes:

Clay ☐ Salt ☐ Oil ☐ Sugar ☐ Coffee grains ☐

Q2. Sarah has a mixture of sand and water. She plans to pour it into a filter paper and filter funnel like those in the diagram.



(i) What will happen to the sand?

✎...

(ii) What will happen to the water?

✎...

(iii) Explain your answer to (i).

✎...

✎...

(iv) Explain your answer to (ii).

✎...

✎...

QUESTIONS

Name: .... **Form:** ....

Q3. Tom has dissolved some sugar in water. He plans to pour the mixture into a filter funnel and filter paper.

(i) What will happen to the water?

✎...

(ii) What will happen to the sugar?

✎...

(iii) Explain your answer to (ii).

✎...

✎...

Q4. Four chemicals were tested to see how much would dissolve in 100cm^3 of water. The results are shown in the table.

Chemical	Amount dissolved (g)
A	68
B	0
C	4
D	19

(i) What does the letter ‘g’ in the table stand for?

✎...

(ii) Which chemical was the most soluble?

✎...

(iii) Which chemical was insoluble?

✎...

QUESTIONS

Name: .... **Form:** ....

Q5. Paul decided to find out how much sugar would dissolve in a cup of water. How would he know when the water could not dissolve any more sugar?

✎...

✎...

Q6. Tom had three kinds of sugar, labelled A, B and C. A had large grains, B had medium-sized grains and C had small grains.

Tom made a plan to dissolve each sugar in a separate beaker of water.

(i) How could he make his test fair?

✎..

✎..

(ii) Which kind of sugar would dissolve fastest? ✎..

(iii) Would this sugar have the largest surface area in contact with the water, or the smallest surface area?

✎..

Q7. Mina dissolved a substance in water at three different temperatures.
Here are her results:

Temp. of water (0°C)	Time for substance to dissolve (seconds)
0	250
20	100
40	30

(i) How does the temperature affect the time it takes for the substance to dissolve?

✎..

(ii) How should Mina check her results?

✎..

QUESTIONS

Name: .... **Form:** ....

Q8. Arif watched a pan of water as it was heated until it boiled. He took the temperature several times, and made some notes each time the temperature of the water was taken. He recorded his notes in a table.

Temp. of water (0°C)	Number and size of bubbles
20	No bubbles
70	A small number of small bubbles
80	A larger number of small bubbles
90	A small number of large bubbles, fewer small bubbles
100	A large number of large bubbles, and small number of small bubbles

(i) How do the bubbles change as the temperature of the water changes?

✎...

(ii) What do the bubbles contain? ✎...

(iii) Why do the bubbles form?

✎...

✎...

Q9. What is the name of the gas in the bubbles in a fizzy drink?

Tick one box:

Oxygen ☐ Helium ☐ Carbon dioxide ☐ Air ☐

QUESTIONS

Name: .... **Form:** ....

Q10. Paul put a drop of blue ink in the middle of a filter paper. Sarah put drops of water on the ink spot.

(i) Where did the water go after it had landed on the ink spot?

✎...

(ii) Tom and Sarah could see that the ink contained more than one colour. How?

✎...

✎...

(iii) What is the name of the process used to investigate colours in inks?

Tick one box:

Evaporation ☐ Filtration ☐ Paper chromatography ☐ Condensation ☐

Q11. Mina set up a beaker like the one in the diagram and left it for two weeks.

(i) Which process took place at A? Select one process from the list below.

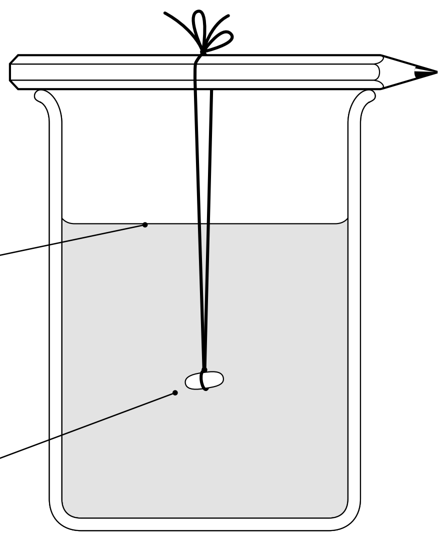
✎...

(ii) Which process took place at B? Select one from the list below.

✎...

distillation **condensation** **evaporation**

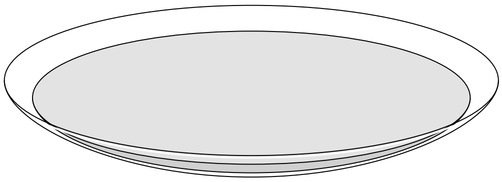
crystallisation **extraction**



QUESTIONS

Name: .... **Form:** ....

Q12. Arif left a bowl of salt water in a warm place.



(i) What happened to the water after a few days?

✎...

(ii) What happened to the salt after a few days?

✎...

Sarah set up the same experiment as Arif, but she put the bowl of salt water in a cold place. Sarah left the bowl for the same amount of time as Arif.

(iii) Do you think she would get the same result as Arif? ✎.....................................

(iv) Explain your answer to (iii).

✎...

✎...

✎...

Q13. Which of these rocks are dissolved by rainwater.

Tick two boxes:

Limestone ☐ Granite ☐ Sandstone ☐ Chalk ☐

Q14. Tom has two samples of water. How could he find out if one was hard water?

✎...

✎...

✎...

✎...

ANSWERS

1. Sugar, salt, coffee grains. *3 marks*

2. (i) The sand will stay in the filter paper. *1 mark*
(ii) The water will pass through the filter paper and into the beaker. *1 mark*
(iii) The sand particles are too large to pass through the holes in the filter paper. *1 mark*
(iv) The holes are too large to stop the water passing through it. *1 mark*

3. (i) It will pass through the filter paper. *1 mark*
(ii) It will pass through the filter paper. *1 mark*
(iii) The dissolved substances will pass through the filter paper with the water. *1 mark*

4. (i) Grams. *1 mark*
(ii) A. *1 mark*
(iii) B. *1 mark*

5. Undissolved sugar would collect at the bottom of the cup. *1 mark*

6. (i) Use the same volume of water in each beaker, have the water in each beaker at the same temperature, stir each solution the same number of times in a certain amount of time. *3 marks*
(ii) C. *1 mark*
(iii) The largest surface area. *1 mark*

7. (i) The higher the temperature, the shorter the time needed to dissolve. *1 mark*
(ii) She should repeat the experiment twice more and compare all her results. *2 marks*

8. (i) Small bubbles form at first. The number of small bubbles increases as the water gets hotter, then decreases at 90°C. Large bubbles form at 90°C and increase in number as the water reaches 100°C. *4 marks*
(ii) Air. *1 mark*
(iii) The air is dissolved in the water, but as the water gets hotter it cannot hold as much dissolved air, so the air escapes and makes bubbles. *2 marks*

9. Carbon dioxide. *1 mark*

10. (i) The water spread out through the filter paper. *1 mark*
(ii) The water carried the different coloured inks for different distances through the paper. It separated them. *1 mark*
(iii) Paper chromatography. *1 mark*

11. (i) Evaporation. *1 mark*
(ii) Crystallisation. *1 mark*

12. (i) It all evaporated. *1 mark*
(ii) It collected at the bottom of the bowl and formed crystals. *1 mark*
(iii) No. *1 mark*
(iv) Evaporation is slower when it is cold, so there would still be some water in the bowl and all the salt may still be dissolved in it. *2 marks*

13. Limestone, chalk. *2 marks*

14. He could put soap into both and try to make a lather. If one of the water samples was hard, only a small amount of lather could be made and scum would form. *2 marks*

Total marks: 44