Science@School Book 5D

Changing
from solids to liquids to gases

Teacher's Guide

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The pupil book explained unit by unit

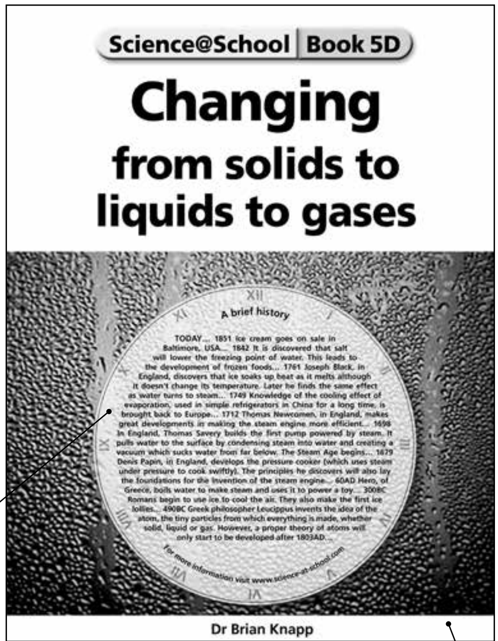
Although the pupil book – *Changing from solids to liquids to gases* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Changing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

It is possible to use *Changing from solids to liquids to gases,* 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.

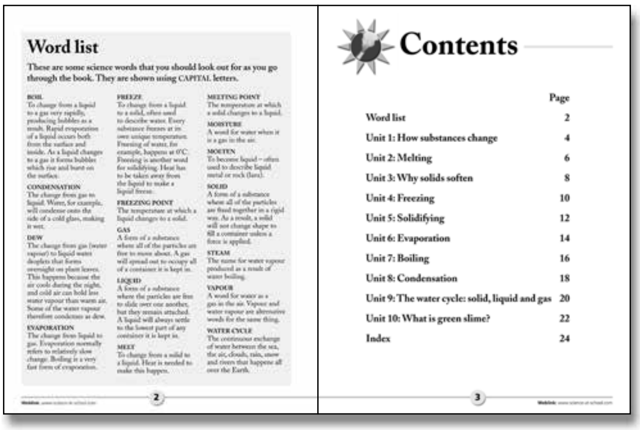
The picture shows water droplets that have formed on a cold window by condensation of water vapour from the air.

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.

BOIL
To change from a liquid to a gas very rapidly, producing bubbles as a result. Rapid evaporation of a liquid occurs both from the surface and inside. As a liquid changes to a gas it forms bubbles which rise and burst on the surface.

CONDENSATION
The change from gas to liquid. Water, for example, will condense onto the side of a cold glass, making it wet.

DEW
The change from gas (water vapour) to liquid water droplets that forms overnight on plant leaves. This happens because the air cools during the night, and cold air can hold less water vapour than warm air. Some of the water vapour therefore condenses as dew.

EVAPORATION
The change from liquid to gas. Evaporation normally refers to relatively slow change. Boiling is a very fast form of evaporation.

FREEZE
To change from a liquid to a solid, often used to describe water. Every substance freezes at its own unique temperature. Freezing of water, for example, happens at 0°C. Freezing is another word for solidifying. Heat has to be taken away from the liquid to make a liquid freeze.

FREEZING POINT
The temperature at which a liquid changes to a solid.

GAS
A form of a substance where all of the particles are free to move about. A gas will spread out to occupy all of a container it is kept in.

LIQUID
A form of a substance where the particles are free to slide over one another, but they remain attached. A liquid will always settle to the lowest part of any container it is kept in.

MELT
To change from a solid to a liquid. Heat is needed to make this happen.

MELTING POINT
The temperature at which a solid changes to a liquid.

MOISTURE
A word for water when it is a gas in the air.

MOLTEN
To become liquid – often used to describe liquid metal or rock (lava).

SOLID
A form of a substance where all of the particles are fixed together in a rigid way. As a result, a solid will not change shape to fill a container unless a force is applied.

STEAM
The name for water vapour produced as a result of water boiling.

VAPOUR
A word for water as a gas in the air. Vapour and water vapour are alternative words for the same thing.

WATER CYCLE
The continuous exchange of water between the sea, the air, clouds, rain, snow and rivers that happens all over the Earth.

2

Contents

3

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

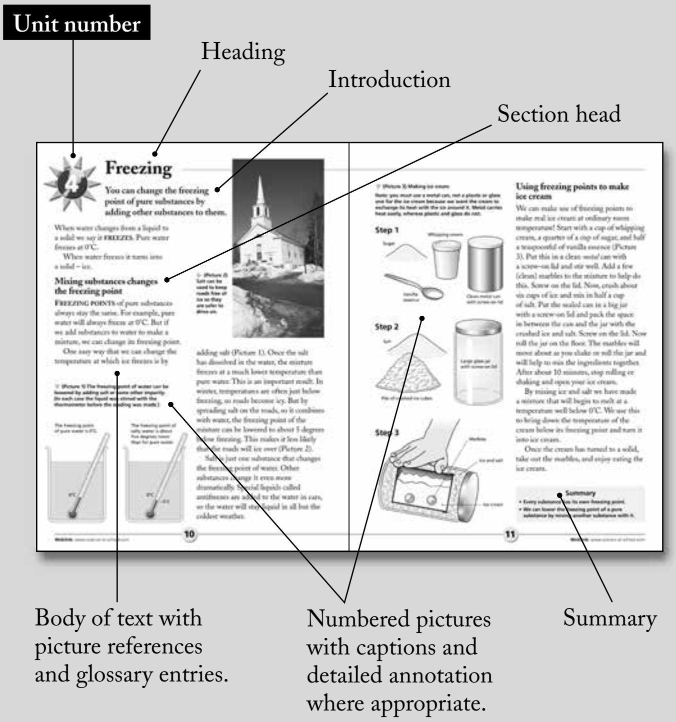
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

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.

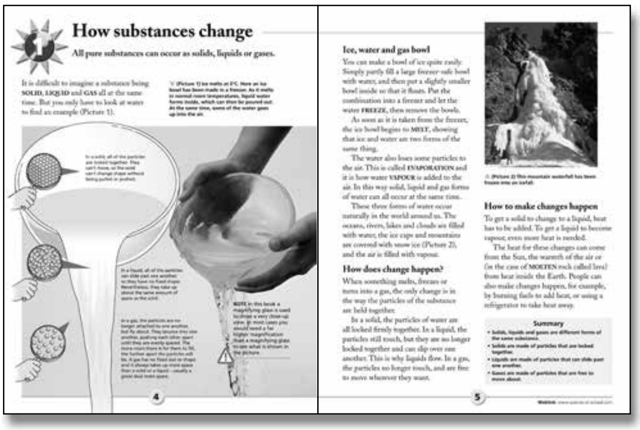


1 How substances change

You may wish to begin by brainstorming ideas about solids, liquids and gases. The children may give examples of the different states of matter, but ask them if a substance can be all three. This may cause some of the children to hesitate and you can use the pause to introduce the unit.

The unit begins by answering your question. A photograph of an ice bowl pouring water is supported by a clear diagram showing how the particles are arranged in ice, water and water vapour. There are instructions on how to make an ice bowl, so you might like to make one before the lesson and demonstrate pouring water from it as the photograph and diagram show. You could then place the bowl in a deep tray and put it to one side so the children could watch the bowl melt as they work through the unit.

The main text moves on to explain that when a substance changes state the only change is in the arrangement of its particles. The unit ends by



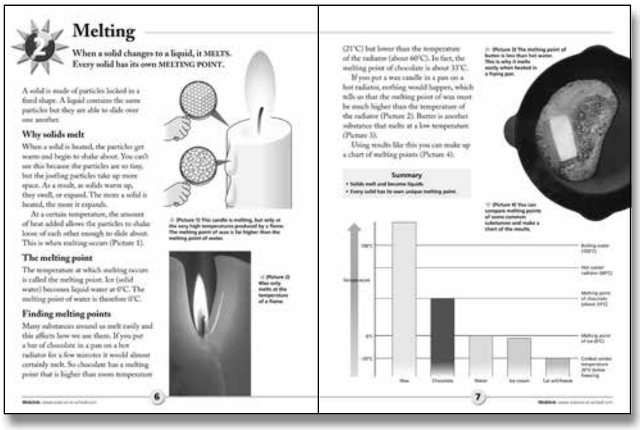
considering how the changes in state are brought about by the application or the removal of heat.

The unit is supported by complementary work in which the children find out about the amount of solid, liquid and gaseous water on the Earth. In the practical activity, the children observe closely the changes in an ice cube as it melts, and speculate on how the water produced can be turned into a gas.

2 Melting

You may like to begin by putting a lump of margarine in one hand and a lump of lard in the other. Show the children that you have closed your fingers over them but some children may like to check at close quarters to see that it is not a trick. Hold the lumps in your hands for two minutes while you ask the children to predict what your hands will be like when you open them. After two minutes, open your hands. The margarine should have partially melted and the lard should have remained solid but softened. Challenge the children to explain the difference and look for an answer which says that the two substances have different melting points.

This unit closely focuses on the process of melting and explains why solids melt. The concept of melting point is introduced, and a simple experiment is described in which the melting points of some common substances can be compared. The unit ends with a bar chart of the melting points of various substances, ranging from wax to antifreeze.

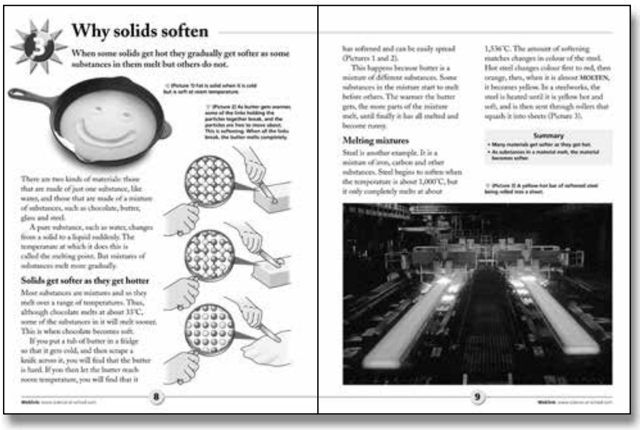


In the complementary work, the children use secondary sources to find out about the melting point of a wide range of substances. They can also perform a fair test to compare the melting points of margarine and butter. In the practical investigation, the children look at the condition of soft margarine at room temperature, 30°C and 45°C.

3 Why solids soften

You could begin by taking a tub of butter and a tub of margarine out of a fridge. Open the tops of the tubs and stick a chopstick vertically into both substances. Push the chopsticks in to a depth of about two centimetres. Ask the children what will happen to the chopsticks as the butter and margarine warm up. Let the children write down their predictions, then leave the two tubs to the side while the children study the unit. At some point, the chopstick in the margarine should fall over first. This indicates that the margarine has softened first. When this happens, you can draw the children's attention to it.

The unit begins by dividing materials into two groups – pure substances and mixtures. A pure substance changes from a solid to a liquid quickly, but mixtures like butter and glass change more slowly and go through a process of softening. The softening process is described using clear illustrations, and the application of softening is described and illustrated with a photograph of yellow-hot steel being rolled into a sheet.


Why solids soften

When some solids get hot they gradually get softer as some substances in them melt but others do not.

Solids get softer as they get hotter

Melting mixtures

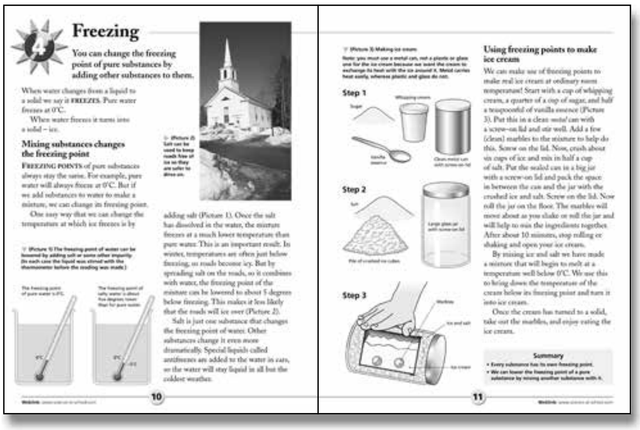
Summary

In the complementary work, the children find out about the uses of sheet steel. They also research to find out about solder and the work of the blacksmith. In the practical investigation, the children perform a fair test on the hardness of margarine at different temperatures.

4 Freezing

You may like to begin by brainstorming about the different forms of frozen water such as snowflakes, icicles, fern frost, hoar frost, glacier ice, icebergs and hail. The children may even mention ice lollipops or ice cream. When they do, turn to the unit and its description of making ice cream.

The unit begins by introducing the concept of freezing point, then moves on to describe how mixing substances together can change the freezing point. The application of salt to icy winter roads is described, and the purpose of antifreeze is explained. The unit ends by showing how the freezing point of a salt and ice mixture can be used to make ice cream. You could make ice cream as a demonstration and let children help at various stages. The ice cream is made from whipping cream, sugar and vanilla essence. It is sealed in a metal container and rolled around inside a large jar of crushed ice and salt.


Freezing

You can change the freezing point of pure substances by adding other substances to them.

Mixing substances changes the freezing point

Using freezing points to make ice cream

Step 1

Step 2

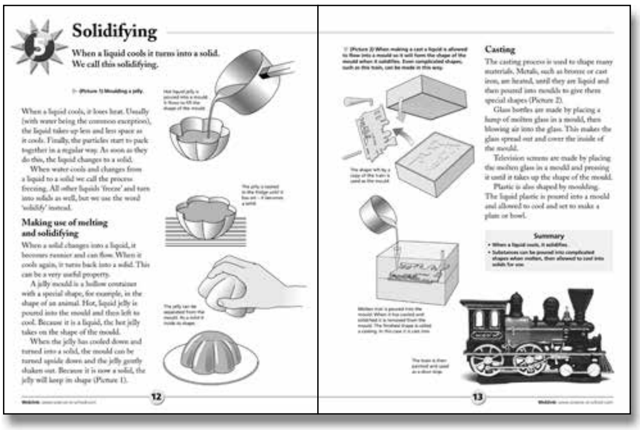
Step 3

Summary

In the complementary work, the children find out how ice cream is made in a factory. They also find out about how ice is made for an ice rink.
In the practical activity, the children investigate the effect of salt on ice by performing a fair test.

5 Solidifying

You could begin by showing the children a less familiar substance – a block of coconut cream (available in the Asian section of most grocery stores). You could demonstrate how solid it is by banging it on a table. Use a knife to cut off a small piece. Put the piece in an old metal kitchen spoon and heat it over a night light candle in a sand tray. When the lump has melted, pour a little out to demonstrate that it is now a liquid, then remove the spoon and gently rest it on the surface of cold water in a bowl. After a minute, raise the spoon and slowly turn it. The coconut cream should have become solid again. You should be able to turn the spoon upside down and the coconut cream will stay in place.


Solidifying

When a liquid cools it turns into a solid. We call this solidifying.

Making use of melting and solidifying

Casting

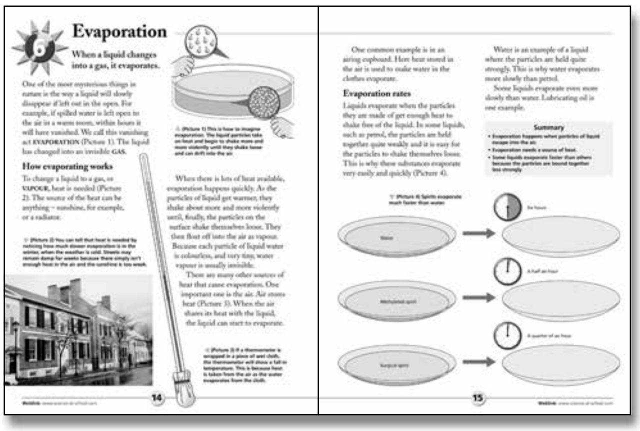
Summary

The unit begins by describing what happens when a substance solidifies. Freezing is introduced as a term related to the solidifying of water and the term 'solidify' is given for the change that takes place when substances move from a liquid to a solid. The text moves on to consider how melting and solidifying can be useful to us, and features jelly making and casting. In this last section, the shaping of metals, glass and plastic are described.

In the complementary work, the children can find out about how casting was used in the Bronze Age. In the practical activity, the children use Plasticine to make moulds and cast a margarine star and a wax star.

6 Evaporation

You may wish to begin by telling the children that you want to make a scientific model of evaporation and you need their help. Ask eight children to stand in the middle of the classroom. They are water particles in a puddle of water. Ask the children to sway gently. This is to show that the particles move inside the water. Ask one child to shake about, then walk around the classroom. This is a water particle that has evaporated. Ask several other 'water particles' to 'evaporate' so the class can visualise the process of evaporation.


Evaporation

When a liquid changes into a gas, it evaporates.

How evaporating works

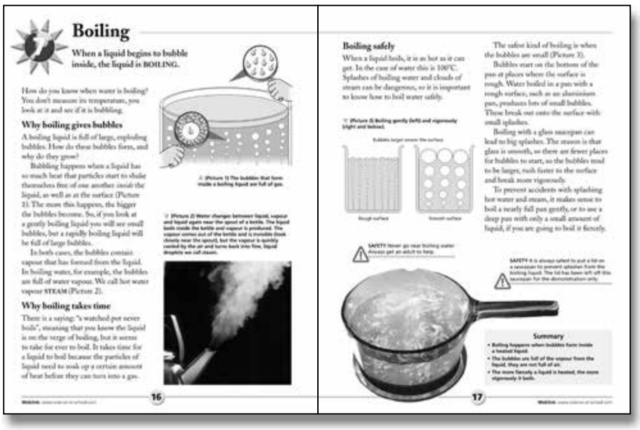
Evaporation rates

Summary

The unit begins by stating that evaporation seems a mysterious process in which water appears to vanish. The process is then carefully described by first introducing some form of heat as a requirement for evaporation. The text then moves on to show how heat affects some of the particles of water to cause evaporation. A thermometer wrapped in a wet cloth is illustrated to show that heat is used up as evaporation occurs. Examples of evaporation in airing cupboards and on wet streets are given. The concept of evaporation rates is introduced and illustrated by comparing the evaporation rates of three liquids.

In the complementary work, you could demonstrate the experiment illustrated in the unit and the children can devise a fair test to investigate how a damp cloth loses heat. In the practical activity, the children compare the evaporation rates of water and cooking oil.

7 Boiling

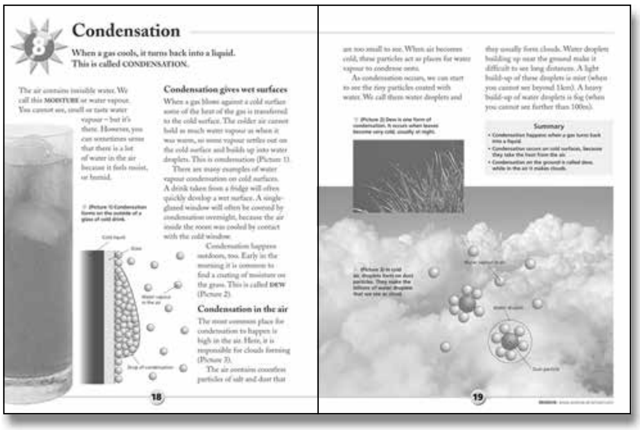


Begin by brainstorming with the class about boiling. They could refer to boiling in cooking and what it does to food, boiling to make a hot drink, boiling to kill germs, boiled sweets, a boiler in a steam engine, boiling water in a geyser and the misapplication of the word boiling when describing hot weather.

The unit begins by explaining that the key to finding out if a liquid is boiling is to look for bubbles. The formation of bubbles is described and the process taking place inside a bubble is explained and illustrated. The saying "a watched pot never boils" is explained and it is revealed that water boils differently in glass and aluminium pans owing to the nature of their surfaces. Gentle and vigorous boiling are compared, and advice is given on how water can be boiled safely.

In the complementary work, the children use secondary sources to find out about the boiling points of different substances. They are also given instructions on how they can make a model of a geyser, like those found in volcanic areas, and produce a fountain without using heat. In the practical activity, the children record the rise in temperature as the teacher heats water to boiling point. They then extract information from the graph they have produced.

8 Condensation

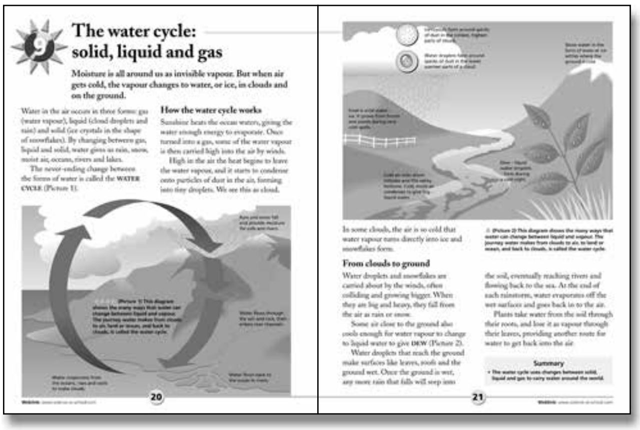


You may like to begin by telling the children that you want to make a scientific model of condensation and need their help. Ask eight children to walk round the room. They are water particles in the air. Now ask a ninth child to hold up a large sheet of card. This is a cold surface. Ask one of the 'water particles' to walk towards the card and slow down as he or she approaches it. When the child reaches the card ask him or her to stop. Ask each child in turn to approach the card and 'condense'. At the end of the demonstration you should have a 'water drop' with eight 'water particles' in it.

The unit opens by clearly linking the words moisture, water vapour and humid. The process of condensation is then clearly explained and illustrated. Everyday examples of condensation are given, including the formation of dew. Children can sometimes find the process of condensation in the air difficult to understand but the clear explanations and illustrations here should help them appreciate how clouds, mists and fog are formed.

In the complementary work, the children can compare how condensation forms on cold and warm cans. They can also look for signs of condensation in a sealed jar of water. In the practical activity, the children investigate how hot water condenses on a sheet of cling film that is cooled by an ice cube.

9 The water cycle: solid, liquid and gas

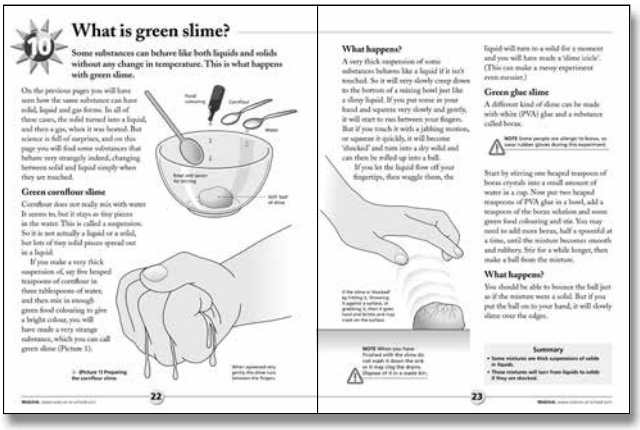


Begin by asking three children to stand at the front of the class in a line. They should be a few paces apart. Each child should face the class and hold up a card. The child on the left should have a card with the word 'solid' written on it. The child in the middle should have a card with the word 'liquid' written on it, and the child on the right should have a card with the word 'gas' written on it. Ask another child to stand behind the 'liquid' child. Write the words evaporate, condense, melt and freeze on the board. Tell the class that they can change the state of the fourth child (use his or her name) by calling out one of the instructions on the board. Let the class then change the state of the child following this sequence – solid, liquid, gas, liquid, gas, liquid, solid. Tell the class that over two-thirds of their body is made of water. Then start the unit.

The unit opens by describing the three states in which water is found on the planet. A diagram shows how water evaporates and condenses to make the water cycle. The text describes how the water cycle works, and traces the path of water from a cloud to the ground and back into the air.

In the complementary work, the children investigate rainfall, clouds and local rivers. In the practical activity, the children observe a scientific model of a sea and a lake.

10 What is green slime?



Slime is generally considered to be a revolting substance, but children find it fascinating. You may like to begin by talking about films where the children have seen slime. These are probably science fiction films or films for children where slime is introduced to shock or amuse. Introduce the unit by saying that the children are going to find out how to make slime.

The unit opens by stating that slime is unusual because it can behave both like a liquid and a solid, but heat is not needed to bring about any changes. Instead, slime changes between the solid and liquid state according to the way you touch it.

Instructions are given on how to make green cornflour slime and you may wish to let the children make it at this point. They will be amazed at how it can change quickly into a solid, then back into a liquid again. They will enjoy making 'slime icicles'. A recipe for green glue slime is included which they can also make, or you could demonstrate.

In the practical activity, the children follow a recipe to make slime from flour, salt, cooking oil and water, then investigate the effect of changing the proportions of the ingredients. This can be followed by complementary work on further changing the proportions of the ingredients and working out a test to compare the rate of flow of the new slimes that are made.

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 changing from solids to liquids to gases 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 sheet, 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 of this *Teacher's Guide*.

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. 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.

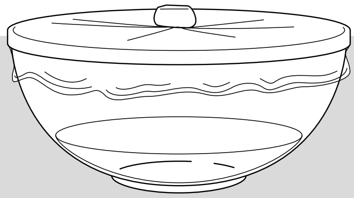
Safety

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.



▲ *Investigating condensation in the Unit 8 activity.*

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. Make an ice bowl following the instructions on pages 4 and 5 of the pupil's book.
2. Lump of margarine, lump of lard.
3. Tub of butter and tub of margarine (both cooled in a fridge), two chopsticks.
4. Whipping cream, sugar, vanilla essence, metal can with screw-on lid, large plastic jar with screw-on lid, crushed ice, rock salt, marbles (optional).
5. Block of coconut cream, knife, old kitchen spoon (metal), night light candle and sand tray, bowl of cold water. (Check for nut allergies in class).
6. –
7. –
8. Large sheet of card.
9. Three pieces of card on which to write the words solid, liquid and gas.
10. Cornflour, green food colouring, white (PVA) glue, borax.

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

1. Secondary sources about the amount of fresh water, ice and water vapour on the Earth and the amount of water in the oceans.
2. Secondary sources about the melting points of substances such as metals and rock.
3. Secondary sources about the uses of sheet metal. Secondary sources about solder and its uses. A visit by someone skilled in the use of a soldering iron. A visit to a blacksmith's forge.
4. Secondary sources about how ice cream is made in a factory. A visit to an ice cream factory. Secondary sources about how ice is made at an ice rink.
5. Secondary sources about the casting of metal in the Bronze Age.
6. TEACHER DEMONSTRATION ONLY: three shallow dishes, methylated spirit, surgical spirit (make sure these liquids are stored and used in accordance with the school safety policy), clock. Children's practical: two thermometers, a wet cloth, a dry cloth, clock.
7. Secondary sources about the boiling points of different substances, including liquid metals. Bucket, large plastic funnel, plastic tube.
8. Cold unopened drinks can, unopened drinks can at room temperature. Clear plastic bottle or jar with lid, sunny windowsill.
9. Rain gauge. Local and national maps showing rivers. Secondary sources about how cumulus and cirrus clouds form.
10. Ingredients and materials from activity 10 (list 3).

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. Ice cube, dish, access to a warm place, ruler, clock.
2. Three squares of aluminium foil with sides of 6cm, ruler, soft margarine, plastic knife or spoon, bowl, access to cold and hot taps, thermometer, clock, measuring cylinders (optional).
3. Three squares of aluminium foil with sides of 6cm, ruler, soft margarine, plastic knife or spoon, access to fridge, two bowls, thermometer, chopstick.
4. Two ice cubes, two dishes, salt.
5. Two lumps of Plasticine, ruler, margarine, metal teaspoon (preferably one with a pointed end which is easier to pour from), night light candle and sand tray, candle wax, oven gloves.
6. Two dishes, cold water, cold cooking oil, access to a warm place.
7. TEACHER DEMONSTRATION ONLY: heater, container in which water is boiled, thermometer, data logger (optional).
8. Bowl, cling film, ice cube, clock, magnifying glass (optional).
9. Salt, beaker, food colouring, heatproof bowl, heatproof dish, hot water (used by teacher only), ice cube.
10. Flour, salt, cooking oil, water, four tablespoons, bowl, food colouring, four dishes.

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

- ▶ Solids, liquids and gases are different forms of the same substance.
- ▶ The different forms of a substance can be explained in terms of how the particles within them are arranged.
- ▶ Heat is needed to make changes happen.

Unit 2

- ▶ When a solid melts it becomes a liquid.
- ▶ Every solid has its own unique melting point.

Unit 3

- ▶ Pure substances change from a solid to a liquid quickly.
- ▶ Mixtures of substances melt over a range of temperatures.
- ▶ As substances in a material melt, the material gets softer.

Unit 4

- ▶ Every substance has its own freezing point.
- ▶ The freezing point of a pure substance can be lowered by mixing another substance with it.

Unit 5

- ▶ A liquid can be cooled down to form a solid.
- ▶ Melting and cooling are important processes in the casting of metals.

Unit 6

- ▶ Evaporation needs a source of heat.
- ▶ A substance changes from a liquid to a gas when it evaporates.
- ▶ Different liquids evaporate at different rates.

Unit 7

- ▶ Boiling happens when bubbles form inside a heated liquid.
- ▶ The bubbles contain vapour from the liquid.
- ▶ The more fiercely a liquid is heated, the more vigorously it boils.

Unit 8

- ▶ Condensation occurs when a gas turns into a liquid.
- ▶ Condensation occurs on cold surfaces because the surface takes heat from the gas.

Unit 9

- ▶ Water exists as a solid, a liquid and a gas on the Earth.
- ▶ Water can change form according to the temperature of its surroundings.
- ▶ The way water changes form enables it to move around the Earth in a process called the water cycle.

Unit 10

- ▶ Some mixtures are thick suspensions of solids in liquids.
- ▶ These mixtures turn from liquids to solids if they are squeezed.
- ▶ The mixture turns back from solid to liquid when the pressure on it is released.

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

- Record observations in written form.
- Make a prediction.
- Plan an investigation to test a prediction.

Unit 2

- Use simple equipment safely.
- Use a thermometer.
- Record observations in written form.

Unit 3

- Use simple equipment and resources, such as a fridge, with care.
- Take measurements with a thermometer.
- Draw conclusions.

Unit 4

- Record observations in written form.
- Make predictions.
- Make a comparison.

Unit 5

- Use equipment and materials safely.
- Use scientific knowledge and understanding to make a prediction.

Unit 6

- Make a prediction.
- Use scientific knowledge and understanding to support a prediction.

Unit 7

- Fill in a table.
- Make a line graph.
- Extract information from a graph.

Unit 8

- Identify a simple pattern in observations.
- Use scientific knowledge and understanding to explain observations.

Unit 9

- Make a prediction.
- Use scientific knowledge and understanding to explain observations.

Unit 10

- Use materials and equipment safely.
- Make predictions.
- Test predictions and record results in written form.

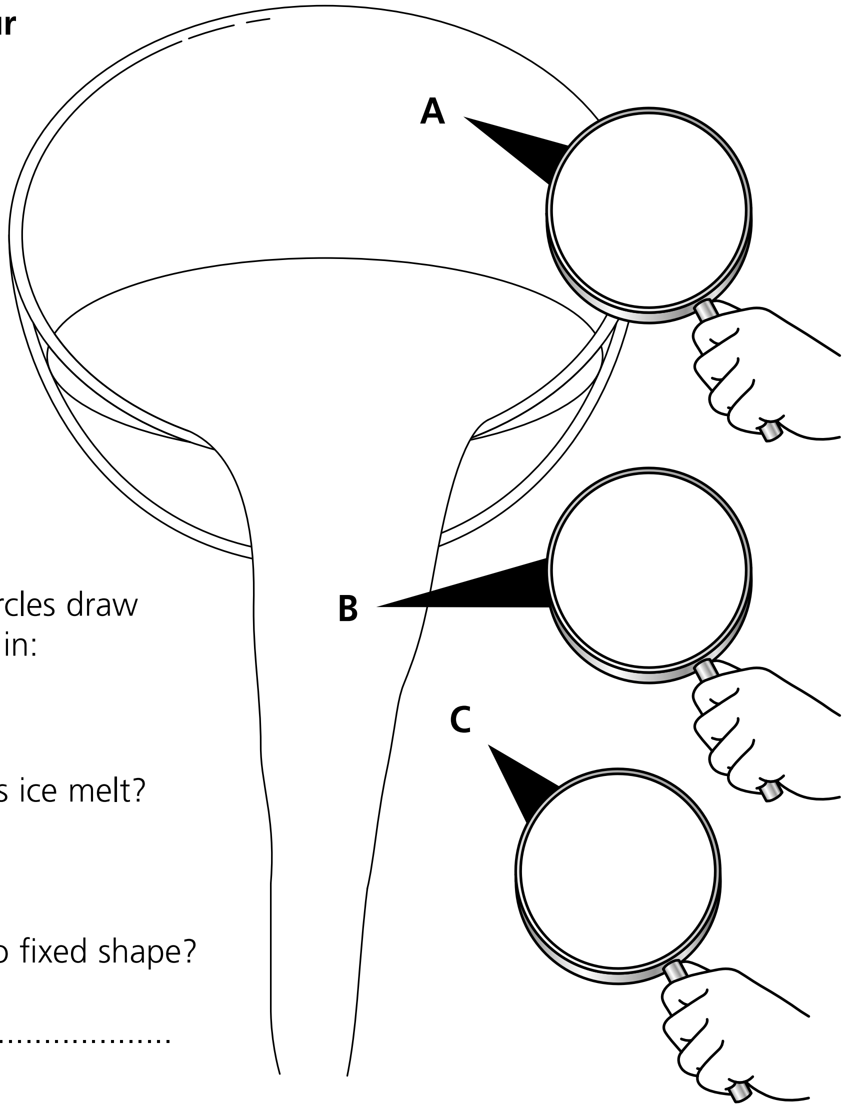
1

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

See **pages 4 and 5** of *Changing from solids to liquids to gases*

How substances change

All pure substances can occur as solids, liquids or gases.



Q1. In the magnifying glass circles draw how the particles are arranged in:

A ice, **B** water and **C** gas.

Q2. At what temperature does ice melt?

✎....................................

Q3. Which substances have no fixed shape?

✎..

✎..

Q4. Which substance has no fixed size or shape? ✎..

Q5. What is the process in which water loses some of its particles to the air?

✎..

Q6. (a) What must you do to a solid to turn it into a liquid? ✎..................................

(b) What must you do to a liquid to turn it into a gas? ✎..

(c) When does a gas turn into a liquid? ✎...

(d) When does a liquid turn into a solid? ✎...

1 Teacher's sheet: comprehension

See **pages 4 and 5** of *Changing from solids to liquids to gases*

Answers

1. **In A the particles are locked together in a pattern, in B the particles are close to each other but moving over each other, in C the particles are far apart and moving in all directions.**
2. **0°C.**
3. **Liquids and gases.**
4. **A gas.**
5. **Evaporation.**
6. **(a) Heat it; (b) heat it; (c) when it is cooled; (d) when it is cooled.**

Complementary work

(a) The children can use secondary sources to find out the amount of sea water, fresh water, ice and water vapour on the Earth.

Teaching notes

The purpose of this unit is to provide an opportunity to revise what the children have so far learned about solids, liquids and gases. You may wish to begin with solids and consider their properties, such as a fixed shape and volume. You may even wish to consider powders as small fragments of solids. If you do, make sure that the children are aware that the term 'particle' has two meanings. It can be used to describe tiny fragments of solid matter that can be seen with the eye, magnifying glass or microscope. It can also be used to describe the atoms or groups of atoms (called molecules) from which all matter is made. These particles cannot be seen by microscopes that use light, but can be revealed by powerful electron microscopes.

After mentioning solids, you may wish to compare them with liquids and gases. The children may need reminding that liquids do not have a fixed shape but do have a fixed volume. They may also need to remember that gases do not have a fixed shape or size.

As this is an introductory spread, the main focus is on the action of heat in bringing about the change from a solid to a liquid, and the change from a liquid to a gas. Later units cover all other changes in detail, but you may wish to mention the following terms now and show how they link together – evaporation, condensation, melting and freezing.

1

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

Based on **pages 4 and 5** of *Changing from solids to liquids to gases*

How does the water in an ice cube change?

Try this...

1. Put an ice cube in a dish. Draw it. Measure its height and write this on your drawing.

2. Place the ice cube in a warm place. Predict its height after five minutes.

✎..................................

3. After five minutes, draw the ice cube again and measure its height. Write the new height on your drawing.

4. Predict how long it may take for the entire ice cube to melt and make a note of the time.

✎..................................

5. Check the ice cube regularly until it has melted.

6. How long did the ice cube take to melt from the time you made your prediction in step 4?

✎..................................

7. What will happen to the water that has formed from the ice cube?

✎...

8. Set out a plan to test your prediction.

✎...

✎...

✎...

Teacher's sheet: activity

Based on **pages 4 and 5** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Show the children an ice cube and ask them what will happen to the water in it if the ice cube is left in a warm place? When the children answer confidently that it will melt, ask them how long it will take. Tell the children they can answer this question by performing the activity.

Using the sheet

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

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

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

(e) Go through tasks 7 and 8, then let the children try them (see note (iii)).

Completing the activity

(f) The children can compare the accuracy of their predictions. They can compare the suitability of their plans to check on evaporation (see note (iv)).

Conclusion

The ice cube may only take a few minutes to melt but this will depend on the temperature of its surroundings. The water may take several hours, or even more, to evaporate, depending on the surrounding temperature.

Teaching notes

(i) The predictions of the children may vary widely. They can use the information from task 3 to review how fast the ice cube is melting and use this in their next prediction.

(ii) If the children had predicted how long it would take an ice cube to melt during your introduction, they may change their minds now. Tell them that it is acceptable to change predictions in the light of new information.

(iii) While the idea of melting may have come quickly to the children, they may need more help in following this with evaporation. Make sure that they realise that this is a slower process than melting, and they will have to account for this in their planning. They should look at the water every hour or two. If the water is still present the following day, they can continue with infrequent inspections until evaporation is almost complete, when they may inspect more frequently.

If the water has evaporated overnight you may like the children to set up the same volume of water at the beginning of the day and see how much has evaporated by the end of the day.

(iv) Some children may check for evaporation too frequently and others too infrequently.

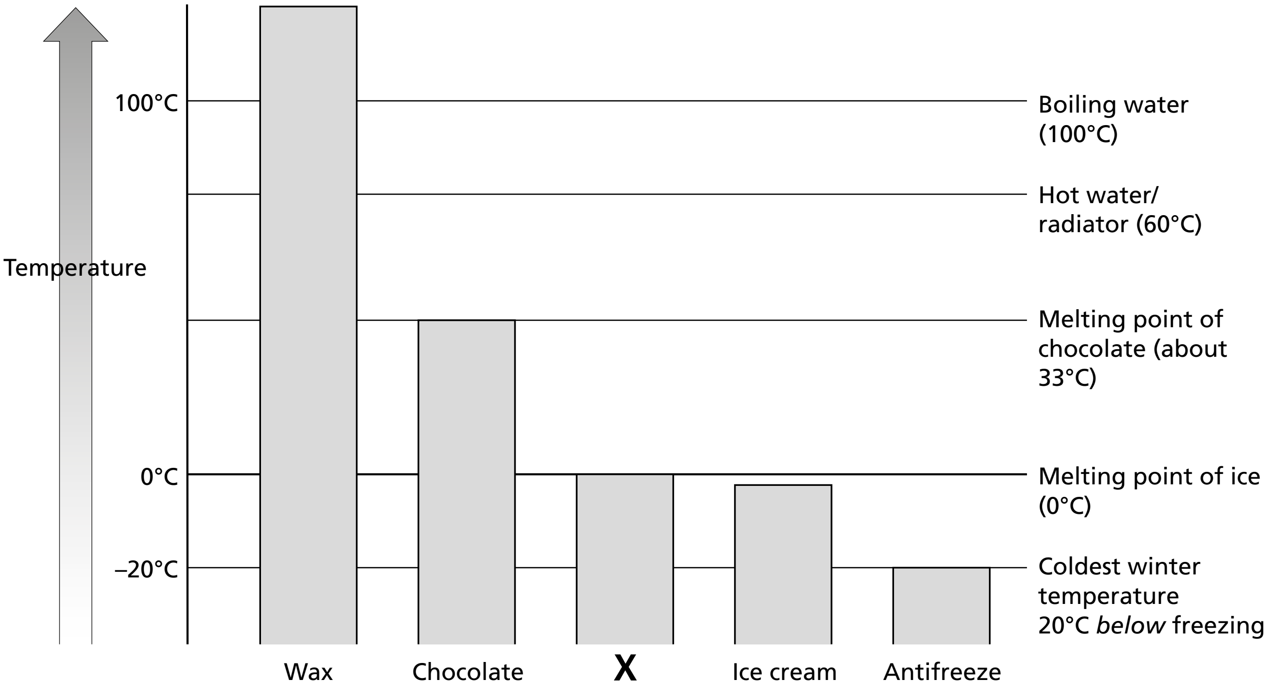
2

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

See **pages 6 and 7** of *Changing from solids to liquids to gases*

Melting

When a solid changes to a liquid, it melts. Every solid has its own melting point.



Q1. Which substances melt below the boiling point of water?

✎...

Q2. Which substances melt above the melting point of ice?

✎...

Q3. What do you think the substance X is? ✎...

Q4. The chocolate was put on a tray on a radiator. The temperature of the radiator was 65°C. What happened to the chocolate?

✎...

Q5. When washing up a pan containing solid fat, why is it helpful that the melting point of solid fat is less than hot water?

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 6 and 7** of *Changing from solids to liquids to gases*

Answers

1. **Chocolate, X, ice cream and antifreeze.**
2. **Wax and chocolate.**
3. **Water, because ice (frozen water) melts at 0°C.**
4. **It melted.**
5. **Solid fat sticks to the pan. Hot water melts the fat and it comes away from the pan.**

Complementary work

(a) The children can use secondary sources to find out about the melting point of substances such as rock and different metals.

(b) The children could perform a fair test to compare how butter and margarine melt. They can base their investigation on the plan given in the practical activity.

Teaching notes

Having established the three states of matter in the previous unit, this unit considers a form of change which might be most familiar to the children. In your introduction to the topic, you may encourage anecdotes about everyday examples of melting – such as the melting of chocolate in a pocket or the melting of an ice cream onto clothing.

Melting provides a good opportunity to introduce the idea that matter is made from tiny particles that cannot be seen. Scientists had the idea that matter was made from particles long before they were ever seen. The first theory about matter being made from particles was put forward by the Greek philosophers like Leucippus (the 'father of atomic theory') and Democritus in the 5th century BC. For example, Democritus observed that when you cut something into two, you could also cut the two halves. In fact, you could go on cutting up a piece of matter into very small pieces. He reasoned that you could probably go on cutting matter up into smaller pieces that the eye could not see, but eventually you would reach a piece of matter that was so small that it could not be divided. He called this particle an atom. Today we know that atoms form groups called molecules, and we use the word particle to describe them both.

You could use interlocking blocks, like Lego, to show how particles behave in a solid and a liquid. You could lock some blocks together to show how they form a solid structure with a fixed shape, then unlock the blocks and show how they flow in a liquid.

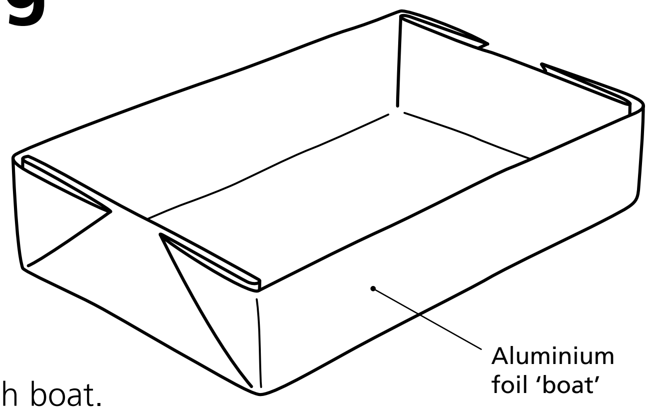
2

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

Based on **pages 6 and 7** of *Changing from solids to liquids to gases*

Looking at melting

Try this...



1. Fold a piece of aluminium foil to make a boat with sides about 1cm high as the diagram shows.

2. Make two more identical boats.

3. Put a 1cm cube of soft margarine in each boat.

4. Fill a bowl with water from the cold tap and take the temperature of the water in the bowl. ✎...............................

5. Float one of the boats on the water and watch the cube of margarine for two minutes. Write down what you saw.

✎...

✎...

6. Mix water from the cold and hot tap to make a bowl of water at 30°C.

7. Float a second boat on the water and watch the cube of margarine for two minutes. Write down what you saw.

✎...

✎...

8. Mix water from the cold and hot tap to make a bowl of water at 45°C.

9. Float the last boat on the water and watch the cube of margarine for two minutes. Write down what you saw.

✎...

✎...

Looking at the results.

10. What did the results show?

✎...

2

Teacher's sheet: activity

Based on **pages 6 and 7** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Show the children some soft margarine. Ask them if it is solid or liquid. Now ask them what their observation tells them about its melting point (see note (i)). Ask the children how they could test the melting point of the margarine using water at different temperatures (see note (ii)).

Using the sheet

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

(c) Let the children carry out tasks 1 and 2.

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

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

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

Completing the activity

(g) Let the children complete task 10 and compare their answers.

Conclusion

The soft margarine remained solid at the temperature of cool tap water. Some of the margarine melted slowly at 30°C and all of it melted quickly at 45°C.

Teaching notes

(i) The soft margarine is a solid. Its melting point must be higher than the temperature in the room.

(ii) To increase the children's confidence and motivation, you could guide their suggestions towards the activity before issuing the sheet.

(iii) You could demonstrate how to make a boat, or have some ready for the children to use. Each boat should be made from a 6cm square of aluminium foil. Turn up the edges so that the sides are about 1cm high. Make sure, as you fold over the foil, that there are not any holes which could cause a leak.

(iv) The children should take care not to make this a messy activity.

(v) This activity gives the children an opportunity to mix water at different temperatures. You may like them to practise this before the activity. One way is to pour half a cup of cool water in the bowl, then add hot water a little at a time until the required temperature is reached.

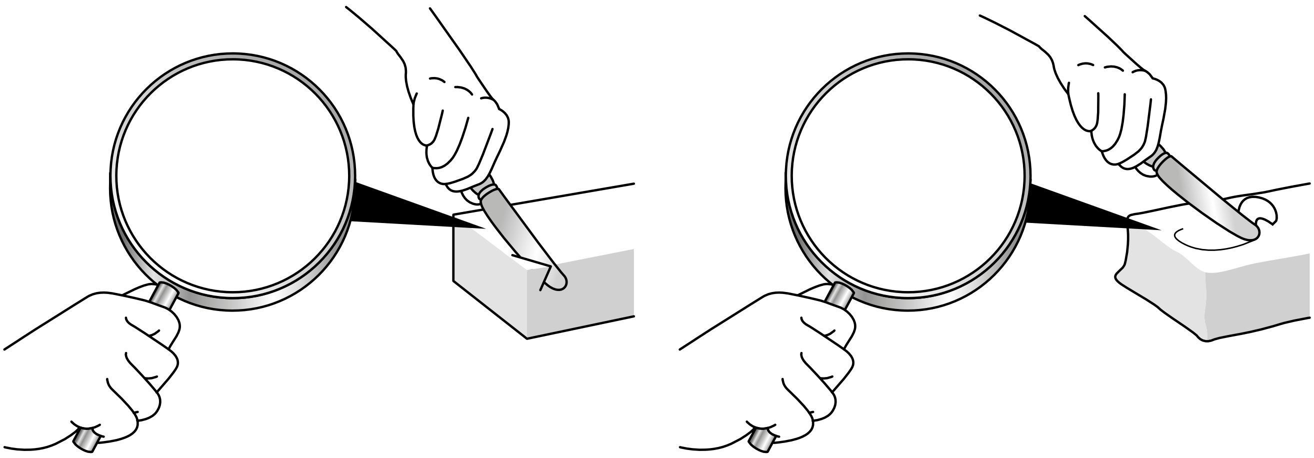
3

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

See **pages 8 and 9** of *Changing from solids to liquids to gases*

Why solids soften

When some solids get hot they gradually get softer as some substances in them melt but others do not.



Q1. The butter on the left is solid. In the magnifying glass circle draw how the particles are arranged.

Q2. The butter on the right is soft. In the magnifying glass circle draw how the particles are arranged.

✎.. ✎..

Q3. Name three materials which are made from mixtures.

✎.. ✎.................................... ✎....................................

Q4. Name a substance which changes suddenly from a solid to a liquid.

✎..

Q5. What colour is steel when it (a) begins to soften, (b) is almost molten?

(a) ✎.. (b) ✎..

Q6. Why do some substances melt gradually?

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 8 and 9** of *Changing from solids to liquids to gases*

Answers

1. **All the particles are linked together.**
2. **Some of the particles are linked together.**
3. **Chocolate, butter, glass, steel.**
4. **A pure substance such as water.**
5. **(a) red, (b) yellow.**
6. **They are made of mixtures. Some of the substances in the mixture melt before others.**

Complementary work

(a) The children may use secondary sources to find out about the uses of sheet steel.

(b) The children may use secondary sources to find out about solder and its uses. The use of the soldering iron may be demonstrated by someone who uses it for their work or in a hobby. Make sure the demonstration is in accordance with the school safety policy.

(c) The children could use secondary sources to find out about the work of a blacksmith. A visit could be arranged to watch a blacksmith at work.

Teaching notes

This unit allows you to look at the melting process in more detail. When an ice cube is warmed, water forms around its sides and flows away. The ice still in the cube remains hard, it does not become soft. However, if we look at butter or margarine, they become soft before they melt. This is due to some substances in the butter or margarine mixture melting before the others. As these substances melt, they give the mixture less support and it becomes softer.

On reflection it is easy to see that most materials soften before they melt. It can be useful to think about what would happen if they did not soften, but melted like ice. The bar of steel shown in the pupil's book would simply form a liquid round the edges and its unmelted part would still be hard. This would make it impossible to roll the iron into a sheet, just as it is impossible to roll out an ice cube into a sheet.

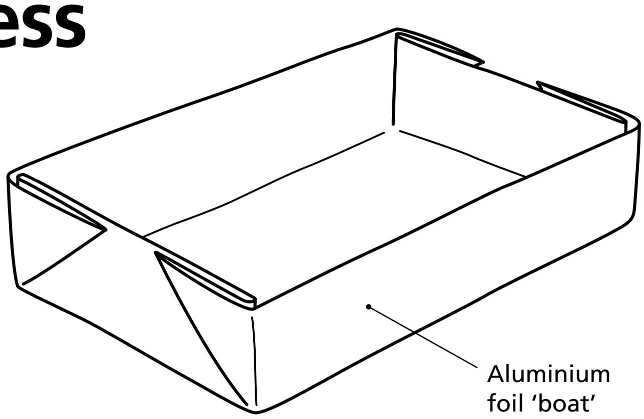
3

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

Based on **pages 8 and 9** of *Changing from solids to liquids to gases*

Testing for hardness

Try this...



1. Fold a piece of aluminium foil to make a boat with sides about 1cm high, as the diagram shows.

2. Make two more identical boats.

3. Put a 1cm x 1cm x 2cm block of soft margarine in each boat. Use a plastic butter knife to make the surface of the block smooth and flat.

4. Put one boat in the fridge.

5. Fill one bowl with cold tap water, and fill another bowl with hot tap water.

6. Float a second boat in the bowl of cold tap water, and the last boat in the bowl of hot tap water. Leave them for two minutes.

7. Take the first boat out of the fridge.

8. Hold a chopstick vertically above the margarine in the first boat from the fridge. Hold the lower end of the chopstick about 2cm above the margarine, then let it drop onto the margarine surface. Note how the end of the chopstick affected the surface.

✎..

9. Take the boat out of the bowl of cold tap water and repeat step 8 on the margarine.

✎..

10. Take the boat out of the bowl of hot tap water and repeat step 8 on the margarine.

✎..

Looking at the results.

11. What do the results show?

✎..

✎..

Teacher's sheet: activity

Based on **pages 8 and 9** of *Changing from solids to liquids to gases*

Introducing the activity

(a) You may wish to begin by asking the children how they tested a material for hardness (see note (i)). Tell the children that in this activity they are going to test the hardness of margarine with a chopstick.

Using the sheet

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

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

(d) Go through task 3 with the children, then let the children try it (see note (iii)).

(e) Go through tasks 4 to 7, then let the children try them (see note (iv)).

(f) Go through tasks 8 to 10, then let the children try them.

Completing the activity

(g) Let the children try task 11 and compare their results.

Conclusion

The chopstick only makes a slight dent in the surface of the cold margarine. It makes a deeper dent in the margarine which has been floating in the cold tap water and may go right through the margarine which has been floating in the hot tap water.

Teaching notes

(i) In *3C Properties of materials* the test for hardness features scratching the surface of a material.

(ii) You could demonstrate how to make a boat, or have some ready for the children to use. Each boat should be made from a 6cm square of aluminium foil. Turn up the edges so that the sides are about 1cm high. Make sure, as you fold over the foil, that there are not any holes which could cause a leak.

(iii) The children should take care not to make this a messy activity.

(iv) The children may need to be reminded of the steps from time to time as they are doing them, as considerable organisation is needed here.

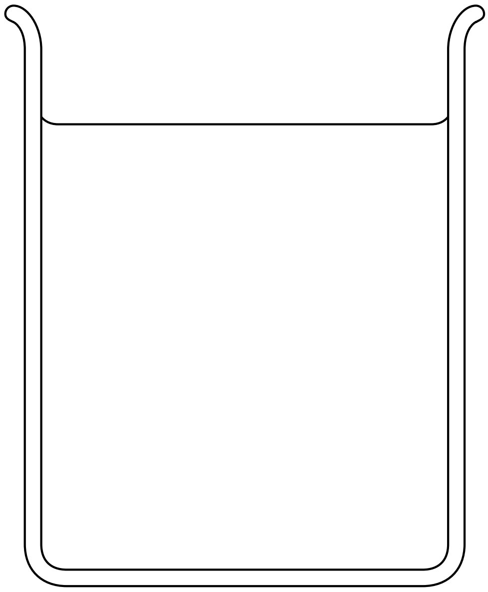
4

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

See **pages 10 and 11** of *Changing from solids to liquids to gases*

Freezing

You can change the freezing point of pure substances by adding other substances to them.



Q1. The diagram shows a beaker of water. Draw in how you would place a thermometer to take its temperature.

Q2. What is the freezing point of (a) pure water, (b) salty water?

(a) ✎...................................

(b) ✎..................................

Q3. Where is salt spread in winter to help travellers?

✎...

Q4. What is added to the water in cars in winter? ✎...

Q5. What are the ingredients of vanilla ice cream?

✎...

Q6. How can you cool down the ingredients to make ice cream?

✎...

✎...

✎...

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 10 and 11** of *Changing from solids to liquids to gases*

Answers

1. **The thermometer may be drawn as in the diagram in the pupil book – bulb at lower left and thermometer slanted towards the right. It may also be drawn vertically, with the bulb in the centre of the water or lower.**
2. **(a) 0°C; (b) –5°C.**
3. **On the roads.**
4. **Antifreeze.**
5. **Whipping cream, sugar, vanilla essence.**
6. **Put the ingredients in a sealed can. Crush about six cups of ice and mix with half a cup of salt. Pack the ice and salt round the sealed can. Roll or shake the ingredients with the ice and salt.**

Complementary work

(a) The children could use secondary sources to find out how ice cream is made at a factory. (Alternatively, you could arrange a trip to a factory to see ice cream being made.)

(b) The children can use secondary sources to find out how ice is made at an ice rink.

Teaching notes

The children may wonder how the salt crystals and ice cube become mixed to make salty water. On the surface of the ice cube is a very thin layer of water. Salt from the crystals dissolves in this to make the salt solution.

The children may say that salt put on the road looks dirty compared to table salt. The reason for this is that the salt on the road comes from the unrefined mineral, rock salt, which contains sand and other impurities. While the salt melts the ice, the sand provides a rough surface on the road which helps the tyres grip.

This unit could also be used with *4C Keeping warm and cool*.

4

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

Based on **pages 10 and 11** of *Changing from solids to liquids to gases*

Salt versus ice

Try this...

1. Put an ice cube in a dish.

2. Put a second ice cube in a second dish and pour salt over the top of it. Make sure that the top surface of this ice cube is coated in salt.

3. Watch the ice cubes for five minutes, then write down what you saw.

✎...

✎...

4. After half an hour make a drawing of each ice cube.

5. Predict what may happen to the ice cubes in the next half an hour. Write your prediction here.

✎...

6. Leave the ice cubes for another half an hour, then write down what you see.

✎...

✎...

Looking at the results.

7. How did the salt affect the ice cube?

✎...

4 Teacher's sheet: activity

Based on **pages 10 and 11** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Before you do this activity, read about the effect of salt on ice on pages 10 and 11 of the pupil book. Tell the children that they are going to test the 'melting power' of salt on an ice cube.

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 (i)).

(c) Let the children perform tasks 1 to 3 (see note (ii)).

(d) Go through task 4, then let the children try it.

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

Completing the activity

(f) Let the children try task 7 and compare their results.

Conclusion

The salt begins to work on the ice almost immediately. The inside of the ice cube may become clear as it starts to melt. The salty surface may show signs of moisture, and the salty water may run down the sides of the ice cube.

While the ice cube without salt melts slowly and maintains a flat top, salt soon sinks into the top of the salty ice cube. The salty ice cube melts more quickly than the ice cube without salt.

Teaching notes

(i) A thick coat of salt can be built up on top of the ice cube.

(ii) The children may notice changes in the salty ice cube after a minute. Its inside may turn from cloudy to clear as the melting begins. They may see moisture on the top of the salty ice cube. The other cube will probably not change in this first period of observation.

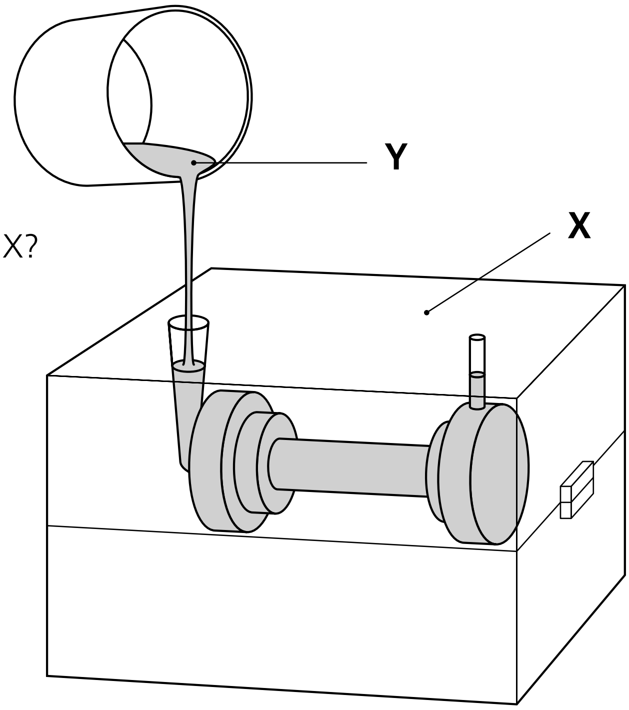
5

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

See **pages 12 and 13** of *Changing from solids to liquids to gases*

Solidifying

When a liquid cools it turns into a solid. We call this solidifying.



Q1. In the diagram, what is the part labelled X?

✎...

Q2. In the diagram, what is Y?

✎...

Q3. What will happen to Y when it is poured inside X?

✎...

✎...

Q4. When water solidifies what word do we use? ✎...

Q5. State three things that a liquid does when it cools and becomes a solid.

1 ✎...

2 ✎...

3 ✎...

Q6. How are glass bottles made?

✎...

✎...

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 12 and 13** of *Changing from solids to liquids to gases*

Answers

1. **The mould.**
2. **Molten metal.**
3. **It will cool down and take the shape of X.**
4. **Freezing.**
5. **It loses heat. It takes up less and less space. The particles start to pack together in a regular way.**
6. **A lump of molten glass is placed in a mould. Air is blown into the glass and makes the glass spread out and cover the inside of the mould.**

Complementary work

(a) The children can use secondary sources to find out about the casting of metal in the Bronze Age.

Teaching notes

As melting and solidifying are two processes in the manufacture of many products, you may like to show the children videos about the manufacture of items made of metal, glass or plastic. Alternatively, you may wish to take the children to a factory to see products being made. If either strategy is used, you could ask the children to look for examples of melting and solidifying in the making of the product.

Although glass appears to be a solid, it is really a supercooled liquid. It flows so extremely slowly that almost all glass items are broken before they show any signs of flow. Some very old windows are thicker at the bottom than the top due to flow. Ancient glassware has been found in which bottles have become flat due to the slow flow of the glass over a few thousand years.

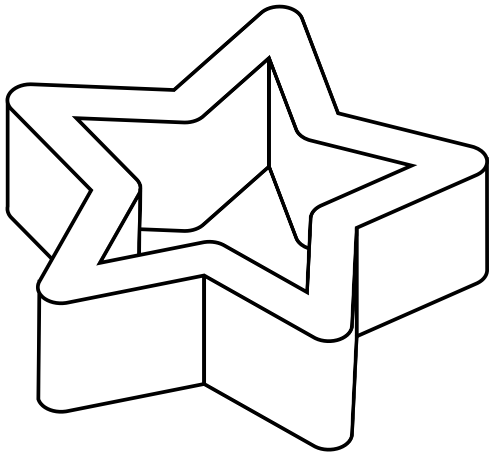
5

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

Based on **pages 12 and 13** of *Changing from solids to liquids to gases*

Make a solid star

Try this...



1. Take a lump of Plasticine and make it into a hollow star shape as the diagram shows. The star should be about 5cm across.

2. Put a pat of margarine in a teaspoon.

3. Set up a nightlight candle on a sand tray.

4. Put on the oven gloves, then hold the teaspoon a few centimetres above the candle flame until all the margarine melts.

5. Pour the molten margarine into the star mould.

6. Leave the margarine star to solidify.

7. If you repeated steps 1 to 6 with candle wax, would the star solidify more quickly or more slowly? ✎..

Explain your answer.

✎..

✎..

✎..

✎..

8. Repeat steps 1 to 6 with candle wax instead of margarine.

Looking at the results.

9. How does your prediction in step 7 compare with your result from step 8?

✎..

✎..

5

Teacher's sheet: activity

Based on **pages 12 and 13** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Introduce this activity after the children have read about solidifying on pages 12 and 13 of the pupil book. Tell them that they are going to make a mould out of Plasticine and cast butter and candle wax to make stars.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through task 1 (see note (i)).

(c) Go through tasks 2 to 6, then let the children try them (see note (ii)).

(d) Go through task 7, then let the children try it (see note (iii)).

(e) Refer the children to task 8. Make sure that they realise they have to make another mould and follow all the safety procedures in the previous steps.

(f) Let the children try task 8 (see note (iv)).

Completing the activity

(g) Let the children remove the moulds from around the wax and the butter. They should check that the butter has set before removing the Plasticine (see note (v)).

(h) Let the children try task 9 and compare their answers and stars (see note (vi)).

Conclusion

The margarine melted quickly but took a long time to solidify in the mould. The wax melted quickly and solidified quickly in the mould. The wax star had a shape with sharper edges than the margarine star.

Teaching notes

(i) The lump of Plasticine should be rolled into a strip, flattened, then folded up as the diagram shows. The children should make sure that there are not any holes in the mould through which molten material can leak.

(ii) Make sure that the children do not put too much margarine on their spoons otherwise, when it melts, it will spill onto the candle and may cause a crackling sound. Try to use teaspoons which are pointed at one end. This will allow the molten margarine to be poured more easily. You must light the candle and supervise the heating of the margarine closely.

(iii) Ask the children to think about their observations on margarine if they have done the previous two activities. Ask them to think about how wax melts, runs down the side of a candle then sets again.

(iv) Maintain the same standard of vigilance as in steps 1 to 6.

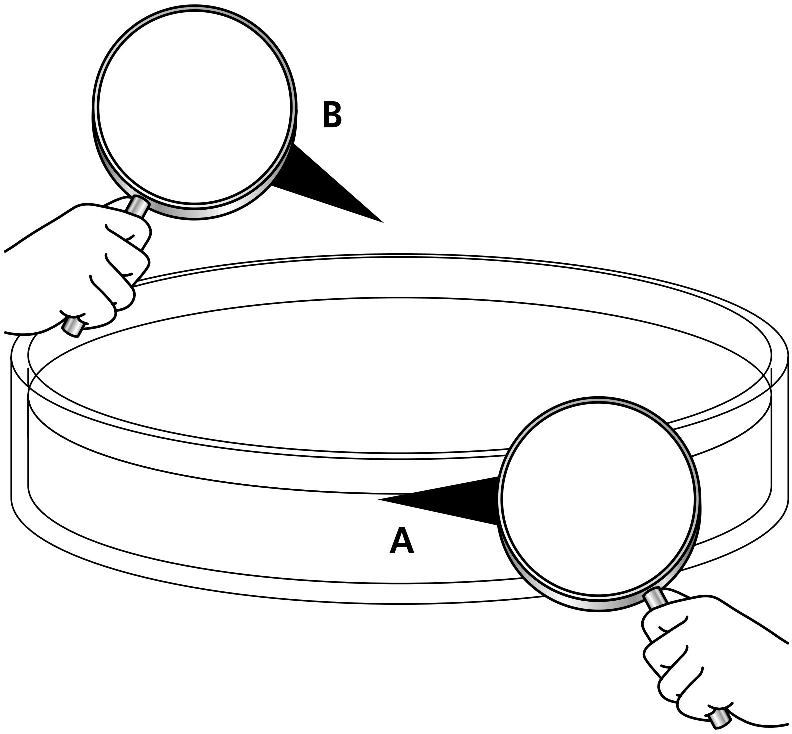
(v) If the margarine is slow to set, arrange to have it put in a fridge for a while.

(vi) When the children compare their results and predictions, they should say whether the prediction matched or did not match the result. They should not use simple phrases like, "It was O.K.".

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

See **pages 14 and 15** of *Changing from solids to liquids to gases*

Evaporation



When a liquid changes into a gas, it evaporates.

Q1. (a) In the magnifying glass circle A, draw how six particles are arranged in the liquid.

(b) In the magnifying glass circle B, draw another six particles of the liquid which have escaped into the air.

Q2. What is needed to change a liquid into a gas or vapour?

✎...

Q3. Why do streets stay damp for weeks in winter?

✎...

✎...

Q4. Why does evaporation occur in an airing cupboard?

✎...

Q5. (a) Name two liquids that evaporate faster than water.

✎... ✎...

(b) Name one liquid that evaporates more slowly than water.

✎...

Q6. What happens to a thermometer whose bulb is wrapped in a damp cloth? Explain your answer.

✎...

✎...

✎...

6 Teacher's sheet: comprehension

See **pages 14 and 15** of *Changing from solids to liquids to gases*

Answers

1. **(a) The six particles should be touching each other but not arranged in a regular pattern. (b) The particles should be separate.**
2. **Heat.**
3. **There is not enough heat in the air and sunshine is too weak for the water to evaporate.**
4. **Heat in the air makes evaporation occur.**
5. **(a) Methylated spirit, surgical spirit; (b) Lubricating oil.**
6. **It cools down. The water in the cloth takes heat from the thermometer so that evaporation can take place.**

Complementary work

(a) You could demonstrate the experiment shown on page 15. Make sure that you follow the school policy on the use of flammable liquids.

(b) The children could plan a fair test to see if a wet cloth does lower the temperature of a thermometer. In their plan they should have a second thermometer wrapped with a dry cloth.

You may wish to let them try their plan.

Teaching notes

The children may think that, as evaporation takes place at room temperature, it does not need any additional heat. You can remind the children of something they may have studied earlier in the study of materials – the evaporation of water from their skin. The children should wet the back of one hand then blow across the back of each hand in turn. They should feel that the hand covered in water is cooler, due to the greater amount of evaporation taking place there.

Humans can control the release of water onto the skin but many animals, such as frogs and slugs, cannot. They must stay in damp surroundings where the rate of evaporation is low.

The key factors which speed up evaporation are high temperature, wind speed and dry air. The key factors which slow down evaporation are low temperature, still air and moist air.

6

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

Based on **pages 14 and 15** of *Changing from solids to liquids to gases*

Investigating evaporation

Try this…

1. Pour cold water into a dish until it just covers the bottom.

2. Pour cold cooking oil into a dish until it just covers the bottom.

3. Put the dishes side by side in a warm place.

4. Write down how often you will examine them. ✎..

5. Examine the dishes regularly.

6. What is the purpose of putting the dishes in a warm place?

✎..

✎..

7. Predict what you think will happen.

✎..

8. Explain your prediction.

✎..

✎..

✎..

9. Write down what you observe over a period of time.

✎..

✎..

Looking at the results.

10. How accurate was your prediction?

✎..

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Introduce this activity after the children have studied pages 14 and 15 in the pupil book. Remind them of the section on evaporation rates.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through tasks 1 to 4 with them.

(c) Let the children carry out tasks 1 to 5 (see note (i)).

(d) Let the children carry out task 6 (see note (ii)).

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

(f) When appropriate let the children carry out task 9 (see note (iv)).

Completing the activity

(g) Let the children try task 10 and compare their results.

Conclusion

The water evaporates faster than the cooking oil. It does this because its particles are not held as strongly together as the particles in the cooking oil, so they can leave the liquid surface more easily.

Teaching notes

(i) In steps 1 and 2 you may wish the children to pour in a measured amount of each liquid to make the test as fair as possible. You could challenge the children to see if they could suggest ways of making the test fairer.

If the children have read the section on evaporating rates carefully they should have seen that, in the illustrated experiment, water takes six hours to evaporate. They should have also read that lubricating oil evaporates more slowly. From this they may expect the experiment to take at least a day and may decide to examine the dishes every hour, then more frequently when the water shows signs of drying up.

(ii) Some children may need help, especially if you are looking for explanations in terms of particles.

(iii) In the children's explanations, look for the statement that the particles in oil are being held more strongly together than the particles in the water.

(iv) The water may evaporate in a day or two. The cooking oil may still be present several days later.

7

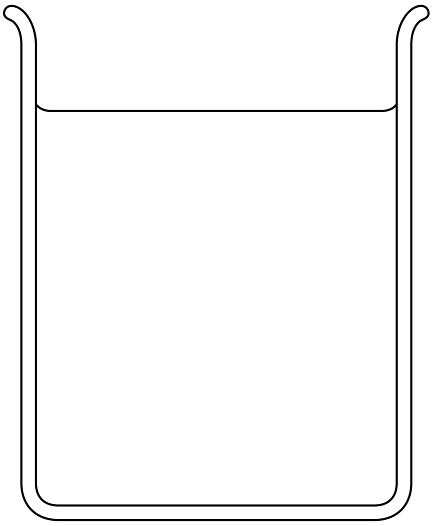
Name: .... Form: ....

See **pages 16 and 17** of *Changing from solids to liquids to gases*

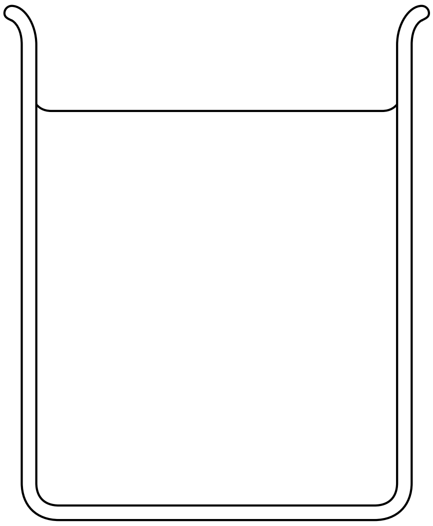
Boiling

When a liquid begins to bubble inside, the liquid is boiling.

A



B



Q1. The water in beaker A is boiling vigorously. Draw in some bubbles rising from the bottom of the beaker.

Q2. The water in beaker B is boiling gently. Draw in some bubbles rising from the bottom of the beaker.

Q3. What is inside the bubbles of water? ✎..

Q4. When is a liquid as hot as it can be?

✎...

Q5. Where do bubbles start in a pan of hot water?

✎...

Q6. Water is boiled in an aluminium pan and in a glass pan. Which pan will have larger bubbles? Explain your answer.

✎...

✎...

✎...

✎...

7 Teacher's sheet: comprehension

See **pages 16 and 17** of *Changing from solids to liquids to gases*

Answers

1. **The bubbles are small at the bottom but get much larger towards the top. Some can be shown bursting, with splashing at the surface.**
2. **The bubbles are small at the bottom and get gradually larger as they reach the top. These bubbles are much smaller than the bubbles in beaker A and the surface does not show splashing.**
3. **Steam.**
4. **When it is boiling.**
5. **At places where the surface is rough.**
6. **The glass pan. It has a smoother surface so there are fewer places for bubbles to start. This tends to make the bubbles larger.**

Complementary work

(a) The children use secondary sources to find out the boiling points of different liquids, including liquid metals.

(b) A model geyser can be made by turning a large funnel upside down and placing it in a bucket of water. Place one end of a plastic tube under the funnel and blow down the other end. Prepare for wet children!

Teaching notes

It is unfortunate that the cloud of water droplets produced over a container of boiling water is commonly known as steam. The real steam is invisible. In Picture 2, on page 16, the real steam is in the space between the end of the kettle spout and the beginning of the cloud. As the steam rushes out of the spout it is cooled by the air and condenses to form the cloud.

It may be worth emphasising that if you apply more heat to boiling water it will not get any hotter. It has reached the temperature at which its particles fly apart and will not get any hotter. Adding more heat simply speeds up the boiling process.

Some children may be aware of pressure cookers. The temperature at which a liquid boils depends on the pressure of the air around it. In a pressure cooker, the pressure of the air above the boiling water increases as boiling proceeds. This makes it harder for the particles to leave the liquid, and increases the temperature at which the water boils. This speeds the cooking process.

Some children may have read that water boils at a lower temperature high up on a mountain. As you ascend a mountain the pressure of the air falls. When water is heated at a lower air pressure it boils at a temperature below 100°C. High up on a mountain, boiling water will be cool enough to drink.

7

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

Based on **pages 16 and 17** of *Changing from solids to liquids to gases*

Investigating boiling

Try this…

1. Your teacher will set up a container of water and boil it for you.

2. The temperature of the water will be taken before it is heated. It will then be taken every minute after that until the investigation is complete.

3. Your teacher will tell you the temperature of the water at every stage of the investigation. Write it down in this table.

Time (mins)	Temperature of water (°C)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

4. Make a graph or chart of your results.

Looking at the results.

5. When did the water start to boil? ✎..

6. How long did it boil for? ✎..

Teacher's sheet: activity

Based on **pages 16 and 17** of *Changing from solids to liquids to gases*

Introducing the activity

(a) If you have done the previous activity you may like to start by reminding the children of it and how the water vapour gently leaves the water surface in evaporation. Now tell them that in boiling, the water gets much hotter and that you must do the practical work for safety reasons. However, you should involve the children in the activity by calling out the readings and letting them record the data in a table for you.

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 (i)).

(c) Perform tasks 1 to 3 while the children perform task 3.

(d) Go through task 4 with the children (see note (ii)).

(e) Let the children try task 4.

Completing the activity

(f) Let the children try tasks 5 and 6.

Conclusion

The temperature of the water climbs steadily as it is heated, then remains constant at 100°C – the boiling point of water.

Teaching notes

(i) You must use a heater which is in accordance with your school's safety policies. You may use a thermometer for this activity and repeat the experiment with a data logger for comparison.

(ii) The type of graph the children produce will depend on their ability, but they all should be encouraged to make a line graph if possible.

8

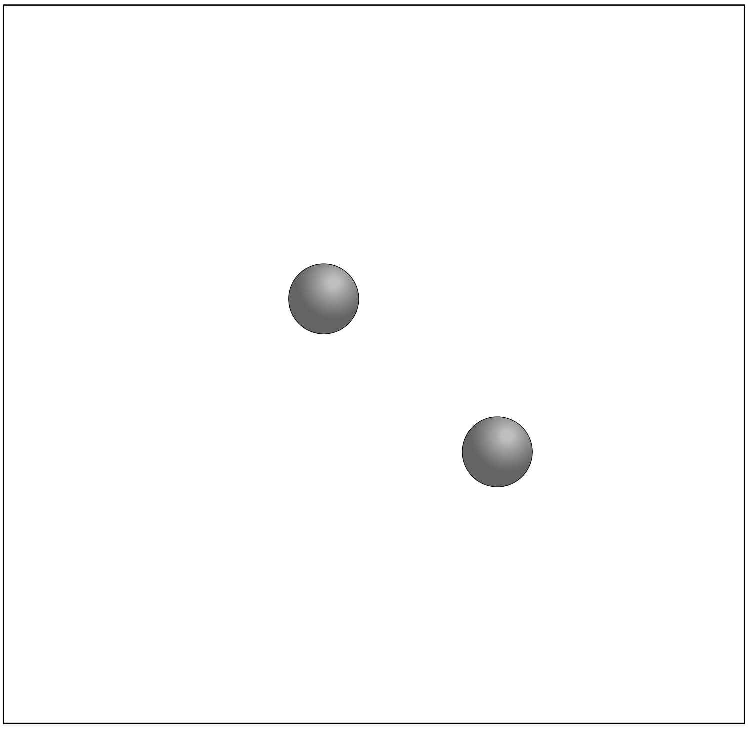
Name: .... Form: ....

See **pages 18 and 19** of *Changing from solids to liquids to gases*

Condensation

When a gas cools, it turns back into a liquid. This is called condensation.

Q1. The diagram shows two dust particles in the air. Add water particles to the picture to show how water droplets form.



Q2. What are two names for the invisible water in the air?

✎..

✎..

Q3. What happens to the heat in a gas when it blows against a cold surface?

✎..

Q4. Why does condensation occur when warm air cools?

✎..

✎..

Q5. Name two places in the home where condensation may occur.

1 ✎...

2 ✎...

Q6. What is a cloud made from?

✎..

✎..

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 18 and 19** of *Changing from solids to liquids to gases*

Answers

1. **There may be a few particles moving free in the air. One dust particle may have a few water particles around it. The other dust particle may have more water particles around it.**
2. **Moisture, water vapour.**
3. **It is given up to the cold surface.**
4. **The cold air cannot hold as much water vapour, or moisture, as warm air.**
5. **On a cold drink taken from a fridge; On a single-glazed window overnight.**
6. **It contains countless particles of salt and dust on which particles of water have settled. The water particles and dust form water droplets.**

Complementary work

(a) The children can breathe on a cold can from the fridge, and a can at room temperature, to compare condensation.

(b) Pour about 1cm of water into a jar. Seal the jar and put it on a sunny window sill. The children can look for signs of condensation inside the jar.

Teaching notes

The air has a capacity to hold water vapour. This capacity depends on the temperature of the air. If the air is warm, it has a greater capacity to hold water vapour, and the warm air may become damp and clammy, as in a bathroom in which there is a hot bath. Air which is holding a great deal of water vapour is described as humid. The air in tropical rainforests is usually humid due to the heat and the release of water from the plants.

When humid air meets cooler air it loses heat and can no longer hold the same amount of water as vapour. The water which cannot be held as vapour condenses and forms a cloud of water droplets. If humid air strikes a cold surface it also loses heat and some water vapour condenses.

The children may wonder where the water comes from that causes condensation when we breathe out in cold air. The water comes from the lining of the air passages in our lungs.

8

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

Based on **pages 18 and 19** of *Changing from solids to liquids to gases*

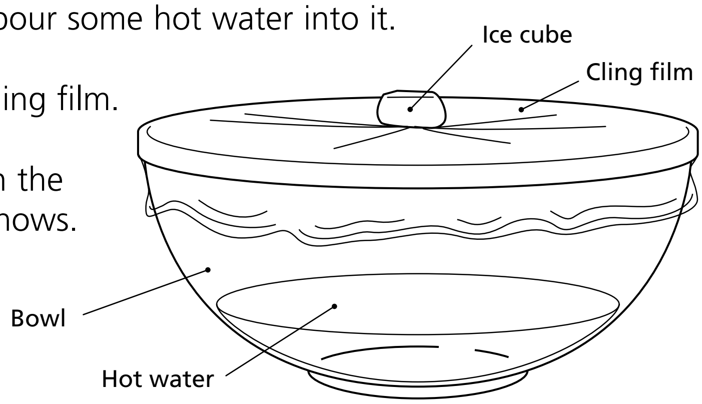
Investigating condensation

Try this…

1. Set up a container on your desk and pour some hot water into it.

2. Cover the top of the container with cling film.

3. Ask your teacher to put an ice cube in the middle of the cling film as the diagram shows.



4. Watch the cling film for a few minutes and write down what you see.

✎..

✎..

5. Look at the cling film again every ten minutes during the next half an hour and write down what you see.

✎..

✎..

✎..

✎..

✎..

✎..

Looking at the results.

6. Explain what you have seen.

✎..

✎..

8 Teacher's sheet: activity

Based on **pages 18 and 19** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Let the children study pages 18 and 19 of the pupil book before they try this activity. Ask the children how they could trap water vapour rising from a bowl of hot liquid water. Steer them into thinking about cling film, then ask them how they could get water to condense on the cling film. When someone suggests placing a cold object on the cling film, begin the activity.

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 (i)).

(c) Let the children try task 4.

(d) Go through task 5, then let the children try it.

(e) Let the children try task 6.

Completing the activity

(f) Ask the children to compare their observations and explanations.

Conclusion

When the cling film is first put over the top of the container, a mist may form in the air above the water and the underside of the cling film may become slightly wet from the condensation of tiny water droplets. When the ice cube is placed on the cling film, it cools the area on which it is resting. Water vapour in the container condenses on the cling film. It forms the largest drops in the coolest places, around the edges of the melting ice cube. The ice takes heat from the hot water vapour to provide energy for the melting process. As you move further away from the ice cube, the bubbles of water vapour become smaller because the cling film is warmer. In time, water gathers on top of the cling film from the melted ice.

Teaching notes

(i) Depending on the ability and attitude of the children you may wish to pour the hot water into the containers for them and help them to put the cling film in place.

9

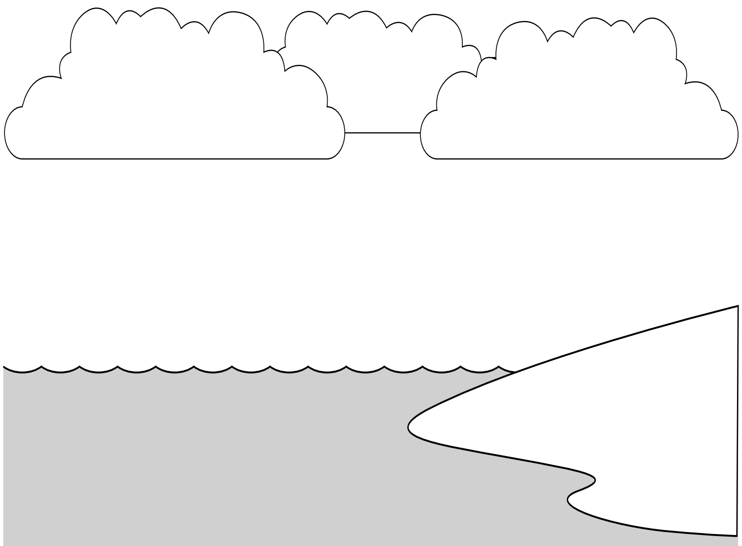
Name: .... Form: ....

See **pages 20 and 21** of *Changing from solids to liquids to gases*

The water cycle: solid, liquid and gas

Moisture is all around us as invisible vapour. But when air gets cold, the vapour changes to water, or ice, in clouds and on the ground.

Q1. On the diagram write an E where large amounts of water evaporate. Write a C where large amounts of water vapour condenses.



Q2. Liquid water is found in the air in two forms. What are they?

✎..

✎..

✎..

Q3. What are made from solid water in the air?

✎..

Q4. Where does the heat come from to make the water cycle? ✎............................

Q5. How does dew form? ✎...

✎..

✎..

Q6. How may the water in a raindrop that falls on land get back to the sea?

✎..

✎..

✎..

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 20 and 21** of *Changing from solids to liquids to gases*

Answers

1. **The E should be written on the sea. The C should be written on the clouds.**
2. **Water droplets in clouds, raindrops.**
3. **Ice crystals in snowflakes.**
4. **The Sun.**
5. **At night, air close to the ground cools and its water vapour changes to liquid. This settles on the ground as dew.**
6. **It may flow through the soil and rock, then enter a river. It may evaporate from the ground surface, condense and form a cloud, then rain on the ground again then flow to the sea. It may enter the soil, pass through a plant, condense and form part of a cloud then rain on the ground again and flow to the sea. (Reward imagination.)**

Complementary work

(a) The children could set up a rain gauge where it will not be disturbed and record the rainfall for a week.

(b) The children could look at local maps of the area to find the nearest rivers, then use other maps to trace the paths of water in them until they reach the sea.

(c) The children may use secondary sources to find out how cumulus clouds and cirrus clouds are formed.

Teaching notes

Although most water enters the air from the evaporation of sea water, some enters the air from the burning of fuels such as wood, by exhaled breath of humans and animals and from the leaves of plants. Water may also evaporate from wet surfaces after rain.

Some children may want to know how water collects in streams and rivers. They should know that when it rains, the water passes down into the soil until it meets a rock through which it cannot pass. The water then moves along under the ground until it can reach the surface again. This is a spring. The water flowing from a spring enters streams and rivers. It does not sink through them and back into the ground because their beds are made of rocks which will not let the water through.

You could use the water cycle to remind the children of some of the properties of rocks and soils.

9

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

Based on **pages 20 and 21** of *Changing from solids to liquids to gases*

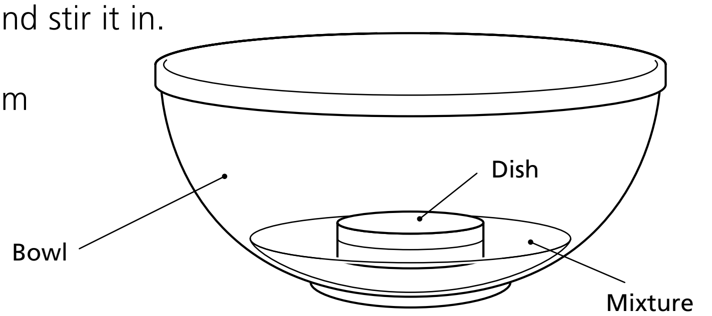
How water gets from the sea to a lake

Try this…

1. Mix up some salt and warm water in a beaker.

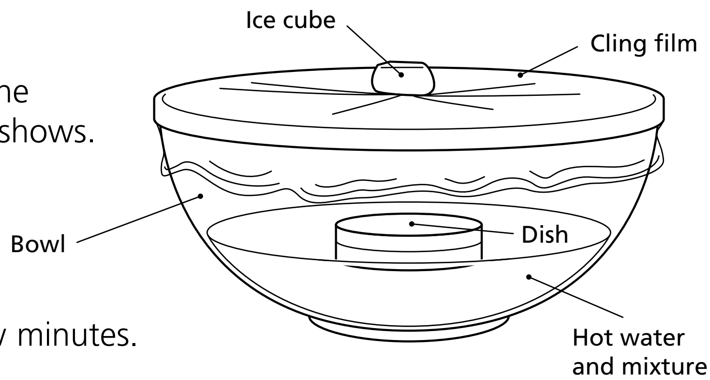
2. Add a few drops of food colouring and stir it in.

3. Set up a bowl and dish as the diagram shows and pour in your water mixture.



4. Let your teacher pour in hot water and put cling film over the bowl.

5. Let your teacher put an ice cube in the middle of the container as the diagram shows.



6. Predict what may happen after a few minutes.

✎...

7. Describe what happens after a few minutes.

✎...

8. Predict what may happen after a few hours.

✎...

9. Describe what happens after a few hours.

✎...

10. Which part of the model is the (a) sea; (b) lake; (c) cloud?

(a) ✎...

(b) ✎.. (c) ✎..

9 Teacher's sheet: activity

Based on **pages 20 and 21** of *Changing from solids to liquids to gases*

Introducing the activity

(a) Use this activity after you have done the previous one and have studied pages 20 and 21 in the pupil book. Tell the children that scientists make models of things that they are trying to understand. In this activity the children are going to make a model of part of the water cycle and see if it works.

Using the sheet

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

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

(d) Perform tasks 4 and 5 for the children (see note (ii)).

(e) Let the children try tasks 6 and 7 (see note (iii)).

(f) Let the children try tasks 8 and 9 (see note (iv)).

(g) Let the children try task 10.

Completing the activity

(h) Ask one or more children to explain to the rest of the class how the model works.

(i) Ask the class how they could test if there was salt in the lake water without tasting it (see note (v)).

Conclusion

When water evaporates from around the bowl (the sea) it leaves salt and other substances (food colouring) behind. The water vapour condenses on the cling film (the cloud) and drips (rains) into the dish (the lake).

Teaching notes

(i) The large bowl and the dish need to be heatproof. Only a small amount of water (less than $100cm^3$) is needed to make the solution.

(ii) Make sure that the cling film dips down towards the centre of the dish. This will encourage the drops to run off and form 'rain'.

(iii) If the children are having difficulty remind them of the results of the last activity. You can use this as an example of how information discovered in one experiment can be used in another experiment.

(iv) If the children are having difficulty remind them of the pages in the pupil book. You can use this as an example of where information in a book can be used to understand what is going on in a related experiment.

(v) The water from the 'sea' and the 'lake' could be poured into separate dishes and left to evaporate. Salt crystals will be found in the 'sea water' but not in the 'lake water'.

10

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

See **pages 22 and 23** of *Changing from solids to liquids to gases*

What is green slime?

Some substances can behave like liquids and solids without any change in temperature. This is what happens with green slime.

Q1. In the space draw how green cornflour slime flows from a hand.

Q2. What is a liquid called when there are tiny pieces of a solid in it?

✎...

Q3. What happens when you squeeze cornflour slime gently?

✎...

Q4. What happens if you squeeze the cornflour slime quickly?

✎...

Q5. What are the ingredients of green glue slime?

✎...

✎...

Q6. How must you dispose of green glue slime? Explain your answer.

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 22 and 23** of *Changing from solids to liquids to gases*

Answers

1. **The cornflour can be shown as sheets flowing from the hand, or as 'slime icicles' flowing from the fingers.**
2. **A suspension.**
3. **It will run between your fingers.**
4. **It turns into a dry solid.**
5. **White (PVA) glue, borax, green food colouring.**
6. **Put it in a waste bin. If it is washed down the sink it may block the drains.**

Complementary work

(a) After the children have done the practical activity they could make slimes using different proportions of the ingredients and test how the different slimes flow.

Teaching notes

The slime examined in this unit is similar to that used in special effects for science fiction films or other films suitable for the entertainment of young people. In such films the slime is often associated with monsters or aliens. The slime in this unit is not of biological origin being made from corn starch, flour or PVA glue.

The emphasis in this unit is not on slime as a biological material, but on a physical material which can exist as both a solid and liquid without adding or taking away heat. The changes in the slime are brought about by adding or taking away pressure. If there is only limited time to spend on this unit make sure the children have a chance to make cornflour slime. They will find it hard to believe its special properties. If the children have studied *4D Solids and liquids* in this series, they may have met a mixture of cornflour and water before in Unit 3 (Grains and powders). However, they will enjoy examining it again in a new context.

The green slime found on rocks in streams is made of threads of plant-like organisms called algae. They make slime to reduce evaporation. Seaweeds (also members of the algae family) produce slime to help them conserve water when the tide is out, and to provide a protective coating. Snails produce slime to help them travel over rocks. The skins of some frogs are slimy to help slow down the evaporation of water from their skin and as a defensive mechanism – to help them slip out of a predator's grasp!

10

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

Based on **pages 22 and 23** of *Changing from solids to liquids to gases*

Investigating slime

Try this…

1. Put six heaped tablespoons of flour in a bowl.

2. Add two and a half, flat tablespoons of salt.

3. Mix the flour and salt together.

4. Add half a tablespoon of cooking oil.

5. Add eight tablespoons of water.

6. Add a few drops of food colouring.

7. Mix all the ingredients together. You have made slime. If you put some on a tablespoon and turn the tablespoon vertically the slime should drop very slowly off the spoon.

8. Divide your slime into four parts and put each part in a separate bowl. Label them A, B, C and D.

9. You are going to add one tablespoon of each of the ingredients to each slime and stir it in. Then you will hold the slime on a tablespoon, turn the tablespoon vertically and watch the slime. Before you do this you must predict what you think will happen, then record your prediction in the table and carry out the test. Record the results in the table.

Slime	Add a tablespoon of	Prediction	Result
A	Water		
B	Cooking oil		
C	Salt		
D	Flour		

Looking at the results.

10. How good were your predictions?

✎...

11. What would you add to make a runnier slime? ✎...

12. What would you add to make a slimier slime? ✎...

Teacher's sheet: activity

Based on **pages 22 and 23** of *Changing from solids to liquids to gases*

Introducing the activity

(a) You may use this activity as additional practical work with the activities in the pupil book, or you may use it instead of the activities. Tell the children they are going to investigate the effect of varying the amounts of ingredients in a slime recipe.

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 and let the children try them (see note (i)).

(c) Go through task 8, then let the children try it (see note (ii)).

(d) Go through task 9 slowly. Make sure that the children write in their prediction before each test.

(e) Let the children carry out task 9 and complete the table.

Completing the activity

(f) Let the children try tasks 10 to 12 and compare their results (see note (iii)).

Conclusion

When a tablespoon of water is mixed with the slime, it makes the slime runny. When a tablespoon of cooking oil is added to the slime, it makes the slime slippery or slimy. It does not run, but flows more slowly off the spoon. If the outside is coated in oil, most of the slime may slide off the spoon. When a tablespoon of salt is added to the slime, it makes the slime a little thicker but it still flows off the spoon. When a tablespoon of flour is added to the slime, it dries up the slime and it forms lumps which simply drop off the spoon.

Teaching notes

(i) The quantities are given here in the form of 'tablespoons' to help with the speed and organisation of the activity. As each person's idea of a heaped or flat tablespoon can vary, try the activity yourself first to make sure you get a thick paste which flows a little by step 7.

You may like to take the children step-by-step through the practical work at this stage so that they are making heaped and flat spoonfuls in the way you wish.

(ii) The children should each have four bowls, such as cereal bowls, and four tablespoons to prevent cross-contamination. The children could perhaps bring these in from home.

(iii) The children should assess their accuracy with predictions by saying, for example, that they have two out of four predictions correct. Make sure the children put the slime in the waste bin and not down the sink when they are cleaning up.

QUESTIONS

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

Q1. What is the process that changes ice into water?

Tick one box:

Freezing ☐ Evaporation ☐ Melting ☐ Condensation ☐

Q2. Almost every substance can take three forms. One is the solid form.
What are the other two forms of a substance?

✎.. ✎..

Q3. Arif puts a bowl of water in a freezer and leaves it there for the day.

(i) What process takes place to change the water?

✎...

(ii) In what form is the water when Arif puts it in the fridge?

✎...

(iii) In what form is the water when Arif takes the water out of the fridge ?

✎...

(iv) Which form of the water had a fixed shape?

✎...

(v) Which form of the water could flow?

✎...

QUESTIONS

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

Q4. What is the melting point of water?

Tick one box:

0°C ☐ 10°C ☐ 37°C ☐ 100°C ☐

Q5. Jane looked up the melting points of some metals. She set them out in a table.

Metal	Melting point °C
Copper	1,085
Iron	1,536
Silver	962
Tin	232
Zinc	419

(i) Which metal has the highest melting point?

✎...

(ii) Which metal has the lowest melting point?

✎...

(iii) If the five metals were put in a furnace at 1,000°C. Which ones would melt?

✎...

(iv) How much higher is the melting point of silver than the melting point of tin?

✎...

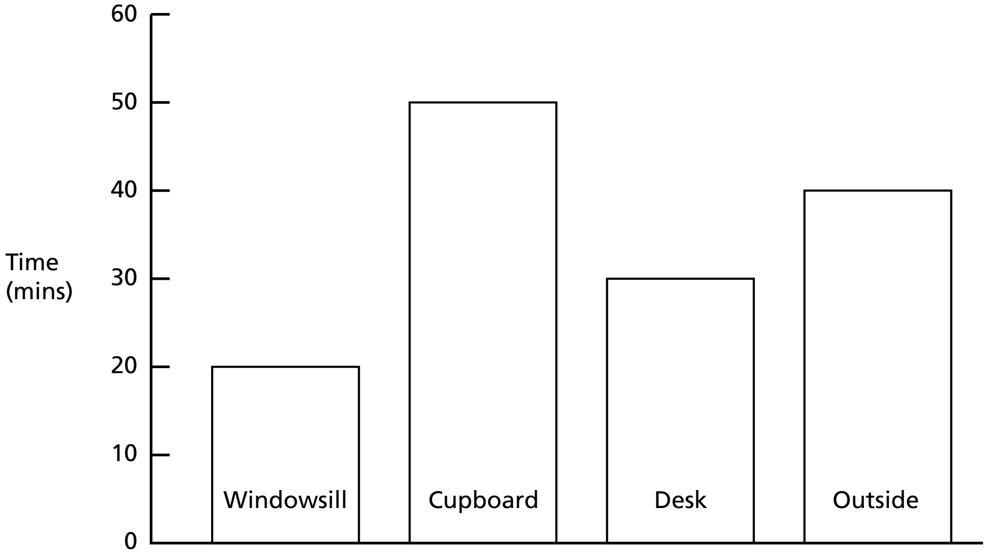
(v) Jane found that the melting point of platinum is 1,769°C. How does this melting point compare with the melting points of the other metals?

✎...

QUESTIONS

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

Q6. Mina and Ben set up four ice cubes around their classroom. They timed how long it took each ice cube to melt and recorded their results in a bar chart.



(i) Which place was the coldest? ✎..

(ii) Which place was the warmest? ✎...

(iii) What was the difference in melting time between the ice cube outside and the ice cube on the desk? ✎..

(iv) How does the temperature of a place affect the speed at which the ice cube melts?

✎..

(v) How do you think Mina and Ben made their test fair?

✎..

Q7. Jane took some butter out of the fridge and tried to spread it on some bread. She found the butter too hard to spread.

(i) How could she make the butter easier to spread?

✎..

(ii) What is the process that makes the butter change?

✎..

QUESTIONS

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

Q8. What is the freezing point of water?

Tick one box:

0°C ☐ 10°C ☐ 37°C ☐ 100°C ☐

Q9. Arif added some salt to some water. When he froze the water what did he find?

Tick one box:

☐ The freezing point went down.

☐ The freezing point stayed the same.

☐ The freezing point went up.

☐ The water would not freeze at all.

Q10. Which of these materials can be melted and cast in a mould to make an object?

Tick two boxes:

Wood ☐ Metal ☐ Glass ☐ Stone ☐

Q11. What is the process that changes water into water vapour?

Tick one box:

Freezing ☐ Evaporation ☐ Melting ☐ Condensation ☐

QUESTIONS

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

Q12. What is water vapour?

Tick one box:

A solid ☐ A liquid ☐ A gas ☐

Q13. Four liquids were set up in a warm place. They were examined frequently to see how long they took to evaporate. After two hours the experiment was stopped and the results were recorded in the table below.

Liquid	Time to evaporate (mins)
A	5
B	10
C	120
D	Liquid still present

(i) Which liquid evaporated the fastest? ✎......................

(ii) Which of the liquids evaporated (a) faster than C, (b) slower C?

(a) ✎............................ (b) ✎............................

(iii) What is the difference in evaporation time between liquid A and liquid B?

✎.................................

(iv) What is the difference in evaporation time between liquid B and liquid C?

✎.................................

Q14. What is the boiling point of water?

Tick one box:

0°C ☐ 10°C ☐ 37°C ☐ 100°C ☐

QUESTIONS

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

Q15. Arif breathed on a cold can of fizzy drink. He saw water droplets appear.

(i) Where had the water come from? ✎..

(ii) What was the process that made the water droplets appear?

✎..

(iii) Before the water appeared as droplets of liquid what form was it in?

✎..

Q16. Here are some ways that water changes during the water cycle. Use one of the words in the list to describe each change. You may use each word more than once.

condensation **evaporation** **melting** **freezing**

(i) Water escapes from the surface of the sea and forms a gas.

✎...

(ii) Water vapour in the air forms droplets on dust in the air.

✎...

(iii) Water droplets in a cloud become so cold they turn to crystals of ice.

✎...

(iv) Ice crystals in a cloud fall into warm air and change to water.

✎...

(v) Rain water on a rock changes into water vapour.

✎...

(vi) Water vapour in the air forms drops of liquid on grass.

✎...

(vii) The drops of liquid on the grass turn to ice crystals.

✎...

ANSWERS

1. Melting. *1 mark*

2. (i) Liquid. *1 mark*
(ii) Gas (any order). *1 mark*

3. (i) Freezing. *1 mark*
(ii) Liquid. *1 mark*
(iii) Solid. *1 mark*
(iv) Solid. *1 mark*
(v) Liquid. *1 mark*

4. 0°C. *1 mark*

5. (i) Iron. *1 mark*
(ii) Tin. *1 mark*
(iii) Silver, tin, zinc. *3 marks*
(iv) 730°C. *1 mark*
(v) It is higher than the others. *1 mark*

6. (i) Cupboard. *1 mark*
(ii) Windowsill. *1 mark*
(iii) 10 minutes. *1 mark*
(iv) The higher the temperature, the faster the ice melts. *1 mark*
(v) They used ice cubes that were all the same size. *1 mark*

7. (i) Put it in a warm place for a while. *1 mark*
(ii) Melting. *1 mark*

8. 0°C. *1 mark*

9. The freezing point went down. *1 mark*

10. Metal, glass. *2 marks*

11. Evaporation. *1 mark*

12. A gas. *1 mark*

13. (i) A. *1 mark*
(ii) (a) A, B (b) D. *3 marks*
(iii) 5 minutes. *1 mark*
(iv) 110 minutes. *1 mark*

14. 100°C. *1 mark*

15. (i) His breath (or from his lungs). *1 mark*
(ii) Condensation. *1 mark*
(iii) Gas or water vapour. *1 mark*

16. (i) Evaporation. *1 mark*
(ii) Condensation. *1 mark*
(iii) Freezing. *1 mark*
(iv) Melting. *1 mark*
(v) Evaporation. *1 mark*
(vi) Condensation. *1 mark*
(vii) Freezing. *1 mark*

Total marks: 46