Science@School | Book 6D

Changing materials

Teacher's Guide

Support material for the pupil book
can be found at the dedicated web site:

www.science-at-school.com

You can also consult our web site:
www.AtlanticEurope.com
to view our on-line catalogue

Peter Riley

Atlantic Europe Publishing

Science@School is a series published by Atlantic Europe Publishing Company Ltd.

Author
Peter Riley, BSc, C Biol, MI Biol, PGCE

Science Consultant
Brian Knapp, BSc, PhD

Art Director
Duncan McCrae, BSc

Senior Designer
Adele Humphries, BA, PGCE

Editors
Lisa Magloff, BA, and Barbara Bass, BA

Illustrations
David Woodroffe

Designed and produced by
EARTHSCAPE EDITIONS

The pupil book explained unit by unit

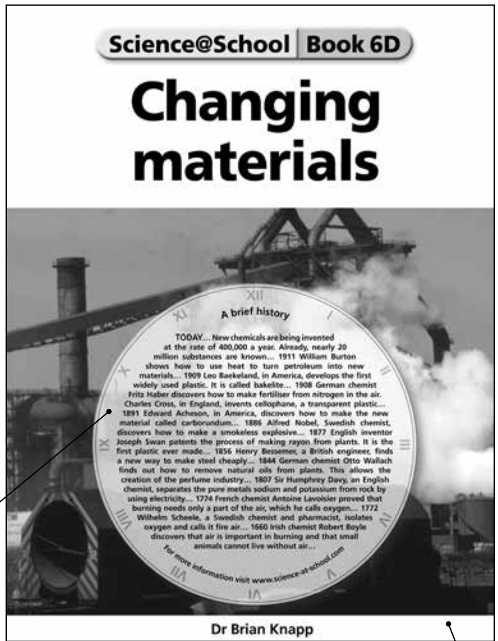
Although the pupil book – *Changing materials* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Changing materials*.

It is possible to use *Changing materials,* 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.

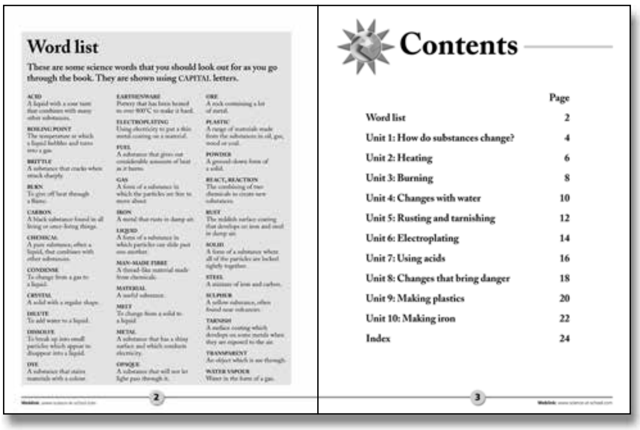
The picture shows iron being separated from ore in a blast furnace.

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.



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

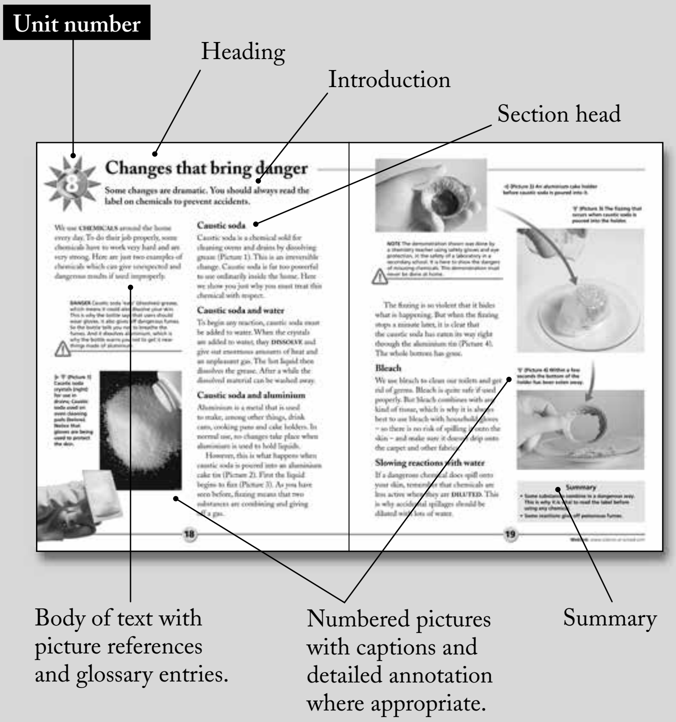
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

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.

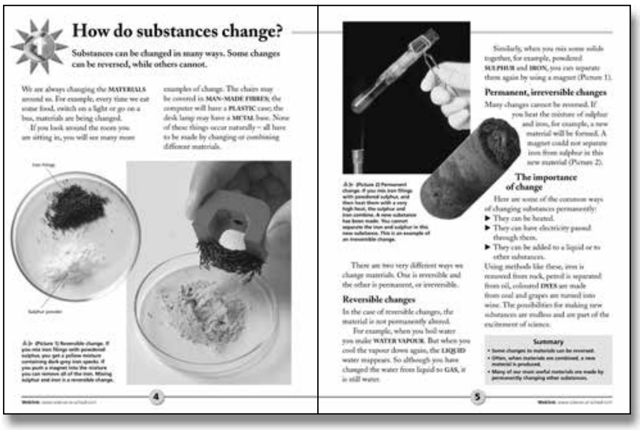
Summary

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



1 How do substances change?

You may like to begin by asking a child to pour a dozen steel paperclips into a bowl of flour. Ask a second child to stir in the paperclips until they cannot be seen. Now ask the class to think of an easy way to separate the flour and paperclips. They might suggest a magnet, which you can produce as they answer, and let a third child use it to retrieve the paperclips. Now produce two sets of ingredients for biscuits. Mix together one set of ingredients, then show the children some biscuits that you made earlier. Compare the biscuits to the second set of ingredients and ask the children if they could separate the ingredients in the biscuits. Point out that there are two kinds of change – reversible change and irreversible change.

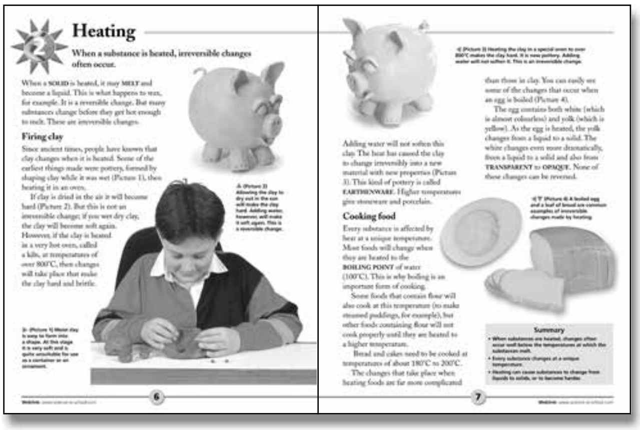


The unit begins by describing examples of everyday changes. An unusual reversible change is shown – the mixing of iron filings with sulphur and their separation. The two materials are then used again to show an irreversible change. When they are mixed and heated they form a new substance from which the iron and sulphur cannot be separated. The two changes are illustrated by clear, colourful photographs. The unit ends by looking at common ways of changing substances permanently.

In the complementary work, the children can find out how biscuits are made in a factory. In the activity, they investigate how different substances behave when they are mixed with water.

2 Heating

You may like to begin by mixing some clay and water together to make a clay which can be shaped. You could follow this by showing the children some dried clay ready for firing. Finally, show the children some pottery that has been fired. Tell the children that the fired pottery can last for thousands of years. You may like to show the children some photographs of pottery from ancient civilisations.



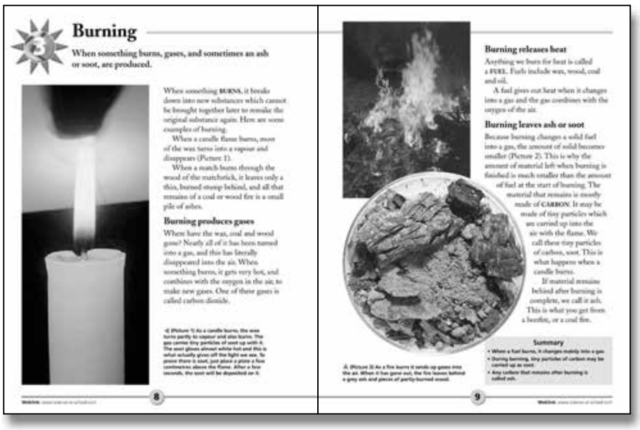
The unit begins by considering the melting of wax as a reversible change. It then moves on to describe the reversible change which takes place in the preparation of pottery for firing, and the irreversible change which takes place in the firing process. The cooking of food is considered as an example of an irreversible change, and the changes which take place in the boiling of an egg are described.

In the complementary work, the children use secondary sources to find out about brick-making. They can also examine uncooked and cooked food to note the irreversible changes that take place, and they can look at how blanching affects frozen foods. In the activity, the children look at the changes which take place when butter, margarine, egg white and sugar are heated.

3 Burning

You could begin by lighting an extra-long match which is designed for lighting candles and barbecues. Hold up the match so the children can watch it burning and ask them to describe the change that they see. They should mention the production of light, the match becoming smaller and the production of ash. You may like to add that you can also feel the heat. When the match has burned away, let the children compare it with an unburned match, and ask them whether the change is reversible or irreversible.

The unit begins by describing how a candle burns, and compares this with the burning of a match or coal. It goes on to consider what happens during burning in more detail. First, the production of gases is described. The releasing of heat is then considered, and the concept of fuel is introduced. Finally, the production of ash is considered and distinguished from the production of soot.

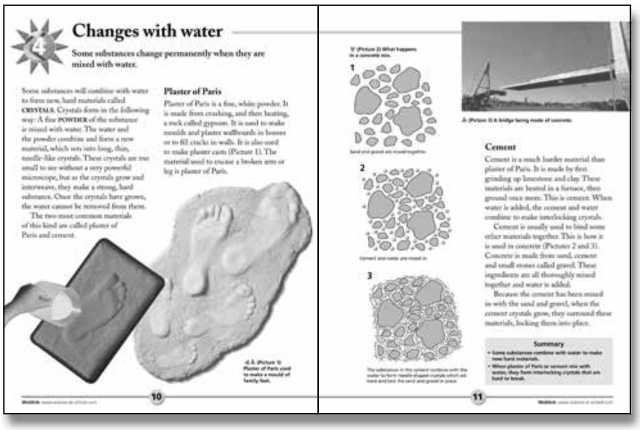


In the complementary work, the children find out how a small range of materials change when they burn; they can examine hazard labels on furniture materials and use secondary sources to find out how firefighters put out fires. In the activity, the children find out how fast a birthday cake candle burns by repeating observations and measurements.

4 Changes with water

You may like to begin by showing the children a clear polythene bag with some cement in it, a clear polythene bag with some sand and gravel in it and a piece of concrete which shows gravel embedded in the cement. Ask the children how the materials in the two bags could be converted into the block of concrete. When they answer, “Add water”, produce a jug of water and place it next to the two bags, to show the ingredients needed for making concrete. You may wish to extend the discussion by considering the small and large concrete mixers which the children may have seen on local building sites.

The unit begins by describing the mechanism which makes some materials become hard when mixed with water. This mechanism involves the development of long, interlocking, needle-like crystals. The development of these crystals is clearly shown in a series of diagrams. The text then moves on to describe how plaster of Paris is made and how it is used. The production of cement is described. This is followed by a description of how the crystals in cement bind the sand and gravel together.

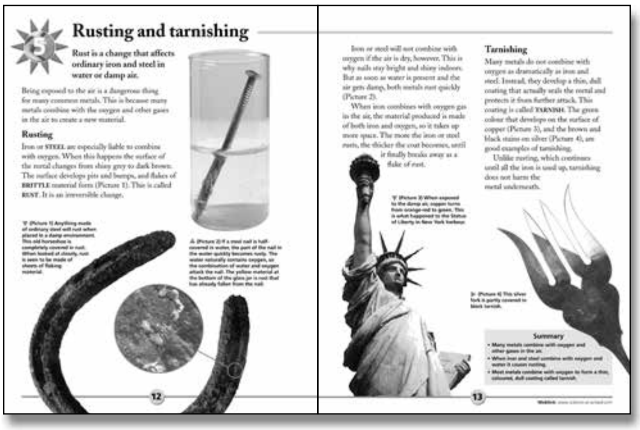


In the complementary work, the children can find out about reinforced concrete. They also review how solids which do not dissolve or react with water can be separated by filtering, and how solids that dissolve in water can be separated by evaporation. In the activity, the children mix different proportions of plaster of Paris to compare how they set, and find that they can make plaster of Paris into sheets, or make a simple plaster of Paris ‘concrete’.

5 Rusting and tarnishing

You could begin by holding up a rusty piece of steel, and a piece which is not rusty. Ask the children what could have caused the change. Look for the word ‘dampness’ in their answers, and ask them if they consider rusting a reversible or irreversible change. Hold up a piece of silver which is clean, and a piece of silver which is tarnished. Ask the children to compare the two pieces of metal.

The unit begins by stating that many common metals combine with oxygen and other gases in the air. This combination makes a change which can be seen on the surface of the metal. Rusting is dealt with in detail, and examples are shown of badly-corroded metal. Two examples of tarnishing are considered. They are the copper on the Statue of Liberty and the silver on an ornament. Tarnishing and rusting are compared, and the conclusion is drawn that, while rusting is disastrous for iron and steel, the tarnishing of other metals does no real harm.

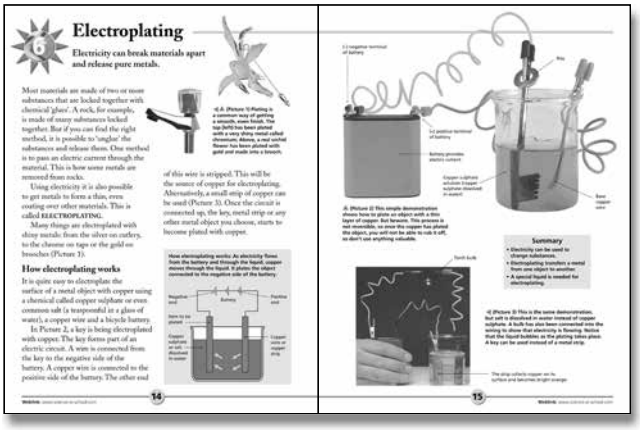


In the complementary work, you could demonstrate how tarnished silver can be cleaned. In the activity, the children plan an investigation to compare how galvanised steel and ordinary steel survive in dry, damp and salty conditions.

6 Electroplating

This unit gives you the opportunity to show how an electric circuit can be used in an uncommon application. It also gives you an opportunity to show the children that different branches of science – electricity and the study of materials – can be brought together for a particular purpose. You could begin by showing the children a chrome-plated tap and tell them that the shiny material is only a thin layer on the top of the object. Show them an older object where the metal coating has peeled away. Tell them that there is a special way in which a layer of metal can be put onto another material. Hold up a battery and say that it is important in this irreversible change.

The unit begins by explaining that a rock is made from many substances which are locked together, and that electricity can be used to separate them. It then goes on to show examples of objects coated in attractive shiny metals and explains that electricity can be used to make the coating. In the final section, an experiment is clearly illustrated and described, in which a key is coated with copper.

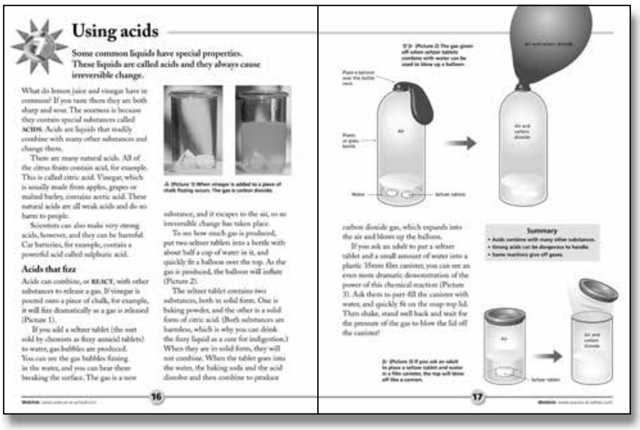


In the complementary work, the children find out how aluminium is separated from its ore, and there are instructions for you to demonstrate the experiment shown on page 15. In the activity, the children assemble a circuit, mix vinegar and salt and set up their own experiment to coat a nail with copper.

7 Using acids

Ask the children, "Who likes acid on their chips?" If they are puzzled explain that vinegar contains an acid. Ask the children what they know about acids. Some children may know that they can be corrosive. Hold up some eggshell in a jar and ask the children what might happen if they put vinegar on it. When they have made their suggestions, pour vinegar on the eggshell and let the children see the bubbles forming. Ask them what might happen it you put a hard-boiled egg in vinegar. Put one in a jar of vinegar so that it floats with its top above the liquid. Leave it there while you work through the unit, then let the children see how the eggshell has been dissolved.

The unit begins by explaining that acids are sour-tasting liquids that readily combine with other substances to change them. A range of acids in foods are identified and compared with a strong acid used in car batteries. Two experiments are described in which acids produce a gas when they bring about a change. This gas is used to blow up a balloon or make the top of a film canister shoot into the air.


Using acids

Some common liquids have special properties. These liquids are called acids and they always cause irreversible change.

Acids that fizz

Summary

16

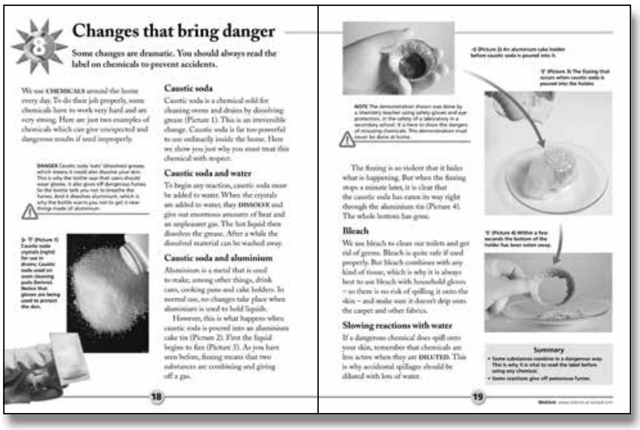
17

In the complementary work, the children use secondary sources to find out how vinegar is made. They can also compare how bicarbonate of soda and baking powder behave when they are mixed with water. You may also like to demonstrate the two experiments shown on page 17 in the pupil's book. In the activity, the children make vinegar solutions of different strengths and test how they react with bicarbonate of soda.

8 Changes that bring danger

You may like to begin by passing a bar of wet soap around a group of children. Ask the children how their hands feel, and when they say slippery, tell them that soap is not really dangerous. Soap is made with dangerous chemicals that have been changed so they can remove grease without burning the skin. Tell the children that some dangerous chemicals can be found in the home, and that substances containing these chemicals have hazard warning symbols on their containers. Show the children some clean, empty containers with their hazard warning symbols.

The unit opens by reminding the reader that if chemicals are used improperly they can produce unexpected and dangerous changes. Caustic soda is introduced as a useful drain cleaner but it can produce dangerous amounts of heat and unpleasant fumes. An experiment is described and illustrated to show what happens if caustic soda is allowed near aluminium. This experiment has been performed in a laboratory, and under no circumstances should it be repeated in a classroom or at home. It is simply


Changes that bring danger

Some changes are dramatic. You should always read the label on chemicals to prevent accidents.

Caustic soda

Caustic soda and water

Caustic soda and aluminium

Bleach

Slowing reactions with water

Summary

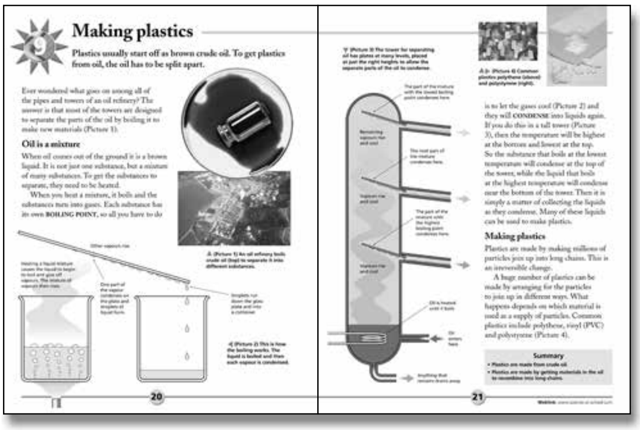
18

19

to show the corrosive power of caustic soda. Bleach is the second dangerous chemical that is considered. Safety measures are considered for the handling of bleach and dealing with spills.

In the complementary work, the children find out about first aid treatment if harmful chemicals are spilled or accidentally swallowed. In the activity, the children examine the labels from containers of hazardous substances.

9 Making plastics

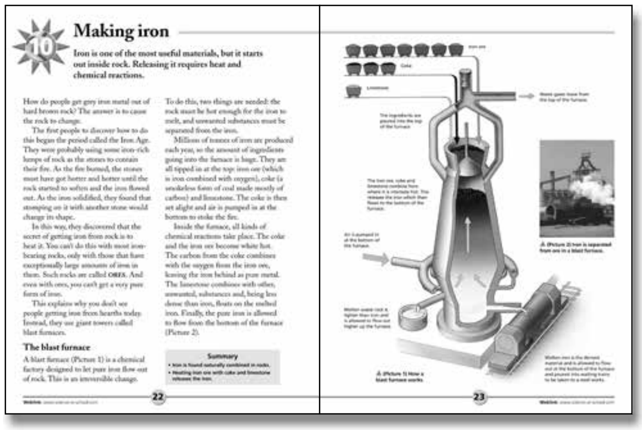


Tell the children that in the past people from each period of time left behind items made of certain materials. These times became known as 'Ages'. The first of these ages was the Stone Age, when people made items such as axes and arrowheads. Later came the Bronze Age, when people made items such as brooches, swords and shields from a metal called bronze. Today, some people think we live in the Plastic Age. When our civilisation passes away, the plastic objects we used will remain. Ask the children to look around them and identify the objects made of plastic that we use today. Ask them if they think we live in the Plastic Age.

The unit begins by showing an aerial view of an oil refinery, and asks what might be going on there. The following section identifies oil as the source of plastics, and states that oil is a mixture of substances. The substances are separated by the processes of evaporation and condensation – both examples of reversible reactions. The processes are first considered in a laboratory situation, and then shown at work in an industrial situation – the inside of a tower at an oil refinery. The unit ends by briefly explaining how the substances in oil are made into plastic.

In the complementary work, the children find out about the uses of polythene, PVC and polystyrene. In the activity, the children make a plastic from milk and vinegar.

10 Making iron



You may like to begin by holding up a piece of iron ore and a piece of iron. Tell the children that about 3,500 years ago, people discovered they could remove the metal from the ore. Put the ore and metal on your desk with a space between them. Tell the children that charcoal was used to separate things, and produce a piece of barbecue charcoal and place it between the ore and the metal. Produce a piece of coke and say that in time people found that coke was better to use than charcoal for removing iron from ore, and replace the charcoal on your desk with a piece of coke.

The unit opens by tracing how the discovery of extracting iron from rock may have been made. Throughout the text, the emphasis on change is made. At first, heat is described as an important agent in the change. The text moves on to describe the blast furnace. It is accompanied by a photograph showing iron being tapped from a blast furnace and a large clear annotated diagram of a blast furnace. By reading the text and studying the diagram, the children will find that chemical changes also take place inside the blast furnace to release the iron from its ore.

In the complementary work, the children find out how iron is converted into steel. In the activity, the children work out tests to compare the properties of steel with other materials.

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 materials in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets on pages 18 to 57, 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 teh following pages.

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 on the following pages 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 given here. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

Safety

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

Resources

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

▶ List 1 shows resources for demonstrations suggested for starting a unit.

▶ List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.

▶ List 3 details those resources needed for the 10 activity worksheets.

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. Bowl of flour, beaker with 12 steel paperclips, large magnet, two sets of ingredients for biscuits, biscuits that you have made earlier from the same ingredients.
2. Bowl of clay powder, jug of water, unfired clay, fired clay, photographs of pottery from ancient civilisations.
3. Nightlight candle, sand tray, match, cook's extra-long match.
4. A clear polythene bag containing cement powder, a clear polythene bag containing sand and gravel, a jug of water, a piece of concrete.
5. Steel object without rust, badly rusted object, clean item of silverware, tarnished item of silverware.
6. Chrome-plated object such as a tap, old metal-plated object where part of coating has peeled away.
7. A jar containing a few pieces of broken eggshell and vinegar. A jar of vinegar with a hard-boiled egg floating in it. Try to make sure that one end of the egg stays above the liquid.
8. Wet bar of soap. Clean, empty containers showing the harmful, or irritant, warning symbol on their labels.
9. –
10. Piece of iron ore (available from educational suppliers), a piece of barbecue charcoal, a piece of coke, a piece of iron.

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

1. Secondary sources about how biscuits are made in a factory. Alternatively, you could arrange a visit to a factory making biscuits.
2. Secondary sources about brick-making. A selection of foods in their uncooked and cooked states. Blanched and unblanched vegetables that have been frozen.
3. Sand tray, night light candle, wooden peg with handle, postage stamp sized pieces of wool, cotton, paper, a spent matchstick. Hazard warning labels from fabrics used in furnishings, secondary sources about how fire fighters fight fires.
4. Secondary sources about reinforced concrete. Filter funnel, filter paper, two beakers, sand, salt, water, dish, warm place for evaporation to take place.
5. Tarnished silverware, cleaner for you to use to show how tarnish can be removed.
6. Secondary sources about the extraction of aluminium from its ore. One 4.5v bicycle battery, one 4.5v bulb, nail, wires and connections, copper strip, key, nail, beaker, salt. Wires and connections, bulb and holder. Copper sulphate from educational suppliers or perhaps from a local secondary school science department.
7. Secondary sources about how vinegar is made. Baking soda, bicarbonate of soda, two jars, teaspoon of vinegar. Plastic bottle, balloon, two seltzer tablets. Film canister, seltzer tablet.
8. Secondary sources about the first aid treatment of skin on which harmful substances have spilled and first aid advice for people who have accidentally swallowed a harmful chemical.
9. Secondary sources about the use of polythene, PVC and polystyrene.
10. Secondary sources about how iron is converted into steel.

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. Teaspoon, jar, sand, sugar, flour, bath salts, plaster of Paris, baking powder, liver salts.
2. Sand tray, night light candle, teaspoon with long handle, margarine, butter, egg white, sugar, clock.
3. Sand tray, Plasticine, tin lid, birthday cake candle, plastic knife, ruler, clock.
4. Four pieces of aluminium foil – they should be in 6cm squares, bowl, teaspoon, plaster of Paris, newspaper.
5. Galvanised bucket, steel nails, galvanised steel nail, two jam jars with tightly fitting screw-top lids, warm place to leave the experiment for a few days.
6. One 4.5v bicycle battery, one 4.5v bulb, nail, wires and connections, copper strip, key, nail, beaker, salt.
7. Four jars, measuring cylinder, teaspoon, vinegar, bicarbonate of soda.
8. The labels from a wide range of containers which contained hazardous substances. The hazard warning symbols that should appear are toxic, corrosive, flammable, irritant or harmful. Three others which may be found but not essential are explosive, oxidising and toxic. You may wish to display clean, empty containers in a locked display case so the children can see the labels on the containers.
9. Half a cup of warm, full cream milk, (the milk should be heated by you but not allowed to boil), a tablespoon, vinegar, a sieve, two jars, a dish.
10. A steel nail, a piece of copper, a piece of candle wax, a piece of paper, a piece of woollen cloth, a piece of transparent plastic sheet, magnet, beaker of water, battery, light bulb, switch, connecting wires to make circuit for testing electrical conductance of materials.

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

- A substance made by a reversible change can be changed back into the original substance.
- A substance made by an irreversible change cannot be changed back into the original substance.
- Irreversible changes produce new materials.

Unit 2

- Heating causes some materials to melt.
- Heating causes many materials to change and form new materials.

Unit 3

- Burning is an irreversible change.
- When a material burns it forms new substances.
- When a fuel burns it changes mainly into a gas.

Unit 4

- When some substances are mixed with water an irreversible change takes place.
- The irreversible change caused by mixing with water may produce a strong, hard material.

Unit 5

- Iron and steel rust in the presence of water and oxygen.
- Some metals tarnish but this does not damage them.

Unit 6

- Electricity can be used to extract metals from their ores.
- Electricity can be used to produce thin, even coatings on materials in a process called electroplating.

Unit 7

- Acids cause irreversible changes.
- Acids can be either strong or weak.
- Acids can release a gas from solids.

Unit 8

- Some chemicals are dangerous.
- There are safe procedures for dealing with dangerous chemicals.

Unit 9

- The substances in oil can be separated by boiling and condensation.
- The materials separated from oil can be used to make plastics.

Unit 10

- Iron can be extracted from its ore in a blast furnace.
- Irreversible changes take place inside a blast furnace.

Learning objectives

Activity worksheets

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

Unit 1

- Make a prediction and test it.
- Use simple materials safely.
- Use data to set up a system of classifying materials.

Unit 2

- Use simple equipment safely.
- Make accurate observations.
- Compare predictions with results.

Unit 3

- Repeat observations and measurements.
- Construct a table and record data in it.

Unit 4

- Use materials safely.
- Plan and carry out an investigation involving a fair test.

Unit 5

- Plan and carry out a whole investigation.
- Construct a fair test.
- Draw conclusions from data.

Unit 6

- Use equipment safely.
- Make accurate observations.
- Record observations in the form of a diagram.

Unit 7

- Make accurate measurements.
- Make predictions and compare them with results.
- Identify a simple pattern.

Unit 8

- Construct a table.
- Use data to answer questions.

Unit 9

- Use equipment safely.
- Make observations over an extended period of time.

Unit 10

- Plan and carry out a whole investigation.
- Construct a fair test.
- Draw conclusions from data.

1

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

See **pages 4 and 5** of *Changing materials*

How do substances change?

Substances can be changed in many ways. Some changes can be reversed, while others cannot.

Q1. In the space draw how iron and sulphur look after they have been mixed together and heated.

Q2. If you mixed iron filings and sulphur together, how could you separate them again?

✎...

Q3. Can you separate iron and sulphur after they have been heated together? Explain your answer.

✎...

Q4. State three ways in which substances can be changed permanently.

1 ✎...

2 ✎...

3 ✎...

Q5. Why is boiling a reversible change?

✎...

Q6. What is the difference between a reversible change and an irreversible change?

✎...

✎...

✎...

✎...

✎...

✎...

✎...

1 Teacher’s sheet: comprehension

See **pages 4 and 5** of *Changing materials*

Answers

1. **In the space should be a grey lump.**
2. **You could push a magnet into the mixture and it would collect all the iron filings.**
3. **No. A new substance has been made.**
4. **(i) by heating; (ii) by having electricity passed through them; (iii) by being added to a liquid. (In any order.)**
5. **Because when steam cools, it forms water again.**
6. **When a reversible change takes place, the new substance produced can be changed back to the original substance. When an irreversible change takes place, the new substance cannot be changed back to the original substance.**

Complementary work

(a) Let the children use secondary sources to find out how biscuits are made in a factory.

Alternatively, a visit could be arranged to a biscuit factory.

Teaching notes

When two or more substances that do not react with each other are mixed together, no chemical reaction takes place between them, so no new material is made. This is a mixture. It is possible to separate the substances in a mixture using reversible changes. For example, when salt is dissolved in water, a mixture called a salt solution is made. The salt and water can be separated by evaporation.

When two or more substances react together in a chemical reaction, an irreversible change takes place. In this type of reaction, the atoms that make up the substances break apart and recombine in a different way. The new combinations of atoms make new substances. These new substances have different properties from the original substances. For example, when iron and sulphur part in a chemical reaction, an irreversible change takes place between them. In this reaction the atoms of iron and sulphur combine to form a new substance called iron sulphide. Although this substance contains iron, it does not have magnetic properties.

1

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

Based on **pages 4 and 5** of *Changing materials*

Mixing with water

Try this...

1. Look at the substances in the left hand column of the table. Think about what might happen when you stir each one up with water.

2. In the middle column of the table below, write down your prediction for what happens when you add water to each item.

Substance	Prediction	Result
Sand		
Sugar		
Flour		
Bath salts		
Plaster of Paris		
Baking powder		
Liver salts		

3. Take a spoonful of each substance in turn and mix it with a small amount of water.

4. Watch what happens to the mixture.

5. In the third column of the table above, record what you saw.

6. Look at the results and use them to divide the substances into two groups.

7. In the space below, write the name of each group. Under each name list the substances in that group.

Teacher's sheet: activity

Based on **pages 4 and 5** of *Changing materials*

Introducing the activity

(a) Ask the children what may happen to a substance when they mix it with water. You may find that they mention dissolving and not dissolving. Do not press them for more ideas but tell them they are going to find out a little more by testing a range of substances you have prepared for them.

Using the sheet

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

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

(d) Go through tasks 3 to 5, then let the children try them.

(e) Go through tasks 6 and 7, then let the children try them.

Completing the activity

(f) The children can compare the accuracy of their predictions.

(g) The children can compare their criteria for groups and the substances in each group.

(h) Ask the children to identify any reversible or irreversible changes (see note (ii)).

Conclusion

Substances behave differently when they are mixed with water. Some, such as sand, do not dissolve or react with the water in any way. Some, such as sugar and bath salts, dissolve. Some, such as baking powder and liver salts, produce a gas which makes bubbles, while yet others, such as flour and plaster of Paris, combine with the water to make a new solid substance.

Teaching notes

(i) The children may have studied *6C Dissolving* in this series and may confidently predict that some substances will dissolve or not dissolve. If they simply base their predictions on this alternative, let them. It will give you an opportunity to discuss how predictions are sometimes wrong and lead to new discoveries.

(ii) The dissolving of sugar and bath salts is a reversible change. There is no change when sand and water are mixed. The mixing of water with flour, plaster of Paris, baking powder and liver salts are examples of irreversible changes.

2

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

See **pages 6 and 7** of *Changing materials*

Heating

When a substance is heated, irreversible changes often occur.

Q1. In the space above, draw a fried egg and label the yolk and the white. Write next to each label how the part changes as it is heated.

Q2. When some solids are heated, a reversible change takes place. What is it?

✎..

Q3. How is pottery made? ✎..

✎...

Q4. If clay is dried in air, is it a reversible change or an irreversible change? Explain your answer.

✎...

✎...

Q5. What temperatures are used to (i) bake clay, (ii) boil foods, (iii) bake bread and cakes?

(i) ✎.................................... (ii) ✎.................. (iii) ✎....................................

Q6. How do the properties of clay change when it is baked in a kiln?

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 6 and 7** of *Changing materials*

Answers

1. **The yolk should be shaded darker than the white. The label next to the yolk label should say 'changed from liquid to solid'. The label next to the white should say 'changed from transparent to opaque and from liquid to solid'.**

2. **Melting.**

3. **Clay is shaped while it is wet, then heated in an oven.**

4. **A reversible change. Water can be added to the dry clay to make it wet and soft again.**

5. **(i) 800°C to 2,000°C, (ii) 100°C, (iii) 180°C to 200°C.**

6. **Unbaked clay is wet, soft and can be shaped. Baked clay is hard, dry, brittle and cannot be shaped.**

Complementary work

(a) The children could use secondary sources to find out about brick making.

(b) The children could look at a range of foods in their uncooked and cooked states.

(c) The children could look at some foods which have been blanched and frozen, and some foods which have not been blanched before freezing. (Blanching is to scald or parboil in water or steam in order to remove the skin from, whiten, or stop enzymatic action in food before freezing.)

Teaching notes

In previous work the children may have only considered heating as a way of changing the state of a substance. For example, heat is used to change a solid to a liquid in the process of melting. When mixtures are heated, energy is given to the atoms in the substances, and they use it to break apart from each other and recombine in new ways. This change is a chemical reaction.

Once a reaction is taking place, it may also produce heat. For example, when a match is struck, heat is generated by friction. This is sufficient to make the chemicals in the match-head react. As they do, they give off so much heat that a flame is produced and the wood in the stick gets so hot that it burns.

Clay is a substance made of tiny particles. When clay is fired in a kiln, a crystal-like substance forms where the particles meet, and this binds the clay particles together. This process makes the clay hard and brittle.

Food is made from complex molecules. The atoms in these molecules are arranged into long chains. When heat is applied, the shape of the molecule changes and this in turn changes the property of the food. This is the change that can be seen when egg white is heated. These changes are irreversible.

There are three ways of applying heat in cooking. Dry heat (120°C to 250°C) is used in roasting, baking and grilling; moist heat (82°C to 100°C) is used in boiling, stewing and steaming; and frying in fat (155°C to 225°C) is used in shallow or deep fat frying.

2

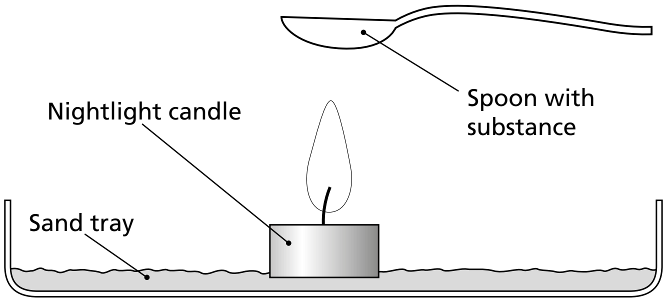
Name: .... **Form:** ....

Based on **pages 6 and 7** of *Changing materials*

Heating carefully

Try this...

1. Look at the substances in the left-hand column of the table. Think what might happen to each substance if you heated it for one minute, as the diagram shows.



2. In the middle column of the table, write down your prediction for each substance.

Substance	Prediction	Result
Margarine		
Butter		
Egg white		
Sugar		

3. Take half a teaspoon of margarine and heat it carefully for one minute. Let the substance cool down.

4. Watch what happens to the substance.

5. In the third column of the table above, write down what you saw in the appropriate box.

6. Repeat steps 3 to 5 with butter and with egg white.

7. Put a sprinkling of sugar in the bottom of the spoon.

8. Heat the sugar carefully for one minute and watch what happens.

9. Write down what you saw in the appropriate box in the third column of the table.

Looking at the results.

10. Which substances undergo a reversible change and which substances undergo an irreversible change?

✎...

✎...

Teacher's sheet: activity

Based on **pages 6 and 7** of *Changing materials*

Introducing the activity

(a) Ask the children if they have heated any substances in science in the past. They may mention using warm water or holding spoons in a candle flame. Ask them about how they can make heating safe (see note (i)).

Using the sheet

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

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

(d) Go through tasks 3 to 5, then let the children try them.

(e) Go through task 6, then let the children try it (see note (ii)).

(f) Go through tasks 7 to 9, then let the children try them (see note (iii)).

Completing the activity

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

Conclusion

The margarine and butter melted when they were heated, but solidified again when they cooled down. These substances underwent reversible reactions. The egg white formed a white spot soon after it was heated. This spread through the material and soon all of it had turned white and solid. The sugar crystals melted and turned to a light brown liquid which set hard on cooling. The egg white and sugar underwent irreversible reactions.

Teaching notes

(i) Use this introduction to make the children aware of your school safety policy on heating materials. This should include items such as the use of eye protection, tying back long hair, standing while heating and the use of sand trays. Depending on the ability and attitude of the children, you may prefer to demonstrate the practical elements of this investigation.

(ii) The egg white should not start to bubble in under a minute, but if it does, stop heating straight away. It will have turned white by this stage.

(iii) Only a light covering of sugar in the bottom of the spoon is needed (about thirty crystals). The sugar caramalises and so it may be hard to clean off the spoon.

3

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

See **pages 8 and 9** of *Changing materials*

Burning

When something burns, gases, and sometimes ash or soot, are produced.

Q1. Draw a burning candle in the space provided. Label the place where melting takes place with an M. Label the place where soot particles are white hot with an S.

Q2. Which part of the candle disappears as the candle burns?

✎..

Q3. What is left behind after coal has been burned?

✎..

Q4. (i) When something burns, which gas in the air does it combine with?

✎..

(ii) Name a new gas that is made when something burns.

✎..

Q5. (i) What is a fuel? ✎...

(ii) Name three fuels. ✎......................... ✎......................... ✎.........................

How are soot and ash different?

✎..

✎..

✎..

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 8 and 9** of *Changing materials*

Answers

1. **M should be pointing to the top of the candle. S should be pointing into the flame.**
2. **The wax.**
3. **A small pile of ashes.**
4. **(i) oxygen; (ii) carbon dioxide.**
5. **(i) anything we burn for heat; (ii) wax, wood, coal, oil.**
6. **Soot is made from tiny particles which are carried up into the air with the flame. Ash remains where the fuel was burned. (Soot is made from particles of carbon. Ash contains other substances that did not burn away).**

Complementary work

(a) If a sand tray and candle are set up, the children can compare the burning of wool, cotton, paper and wood. A piece of material only the size of a postage stamp should be used when burning wool, cotton and paper. A spent matchstick can be used as the material for wood. All the materials must be held in a metal clamp.

(b) The children could examine hazard labels from items of furniture.

(c) Use secondary sources to find out how firefighters put out fires.

Teaching notes

Oxygen is essential for the burning process. When something burns, some of the substances it contains combine with oxygen in a chemical reaction to make oxides. For example, wax is made of chemicals called hydrocarbons. They contain hydrogen and carbon. When a candle burns, the carbon combines with oxygen to form carbon dioxide, and the hydrogen combines with oxygen to form hydrogen oxide, or water. The water leaves the candle as invisible vapour, the carbon dioxide leaves the candle as a gas and so nothing is left behind.

Substances are made of atoms that are linked together. The links between the atoms are called bonds and they contain stored energy. When something burns, the bonds between the atoms are broken and some of the stored energy is released. Most of it is released as heat, but some is released as light, or even sound. The heat energy released in burning may be used to produce reversible changes such as melting or boiling. It may also be used to produce irreversible changes, as in baking.

Most fuels, such as oil and coal, are non-renewable and must be conserved. Wood is a renewable fuel. Solar power and wind power are renewable forms of energy.

3

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

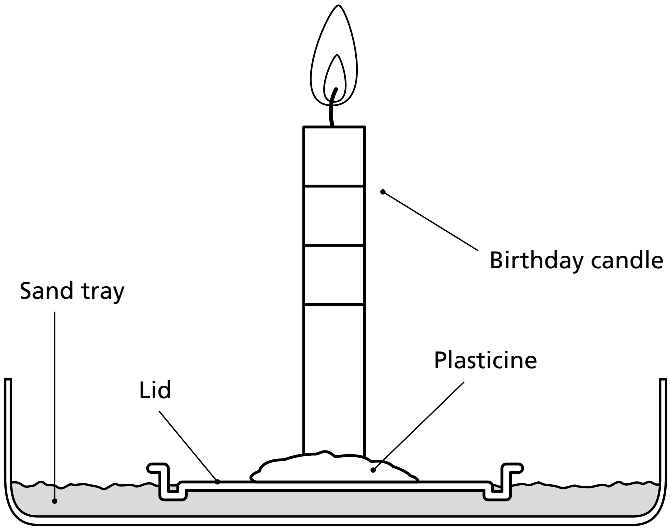
Based on **pages 8 and 9** of *Changing materials*

How fast does it burn?

Try this...

1. Take a birthday cake candle and mark lines on it 1 centimetre apart, starting at the end with the wick. You should divide the top part of the candle into three, 1 centimetre sections.

2. Set up the candle as the diagram shows.



3. Predict how long you think it will take to burn away one centimetre of the candle. Write down your prediction here.

✎..........................

4. Ask your teacher to light the candle and time how long it takes to burn down to the first mark.

✎..........................

5. Record how long it takes for the candle to burn down to the next mark.

✎..........................

6. Record how long it takes for the candle to burn down to the last mark, then blow out the candle.

✎..........................

7. Present your results in a table on a separate sheet of paper.

Looking at the results.

8. Estimate how long it would take for the candle to burn out completely.

3

Teacher's sheet: activity

Based on **pages 8 and 9** of *Changing materials*

Introducing the activity

(a) You may wish to begin by producing a cake with several birthday candles on it. Challenge the children to predict how long a candle might burn if it was not blown out. When they have made their predictions, tell the children that they are going to find out how long it takes for one centimetre of candle to burn down.

Using the sheet

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

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

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

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

Completing the activity

(f) Let the children compare their results (see note (iii)).

(g) Go through task 8, then let the children try it. You could relight the candles for the children and let them test their estimate. Alternatively, the class could decide on an estimate then light a new candle and see how accurate they were.

Conclusion

The candle burns steadily taking approximately the same length of time to burn through each of the three centimetres of wax.

Teaching notes

(i) The children need only mark the wax lightly with a felt-tipped pen. If they make deep furrows in the wax it will adversely affect the accuracy of the investigation.

(ii) The children may like to construct a table before they carry out the investigation. The table could have two columns headed 'Section of candle' and 'Time to burn (seconds)'. In the first column could be the numbers 1, 2 and 3 referring to the three sections of the candle, starting from the top. You may find that a section of candle takes about two and a half minutes to burn away.

Section of candle	Time to burn (seconds)
1	
2	
3	

(iii) You may like to use the results to discuss averages and how they provide useful data. You could ask the children how they could improve the investigation. Their answers may include trying to keep the candle burning in still air, and making the same size of marks on the candle.

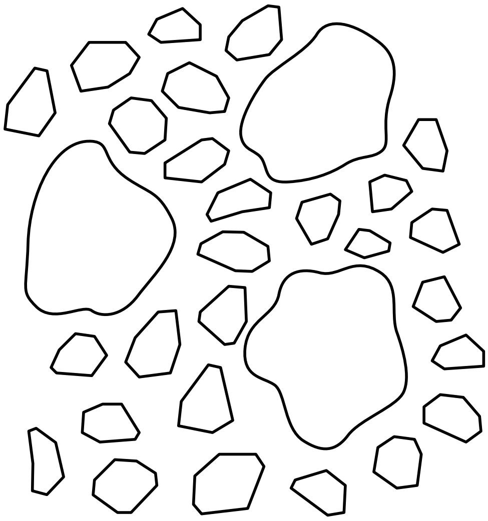
4

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

See **pages 10 and 11** of *Changing materials*

Changes with water

Some substances change permanently when they are mixed with water.



Q1. The diagram shows a mixture of sand and gravel. Label a particle of sand and a particle of gravel.

Q2. When water and cement are mixed with the sand and gravel some new structures are made.

(i) What are they? ✎...

(ii) Draw some in the diagram.

(iii) What do these structures do to the sand and gravel?

✎..

Q3. How is plaster of Paris made?

✎..

Q4. Name two uses of plaster of Paris.

1 ✎...

2 ✎...

Q5. How is cement made?

✎..

✎..

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 10 and 11** of *Changing materials*

Answers

1. **A large particle should be labelled gravel, and a small particle should be labelled sand.**

2. **(i) Crystals; (ii) the crystals should be drawn in the spaces between the sand and gravel particles; (iii) they lock them in place.**

3. **It is made from gypsum which is crushed and heated.**

4. **To make plaster wallboards, fill cracks, make moulds and make plaster casts for broken limbs.**

5. **It is made by grinding up clay and limestone then heating them in a furnace. The heated mixture is ground up again.**

Complementary work

(a) Use secondary sources to find out about reinforced concrete.

(b) The children can revise filtering and evaporating by mixing sand, salt and water together, then filtering the mixture and leaving the water to evaporate. The sand should be left behind on the filter paper, and the salt crystals should be left behind after evaporation.

Teaching notes

When a substance such as salt dissolves in water, it splits into tiny particles which cannot be seen. These mix with water particles and form a solution. No chemical reaction takes place between the salt and the water, so the two substances can still be separated. Water does enter into chemical reactions with some substances, and when it does, new materials are formed. The change that takes place is irreversible. It may be worth emphasising that plaster of Paris and cement do not dissolve in water.

Many chemical reactions give out heat when they take place. If plaster of Paris and water are mixed in an aluminium foil tray, you may be able to feel the warmth generated on the outside of the tray.

Plaster of Paris sets quickly. This makes it useful for treating damaged limbs. The plaster used on walls is a mixture of plaster of Paris and mineral lime, or keratin. Both these substances slow down the setting time of the mixture and make it easier for the plasterer to use. Bricks are held together by mortar. This is a mixture of cement, sand, mineral lime and water. The lime makes the cement form a stronger, more weather-resistant material.

4

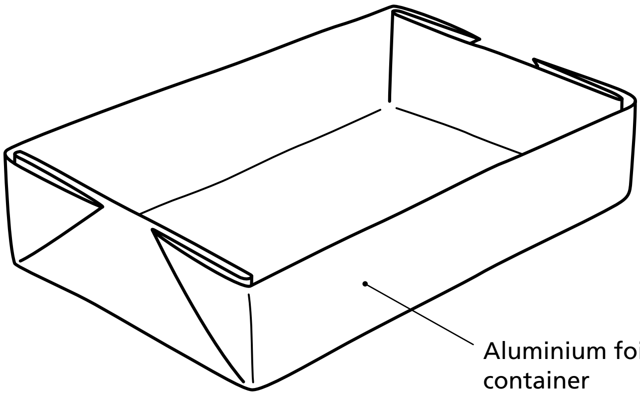
Name: .... Form: ....

Based on **pages 10 and 11** of *Changing materials*

Investigating plaster of Paris

Try this...

1. Take four pieces of aluminium foil and fold up their edges to make four containers like the one in the diagram.



2. Put a teaspoonful of plaster of Paris in a bowl. Add a teaspoon of water and mix thoroughly.

3. Put the mixture into one of the containers.

4. Repeat steps 2 and 3, but use two teaspoons of plaster of Paris instead of one.

5. Repeat steps 2 and 3, but use three teaspoons of plaster of Paris instead of one.

6. Predict what may happen when you use four teaspoons of plaster of Paris instead of one.

✎..

7. Test your prediction.

8. How could you make the mixture useful?

✎..

9. Test your idea.

10. Work out plans to test the following ideas:

(a) Plaster of Paris can be made into a thin sheet.

(b) Plaster of Paris can be used to stick gravel together.

11. Try your plans if your teacher agrees.

4

Teacher's sheet: activity

Based on **pages 10 and 11** of *Changing materials*

Introducing the activity

(a) If the children have done Activity 1 they will have seen plaster of Paris before and categorised it as a substance that mixes with water and forms a solid. Take this idea further by reading through pages 10 and 11 with the children. This should help them visualise what is happening when the plaster hardens.

Using the sheet

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

(c) Let the children perform task 1.

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

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

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

(g) Go through tasks 10 and 11, then let the children try them (see note (iv)).

Completing the activity

(h) Let the children examine the plaster of Paris casts by peeling away the aluminium foil. Let them compare their attempts to make thin sheets and plaster of Paris 'concrete'.

Conclusion

A large amount of powder may combine with a small amount of water. As the amount of powder in the mixture increases the mixture gets thicker. If there is too much powder lumps form instead of a paste. The lumps can be made into a paste by adding more water. Plaster of Paris will set if it is quite a thin mixture or a thick paste. Plaster of Paris can be made into a thin sheet and can stick gravel together.

Teaching notes

(i) Each piece of foil should be about 6cm square. The children should turn up the edges to about a height of 1cm. It does not matter if the sides and the floor of the container are crinkly. This allows the children to see how the plaster can be used to make a cast.

(ii) The children will need to clean and dry the bowl and spoon between the making of each mixture.

(iii) Depending on the ability of the children, you may like to break this down into performing tasks 6 and 7 first and then tasks 8 and 9.

(iv) A thin sheet may be made by pouring a thin paste onto a flat sheet of aluminium foil. Gravel and sand can be mixed with the powder to make a 'concrete'. This can be put into a foil container and made into a block to set.

5

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

See **pages 12 and 13** of *Changing materials*

Rusting and tarnishing

Rust is a change that affects ordinary iron and steel in water or damp air.

Q1. In the space above, draw a new nail on the left, and draw how it will appear when it is rusty on the right. Label the rust.

Q2. How does the colour of iron change when it goes rusty?

✎...

Q3. Is rusting a reversible change or an irreversible change?

✎...

Q4. Why don't nails rust as quickly indoors?

✎...

Q5. How does copper change when it is exposed to damp air?

✎...

Q6. How is tarnishing different from rusting?

✎...

✎...

✎...

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 12 and 13** of *Changing materials*

Answers

1. **A nail with smooth sides should be drawn on the left. A nail with rough and flaky sides should be drawn on the right. The label should point to an uneven surface, or a flake.**
2. **From shiny grey to dark or reddish brown.**
3. **An irreversible change.**
4. **Because it is dry indoors.**
5. **It changes from orangy-red to green.**
6. **Iron and steel rust, while other metals tarnish. Rust forms a coat which gets thicker and flakes off until all the metal is destroyed. In tarnishing, a thin, coloured and dull coat forms which seals in the metal and protects it. Tarnishing does no real harm while rust causes the complete destruction of the metal.**

Complementary work

(a) You could demonstrate how tarnish may be removed from tarnished silverware.

Teaching notes

When iron is extracted from its ore in a blast furnace it contains about 5% carbon. This can be used to make cast iron, or all the carbon can be removed to make wrought iron. Steel is made by removing a certain amount of the carbon, to give a mixture with specific properties. For example, high-carbon steel is tough yet brittle and used for making scissors. The point to emphasise is that steel is mostly made from iron, and shares with iron the property of rusting in the presence of oxygen and water. Salt also speeds up the process of rusting.

Stainless steel is made by mixing chromium and nickel with steel. This makes a metal mixture, or alloy, which does not rust. Stainless steel is commonly used for making cutlery and kitchen sinks. Iron can also be protected by being galvanised. In this process, a coating of zinc is applied to the iron. The zinc reacts with oxygen in the air to form a film of zinc oxide on the surface of the iron which is corrosion resistant. Iron and steel can also be protected from rusting by being coated in paint, oil or grease. Tin cans are really made of steel that has been coated with a thin layer of tin to prevent rusting.

5

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

Based on **pages 12 and 13** of *Changing materials*

Investigating rusting

Try this...

1. Damp conditions may affect how iron and steel rust. Coating iron or steel in zinc in a process called galvanising may help protect the metal. Write out a plan to investigate these ideas. You should use some ordinary steel nails, some galvanised steel nails and two jam jars with tightly fitting screw-top lids and a teaspoon of water.

✎...

✎...

✎...

✎...

✎...

✎...

✎...

2. Try your plan if your teacher agrees.

3. Record your results here.

Looking at the results.

4. What conclusions can you draw from your investigations?

✎...

Teacher's sheet: activity

Based on **pages 12 and 13** of *Changing materials*

Introducing the activity

(a) You may like to begin this activity by showing the children a galvanised bucket. Point out the crystals of zinc which are coating the steel. Tell the children they have to find out if the zinc helps to stop the steel rusting.

Using the sheet

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

(c) Go through task 2 with the children and ask how they will record their results (see note (ii)).

(d) Let the children try their investigation and complete task 3.

(e) Let the children complete task 4.

Completing the activity

(f) Let the children compare their results and conclusions.

Conclusion

Steel nails rust in damp conditions. Galvanised nails do not rust in these conditions. Neither steel nails nor galvanised nails rust in dry conditions.

Teaching notes

(i) The children will have seen that water affects the rusting of steel, on page 12 of the pupil's book. Dampness is the same thing as water. For this investigation, the children can put nails in jam jars, one with a small amount of water in the bottom, another with no water in. The lids should be screwed tightly on the jam jars. Some water will evaporate and make the air moist. If the children have suggested more than one nail for each condition ask them for a reason and look for an explanation about increasing accuracy.

(ii) They could make a table with three columns – 'Nails', 'Damp conditions' and 'Dry conditions'. In the 'Nails' column, the top box could say 'Steel' and the lower box 'Galvanised'. If only one nail of each kind is used in each condition the words rusted or not rusted (or a tick or cross) may be entered in the appropriate boxes in the other columns. If more that one nail is used in each condition, the number of nails rusted or not rusted can be recorded.

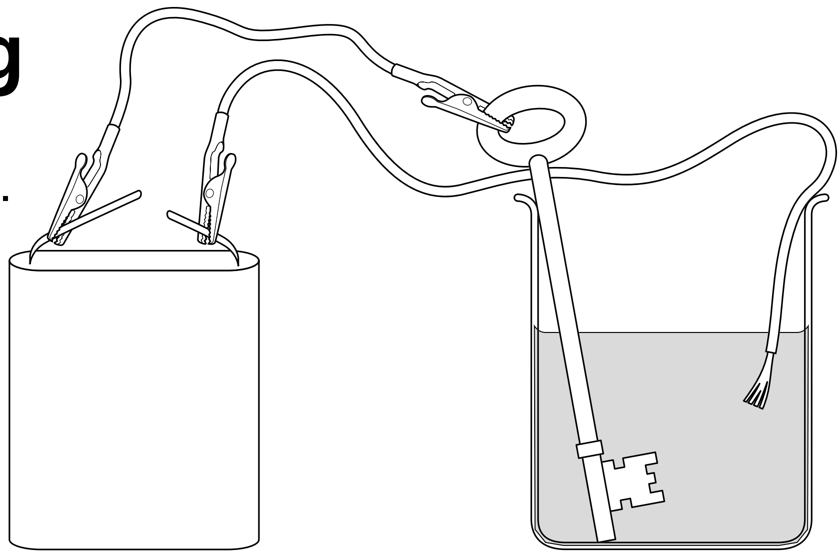
Nails	**Damp conditions**	**Dry conditions**
Steel		
Galvanised		

6

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

See **pages 14 and 15** of *Changing materials*

Electroplating



Electricity can break materials apart and release pure metals.

Q1. In the diagram, shade in where a layer of copper metal forms.

Q2. What is the name of the liquid in the beaker?

✎...................................

✎...

Q3. What may be removed from some types of molten rock by passing electricity through them? ✎...

Q4. What happens in the process of electroplating?

✎..

✎..

Q5. Name two things that are often electroplated.

1 ✎..

2 ✎..

Q6. Describe how the electroplating works in the diagram above.

✎..

✎..

✎..

✎..

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 14 and 15** of *Changing materials*

Answers

1. **The lower part of the key, that is in the liquid, should be shaded.**
2. **Copper sulphate solution.**
3. **Metals.**
4. **Electricity causes a metal to form a thin, even coating on another object.**
5. **Silver on cutlery, chrome on taps, gold on brooches.**
6. **The wire from the key goes to the negative side of the battery and the copper wire is connected to the other side (the positive side) of the battery. The end of this wire is stripped. Electricity now flows through the circuit made by the wires and the copper sulphate solution and copper is plated on the key in seconds.**

Complementary work

(a) Use secondary sources to find out how aluminium is extracted from its ore.

(b) You could demonstrate the experiment shown on page 15 of the pupil book. You may use the equipment shown in the picture, including the 4.5 volt bicycle battery. The children need to be closely supervised when copper sulphate solution is being used. Make up a solution as described in the pupil's book. Check that the circuit works by completing the circuit with a 4.5 volt bulb. Remove the connectors from the bulb, connect them to your copper object and the object to be plated. Make sure that the copper object is connected to the positive terminal of the row of batteries. You should find that the coating of copper is almost instantaneous and if you allow the coating to proceed for three minutes a thick coating will form which may flake off and fall to the bottom of the liquid.

Teaching notes

During studies on electricity, you may have mentioned that a current of electricity flowing through a wire is made by the movement of electrons – tiny particles charged with electricity. Certain liquids will also allow a current of electricity to pass through them. When a circuit is set up for electroplating, the current of electricity passes through the liquid in the form of larger, charged particles called ions. In the experiment on page 15 of the pupil's book, copper ions flow from the wire to the key. The ions are charged particles of copper. When they reach the key they receive electrons which have flowed through the wires in the circuit. When the ions receive the electrons, they become uncharged particles of metal again and form a coating on the key.

Electroplating is used in rust prevention when steel is coated with chromium. Electroplating is also used to make some kinds of cutlery look more attractive. This cutlery is called EPNS. The letters stand for electroplated nickel silver. You may show the children some examples in houseware catalogues.

When copper is extracted from its ore, it has impurities such as gold, silver and platinum in it. To remove these impurities, sheets of impure copper are electroplated onto pure copper sheets. This process causes the valuable impurities to fall to the bottom of a tank, where they are collected.

Gold is electroplated onto the microprocessors used in computers. Circuit boards, which the children may have seen in their studies on electricity, have lines of copper electroplated onto them to make the circuits.

6

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

Based on **pages 14 and 15** of *Changing materials*

Coating a nail with copper

Try this…

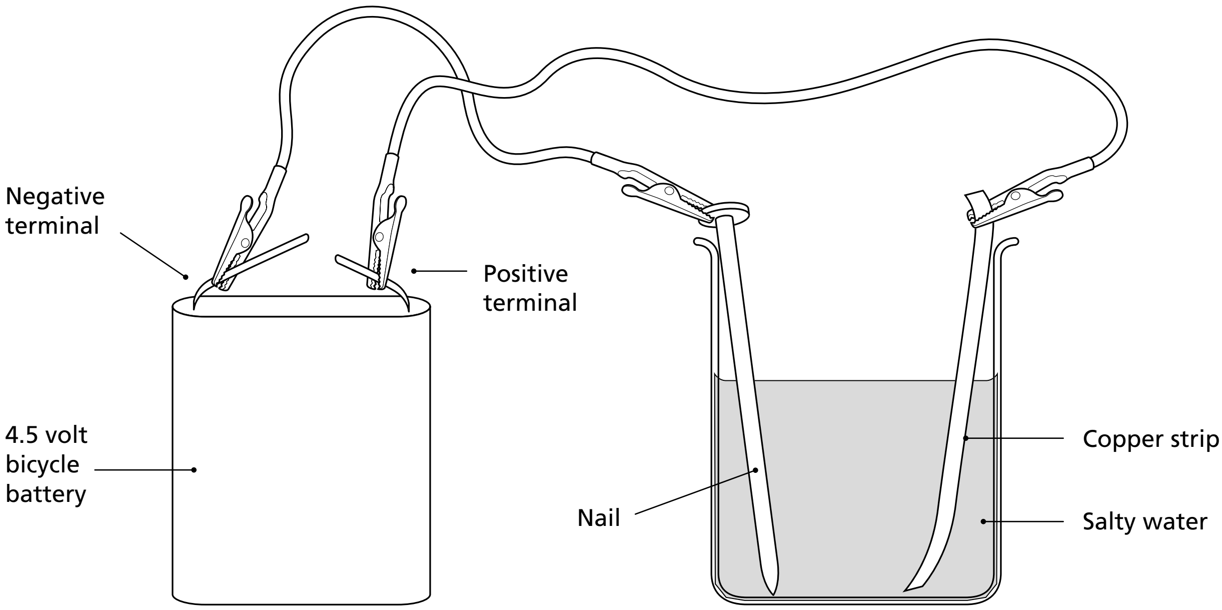
1. Put two tablespoons of salt in half a beaker of water.

2. Have ready a 4.5 volt bicycle battery.

3. Connect a nail to the negative terminal of the battery.

4. Connect a copper strip to the positive terminal of the battery.

5. Make sure the nail and copper strip are not touching.



6. Leave the nail and copper strip in the liquid for two minutes then take them out.

7. Write down what happened when you put the nail and copper strip in the liquid.

✎...

✎...

8. On a separate piece of paper draw how the nail appears after it has been in the liquid.

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Changing materials*

Introducing the activity

(a) You may introduce this activity either before or after you have performed the complementary activity with copper sulphate.

Tell the children that they are going to find out whether they can coat a nail with copper using electricity and salty water.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through tasks 1 and 2 with them.

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

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

(e) Go through tasks 5 to 8 with the children, then let them try them (see note (ii).

(f) Once the children have completed task 6 make sure that they disconnect the circuit (see note (iii).

Completing the activity

(g) Let the children compare their results.

(h) If you have not done the activity with copper sulphate in the complementary work, you may like to demonstrate it now.

Conclusion

As soon as the nail and copper strip are placed in the liquid, bubbles appear around the nail. They rise and make a froth on the top of the liquid. In two minutes a coating of copper appears on the nail where the nail has been in the liquid. The part of the nail that has not been in the liquid remains unchanged.

Teaching notes

(i) The purpose of the salt is to provide a substance in the water that will break up and act as a carrier for the electricity. It is technically called an electrolyte.

(ii) Make sure that the children do not hold the nail and copper strip together in the liquid as this will stop the electroplating process.

(iii) If you wish to revise circuits at the same time you may wish to include a switch in the circuit with the bulb.

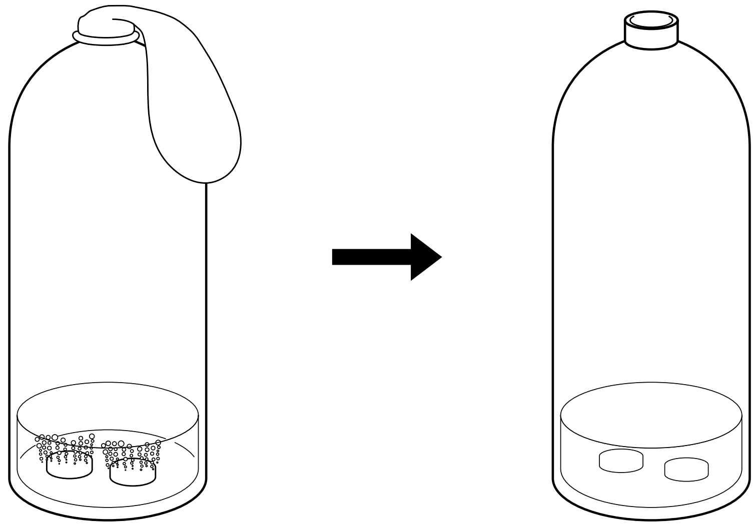
7

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

See **pages 16 and 17** of *Changing materials*

Using acids

Some common liquids have special properties. These liquids are called acids and they always cause irreversible change.



Q1. (i) Draw in the balloon on the bottle on the right.

(ii) What is in the balloon on the right?

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

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

Q2. Where is citric acid found?

✎...

Q3. Name two things that can be used to make vinegar.

1 ✎...   2 ✎...

Q4. What acid is used in car batteries? ✎...

Q5. What happens when vinegar is poured on chalk?

✎...

Q6. Why do seltzer tablets fizz in water?

✎...

✎...

✎...

✎...

✎...

7

Teacher's sheet: comprehension

See **pages 16 and 17** of *Changing materials*

Answers

1. **(i) The balloon should be inflated; (ii) Air and carbon dioxide.**
2. **In citrus fruits.**
3. **Apples, grapes or malted barley.**
4. **Sulphuric acid.**
5. **Fizzing occurs and carbon dioxide gas is produced.**
6. **They contain two solids called baking powder and citric acid. They dissolve in the water and combine to make carbon dioxide gas, which makes the liquid fizz.**

Complementary work

(a) Use secondary sources to find out how vinegar is made.

(b) The children can set up two jars of water, and add a teaspoon of baking powder to one jar and a teaspoon of bicarbonate of soda to the second jar. When they stir each one, they will find that the contents of the first jar fizz. This is because there is an acid mixed with the bicarbonate of soda in the baking powder which combines with the bicarbonate of soda in the presence of water. This acid is called sodium pyrophosphate. The contents of the second jar will not fizz because there is not any acid present. If the children add a teaspoon of vinegar to the second jar they should see the contents fizz.

(c) You may like to demonstrate the three experiments illustrated on pages 16 and 17.

Teaching notes

The word acid is derived from the Latin word *acidus*, which means sour. The acid in vinegar which makes it sour tasting is ethanoic acid. This is sometimes called acetic acid. Orange and lemon juice contain citric acid and ascorbic acid (vitamin C), while grapes contain tartaric acid. The sting of nettles and from some types of ants is produced by the same acid – methanoic acid. All these acids are produced by living things and are called organic acids. These acids are weak. There is a second group of acids called mineral acids. They are strong acids and are not used in primary schools. Hydrochloric acid, sulphuric acid and nitric acid are mineral acids.

The strength of an acid may be found by using universal indicator paper (obtainable from educational suppliers). The indicator paper contains dyes which change to a certain colour when dipped in acids of certain strengths. The strength of an acid is measured on a scale called a pH scale. The pH stands for 'power of hydrogen'. Acids contain particles called hydrogen ions. These are hydrogen atoms that are missing an electron. The number of hydrogen ions gives the acid its strength. There are 15 divisions of the pH scale. They are 0 to 14. The strongest acids have a pH of 0, 1 and 2. The weakest acids have a pH of 5 and 6. The 7 on the scale stands for neutral, and substances having a pH of 8 to 14 are described as alkalis, or bases.

The experiments on pages 16 and 17 of the pupil's book demonstrate how acids break down bicarbonate of soda to release carbon dioxide gas.

7

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

Based on **pages 16 and 17** of *Changing materials*

Investigating the strength of an acid

Try this…

1. Set up four jars and label them A to D. Pour 120ml of water into jar A. Pour 60ml of water into jar B, and pour 30ml of water into jar C. Leave jar D empty.

2. Add a teaspoon of vinegar to each of the four jars.

3. Which jar has the most concentrated acid solution? ✎..........................

4. Which jar has the most dilute acid solution? ✎..........................

5. Predict what will happen when you add a quarter of a teaspoon of bicarbonate of soda to each jar. Write your prediction in the table.

Jar	Prediction	Result
A		
B		
C		
D		

6. Add a quarter of a teaspoon of bicarbonate of soda to each jar.

7. Stir each solution in turn.

8. Write down your results in the table.

Looking at the results.

9. What can you conclude from your results?

✎...

✎...

✎...

Teacher's sheet: activity

Based on **pages 16 and 17** of *Changing materials*

Introducing the activity

(a) Ask the children what they need to do to a concentrated drink to make it drinkable. Look for "add water" or a description of dilution, then ask what do they think would happen if they applied the same process to vinegar. Tell the children that this activity will help them find the answer.

Using the sheet

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

(c) Let the children try task 1.

(d) Go through tasks 2 to 4, then let the children try them.

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

(f) Go through tasks 6 to 8, then let the children try them (see note (ii)).

Completing the activity

(g) Ask the children to complete task 9, then let them compare their conclusions.

Conclusion

Jar D has the most concentrated acid solution, and jar A has the most dilute acid solution. The fizzing is the release of carbon dioxide gas. The least amount of fizzing occurs with the most dilute solution in jar A. More fizzing occurs in jar B, and even more fizzing in jar C. The greatest amount of fizzing occurs in jar D. The more concentrated the acid, the more gas it produces.

Teaching notes

(i) If you prefer to use simpler measures, you can use half a cup, a quarter of a cup, and an eighth of a cup.

(ii) The bicarbonate of soda should fizz immediately with the vinegar in jar D but it may need stirring up in jars A, B and C before it fizzes.

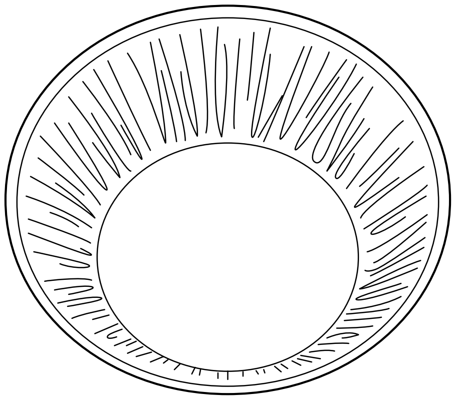
8

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

See **pages 18 and 19** of *Changing materials*

Changes that bring danger

Some changes are dramatic. To prevent accidents you should always read the label on chemicals.



Q1. The diagram on the right shows an aluminium cake holder. In the space below, draw how the cake holder would look after caustic soda had been poured into it and left for a few seconds.

Q2. What is caustic soda used for?

✎...

✎...

Q3. What happens when caustic soda crystals are added to water?

✎...

✎...

✎...

Q4. Why should people using caustic soda wear gloves and be careful how they breathe?

✎...

✎...

Q5. What is bleach used for?

✎...

Q6. If a dangerous chemical were to be spilt on your skin what should you do? Explain your answer.

✎...

✎...

✎...

8

Teacher's sheet: comprehension

See **pages 18 and 19** of *Changing materials*

Answers

1. **The cake holder should have a large jagged hole in the bottom.**
2. **Cleaning ovens and drains by dissolving grease.**
3. **They dissolve and give out enormous amounts of heat and an unpleasant gas.**
4. **The caustic soda can dissolve, or 'eat' skin. It gives off dangerous fumes.**
5. **For cleaning toilets and getting rid of germs.**
6. **Wash the skin with plenty of water. The water dilutes the chemical and makes it less active.**

Complementary work

(a) Use secondary sources to find out about first aid treatments for spilling dangerous chemicals on the skin or swallowing them accidentally.

Teaching notes

The demonstrations shown here are not intended to be done in class. They are shown in the book because they are unsafe to do in class or at home, but they illustrate how dramatic changes can occur from apparently common substances if handled inappropriately. A fuller discussion of the hazards of chemicals, their warning symbols and meanings are given on page 49 of this guide. It is recommended that you read these notes carefully and make sure that children are aware of the symbols' meanings as well.

8

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

Based on **pages 18 and 19** of *Changing materials*

Surveying dangerous products

Try this…

1. Look at the labels on a collection of products and identify the hazard warning symbols using this chart to help you.

2. Write the name of each product in the first column of the table below.

3. Write down what it is used for in the second column of the table.

4. Tick the box or boxes to show which hazard warning symbols are on the labels.

Product	Purpose	TOXIC	IRRITANT	HARMFUL	FLAMMABLE	CORROSIVE

5. Arrange the products into the following groups: Corrosive, irritant, flammable, harmful or toxic.

✎...

✎...

✎...

✎...

✎...

Teacher’s sheet: activity

Based on **pages 18 and 19** of *Changing materials*

Introducing the activity

(a) Remind the children that the home may contain dangerous chemicals, but they are only dangerous if they are not handled properly. Tell the children that the handling of dangerous chemicals should always be done by an adult. Containers of dangerous chemicals have warning symbols which everyone should be familiar with.

Using the sheet

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

(c) Go through tasks 2 to 4, then let the children try them (see note (i)).

Completing the lesson

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

Conclusion

Hazardous products can be arranged into groups. Some products may contain substances which qualify them for two hazard warning symbols, such as flammable and irritant.

Teaching notes

The hazard warning symbols on labels are designed to alert and convey something of the nature of the hazard.

The children may have noticed that the symbols may be in squares, diamonds or triangles. They are presented in squares on bottles, in diamonds on vehicles, such as tankers, and as triangles on walls. One example of a triangle sign that the children may have seen is the black lightning bolt on a local substation.

Some safety signs appear in circles. They tell you that something must or must not be done. For example, you may see a sign showing a person wearing spectacles. This means that eye protection must be worn. If the circle has a line going through it, it means ‘don’t do’. For example, if the line goes through a burning match, it means don’t use any naked flames.

The caustic soda and bleach featured on pages 18 and 19 of the pupil’s book are not acids. They are strong alkalis. On the pH scale mentioned on page 43, they have a pH of 11 and over.

(i) You may have to explain the purpose of some of the products in your collection. These could be written on the board.

(ii) Not all containers of hazardous chemicals have hazard warning symbols. This does not mean that if a container does not carry a hazard warning symbol it is safe. The only way to check the safety of a container which does not carry a hazard warning symbol is to read the label carefully.

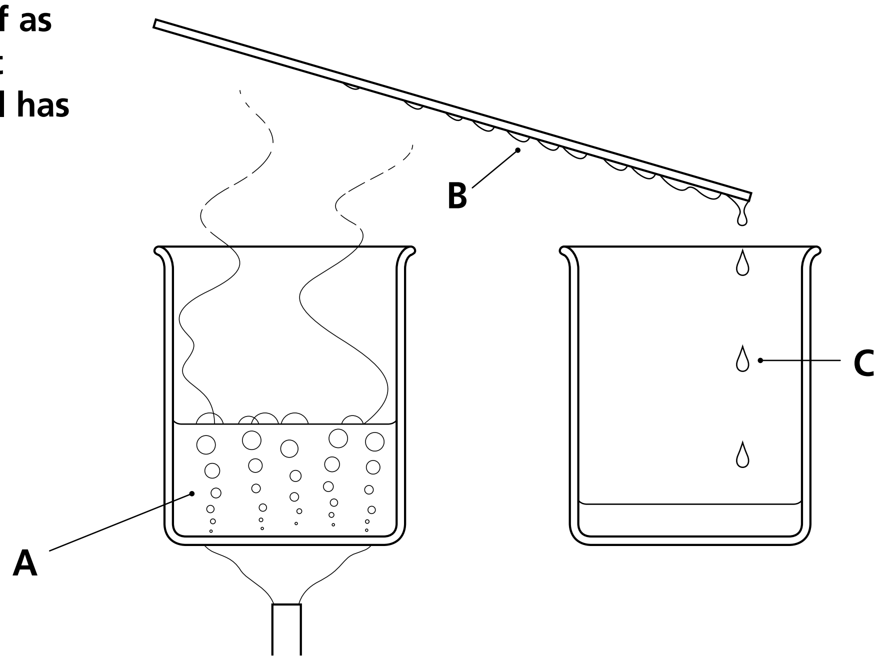
9

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

See **pages 20 and 21** of *Changing materials*

Making plastics

Plastics usually start off as brown crude oil. To get plastics from oil, the oil has to be split apart.



Q1. (i) What is happening at the part labelled A in the diagram?

✎...

(ii) What is happening at the part labelled B in the diagram?

✎...

(iii) What is happening at the part labelled C in the diagram?

✎...

Q2. What is the place called where oil is split apart? ✎...

Q3. The place in Q2 contains a tower. What happens at the bottom of the tower?

✎...

Q4. Where is the coolest part of the tower? ✎...

Q5. (i) How are plastics made? ✎..

✎...

(ii) What kind of change occurs when plastics are made? ✎..

Teacher's sheet: comprehension

See **pages 20 and 21** of *Changing materials*

Answers

1. **(i) Liquid is boiling; (ii) One part of the vapour is condensing; other vapours rise; (iii) The condensed vapour is collected.**
2. **A refinery.**
3. **Oil is boiled.**
4. **The top.**
5. **(i) By getting millions of particles to join up into long chains; (ii) An irreversible change.**

Complementary work

(a) Use secondary sources to find out about the uses of polythene, PVC and polystyrene.

Teaching notes

Oil is made from a mixture of substances called hydrocarbons. The atoms in hydrocarbons are linked together to form long chains. These are called long chain molecules. You can think of a long chain molecule as being like a necklace made from poppet beads. You can think of oil as being made of a mixture of necklaces of different lengths.

Each type of hydrocarbon has a different boiling point. The hydrocarbons with the shortest chains have the lowest boiling points, and the hydrocarbons with the longest chains have the highest boiling points. When the oil is heated, nearly all the hydrocarbons form gases. The gases rise up the column. As they rise they cool down. As soon as a hydrocarbon gas cools below its boiling point, it condenses. About a third of the way up the column the temperature drops to 260°C. All the long chain hydrocarbons that have boiling points higher than 260°C condense in this region. Near the top, the temperature has dropped to 40°C, so hydrocarbons with short chains will have condensed by the time they reach here. Four hydrocarbons have such short chains and low boiling points that they do not condense in the column. They are the gases methane, ethane, propane and butane.

Plastics are made by rearranging the chains of hydrocarbons and adding other chemicals to them.

9

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

Based on **pages 20 and 21** of *Changing materials*

Making plastic from milk

Try this…

1. Collect a jar of warm milk from your teacher.

2. Add a tablespoon of vinegar to the jar.

3. Stir the mixture for a minute and write down any changes that you see.

✎..

✎..

4. Let the mixture cool down for about a quarter of an hour.

5. Place a strainer over another jar and pour the mixture into the strainer.

6. Write down what happened when you poured the mixture into the strainer.

✎..

✎..

7. Press the top of the solid substances in the strainer a little to squeeze out any extra liquid.

8. Tip the solid substance into a dish, form it into a pancake and leave for two hours.

9. Look at the solid after two hours and describe it.

✎..

✎..

10. Look at the solid after one day and describe it.

✎..

✎..

11. Look at the solid after two days and describe it.

✎..

✎..

Teacher's sheet: activity

Based on **pages 20 and 21** of *Changing materials*

Introducing the activity

(a) Tell the children that milk can be used to make a plastic. It can be used to make egg cups, napkin rings, buttons and buckles. Tell the children they are going to try and make a plastic from milk and vinegar.

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 tasks 1 to 3.

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

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

(f) Let the children try tasks 9 to 11.

Completing the activity

(g) Let the children compare the plastic materials they have made. They could make some more plastic and make it into a shape before it sets. After it sets, they could glue a safety pin to the back so that the plastic object could be painted and used as a badge.

Conclusion

When vinegar is added to warm milk, white, solid curds form and white liquid called whey surrounds them. When the mixture is put into a strainer the whey passes through but the curds remain. After two hours the solid is still sticky and rubbery. Over the following days it sets and becomes harder.

Teaching notes

(i) Warm the milk but do not let it boil. Pour half a cup of milk into each jar.

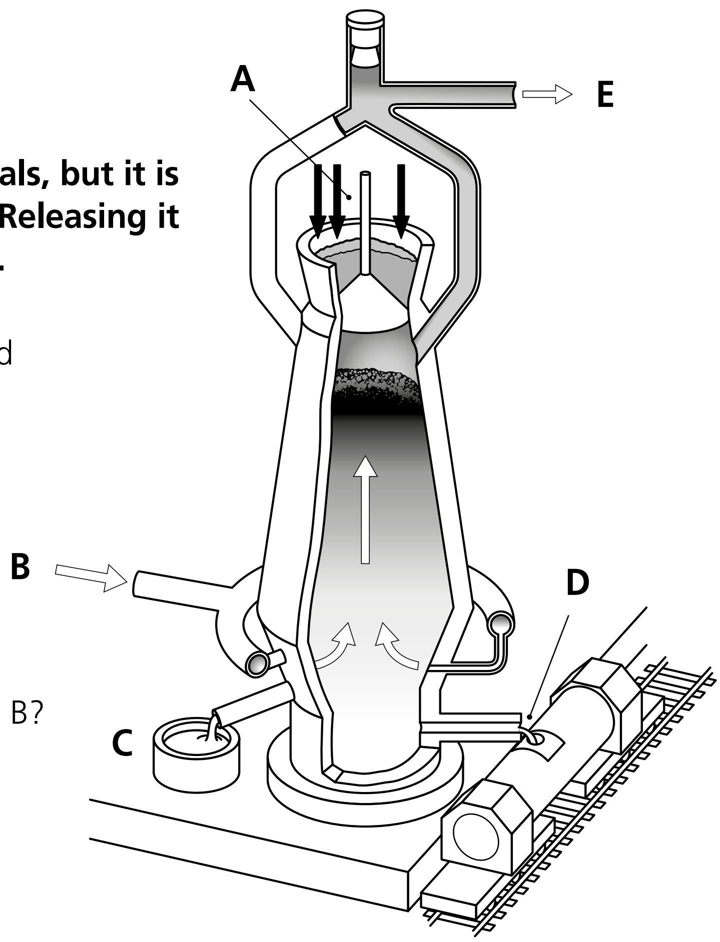
(ii) You may like to set up a jar of milk and vinegar for yourself and demonstrate the processes in these tasks before the children try them.

10

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

See **pages 22 and 23** of *Changing materials*

Making iron



Iron is one of the most useful materials, but it is found naturally inside certain rocks. Releasing it requires heat and chemical reactions.

Q1. (i) What three substances are added to the blast furnace at A?

1 ✎..

2 ✎..

3 ✎..

(ii) What is sent into the blast furnace at B?

✎..

(iii) What leaves the blast furnace at C, D and E?

C ✎............................... D ✎............................... E ✎...............................

Q2. What was the first use of stones that contained iron?

✎...

Q3. How might people have changed the shape of the first iron they got from stones?

✎...

✎...

Q4. What is set alight in the blast furnace? ✎..

Q5. How does carbon make iron pure?

✎...

Q6. What substance combines with impurities in the blast furnace and where does it collect?

✎...

Teacher's sheet: comprehension

See **pages 22 and 23** of *Changing materials*

Answers

1. **(i) Iron ore, coke, limestone;**
   (ii) Air (oxygen); (iii) C – waste rock, D – molten iron, E – waste gases.
2. **Hearth stones to contain a fire.**
3. **Stomping on it with a stone.**
4. **Coke.**
5. **It combines with oxygen from the iron ore, leaving the iron behind as pure metal.**
6. **Limestone. It floats on the molten iron.**

Complementary work

(a) Use secondary sources to find out how iron is converted into steel.

Teaching notes

It is easy for the children to think that the iron ore is just heated in a blast furnace until the metal in the rock melts and flows out. This is not the case. The heat allows a chemical change to take place, and this must be emphasised.

The iron exists in the rock as a substance called iron oxide. This means that atoms of iron and oxygen are bound together in the rock. When the ore is heated with coke, reactions take place in which the oxygen joins with carbon from the coke to form carbon dioxide. When this happens, metal iron forms and, as the temperature in the blast furnace is higher than the melting point of iron, the iron melts.

The limestone is used to collect the other rocky materials in the iron ore. It joins with them to form a substance called slag. This floats on top of the molten iron and can be easily separated from it.

10

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

Based on **pages 22 and 23** of *Changing materials*

Comparing steel with other materials

Try this…

1. Collect a steel nail, a piece of copper, a piece of wax, a piece of paper, a piece of plastic sheet, a piece of woollen fabric.

2. Write down how you would test whether the materials were magnetic.

✎...

3. Write down how you would test whether the materials were transparent.

✎...

4. Write down how you would test whether the materials were waterproof.

✎...

5. Write down how you would test whether the materials conducted electricity. (You may draw a diagram of the equipment you would use.)

6. Check your plans with your teacher.

7. Carry out your investigation if your teacher approves your plans.

8. Make a table for your results on a separate sheet of paper and fill it in.

Looking at the results.

9. Describe the properties of steel.

✎...

Teacher's sheet: activity

Based on **pages 22 and 23** of *Changing materials*

Introducing the activity

(a) You may wish to begin by reminding the children that materials have different properties. We may find a material useful because of one or more of its properties. We use large quantities of steel, so in this activity we compare some of its properties with properties of other materials.

Using the sheet

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

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

(d) Let the children try tasks 6 to 8 and complete the table (see note (ii)).

Completing the activity

(e) Let the children complete task 9 then compare their results.

Conclusion

Steel is a magnetic, opaque, waterproof material that conducts electricity. It rusts if left in water for a day or more. Copper is a non-magnetic, opaque and waterproof material that conducts electricity. It does not rust in water. Wax is a non-magnetic, opaque, waterproof material which does not conduct electricity. Paper is a non-magnetic, opaque material which is not waterproof and does not conduct electricity. Plastic is a non-magnetic, transparent, waterproof material which does not conduct electricity. Wool is a non-magnetic, opaque material which is not waterproof and does not conduct electricity.

Teaching notes

(i) The children may need help in remembering their work on waterproof materials earlier in their school work. You may also like to remind the children of how to make a circuit, or ask them to produce a circuit diagram in task 5.

(ii) The table should have five columns. The left-hand column should be headed 'Materials'. The other columns should be headed 'Magnetic', 'Transparent', 'Waterproof', 'Conducts electricity'. They can fill in the table by writing 'yes' or 'no' under each entry. (See the example below.)

Materials	Magnetic	Transparent	Waterproof	Conducts electricity
Steel nail				
Copper				
Wax				
Paper				
Plastic sheet				
Woollen fabric				

QUESTIONS

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

Q1. Arif mixed some currants and flour together in a bowl.

Is this mixing a reversible change or an irreversible change?

Tick one box:

Reversible change ☐ Irreversible change ☐

Q2. Jane drops some steel pins in a sand pit.
What could she use to remove them from the sand? ✎..

Q3. Mina is watching a pan of water boil.

(i) How does water change when it boils?

✎..

Mina's teacher puts a cold plate above the boiling water.

(ii) What does Mina see forming on the plate? ✎...

(iii) What process has taken place on the plate? ✎...

(iv) Is the process reversible? Explain your answer.

✎..

✎..

Q4. Ben made a cat out of moist clay. He put the model cat to one side and forgot about it. The clay dried out and the head fell off. What could Ben do to repair his model before it was put in the kiln? Explain your answer.

✎..

✎..

✎..

QUESTIONS

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

Q5. Clay is baked in a kiln. What is the temperature inside a kiln?

Tick one box:

0°C ☐ 50°C ☐ 100°C ☐ Above 800°C ☐

Q6. Is the baking of clay in a kiln a reversible or irreversible change?

Tick one box:

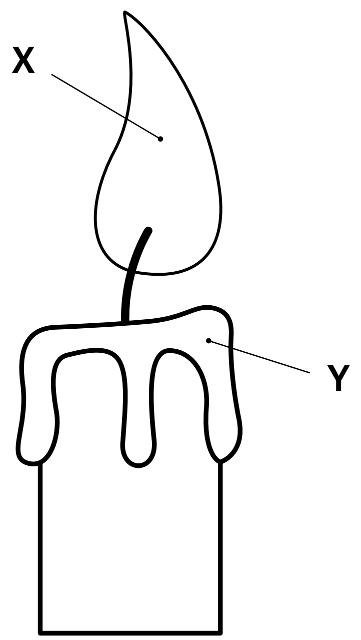
Reversible change ☐ Irreversible change ☐

Q7. What are two properties of baked clay?

Tick two boxes:

Soft ☐ Hard ☐ Brittle ☐ Flexible ☐

Q8. A candle is lit. After a few minutes it appears as the diagram shows.



(i) What change is taking place at X?

✎...

(ii) Is the change reversible or irreversible?

✎...

(iii) What change is taking place at Y?

✎...

(iv) Is the change reversible or irreversible?

✎...

QUESTIONS

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

Q9. Jane and Arif build a campfire.

(i) What gas in the air helps the fire to burn? ✎..

(ii) What gas is made as the fire burns? ✎..

(iii) What are the tiny, solid particles that make the smoke? ✎................................

(iv) What is the name of the solid substance left behind when the fire has gone out?

✎...

Q10. Mina put some sugar in water and stirred it up. The sugar disappeared.

(i) What is the name of the process that made the sugar disappear?

✎..

Mina thought that the process was reversible.

(ii) Is she right? Explain your answer.

✎..

✎..

Q11. Ben mixed up some plaster of Paris and water. At first, the mixture was a thick paste, then it changed.

(i) How did the mixture change?

✎..

(ii) What kind of change had taken place? ✎...

(iii) Ben put the mixture in water for a few minutes. He thought it would turn into a paste again. The mixture did not change with the addition of water. Why?

✎...

✎...

QUESTIONS

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

Q12. Jane and Mina wanted to make some concrete.

(i) Name three solid substances they need to make concrete.

✎..

(ii) What must they add to these substances to make concrete?

✎..

(iii) Name one useful property of concrete. ✎..

Q13. Ben had some steel nails. He set them up in four jars. The table shows the conditions in the jars and the results of his investigation.

Jar	Conditions in jar	Result
A	Nails and normal water (contains air)	Rust
B	Nails and boiled water (water without air)	No rust
C	Nails without water (only air)	No rust
D	Painted nails and water (contains air)	No rust

(i) Did the experiment test a reversible or irreversible change?

✎...

(ii) What could Ben conclude from the results?

✎..

(iii) What would be the result if Ben repeated the experiment with copper nails?

✎..

Q14. What happens in the electroplating process? *Tick one box*:

☐ A piece of metal is melted into a sheet.

☐ One metal is coated onto another metal.

☐ Two metals are melted together.

☐ A metal is shaped into a plate by electricity.

Q15. Arif mixed some bicarbonate of soda with water. The powder disappeared into the water.

Ben mixed some sugar with water. The crystals disappeared into the water.

Jane mixed some bicarbonate of soda with vinegar. The powder disappeared into the mixture and the mixture fizzed and frothed.

Mina mixed some sugar with vinegar. The crystals disappeared into the vinegar.

(i) In which mixtures did dissolving take place?

✎...

(ii) What did the results tell the children about sugar?

✎...

(iii) In whose mixture did an irreversible change take place?

✎...

Q16. Which of these substances fizz when mixed with water?

Tick two boxes:

Flour ☐ Baking soda ☐ Liver salts ☐ Table salt ☐

Q17. Which gas is made when vinegar is mixed with bicarbonate of soda?

Tick one box:

Oxygen ☐ Helium ☐ Carbon dioxide ☐ Water vapour ☐

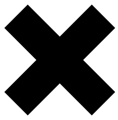
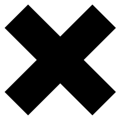
Q18. A seltzer tablet contains bicarbonate of soda and citric acid. What needs to be added to make them change?

✎...

QUESTIONS

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

Q19. Here are five hazard warning symbols.

				
A	**B**	**C**	**D**	**E**

(i) Which symbol means that a substance is flammable? ✎.....................................

(ii) Which symbol means a substance is corrosive? ✎.......................................

(iii) Which symbol means that the substance could be harmful or an irritant?

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

Q20. Ben and Mina made some tests on plastic and iron.

(i) Fill in the results in the table.

Test	Plastic	Iron
Attracted to magnet?		
Rust after two days?		
Conductor of electricity?		

(ii) Which kind of changes are used to separate the chemicals in oil?

Tick one box:

Reversible changes ☐ Irreversible changes ☐

(iii) Iron is separated from rock in a blast furnace. What kind of change makes the iron leave the rock?

Tick one box:

A reversible change ☐ An irreversible change ☐

ANSWERS

1. Reversible. *1 mark*
2. Magnet. *1 mark*
3. (i) It changes into water vapour, or gas. *1 mark*
(ii) Liquid water. *1 mark*
(iii) Condensation. *1 mark*
(iv) Yes. The water can be boiled again, or allowed to evaporate. *1 mark*
4. He could add water to make the clay moist again and replace the head.
The drying of clay in air is a reversible reaction. *1 mark*
5. Above 800°C. *1 mark*
6. Irreversible. *1 mark*
7. Hard, brittle. *2 marks*
8. (i) Burning. *1 mark*
(ii) Irreversible. *1 mark*
(iii) Melting. *1 mark*
(iv) Reversible. *1 mark*
9. (i) Oxygen. *1 mark*
(ii) Carbon dioxide. *1 mark*
(iii) Soot. *1 mark*
(iv) Ash. *1 mark*
10. (i) Dissolving. *1 mark*
(ii) Yes. The sugar can be separated from the water by evaporation. *2 marks*
11. (i) It became hard. *1 mark*
(ii) Irreversible. *1 mark*
(iii) A new material had been made which did not mix with water. *1 mark*
12. (i) Cement, sand, gravel. *3 marks*
(ii) Water. *1 mark*
(iii) Hard, strong, waterproof. *1 mark*
13. (i) Irreversible. *1 mark*
(ii) Both water and air are needed for rust to form. *1 mark*
(iii) None of the nails would go rusty. *1 mark*
14. One metal is coated onto another metal. *1 mark*
15. (i) All of them. *1 mark*
(ii) It dissolves in both water and vinegar. *1 mark*
(iii) Jane's mixture. *1 mark*
16. Baking soda, liver salts. *2 marks*
17. Carbon dioxide. *1 mark*
18. Water. *1 mark*
19. (i) D. *1 mark*
(ii) E. *1 mark*
(iii) B or C. *1 mark*
20. (i) Plastic column: (from top to bottom) 'No', 'No', 'No'. *3 marks*
Iron column: (from top to bottom) 'Yes', 'Yes', 'Yes'. *3 marks*
(ii) Reversible changes. *1 mark*
(iii) An irreversible change. *1 mark*

Total marks: 52