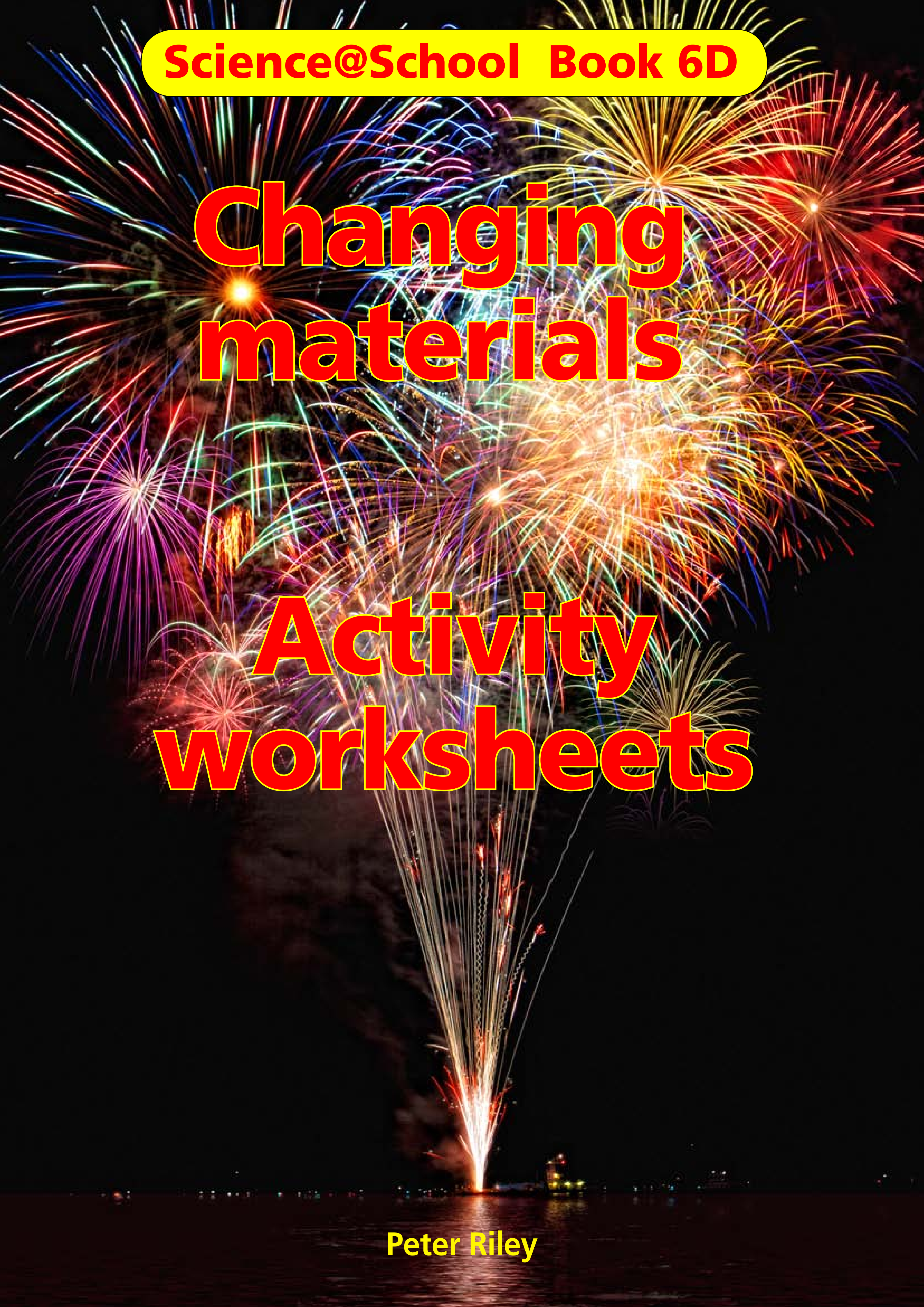

Science@School Book 6D

Changing materials

Activity worksheets

Peter Riley

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 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.

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.

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 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

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 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.

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 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 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

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

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.

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

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.

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 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.

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.

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 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.

Teacher's sheet: activity

10

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				