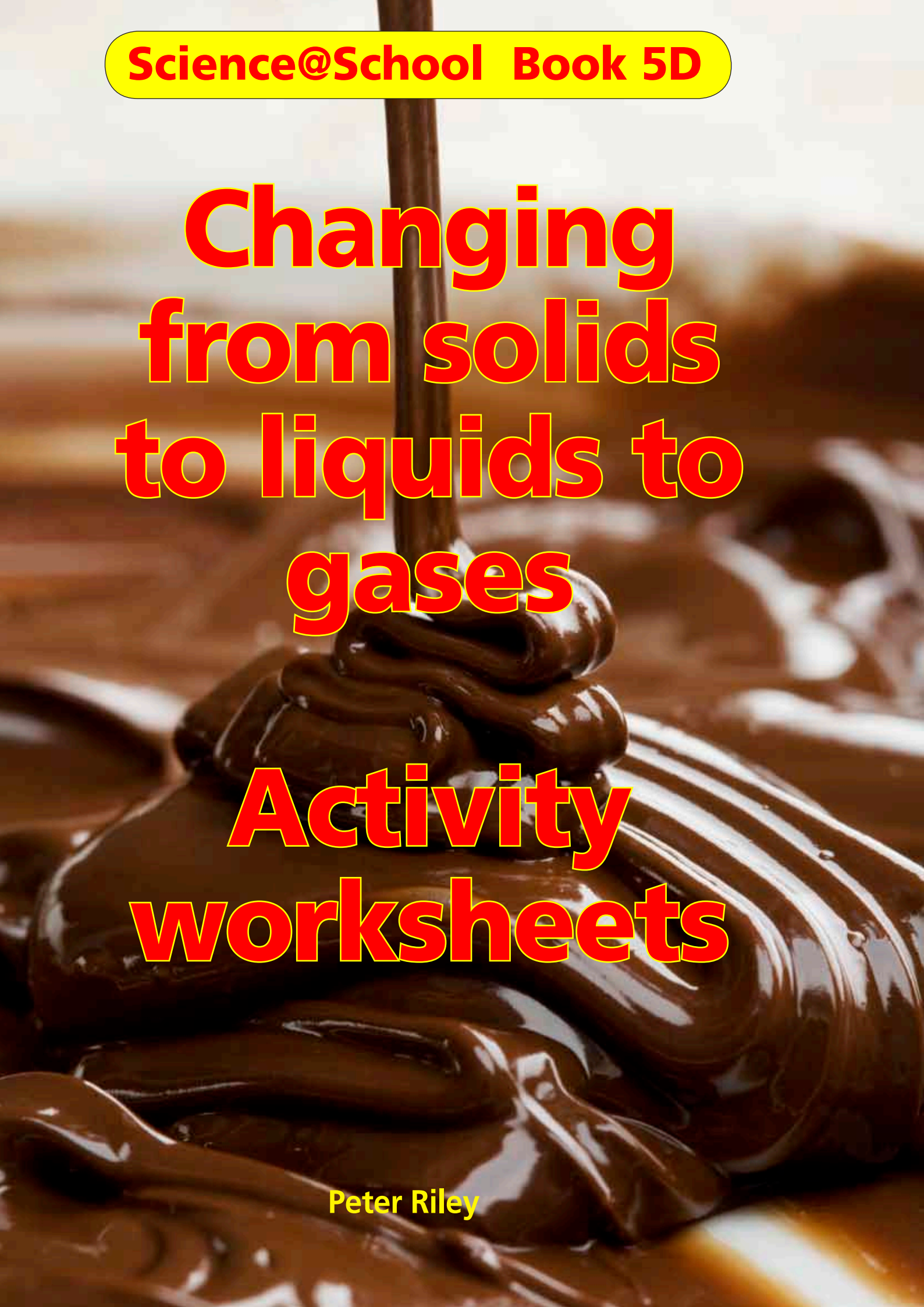
Science@School Book 5D

Changing from solids to liquids to gases

Activity worksheets



Peter Riley

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

Teaching notes

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

Completing the activity

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

Conclusion

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

Teaching notes

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

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

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

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

Teaching notes

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

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

Completing the activity

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

Conclusion

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

Teaching notes

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

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

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

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

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

Teaching notes

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

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

Completing the activity

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

Conclusion

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

Teaching notes

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

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

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

Teaching notes

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

Completing the activity

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

Conclusion

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

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

Teaching notes

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

Teaching notes

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

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

Completing the activity

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

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

Conclusion

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

Teaching notes

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

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

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

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

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

You may wish to let them try their plan.

Teaching notes

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

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

Completing the activity

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

Conclusion

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

Teaching notes

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

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

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

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

Teaching notes

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

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

(e) Let the children try task 4.

Completing the activity

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

Conclusion

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

Teaching notes

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

Teaching notes

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

(c) Let the children try task 4.

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

(e) Let the children try task 6.

Completing the activity

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

Conclusion

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

Teaching notes

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

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

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

Teaching notes

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

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

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

9 Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

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

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

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

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

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

(g) Let the children try task 10.

Completing the activity

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

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

Conclusion

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

Teaching notes

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

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

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

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

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

Teacher's sheet: comprehension

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

Answers

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

Complementary work

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

Teaching notes

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

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

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

Teacher's sheet: activity

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

Introducing the activity

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

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 to 7 and let the children try them (see note (i)).

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

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

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

Completing the activity

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

Conclusion

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

Teaching notes

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

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

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

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