Cambridge Primary

Science

Second Edition

Learner's Book 6

Series editors:
Judith Amery
Rosemary Feasey

Cambridge Assessment International Education

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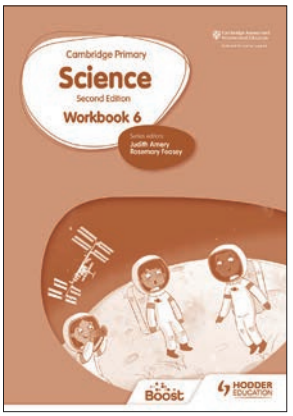

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4 Reversible and irreversible changes

Materials

What do you remember about materials and how they change?

Matter makes up everything around us. Scientists define matter as anything that has volume (takes up space) and mass. Matter exists in one of three states: solid, liquid or gas. When scientists talk about **materials**, they mean the types of matter from which objects are made. Examples are the wood in a tree, the tin in a can, the oxygen in bubbles.

When materials are heated or cooled enough, they may change state:

- If a solid is heated enough, it may change into a liquid.
- If a liquid is cooled enough, it may change into a solid.
- If a liquid is heated enough, it may change into a gas.
- If a gas is cooled enough, it may change into a liquid.

Let's talk

Talk about how you would define each word in the *Scientific words* box. Discuss your ideas with a partner.

1

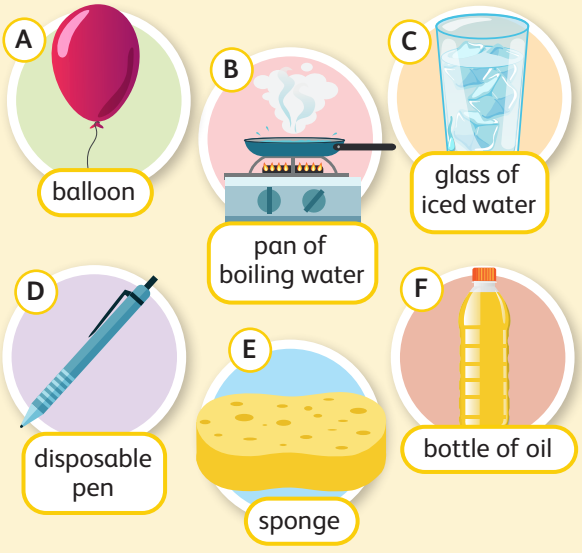
Write which state or **states of matter** have each of the properties below. Discuss your ideas with a partner. There are two examples for you.

a can be poured – liquids and gases
b keep their shape – solids
c fill up spaces
d take the shape of their container
e usually invisible
f can be cut or shaped
g move around

2

Name the material(s) each object below is made from. Say whether it is a solid, liquid or gas. There is one example for you.

A balloon – rubber (solid), air (gas)



Scientific words

matter materials states of matter

Changing materials

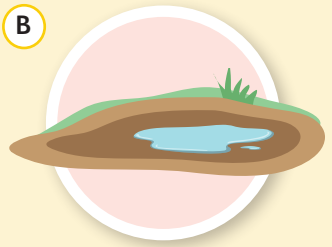
1

Say what is happening in each picture below. Use these words:

condensation | evaporation | freezing | melting

A

B



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D

E

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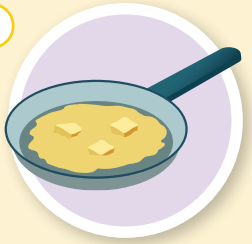
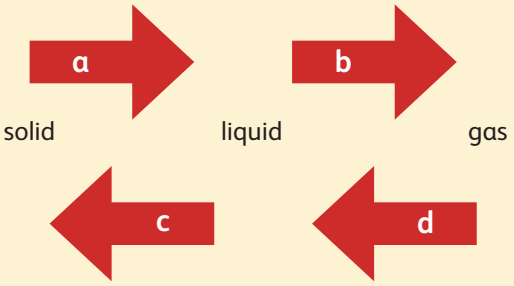


2

Name the processes labelled **a** to **d** in the diagram below. Use these words:

condensation | evaporation | freezing | melting



Scientific words

condensation | evaporation
freezing | melting

3

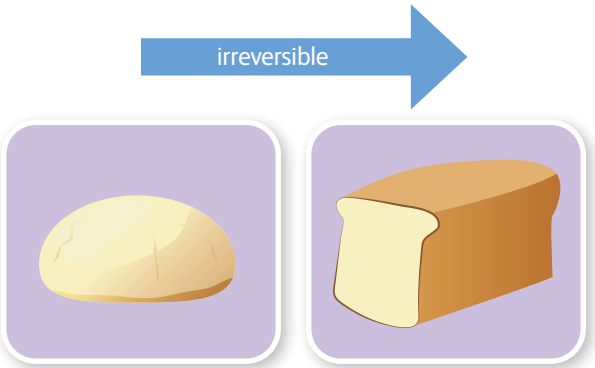
An acrostic is a composition in which certain letters in each line form a word or words, written downwards. Here is an example, using the word Newton.

Use one of the words in the *Scientific words* box to make an acrostic showing what you know about materials and how they change.

Reversible or irreversible?

Think like a scientist!

Some changes in materials are **reversible**. This means that the material can be easily changed back to the way it was before the change took place. Some changes in materials are **irreversible**. This means that the material cannot be easily changed back to the way it was before the change took place. Baking bread is an example of an irreversible change. A loaf of bread cannot be changed back to raw dough.



Let's talk

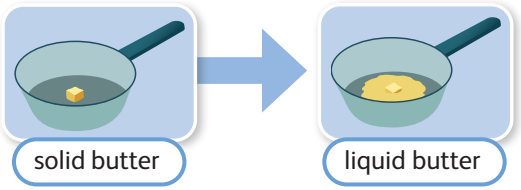
Discuss these questions with a partner:

a What change is taking place in each set of pictures? Use these words:

baking | burning | dissolving | freezing | melting | rusting

b Is each change reversible or irreversible? If the change is reversible, what could you do to reverse it? Share your ideas.

A



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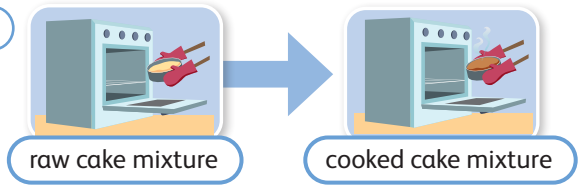

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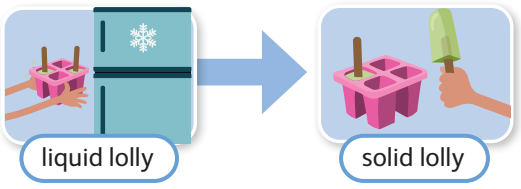
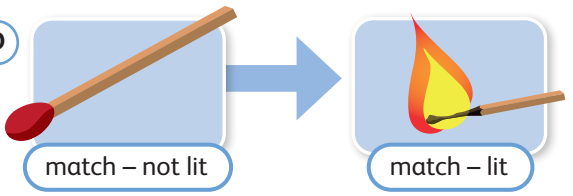


D



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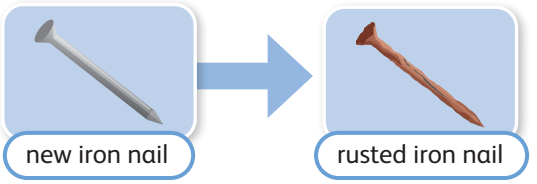

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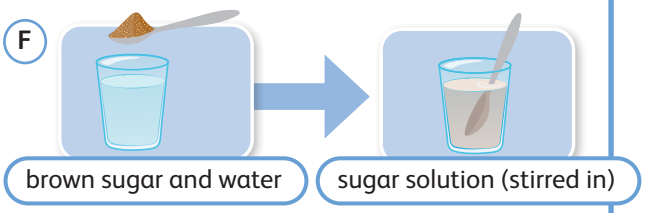


1 Draw an example of each change below. Label the change *reversible* or *irreversible*.

a condensation
b toasting
c rotting
d evaporation

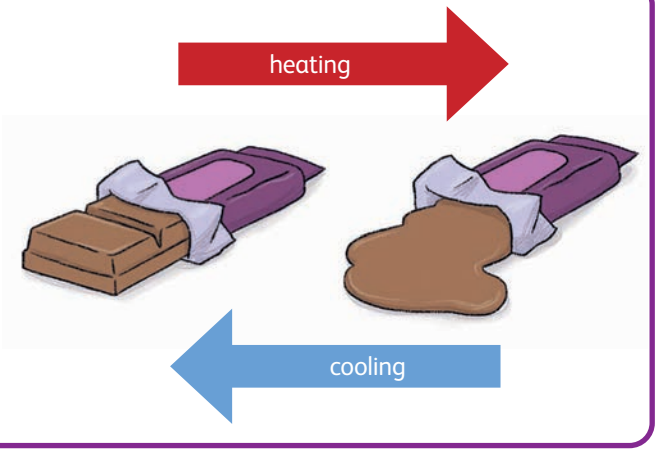
Scientific words

reversible irreversible

Reversible changes

Think like a scientist!

A reversible change is a change that can be easily **reversed** (undone or changed back). Sometimes scientists call reversible changes, **physical changes**. A physical change alters the **physical properties** of a material (how it looks or feels), but it does not produce any new materials. Because no new materials are produced, the material can be changed back to how it was before. Reversible changes include dissolving, freezing, melting, **vaporisation** (**evaporation** or **boiling**) and condensation.



1

Copy and complete the table below about reversible changes. There is one example for you.

Reversible change	It happens when …	It can be reversed by …
a freezing	a liquid is cooled and becomes a solid	heating the solid so that it turns back into a liquid
b melting		
c vaporisation		
d condensation		

2

a Work in a group. Choose an example of a reversible change. Decide how to demonstrate it.

b Collect the materials and equipment you will need.

c Demonstrate the reversible change to another group. Demonstrate changing the material back to the way it was before the change took place.

Scientific words

reversed
physical properties
evaporation
physical changes
vaporisation
boiling

Let's talk

Observe the material you changed in Activity 2. Discuss these questions in your group:

a Is the material exactly the same now as it was before you did the activity? If not, how is it different?

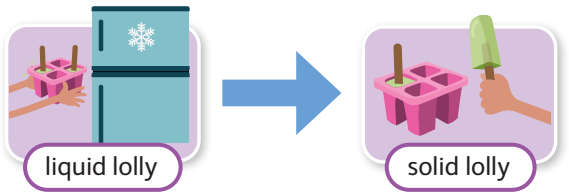
b If there are differences, is the change you demonstrated really reversible? Explain your thinking.

Melting and freezing

Think like a scientist!

Melting and freezing are reversible changes. Melting is when a material changes state from a solid to a liquid. You can make a solid melt by heating it. The **melting point** of a solid is the temperature at which it melts. This is different for every material.

Freezing is the reverse of melting. Freezing is when a material changes state from a liquid to a solid. You can make a liquid freeze by cooling it. The **freezing point** of a liquid is the temperature at which it freezes. This is different for every material.



All materials **conduct** heat (allow heat to pass through them) at different rates. This is called **thermal conductivity**.

1

Study this table and then answer the questions below.

Material	Freezing point (˚C)
petrol	–50
mercury	–39
linseed oil	–20
castor oil	–10
water	0
olive oil	3
palm oil	24
coconut oil	25

a Room temperature is about 22 ˚C. Name three materials that are liquids at room temperature, and two materials that are solids.

b The temperature in a household freezer is –18 ˚C. Name three materials that are liquids at room temperature, but will freeze in a household freezer. Name three materials that will remain liquid in a household freezer.

2

Jed sells ice, but it melts before he can sell it. In a group, discuss these questions and write your answers:

a How can Jed make sure that the temperature in his freezer box does not go above melting point?

b How could you test your ideas? What do you predict?

c What measurements will you make?

d What equipment will you need?

e What **variables** must you take into account to make sure the test is fair?

3

a Carry out the test you planned in Activity 2.

b What pattern can you see in your results?

c Do your results support your prediction? Explain your results scientifically.

d What conclusion can you draw?

e Make another prediction based on your results.

Scientific words

melting point freezing point conduct
thermal conductivity variables

More about melting

1

Some Stage 6 learners carried out a test to discover how the temperature of ice changes as it is heated. They took crushed ice out of the freezer. They used a digital thermometer to measure the temperature of the ice 1 minute apart. Answer these questions about the **line graph** of their results.

a Describe the pattern of the line graph over time.

b Describe what is happening to the ice in each section of the line graph.

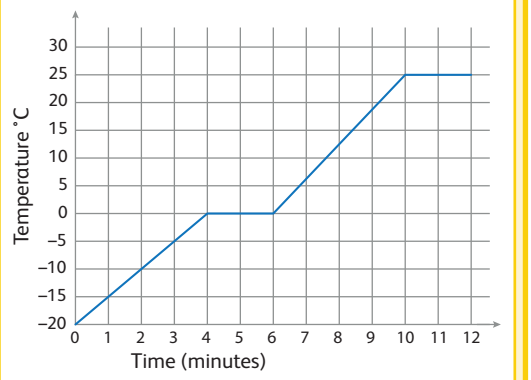
c Predict the temperature after 15 minutes. Explain your answer.

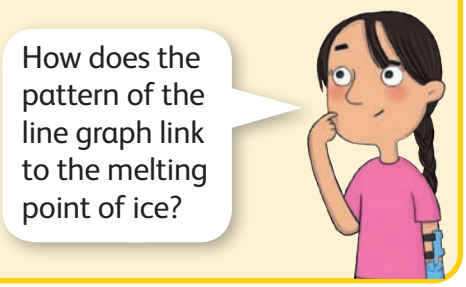
d What was happening to the ice between 4 to 6 minutes? Use data from the graph to explain.

e What was happening to the ice after 10 minutes? Use data from the graph to explain.

f One learner argued that it is possible to heat a substance without the temperature rising. Do you agree or disagree? What are your reasons for your answer?

Line graph to show how the temperature of ice changes as it is heated





Let's talk

Choose one material for each of these properties (for example: margarine, sesame oil, ghee):

- one that is solid when kept in the fridge
- one that is liquid at room temperature
- one that in its solid form is soft enough to put a thermometer inside.

Discuss these questions in a group:

a Are the melting points of your chosen materials the same or different? What do you predict? Explain your prediction using your scientific knowledge about materials.

b What could you do to test your ideas?

c What type of measurements will you need to make?

d Will you need to repeat your measurements? Explain your answer.

2

a Write a plan of the test you discussed in the *Let's talk* activity. Include a labelled diagram showing what you will do.

b Carry out the test you planned.

c Present your results using a line graph.

d Explain whether your results support your prediction.

e What patterns are in your results?

f Are there any results that do not fit the pattern? What do you think caused this?

Scientific word

line graph

Evaporation, boiling and condensation

Let's talk

Discuss what you remember about evaporation and condensation.

a Where has the dew come from?

b Dew forming on grass is an example of which process?

c The dew will evaporate to become which gas?

d What factors will affect the speed at which the dew evaporates?

1

Use the *Think like a scientist!* box to help you answer these questions.

a Where does evaporation take place?

b At what temperature does evaporation take place?

c What are the similarities and differences between evaporation and boiling?

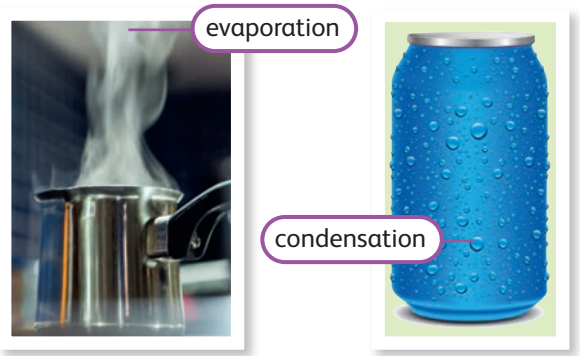
d What happens during the process of condensation?

e What has to happen to a gas before it condenses?

Scientific word
boil

Think like a scientist!

Evaporation and condensation are reversible changes. Evaporation is when a material changes state from a liquid to a gas. It takes place on the surface of a liquid. Evaporation takes place at different temperatures for different materials. You can make a liquid evaporate more quickly by heating it. If you heat a liquid to a high enough temperature it will **boil**. When liquid boils, evaporation takes place throughout the liquid, not just on its surface. You can see bubbles of gas throughout a pan of boiling water.



Condensation is the reverse of evaporation and boiling. Condensation is when a material changes state from a gas to a liquid. A gas condenses if it is cooled enough. A gas may condense when it comes into contact with a cold surface.

2

a Work in a group. On a large sheet of paper, write two headings: *Evaporation* and *Condensation*. Write as many examples of each process as you can.

b Swap sheets with another group. Comment on the other group's work. Say something that you thought was good and something they could find out more about.

Evaporation

Think like a scientist!

Evaporation happens when a liquid slowly changes state to become a gas. When water evaporates, it becomes a gas called **water vapour**.

1

You will need...

- measuring jug
- water
- saucer

Investigate what happens to water when you leave it outside. Start this investigation to observe water evaporation in the morning so that you can complete it the same day.

a Pour 100 ml water into the saucer.

b Place the saucer in a warm place – outside in direct sunlight or on a sunny windowsill.

c A few hours later, measure the volume of water in the saucer. What do you observe?

d Record your observations.

e Explain what has happened to the missing water. Use the correct scientific vocabulary.

Let's talk

Discuss these questions with a partner:

a Predict: In the above *Let's talk* activity, will the water evaporate faster in a sunny place or in a shady place? Why?

b What test could you do to find out the answer?

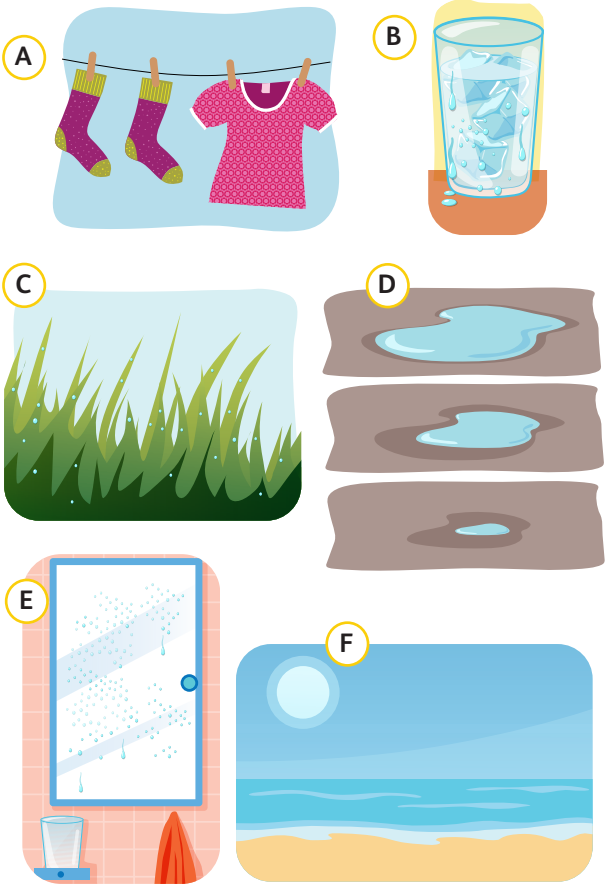
c How could you make sure that the test is fair?

Scientific word

water vapour

Let's talk

With a partner, discuss which pictures show water evaporating to become water vapour.



2

a Carry out the test you discussed in the *Let's talk* activity.

b Describe the results of the test.

c Was your prediction correct? Use your scientific knowledge to explain why or why not.

d What type of scientific enquiry is Activity 1 and 2? Discuss what features of the enquiries make you think this.

Evaporation, air speed and temperature

1

You will need...

- electronic scale
- two washcloths
- bowl of water
- washing line
- clothes pegs
- electric fan
- mains electric socket

a Discuss how the speed or movement of the air (wind) affects how quickly water evaporates.

b Write down your predictions.

c Measure the mass of each dry washcloth. Record each mass.

d Soak both washcloths for the same length of time in the bowl of water. Wring out the water from both washcloths.

e Measure the mass of each wrung-out washcloth. Record its mass.

Work safely!

For safety, the washing line should be above your head. But it should be low enough to reach without stretching.

f Fix the washing line somewhere safe in the classroom. Peg the washcloths on the line.

g Place the electric fan so that it faces one of the washcloths. Plug it into the mains electric socket and switch it on.

h Measure the mass of each washcloth every 30 minutes. Record each mass.

i Do the washcloths dry at different speeds? If so, which washcloth dried faster? Explain why.

2

a In a group, discuss how the temperature of the air affects how quickly water evaporates.

b Write down your predictions.

c Plan and carry out a fair test.

d Decide how you will present your results.

Let's talk

Discuss these questions in your group:

a What have you found out from doing the tests? Were your predictions correct?

b How accurate were your tests?

c If you did your tests again, what would you do differently? What would you improve? How would this help you collect more accurate results?

d Do you think you collected enough data to draw a conclusion?

e Rank these days into the ones you think will dry washing the best. Explain your reasons.

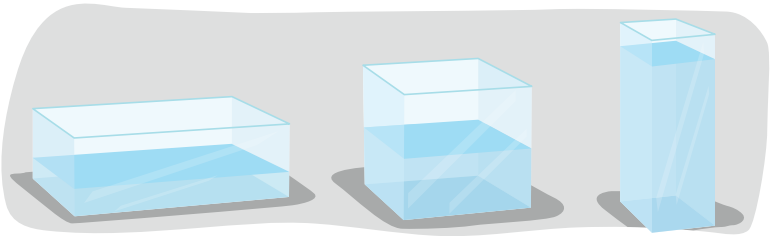
- windy and cold days
- windy and sunny days
- still and cold days
- still and sunny days

f What type of scientific enquiry is Activity 1? What features of the enquiry make you think this?

Evaporation and surface area

Let's talk

Each container holds the same volume of water. The **surface area** (size of the top) of the water is different in each container.



Discuss these questions with a partner:

a Which container has the largest surface area?

b Which container has the smallest surface area?

c From which container do you think water will evaporate fastest? Why?

1

You will need...

- different sized rectangular containers with different surface areas
- sticky labels
- pencil
- ruler
- measuring jug
- water

Investigate how surface area affects the speed of evaporation.

a Label each container with numbers or letters for easy identification.

b Pour the same volume of water into each container.

c Calculate and record the surface area of the water in each container. Read the *Did you know?* box.

d Leave the containers together in a sunny place.

e After a few days, measure the volume of water that is left in each container.

f What conclusion can you draw from your results?

Did you know?

Area = length x width

Area is measured in square units (mm^2 or cm^2).

Think about what evaporates from your body.

Challenge yourself!

If you lick your finger and move it in the air it feels colder, why do you think this happens?

Scientific word

surface area

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