

Can you undo a change?

You know it's important to recycle – to change rubbish back into its original material so it can be used again.

But why can you only recycle some plastics and not others?



Reversible and irreversible change

Scientists use their knowledge to change things. They recycle materials, they make medicines and they even invent new ways of cooking food. But sometimes they need to change a material back to how it was, like recycling a bottle. It turns out that reversing a change can be easy or very hard.

FOCUS ON

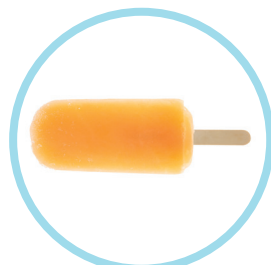
the difference between a reversible and an irreversible change.

Some changes are easy to reverse



Think about what's changing when you make an ice lolly. Liquid fruit juice turns into a solid lolly when you put it in the freezer. Is it easy or hard to reverse the change and get the liquid back?

It's easy! You simply warm up the lolly and it changes back into liquid juice. A change that is easy to reverse like this one is called a **reversible change**.



Solid ice lolly



Liquid fruit juice

Other examples of reversible changes include:

How can you reverse these changes?



Shaping a lump of clay into a pot



Melting chocolate



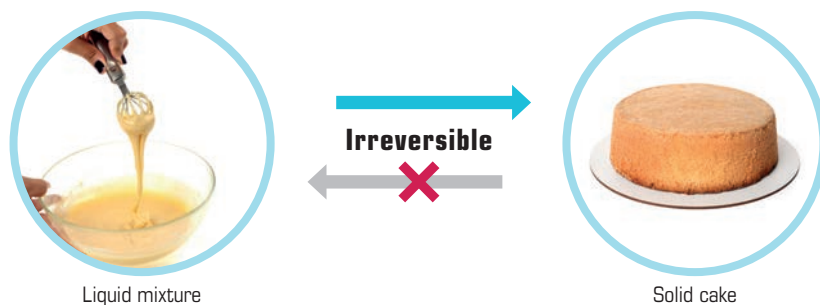
Mixing sand and gravel

Some changes are very hard to reverse



Now think about what's changing when you make a cake. You start with a runny mixture of flour, eggs, sugar and butter. Then when you bake it in the oven, it turns it into a solid cake. Is it easy or hard to reverse this change and get the runny mixture back?

It's very hard. You can't really unbake a cake. A change that is very hard to reverse like this one is called an **irreversible change**.



WRONG!
Irreversible means impossible to change back.

RIGHT!
Actually, almost all changes can be reversed, but some are just very difficult.

Other examples of irreversible changes include:



Frying an egg



Firing clay



Burning wood

Why are these irreversible changes?

REVIEW

- True or false?
 - Heating a substance always causes a reversible change.
 - A reversible change can alter how a substance looks.
 - An irreversible change is one that is very hard to reverse.
- Write one sentence to describe the difference between reversible and irreversible changes.
- Write down if each change is reversible or irreversible:
 - baking bread
 - evaporating water
 - mixing sand and salt
 - melting wax
 - burning a wax candle
- Look at the picture that shows an ice lolly changing. Draw a similar picture to show the change when water boils.
- A jeweller wants to change a gold necklace into a gold ring. Explain how they could do this.



- When plastic bottles are recycled, they are first heated to melt the plastic. Then the liquid plastic is cooled. It hardens into a new plastic object.
 - Is the melting of plastic a reversible or irreversible change?

- When some plastics are heated, they burn rather than melt. Is burning plastic a reversible or irreversible change?
- Why can't you recycle plastics that burn?

What is a physical change?



The instructions on the side of this Instant Snow Powder tin read:

'Experience the magic. Add water, then watch as the powder transforms into fluffy snow! Fool your friends, and re-use it over and over.'

How can this change really work again and again?

FOCUS ON

what changes during a physical change and what doesn't.



Physical change



This sculptor is turning a block of ice into a statue. This change is reversible. He can turn the statue back into an ice block simply by melting it and then re-freezing the water.

The reason it's easy to reverse is that the substance itself has not changed. It's still water whether it's in the liquid state or the solid state. When only the appearance of a substance changes, we call it a **physical change**.

Examples of physical change

Whenever a substance changes state it's a physical change.

WRONG!

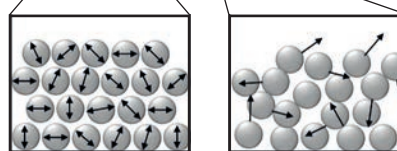
Ice, water vapour, clouds and steam are all different substances.

RIGHT!

They are all the same substance: water. So, changing from one state to another is a physical change.

MELTING AND FREEZING

When you heat the metal lead it melts from the solid state to the liquid state. In the liquid state its particles move more, but they are still the same particles. This means melting is a physical change. Freezing is also a physical change - it's melting in reverse.



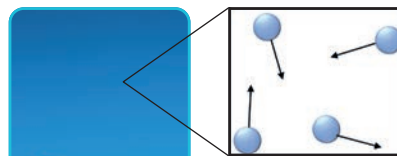
Solid

Liquid

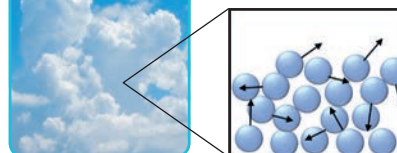
Particles move more but they are the same particles.

CONDENSING AND EVAPORATING

In a cloud, water vapour condenses from the gas state to the liquid state. The water particles move less, but they are still the same particles. It is another physical change. So is evaporating, which is condensing in reverse.



Gas



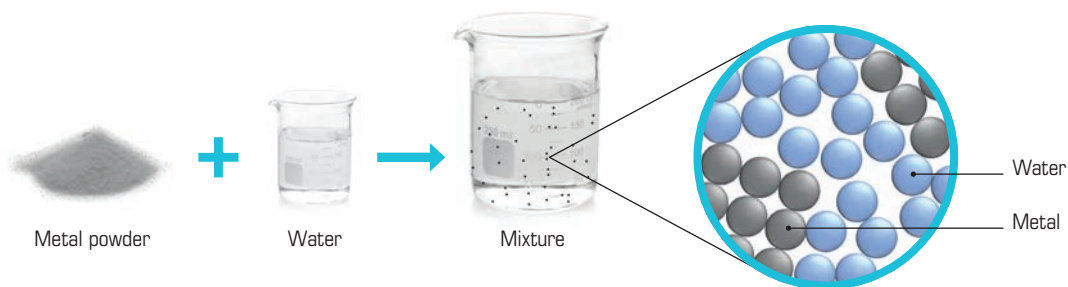
Liquid

Particles move less but they are the same particles.

Making a mixture and dissolving are also physical changes.

MAKING A MIXTURE

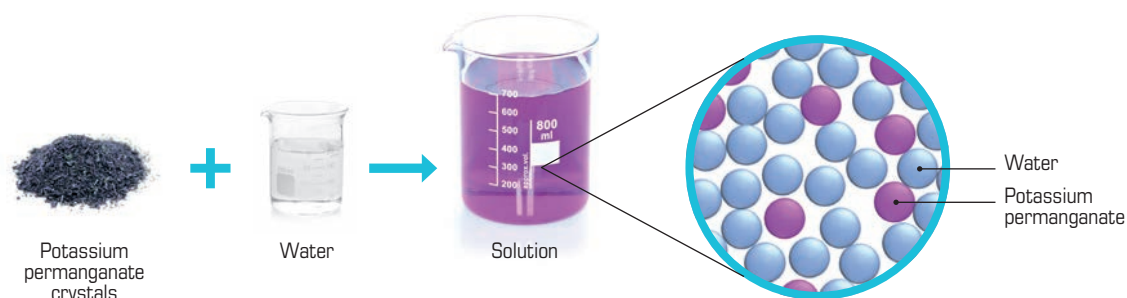
When you mix the metal powder and water, the two substances are still there at the end unchanged. So it's a physical change.



Why are these physical changes?

DISSOLVING

When you dissolve a crystal, the particles mix with water particles. But there are still the same two substances at the end. So it's a physical change.



Some physical changes are irreversible

You might think all physical changes are reversible. But in fact some are very hard to reverse.



When you chop a log you can't easily get it back again. So it's an irreversible change. But it is a physical change because breaking it into parts doesn't change the substance. It is still wood.



When you mix paints you can't easily separate them again. So it's an irreversible change. But it is a physical change because the paints themselves don't change when you mix them.

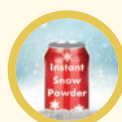
REVIEW

- True or false?
 - New substances are made during a physical change.
 - Physical changes are always reversible.
 - Water turning into steam is a physical change.
- Write one sentence to describe what a physical change is.
- Copy and complete this table.

Type of physical change	Example
Change in state	
Making a mixture	
	Mixing salt and water

- Connie says, 'Melting wax isn't a physical change. It makes a new substance – liquid wax.' Explain why she is wrong.
- If a piece of metal undergoes a physical change, which of these things could change?

Shape	Type of particles	Number of particles
Size	Colour	State of matter



- Adding water to the instant snow powder makes pretend snow. If you leave it uncovered for a while it will turn back into powder. Explain why this is an example of a physical change.

What is a chemical change?



Take these two white powders and crush them together. The mixture will turn yellow.

What could have caused this?

TERMS
Precipitate

FOCUS ON
spotting the four signs of a chemical change.



Chemical change

Baking a cake is a different kind of change to melting or boiling. Heat from the oven turns the baking powder into bubbles of a gas called carbon dioxide. It's what makes cakes light and fluffy. So, the original substance (baking powder) has changed into a new substance (carbon dioxide). We call this kind of change a **chemical change**. The word chemical means substance.

ORIGINAL SUBSTANCE

Baking powder



changes into

NEW SUBSTANCE

Carbon dioxide



Once you've made a new substance it can be very hard to get back the original one. That's why chemical changes are often irreversible.

Examples of chemical changes

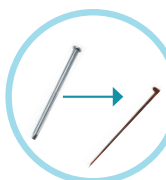
Many experiments that you do in science lessons are chemical changes.



CHEMICAL VOLCANO

Original substances:
Vinegar and baking soda

New substance:
A frothy mixture full of gas bubbles



RUSTING

Original substance:
Shiny iron nail

New substance:
Flaky, brown material called rust



BURNING

Original substance:
Wood

New substance:
A greyish powder called ash

How can you tell that new substances have been made?

Evidence for chemical change

How do we know if a change makes a new substance or not? We look for evidence. Here are the signs that a chemical change is happening.



FIZZING

A chemical volcano makes bubbles of gas. The gas is a new substance. So, if you see fizzing, it's evidence of a chemical change. It's not proof because boiling, which is a physical change, also creates bubbles.



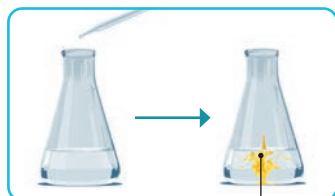
COLOUR CHANGE

If a metal rusts, the colour changes from grey to brown. The brown rust is a new substance. So, if you see a colour change, it's evidence of a chemical change. It's not proof because substances often glow a different colour when they are hot.



HEAT OR LIGHT

Burning wood is a chemical change which makes a flame. It's a combination of heat and light. So if you see heat or light, it's evidence of a chemical change. But it's not proof because an electric heater gives out heat and that's not a chemical change.



Yellow precipitate

A SOLID FORMING IN A SOLUTION

In this experiment, two colourless solutions are mixed and a yellow solid forms. The solid is a new substance, called a **precipitate**. So, if you see a precipitate form, it's evidence of a chemical change.

What other sign of a chemical change is there in this example?

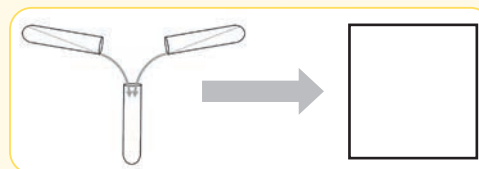
Each sign is a piece of evidence. The more you have, the more likely a chemical change has happened.

REVIEW

- Copy and complete the sentence:
During a chemical change _____ are made.
- List the four signs that are evidence a chemical change may have taken place.
- Copy and complete this table:

Sign	Explanation	Example
Fizzing		
	The new substance has a different colour	
		Burning wood
- Kasey mixed a grey powder with a colourless liquid in a test tube. The mixture fizzed and the outside of the test tube felt warm. Do you think a chemical change happened? How sure are you? Explain why.

- Rashin mixes two solutions in a test tube. A precipitate forms.



- Copy the empty box and draw a diagram inside to show what happens.
- Explain how you know that a chemical change took place.

- Explain why the two white powders turn yellow when they are mixed together.

