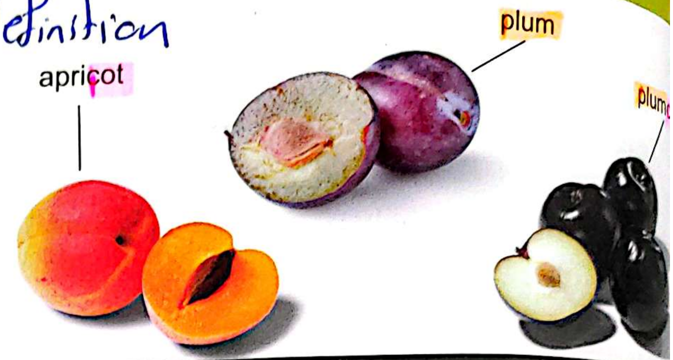
8Bb TYPES OF REPRODUCTIO

WHAT ARE SEXUAL AND ASEXUAL REPRODUCTION?

Sexual reproduction occurs when two organisms breed and produce new organisms. Members of the same species can reproduce sexually to produce offspring that can also reproduce sexually.

Members of two different species cannot usually reproduce, but if they do, the offspring are called **hybrids**. Hybrids cannot reproduce sexually; they are not **fertile**.

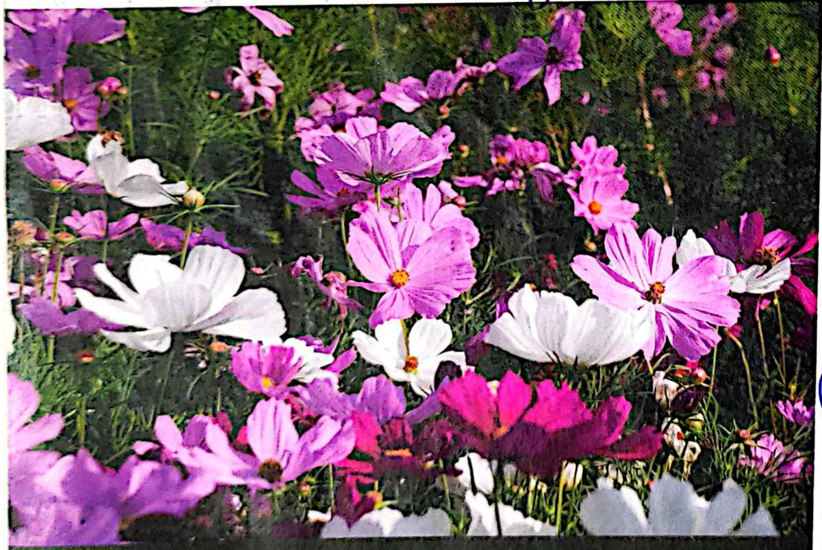


A | A plumcot is the fruit from a hybrid of a plum tree and an apricot tree.

> **1** What is needed for sexual reproduction to happen?
>
> **2** a| Which of the fruits in photo A is a hybrid?
>
> b| Why can't the tree that produces this fruit reproduce?

Sexual reproduction produces offspring that do not lo identical to their parents; they have some characteris from one parent and some from the other. These characteristics are **inherited** and so **variation** in these characteristics is called **inherited variation**.

> **3** Describe one characteristic the plumcot has inherited from:
>
> a| apricots b| plums.



B | Some flowers show a lot of inherited variation.

In sexual reproduction, the parents produce sex cells or **gametes**. A male gamete and a female gamete join together to form a **fertilised egg cell** or **zygote**. The gametes carry the instructions for making a new organism, but each and every gamete made by a parent contains slightly different instructions for characteristics. This means that different offspring wi the same parents will vary, and not look identical.

> **4** What inherited variation is seen in photo B?
>
> **5** In humans what gametes are produced by:
>
> a| males b| females?
>
> **6** Explain why brothers do not usually look exactly alike.

FACT

The male gametes of mosses and ferns are swimming sperm cells. The male gametes of flowering plants and conifers cannot swim and are found inside pollen grains.

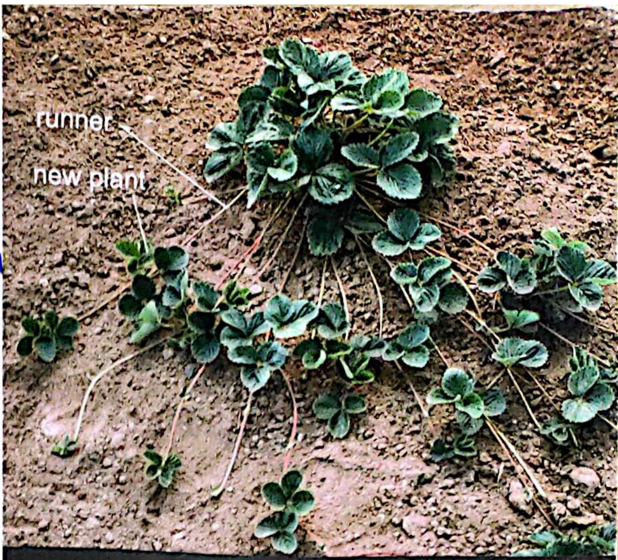
C | a fern sperm (magnification

Asexual reproduction

Plants can reproduce sexually, but many also use **asexual reproduction**. This type of reproduction does not need gametes. Instead, part of the parent plant forms a new plant. This means that the offspring will be identical to the parent.

Strawberry plants grow **runners**, which spread over the ground and sprout roots at intervals. Once the new plants have opened their leaves and can photosynthesise, the runner rots away.

Potato plants grow underground stems. The ends of these swell up to form potato **tubers** (potatoes). They contain a store of food (starch). Each tuber can grow into a new potato plant.

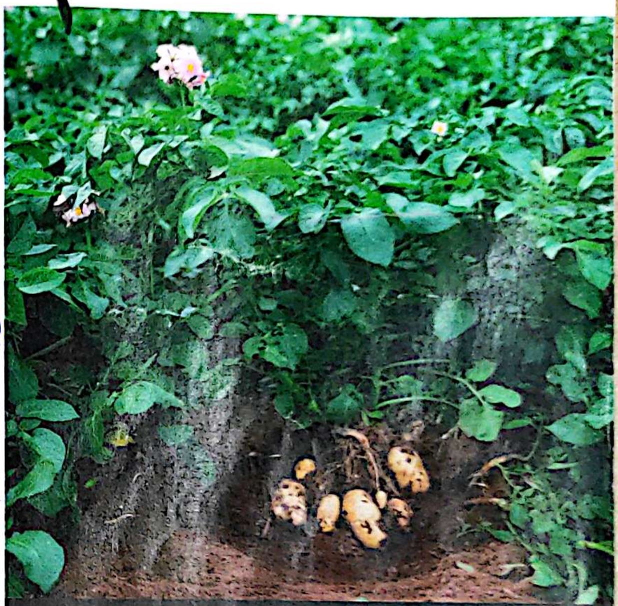


D | Strawberry plants use runners for asexual reproduction.

> **7** What do strawberry plants use to reproduce:
> a| sexually b| asexually?
>
> **8** Tony has seven tubers from one plant in his garden, called *Cyclamen persicum*. When he plants the tubers, why can he be sure that they will all grow into plants that look the same?

Gardeners use asexual reproduction to produce identical new plants quickly and cheaply. Often, they cut off a leaf or side stem from a plant and put it in moist soil. This is called taking a cutting. The cuttings grow roots and form new plants.

Asexual reproduction produces offspring that are all exactly the same as the parent. Asexual reproduction does not produce inherited variation but does allow plants to spread much faster than by using sexual reproduction.



E | Potato plants use tubers for asexual reproduction.

F | taking a cutting

> **9** a| How is taking a cutting an example of asexual reproduction?
> b| Suggest one advantage of taking cuttings compared with collecting seeds from plants and growing them.

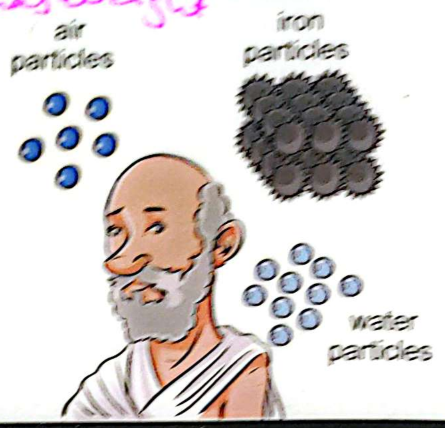
I can ...

- recall the differences between sexual and asexual reproduction
- recall examples of asexual reproduction in plants
- explain characteristics of offspring produced by sexual and asexual reproduction.

8Fa DALTON'S ATOMIC MODEL

WHAT ARE ATOMS LIKE?

The idea that all **matter** is made up of tiny particles started over 2400 years ago. The Greek thinker Democritus wrote about this and called the particles *atomos*, meaning 'indivisible'.



A | Democritus thought these particles had different sizes and shapes, which explained the different properties of substances.

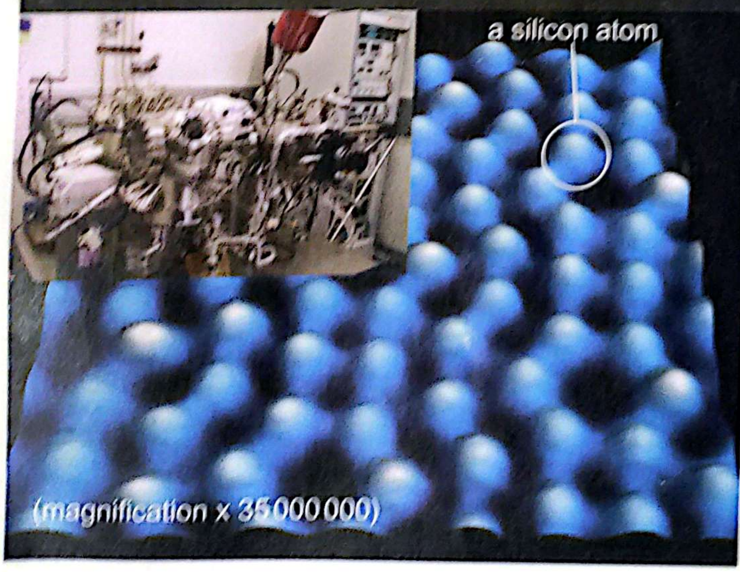
> **1** How did Democritus explain the different properties of substances?
>
> **2** Describe what we now know about the spacing and movement of particles in ice, water and steam.

In 1805, the English chemist John Dalton (1766–1844) published his atomic theory or model, which said:

- all matter is made up of tiny particles called **atoms**
- the atoms in an **element** are all identical (but each element has its own type of atom)
- atoms are indestructible and cannot be created or destroyed
- in **compounds**, each atom of an element is always joined to a fixed number of atoms of other elements
- during chemical reactions, atoms rearrange to make new substances.

> **3** Use Dalton's model to describe what an element is like.
>
> **4** Suggest a difference between how Democritus and Dalton worked out their ideas.

B | The scanning, tunnelling electron microscope can now show us images of atoms and provides further evidence for Dalton's theory.



FACT

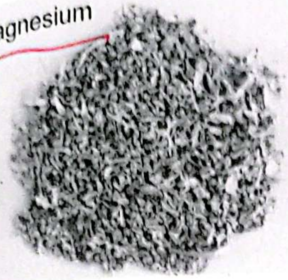
Atoms are extremely small. There are about 50 167 000 000 000 000 000 000 000 atoms in a 500 cm^3 bottle of water.

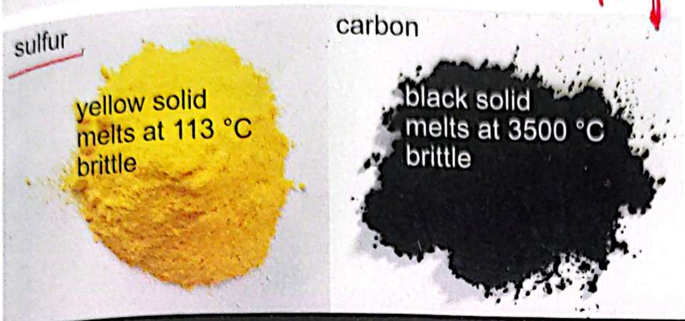
Physical properties

Dalton's atomic model says that all the atoms in an element are identical but that each element has its own type of atoms. The differences in the atoms give each element its own, distinct **properties**.

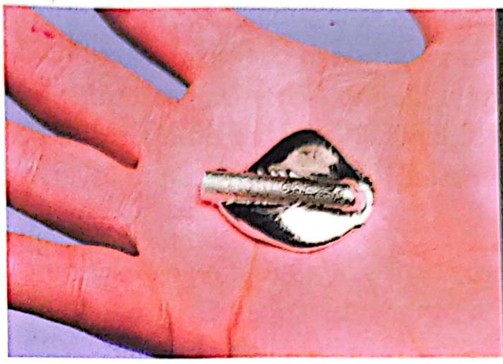
The properties that describe a substance on its own are its **physical properties**. Examples include:

- colour
- melting point
- boiling point
- density
- strength
- flexibility
- conduction of heat
- conduction of electricity.

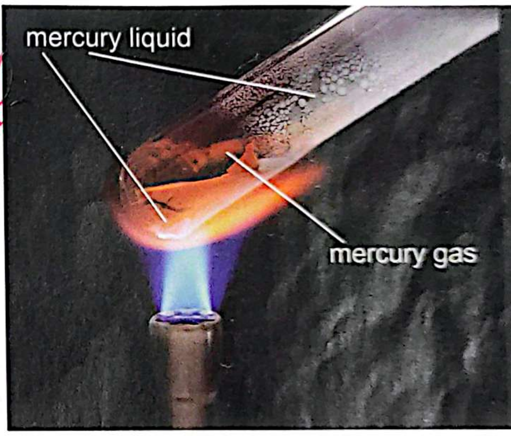




C | some elements used in fireworks and their physical properties



D | Gallium is a metal with a melting point of 30 °C. It will melt in your hand!



E | Mercury evaporates to form a gas when heated. On cooling, the change reverses and droplets of liquid mercury form by condensation.

5 Draw a table to compare the physical properties of the four elements shown above.

6 Which physical properties allow us to work out the state of an element at room temperature?

Physical changes, like physical properties, only involve one substance. These changes are often easy to reverse, like the changes of state shown in photos D and E.

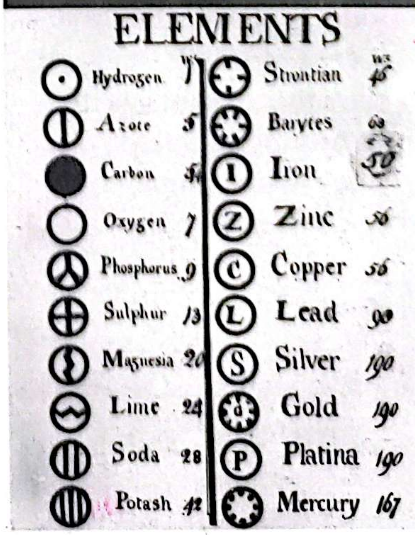
Symbols

To show different atoms, Dalton introduced **symbols** to represent them. The modern symbols are similar but consist of one or two letters (the first letter being a capital), e.g. C for carbon and Cl for chlorine. They have been agreed by the International Union of Pure and Applied Chemistry (IUPAC). All countries use the same symbols so that all scientists can communicate with each other, even though they may use different languages.

7 a| What change will occur if liquid gallium is removed from the hand in photo D?

b| Explain three other changes of state.

F | Dalton's symbols



8 a| Draw Dalton's symbols for the elements:
i| strontium ii| hydrogen iii| phosphorus iv| oxygen v| lead.

b| Give one example of an IUPAC symbol for an element.

c| Why are international symbols useful?

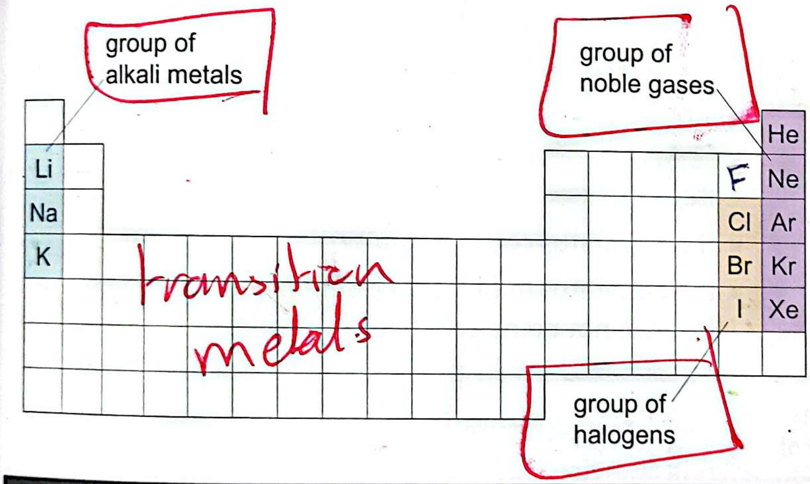
I can ...

- describe Dalton's atomic theory
- describe elements using physical properties
- write and identify the chemical symbols for elements.

that every eighth element had similar properties. The pattern was not consistent and Newland's ideas were dismissed as nonsense at first.

In 1869, however, the Russian chemist Dmitri Mendeleev (1834–1907) published his **periodic table**. Like Newlands, he placed the elements in order of increasing masses of their atoms, forming them into groups with similar chemical properties. One of his original notes can be seen in photo C.

D | Mendeleev and his original periodic table



E | outline of the modern periodic table

3 Use photo C to help you answer the following questions.

a| Give the names and symbols of three elements in Mendeleev's notes.

b| What do the numbers represent?

Mendeleev made sure the elements all fitted into groups with similar properties by changing the order in a few places and leaving gaps for undiscovered elements. He even predicted the properties of the undiscovered elements correctly.

A modern version of the periodic table is shown on page 206. In the modern version, elements with similar properties end up in vertical **groups**. Diagram E shows an outline of the periodic table and the positions of two of Döbereiner's triads. These elements are in groups called the **alkali metals** and the **halogens**.

Mendeleev was not always correct. When argon was discovered in 1894, it did not fit into any of Mendeleev's groups, so he denied its existence. Later argon, along with helium, neon, krypton and xenon, was shown to belong to a new group of elements. These very unreactive gases are in a group we now call the **noble gases**.

4 Describe one chemical property of:

a| halogens b| alkali metals c| noble gases.

5 Why did Mendeleev not believe that argon existed when it was discovered?

6 a| In what order did Mendeleev place the elements in his periodic table?

b| What do elements in the same group have in common?

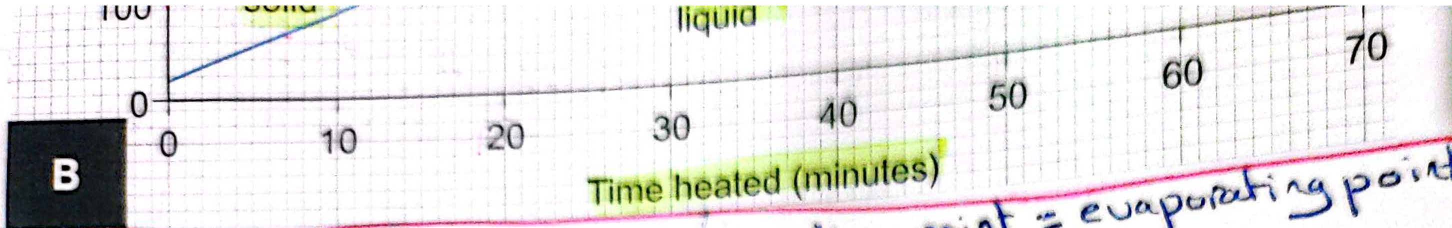
c| Describe two things that Mendeleev did to make the elements fit into the correct groups.

FACT

There is now an element named after Mendeleev. See if you can find it in the periodic table.

I can ...

- use the periodic table to find elements with similar properties
- describe some typical properties of alkali metals, halogens and noble gases
- describe how the periodic table is arranged.



B

...temperature possible. The boiling point of water on the kelvin scale is 373.15 K

meltingpoint = freezing point / boiling point = evaporating point

1 Look at graph B.

a| What is the melting point of sulfur and what is its boiling point? 110 420

b| What state is sulfur in at:
i| 75 °C ii| 140 °C?

2 a| Describe what happens to the movement and spacing of the particles as sulfur melts.

b| Explain why the temperature of the liquid does not change as it boils.

Looking for trends

A trend is a pattern of changes, which shows an increase or decrease. We can find trends in the periodic table.

In the modern table, the vertical columns are called groups and the horizontal rows are called **periods**. There are eight main groups, separated by the block of elements called the **transition metals**. Table C shows the main group elements with information about their physical properties.

The data in table C shows clear trends in properties down many of the groups: for example, the melting points of the alkali metals decrease from lithium to rubidium.

boiling point of water = 100 °C = 373 K / Lowest temperature possible = zero point = -273 K
melting point = 0 °C = 273 K

3 Name and give the symbol for an element that is:

a| in the same group as carbon

b| in the same period as sulfur.

4 Look at figure C.

a| What is the freezing point of nitrogen?

b| When heated from 20 °C, would aluminium or magnesium melt first?

c| What state would magnesium be in at:

i| 100 °C ii| 1000 °C?

5 a| Describe the trend in melting point down groups 7 and 0.

b| Estimate the melting points of caesium (Cs) and astatine (At). Caesium is in group 1 and astatine is in group 7.

element name
melting point (°C)
boiling point (°C)

*sublimes (changes directly from a solid to a gas)

group 1	group 2	group 3	group 4	group 5	group 6	group 7	group 0
hydrogen −259 −253							helium −272 −269
lithium 181 1347	beryllium 1278 2970	boron 2300 4000	carbon *3642	nitrogen −210 −196	oxygen −218 −183	fluorine −220 −188	neon −249 −246
sodium 98 883	magnesium 649 1090	aluminium 660 2467	silicon 1410 2333	phosphorus 44 280	sulfur 113 445	chlorine −101 −35	argon −189 −186
potassium 63 739	calcium 842 1484	gallium 30 2403	germanium 937 2830	arsenic *614	selenium 217 685	bromine −7 59	krypton −157 −152
rubidium 39 688	strontium 769 1384	indium 157 2080	tin 232 2602	antimony 631 1750	tellurium 452 988	iodine 114 184	xenon −112 −107

C | looking for trends

metal
semi-metal
non-metal

1	2											3	4	5	6	7	0
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg	←			transition metals						→	Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

D | metals, semi-metals and non-metals

The trends are not so obvious in the periods across the periodic table, where large differences in properties can be seen between certain neighbouring elements. These changes help us to split the elements into metals and non-metals. Some elements have properties in between those of metals and non-metals and these are sometimes called semi-metals.

Table E compares the main properties of metals and non-metals.

E

Metals	Non-metals
▪ high melting points ▪ strong, **flexible** and **malleable** ▪ shiny (when polished) ▪ good conductors of heat and electricity	▪ low melting points ▪ **brittle** (when solid) ▪ dull ▪ poor conductors of heat and electricity

6 Which of the properties in table E best splits metals from non-metals? Explain your choice.

7 Explain why silicon (Si) and germanium (Ge) are described as semi-metals.

I can ...

- explain melting, freezing and boiling points and use them to predict the state of a substance
- describe and identify trends in physical properties within the periodic table
- identify metals and non-metals by their properties and position in the periodic table.

8Kb TRANSFERRING ENERGY

HOW IS ENERGY TRANSFERRED BY HEATING?

Energy can be transferred by heating in several ways: evaporation, **radiation**, **conduction** and **convection**.

Radiation

When you stand near something hot, such as a radiator, your skin feels warmer. Energy is transferred from hot objects by radiation (sometimes called **infrared radiation**).

All things give out or **emit** infrared radiation. The hotter the object, the more infrared radiation it emits. When radiation hits something, it can be **absorbed** (taken into the object) or **reflected**.

Infrared radiation transfers energy by waves, in a similar way to light. It does not need a **medium** to travel through, and it can also go through transparent substances like air or glass. Infrared radiation can also be focused. Energy travels to the Earth from the Sun by infrared radiation and this energy will burn paper if you focus it using a magnifying glass.

Thermal imagers are instruments that measure infrared radiation and convert the data into maps of temperatures. Thermal imaging can be used for filming things at night.

1. Describe three ways in which infrared radiation and light are similar.
2. Explain which will emit the most radiation: a mug of hot water or a mug of cold water.

A | The children near this fire are being warmed by infrared radiation.

B | Infrared radiation can be focused.

Conduction

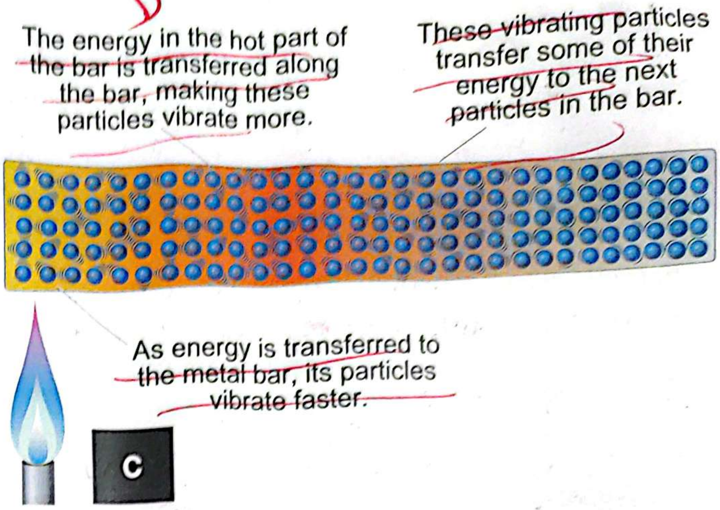
Energy can be transferred through many solid materials by conduction. When a soli is heated, the particles vibrate more. Thes vibrations are passed through the solid. Energy is transferred easily through meta in this way. Metals are good **thermal conductors**. Materials such as wood and plastics are good **thermal insulators** – energy is not transferred through them b conduction very well.

3. a| Why are saucepans usually made from metal? to conduct
   b| Why are saucepan handles usual made from wood or plastic?

Conduction usually happens best in solids because the particles are very close together. Conduction does not take place very well in liquids. It hardly happens at all in gases because the particles are a long way apart.

4 Explain how energy is conducted through a solid object. Use ideas about particles in your answer.

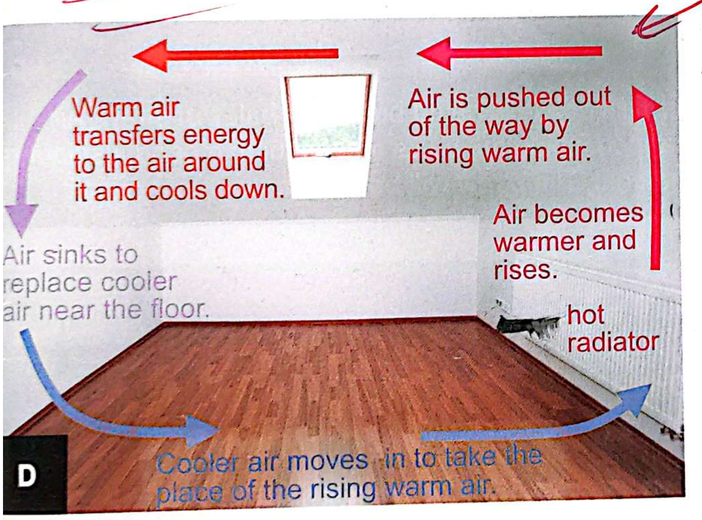
5 Why are solids better thermal conductors than liquids?



C

Convection

Energy is transferred through **fluids** (liquids and gases) by convection. When part of a fluid is heated it expands and becomes less dense than the fluid around it. It floats upwards through the remaining fluid. Cooler fluid moves in to take its place and a **convection current** forms. Convection currents can also form when part of a fluid is colder than its surroundings.



D

6 Look at photo D.

a| How is energy transferred from the hot water inside the radiator to the air in the room?

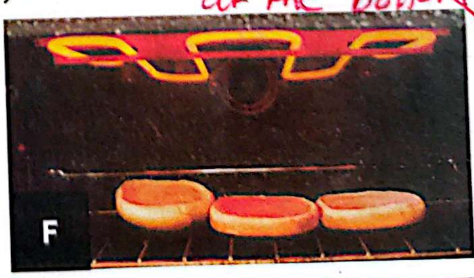
b| How is energy transferred to the side of the room opposite to the radiator?

7 a| Why will air sink if it is colder than the air around it?

b| Sketch a diagram of an ice lolly. Add arrows to show the direction of the convection currents caused by the cold lolly.

8 Why can't energy be transferred through space by conduction or convection?

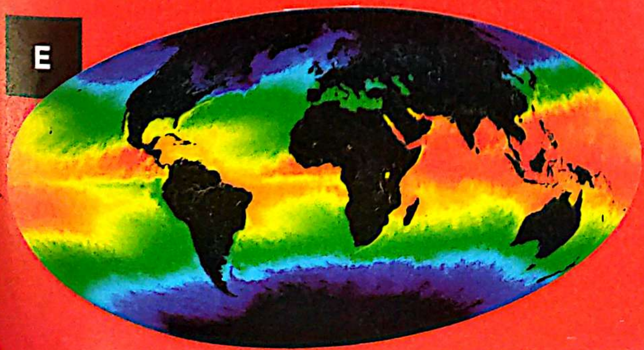
9 Look at photo F. Is the food being cooked by conduction, convection or radiation? Explain your answer.



F

FACT

This temperature map was made using infrared measurements from satellites. The different temperatures in the oceans cause convection currents in the air above. We feel the movement as wind.



E

I can ...

- describe how energy is transferred by radiation, conduction and convection
- use the particle model to explain energy transfers in