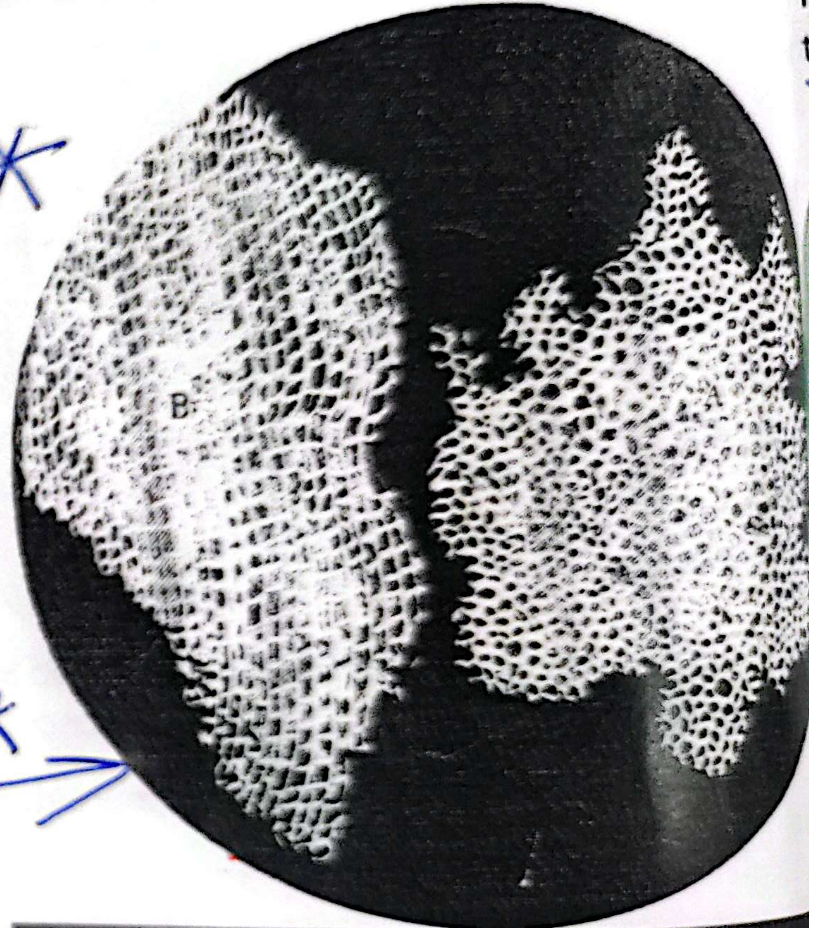
A | Hooke's microscope (far left) had a total magnification of about ×30. Early 19th-century microscopes magnified to about ×200. Modern light microscopes go up to about ×1500.

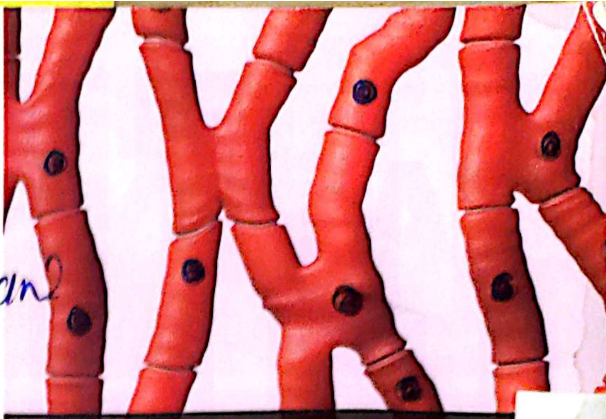
Robert Hooke was the first person to study tissues with a microscope. In 1665, he examined the bark of a cork oak tree and saw little box shapes. He thought that they looked like the **cells** (small rooms) in a monastery and so that's what he called them.

Today we know that cells are the basic units from which all tissues and all living things are made. A tissue is a group of cells of the same type working together.

1. What is a cell?
2. Granville was able to see much more in the mummy tissues than Hooke saw in the cork tissue. Why was this?
3. What do organisms always have that things that have never been alive do not?



B | Hooke's drawing of cork cells, publishe[d] in his book *Micrographia*

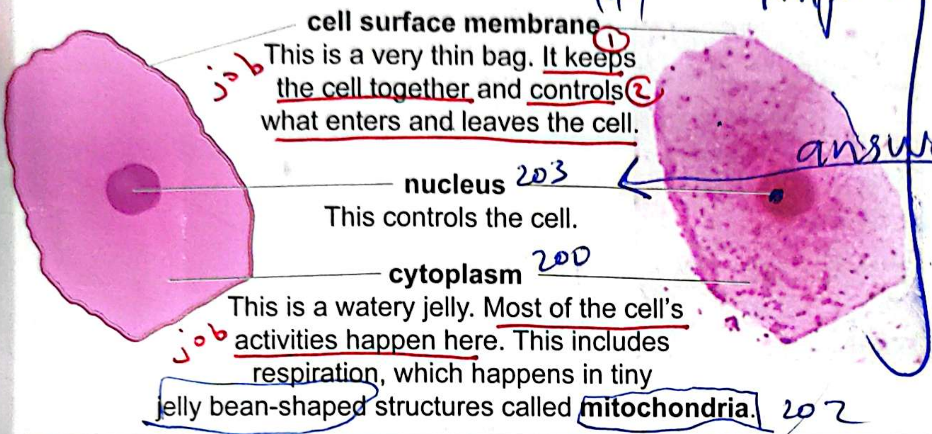


D | Heart muscle cells work together in heart muscle tissue. They are specialised to make the heart move (magnification ×500).

Animal cells

Photo C shows a cell from someone's cheek, viewed using a modern microscope. The photograph has a magnification of ×600, which means that it is 600 times bigger in the photo than in real life. The different parts of the cell are labelled.

All animal cells have the same basic parts, but cells from different tissues have different shapes, sizes and functions to help them do their jobs. The cells are **specialised**.



C | a drawing and microscope image of a cheek cell showing its parts (magnification ×600)

4 a| Look at photo D. What are the dark blobs?
b| What do these structures do?
c| What other parts would you find in a heart muscle cell?
d| What do these parts do?

5 a| Measure the widest part of the animal cell in photo C. Work out its real width.
b| Measure the length of the plant cell in photo E. Work out its real length.

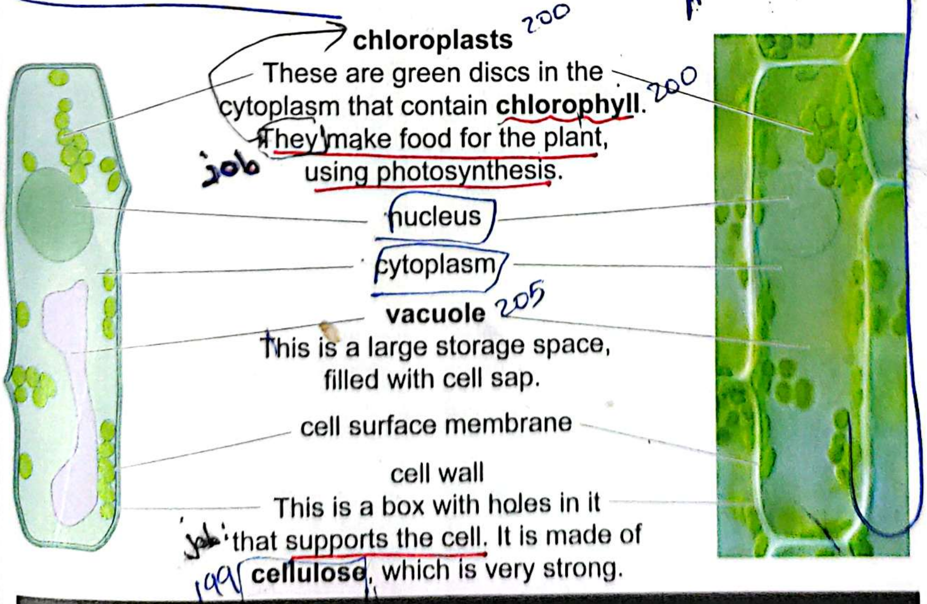
6 Draw a table to compare the parts that can be found in animal cells and plant cells.

7 a| What makes some plant cells green?
b| Which are bigger, chloroplasts or mitochondria? Explain your evidence.

8 Draw and label a root hair cell.

Plant cells

Plant cells have thick **cell walls** and may have some other features that are not found in animal cells.



E | a drawing and microscope image of a leaf cell showing its parts (magnification ×275)

F | Root hair cells are specialised to take water from the soil (magnification ×30).

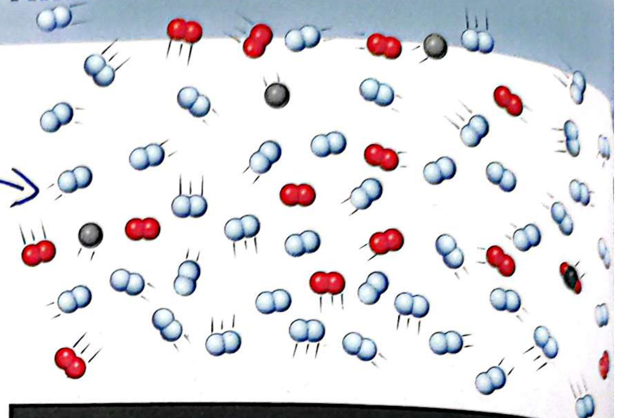
I can ...

- identify the main parts of animal cells and plant cells and describe their functions.

7Ha THE AIR WE BREATHE

WHAT KINDS OF PARTICLES ARE FOUND IN AIR?

Like all matter, air is made up of tiny **particles**. However, the air we breathe is **not pure**. It contains a mixture of gases, including nitrogen, oxygen, argon and **carbon dioxide**. These different substances have different properties, as they are made up of different types of particle.



A | Air contains a mixture of particles.

The simplest particles of matter are called **atoms**. We can imagine that an atom looks like a tiny ball. Argon gas is made up of atoms like the ones shown in diagram B.

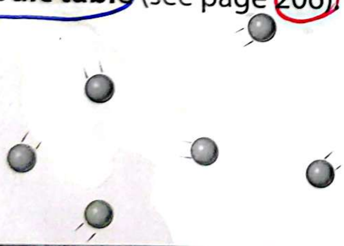
In many substances the atoms are held together in groups called **molecules**. Oxygen and nitrogen are molecules that have two atoms joined together. All the molecules of a certain substance always contain the same type and number of atoms.

1 Describe the arrangement of particles in all gases.

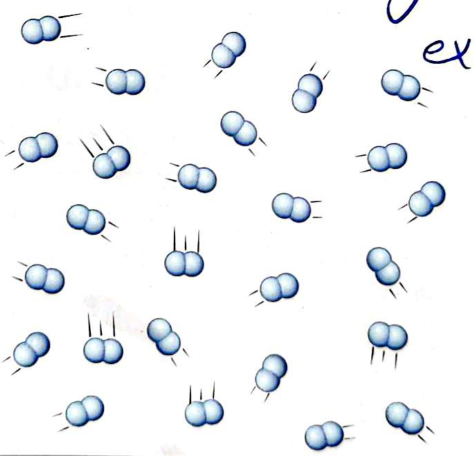
2 a| Using the information on page 120, state the percentage of each gas shown in diagram A.

b| Explain why it is wrong to use the term 'pure air' in science.

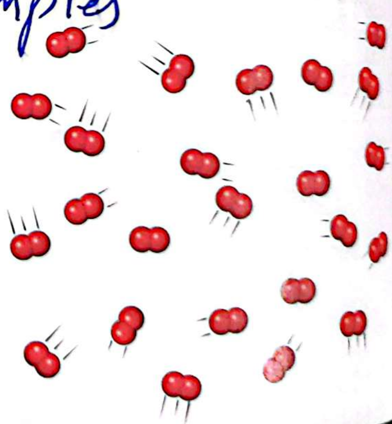
All substances are made up of atoms. If they are made up of one kind of atom, like argon, oxygen and nitrogen, they are called **elements**. Atoms and elements are the building blocks of all matter. There are only about 90 different types of atom found naturally anywhere on Earth. So there are only about 90 different naturally occurring elements. They are all listed in a table called the **periodic table** (see page 206).



B | atoms of argon

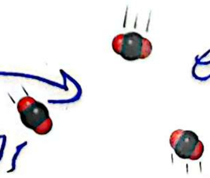


C | molecules of nitrogen



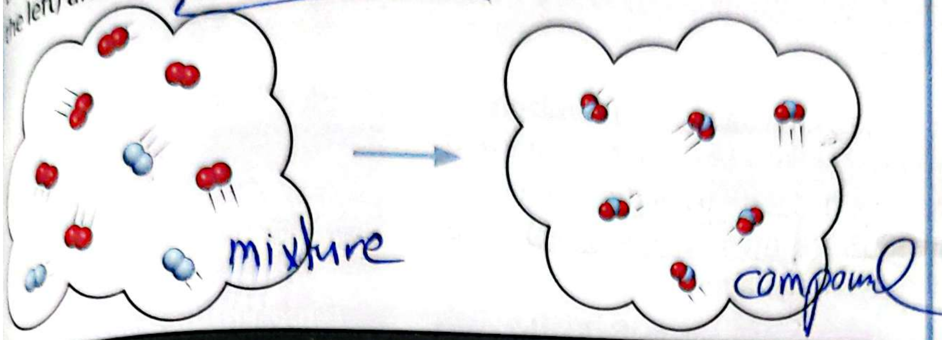
D | molecules of oxygen

The word 'elementary' means simple. Elements are simple substances. You cannot split an element up into anything simpler using a chemical reaction. Most substances, however, can be broken down as they contain more than one kind of atom. If different kinds of atoms are joined together in a substance, the substance is a **compound**. Of the four important gases in air only carbon dioxide is a compound. It contains molecules made up of two elements, carbon and oxygen, joined together.



E | molecules of the compound carbon dioxide

To make a compound, the atoms of the elements have to be joined together. If they are not joined, then it is a mixture of elements. Diagram F shows the difference between a mixture of elements (on the left) and a compound (on the right).

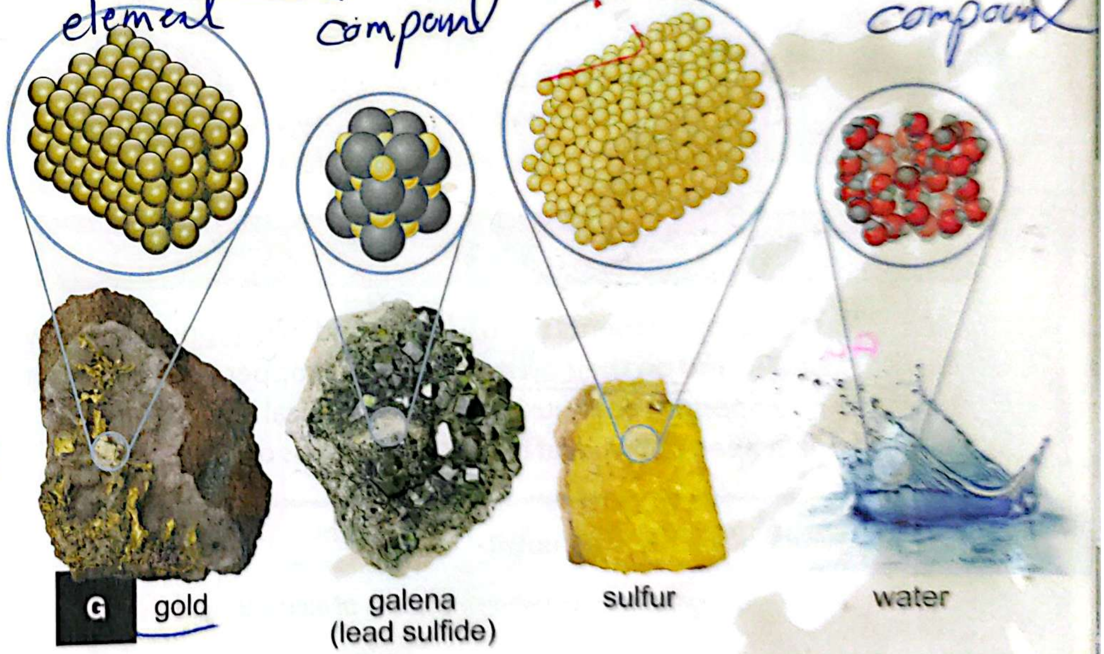


F | A mixture of nitrogen and oxygen can form a compound called nitrogen dioxide.

Although there are only about 90 elements on Earth, there are millions of different substances. The 90 elements join together in different ways to form many different compounds, just like the 26 letters of our alphabet can make millions of different words.

FACT

There are now about 28 manufactured elements to add to the 90 natural elements that have been discovered. The newest element is number 117 in the periodic table. It doesn't have an official name yet so scientists call it ununseptium, which means number 117.



G

3 Use the periodic table on page 206 to find out which of the following substances are elements: zinc, plastic, sea water, chlorine, gold, lead, wood, magnesium, granite and iodine.

4 Describe the difference between:

a elements and compounds

b atoms and molecules.

5 How many different kinds of atom are there in diagram A?

6 Which of the substances in diagram G are elements and which are compounds? In each case briefly explain your choice.

7 The water of our seas and oceans covers over half the surface of the Earth. Each water particle is formed by joining two atoms of hydrogen to one atom of oxygen. The sea also contains dissolved substances, including sodium chloride (salt) and oxygen gas, which supports all sea life.

Using examples of substances from the above passage explain the difference between pure substances and mixtures, elements and compounds, and atoms and molecules.

I can ...

- recognise the difference between atoms and molecules
- identify elements, mixtures and compounds from descriptions and particle diagrams.

7Ga SOLIDS, LIQUIDS AND GASES

HOW ARE SOLIDS, LIQUIDS AND GASES DIFFERENT?

The different properties of waste materials have to be considered when recycling or disposing of the waste. **Corrosive**, **flammable** and **toxic** materials present particular **hazards** and have to be handled carefully.

Waste materials exist in all three **states of matter** (solids, liquids and gases) and have different properties. Therefore they have to be handled differently, during recycling and disposal.

A | Symbols warn of hazardous substances.

Solids

In general, solids do not **flow** or change their shape. Solids stay in one place, unless they are pushed or pulled.

As most of it is solid, most waste going to landfill sites stays where it is put. Solid waste, such as **metals**, paper and plastic, is often easy to transport in open lorries.

The **volume** of an object is the amount of space that it takes up. It can be measured in **cubic centimetres** **(cm³)**. The volume of a solid does not change a great deal and so, even when squeezed, solids cannot easily be **compressed** (squashed into a smaller volume).


B | scrap metal being transported for recycling

1. Describe the properties of a solid.
2. What property allows solid waste to be left in piles at landfill sites? NOT flow

Liquids

Liquids can change their shape and flow. So liquids take the shape of their container. However, liquids don't change their volumes and they cannot be easily compressed.

As they are able to flow, liquid wastes can be pumped along pipelines. It would be very difficult to transport liquids in an open truck like the one in photo B. The liquid would slosh about as it was moved and could spill.


C | Waste cooking oil can be converted to biodiesel.

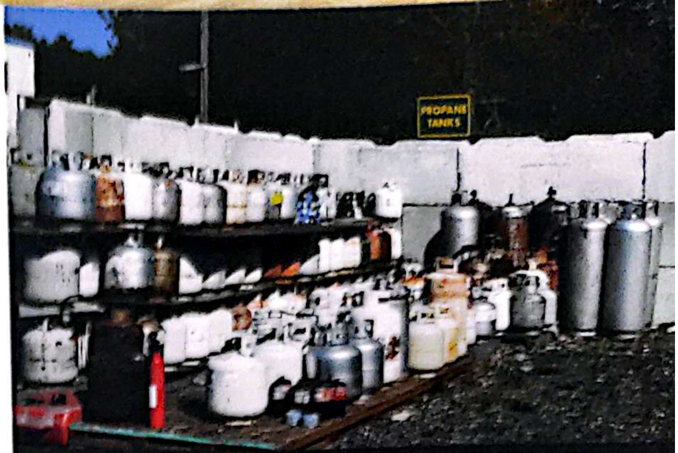
FACT

Waste cooking oil from restaurants can be converted to biodiesel. In the UK all diesel sold must contain at least 5 per cent of biodiesel.

Gases

(1) properties of gases

Gases can change their shape and their volume. They can spread out in all directions and they can also be easily (2) compressed into a smaller volume. The gas cylinders in photo D can contain a lot of gas that has been squeezed into them under **pressure**. They are stored away from other areas in the recycling plant as there could still be gases in the cylinders that are flammable and could cause an explosion or major fire. (5)



D | Gases can be compressed into a small volume.

3 Draw a table to show the differences between solids, liquids and gases. Use these headings: at notebook

Keeps its shape, Keeps its volume, Able to flow, Able to be compressed.

4 Look at photos B and C. Why do solid and liquid wastes need to be transported in different ways? different properties

Many waste gases are released directly into the atmosphere where they can cause harm to the **environment**. Factories and power stations that burn **fossil fuels** produce large amounts of acidic gases. All industries have now taken steps to reduce the amount of harmful gases released and the problem of **acid rain** has almost been solved.

It is not always easy to identify the state of a substance using its properties. For example, sand is a solid but it flows like a liquid as it is made up of small pieces.

E | waste gases released into the atmosphere

5 A cuboid block of wood measures 4 cm high by 5 cm deep by 10 cm long. What is its volume, in cubic centimetres (cm^3)?

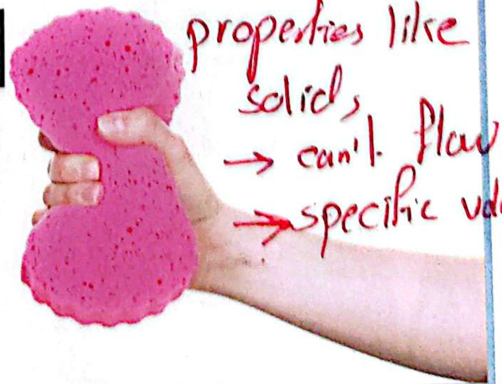
$4 \times 5 \times 10 = 200\ cm^3$

6 In the past, acidic gases produced in the UK have affected life in lakes in Norway. Explain why gases produced in one country can become a problem for other countries. can spread out

7 Look at photo F. How can a sponge be described as a solid if it can be squeezed like this?

it is still have some properties like solid, → can't flow → specific volume,

F



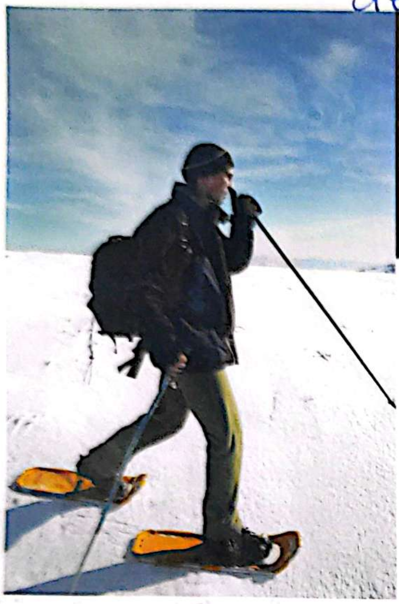
I can ...

- name the three states of matter and give examples of each
- describe what the three states of matter are like, based on their properties
- identify materials that are difficult to classify as solids, liquids or gases.

7Kd PRESSURE

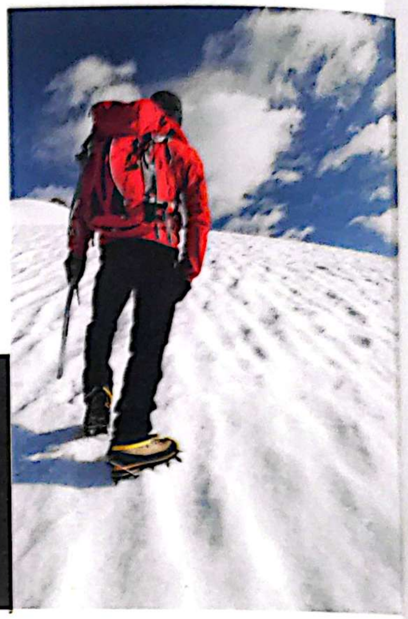
HOW IS PRESSURE USED IN SPORTS?

Pressure is the amount of force pushing on a certain area. Pressure is important in many sports.



A | The walker is wearing snowshoes to spread his weight. The snowshoes reduce the pressure under his feet, to stop them sinking into the soft snow.

B | This mountaineer is walking on hard snow and slippery ice. The crampons on her boots have spikes to concentrate her weight. The points stick into the ice and stop her slipping. The crampons increase the pressure of her feet on the ice.



If there is a high pressure beneath a person's feet, or beneath a vehicle, it is more likely to sink into snow, mud or sand. The size of the pressure depends on the size of the force and the size of the area it is pushing on.

If you keep the size of the force the same:

- for a larger area, the pressure will be lower
- for a smaller area, the pressure will be higher.

If you keep the area the same:

- for a larger force, the pressure will be higher
- for a smaller force, the pressure will be lower.

Pressure affects everyday things as well. It is easier to cut something with a sharp knife than with a blunt one. The sharp knife has a smaller edge, so the force you put on the knife is more concentrated over a smaller area on the object you are cutting.

1 Look at the vehicle in photo C.

a| Is the pressure under the wheels high or low?

b| Explain why the tyres need to be so large.

C

2 The person in photo A puts on a larger pair of snowshoes. Explain how the pressure under his feet will change.

3 a| Explain why a drawing pin is easier to push into the wall if the point is sharp.

b| Explain why the drawing pin has a large head for you to push on.

We use this formula to calculate pressure:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Force is measured in newtons (N) and area is measured in square metres (m^2), so the units for pressure are newtons per square metre (N/m^2). This unit is also called a **pascal (Pa)**. 1 Pa = 1 N/m^2.

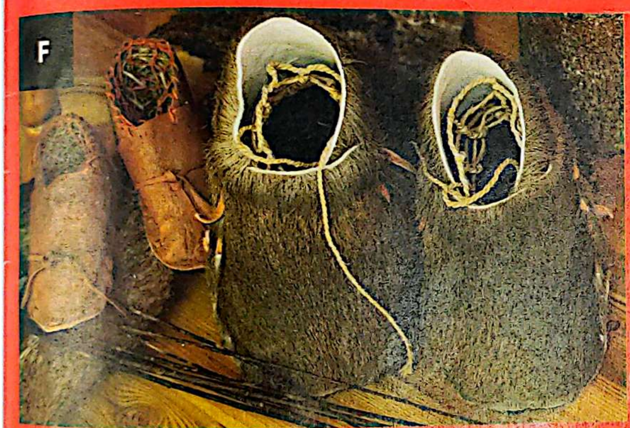
If the area being measured is small, you can measure it in square centimetres (cm^2). The unit of pressure will then be N/cm^2.

The points on Alex's crampons have a total area of 0.2 cm^2. To calculate the pressure under the points:

$$\text{pressure} = \frac{\text{force}}{\text{area}} = \frac{800\,N}{0.2\,cm^2} = 4000\,N/cm^2$$

E | The wide tracks and the skis stop the snowmobile from sinking into the snow. The lugs that stick out of the tracks dig into snow or ice to give grip.

FACT



In 1991, a preserved body was found in a glacier. The body was from about 5300 years ago and was named Otzi. His shoes may be the oldest examples of snowshoes. Photo F shows a reconstruction of his normal shoes and his snowshoes.

4. How could you find the pressure under your shoes when you are standing up? List the apparatus you will need and explain how you would use it.
5. Look at photo D. Calculate the pressure under Sam's snowshoes.
6. Look at photo E. Explain how the tracks and the lugs work. Use ideas about pressure in your answer.

I can ...

- calculate pressure and recall its units
- describe the effects of high and low pressure in simple situations.