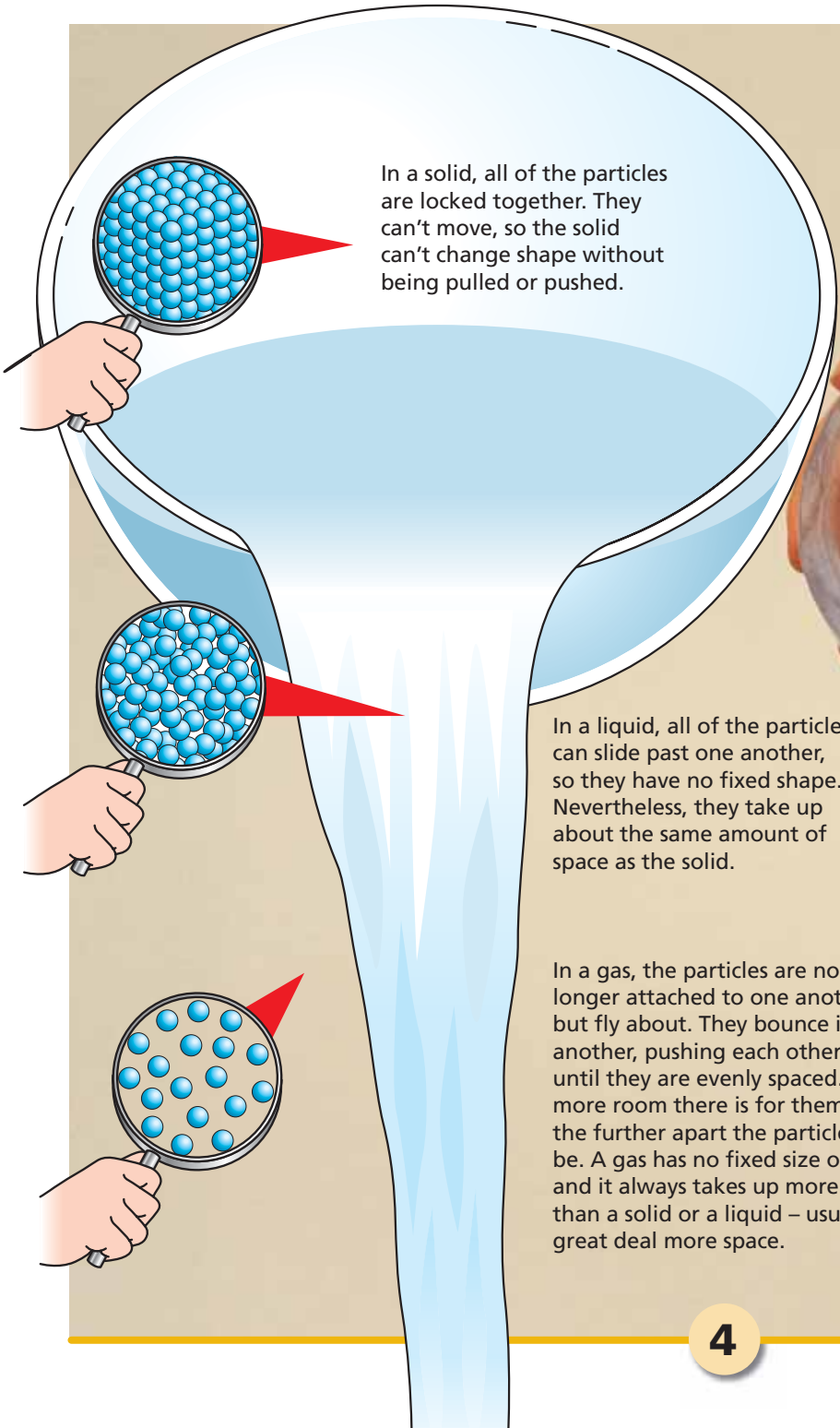
1 How substances change

All pure substances can occur as solids, liquids or gases.

It is difficult to imagine a substance being **SOLID**, **LIQUID** and **GAS** all at the same time. But you only have to look at water to find an example (Picture 1).

▼ (Picture 1) Ice melts at 0°C. Here an ice bowl has been made in a freezer. As it melts in normal room temperatures, liquid water forms inside, which can then be poured out. At the same time, some of the water goes up into the air.



In a solid, all of the particles are locked together. They can't move, so the solid can't change shape without being pulled or pushed.

In a liquid, all of the particles can slide past one another, so they have no fixed shape. Nevertheless, they take up about the same amount of space as the solid.

In a gas, the particles are no longer attached to one another, but fly about. They bounce into one another, pushing each other apart until they are evenly spaced. The more room there is for them to fill, the further apart the particles will be. A gas has no fixed size or shape and it always takes up more space than a solid or a liquid – usually a great deal more space.

NOTE In this book a magnifying glass is used to show a very close-up view. In most cases you would need a far higher magnification than a magnifying glass to see what is shown in the picture.

Ice, water and gas bowl

You can make a bowl of ice quite easily. Simply partly fill a large freezer-safe bowl with water, and then put a slightly smaller bowl inside so that it floats. Put the combination into a freezer and let the water **FREEZE**, then remove the bowls.

As soon as it is taken from the freezer, the ice bowl begins to **MELT**, showing that ice and water are two forms of the same thing.

The water also loses some particles to the air. This is called **EVAPORATION** and it is how water **VAPOUR** is added to the air. In this way solid, liquid and gas forms of water can all occur at the same time.

These three forms of water occur naturally in the world around us. The oceans, rivers, lakes and clouds are filled with water, the ice caps and mountains are covered with snow ice (Picture 2), and the air is filled with vapour.

How does change happen?

When something melts, freezes or turns into a gas, the only change is in the way the particles of the substance are held together.

In a solid, the particles of water are all locked firmly together. In a liquid, the particles still touch, but they are no longer locked together and can slip over one another. That is why liquids flow. In a gas, the particles no longer touch, and are free to move wherever they want.

▲ **(Picture 2) This mountain waterfall has been frozen into an icefall.**

How to make changes happen

To get a solid to change to a liquid, heat has to be added. To get a liquid to become vapour, even more heat is needed.

The heat for these changes can come from the Sun, the warmth of the air or (in the case of **MOLTEN** rock called lava) from heat inside the Earth. People can also make changes happen, for example, by burning fuels to add heat, or using a refrigerator to take heat away.

Summary

- **Solids, liquids and gases are different forms of the same substance.**
- **Solids are made of particles that are locked together.**
- **Liquids are made of particles that can slide past one another.**
- **Gases are made of particles that are free to move about.**