

Using particles to explain matter

We are learning how to:

- Recognise differences between solids, liquids and gases.
- Describe solids, liquids and gases in terms of the particle model.

Have you ever wondered why it is possible to put your hand through a liquid such as water, or a gas, such as air, but not through a solid wooden door? The answer lies in how the particles are arranged in these states of matter.

Particle arrangement

Anything that takes up space and mass is called 'matter'. All matter is made from **particles**. Particles vary in the ways they are arranged and behave. These are known as different states of matter. Figure 2.3.2a shows how particles are arranged in the three most common states of matter – solids, liquids and gases.

1. Name three solids, three liquids and three gases you are familiar with.
2. Describe how the arrangements of particles in solids, liquids and gases differ from each other.

Particles and internal energy

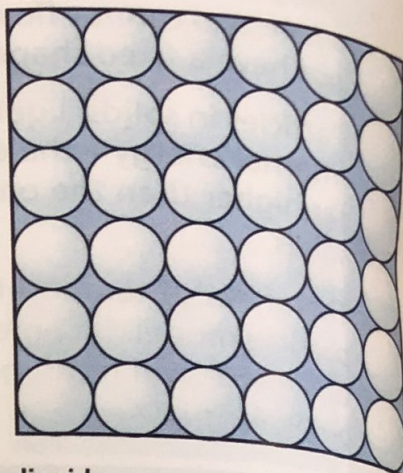
All particles above the temperature known as absolute zero (-273°C) have internal **energy**. Particles in solids, liquids and gases have different amounts of energy.

- In solids, the particles vibrate in their fixed positions.
- Particles in liquids can move slowly from their positions, but are always in contact with other particles.
- Particles in a gas move about very fast, colliding with other particles.

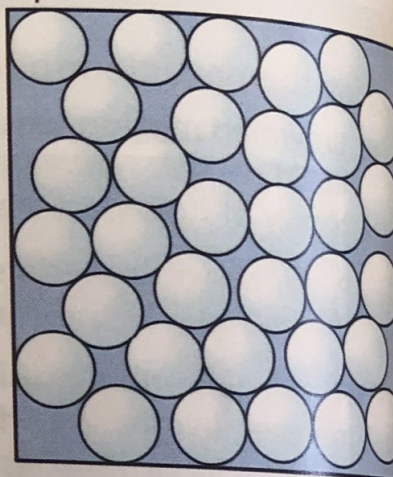
Temperature affects how fast particles move. At higher temperatures, particles in a solid vibrate faster, while in liquids and gases particles move around faster.

3. Draw a cartoon to describe how the energies of the particles in solids, liquids and gases vary.
4. In which of the following do the particles have the most internal energy – ice, oxygen at room temperature or steam (over 100°C)?

solid



liquid



gas

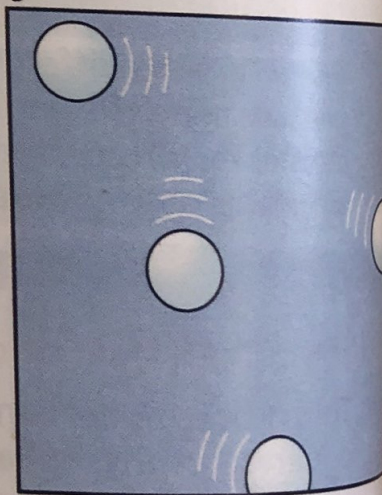


FIGURE 2.3.2a: Solid – particles are in fixed, regular positions.

Liquid – particles are close together and touching. They can move from their position.

Gas – particles have no fixed positions and are far away from each other. They can move very fast.

The particles in a solid have very strong, attractive intermolecular forces between them, which hold the particles in their positions. Between particles in liquids, the intermolecular forces are still strong, but not as strong as in a solid. This is why the particles are able to move about. The intermolecular forces between the particles of a gas are very weak.



FIGURE 2.3.2b: Which particles here have the strongest intermolecular forces?

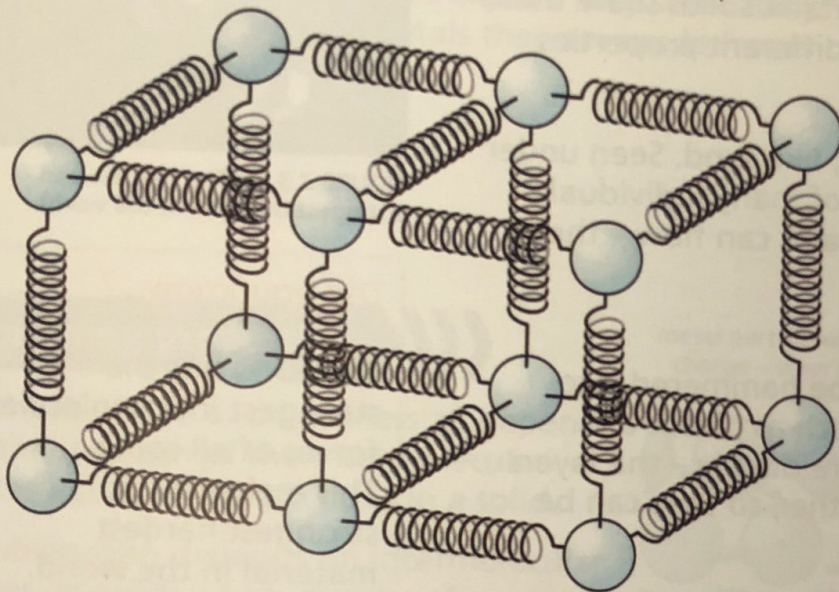


FIGURE 2.3.2c: Forces between particles can be represented by springs. How would you modify this particle model to show a solid with strong intermolecular forces and one with weak intermolecular forces?

Some solids, like metals, have very strong intermolecular forces between the particles – others, like paper, are not nearly as strong.

Did you know...?

The most common state of matter in the Universe is called 'plasma'. It is known as the fourth state of matter, and is a form of gas. The Sun and space are made of plasma. We can make tools from plasma to cut strong metals.

Key vocabulary

particles

energy

intermolecular forces

5. Use ideas about intermolecular forces to explain why you can put your hand through air but not through wood.
6. What can you say about the intermolecular forces between the particles of jelly compared with those of a metal?
7. Describe the relationship between the energy of the particles and the intermolecular forces holding them together.
8. What do you think is in between the particles of a gas?