

How Do Materials Change State?

Materials are made of tiny molecules (also known as particles) and can exist in three forms, which we classify as solids, liquids and gases. In scientific terms, these are called the three **states of matter**. Varying the temperature or pressure of a material's surroundings affects its state.

Solid

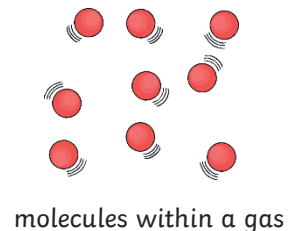
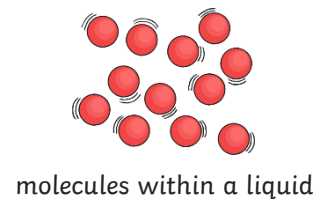
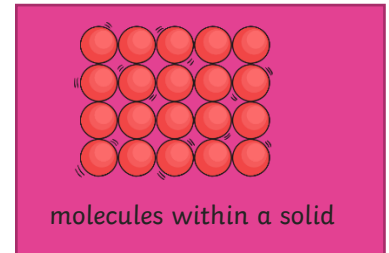
In a solid, the molecules' positions are quite rigid and they cannot move around much, if at all. As a result, solids (for example, ice) hold their shape.

Liquid

A liquid material (such as the water in a tap) has more loosely-packed molecules. Because they have more space, the particles can move around and the material flows to take up the shape of any container.

Gas

A gas's molecules are spaced very widely apart and bounce around freely to occupy the available space. Consequently, they will spread out as far as possible and seem to disappear if they are not trapped in a container.



Most materials, in everyday conditions, appear in only one state. However, many can possibly change between these three states according to alterations in their environment. For example, we can manipulate materials into changing states through the processes of heating and cooling.

Changing States

Evaporation

Evaporation refers to the process of a liquid gradually turning into a gas (vapour) at its surface as it is gently warmed by air currents. This is how water from the oceans becomes the water vapour in the air.

Condensation

Condensation is the scientific term for the process of a gas turning into a liquid, which happens when it is cooled. An example of this is when water vapour (the gas form of water) cools and returns to its liquid state. It is possible to see this process if water is boiled in a kettle. As the boiling water vapour from the spout meets cooler air, it condenses and becomes microscopic droplets (steam). If the steam then touches a cold surface such as a mirror, these droplets come together and the water reverts to its liquid state, dripping from the mirror.

Boiling

When a liquid is heated to its boiling point, it turns immediately into a vapour. Each liquid has a different boiling point. Water boils at 100°C. The material nitrogen, which naturally occurs as a gas, boils at almost -200°C! When water boils, it returns from its liquid state into water vapour. Steam, which is what we see above a boiling kettle's spout, is a mixture of water vapour and tiny droplets of water.

Freezing

In order to turn a liquid into a solid, it must be cooled, causing the molecules to slow down and assume a fixed position. When water is cooled down to 0°C, it solidifies (turns to ice). Interestingly, ice is the only solid that is less dense than its liquid form and therefore floats in water. Why not try it with an ice cube in your next glass of water to see?

Melting

Melting means heating a solid until the molecules can move about again, which will turn it into a liquid. Just like boiling points, each material has its own melting point, although these may vary drastically. For instance, chocolate will melt at a relatively low temperature. You could try to refrigerate a chocolate button then hold it in your hand and see what happens. Other materials, such as gold, require very high temperatures of over 1000°C!

Materials can appear naturally at different states depending on their environment. Otherwise, we have to deliberately alter the temperature or pressure to force materials into changing state. There are a number of different ways we can utilise changing the state of a material, such as freezing food to keep it fresh, boiling water to purify it for drinking or melting gold to form it into jewellery.

