

Solids, liquids and gases explained

Grade 6 science (Year 7 · Class 6) · Lesson

Quick answer: The three states of matter are solid, liquid and gas. A solid keeps its own shape and volume, a liquid keeps its volume but takes the shape of its container, and a gas fills the whole container. The difference comes from how closely the particles are packed and how freely they move.

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What are the three states of matter?

Matter is anything that has mass and takes up space. Your bag, the juice in your bottle and the air in a football are all matter. At everyday temperatures, matter shows up in three main forms called states: solid, liquid and gas. Scientists group materials this way because each state behaves in a clear, predictable way.

Definition

A **state of matter** is the form a material takes, decided by how its particles are arranged and how they move. The three common states are solid, liquid and gas.

How do solids, liquids and gases differ?

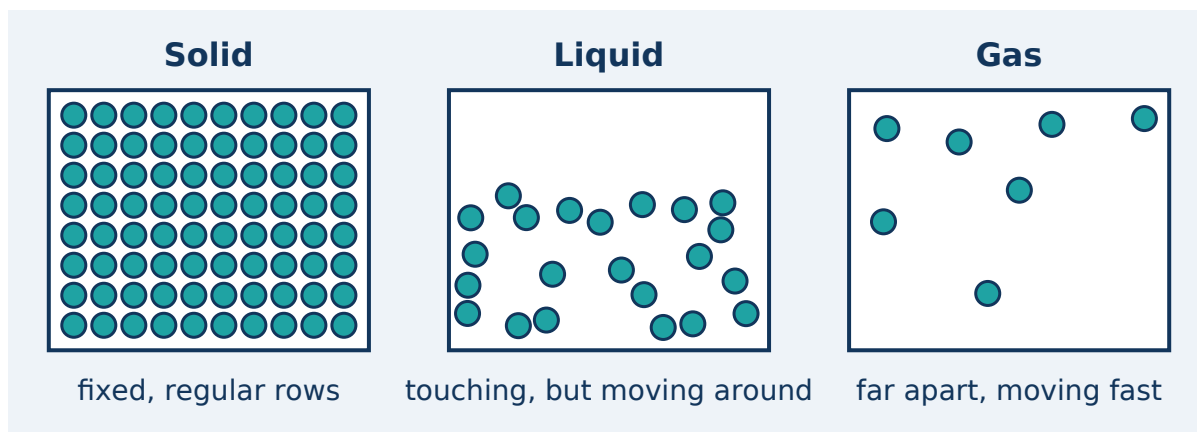
Look at two things for each state: its shape and its volume. Volume is the amount of space a sample takes up. The table sums up what you can observe without any equipment.

Property	Solid	Liquid	Gas
Shape	Fixed	Takes the shape of the bottom of its container	Takes the shape of the whole container
Volume	Fixed	Fixed	Not fixed, it fills the container
Can it flow?	No (a sand pile is many tiny solids)	Yes	Yes
Can it be squeezed?	Hardly	Hardly	Easily
Example	Brick, pencil, coin	Milk, cooking oil	Air, helium, steam

What does the particle picture say about each state?

All matter is made of tiny particles that are far too small to see. The particle picture explains the table above. The differences come from how close the particles are and how freely they

move.

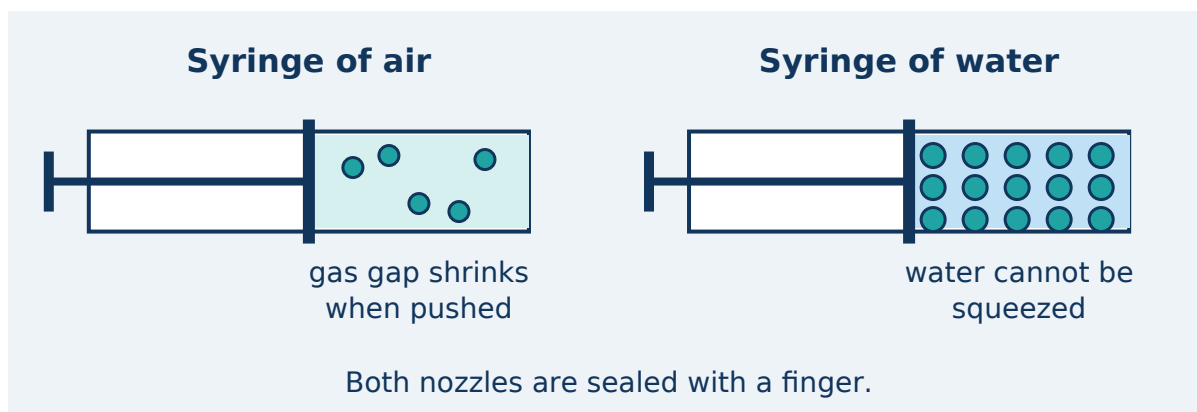


Particle pictures of the three states. Particles are drawn as circles; real particles are much smaller.

- **Solid:** particles are packed tightly in a regular pattern. They cannot swap places, but they vibrate on the spot. That is why a solid keeps its shape.
- **Liquid:** particles stay close and touch, but they slide past one another. That is why a liquid pours and fills the bottom of a container, yet keeps the same volume.
- **Gas:** particles are far apart and move quickly in all directions. They spread out until they fill all the space they are given.

Why can a gas be squeezed but a liquid cannot?

Between gas particles there is mostly empty space, so a push can force them closer together. In a liquid the particles already touch, so there is almost no gap left to close. Pushing on a sealed syringe shows the difference.



Air in a sealed syringe compresses; water does not.

Worked example

Aarav seals a syringe holding 60 mL of air and pushes the plunger until the scale reads 20 mL.

Volume lost = 60 mL – 20 mL = 40 mL.

Fraction left = $20 \div 60 = 1/3$.

The air takes up one third of its first volume, but it still contains the same number of particles.

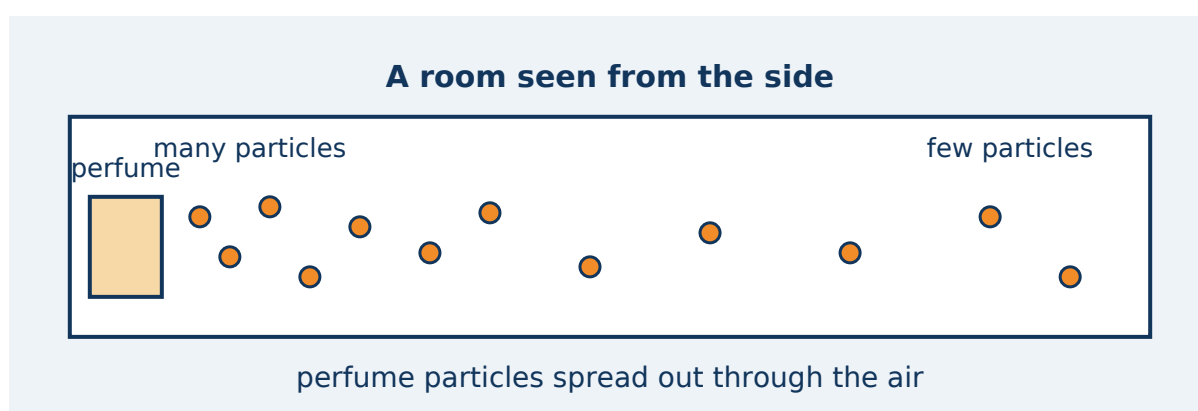
Worked example

Chiamaka pours 500 mL of orange squash from a jug into cups that each hold 200 mL.
 $2 \text{ cups} \times 200 \text{ mL} = 400 \text{ mL}$, so $500 \text{ mL} - 400 \text{ mL} = 100 \text{ mL}$ is left over.

She fills 2 cups completely and has 100 mL in a third cup. The volume of liquid never changed, only its shape did.

How do particles explain smells spreading?

Gas particles move on their own until they mix with everything around them. This spreading is called diffusion. When a tuck shop opens a tray of hot samosas, particles leave the food, bump into air particles and slowly drift across the room. Diffusion is faster in warm air because the particles move faster.



Diffusion: particles spread from where they are crowded to where they are few.

Common mistake

Many students say that particles in a solid do not move at all. They do move: they vibrate in fixed positions. Another slip is to think that a solid must be hard. Powders such as flour and sand are solids made of many small grains.

Lina's tip

Ask two questions: does it keep its shape, and does it keep its volume? Yes and yes means solid. No and yes means liquid. No and no means gas.

Where do awkward materials fit?

Some materials seem to break the rules. A pile of sand pours like a liquid, yet each grain keeps its own shape and volume, so every grain is a solid. Toothpaste and jelly are soft but still hold a shape. When unsure, check whether a single piece keeps its own shape and volume. If it does, it is a solid.

Key points to remember

- Solid: fixed shape and fixed volume; particles vibrate in fixed positions.
- Liquid: fixed volume, no fixed shape; particles touch but slide past each other.

- Gas: no fixed shape or volume; particles are far apart and move fast.
- Gases are easy to compress because most of their volume is empty space.
- Diffusion is the spreading of particles from crowded to less crowded places.

Solids, liquids and gases explained: frequently asked questions

What are the three states of matter?

Solid, liquid and gas. They differ in whether they keep their shape and volume, which depends on how the particles are arranged and how they move.

Why does a liquid take the shape of its container?

Liquid particles touch each other but can slide past one another. They flow to fill the bottom of the container, so the liquid takes its shape while keeping its volume.

Why can you squeeze a gas but not a liquid?

Gas particles are far apart with empty space between them, so they can be pushed closer. Liquid particles are already touching, so there is hardly any space left to squeeze.

Is sand a solid or a liquid?

Sand is a solid. A pile of sand can pour, but every single grain keeps its own shape and volume. The grains slide over one another, which makes the pile behave a little like a liquid.

Do the particles in a solid move?

Yes. Solid particles vibrate around fixed positions. They cannot move from place to place, which is why a solid keeps its shape.