



States of Matter

gases and liquids: what holds molecules together, and what a gas law says about how they move apart

Three States, Compared *

- solid: particles tightly held, regular arrangement, ~3-5 Å apart, practically non-compressible
- liquid: particles loosely packed, ~3-10 Å apart, moves a little, only slightly compressible
- gas: particles far apart, over 5 Å, continuous random motion, highly compressible
- one substance moves between all three purely by exchanging heat, cooling reverses every step

Solid, Liquid, Gas: One Direction Each Way

Solid

fixed shape, fixed volume
particles held in a regular order

→
heat

Liquid

container's shape, own volume
particles loose but still close

→
heat

Gas

container's shape AND volume
particles far apart, free motion

←
cool reverses every step: gas to liquid to solid, with no change to the particles themselves

Table 10.1, Condensed

Property	Solid	Liquid	Gas
intermolecular space	very small	moderate	large
effect of small ΔT	small volume change	moderate change	large volume change
compressibility	practically none	small	compressible

Intermolecular Forces: the Idea

- attractive (and repulsive) forces between neighbouring molecules, weaken as distance grows
- a ranking by strength: STRONG in solids, less in liquids, VERY WEAK in gases
- melting only partially overcomes these forces, vaporisation overcomes them completely
- five named types: dipole-dipole, ion-dipole, dipole-induced dipole, London dispersion, hydrogen bonding

