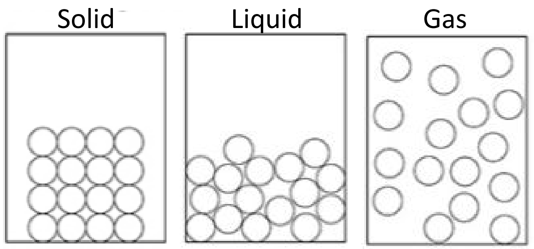
# AQA Physics - Particle Model Journey of Knowledge

**Context and introduction to the unit:** The particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft. It also explains why it is difficult to make a good cup of tea high up a mountain!

**KS3:** Yr7: Particle Model: Builds on atoms and elements unit; Explores the forces between particles, the energy needed to overcome these in state changes; Include temperature as a measure of molecules moving to link atoms. Cells: Diffusion link here from particle model. Separating Mixtures: Builds on particles unit in terms of separation. Yr8: Heating and Cooling: Builds on and revisits particle model and movement from Yr7. Combines particle model and energy. Yr. 9: Light and Sound Waves: Further exploration of ideas held about particles. Pressure: Links to particles unit when exploring pressure in liquids and gases. **KS2** – states of matter, temperature, evaporation, condensation and properties and changes of materials.

## CORE KNOWLEDGE




### 6.3.1.1 Density of materials

The density of a material is defined by the equation: density = mass ÷ volume ($\rho = m \div V$)

Density, ρ, in kilograms per metre cubed, $kg/m^3$. Mass, m, in kilograms, kg. Volume, V, in metres cubed, $m^3$.

The particle model can be used to explain: the different states of matter; differences in density.

The particles in a solid: are in a regular arrangement, vibrate about a fixed position, sit very closely together.

The particles in a liquid: are randomly arranged, move around each other, sit close together.

The particles in a gas: are randomly arranged, move quickly in all directions, are far apart.

### 6.3.1.2 Changes of state

When substances change state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved. Matter is not lost or gained in changes of state. This is because changes of state are physical changes which differ from chemical changes because the material recovers its original properties if the change is reversed.

### 6.3.2.1 Internal Energy

Energy is stored inside a system by the particles (atoms and molecules) that make up the system. This is called internal energy. Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system. Heating changes the energy stored within the system by increasing the energy of the particles that make up the system. This either raises the temperature of the system or produces a change of state.

### 6.3.2.2 Temperature changes in a system ~~and specific heat capacity~~

If the temperature of the system increases: The increase in temperature depends on the mass of the substance heated, the type of material and the energy input to the system.

### 6.3.2.3 Changes of state and specific latent heat

If a change of state happens: The energy needed for a substance to change state is called latent heat. When a change of state occurs, the energy supplied changes the energy stored (internal energy) but not the temperature. The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature. Energy for a change of state = mass x specific latent heat ($E = m \times L$)

Energy, E, in Joules, J. Mass, m, in kilograms, kg. Specific latent heat, L, in joules per kilogram, J/kg

Specific latent heat of fusion – change of state from solid to liquid. Specific latent heat of vaporisation – change of state from liquid to vapour.

### 6.3.3.1 Particle motion in gases

The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules. Changing the temperature of a gas, held at constant volume, changes the pressure exerted by the gas.

The motion of the molecules in a gas is related to both its temperature and its pressure, the relationship shows that with increased temperature there is increased movement, and with increased pressure there is also increased movement.

At a constant volume the pressure of a gas is directly proportional to temperature. As temperature increases, pressure increases.

## Disciplinary knowledge

Required practical activity 17/5: determine the densities of regular and irregular solid objects and liquids.

WS 1.2, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 3.1, 3.5, 3.8, 4.2, 4.3, 4.6

## Vocabulary

Boiling, condensing, density, evaporation, freezing, gas, internal energy, liquid, solid, specific heat capacity (SHC), specific latent heat (SLH), pascals, (SLH of) fusion, (SLH of) vaporisation, sublimation, temperature.

## Reading is Power

## Where next?

Electricity (part 1)

# AQA Physics - Particle Model Journey of Knowledge Part 2 SEPS Only

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**CORE KNOWLEDGE**

**4.3.3.2 Pressure in gases (Physics only)**

A gas can be compressed or expanded by pressure changes.

The pressure produces a net force at right angles to the wall of the gas container (or any surface).

Students should be able to use the particle model to explain how increasing the volume in which a gas is contained, at constant temperature, can lead to a decrease in pressure.

For a fixed mass of gas held at a constant temperature:

pressure x volume = constant (p x V = constant)

Pressure, p, in pascals, Pa. Volume, v, in metres cubed, $m^3$.

**4.3.3.3 Increasing the pressure of a gas (Physics only) (HT only)**

Work is the transfer of energy by a force. Doing work on a gas increases the internal energy of the gas and can cause an increase in the temperature of the gas.

Students should be able to explain how, in a given situation e.g. a bicycle pump, doing work on an enclosed gas leads to an increase in the temperature of the gas.

**Disciplinary knowledge**

Required practical activity 17/5: determine the densities of regular and irregular solid objects and liquids.

WS 1.2, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 3.1, 3.5, 3.8, 4.2, 4.3, 4.6

**Vocabulary**

**Reading is Power**

**Where next?**

Electricity (part 1)