

Chemistry Lecture #62: States of Matter

Most of the time, matter exists as a solid, liquid or gas.

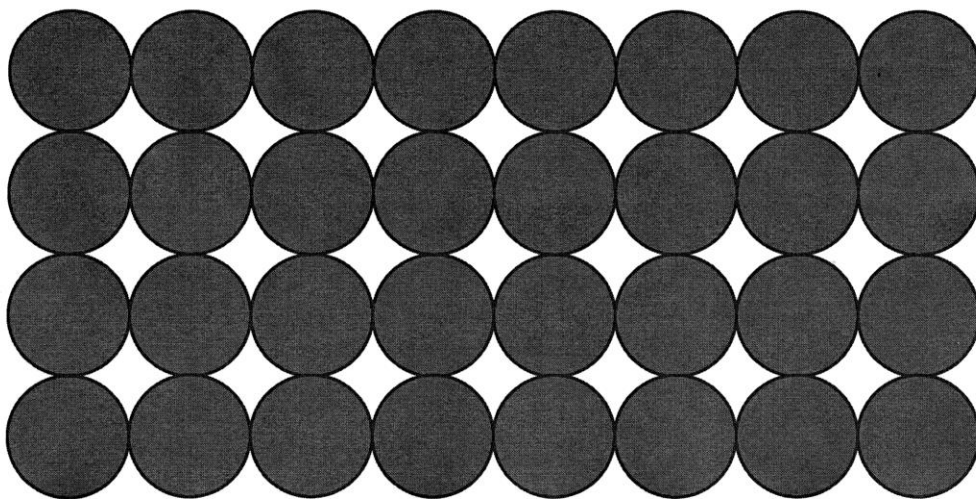
Solids: maintain same shape and volume.

Liquids: maintains the same volume but changes shape to fit the container it occupies.

Gas: changes shape to fit the container it occupies.
Expands/contracts to match the volume of its container.

Movement and spacing of particles determines if a substance is a solid, liquid or gas.

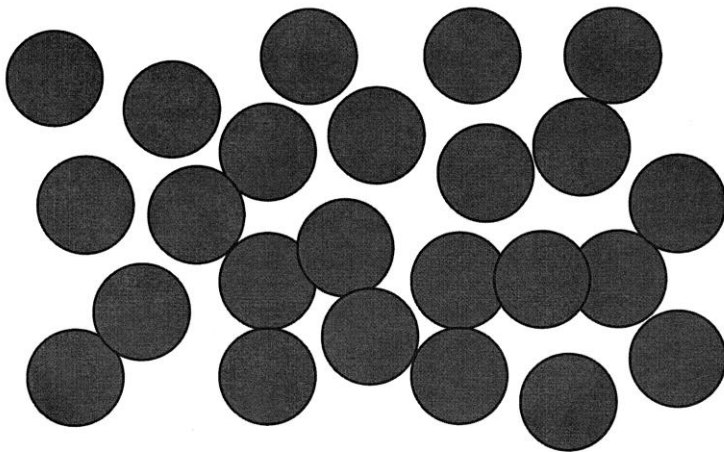
Solid: particles are packed very close together. If the solid is a pure substance, the atoms, molecules or ions will be arranged in an orderly pattern and form a crystal.



Particles in a pure solid are arranged in an orderly pattern.

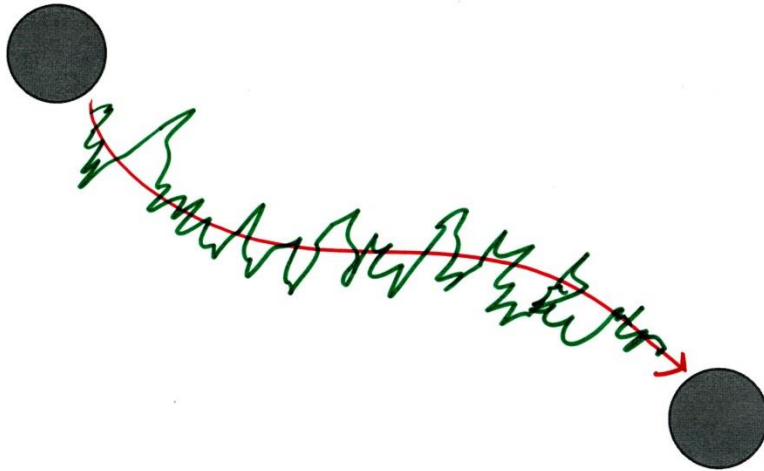
Particles in a solid move in a straight line, but collide immediately with another particle. A particle in a solid appears to vibrate around a fixed point. Since the particles can barely move, the collection of particles maintain the same shape and volume.

Liquid: particles are far enough apart to slip past each other, but are still close enough for collision with another particle to occur very quickly.



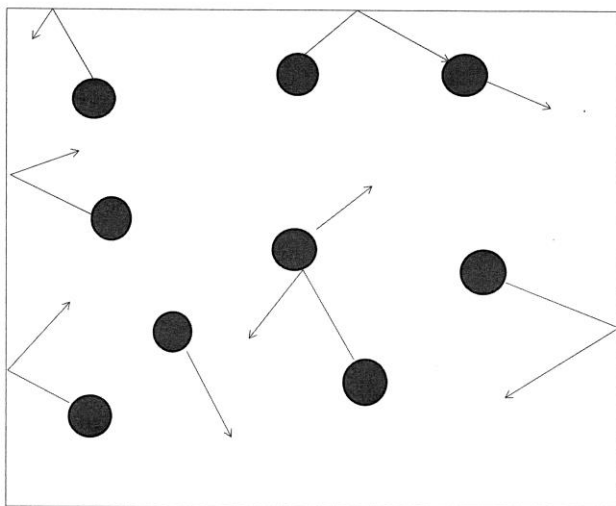
Particles in a liquid have enough space to slip past each other but are still close to each other.

Particles in a liquid move in straight lines, but collisions occur so quickly that they appear to vibrate around a moving point.



The path of the moving point is drawn in red. The squiggly green line represents the vibration of the particle around the moving point.

Gas: particles are far apart and moving rapidly in a straight line. Particles change direction when they collide with other particles or collide with the container wall.



Gas particles are far apart and move rapidly.

Overall, movement determines if a substance exists as a solid, liquid or gas.

If a particle moves, it has *kinetic energy*. Temperature is a measure of average kinetic energy.

At high temperatures, particles are moving fast.

At low temperatures, particles are moving slowly.

Temperature is measured in degrees Celsius or degrees Kelvin.

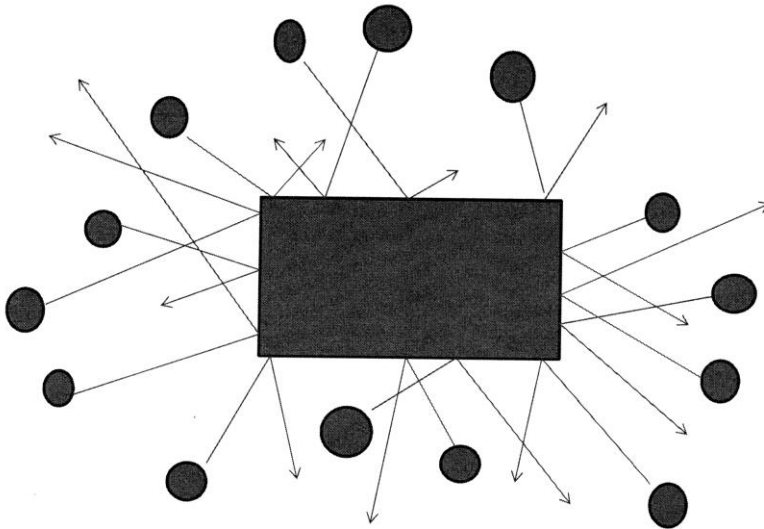
At zero degrees Kelvin, all particle movement stops. This is the complete absence of kinetic energy, and is referred to as absolute zero.

To convert Celsius temperature into Kelvins, use the formula

$$K = C + 273$$

In general, substances at low temperatures will be solids. At higher temperatures, they will exist as liquids. And at even higher temperatures, they will exist as a gas. The temperature of a substance determines if the substance is a solid, liquid or gas.

The atmospheric pressure surrounding a substance also influences the physical state of a substance. Atmospheric pressure is the collision of gas atoms or molecules against a surface.



Atmospheric pressure is the collision of gas atoms or molecules against a surface.

If a surface gets lots of collisions from surrounding gas molecules, it is under high pressure. Substances under high pressure tend to be solids. At lower pressure, substances tend to exist as liquids or gases.

Pressure is measured in kilopascals (kPa), mm Hg, or atmospheres (atm). On an average day, the atmospheric pressure is 101.325 kPa, 760 mm Hg, or 1 atm of pressure.