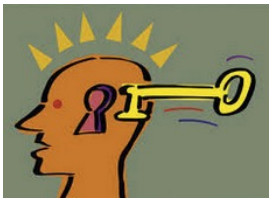
Science
Crucial Knowledge



Year 8

Page numbers highlighted in yellow

Biology

Biology Core Crucial Knowledge		2
8B1	Organ Systems	3 + 4
8B2	Unicellular & Diseases	5
8B3	Genetics & Evolution	6

Biology is the study of living things

Chemistry

Chemistry Core Crucial Knowledge		7
8C1	Atomic Structure & Periodic Table	8
8C2	Reactivity 2	9 + 10
8C3	Rocks & Earth Resources	11

Chemistry is the study of how substances interact

Physics

Physics Core Crucial Knowledge		12
8P1	Particle Model	13
8P2	Waves	14
8P3	Space	15

Physics is the study of forces and energy

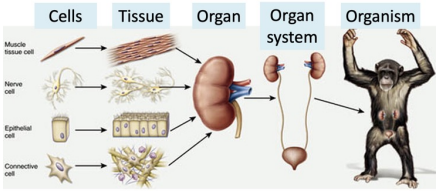
Core Crucial Knowledge

Biology is the study of living things

Year 7 + 8 Biology

MRS GREN – All living things carry out these 7 life processes

- **M**ovement – all living things move, even plants
- **R**espiration – the release of energy from glucose
- **S**ensitivity – all living things detect changes in their surroundings
- **G**rowth – all living things grow
- **R**eproduction – can be either sexual or asexual
- **E**xcretion – all living things produce and release waste products
- **N**utrition – taking in and using nutrients and food

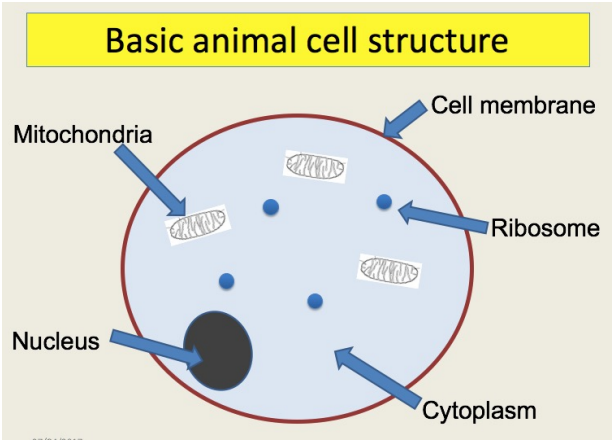


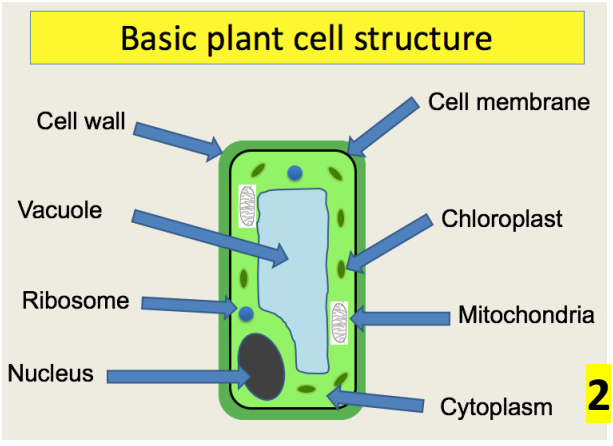
Organisation – how living things are built

- Cells are the basic building blocks of all living organisms
- Tissues are groups of cells with a similar structure and function. Eg muscle tissue
- Organs are groups of tissues performing specific functions. Eg, heart
- Organs are grouped into organ systems, which work together to form organisms

Function of cell parts

- Nucleus – controls the cell, contains DNA
- Cell membrane – allows substances in and out of the cell
- Cell wall – for shape, structure, support. Made of cellulose in plants
- Mitochondria – aerobic respiration occurs here, to release energy from glucose
- Ribosomes – make protein
- Vacuole (plant only) – stores water and sap
- Chloroplast (plant only) – absorbs sunlight energy for photosynthesis
- Cytoplasm – liquid that fills the cell, chemical reactions occur here





Respiration

- Respiration is a chemical reaction that releases energy from glucose
- Living things use this energy to grow, move, keep warm and reproduce
- Aerobic respiration uses oxygen
- Anaerobic respiration occurs without the use of oxygen

- Aerobic respiration word equation:

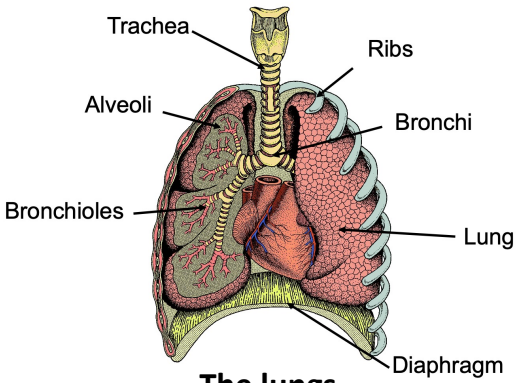
Glucose + oxygen → carbon dioxide + water

- Anaerobic respiration word equation (in animals):

Glucose → lactic acid

Gas exchange

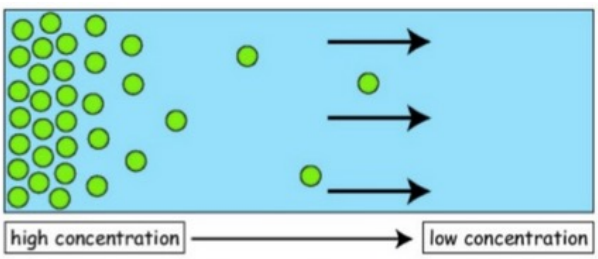
- The air we breathe is 21% oxygen
- Lungs have alveoli (tiny air sacs)
- Alveoli have a large surface area
- Gas is exchanged in the lungs by diffusion



The lungs

Diffusion

- Movement of particles
- From a high concentration to a low concentration



The heart

- The heart is made of cardiac muscle
- The heart has four chambers

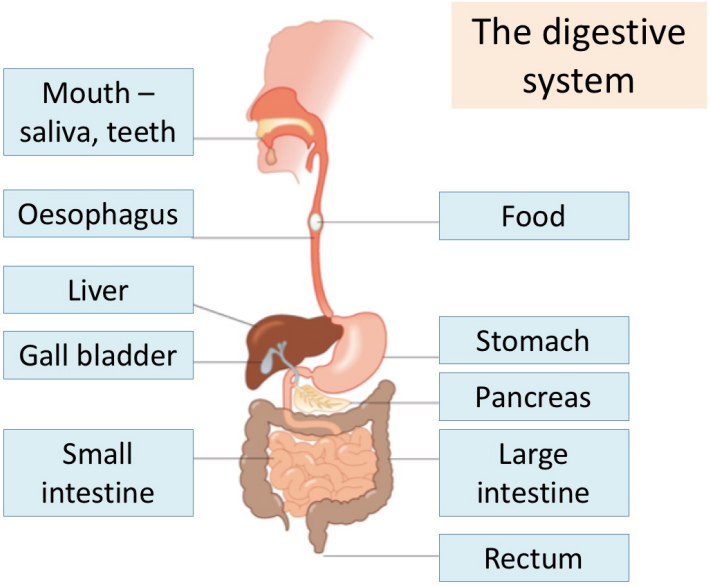
The blood

- Red blood cells carry oxygen
- White blood cells fight pathogens (germs)
- Platelets causes clots
- Plasma is the liquid part of the blood

Red blood cells

Digestive system

- Digestion is breaking large insoluble molecules into smaller, soluble ones
- The stomach contains hydrochloric acid which kills germs
- The liver produces bile
- Bile helps digest fats
- The small intestine absorbs nutrients into the blood

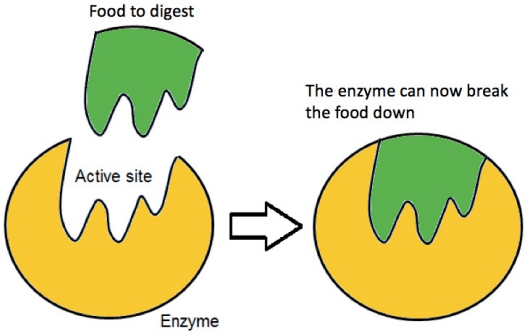


Seven food groups

- Carbohydrate – release energy in the body
- Protein
- Fats
- Vitamins
- Minerals
- Fibre
- Water

Enzymes

- Enzymes speed up reactions
- Enzymes work by the lock and key method
- Enzymes have a special shape called the active site



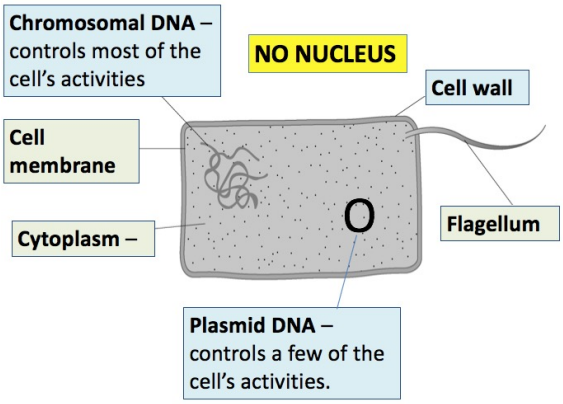
Unicellular organisms

- Unicellular organisms are made up of one cell only
- There are two groups – protoctists and prokaryotes

Prokaryotes

- Have NO nucleus
- Bacteria are in this group

Bacteria



Pathogens and disease

- A pathogen is a microorganism that causes a disease
- There are four types: bacteria, virus, fungi, protist

How diseases are spread

- Through the air
- Through dirty water
- Uncooked food
- Touching
- Animal vectors eg. mosquitos carry the pathogen that causes malaria

Physical defences in the body

- Physical defences STOP pathogens getting into the body
- Skin
- Mucus (which is sticky and traps pathogens)
- Cilia (hair-like structures on cells that move mucus)

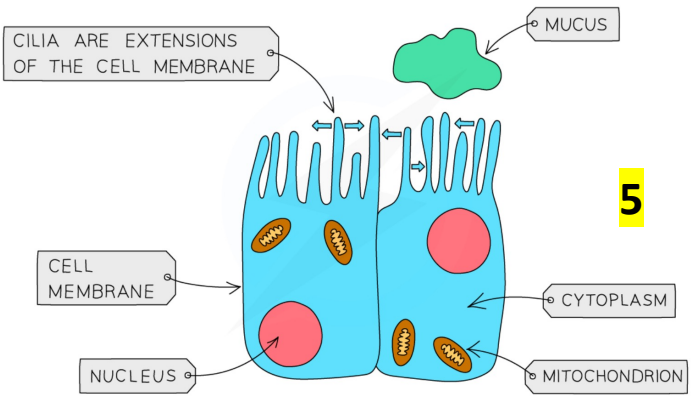
Chemical defences in the body

- Chemical defences KILL pathogens
- Hydrochloric acid in the stomach
- Enzymes in tears

The immune system

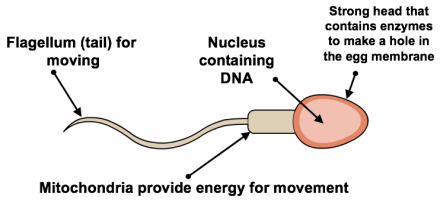
- White blood cells destroy pathogens

A cell with cilia



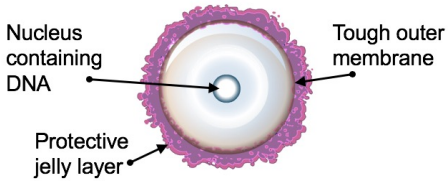
Human gametes

- Gametes are sex cells (sperm and egg)
- Male gamete = sperm, contains 23 chromosomes
- Female gamete = egg, contains 23 chromosomes



DNA

- Chromosomes are made up of DNA
- Chromosomes and DNA are found in the nucleus
- A short section of DNA is a gene
- An allele is a different form of the same gene



Structure of DNA

- Double helix shape
- Sugar-phosphate backbone
- 4 base pairs
- Base pairs always match up the same way: A – T C – G

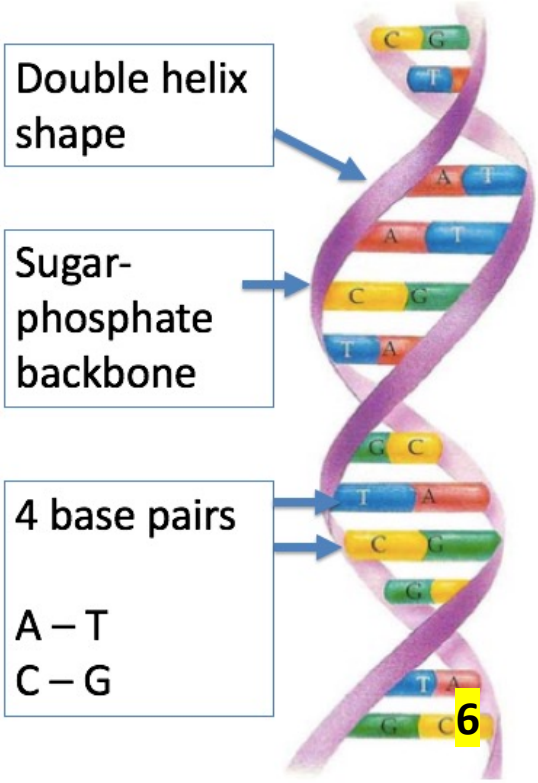
Variation

- Organisms are different to each other because of variation
- Genetic variation is from parents
- Environmental variation is from your surroundings

Evolution

- Random mutations in organisms' DNA means there is variation
- A change in the environment causes competition
- The best adapted organisms survive, reproduce and pass on their genes
- Over time a new species is formed

DNA



Core Crucial Knowledge

Chemistry is the study of how substances interact

Year 7 + 8 Chemistry

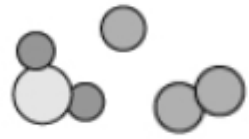
Atoms, elements, molecules, compound, mixture

- Atoms make up everything
- An element is made up of only one type of atom
- A molecule is made up of two or more atoms
- A compound is made up of two or more different atoms. Example: CO_2
- A mixture is a group of chemicals not bonded together. Example: air

Atom
Element

Elements
Molecules

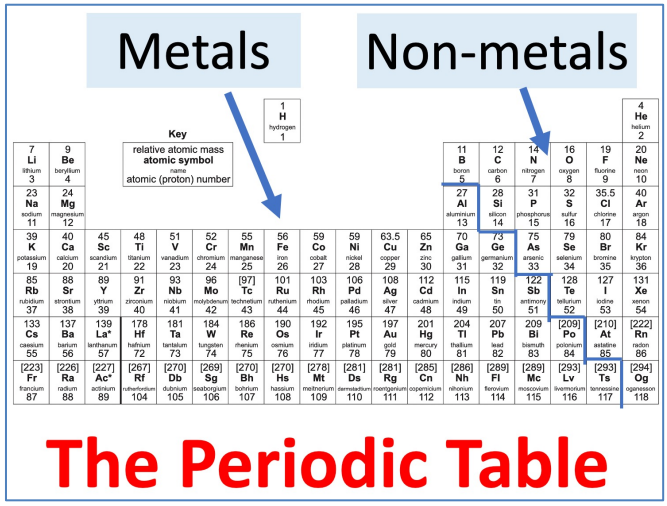
Compound



Mixture

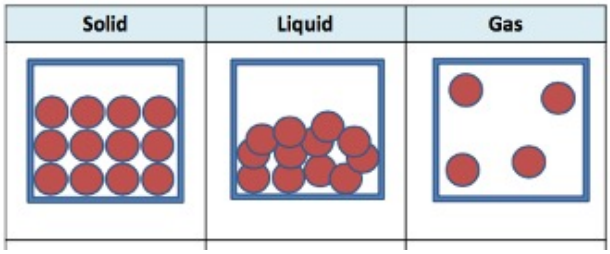
The Periodic Table

- All elements have their own symbol eg. H is hydrogen, Na is sodium
- Metals are on the left and in the middle
- Non-metals are on the right



The Periodic Table

Solid, liquid and gas particle diagrams



Word equations

- Reactants are the substances on the left, that are reacting
- Products are the substance on the right, that are made in the reaction
- The arrow shows a reaction has taken place

methane + oxygen ⟶ carbon dioxide + water

Reactant — Product

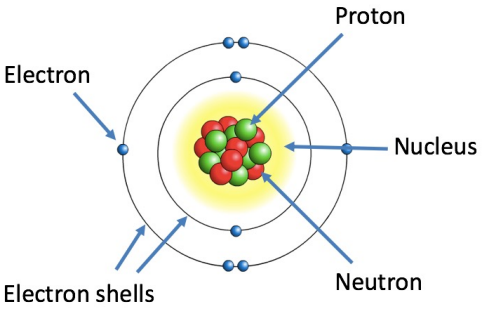
Crucial Knowledge Year 8

8C1 Atomic Structure & The Periodic Table

8C1

Structure of the atom

- Protons and neutrons in the nucleus
- Electrons in the shells



Mass and charge

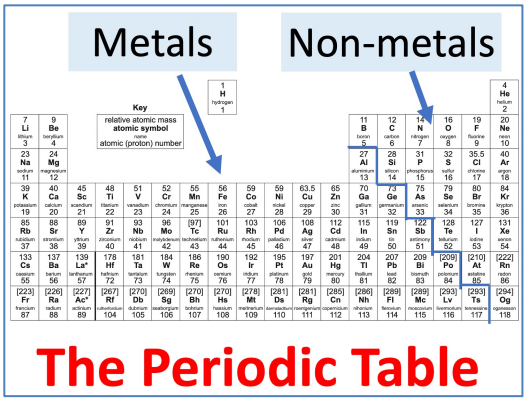
Particle	Mass	Charge
Proton	1	+1
Neutron	1	0
Electron	Very small	-1

Ions

- An ion is an atom that has lost or gained one or more electrons
- Ionic bonds form between metal ions and non-metal ions

The Periodic Table

- Metals on the left and in the middle
- Non-metals on the right
- Group 1 = alkali metals
- Group 7 = halogens
- Group 0 = noble gases



Equations

- Reactants are the substances on the left, that are reacting
- Products are the substance on the right, that are made in the reaction
- The number of atoms must be the same on both sides of the equation

methane + oxygen ⟶ carbon dioxide + water

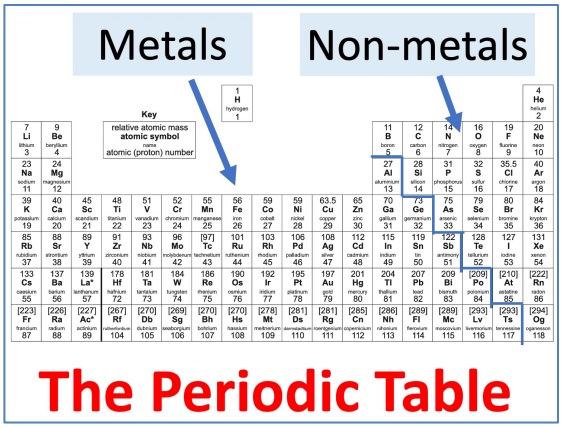
Reactant | Product

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

Crucial Knowledge Year 8

8C2 Reactivity 2

8C2



Properties of metals

- Conduct heat and electricity
- Ductile (can be pulled into a wire)
- Malleable (can be bent into different shapes)
- Strong
- Lustrous (shiny when polished)

Reactions with metals

- Metal + acid → salt + hydrogen

- Alkali metal + water → metal hydroxide + hydrogen

Test for hydrogen gas

- A lit splint makes a squeaky pop

State symbols

State symbol	Meaning	Example
(s)	Solid	Iron oxide$_{(s)}$
(l)	Liquid	Water$_{(l)}$
(g)	Gas	Carbon dioxide$_{(g)}$
(aq)	Aqueous, dissolved in water	Sodium chloride solution$_{(aq)}$

Displacement

- In a reaction, more reactive elements displace less reactive ones

Electrolysis

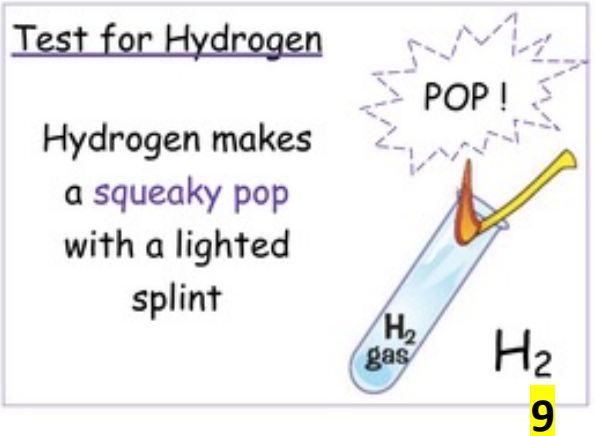
- Splitting a compound using electricity

Exothermic reactions

- Exothermic reactions give OUT heat

Endothermic reactions

- Endothermic reactions take heat IN



Reversible + irreversible reactions

- Reversible reactions can be changed back eg. melting ice
- Reversible reactions are physical changes
- Irreversible reactions cannot be changed back eg. cooking an egg
- Irreversible reactions are chemical changes

Particles and reactions

- Particles are always moving
- They collide
- If they collide with enough energy there will be a reaction

Rate of reaction

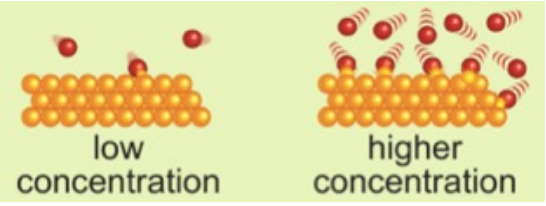
- Rate of reaction is how fast the reaction goes in a set amount of time

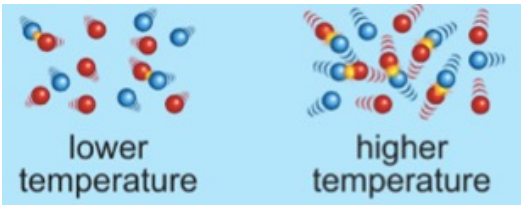
Factors that affect rate of reaction

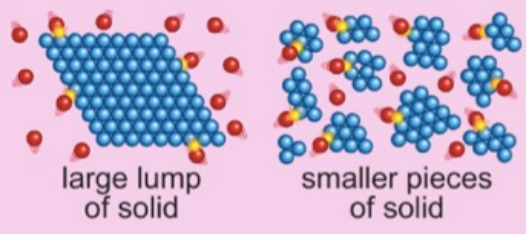
- Surface area of the chemicals. A larger surface area = faster reaction
- Concentration of chemicals. Higher concentration = faster reaction
- Temperature of chemicals. Higher temperature = faster reaction
- Catalysts speed up a reaction

Variables in an investigation

- Independent variable – this is what you change
- Dependent variable – this is what you measure
- Control variable – this is what you keep the same







Slate

Marble

Granite

Sandstone

Limestone

Basalt

Types of rock

- Rocks are natural solids made of a mixture of chemicals called minerals
- Sedimentary – sandstone, limestone
- Metamorphic – marble, slate
- Igneous – granite, basalt

Formation of rocks

- Sedimentary rocks are formed under water in layers
- Metamorphic rocks are formed underground by heat and pressure
- Igneous rocks are formed when lava cools down and solidifies
- Slower cooling of lava forms larger crystals
- Faster cooling of lava forms smaller crystals

Fossils

- A fossil is the remains of an organism preserved in a rock
- Older fossils are found deeper underground
- The fossil record has gaps in it

Reasons for gaps in the fossil record

- Conditions where an organism died not suitable for fossil formation
- Only organisms with bones leave fossils (usually)
- Dead organism might get eaten before they can form a fossil
- Fossils could be destroyed by earthquakes or volcanic eruptions
- Not all fossils found yet

An ichthyosaur fossil **A human child**

Core Crucial Knowledge

Year 7 + 8 Physics

Physics is the study of forces and energy

Conservation of energy

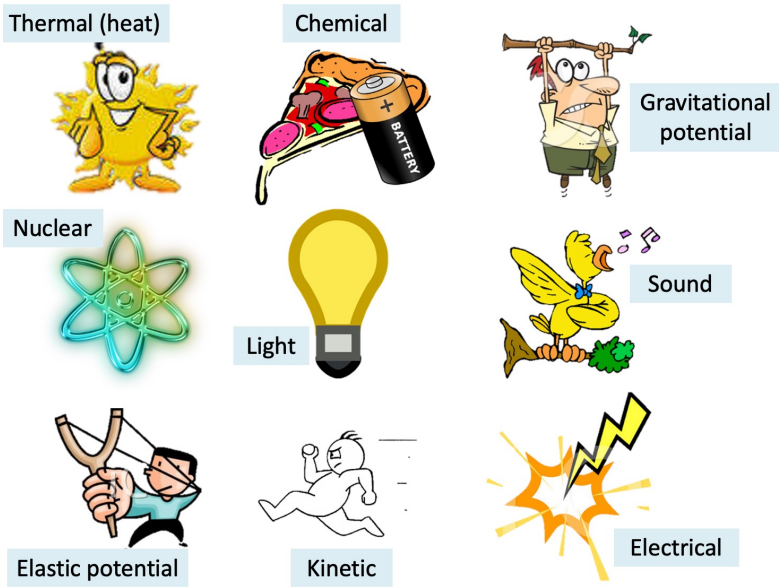
- Energy cannot be created or destroyed, only transferred from one form to another
- Energy is usually wasted as heat
- Example: A car uses petrol to move. The chemical energy in the petrol is transferred to kinetic energy, heat energy and sound energy. The total amount of energy overall is the same

Chemical energy → kinetic energy + heat energy + sound energy

10,000 J → 6000 J + 3000 J + 1000 J

Nine types of energy

- Thermal / heat
- Light
- Sound
- Chemical – all fuels contain chemical energy
- Kinetic – things moving
- Gravitational potential
- Elastic potential
- Nuclear
- Electrical



- Energy is measured in joules (J)

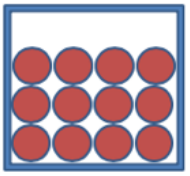
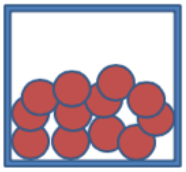
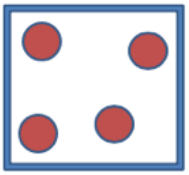
Forces

- Force is measured in newtons (N)
- Forces always come in pairs
- A force can change an object's shape, speed or direction

Fluids

- Fluids are liquids and gases

Particle diagrams and properties

Solid	Liquid	Gas
		
Cannot be compressed Fixed shape Doesn't flow High density	Cannot be compressed Takes shape of container Flows Quite high density	Can be compressed Takes shape of container Flows Low density

Changes of state

- Solid → liquid = melting
- Liquid → gas = evaporation
- Liquid → solid = freezing
- Gas → liquid = condensation
- Solid → gas = sublimation

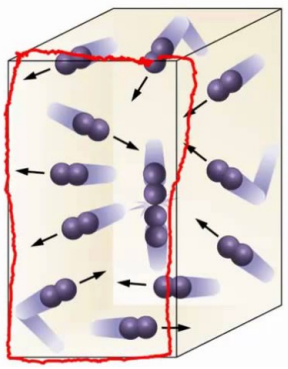
Density

- Density is a measure of how much mass an object has in a certain volume
- Density = mass ÷ volume

Gas pressure

- Particles are always moving and colliding
- When particles collide with the walls of a box or container they cause pressure
- Higher temperature = faster movement of particles = more collisions = higher pressure

Gas Pressure is the **force** of the gas particles **colliding** with the **walls** of its container

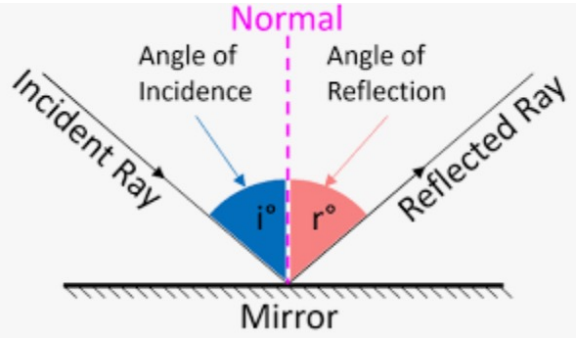


Pressure in fluids

- Pressure gets higher if a fluid is deeper

Waves
- Waves transfer energy
- There are two types of wave: transverse and longitudinal

Light
- Light is a transverse wave
- Light travels in straight lines
- Light travels faster than sound



The law of reflection
- Angle of incidence = angle of reflection

Refraction
- Refraction means light waves changing direction
- This is because light waves travel at different speeds in different objects eg. air, water, glass

Sound
- Sound is a longitudinal wave
- Sound is caused by particle vibrations
- Sound is slower than light
- Sound reflections are called echoes

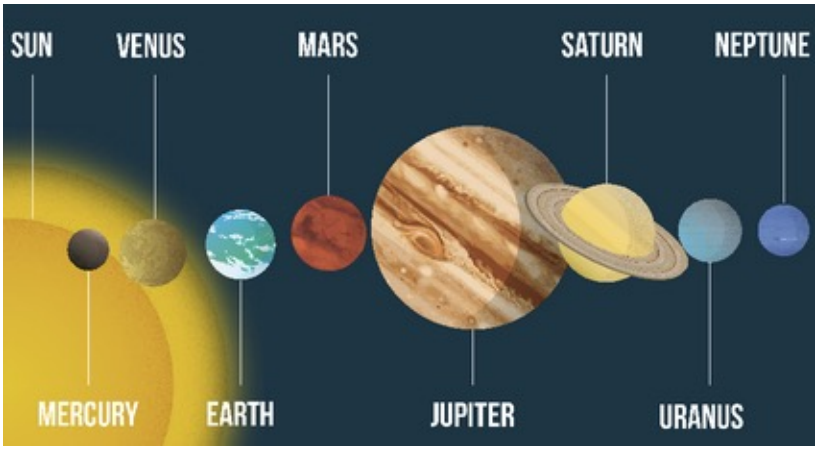
Speed
- The speed of a wave is how fast the wave is moving
- Speed is calculated with this equation:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Units
- Speed = metres per second (m/s)
- Distance = metres (m)
- Time = seconds (s)

The Solar System

- Our solar system is in the Milky Way galaxy. The planets orbit the Sun.
- The order of the planets in the Solar System:



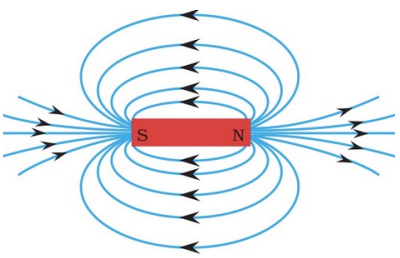
Life cycle of a star

A star like our Sun will go through these stages:

- Nebula – a huge cloud of gas and dust that is pulled together by gravity
- Protostar – a glowing cloud of gas. Not a proper star
- Main sequence star – this is what the Sun is today
- Red giant – a star that has expanded
- White dwarf – left over after a red giant has burnt up lots of fuel

Evidence for The Big Bang Theory

- The Big Bang theory states that the universe and everything in it was created 13.8 billion years ago
- Red-shift – galaxies are still moving away from us because of the Big Bang
- Cosmic Microwave Background Radiation – the left over radiation from the Big Bang

Magnetic Earth

- The Earth has a magnetic field
- The shape of it is the same shape as the magnetic field around a bar magnet
- Magnets have a north-seeking pole and a south-seeking pole
- Magnet field lines point from North to South
- The shape of the magnetic field