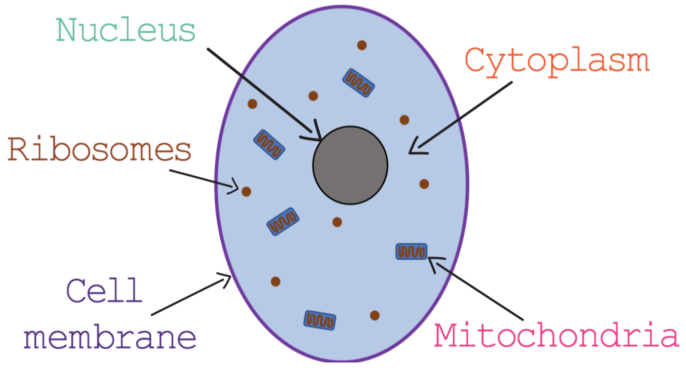
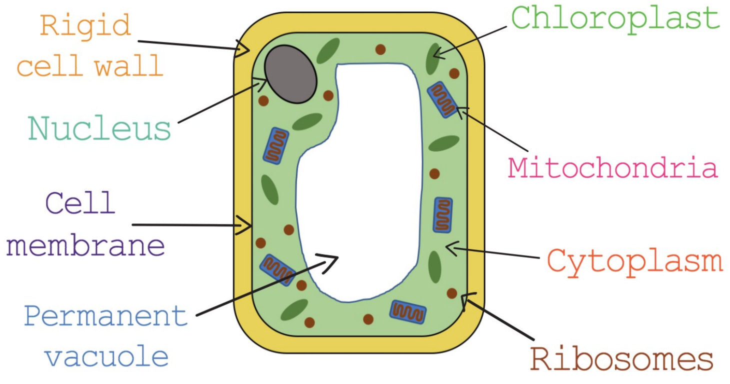
Trilogy: Biology Cell Structure & Transport Knowledge Organiser

1. Early light microscopes	Use light & lenses. Have magnifications of x100 to x2000.
2. Electron microscope	Modern. Use a beam of electrons. Magnifications up to x2000000.
3. Magnification	How much bigger an image appears than the real object. E.g. magnification of x100, image looks 100 times bigger than object. Magnification = size of image / size of object
4. Resolving power	Smallest size microscope can show.

5. Typical animal cell



6. Typical plant cell



7. Photosynthesis	Reaction plants use to make glucose from light, water & carbon dioxide.
8. Specialised animal cells	Sperm—tails to swim. Nerve—carry electrical impulses. Muscle—contract & relax.
9. Specialised plant cells	Root hair—absorb water & ions. Xylem—carry water & minerals. Phloem—carry glucose to cells.

10. Mitochondria	Perform respiration to release energy.
11. Cell membrane	Controls movement in/out of the cell.
12. Ribosomes	Makes protein by protein synthesis.
13. Nucleus	Controls activities of a cell. Contains genes to build new cells.
14. Cytoplasm	Liquid where most reactions happen.
15. Vacuole	Sack filed with sap. Keeps cell rigid.
16. Cell wall	Made of cellulose. Support cell.
17. Chloroplasts	Green and full of chlorophyll.
18. Chlorophyll	Absorbs light for photosynthesis.
19. Eukaryotic cells	Animal cells & plant cells. Have cell membrane, cytoplasm & nucleus.
20. Prokaryotic cells	Bacteria. Do not have a nucleus. Genetic material is looped.
21. Diffusion	Particles spreading out in a gas/liquid. Mover from high to low concentration. Dissolved substances like oxygen & carbon dioxide move in/out of cells by diffusion.
22. Factors affecting diffusion	Difference in concentration. Temperature. Surface area to diffuse through.
23. Osmosis	Diffusion of water through a partially permeable membrane. Moves from dilute solution to more concentrated solution.
24. Active transport	Moves substances from low to high concentration. Needs energy.

Background

Big or small all organisms are made of cells. Normally too small to see without a microscope, they are the building blocks of all life: animals, plants, insects, microbes & us.

Maths Skills

Prefix	Meaning	Standard Form
Mega	X 1000000	X 10^{6}
Kilo	X 1000	X 10^{3}
Milli	÷ 1000	X 10^{-3}
Nano	÷ 1000000000	X 10^{-9}

Trilogy: Biology Cell Division

Knowledge Organiser

Background

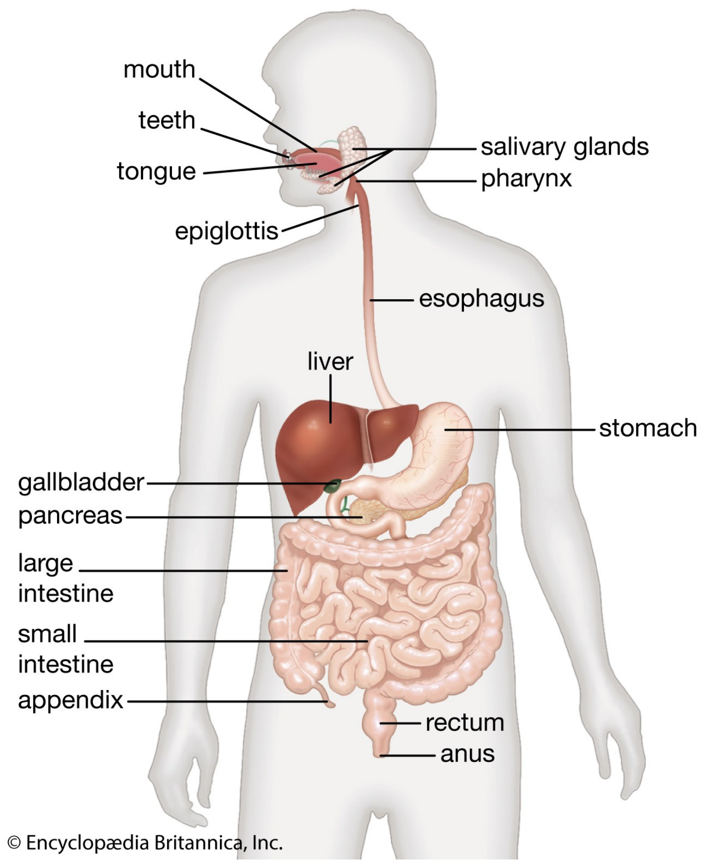
Taste buds are replaced approximately every 10 days, skin cells every 14 days and your lungs every 6 weeks.

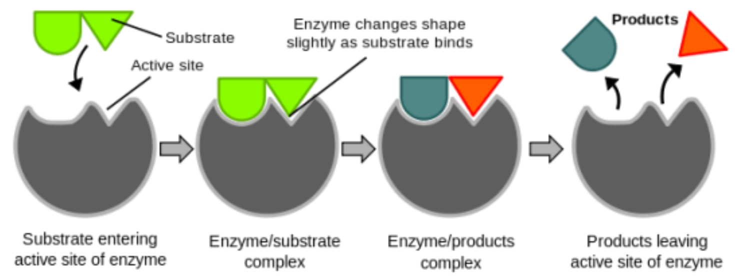
How can this happen and how old are we really?

1. Cell cycle	Process by which body cells divide. Three stages: 1. Copy: 2 copies of chromosomes and internal cell structures. 2. Mitosis: copies of chromosomes move and form 2 nuclei. 3. Split: cytoplasm and cell membranes split to make 2 identical cells.
2. Mitotic cell division	Makes 2 identical copies of cells. Used in growth & repair.
3. Asexual reproduction	Form of reproduction using mitotic cell division to make clone cells.
4. Chromosomes	Contains large numbers of genes. Made of DNA molecules.
	Human body cells contain 23 pairs of chromosomes.
5. Genes	Instructions for a characteristic.
6. DNA	Molecules that make genes.
7. Cell differentiation	Stem cells can form different types of specialised cells.
	Most animal stem cells differentiate early.
	Many plant cells can differentiate at any time.
8. Clone	Genetically identical copy of a cell or organism.

9. Stem cells	Not differentiated. Can become any type of cell that is needed.
10. Human stem cells	From embryos can become most types of human cell. From adult bone marrow can form many cells like red blood cells.
	May be able to help conditions like diabetes and paralysis.
	Issues with use: Potential spread of virus or immune response. Some people have ethical or religious objections.
11. Meristem cells	Plant stem cells. Can become any type of plant cell at any time.
	Used to clone: Rare plants from extinction. Crops with desirable features.
12. Specialised animal cells	Sperm—tail to swim. Nerve—carry electrical impulses. Muscle—contract & relax.
13. Specialised plant cells	Root hair—absorb water & ions from soil. Xylem—carry water and minerals from roots. Phloem—carry glucose to cells.
14. Ethical objections	Related to what a person thinks is morally good or OK.

Trilogy: Biology Organisation & the Digestive System Knowledge Organiser

1. Specialised animal cells	Sperm—tail to swim. Nerve—carry electrical impulses. Muscle—contract & relax.
2. Tissue	Group of similar cells.
3. Organ	Group of tissues working together.
4. Organ systems	Group of organs which work together in an organism.
5. Digestive system	A group of organs that digest and absorb food.
6. Digestion	Breaking large food molecules into small soluble ones.
7. Human digestive system	
8. Carbohydrate	Types of sugars: glucose, starch, cellulose. Used for energy.
	Test: starch turns iodine bluey black.
9. Proteins	Used to make enzymes, tissues and cells. Found in meat, fish, pulses, milk.
	Test: Biuret reagent turns from blue to purple.
10. Lipids	Fats and oils made of fatty acids and glycerol.

11. Mouth	Chews food, releases saliva.
12. Stomach	Churns food. Partial digestion here.
13. Liver	Makes bile to be stored in gall bladder.
14. Pancreas	Releases enzymes in small intestine.
15. Small Intestine	Majority of digestion happens here. Makes lots of enzymes.
16. Large intestine	Absorbs water.
17. **Bile**	Alkaline to neutralise stomach acid. Added at start of small intestine. Emulsifies fat into small droplets.
18. Catalyst	Chemical which speeds up a reaction without being used itself.
19. Enzyme	Biological catalysts. Like a specific temperature & pH
20. Lock & Key Theory	
21. Metabolism	The sum of all the reactions in a cell or the body of an organism.
22. Protease	Enzyme breaks down protein. Made in stomach, pancreas & small intestine.
23. Lipase	Enzyme breaks down lipids. Made in pancreas & small intestine.
24. Amylase	Type of carbohydrase enzyme. Breaks down carbohydrates. Made in salivary glands, pancreas & small Intestine.

Background

Have you ever wondered why the human body temperature is 37oC or why the male testes are outside the body? The answer is enzymes. They are also crucial for digestion.

Why can't you kill an enzyme?

They are not alive!!! So cannot die!!!

BUT they will change shape and 'denature' at the wrong temperature or pH.

Each one has an ideal temperature and pH they work best at.

Trilogy: Biology

Organising Animals & Plants

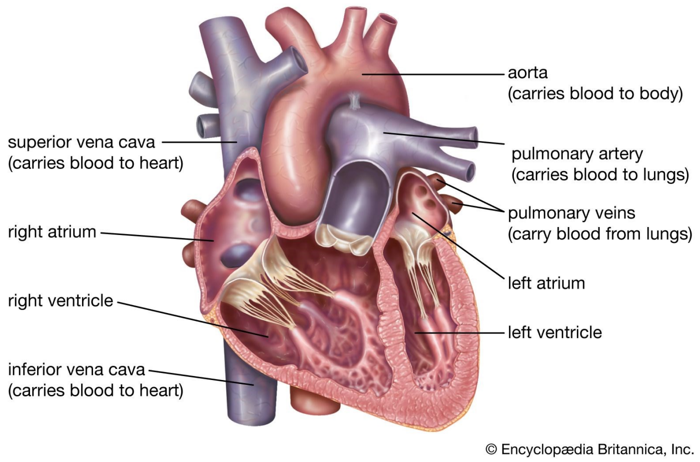
Knowledge Organiser

Background

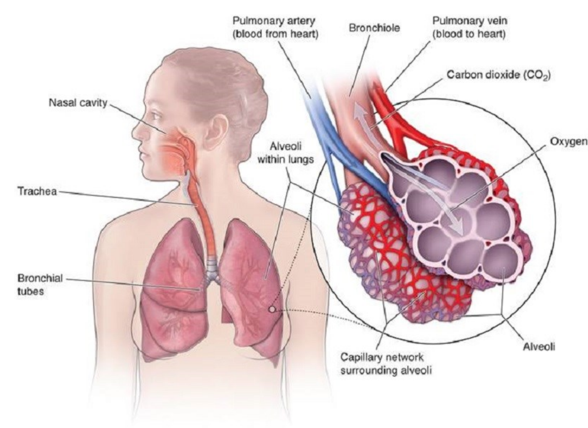
All living cells need glucose & oxygen for respiration. Getting these ingredients to the organism is only part of the struggle.

How do you get them to the cells, keep them and get rid of waste products?

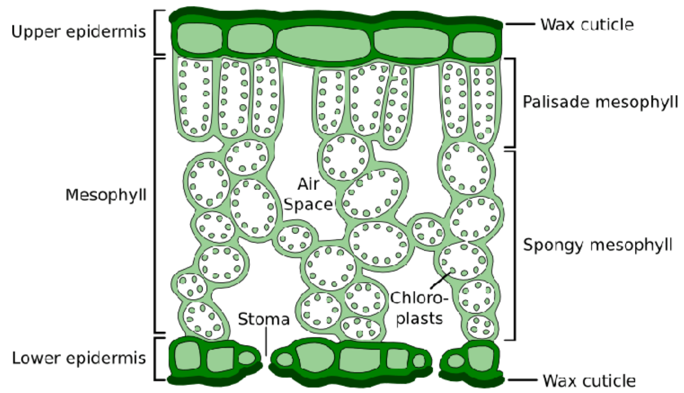
1. Blood	A tissue of plasms,, red blood cells, white blood cells and platelets.
2. Plasma	Yellow liquid that transports: Red & white blood cells Waste carbon dioxide to lungs. Urea from liver to kidneys. Digested nutrients to cells.
3. Red Blood Cells	Biconcave discs with no nucleus. Packed with red haemoglobin that carries oxygen to body cells.
4. White Blood Cells	Part of the body's defence against microorganisms.
5. Platelets	Small pieces form scabs over cuts.
6. Circulatory System	Transports substances to/from body cells. Made up of: Blood Blood vessels The Heart
7. Arteries	Carry blood away from your heart at high pressure.
8. Veins	Carry blood back to your heart. Use valves to stop reverse blood flow.
9. Capillaries	Network of tiny, thin vessels connecting to every individual cell. Substances diffuse in/out of blood.
10. Coronary Arteries	Blood vessels that supply the heart with oxygen.
11. Aerobic Respiration	Process by which all living things get energy from glucose & oxygen. Glucose + Oxygen ⟶ Carbon Dioxide + Water
12. The Heart	Organ made of muscle that pumps blood in two loops around body.



13. The Lungs	Organs for gas exchange. Take in O_2, release CO_2.



14. Alveoli	Thin sac like structures within the lungs. Covered in blood vessels to help gas exchange.
15. Plant Organs	Leaf—carries out photosynthesis. Stem—supports. Roots—take in water and minerals.
16. Leaf Structure	



17. Transport within plant	Phloem—moves sugars. Xylem—moves water & ions.
18. Transpiration	Evaporation from leaf pulls water through plant xylem. Affected by temperature, humidity, wind & light.

Trilogy: Biology

Communicable Diseases

Knowledge Organiser

Background

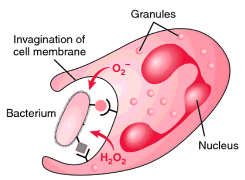
Nobody likes getting ill.

To better avoid disease, we need to understand what causes it and how our bodies try and defend us.

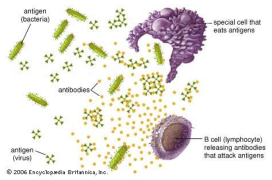
1. Bacteria	Large microbe. Living.
	Divide by splitting in two.
	May produce toxins that make us ill.
	Cause: Salmonella—food poisoning. Gonorrhoea—sexually transmitted disease.
2. Viruses	Smallest microbe. Not alive.
	Live and reproduce inside cells.
	Cause: Measles—can be fatal. HIV—can turn into AIDS. Tobacco mosaic virus—affects photosynthesis in plants.
3. Fungi	The other type of microbe. Living.
	Cause: Rose black spot—affects photosynthesis in plants.
4. Pathogens	Microbes/microorganisms that cause disease.
	Spread by air, contact & water.
5. Communicable Diseases	Infectious diseases that can be passed from one person to another.
	Caused by pathogens.
6. Malaria	Is a protist disease. Spread by mosquito bites.
7. Causes of Ill Health	Pathogens, diet, stress, life situations/ conditions.
8. Non-communicable Disease	Cannot be transmitted from one person to another.
	E.g. heart disease, arthritis.
9. Ignaz Semmelweis	Doctor in mid 1850's who persuaded doctors to wash their hands.
10. Louis Pasteur	Showed that microbes caused disease. Developed vaccines.
11. Vaccines	An inactive form of a pathogen used to prepare your immune system.
12. Human Defence Against Pathogens	Skin barrier—covers your body. Nose—hair and mucus act as a trap. Trachea & bronchi—covered in cilia and mucus. Stomach—makes acid to destroy pathogens. Immune system—white blood cells defend us in three ways.
13. Trachea	Pipe from mouth to bronchi.
14. Bronchi	Pipe into each lung.
15. Cilia	Tiny hair-like cells.

16. White Blood Cells

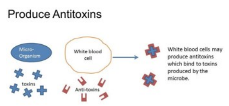
Phagocytosis—ingest microbes.



Produce antibodies—chemicals to destroy microbes.



Produce antitoxins—chemical to cancel out toxins made by pathogens.



Trilogy: Biology

Preventing and Treating Diseases

Knowledge Organiser

Background

Nobody likes getting ill.

To better avoid disease, we need to understand what causes it and how our bodies try and defend us.

1. Bacteria	Large microbe. Living.
	Divide by splitting in two.
	May produce toxins to make us ill.
	Cause: Salmonella Gonorrhoea
2. Viruses	Smallest microbe. Not alive.
	Live and reproduce inside cells.
	Cause: Measles HIV Tobacco mosaic virus
3. Pathogens	Microbes/microorganisms that cause disease.
	Spread by air, contact & water.
4. Communicable Diseases	Infectious diseases that can be passed from person to person.
	Caused by pathogens.
5. Louis Pasteur	Showed that microbes caused disease. Developed vaccines.
6. Painkillers	No effect on the pathogens but do reduce the symptoms of illness. E.g. aspirin, paracetamol.
7. Destroying Viruses	Is very difficult without damaging body tissue as they live inside cells.
8. Discovery of New Drugs	Medicines used to be extracted from plants & microorganisms, e.g.: Heart drug digitalis from foxglove Painkiller aspirin from willow tree Penicillin from mould
9. Placebo	A tablet with no active medicine content.

10. Vaccines	An inactive form of a pathogen used to prepare your immune system.
	White blood cells are able to respond quickly to prevent infection.
	MMR is a vaccine against measles, mumps and rubella.
11. Antibiotics	Medicines that kill specific bacteria. Greatly reduced deaths from bacterial diseases.
	Cannot kill viruses.
	Some bacteria are becoming resistant which is very concerning.
	Alexander Fleming discovered penicillin.
12. Making New Medicines	Need to be checked for toxicity (safety), efficacy (effectiveness) and dose.
	First trials are done using cells, tissues and live animals.
	Clinical trials use healthy volunteers and patients: 1. Very low doses at start of trial. 2. If safe, more trials done. 3. In double blind trial some patients given placebo.
13. White Blood Cells	Phagocytosis—ingest microbes
	Produce antibodies—chemicals to destroy microbes.
	Produce antitoxins—chemicals to cancel out toxins made by pathogens.

Trilogy: Biology Non-Communicable Disease Knowledge Organiser

1. Non-communicable Disease	Cannot be transmitted from one person to another.
	E.g. heart disease, arthritis.
2. Causes of Ill Health	Pathogens, diet, stress, life situations/ conditions
3. Communicable Diseases	Infectious diseases that can be passed on from one person to another.
	Caused by pathogens.
4. Coronary Heart Disease	Layers of fat build up inside coronary arteries, reducing blood flow and oxygen
	Stents used to keep arteries open.
	Statin medicines used to reduce blood cholesterol levels which reduces rate of
5. Heart failure	A failed heart can be replaced by a donor heart.
6. Faulty Heart Valves	Can be replaced by biological/mechanical valves.
7. Coronary Arteries	Blood vessels that supply the heart.
8. Cancer	Uncontrolled growth & division of cells.
	Lifestyle and genetic factors can increase the risk of some cancers.
9. Tumour	Lump or growth in a part of the body.
10. Health	State of physical and mental wellbeing.

11. Malignant Tumour	Are cancers.
	Invade neighboring tissues and spread throughout body forming secondary tumours.
12. Benign Tumour	Not cancers.
	Growths of abnormal cells in one area that do not invade t=other parts of the body.
13. Different Diseases Can Interact	A defective immune system can lead to more infections. Viruses can trigger cancer. Pathogens can trigger allergies. Physical ill health can lead to depression & mental illness.
14. Smoking & Risk of Disease	Carbon monoxide harms unborn babies.
	Carcinogens increase risk of cancers.
	Increases risk of coronary heart disease.
	Increases risk of lung disease & lung cancer.
15. Risks of diet, exercise & obesity	Increases risk of coronary heart disease and high blood pressure.
	Obesity can lead to type 2 diabetes.
16. Alcohol & Risk of Disease	Damages the liver and carcinogens increase risk of liver cancer.
	Affects brain function.
	Passes to and harms unborn babies.
17. Exposure to Ionising Radiation	EM waves and radioactive material.
	Can increase risk of cancers.

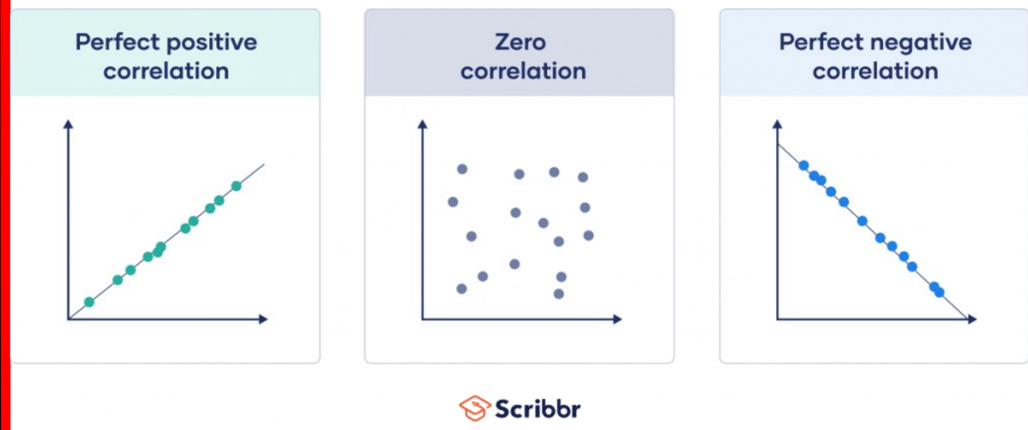
Background

A reported 25% of people in the UK are now obese. Around 17% of adults smoke and many more consume alcohol. So, what are the risks of these lifestyle choices.

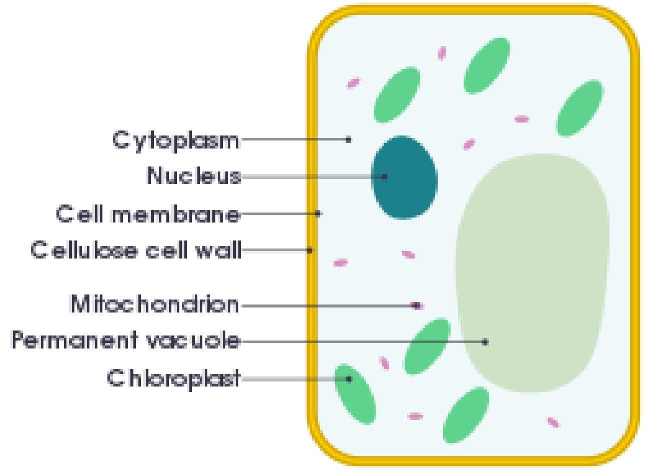
Maths Skills

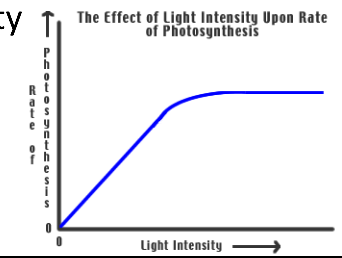
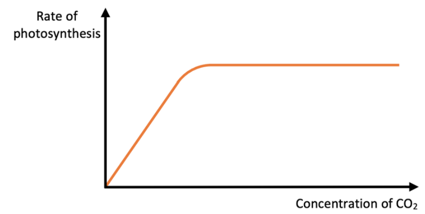
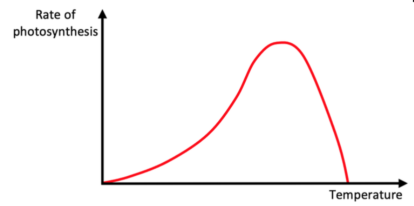
Use scatter diagrams to identify correlation between factors.

Using samples to estimate population trends.



Trilogy: Biology Photosynthesis Knowledge Organiser

1. Plant Leaf Cell	
2. Mitochondria	Perform respiration to release energy.
3. Cell Membrane	Controls movement in/out of the cell.
4. Ribosomes	Makes proteins by protein synthesis.
5. Nucleus	Control activities of cell. Contains genes to build new cells.
6. Cytoplasm	Liquid where most reactions happen.
7. Vacuole	Sack filled with sap. Keeps cell rigid.
8. Cell Wall	Made of cellulose. Supports cell.
9. Chloroplasts	Green and full of chlorophyll.
10. Chlorophyll	Absorbs light for photosynthesis.
11. Photosynthesis	The process of chloroplasts making their food (glucose) using light.
	The reverse of respiration.
	Carbon dioxide + water → glucose + oxygen
	Endothermic reaction—light energy is absorbed.

12. Leaf Adaptations for Photosynthesis	Big surface area to catch light. Thin—helps diffusion of gases. Chloroplasts—contain chlorophyll. Veins—bring water through xylem and move glucose through phloem. Air spaces—help diffusion of gases. Guard cells—open & close stomata to control gas movement
13. Rate of Photosynthesis	Can be measured by using pond weed and counting number of bubbles of oxygen
	Affected by light intensity 
	Affected by carbon dioxide concentration 
	Affected by temperature 
14. How Plants Use Glucose	In respiration—provides energy. Glucose + oxygen → carbon dioxide + water
	Store it as insoluble starch
	Make fat or oil for storage.
	Make cellulose to strengthen cell wall.
	To produce amino acids for protein synthesis and making DNA
15. Nitrate Ions	Also needed to make amino acids.

Background

Plants and algae are both amazing as they can make their own food.

This process means they are an essential part of every food chain.

Maths Skills

Interpreting sketch graphs.

Additional Information

The photosynthesis & respiration equations are the same, but the arrow is reversed.

This means you only really need to remember one of them .

Trilogy: Biology

Respiration

Knowledge Organiser

Background

It is one of the R's in MRS GREN.

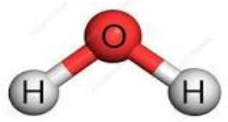
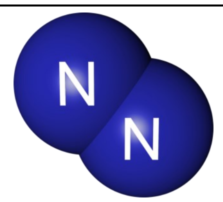
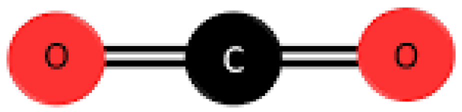
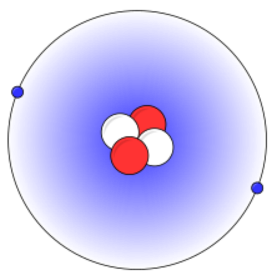
All living things do it, all of the time.

Every single one of your 10 trillion living body cells are doing it right now.

As are the 100 trillion microbes living in your intestines!!

1. Breathing	Not the same as respiration. Method of obtaining oxygen from the air.
2. Aerobic Respiration	Process by which all living things get energy from glucose & oxygen.
	Glucose + oxygen → carbon dioxide + water
	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
	Exothermic reaction—gives off heat.
	Happens continuously in plants & animals. Provides lots of energy.
	Occurs within mitochondria in cells.
3. Response to Exercise	During exercise the body needs more energy so rate of aerobic respiration increases. This needs: Heart rate increases—blood carries glucose & oxygen faster. Breathing rate & volume increases—lungs obtain more oxygen. Glycogen stores turned into glucose—more glucose available.
	More respiration means you get hotter and may need to cool down.
4. Anaerobic Respiration	Provides energy from glucose if there is not enough oxygen available.
5. Anaerobic Respiration in Plants & Yeast	Called fermentation. Used to make bread & alcohol.
	Glucose → ethanol + carbon dioxide
6. Enzymes	Biological catalyst. Helps reactions to happen in living things.
7. Anaerobic Respiration in Animal Cells	Glucose → Lactic Acid
	Much less energy provided than aerobic respiration.
8. Lactic Acid	Leads to an oxygen debt which requires more oxygen after exercise is complete to break down
	Causes muscles to tire and cramp.
9. Metabolism	The sum of all the reactions in a cell or the body of an organism.
	Energy provided by respiration is used in these metabolic reactions to make new molecules.
10. Metabolic Reactions	Turning glucose into starch, glycogen & cellulose. Making lipids from glycerol and fatty acids. Using glucose and nitrate ions to make amino acids. Respiration. Turning excess proteins into urea.
11. Metabolic Rate	The rate at which reactions happen in an organism.
12. Lipids	Fats and oils.
13. Starch	Carbohydrate store in plants.
14. Glycogen	Carbohydrate store in animals.
15. Cellulose	Makes cell walls in plants.
16. Urea	Waste product from liver.

Trilogy: Chemistry Atomic Structure Knowledge Organiser

1. Atom	Smallest part of an element that can exist.
2. Molecule	Two or more atoms chemically bonded. 
3. Element	Only one type of atom present. Can be single atoms or molecules. 
4. Compound	Two or more different elements chemically bonded. 
5. Nuclear Atom Model	Electrons orbit. Protons & neutrons in nucleus. Number of protons = electrons. 
6. Nucleus	The center of the atom. Contains neutrons and protons.
7. Proton	Charge of +1. Mass of 1. Found inside the nucleus.
8. Neutron	Charge of 0. Mass of 1. Found inside the nucleus.
9. Electron	Charge of –1. Mass of almost 0. Found orbiting the nucleus.

10. Mixture	Two or more chemicals not chemically bonded.
11. Separation Techniques	Used to separate mixtures. Filtration—get an insoluble solid from a liquid. Crystallization—get a soluble solid from a liquid by evaporating liquid off. Distillation—get a pure liquid from a mixture of liquids. Chromatography—separate mixtures of colored compounds.
12. Electron Energy Levels	Where electrons are found. The shells can each hold this many electrons maximum: 2,8,8
13. Periodic Table	A list of all the elements in order of atomic number. Columns called groups. Rows called periods.
14. Conservation of Mass	In a chemical reaction the total mass of reac-tants = total mass of products.
15. Mass Number	Number of neutrons + protons.
16. Atomic Number	Number of protons.
17. Isotope	Same number of protons different number of neutrons.
18. Ion	Atom where number of protons is not equal to electrons (+ve or-ve)
19. Plum Pudding Atom Model	Early model: ball of positive charge with electrons in it.

Background

Atoms are the main building blocks of us, our world and our universe.

Everything that we can touch is made of atoms.

The Periodic Table organizes them into a way that helps us make sense of the physical world.

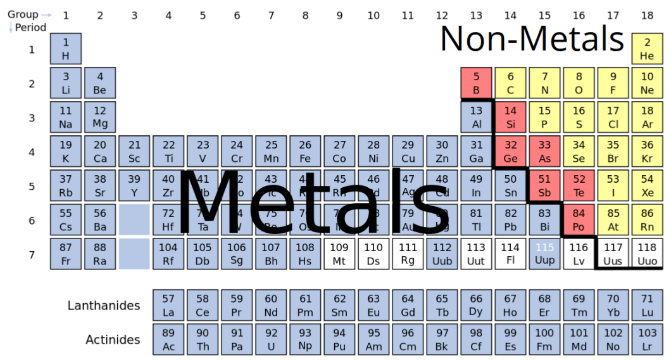
Even though they make everything atoms are mostly (99.9%) empty space.

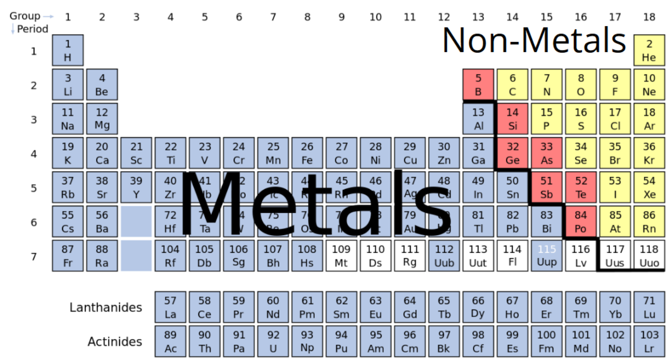
If an atom was as big as Wembley, the nucleus would be pea sized.

Trilogy: Chemistry The Periodic Table Knowledge Organiser

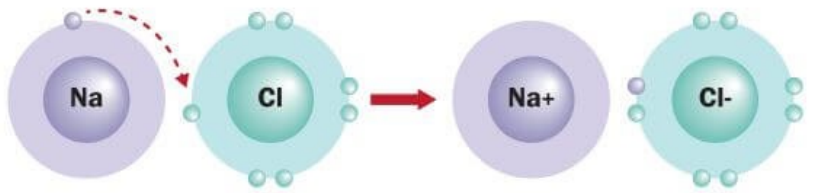
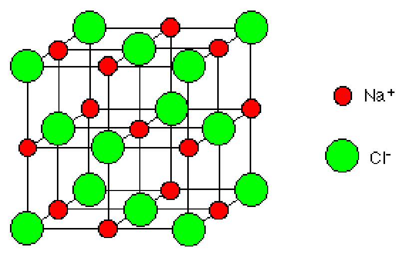
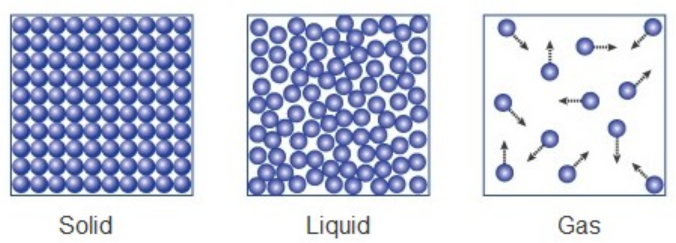
Background

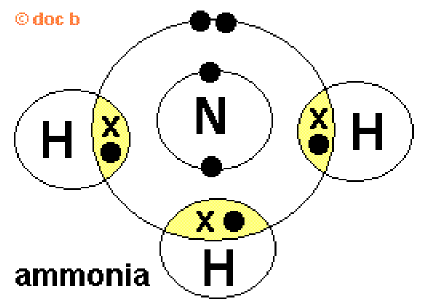
The Periodic Table is amazing because it allows us to predict and explain the properties of elements even before they are discovered.

1. Chemical Symbol	An abbreviated name for every element. Maximum of 2 letters always starts with a capital letter.
2. Reactivity	How easily an element will react.
3. Group	Columns in the Periodic Table.
	Elements in the same group have similar properties.
	Tells you how many electrons that atom has in its outer shell.
4. Period	Rows in the Periodic Table.
	Tells you how many electron shells that atom has.
5. Mass Number	Number of neutrons + protons.
6. Atomic Number	Number of protons.
7. Ion	Atom where number of protons is not equal to electrons (+ve or –ve)
8. Mendeleev	Scientist who placed elements in order of atomic weight but left gaps for undiscovered elements.
9. Metals	Have delocalized (free) electrons that can move.
	Atoms lose electrons and become positive (+ve) ions.
	

10. Non-metals	Have electrons that cannot move.
	Nearly always gain electrons and become negative (-ve) ions.
	
11. Group 0 Noble Gases	He, Ne, Ar, Kr, Xe, Rn
	Unreactive: full outer shell.
	Boiling point increases as you go down the group.
12. Group 1 Alkali Metals	Li, Na, K, Rb, Cs, Fr
	Very reactive: only one electron in their outer shell.
	Reactivity increases as you go down the group.
	React with oxygen to give metal oxides e.g. MgO.
	React with water to give metal hydroxide (alkali) and hydrogen e.g. MgOH.
	React with chlorine to give metal chloride e.g. MgCl.
13. Group 7 Halogens	F, Cl, Br, I
	Melting and boiling point increase as you go down group.
	Reactivity decreases as you go down the group.
	A more reactive halogen will displace a less reactive one.

Trilogy: Chemistry Structure & Bonding Knowledge Organiser

1. Chemical Bonds	Hold atoms together in a molecule after a reaction.
2. Ionic Bonding	Metal + Non-Metal
	Metal loses electrons and becomes a positive ion. Non-metal gains the electrons and becomes a negative ion.
	
3. Giant Ionic Structures	High melting & boiling points.
	Conduct electricity when melted or dissolved in water.
	
4. Metallic Bonding	Metal + Metal
	Giant structures with free electrons moving throughout.
5. Conductors	Metals conduct electricity because they have free electrons.
6. Graphite	Non-metal that conducts electricity.
7. Alloys	A mixture of different metals.
8. States of Matter	 © The University of Waikato Te Whare Wānanga o Waikato | www.sciencelearn.org.nz

9. Covalent Bonding	Non-metal + Non-metal
	Atoms share electrons.
	
10. Giant Covalent Structures	Examples are diamond and silicon dioxide.
	Solids. Very high melting points.
11. Small Molecules	Usually gases or liquids. Do not conduct electricity.
12. Polymers	Long chain molecules linked by strong covalent bonds.
13. Particle Theory	Particles are held together by intermolecular forces that get weaker as particles gain energy.
14. State Symbols	Solid (s), liquid (l), gas (g), aqueous solution (aq).
15. Graphene	A single layer of graphite used in electronics.
16. Fullerenes	Molecules of carbon with hollow shapes. Used in nanotechnology, electronics and materials.

Background

Chemical reactions are a crucial part of all our lives.

Without them the Universe as we know it could not exist.

This topic considers the three types of chemical bonds.

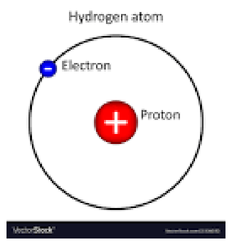
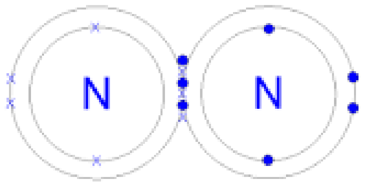
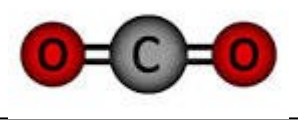
All involve atoms trying to fill or empty their outer shells.

Together these bonds are responsible for the wide range of different properties we see around us.

Trilogy: Chemistry

Chemical Calculations

Knowledge Organiser

1. Atom	Smallest part of an element that can exist.
	E.g. 
2. Molecule	Two or more atoms chemically bonded.
	E.g. 
3. Element	Only one type of atom present. Can be single atoms or molecules.
	E.g. 
4. Compound	Two or more different elements chemically bonded.
	E.g. 
5. Mass Number	Number of neutrons + protons.
6. Atomic Number	Number of protons.
7. Relative Atomic Mass	Ar, the mass number of an atom. E.g. Ar of O is 16 and H is 1.
8. Relative Formula Mass	Mr, the mass of all the atoms of a molecule added together. E.g. Mr of H2O is (2x1) + 16 = 18.
9. Mole	An amount where the Ar or Mr is written in grams. E.g. one mole of water has a mass of 18g.
10. Solute	Solid that has been dissolved.

11. Isotope	Same number of protons different number of neutrons.
12. Numbers in Reaction	Big numbers in front of a chemical tell us how many molecules/atoms of that chemical there
13. Balancing Equations	The number of atoms in the reactants must equal the number of atoms in the products.
	Steps to balance an equation: 1. $Mg + O_2 \longrightarrow MgO$ (Needs another O on product side.) 2. $Mg + O_2 \longrightarrow 2MgO$ (Now needs more Mg on reactants) 3. $2Mg + O_2 \longrightarrow 2MgO$
	Only add big numbers in front.
14. Chemical Reaction	Reactants ⟶ Products
15. Conservation of Mass	In a chemical reaction the total mass of reactants = total mass of products.
16. If Mass Seems to be Lost/Gained	Conservation of mass always applies but sometimes the mass of a gas being used/
17. Concentration	The mass of a solute in a given volume of solution.
	Concentration (g/dm^3) = mass of solute (g) ÷ volume of solution (dm^3)
18. Solution	Liquid containing dissolved solute.

Background

Want to make enough pancakes for everyone?

Then you need to know quantities.

Chemical reactions are the same.

Trilogy: Chemistry

Chemical Changes

Knowledge Organiser

1. Chemical Reaction	Reactants → Products
2. Oxidation	Losing electrons (or gaining oxygen)
3. Reduction	Gaining electrons (or losing oxygen)
4. OiL RiG	Oxidation is Loss of electrons. Reduction is Gain of electrons.
5. Reactivity Series	List of metals with the most reactive at the top and least reactive at the bottom. The most reactive metals are most likely to lose electrons.
6. Metals & Oxygen	Metal + Oxygen → Metal Oxide E.g. Iron + Oxygen → Iron Oxide
7. Metals & Water	Metal + Water → Metal Hydroxide + Hydrogen E.g. Sodium + Water → Sodium Hydroxide + Hydrogen
8. Metals & Acid	Metal + Acid → Metal Salt + Hydrogen E.g. Zinc + Hydrochloric Acid → Zinc Chloride + Hydrogen
9. Metal Carbonates & Acids	Metal Carbonate + Acid → Metal Salt + Water + Carbon Dioxide E.g. Lead Carbonate + Nitric Acid → Lead Nitrate + Water + Carbon Dixoide
10. Metal Salts	Hydrochloric acid makes chloride. Sulfuric acid makes sulfate. Nitric acid makes nitrate.
11. State Symbols	Solid (s), Liquid (l), Gas (g), Aqueous (Aq)

12. Displacement Reaction	A more reactive metal will displace a less reactive metal from a chemical compound. E.g. $CuCl_2 + Zn \rightarrow ZnCl_2 + Cu$
13. Ion	Atom where number of protons is not equal to electrons.
14. Neutralisation Reaction	Acid + Alkali → Metal Salt + Water
15. pH Scale	1—strong acid 7—neutral 14—strong alkali
16. Universal Indicator	Turns red in strong acid. Turns green in neutral. Turns purple in strong alkali.
17. Acids	Contains H^+ ions. Opposite of a base.
18. Base	Usually contains OH^- ions. Opposite of an acid.
19. Alkali	A base that is dissolved in water.
20. Test for Hydrogen	Hydrogen makes a squeaky pop when lit with a splint.
21. Test for Carbon Dioxide	If you bubble carbon dioxide through limewater it will turn milky.
22. Ionic Equation	Ions making neutral product. E.g. $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$

Background

In the past, scientists would discover reactions by trial and error.

This was time consuming & dangerous.

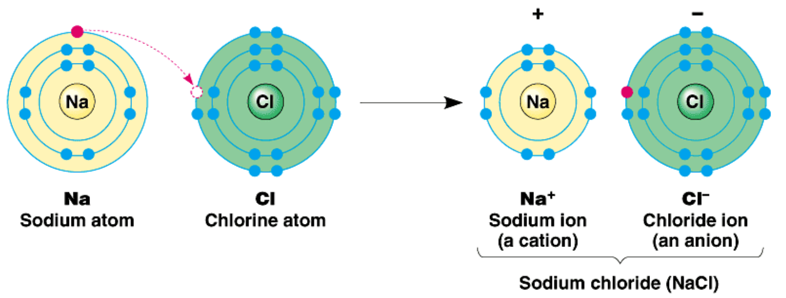
Today we can use patterns to predict the outcomes of a whole range of reactions.

This has allowed us to develop new materials and understand reactions that happen inside all living things.

Trilogy: Chemistry

Electrolysis

Knowledge Organiser

1. Electrolysis	Breaking down a substance using electricity.
2. Electrolyte	The ionic compound that is broken down in electrolysis. Must be an ionic compound in liquid form (either molten or dissolved in water).
3. Electrode	Connected to the power supply.
4. Anode	The positive electrode.
5. Cathode	The negative electrode.
6. Ion	Atom where number of protons is not equal to electrons.
7. Positive Ions	Metals and hydrogen. Collect at the cathode.
8. Negative Ions	Non-metals except hydrogen. Collect at the anode.
9. Ionic Bonding	Metal + Non-metal Metal loses electrons and becomes a positive ion. Non-metal gains the electrons and becomes a negative ion. 
10. Group	Column number in the Periodic Table. Tells you how many electrons in outer shell of atom. Used to work out the charge of an ion.

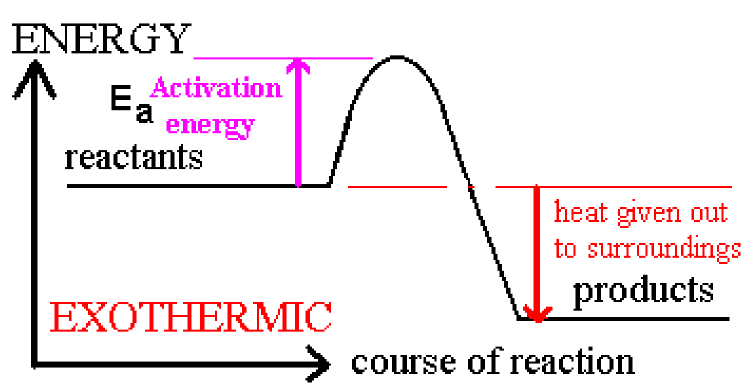
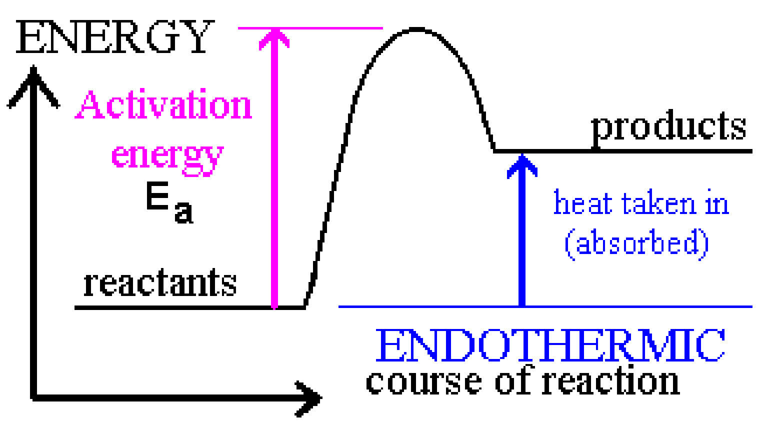
11. Half Equations	Equation showing what happens to electrons at each electrode. E.g. lead ions gaining 2 electrons at the cathode to become lead ions. $Pb^{2+} + 2e^- \rightarrow Pb$
12. Oxidation	Losing electrons (or gaining oxygen)
13. Reduction	Gaining electrons (or losing oxygen)
14. OiL RiG	Oxidation is loss of electrons. Reduction is gain of electrons.
15. Electron Shells	Where electrons are found. The shells can each hold this many electrons maximum: 2,8,8
16. Aluminium	Obtained from molten bauxite ore. Extracted by electrolysis mixed with cryolite to reduce melting temperature.
17. Cryolite	Used to extract aluminium.
18. Ore	Rock containing enough metal to be worth extracting.
19. Brine	Salt water (sodium chloride solution) Can be separated using electrolysis to produce chlorine, hydrogen and sodium hydroxide.
20. Test for Hydrogen	Hydrogen makes a squeaky pop when lit with a splint.
21. Test for Oxygen	Oxygen will relight a glowing splint.

Background

Electrolysis is important to our lives as it allows us to obtain reactive metals from their ores.

It is likely to become even more important over the next 10 years as we separate hydrogen from water for use in fuel cells.

Trilogy: Chemistry Energy Changes Knowledge Organiser

1. Exothermic Reaction	One that transfers energy to the surroundings so the temperature of the surroundings increases.
	
	Used in hand warmers and self heating cans.
	Examples: Combustion Respiration Oxidation Neutralisation
2. Endothermic Reaction	One that absorbs energy from the surroundings so the temperature of the surroundings
	
	Used in cold packs for injuries.
	Examples: Photosynthesis Thermal decomposition Citric acid & sodium hydrogencarbonate

3. Reactant	Used in a reaction.
4. Product	Made in a reaction.
5. Conservation of Energy	Energy is never created of destroyed it is just transferred from one form to another.
6. Activation Energy	Is the energy required to start a reaction.
7. Catalyst	Chemical which speeds up a reaction without being used itself.
	Reduces the activiation energy required to start a reaction.
8. Breaking & Making Bonds	This is what happens during a chemical reaction.
	Energy required to break bonds—endothermic.
	Energy released when bonds are made—exothermic.
	Bonds between different atoms need different amounts of energy.

Bond	Bond Energy (kJ/mol)
H—H	436
O = O	498
H—O	464

Background

The interaction of particles in chemical reactions often involves transfers of energy.

These produce heating or cooling effects that are used in a range of everyday applications.

Maths Skills

Using bond energies to calculate the difference in a reaction.

E.g.

$2H_2 + O_2 \longrightarrow 2H_2O$

Reactants bond energy

(2 x 436) + 498 = 1370kJ/mol

Products bond energy

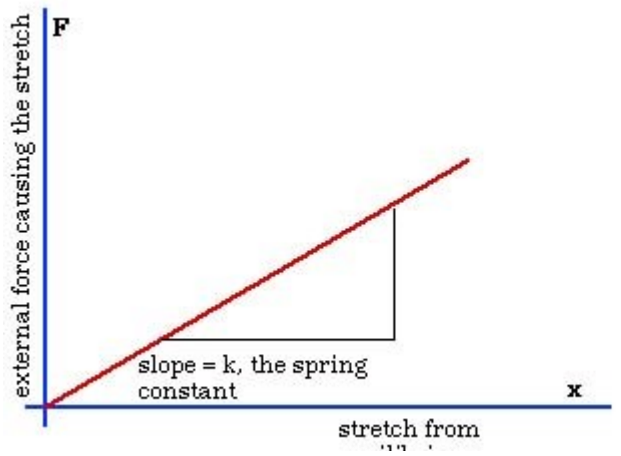
2x(2x464) = 1856kJ/mol

1370—1856 = -486 kJ/mol

Therefore exothermic.

Trilogy: Physics Conservation & Dissipation of Energy Knowledge Organiser

1. Energy Stores (J)	Chemical energy
	Kinetic energy
	Gravitational potential energy
	Elastic potential energy
2. Chemical Energy (J)	Transferred during chemical reactions. E.g. fuels, food or in batteries.
3. Kinetic Energy (J)	All moving objects have it.
	KE (J) = 1/2 x mass (kg) x speed^2 (m/s)
4. Gravitational Potential Energy	Stored in an object lifted up.
	GPE (J) = mass (kg) x gravity (N/kg) x height (m)
5. Elastic Potential Energy (J)	Energy stored in a springy object.
	EPE (J) = 1/2 x spring constant (N/m) x extension^2 (m)
6. Energy Can Be Transferred By….	Heating—thermal energy flows from hot to cold objects.
	An electrical current flowing.
	A force moving an object.
7. Useful Energy (J)	Energy transferred to the place and in the form we need it.
8. Wasted Energy (J)	Not useful. Eventually transferred to surroundings.

9. Work Done (J)	Equal to energy transferred.
	When a force moves an object.
	Work done (J) = Force (N) x Distance Moved (m)
10. Energy Flow Diagram	Show energy transfers.
	E.g. for a torch Chemical → Light + Heat
11. Conservation of Energy	Energy cannot be created or destroyed. It can only be transferred usefully, stored or dissipated.
12. Dissipated Energy (J)	Wasted energy, usually spread to the surroundings as heat.
13. Hooke's Law and k the Spring Constant	The extension of a spring is proportional to the force on it.
	
14. Efficiency	Proportion of input energy transferred to useful energy. 100% means no wasted energy. Efficiency = useful energy ÷ total input energy
15. Power (W)	Energy (J) transferred in 1 second.
	Power (W) = Energy (J) ÷ time (s)
16. Wasted Power (W)	Total power in—useful power out.

Background

Energy is the capacity of something to make something happen.

The Universe and everything in it is constantly changing energy from one form to another.

Maths Skills

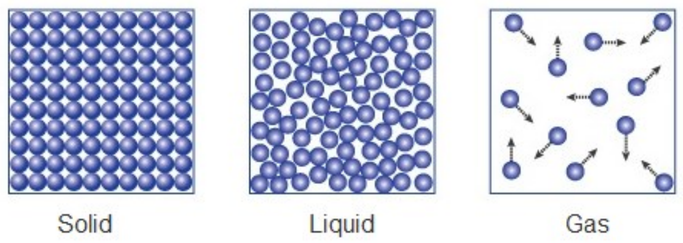
You should be able to recall, use and rearrange all of these equations except EPE.

g is Earth's acceleration due to gravity. It has value of approximately 9.8 m/s2.

You need to remember the units for each quantity.

You should be able to calculate the gradient of a force-extension graph.

Trilogy: Physics Energy Transfer By Heating Knowledge Organiser

1. States of Matter	
2. Solid	Particles held together in fixed positions by strong forces. Least energetic state of matter.
3. Liquid	Particles move at random and are in contact with each other. More energy than solids, less than gas.
4. Gas	Particles move randomly and are far apart. Weak forces of attraction. Most energetic.
5. Vacuum	No particles at all. Space is a vacuum.
6. Metals	Have free electrons which makes them good conductors.
7. Non-metals	Have fixed electrons which makes them good insulators.
8. Conductor	Is good at carrying heat energy or electrical energy.
9. Thermal Conductivity	A measure of how good something is at conducting.
10. Insulator	A poor conductor.
11. Friction	Two surfaces rubbing together.
	Causes energy to be transferred as heat.
	Can be reduced by using a lubricant.
12. Lubricant	Fluid (e.g. oil) that smooths contact points between surfaces.

13. More Energy Loss From A Building	If walls are thin.
	If walls have high thermal conductivity.
	Big temperature difference between inside and outside.
14. Reduce Heat Loss by….	Using material with low thermal conductivity i.e. an insulator.
	Make insulator thicker.
15. Specific Heat Capacity (J/kg^{o}C)	Amount of energy needed to change temperature of 1kg by 1^{o}C.
	Change in energy (J) = mass (kg) x specific heat capacity (J/kg^{o}C) x change in temperature (^{o}C) Can be written as: $E = mc\theta$
	Objects with a high specific heat capacity take a long time to heat up and cool down. They are good at storing heat energy.
16. Loft Insulation	Fiberglass which traps air which is a good insulator.
17. Cavity Wall Insulation	Traps air pockets in gaps which is a good insulator.
18. Double Glazing	Traps air in gaps between glass which is a good insulator.
19. Foil Behind Radiator	Reflects heat away from wall back into room.

Background

Not wasting heat energy in your home is important for the environment and for your finances.

This topic will help you make more informed decisions so you can save even more.

Maths Skills

You should be able to use the specific heat capacity equation to find energy change and the specific heat capacity when given all other variables.

You need to be able to rearrange to make specific heat capacity the subject.

Trilogy: Physics Energy Resources Knowledge Organiser

Background

It is hard to imagine a world without electricity.

It reaches into every aspect of our lives.

But where do we get the energy to make it from?

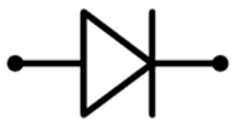
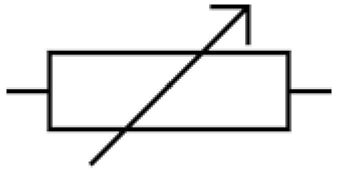
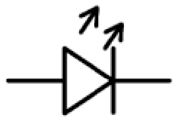
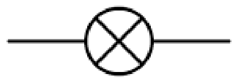
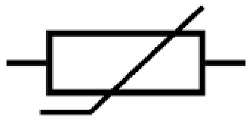
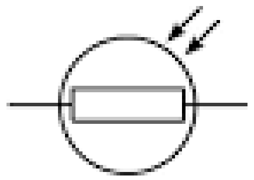
Will they run out?

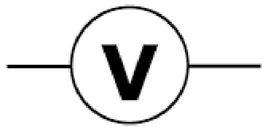
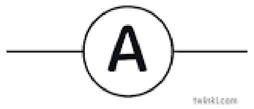
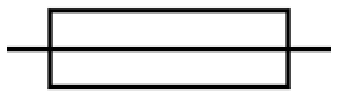
Have we got a backup plan?

1. Fuel	Substance that we burn to release heat energy.
	Stores chemical energy.
2. Fossil Fuels	Coal, oil and gas.
	Remains of ancient organisms. Millions of years to form.
	Are non-renewable.
	Release carbon dioxide when burnt.
3. Non-Renewable	Are used quicker than they are made so will run out.
4. Renewable Fuels	Made quicker than they are used. Will not run out.
	Biofuel Wind & Wave Geothermal Hydroelectric & Tidal Solar
5. Biofuel	Fuel made from living organisms e.g. vegetable oil, ethanol, wood.
	Are considered carbon neutral because CO2 released is balanced by amount taken in by
	Reliable—can even be used in fossil fuel power stations.
	Reduces land available for food growth.
	Renewable.
6. Burning Fuels	Releases carbon dioxide which contributes to the greenhouse effect and global warming.

7. Wave & Wind Power	Kinetic energy of the air/water turns turbines.
	Unreliable as both need wind.
	Renewable.
8. Geothermal Power	Use heat energy from deep underground instead of fuel.
	Not available everywhere.
	Renewable.
9. Hydroelectric & Tidal Power	Water stored high up in dams then released to spin a turbine.
	Very quick start up time.
	Can destroy habitats for animals.
	Renewable.
10. Solar Power	Use light or heat energy from the Sun.
	Unreliable as needs Sun.
	Renewable.
11. Nuclear Fuel	Energy stored in nucleus as nuclear energy. Uranium or plutonium.
	Heat release in reactor core.
	High energy yield.
	Very slow start up time as potentially dangerous.
	Fuel and waste is radioactive.
	Very expensive to set up and decommission.
12. Decommission	Take apart and make safe at the end of its life.

Trilogy: Physics Electric Circuits Knowledge Organiser

1. Diode	Current only flows one way. Very high resistance in other direction. 
2. Resistor	Resistance stays constant. Current proportional to potential difference. 
3. Variable Resistor	Resistance can be set by a human. Used in dimmer switches. 
4. LED	A diode that gives off light. 
5. Lamp	Resistance increases as the temperature increases. 
6. Thermistor	 Resistance decreases as the temperature increases. Used in thermostats.
7. LDR	 Resistance decreases as the light intensity increases. Used in automatic lights.

8. Cell & Battery	Provides the potential difference and energy for a circuit.  FIGURE 8–19. One-cell and three-cell battery symbols.
9. Current, I	Rate of flow of electrical charge. Measured in Amps (A).
10. Charge, Q	Measured in Coulombs (C)
11. Potential Difference, V	Energy transferred per unit charge. Measured in Volts (V).
12. Resistance, R	Ability to slow current. Measured in Ohms (Ω).
13. Series Circuit	Current has only one route. Current is the same all the way around. Potential difference is shared across components. Resistances are added together.
14. Parallel Circuit	Current has different paths it could take. Current is shared through each branch. Potential difference is the same across each branch. Total resistance is lower than the smallest single resistor.
15. Voltmeter	Measures potential difference across a component. 
16. Ammeter	Measures current through a component. 
17. Fuse	Resistor that melts if the current is too high. 

Background

Electrical power fills the modern world with light and sound, information and entertainment, remote sensing and control.

Its use was identified and explored by scientists in the 19th century but it becomes more important every day.

Maths Skills

Charge (C) = Current (A) x time (s)

Potential difference (V) = Current (A) x Resistance (Ω)

Trilogy: Physics Electricity in the Home Knowledge Organiser

Background

We use electricity in all aspects of modern life.

But how is it moved from power stations to our homes and then to our devices?

This topic answers that question as well as investigating how power companies measure our electricity usage.

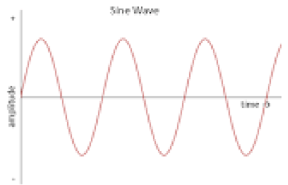
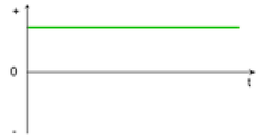
Maths Skills

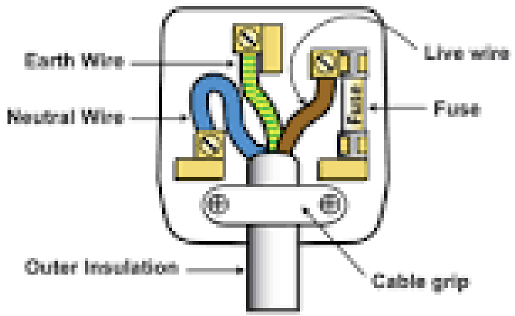
Power (W) = Potential difference (V) x Current (A)

Power (W) = Current^2 (A) x Resistance (Ω)

Work Done (J) = Power (W) x Time (s)

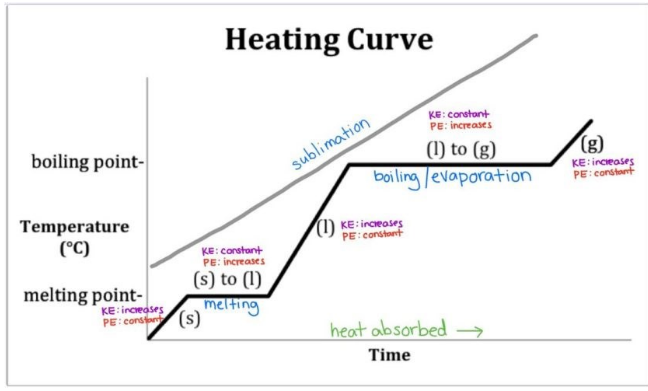
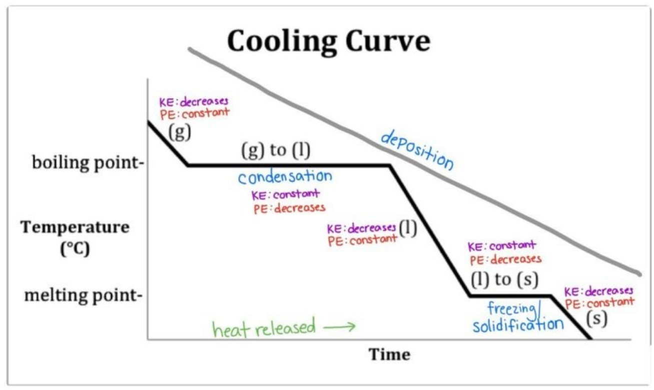
Work Done (J) = Charge Flow (C) x Potential Difference (V)

1. AC	Alternating current found in mains.
	Has an alternating potential difference negative to positive. 
2. DC	Direct current, found in batteries.
	Has a constant potential difference. 
3. UK Mains	AC supply of 230 Volts and frequency of 50Hz.
4. Power, P	Energy (J) transferred in 1 second. Measured in Watts (W).
5. Potential Difference, V	Also known as voltage. Measured in Volts (V).
6. Energy Transferred, E	Depends on the power of the appliance and the time it is on for. Also called work done.
7. Energy Transfer	Energy input ⟶ Useful Energy + Wasted Energy
8. Work Done, E	Energy transferred when current flows in a circuit.
9. National Grid	System of cables and transformers.
10. Step Up Transformer	Increase potential difference so that less heat energy is wasted.
11. Step Down	Decrease potential difference to make electricity more easily used.

12. Current, I	Measured in Amps (A).
13. Resistance, R	Measured in Ohms (Ω)
14. Live Wire	Brown. Connects to fuse.
	Carries the alternating potential difference from the supply.
	About 230V.
15. Neutral Wire	Blue wire.
	Completes the circuit.
	Around 0V.
16. Earth Wire	Green and yellow striped wire.
	Carries current safely to Earth if there is a fault.
	Normally 0V.
17. Electrical Plug	Made of plastic as it is a good insulator.
	

Trilogy: Physics Molecules & Matter Knowledge Organiser

1. Mass, m	Amount of matter in something. Measured in kg.
2. Volume, V	Amount of space something takes up. Measured in m^3.
	Volume of a cuboid = width x depth x height
	Volume of an irregular object can be found by dropping in a liquid and measuring displacement.
3. Density, ρ	Mass per unit volume. Measured in kg/m^3.
	Density = mass ÷ volume.
4. Floating	An object that has a lower density than the fluid will float.
5. Sinking	An object that has a higher density than the fluid will sink.
6. Evaporation	Happens at any temperature.
7. Sublimation	Solid turns straight into a gas.
8. Solid	Particles held together in fixed positions by strong forces. Least energetic state of matter.
9. Liquid	Particles move at random and are in contact with each other. More energy than solids, less than gas.
10. Gas	Particles move randomly and are far apart. Weak forces of attraction. Most energetic.

11. Melting Point	Temperature when solid turns into liquid. Same as freezing point.
12. Boiling Point	Temperature when liquid turns into gas. Same as condensation point.
13. Condensation Point	Temperature when gas turns into a liquid. Same as boiling point.
14. Freezing Point	Temperature when liquid turns into a solid. Same as melting point.
15. Latent Heat	Energy transferred when a substance changes state but temperature doesn't change.
16. Specific Latent Heat of Fusion	Energy needed to melt 1kg of solid into liquid.
17. Specific Latent Heat of	Energy needed to boil 1kg of liquid into gas.
18. At State Changes…..	Temperature and kinetic energy of particles stays constant.
	Internal energy increases due to an increase in potential energy as particles move further
19. Heating & Cooling Curves	 
20. Gas Pressure	Caused by particles hitting surfaces. Increases when temperature increases.

Background

The particle model is widely used to predict the behavior of solids, liquids & gases.

It helps us to design vehicles from submarines to spacecraft.

It even explains why it is difficult to make a good cup of tea high up a mountain!

Maths Skills

Density (kg/m^3) = mass (kg) ÷ volume (m^3)

Energy (J) = mass (kg) x specific latent heat (J/kg)

Trilogy: Physics Radioactivity Knowledge Organiser

1. Radioactive Decay	Unstable nuclei emitting a type of radiation (α, β, γ or neutron)
2. Random Event	You cannot predict or change when decay might happen.
3. Ionising	The ability to charge atoms.
4. Alpha Particle (α)	Two neutrons and two protons. The same as a helium nucleus.
	Stopped by paper or skin.
	Range of a couple of cm in air.
	Highly ionizing. Has a charge of +2.
	Parent atom mass drops by 4 and atomic number drops by 2.
5. Beta Particle (β)	A high speed electron made when a neutron turns into a proton.
	Stopped by thin aluminium.
	Range of up to 1 meter.
	Mid ionizing. Has a charge of –1.
	Parent atom mass remains the same and atomic number rises by 1.
6. Gamma Ray (γ)	An electromagnetic wave.
	Stopped by thick lead.
	Unlimited range.
	Low ionizing: has no charge.
	Parent atom mass an atomic number remains the same.
7. Neutron	Neutron ejected from the nucleus.

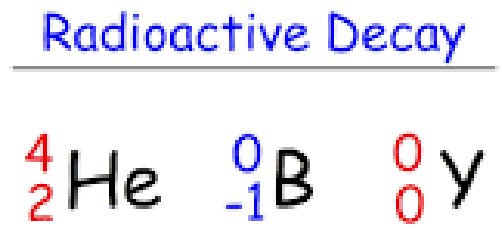
8. Activity	Rate of unstable nuclei decay. Measured in Becquerel (Bq)
9. Irradiated	Exposed to radiation but does not become radio-active.
10. Radioactive Contamination	Unwanted presence of radioactive material.
11. Geiger Counter	Nuclear radiation detector.
12. Half-Life	Time it takes for radioactive nuclei to halve. Or the time it takes for the activity to halve.
13. Nuclear Model of the Atom	Very small, radius of 1 x 10 $^{-10}$ m. Most of the mass in the nucleus. Number of electrons = protons.
14. Mass Number	Number of neutrons + protons.
15. Atomic Number	Number of protons.
16. Isotope	Same number of protons different number of neutrons.
17. Ion	Atom where number of protons is not equal to electrons.
18. Plum Pudding Atom	Early model. Ball of positive charge with electrons stuck in it.
19. Bohr Model	Idea that electrons have to be at certain distances from nucleus.
20. Chadwick	Discovered neutrons.

Background

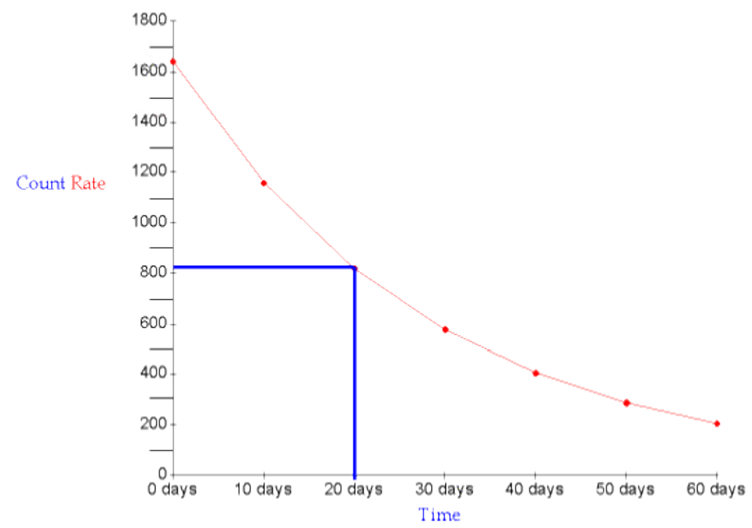
Researched by Henri Becquerel and Marie Curie around 1900 it remains mysterious and frightening.

Maths Skills

Nuclear decay equations—balance top and bottom numbers on RHS and LHS.



Finding Half Life Using A Graph—find how long it takes until you have half of what you started with.



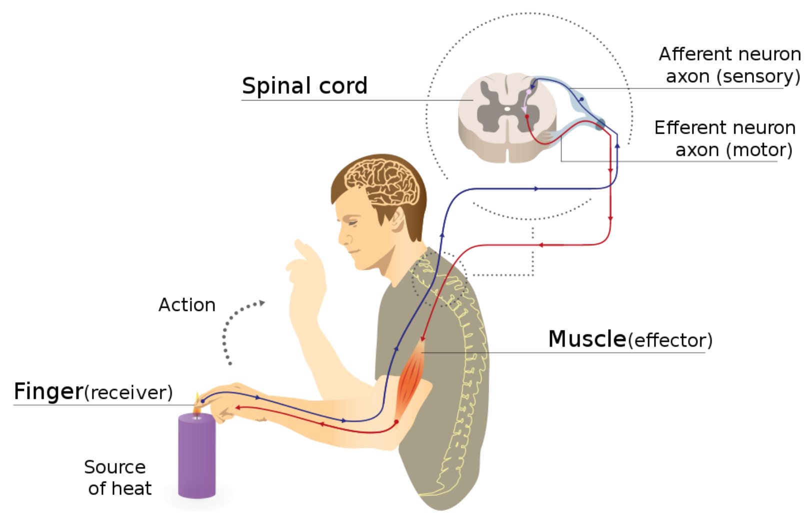
Trilogy: Biology—The Human Nervous System Knowledge Organiser

Background

Cells in the body need very specific conditions to survive and operate.

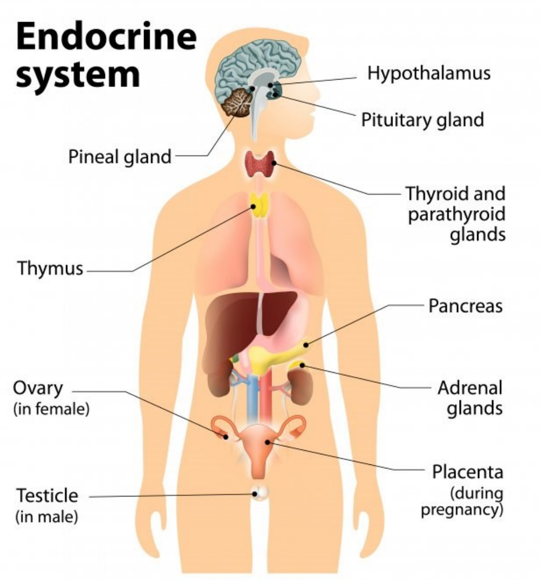
How does our nervous system ensure that these conditions are monitored & controlled?

1. Catalyst	Increase rate of reaction without being used up themselves.
2. Enzyme	Biological catalysts. Work at a specific temperature & pH.
3. Homeostasis	Automatic control of conditions inside a cell or organism so that enzymes and cells work
	In the human body it controls: 1. blood glucose concentration. 2. Body temperature 3. Water levels
	Uses receptors, coordination centers and effectors.
4. Receptors	Cells that detect changes.
5. Coordination Centers	Use information from receptors
	Brain, spinal cord & pancreas
6. Effectors	Bring about response to changes
	Muscles or glands
7. Pancreas	Monitors and controls blood glucose levels.
8. Glands	Make hormones which act as chemical messages in the body.
9. Stimuli	A change noticed by a sensory receptor. Can be changes in: Temperature Taste Touch Sound Light Smell
10. Neuron	Specialized cell that carries electrical impulses in nervous system.

11. CNS	Central nervous system. Brain and spinal cord.
12. Reflex Actions	Automatic, rapid actions that do not use conscious part of brain.
	Safety mechanism for our body.
	E.g. blinking, jumping at loud sounds.
13. Reflex Arc	The sequence in a reflex action. E.g. tasting something sour. 1. Stimulus—sour taste 2. Receptor—taste bud cell 3. Sensory neuron—carries impulse to coordinator 4. Relay neuron—in coordinator—spinal cord 5. Motor neuron—carries impulse to effector 6. Effector—muscle in face 7. Response—muscle contracts
	
14. Synapse	Gap between two neurons. Chemicals diffuse across gap instead of electrical impulse.
15. Muscle	Tissue that can contract or relax to cause movement.

Trilogy: Biology—Hormonal Coordination Knowledge Organiser

1. Endocrine System	Contains glands that secrete hormones into the blood stream.



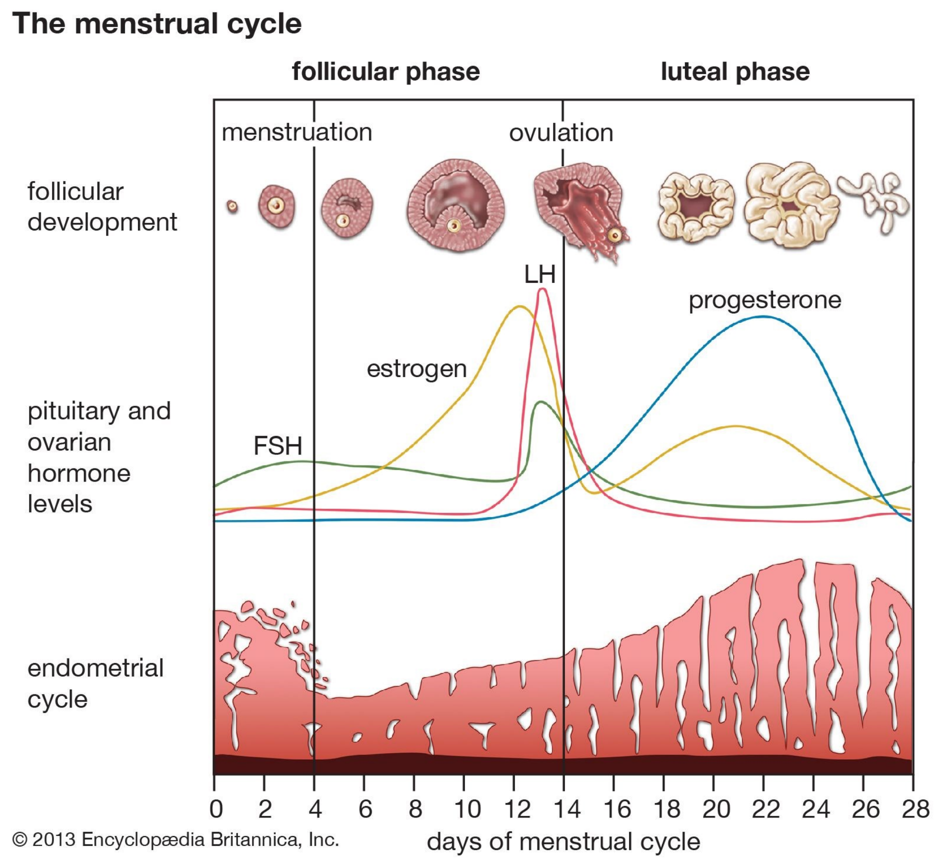
2. Hormones	Chemical messages in the body.
3. Pituitary Gland	Master gland that secretes hormones that act on other glands.
4. Pancreas	Monitors and controls blood glucose levels.
	Releases insulin hormone if blood glucose concentration is too high.
	Releases glucagon if blood glucose concentration too low.
5. Insulin	Causes cells to take glucose from blood. Liver and muscle cells store it as glycogen.
6. Glucagon	Converts glycogen into glucose. Interacts with insulin in a negative feedback cycle to control glucose.
7. Adrenaline	From adrenal gland. Increases heart rate in fight or flight response.
8. Contraception	Oral pill—FSH stops eggs maturing Injection/implant—progesterone to stop maturation & release of eggs. Spermicides—chemicals kill sperm. Barrier—stop sperm reaching egg. Abstinence—no sexual intercourse. Surgical—removal/cut reproductive organs.
9. Type 1 Diabetes	Pancreas does not produce enough insulin when glucose concentration too high. Needs insulin injections.
10. Type 2 Diabetes	Body no longer responds to insulin. Controlled by diet and exercise.
	Obesity is a risk factor for this diabetes.
11. Thyroxine	From the thyroid gland. Controls the body's metabolic rate. Important in growth and development. Controlled by negative feedback.
12. Oestrogen	Main female reproductive hormone. From ovaries.
13. Ovulation	Once a female has gone through puberty she releases an egg every 28 days during the
14. Hormones During Menstrual Cycle	FSH causes an egg to mature in the ovary.
	LH triggers ovulation.
	Oestrogen causes uterus lining to grow, stops the release of FSH and triggers release of LH.
	Progesterone maintains uterus lining, stops production of both FSH and LH.
15. Testosterone	Main male reproductive hormone. From testes. Starts sperm production.
16. Infertility Treatment	FSH and LH can be taken to stimulate egg development and release. IVF uses eggs that are removed, fertilized and re-implanted into uterus.

Background

The journey from a child into an adult is a difficult time for all living things.

Its all because of our hormones.

Here are the hormones that change and control the female menstrual cycle.



1. Asexual Reproduction	Only one parent. Cells divide by mitosis. Offspring are clones of parent.
2. Sexual Reproduction	Two parents. Fusing of male and female gametes which mixes genetic information from parents. Variation between offspring
3. Gametes	Male and female sex cells: Male—sperm & pollen Female—egg
	Half chromosomes of a normal cell.
4. Mitosis	One parent cell divides into two identical versions. Used in growth & repair.
5. Meiosis	Cells divide to make gametes. 1. Copies genetic information 2. Cell divides into two each with full set of chromosomes. 3. Two cells divide into four gametes—each with half a set of chromosomes. 4. Gametes are genetically unique.
6. Fertilization	Male and female gametes fuse together—now have full set of chromosomes for offspring.
	Fusing half mother chromosomes with half of fathers.
7. Clone	Genetically identical.
8. Characteristics	Features of an individual.

9. DNA	Chemical that makes chromosomes.
	Polymer made of 2 strands. Double helix shape.
10. Gene	Small section of DNA in a chromosome. Codes for a certain amino acids to make a certain protein.
11. Chromosome	Made of genes. Carry all genetic information on how to make organisms what they are. Humans have 23 pairs of chromosomes
12. Genome	All the genetic material of an organism. The whole human genome has been studied and will have great importance for future medicine.
13. Using the Human Genome	Search for genes related to certain diseases. Treating inherited disorders. Study human migration patterns.
14. Allele	Single gene that controls one inherited characteristic e.g. fur colour.
15. Genotype	Allele version present e.g. BB, Bb or bb
16. Phenotype	Characteristic displayed e.g. green eye
17. Dominant	Allele that wins if present e.g. B
18. Recessive	Allele that is masked by dominant e.g. b
19. Heterozygous	Both alleles are identical e.g. BB or bb
20. Homozygous	Both alleles are different e.g. Bb
21. Inherited Disorders	Polydactyl—extra fingers or toes. Caused by dominant allele. Cystic Fibrosis—recessive allele.
22. Gender	Females—XX Males—XY

Trilogy: Biology—Reproduction Knowledge Organiser

Background

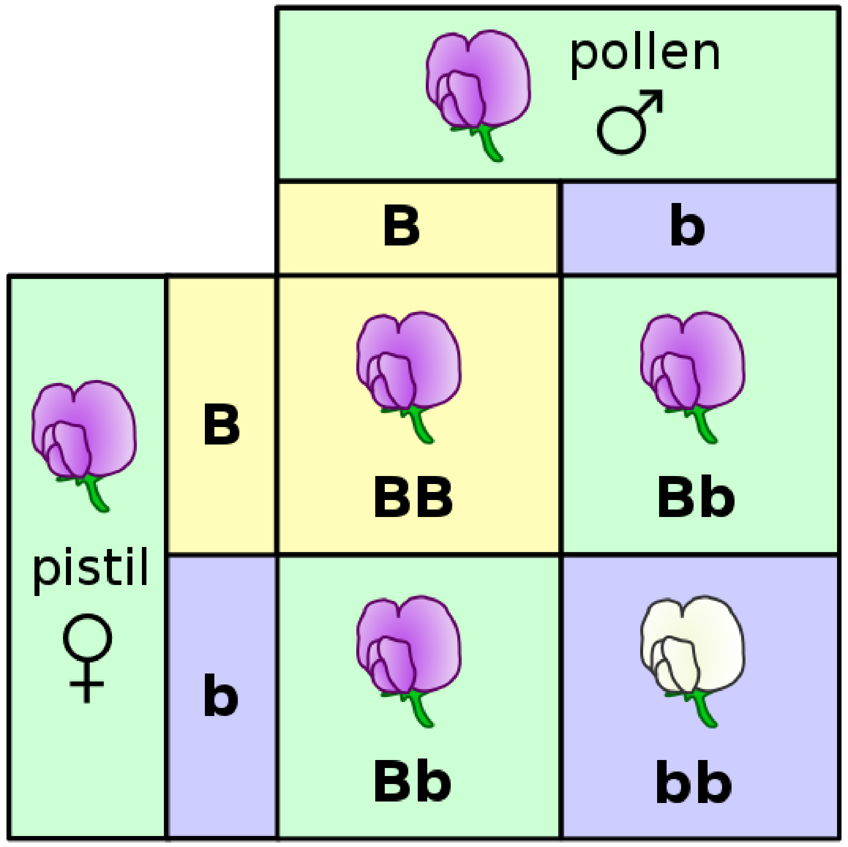
Why is there such variation between humans? How are some characteristics inherited from mothers and some from fathers?

Punnett Squares

Predict outcomes of genetic crosses.

Parents genotype outside.

Possible offspring genotypes in middle.



Trilogy: Biology—Variation & Evolution Knowledge Organiser

1. Variation	Differences between individuals in a species. Caused by combination of genes and environment.
2. Inherited Characteristics	Features from genes you inherit. E.g. hair colour, tongue rolling.
3. Environmental Characteristics	Features caused from conditions you have grown up in. E.g. accent.
4. Mutations	Changes in DNA code. Occur continuously.
	Responsible for all different phenotypes.
5. Phenotype	Characteristic displayed due to a genetic allele. E.g. green eyes.
6. Evolution	Change in inherited characteristics over time due to natural selection.
7. Darwin's Theory of Evolution Through Natural Selection	All living things evolved from simple life forms over 3 billion years ago.
	1. Different phenotypes in species. 2. Some phenotypes are better suited to environment. 3. Individuals with better suited phenotypes survive and breed. 4. Successful phenotypes are passed on to the next generation.
8. Genome	All genetic information in an organism.

9. New Species	Evolve such different phenotypes that they can no longer breed.
10. Selective Breeding	Choosing parents with desired characteristics so that their offspring show those characteristics.
	Takes many generations to obtain desired characteristic reliably.
	Desirable characteristics include: Disease resistant crops More milk or meat Dogs with gentle nature Large or unusual flowers
11. Inbreeding	Selective breeding can lead to this. Where breeds are prone to disease or inherited defects.
12. Genetic Engineering	Modifying the genome of an organism by adding a gene from another organism. Examples: Bacteria to produce insulin. Possibly curing human inherited disorders.
13. GM Crops	Genetically modified crops can be resistant to disease or have higher yield.
	Concerns over effect on wild plants and insects. Also long term effects on human health.
14. Processes of Genetic Engineering	1. Enzyme isolates gene. 2. Gene loaded into vector e.g. virus 3. Vector inserts gene into cell 4. Genes transferred at early stage of development so organism develops with desired characteristics.

Background

It is hard to imagine that all life on Earth shares the same ancestors

The process of evolution through natural and artificial selection have both been in action for a very, very long time.

This topic considers how living things have and continue to evolve.

Trilogy: Biology—Genetics & Evolution Knowledge Organiser

Background

Understanding where we come from may be far more useful than satisfying our curiosity.

It might help us fight the emergence of antibiotic resistant bacteria—describe as one of the greatest current threats to humanity.

So what is evolution all about?

1. Darwin's Theory of Evolution Through Natural Selection	All living things evolved from simple life forms over 3 billion years ago.
	1. Different phenotypes in species. 2. Some phenotypes are better suited to environment. 3. Individuals with better suited phenotypes survive and breed. 4. Successful phenotypes are passed on to next generation.
	Theory is now widely accepted.
2. Evidence for Evolution	From looking at fossils. Antibiotic resistance in bacteria. Understanding of genetics.
3. Fossils	Remains of organisms from millions of years ago found in rocks.
	Formed by: 1. Conditions needed for decay were not present. 2. Parts of organisms replaced by minerals as they decayed. 3. Preserved traces e.g. footprints.
4. Why So Few Fossils?	Many life forms had soft bodies. Geological activity destroyed some.
5. Extinct	No more surviving individuals of a species.
6. Evolutionary Tree	Used to show how we think organisms are related.

7. Extinction	Permanent loss of all members of a species. Can be caused by: 1. Changes in environment e.g. climate 2. New predators 3. New diseases 4. New competition e.g. for food
8. Bacterial Evolution	Can evolve quickly as they reproduce at such a fast rate.
9. Resistant Bacteria	Some bacteria have a mutation that makes them resistant to antibiotics. This means we cannot kill them.
	MRSA is resistant to antibiotics.
10. Reducing Development of Resistant Bacteria	1. Humans not to use antibiotics as often. 2. Patients should always complete their courses of antibiotics so all bacteria are killed. 3. Reduce use of antibiotics in agriculture.
11. Developing New Antibiotics	Is expensive and slow. It is unlikely to be done quick enough to cope with resistant bacteria.
12. Classification	Putting living things into similar groups.
13. Linnaean System	Carl Linnaeus's classification system. Kingdom, Phylum, Class, Order, Family , Genus , Species
	Remember it using the mnemonic: Keep Ponds Clean Or Frogs Get Sick
14. Three Domain System	Classification developed by Carl Wrose. Archaea—primitive bacteria Bacteria—true bacteria Eukaryota—everything else living

Trilogy: Biology—Adaptations, Interdependence & Competition Knowledge Organiser

1. Communities	Group of interdependent plants or animals living together.
2. Ecosystem	A system that includes all living organisms (biotic) in an area as well as non-living (abiotic)
3. Plants Compete For	Light & Space Water Mineral ions from soil.
4. Animals Compete For	Food Mates—for reproduction Territory
5. Interdependence	Different species relying on each other for food, shelter, pollination, seed dispersal.
	Changes to one species affect the whole community.
6. Energy Source for Ecosystems	The Sun is the source of all energy in all food webs.
	Plants use photosynthesis to convert light into chemical energy in glucose.
7. Abiotic Factors	Non-living factors that affect communities: Light intensity Temperature Moisture levels Soil pH and mineral content Wind intensity and direction Carbon dioxide levels—plants Oxygen levels—aquatic animals
8. Aquatic	Lives in water
9. Food Chain	A single path in a food web.

10. Biotic Factors	Living factors that affect communities: Availability of food New predators New pathogens One species outcompeting leading to numbers too low to breed.
11. Adaptations	Features which make an organism better suited to its environment.
12. Structural Adaptations	Physical features. E.g. fur, beak shape, foot size, sharp claws, thick blubber, big leaves, long roots, camouflage.
13. Behavioral Adaptations	Changes in behavior to help survive. E.g. migration, tools, pack hunting.
14. Functional Adaptations	Biological processes such as reproduction or metabolism. E.g. giving birth to lots of young, hibernation, a
15. Extremophiles	Organisms that live in very extreme environments such as high pressure /
	E.g. bacteria in deep sea vents.
16. Example Plant Adaptations	Long roots collect water; small leaves reduce water loss; big leaves increase light captured.
17. Example Animal	Camouflage to hide/hunt; big surface area increases heat loss; blubber reduces heat loss
18. Quadrat	Randomly chosen small area. Used to estimate total numbers.
19. Line Transect	A line along which you measure distribution of organisms.

Background

A study recently estimated there to be 8.7 million different species of organism on our planet.

They all compete for the limited resources available and nearly all rely on the Sun as their ultimate source of energy.

Maths Skills

Find the mean, median and mode for a set of data.

E.g. 1, 2, 3, 4, 5, 5, 6

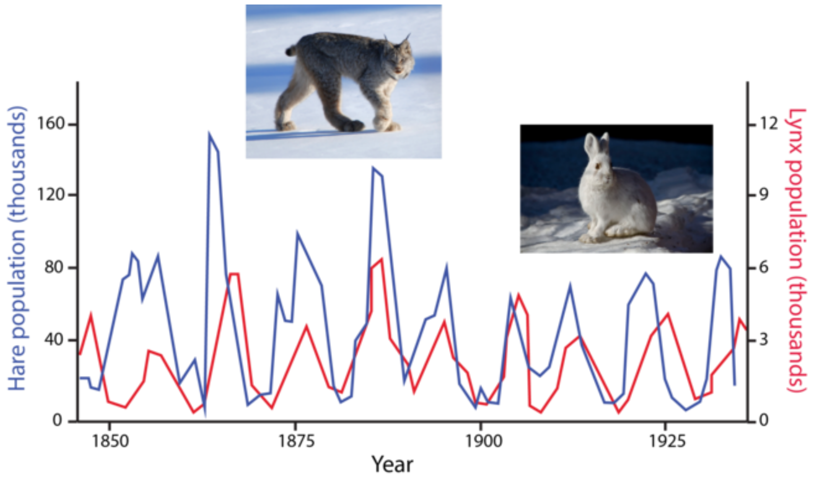
Mean = (1+2+3+4+5+5+6) ÷ 7 = 3.7

Median (middle number) = 4

Mode (most common number) = 5

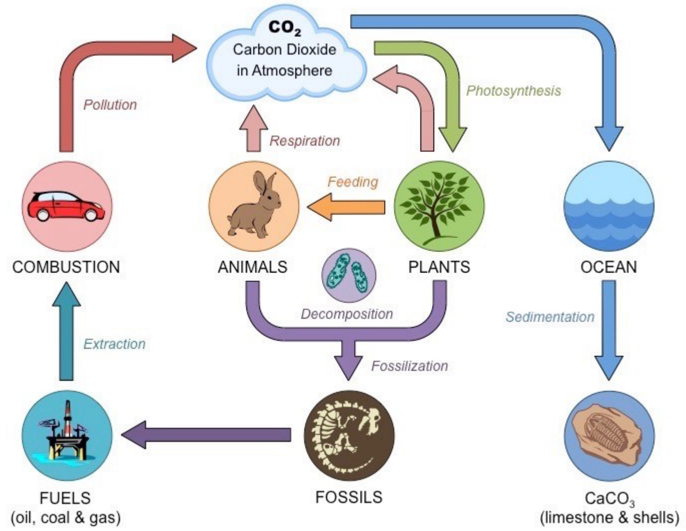
Trilogy: Biology—Organising An Ecosystem Knowledge Organiser

1. Food Chains	Producer → Primary Consumer → Secondary Consumer
2. Biomass	Amount of biological mass in an organism.
3. Producers	Green plants or algae. Always first organism in a food chain. Produce most of the biomass for life on Earth e.g. phytoplankton
4. Primary Consumers	Eat producers e.g. fish
5. Secondary Consumers	Eat primary consumers e.g. seal
6. Tertiary Consumers	Eat secondary consumers e.g. killer whale
7. Predators	Consumers that kill and eat other animals.
8. Prey	Consumers that get eaten by predators.
9. Predator-Prey Cycles	Numbers both rise and fall in cycles.

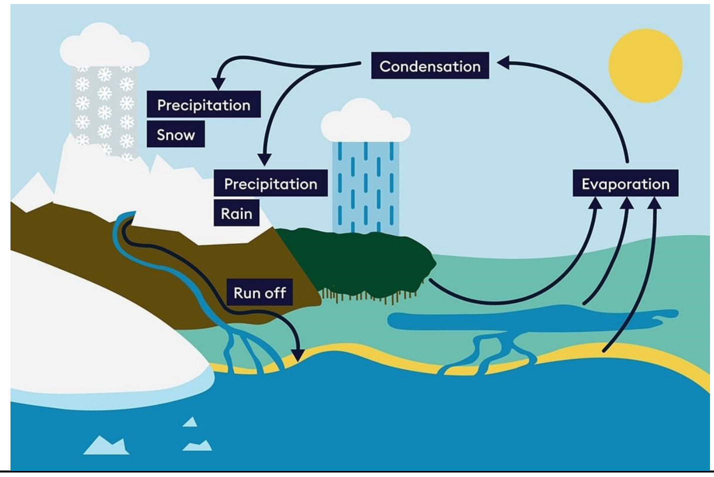


1. Lots of plants means prey number increase.
2. Lots of prey means predator numbers increase.
3. Lots of predators mean prey numbers decrease.
4. Less prey means predator numbers fall.
5. Less predators means prey numbers increase.

10. Distribution	Where things are.
11. Abundance	How many there are.
12. Decomposers	Microorganisms that feed on dead organisms and waste. Release carbon back into atmosphere and mineral ions into soil.
13. Carbon Cycle	



14. Photosynthesis	Chemical reaction in which chloroplasts make glucose and oxygen. The reverse of respiration. Carbon dioxide + Water → Glucose + Oxygen
15. Respiration	Process by which all living things get energy from glucose and oxygen. Glucose + Oxygen → Carbon Dioxide + Water
16. Water Cycle	



17. Material Recycling	Many materials are recycled to provide building blocks for future.
18. Combustion	Fuel + Oxygen → Carbon Dioxide + Water

Background

All living and non-living things are made of atoms.

These atoms have been around for millions of years and have been continuously cycled over that time.

It is amazing to think that the carbon in us could once have been part of Einstein, a cloud, a grasshopper, Cleopatra, a tree or even a piece of T-Rex dung.

This process of cycling material and energy is essential to all life on Earth.

Trilogy: Biology—Biodiversity & Ecosystems Knowledge Organiser

Background

In order to ensure our future health, prosperity and wellbeing we need to take some actions now.

Humans need to survive in the environment in a sustainable way.

This topic explores the negative and positive impact we are having on biodiversity and the natural systems that support it.

1. Biodiversity	The variety of all different species in a particular ecosystem.
2. Ecosystem	A system that includes all living organisms in an area and non-living factors.
3. High Biodiversity	Ensures stability of ecosystems by reducing one species dependence on another.
	Future of human species on Earth relies on high biodiversity.
4. Negative Human Impact on Biodiversity	Human actions are reducing biodiversity. Actions such as: More waste More land use Population growth Using resources
	Only recently have we tried to reduce impact of these actions.
5. Pollution from Waste	Pollution kills plants and animals which can reduce biodiversity.
	In water, from sewage, fertilizer or toxic chemicals. In air, from smoke and acidic gas. On land, from landfill and from toxic chemicals.
6. Land Use	Humans reduce land available for animals by: Building Quarrying Farming Dumping waster

7. Destruction of Peat Bogs	Used for compost. Leads to reduction in size of this habitat.
	Decay or burning of peat releases carbon dioxide.
8. Deforestation	Removal of forests to: Grow cattle and rice fields. Grow crops for biofuels.
9. Causes of Global Warming	Carbon dioxide and methane in the atmosphere contribute to global warming.
10. Biological Impact of Global Warming	Loss of habitat through flooding. Changes in distribution of organisms as temperatures, rainfall and climate change. Changes in migration patterns as climates and seasons change. Reduced biodiversity as many organisms become extinct.
11. Maintaining Biodiversity	Actions humans are taking to reduce loss of biodiversity: Breeding programmes for endangered species. Protection and regeneration of rare habitats. Reintroduction of field margins and hedgerows. Reduce deforestation. Reduce carbon dioxide emissions. Recycling rather than dumping in landfill.

Trilogy: Chemistry—Rates & Equilibrium Knowledge Organiser

1. Chemical Reaction	Reactants ⟶ Products
2. Reactants	Ingredients in a chemical reaction.
3. Products	The chemicals that are produced.
4. Conservation of Mass	In a chemical reaction the total mass of the reactants = total mass of products.
5. Rate	How quickly something happens. Usually measured per second.
6. Rate of Reaction	How fast reactants turn into products.
7. Measuring Rate of Reaction	Measure decrease in mass of a reaction if gas is given off.
	Increase in volume of gas given off. Catch gas given off.
	Decrease in light passing through a solution.
8. Calculating Rate of Reaction	The steepness of a line at any point on a reaction vs time graph.
	The steeper the line on the reaction vs time graph, the faster the reaction.
9. Increasing Temperature	Increases speed and energy of particles.
10. Concentration	Amount of a substance per defined volume units of mol/dm^3
11. Pressure	Force applied per unit area (N/m^2)
12. Endothermic	Reaction that absorbs energy.
13. Exothermic	Reaction that releases heat energy.
14. Equilibrium	Concentrations remain constant.

15. Collision Theory	Reactions occur when particles collide with enough energy.
16. Activation Energy	Minimum energy needed in a collision for a reaction to occur.
17. Increasing Rate of Reaction	Either need more particle collisions or more energetic collisions.
	Increase surface area to volume ratio—greater rate of collisions.
	Increase concentration—more particles, greater rate of collisions.
	Increase temperature—greater rate of collisions each with more energy.
	Increase pressure—particles closer, greater rate of collisions.
	Use of a catalyst—reduce activation energy required for a reaction to happen.
18. Catalyst	A substance that helps a reaction take place but is not used up itself.
	In industry this increases the rate of reaction and reduces energy costs.
19. Reversible Reactions	A reaction where the products will turn back into the products.
	Reactants ↔ Products
	E.g. Hydrated Copper Sulfate ↔ Anhydrous Copper Sulfate + Water

Background

In your body there are lots of reactions taking place all the time.

Reactions are also important in industry to make products to sell for money.

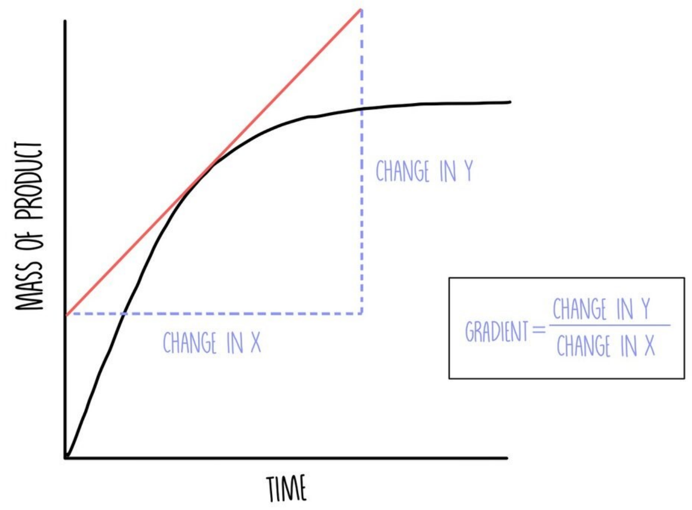
How do we measure or speed these reactions up?

Maths Skills

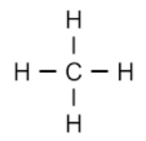
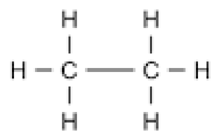
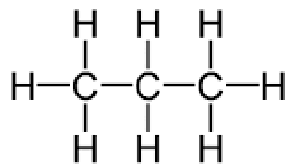
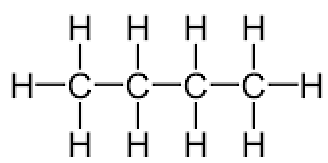
Finding the steepness (gradient) of a curved line at a point using a tangent.

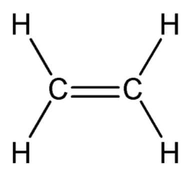
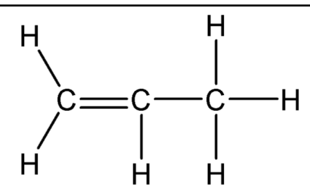
Gradient = rise ÷ run

Rate of reaction = product ÷ time



Trilogy: Chemistry—Crude Oil & Fuels Knowledge Organiser

1. Mixture	Not pure. Different compounds/elements not chemically bonded.
2. Hydrocarbon	Compound containing only hydrogen and carbon. E.g. CH_4
3. Crude Oil	Fossil fuel mixture of hydrocarbons.
4. Distillation	Separating liquid from a mixture by evaporation and condensation.
5. Compound	Two or more different elements chemically bonded.
6. Molecule	Two or more atoms chemically bonded.
7. Fractions	Hydrocarbons with similar boiling points separated from crude oil.
8. Alkanes	Hydrocarbon with only single covalent bonds. E.g. C-C
	Known as saturated hydrocarbons
	Methane (CH_4) 
	Ethane (C_2H_6) 
	Propane (C_3H_8) 
	Butane (C_4H_{10}) 
9. Boiling Point	Temperature liquid turns to gas. (Higher in long hydrocarbons)
10. Volatility	How easily it evaporates. (Lower in long hydrocarbons)
11. Flammability	How easily it lights and burns. (Lower in long hydrocarbons)

12. Viscosity	The resistance of a liquid to flowing or pouring. (Higher in long hydrocarbons)
13. Fractional Distillation	Separating liquids from a mixture by boiling then condensing at different temperatures.
14. Burning Hydrocarbons	Hydrocarbon + Oxygen → Water + Carbon Dioxide
	E.g. $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
15. Oxidised	Oxygen added or electrons lost.
16. Test for CO_2	Turns limewater cloudy.
17. Incomplete Combustion	When a fuel burns with insufficient oxygen. Produces toxic carbon monoxide (CO)
18. Cracking	Breaking large alkanes into smaller, more useful ones.
19. Thermal Decomposition	Breaking down a compound by heating it.
20. Catalyst	Chemical which speeds up a reaction without being used itself.
21. Alkenes	Hydrocarbon with a double covalent bond. E.g. C=C
	Known as unsaturated hydrocarbons.
	Has twice as many H as C atoms.
	E.g.  Ethene  1-Propene
22. Testing for Alkenes	Unsaturated hydrocarbons (alkenes) turn bromine water colourless.

Background

Fossil fuels are non-renewable which means they are running out.

But why is oil so useful?

Trilogy: Chemistry—Chemical Analysis Knowledge Organiser

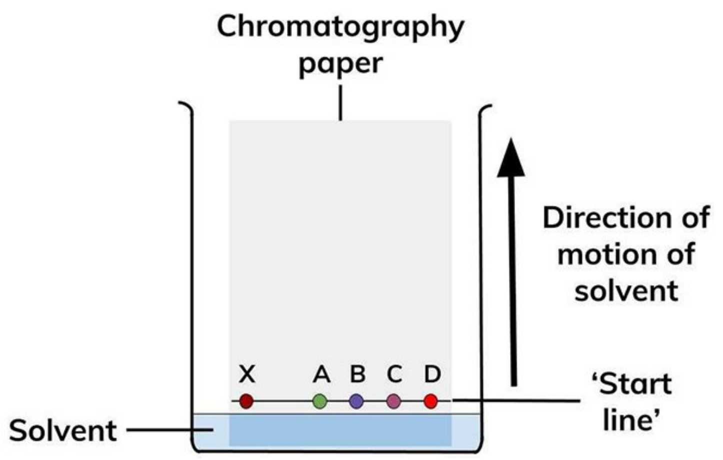
Background

Some things are useful, some are harmful.

It's important that we can test to see what is in a substance or what is made in a reaction.

Here are some of the methods used.

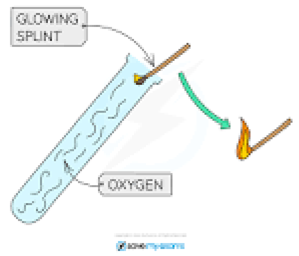
1. Melting Point	The temperature at which substances melt or freeze.
2. Boiling Point	The temperature at which substances boil or condense.
3. Pure	Made of one substance. Can be an element or compound.
4. Impure	Made of a mixture of substances.
5. Fixed Points	Melting and boiling points of a pure substance. E.g. water 0°C and 100°C
6. Formulation	A mixture designed to produce a useful product. E.g. paints, washing liquids, fuels, alloys, fertilisers, cosmetics.
7. Paper Chromatography	A separation technique where a solvent moves up a material and carries different substances up



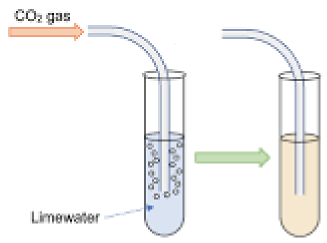
	Each substance has a unique retention factor (Rf) at the same temperature in the same
	Rf = distance moved by substance ÷ distance moved by solvent

8. Test for Hydrogen	Hydrogen makes a squeaky pop when lit with a splint.

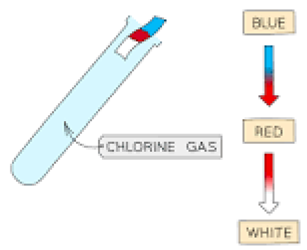
9. Test for Oxygen	Oxygen will relight a glowing splint.



10. Test for Carbon Dioxide	If you bubble carbon dioxide through limewater it will turn cloudy.



11. Test for Chlorine Gas	Chlorine gas will turn blue litmus paper white.



	Need to be very careful as chlorine gas is toxic.
12. Element	Only one type of atom present. Can be single atoms or molecules.
13. Compound	Molecule containing more than one type of atom.
14. Mixture	Two or more chemicals not chemically combined.

Trilogy: Chemistry—The Earth’s Atmosphere Knowledge Organiser

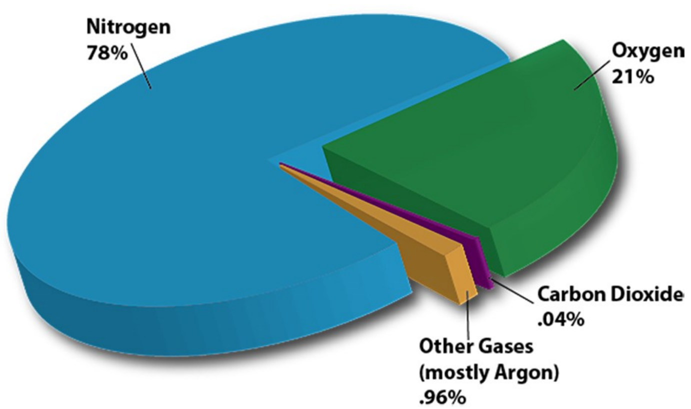
Background

The bubble of gas around our planet that we call Earth’s atmosphere does far more than provide the oxygen we need for respiration.

In Europe, winters are almost 2 weeks shorter than they were 40 years ago.

Extreme weather seems more common than ever.

Cases of asthma and respiratory difficulties increase year on year and we are always looking at ways of making our air cleaner.

1. Atmosphere	Layer of gas around Earth.
2. Earth’s Early Atmosphere Theory	Volcanoes released carbon dioxide, water vapour and nitrogen.
	Similar to Mars and Venus.
3. Photosynthesis	We think it was responsible for changing early atmosphere.
	Removes carbon dioxide and makes oxygen.
	Carbon Dioxide + Water → Oxygen + Glucose
4. Fossil Fuels	Coal, crude oil and natural gas. Formed from fossilized remains of plants and animals.
5. Carbon ‘locked into’ Rock	Carbon stored in shells and skeletons turned in-to limestone.
	Carbon in living things was also locked away as fossil fuels.
6. Ammonia & Methane	Removed from the atmosphere by reactions with oxygen.
7. Earth’s Atmosphere Today	
8. Ozone Layer	Nothing to do with global warming or the greenhouse effect. A layer of O_3 protecting us from UV rays.
9. Incomplete Combustion	If not enough oxygen is available. Poisonous carbon monoxide and soot is produced.
10. Greenhouse Effect	Greenhouse gases stop heat escaping from the Earth into space. This results in the Earth getting hotter.
11. Greenhouse Gases	Carbon dioxide—released from burning fossil fuels. Methane—released from swamps, rice fields. Water vapour—e.g. steam and clouds
12. Risks of Global Climate Change	Rising sea levels as a result of melting ice caps. Extreme weather e.g. storms. Changes to temperature and rainfall patterns. Ecosystems under threat.
13. Issues with Reducing Greenhouse Gas Emission	It will cost money. There is still disagreement that there is a problem. It is difficult to implement.
14. Carbon Footprint	The CO_2 released as a result of a persons activities over a year.
15. Ideas for Reducing our Carbon Footprint	Burn less fossil fuels. Carbon capture. Reduce demand for beef. Planting more trees.
16. Carbon Capture	Pumping and storing CO_2 underground in rocks.
17. Nitrogen Oxide	Released by burning fossil fuels. Causes acid rain and breathing issues.
18. Sulfur Dioxide	Released by burning fossil fuels. Causes acid rain.

Trilogy: Chemistry—The Earth's Resources Knowledge Organiser

Background

Up to 60% of the rubbish in the average dustbin could be recycled.

This wasteful approach has big environmental and economic impact for us all.

What are natural resources and why are they important?

This topic looks at some of the issues that affect all of humankind.

1. Natural Resources	Can be found in their natural form. Some are finite and will run out.
2. Fossil Fuels	Coal, crude oil and natural gas. Formed from fossilized remains of plants and animals.
3. Non-renewable	Finite. Are used quicker than they are made. So will run out.
4. Renewable	Made quicker than they are used. Will not run out.
5. Sustainable Development	Meets current demands without affecting future generations.
6. Potable Water	Water that is safe to drink. Not pure as it contains dissolved substances.
7. Pure Water	No dissolved substances. Only H2O
8. Normal Way of Making Potable Water	Choose source of water. Filter the water in filter beds. Sterilize the water with chlorine, ozone or ultraviolet light.
9. Desalination	Method for treating salty water. Two methods both energy intensive. Distillation—evaporate water then condense the steam. Reverse osmosis. Uses membranes.
10. Life Cycle Assessments	Product environmental impact in: Extracting raw materials. Manufacturing and packing. Use during life. Disposal at end of life.
11. Recycling	Saves energy and finite resources. Less pollution from making new.

12. Aerobic	With oxygen.
13. Anaerobic	Without oxygen.
14. Treating Waste Water	Remove lumps—screening. Let sludge sink—sedimentation. Bacteria added to clean—aerobic treatment.
15. Treating Sludge	Anaerobic digestion by bacteria. Can be used as fertilizer or as biofuel.
16. Ore	Rock containing enough metal compounds to be worth extracting.
17. Copper Ores	Contain copper compounds. Becoming scarce so much harder to find large quantities. Main ways of extracting copper: Mining—dig up rocks Phytomining Bioleaching Electrolysis Displacement with iron
18. Phytomining	Plants absorb copper compounds. Plants then burned and copper obtained from ash.
19. Bioleaching	Bacteria pumped underground absorb copper. Produce leachate solutions containing copper compounds.
20. Electrolysis	Breaking down a substance in a liquid using electricity.
21. Displacement	A more reactive metal will displace a less reactive metal.
22. Economic Issues	The cost of doing something.

Trilogy: Physics—Forces in Balance

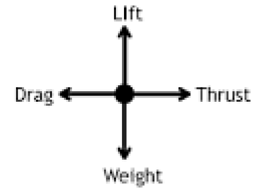
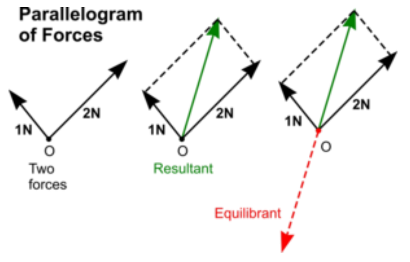
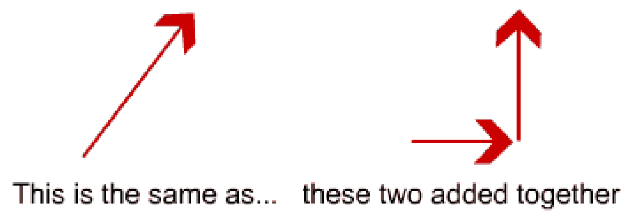
Knowledge Organiser

Background

Anything that changes direction, speed or shape does so because of unbalanced forces.

They are the reason we go to bed up to 2cm shorter than we are when we wake up. Weird? That's forces.

1. Scalar	Magnitude only e.g. speed.
2. Vector	Magnitude and direction e.g. velocity, force
	Can be drawn as an arrow →
3. Displacement	Distance away from start point in a straight line.
4. Magnitude	Size of a quantity.
5. Force	Push or pull acting on an object.
6. Contact Force	Forces that act through touch e.g. friction, air resistance, tension.
7. Non-contact Force	Forces that act without the need for touch e.g. magnetism, gravity, electrostatic force.
8. Newton's Third Law	When two objects interact they exert an equal and opposite force on each other.
9. Driving Force	A force that makes a vehicle move.
10. Friction	A force that tries to stop an object moving. Generates heat.
11. Resultant Force	The force you have if you replaced all the forces on an object with one single force.
	If it is zero forces are balanced.
12. Newton's First Law	If the forces on an object are balanced the object will either: Remain still Keep moving at the same velocity

13. Free Body Force Diagram	Shows the forces as arrows acting on an object. Object represented as a dot on centre of mass.
	
14. Centre of Mass	Point at which the mass of an object appears to be concentrated.
	All objects will hang with their centre of mass below the pivot.
	The centre of mass of a regular shape is at the centre.
15. The Parallelogram of Forces	Used to find the resultant of two forces that are not parallel. 
16. Resolving Forces	Drawing two forces at right angles to represent a single resultant force. 
17. Weight	Force acting on a mass due to gravity.
18. Mass	The amount of matter in an object.
19. Normal Contact Force	Push between solids. Acts at right angle to the surface at the point of contact.

Trilogy: Physics—Motion Knowledge Organiser

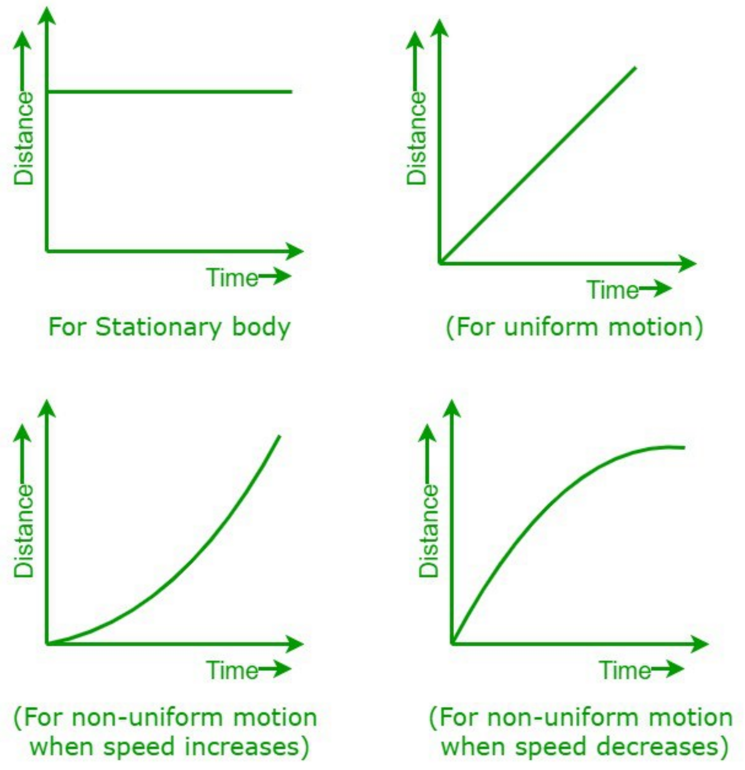
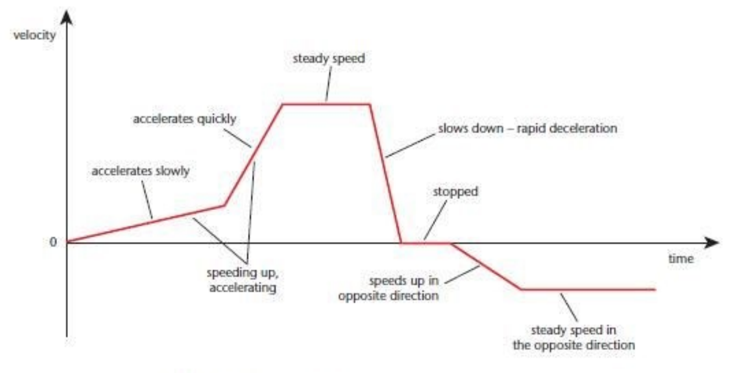
Background

We all know about acceleration and speed, but how are they really related.

The ideas on this page are essential in vehicle design and tectonic movement.

They can be used to describe any journey by any object.

1. Distance-time graph	A graph showing how distance changes with time.
	Gradient represents speed.
2. Speed (m/s)	Scalar distance travelled in one second. Speed (m/s) = distance travelled (m) ÷ time (s)
3. Average Speed (m/s)	Considers the total distance travelled and the total time taken.
4. Velocity (m/s)	Vector. Speed in a given direction. Uses the same formula as speed.
5. Displacement	Vector. Distance travelled in a certain direction.
6. Acceleration (m/s^2)	Any change in velocity. Can be either speed or direction.
	Change in velocity per second.
	Acceleration (m/s^2) = change in velocity (m/s) ÷ time taken for change (s)
7. Deceleration (m/s^2)	When acceleration is negative. Object slows down.
8. Scalar	Magnitude only e.g. speed
9. Vector	Magnitude and direction e.g. velocity
10. Velocity-time graph	A graph showing how velocity changes with time.
	Gradient represents acceleration.
	Area under a v-t graph line represents distance travelled.

11. Typical Speeds	Walking—1.5m/s Cycling—6m/s Sound—330m/s
12. Slopes of d-t graphs	
13. Slopes of v-t graphs	Fig. 9.2 A velocity–time graph.
14. Gravitational Acceleration	Acceleration due to gravity on earth is 9.8 m/s^2
15. Equation of Motion	You need to be able to use this equation. It is given in the exam. V^2 $u^2 = 2as$ V = final velocity in m/s U = start velocity in m/s A = acceleration in m/s^2 S = distance travelled in m

Trilogy: Physics—Force & Motion

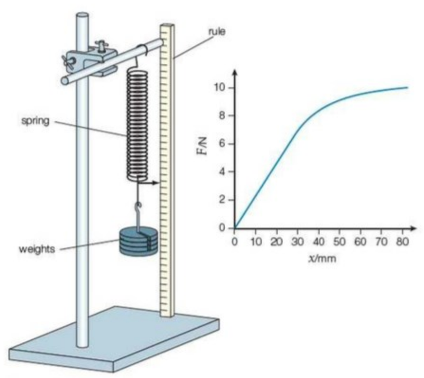
Knowledge Organiser

Background

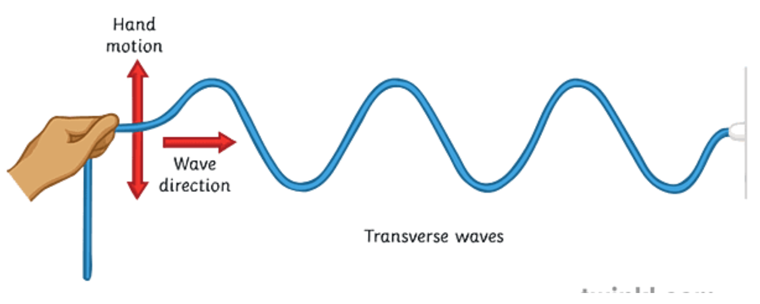
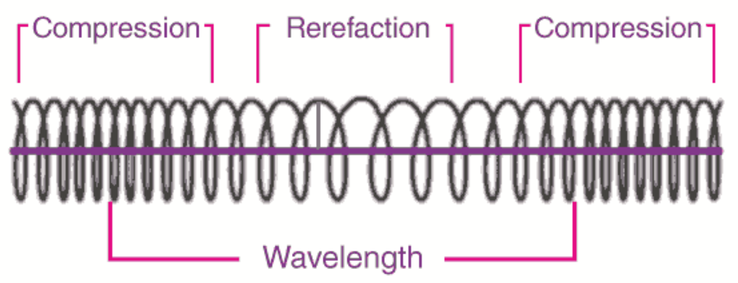
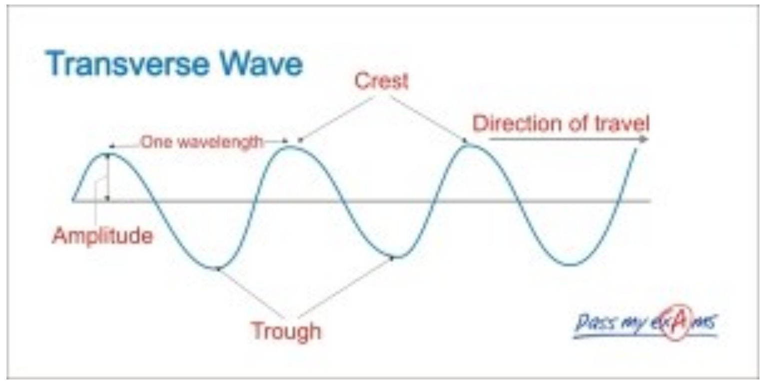
Forces can make things change how they move or makes things change shape.

Every time one of these things happens it is down to a resultant force.

1. Newton's Second Law	Acceleration is directly proportional to force and indirectly proportional to mass.
	Resultant force (N) = mass (kg) x acceleration (m/s^2)
	Greater resultant force leads to greater acceleration.
2. Inertial Mass	How difficult it is to change the velocity of an object.
	Ratio of force ÷ acceleration
3. Inertia	Tendency of objects to maintain same motion.
4. Force (N)	Push or pull acting on an object.
5. Acceleration (m/s^2)	Any change in velocity. Can be either speed or direction.
	Change in velocity per second.
	Acceleration = change in velocity ÷ time taken for change
6. Resultant Force (N)	The force you have if you replaced all the forces on an object with one single force.
	If it is zero forces are balanced.
7. Mass (kg)	Amount of matter in something.
8. Gravitational Field Strength	Constant on each planet. Symbol of g. On Earth it is 9.8 N/kg

9. Weight (N)	The force on a mass due to gravity.
	Weight (N) = mass (kg) x gravitational field strength (N/kg)
10. Terminal Velocity (m/s)	Maximum velocity of a falling object. When fluid drag increases until it balances weight.
11. Stopping Distance (m)	Shortest distance a vehicle can safely stop.
	Split into two parts: Thinking distance—travelled during reaction time. Braking distance—travelled once brakes applied. Stopping distance = thinking distance + braking distance
12. Reaction Time (s)	Time it takes a person to react..
	Affected by tiredness, drugs, alcohol and distractions.
13. Factors Affecting Braking Distance	Road and weather conditions. Condition of vehicle brakes or tyres.
14. Momentum (kg m/s)	Momentum (kg m/s) = mass (kg) x velocity (m/s)
15. Conservation of Momentum	In a closed system, total momentum before an event is the same as the total momentum after.
16. Elastic	Will return to its original shape.
17. Inelastic	Will not return to its original shape.
18. Hooke's Law	A springs extension/compression is proportional to the force on it.
	Force (N) = spring constant (N/m) x extension (m)
	

Trilogy: Physics—Wave Properties Knowledge Organiser

1. Oscillations	Vibrations of a wave.
2. Waves	Carry energy using oscillations.
	Can reflect—bounce off a boundary.
	Can refract—change direction at a boundary as they change speed.
	Two types—transverse and longitudinal.
3. Transverse Waves	Oscillate at right angles to direction that the wave transfers energy.
	E.g. electromagnetic waves.
	
4. Longitudinal Waves	Oscillate in same direction as the wave transfers energy e.g. sound.
	
5. Drawing Waves	
6. Mechanical Waves	Need particles to move. E.g. sound.
7. Vacuum	No particles.
	Space is a vacuum.

8. Electromagnetic Waves	Family of transverse waves.
	Travel through vacuum at speed of light (300,000 km/s)
	The waves in the EM family are: Radio, infra red, visible light, ultra violet, x-ray and gamma.
	Remember it using the mnemonic: Rich men In Vegas Use X-ray Glasses
9. Amplitude (cm)	Height/depth of the wave above/below the rest point.
10. Wavelength (m)	Length of one wave. Distance on a wave from one point to the next identical point.
11. Frequency (Hz)	Number of waves in one second. Measured in Hertz (Hz)
	Frequency (Hz) = 1 ÷ Period (s)
12. Period (s)	Time for one wave to pass.
13. Wave Equation	Speed of a wave (m/s) = frequency (Hz) x wavelength (m)
14. Sound Waves	Longitudinal. Cannot travel through a vacuum. Reflections are called echoes.
15. Observing Waves	We can use these devices: A ripple tank. A slinky spring. A signal generator.
16. Law of Reflection	Angle of reflection is same as angle of incidence. Speed and wavelength not changed.

Background

We are continuously hit with waves in many forms from sound to radio.

They are so much more than just ripples on water we can surf on.

Maths Skills

The wavelength & frequencies of waves varies hugely.

You will be expected to use standard form.

Prefix	**Meaning**	**Standard Form**
Mega (M)	X 1000000	X 10^6
Kilo (k)	X 1000	X 10^3

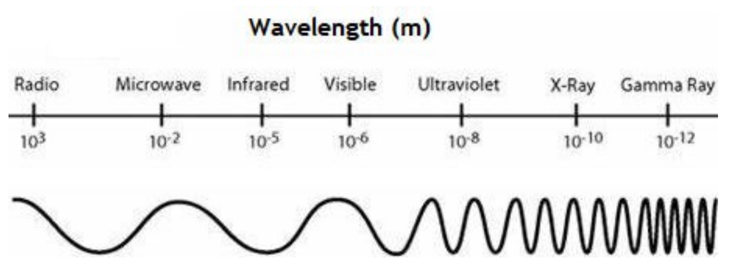
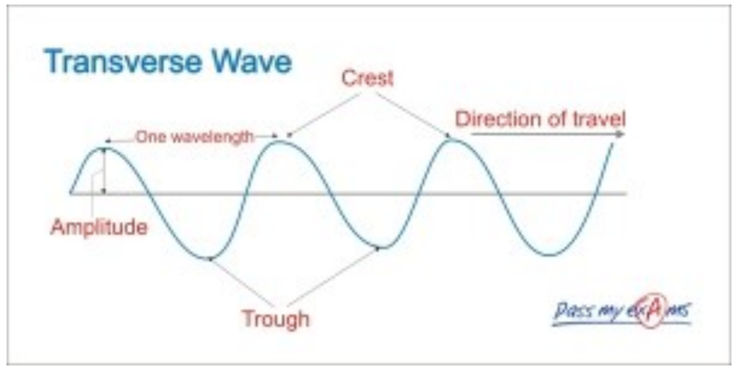
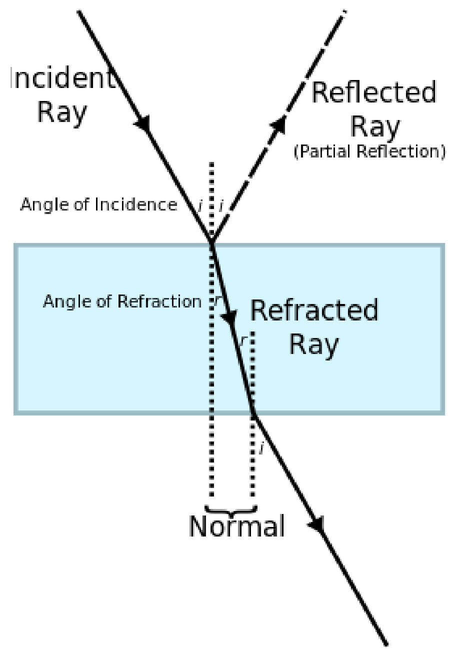
Trilogy: Physics—Electromagnetic Waves Knowledge Organiser

Background

This family of waves is all around us, all the time.

They travel at 300 million metres a second through space and are some of the building blocks of the universe.

So what are they and how do we use them?

1. Electromagnetic Waves	Family of transverse waves. Travel through vacuum at speed of light.
	
2. Drawing Waves	
3. Transverse Wave	Oscillate at right angles to direction that the wave transfers energy.
4. Wave Equation	Speed of a wave = frequency x wavelength V = f x λ
5. Energy of Waves	Increases as frequency increases. Gamma have most, radio least.
6. Refraction	Light changing direction as it changes speed at a boundary.
	
7. Ionising	Knocking electrons off atoms.
8. Absorbing Waves	Waves carry energy so absorbing any wave generates some heat.

9. Radio Waves	No known dangers.
	Can be made and absorbed by electrical circuits.
	Used for television and radio.
10. Microwaves	Some can cause burning.
	Used for satellite communications and cooking food.
11. Infrared Radiation	Can cause burning.
	Emitted by hot objects.
	Matt black surfaces are best absorbers and emitters.
	Used for electric heaters, cooking, infrared cameras.
	Smooth shiny surfaces reflect IR waves so are worst absorbers and emitters.
12. Visible Light	Very bright light can cause blindness.
	We see. Used in fibre optics.
13. Ultraviolet	Ionising: can cause skin cancer.
	Used in energy efficient lamps, sun tanning and sterilizing.
14. X-Rays and Gamma Rays	Ionising: can cause cancer.
	Used in medical imaging and in radiotherapy treatment and sterilizing.
15. Carrier Waves	Used in communication. Different amplitudes mean different things.
16. Frequency (Hz)	Number of waves in one second. Measure in Hertz.

Trilogy: Physics—Electromagnetism Knowledge Organiser

Background

Electromagnetic effects are used in motors to make things move, generators to provide electricity and automatic locks on security doors.

Magnetism is far more useful to us than just helping pigeons to navigate.

1. Magnetic Poles	North and south. Like poles attract. Unlike poles repel.
2. Permanent Magnet	Has its own magnetic field.
3. Induced Magnet	Becomes a magnet when put in a magnetic field. Loses it when removed.
4. Magnetic Field	Region around a magnet which attracts magnetic material.
	Caused by magnetic field lines.
	Strongest at poles of a magnet.
	Known as magnetic flux density, B, measured in Tesla, T.
5. Magnetic Field Lines	Closer the lines, the stronger the magnetic field.
6. Earth's Magnetic	Acts like a giant bar magnet.
7. Magnetic Material	Are attracted by magnetic fields: iron, steel, cobalt and nickel.
8. Solenoid	A coil of wire, looks like a spring.
9. Magnetic Field Around	If a wire carries a current it becomes an electromagnet.

10. Magnetic Field Around A Solenoid	If a wire is coiled and carries a current it becomes an electromagnet.
	Magnetic field inside is strong and uniform.
	Outside looks similar to a bar magnet.
11. Increasing Strength of Electromagnet	Add an iron core. Increase current. More coils
12. Motor Effect	A wire carrying a current at a right angle through a magnetic field feels a force.
13. Size of Motor Effect Force	Force (N) = magnetic flux density (T) x current (A) x length (m)
14. Direction of Motor Force	Is given by Flemings Left Hand rule.
15. Increasing Force of A Motor	More current. Stronger magnetic field. More coils.
16. Electric Motor	Coil of wire carrying a current inside a magnetic field Each side moves in a different direction causing
17. Commutator	Stops motor wires twisting.