Science

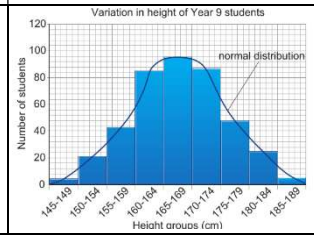
Year 9 Knowledge Organisers

9A - Genetics and Evolution

1. Environmental Variation

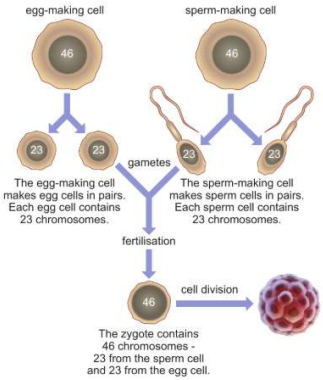
Environment	An organisms surroundings - affected by physical environmental factors and living organisms.
Characteristics	The features of an organism.
Variation	The differences between characteristics of organisms.
Environmental Variation	Variation caused by an organism's environment *e.g. hairstyle*
Continuous Variation	Variation that can have any value between two points *e.g. height, mass*
Discontinuous Variation	Variation that can only have a value from a limited set of values *e.g. eye colour*
Classification	Sorting organisms into groups.
Species	The smallest group an organism is classified into. Members of the same species can reproduce together and produce fertile offspring.

2. Inherited Variation

Inherit	Offspring / children get a mixture of characteristics from their parents.
Inherited Variation	The variation in characteristics inherited from parents *e.g. blood group*
Genetic Information	The instructions for inherited characteristics stored inside the nuclei of cells.
Gametes	Sex cells (sperm and egg)
Sexual Reproduction	Two gametes fuse together during fertilisation.
Zygote	Fertilised egg cell formed during fertilisation. Contains genetic material from both parents.
Normal Distribution	Bell shape usually given by plotting characteristics that show continuous variation.
Normal Distribution Example	

3. DNA

Watson and Crick	Used data from themselves and other scientists to build the first model of DNA in 1953.
Rosalind Franklin	Took x-ray images of DNA and showed it was a spiral structure.
Chromosomes	DNA is found in structures called chromosomes inside nuclei of cells.
Human DNA	Human cell nuclei contain 46 chromosomes (23 pairs).
Genes	A gene is a section of DNA /a chromosome.
Sex Chromosomes	Determines sex of offspring. Girls have two X chromosomes, boys have an X and a Y.
Cell Division	The splitting of a parent cell to form two daughter cells.

Zygote Formation	

4. Genes and Extinction

Adaptations	Features of an organism to help it survive in its habitat.
Ecosystem	All the physical environmental factors and living organisms in a habitat.
Endangered	When a species is at risk of becoming extinct.
Extinct	When a species no longer exists.
Competition	Organisms fighting over the resources that are available.
Native	A species that has always lived in an area.
Squirrels	Red squirrels are native to the UK and grey squirrels came to the UK in the 1870's. Grey squirrels can store more fat to survive the winter and can digest unripe acorns unlike red squirrels. This has meant grey populations have increased leaving less food for red squirrels.
Biodiversity	The number of different species within an area.
Preserving Biodiversity	Banning hunting, set up nature reserves, start breeding programmes and gene banks.
Gen Banks	Storing parts of organisms (seeds, gametes etc.) to grow if they become extinct.

5. Natural Selection

Natural Selection	A change in the environment causes certain characteristics to be 'selected' to pass on to the next generation.
Peppered Moths	Most peppered moths were pale in the 1850's. Then factories started churning out soot, turning trees black. Birds could now easily spot the pale moths to eat them. More black moths survived and reproduced, increasing their numbers. This is an example of natural selection.
Evolution	A change over time in the characteristics of organisms.
New Species	As populations evolve they can become new species.
Darwin's Theory of Evolution	Charles Darwin and Alfred Russel Wallace developed a hypothesis that natural selection causes evolution.

9B - Plant Growth

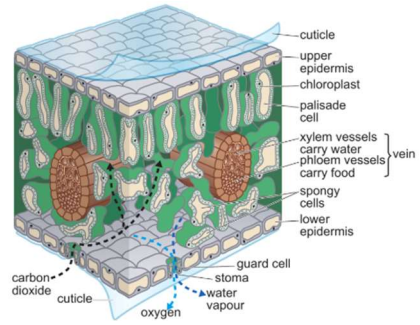
1. Reactions in Plants

Reactants	The substances that take part in a chemical reaction.
Products	The new substances made in a chemical reaction.
Photosynthesis	A process that plants use to make their own food.
Photosynthesis Word Equation	carbon dioxide + water ⟶ glucose + oxygen
Chloroplasts	Where photosynthesis occurs inside plant cells.
Chlorophyll	A substance inside chloroplasts that captures the light energy needed for photosynthesis.
Limiting Factor	A variable that slows down the rate of photosynthesis.
Aerobic Respiration	The process by which living organisms release energy stored in glucose.
Aerobic Respiration Word Equation	glucose + oxygen → carbon dioxide + water
Phloem	The vessels inside plants that transport glucose.

2. Plant Adaptations

Adaptations	Features that something has to enable it to do a certain job.
Root Adaptations	They are branched and spread out, helping them to get a large volume of water.
Root Hair Cells	Increase the surface area of roots so that more water can be absorbed.
Xylem	The vessels inside plants that transport water.
Uses of Water	- photosynthesis - keeping leaves cool - filling up cells to keep them expanded and firm
Palisade Cells	Cells in a leaf adapted to carry out photosynthesis by having lots of chloroplasts.
Cuticle	A waxy layer on the outside of a leaf that stops them from losing too much water.
Stomata	Small holes in a leaf that open and close to allow gas exchange.
Guard Cells	The cells that open and close the stomata.
Gas Exchange	The swapping of different gases from inside the leaf and the atmosphere.

Structure of a Leaf



3. Plant Products

Lipids	Insoluble substances that include fats and oils.
Uses of Lipids	- Found in the cuticle, making it waterproof - make parts of the cell like cell membranes - energy store found in seeds
Polymer	A substance made up of a long chain of repeating groups of atoms (monomers).
Starch	A polymer formed by linking together glucose molecules.
Uses of Starch	Stored in the chloroplast until photosynthesis stops then broken down into sugars to be transported. It can then be converted to starch and stored in storage organs or used to make cellulose.
Testing for Starch	Iodine solution will turn blue-black is starch is present.
Proteins	Polymer formed by joining long chains of amino acids.
Nitrates	Needed to make amino acids.
Germination	Water and oxygen enter seed allowing molecules to move around. Enzymes released that digest starch into glucose which enters the embryo allowing it to respire and grow.

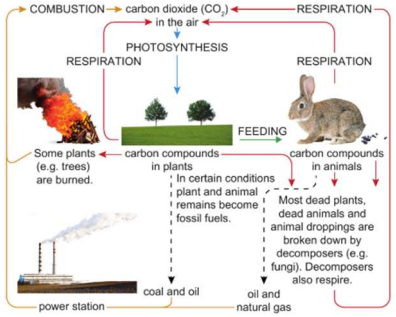
4. Growing Crops

Yield	The amount of useful product you get from a crop.
Increasing Yield	Forests are cut down, hedgerows removed, machines used
Fertilisers	Contain mineral salts that plants need to grow.
Decomposers	Microorganisms that break down manure and release mineral salts.
Pesticides	Kill pests
Insecticides	Kill insect pests
Fungicides	Kill fungi that cause plant disease
Herbicides	Kill weeds (weedkillers) that compete with crops for resources- they are selective so only kill the weeds
Variety	Group of plants bred for a certain characteristic.
Cross-Breeding	Breeding different varieties together to produce offspring with characteristics of both.
Selective Breeding	Choosing organisms to breed based on the characteristics that you want in the offspring.

5. Farming Problems

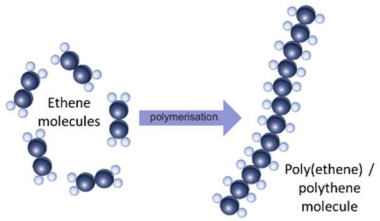
Fertiliser Problems	Can wash into rivers causing fast growth of algae which blocks out the light causing plants to die. Decomposers break down dead material using up oxygen.
Pesticide Problems	Some do not break down in the environment (they are persistent) so move up the food web.
Varieties Problems	They are identical so a disease will affect them all. Biodiversity is reduced.

The Carbon Cycle



9E - Making Materials

1. About Ceramics	
Ceramics	Range of hard, durable, non-metallic materials, generally unaffected by heat. *e.g. glass, china*
Ceramic Properties	• Hard, strong and brittle • High melting point and heat resistant • Good insulators of heat and electricity • Very unreactive
Glass	Hard, rigid, unreactive and can be transparent making it ideal for windows, bottles and jars.
Porcelain	Rigid, strong when compressed and an electrical insulator making it ideal to support electrical cables on pylons.
Ceramics	Heat resistant so used for brakes in high-performance cars
Raw Materials	Clays are used for making pottery and sand for glass.
Using Clay	When heated, chemical reactions occur forming new compounds. When cooled, crystals form and bind together in the ceramic.
Crystal Size	Dependent upon speed of cooling. Slower cooling produces larger crystals.
Lattice Structure	Grid-like structure formed by crystals.
Bonds	Because atoms in a lattice structure are joined by strong bonds it explains why ceramics are so stiff and have high melting points.

2. Polymers	
Polymer	Substances that have molecules made of long chains of repeated groups of atoms.
Monomer	Small molecule joined with the identical molecules to form polymers.
Rubber	Polymer from certain trees. Soft and sticky when hot, but hard and brittle when cold.
Vulcanisation	Rubber is heated with sulfur to form cross-links between molecules making it harder and tougher.
Natural Polymer	Polymers found naturally. *e.g. rubber, DNA, proteins*
Synthetic Polymers	Polymers made in laboratories mainly using raw materials from crude oil.
Polymerisation	Reaction that joins together monomers into chains.
Forming Polythene Diagram	
Exothermic	Reactions that transfer energy to the surroundings. e.g. polymerisation
Endothermic	Reactions that absorb energy from the surroundings.

3. Composite Materials	
Composite Material	Combinations of 2 or more materials with properties of each. *e.g. concrete, paper*
Laminated Glass	Combines layers of glass with a clear polymer
Laminated Glass Properties	Laminated glass is rigid and hardwearing like glass but holds together under impact.
Making Composite Materials	Many are made by mixing fibres into a liquid resin which then sets hard.
GRP (Glass Reinforced Plastic)	Composite of glass fibres in a polyester resin. Used in boatbuilding as it is strong, light and slightly flexible.
Concrete	Composite material made from a mixture of cement, sand, aggregate and water.
Concrete Properties	Strong, hardwearing and easy to mould into shapes.
Aggregate	Crushed rocks
Reinforced Concrete	In building works, steel rods are also added to make it even stronger.
Cement	Mainly calcium oxide which is made by roasting calcium carbonate (limestone) in a thermal decomposition reaction which is endothermic
Thermal Decomposition of Limestone	Calcium carbonate → calcium oxide + carbon dioxide

4. Problems With Materials	
Finite	Limited resource that will eventually run out.
Fossil Fuels	Usually used in the manufacture of materials.
Incomplete Combustion	Produces carbon monoxide and soot due to lack of oxygen
Sulfur Dioxide	Caused by sulfur impurities in fuel. Leads to acid rain.
Nitrogen Oxides	Caused by high combustion temperatures. Form acid rain.
Carbon Dioxide	Traps the Sun's energy, increasing the greenhouse effect, leading to global warming.
Carbon Capture Technology	Technology used to remove carbon dioxide from waste gases given off.
Toxic Substances	Pass along the food chain as organisms eat smaller animals.
Non-Biodegradable	Materials that do not break down naturally.

5. Recycling Materials	
Recycling	Using the same materials again.
Recycling Benefits	Reduce use of finite resources, save fuel/energy, reduce landfill use.
Recycling Metals	Can be melted down and used again.
Recycling Glass	Can be crushed, melted and moulded into new glass.
Recycling Polymers	Difficult and expensive to separate different polymers so recycling levels are low.
Recycling Paper	Water added, filtered, heated and mixed to form pulp, squeezed and dried to form paper.
Recycling Concrete	Crushed using large machines and used aggregate.

9F - Reactivity

1. Types of Explosion

Explosion	Sudden increase in volume of gas and huge transfer of energy to the surroundings.
Physical Changes	Changes where no new substances were made.
Chemical Reaction	Changes where one or more new substances are made.
Flammable	A substance that catches fire easily.
Reactants	The starting substances- written on left of word equation.
Products	The new substances made- written on right of word equation.
Gas Pressure	The force gas particles exert by hitting the walls of the container they are in.
Increasing Gas Pressure	• Increasing number of particles • Decreasing size of container • Increasing temperature

2. Reactivity

Reactivity Series	List of metals in order of reactivity
Metals & Water	React to form metal hydroxides and hydrogen. *sodium + water → sodium hydroxide + hydrogen*
Metals & Acids Word Equation metal + acid → salt + hydrogen *magnesium + sulfuric acid → magnesium sulfate + hydrogen*	
Naming Salts	The first word in the salt is the metal the second depends on the acid used.
Hydrochloric Acid	Forms salts ending in chloride
Sulfuric Acid	Forms salts ending in sulfate
Nitric Acid	Forms salts ending in nitrate
Metals & Oxygen	React to form metal oxides *Zinc + oxygen → zinc oxide*
Oxidation	Reaction in which a substance gains oxygen.

Reactivity Series

Metal	Reaction with oxygen in air	Reaction with cold water	Reaction with dilute acid
potassium	🔥	🔥	💥
sodium	🔥	✓✓✓	💥
lithium	🔥	✓✓	✓✓✓
calcium	🔥	✓✓	✓✓✓
magnesium	🔥	✓	✓✓
aluminium	✓✓✓	●●●	✓✓
zinc	✓✓	●●●	✓✓
iron	✓✓	●●●	✓
tin	✓	●●●	✓
lead	✓	●●●	✓
copper	✓	✗	✗
mercury	●●●	✗	✗
silver	●●●	✗	✗
gold	✗	✗	✗
platinum	✗	✗	✗

Increasing reactivity

Key

💥 explosive	🔥 can catch fire	✓✓✓ reacts very quickly
✓✓ reacts quickly	✓ reacts	●●● slow or partial reaction
✗ no reaction		

Rust	Formed by the corrosion of iron and steel.
Preventing Rust	Use a barrier such as paint/ plastic/oil to keep away air/water
Sacrificial Protection	More reactive metals are attached to react with water & oxygen instead of the iron.

3. Energy and Reactions

Oxygen	Often needed in many chemical reactions that cause explosions.
Oxidising Agent	A substance that provides oxygen to oxidise another substance.
	**Oxidising** The hazard symbols for substances which are oxidising.
Potassium Nitrate	Oxidising agent mixed with powdered charcoal to make gunpowder.
Oxygen Test	Oxygen will relight a glowing splint.
Surface Area	Small pieces of solid have a greater surface area over which a chemical reaction can occur. Explosives react more quickly if the solid fuel is broken into tiny pieces.
Energy	Cannot be created or destroyed only transferred and stored.
Exothermic Reactions	Energy stored in the reactants is transferred to the surroundings. *e.g. combustion, neutralisation*
Endothermic Reactions	Energy is transferred from the surroundings to the reactants *e.g. thermal decomposition*
Hydrocarbon	Compound containing only hydrogen and carbon. *e.g. methane (CH_4)*

4. Displacement

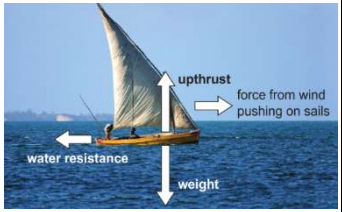
Displacement Reaction	Reaction where a more reactive metal displaces (takes the place of) a less reactive one.
Displacement Reaction Word Equation Aluminium + iron oxide→aluminium oxide + iron	
Thermite Reaction	Displacement reaction between aluminium and iron oxide.
Energy	Thermite reaction needs an input of energy by lighting a fuse.
Thermite Reaction Uses	Used on a large scale to join two sections of railway track as molten iron runs into the gap and solidifies.
Solutions	Displacement reactions also occur in solutions. *e.g. zinc in copper sulfate*

5. Extracting Metals

Native State	When a metal is found in the Earth as an element.
Ore	Rock that contains enough of a metal/metal compound to be worth mining.
Extracting Iron	Iron is found as iron oxide. Oxygen is removed by heating with carbon.
Extracting Iron Word Equation Iron oxide + carbon → iron + carbon dioxide	
Reduced	When a substance has lost oxygen.
Electrolysis	Used to extract reactive metals (e.g. aluminium) from their ores using electricity.
Extracting Aluminium Word Equation Aluminium oxide → aluminium + oxygen	
Potassium - Aluminium	Extracted through electrolysis
Zinc - Copper	Extracted by heating with carbon.
Silver- Platinum	Found in native state.

9I - Forces and Motion

1. Forces and Movement

Friction	Force between two surfaces sliding across each other.
Reducing Friction	Using rollers or wheels / sleds in snowy countries
Balanced	When a force acting on an object is the same size as the force in the opposite direction.
Constant Speed	Caused by balanced forces acting on an object.
Unbalanced	Forces acting in opposite directions are not equal.
Resultant	The difference between the forward and backward force.
Accelerate	Get faster- caused by unbalanced forces.
Boat Force Diagram	
Drag	Acts to slow down objects moving through fluids (liquids/ gases) *e.g. water resistance and air resistance*
Top Speed	Dependent on the maximum force a vehicle can move forwards an on the friction/ drag acting to slow it down.

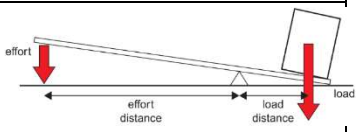
2. Energy For Movement

Food	Supplies humans the energy they need.
Solar Energy	Energy stored in food originally came from the Sun.
Kinetic Energy	Stored in anything that is moving.
Fossil Fuel	Fuels formed by remains of plants / animals that store large amounts of energy. *e.g. coal, oil, natural gas*
Non-Renewable	Resources that will run out one day like fossil fuels.
Using Fossil Fuels	Energy stored in oil and natural gas is used for transport. Energy released by burning fuels is transferred by heating for cooking or keeping warm
Gravitational Potential	Energy stored in raised objects.
Elastic Potential	Energy stored in stretched or squashed objects.
Thermal	Energy stored in the movement of particles. Transferred from hot objects to cooler ones by heating.
Renewable	Resources that will not run out. *e.g. wind, moving water*
Nuclear Energy	Non-renewable resource used to generate electricity.
Electricity	Cannot be stored, has to be generated by renewable or non-renewable resources.
Conservation of Energy	Energy cannot be created or destroyed, only transferred.
Efficiency	The useful energy transferred compared to the total energy transferred by a device.
Dissipated	Energy that spreads out.
Transfers	Energy is often transferred by heating or sound.

3. Speed

Speed	How far something can travel in a certain time.
Units	Dependent on measurements taken *e.g. miles per hour, metres per second*
Speed Formula	$\text{speed} = \frac{\text{distance}}{\text{time}}$
Mean Speed	Total distance travelled, divided by the total time taken.
Distance-Time Graph	Used to show how fast someone travelled during a journey. Also called a displacement-time graph
Displacement	Distance in a straight line between an object and its starting point.
Horizontal Line	Shows an object isn't moving on the distance-time graph.
Steep Line	Shows an object is moving quickly
Relative	Looking speed compared to another object which may be moving.

4. Turning Forces

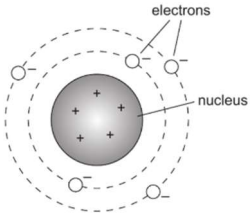
Lever	Long bar used to life heavy objects.
Pivot / Fulcrum	Point that the lever turns around.
Effort	Force applied down on lever.
Load	The object being lifted.
Lever Diagram	
Force Multiplier	Effort distance is greater than the load distance meaning that the effort force is smaller than the force lifting the load.
Distance Multiplier	Large effort force moves a small distance and the load is moved a greater distance.
Moment	The turning effect of a force.
Units	Moments are measured in newton metres (**N m**)
Moment Formula	moment of the force (N m) = force (N) × perpendicular distance from the pivot (m)
Equilibrium	Opposing forces are balanced.

5. More Machines

Machine	Anything that helps us work with forces.
Ramp	A simple machine that means less force is needed to push an object up a slope compared to lifting.
Pulleys	Makes lifting a load easier by pulling down a rope.
Work	Amount of energy transferred when a force moves something.
Units	Work is measured in Joules (**J**)
Work Done Formula	work done (J) = force (N) × distance moved in the direction of the force (m)
Conservation of Energy	If a smaller force is needed to move something, the force has to move through a greater distance.

9J - Force Fields and Electromagnets

1. Force Fields	
Force Field	The area around something where a non-contact force can affect things.
Non-Contact Force	A force which can affect something from a distance.
Magnetic Field	The space around a magnet where it can affect magnetic materials or other magnets.
Repel	To push away. Two of the same poles will repel each other.
Attract	To draw together. A north and a south pole will attract each other.
Earth's Magnetic Field	Protects the Earth from charged particles emitted by the Sun
Mass	The amount of matter that something is made up of- measured in grams / kilograms.
Gravitational Field	The space around any object with mass where its gravity attracts other masses.
Gravitational Field Strength	The force with which a gravitational field pulls on each kilogram of mass. Earths gravitational field strength is approximately 10 N/Kg.
Weight	The amount of force with which gravity pulls things. Measured in Newtons. Weight = mass x gravitational field strength
Gravitational Potential Energy (GPE)	Energy stored in objects in high places that can fall down.

2. Static Electricity	
Static Electricity	A positive or negative charge on an insulating material caused when rubbing transfers electrons from one material to another.
Nucleus	The central part of an atom- has a positive charge.
Electrons	Small particles moving around the nucleus in an atom- have a negative charge
Atom	
Charges	Something with a charge of static electricity can attract uncharged objects. Two charged objects can attract or repel each other.
Electric Field	The space around an object with a charge of static electricity where it can affect other objects.

3. Current Electricity	
Electric Current	The flow of electrons in a circuit.
Current in Series	The current is the same everywhere in a series circuit.
Current in Parallel	The current through the cell splits up when it comes to a junction in a parallel circuit.
Ammeter	Connected in series and used to measure the current flowing through a circuit- measured in amperes (A).
Voltage	How much energy is transferred by electricity by a cell / component.
Voltmeter	Connected in parallel and used to measure the voltage of a component- measured in volts (V)

4. Resistances	
Resistance	How difficult it is for electricity to flow through something.
Resistors	A component that makes it difficult for electricity to flow. Used to reduce the size of the current in a circuit.
Factors Affecting Resistance	Increasing the length of a wire or decreasing the thickness will increase the resistance.
Insulators	Do not conduct electricity- they have very high resistances.
Ohms	The units for measuring resistance- Ω
Calculating Resistance	Voltage = current x resistance

5. Electromagnets	
Electromagnets	A coil of wire with electricity flowing in it that has a magnetic field around it.
Increasing Electromagnet Strength	Increasing the number of coils. Increasing the current in the wire. Using a magnetic material as a core.
Relays	A small current is used to switch on a circuit that carries a much bigger current
Motor Effect	The force produced when a wire carrying a current is placed in a magnetic field.
Electric Motor	A coil of wire in a magnetic field. The coil spins when a current flows through it.