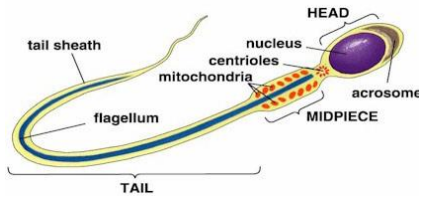
Biology 1: Cell Biology

Section 1: Cell Structure

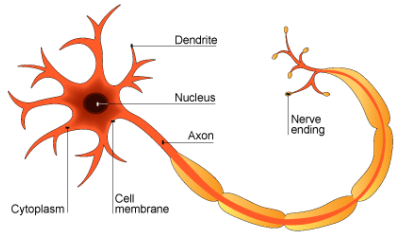
Cell Structure	Function	Eukaryotic (with a nucleus)		Prokaryotic (no nucleus)
		Animal Cells	Plant Cells	Bacterial Cells
Nucleus	Contains **DNA** that **controls** the cell.	Y	Y	
Cell membrane	Controls what **enters** and **leaves** the cell.	Y	Y	Y
Cytoplasm	Where many **chemical reactions** within the cell occur.	Y	Y	Y
Mitochondria	Releases **energy** from **aerobic respiration**.	Y	Y	
Ribosome	**Synthesises** (makes) **proteins**.	Y	Y	Y
Chloroplast	Where **photosynthesis** occurs.		Y	
Permanent vacuole	Used to **store** water and other chemicals as **cell sap**.		Y	
Cell wall	**Strengthens** and **supports** the cell. (Made of **cellulose** in plants.)		Y	Y
Plasmid	A **small circle of DNA**, may contain **genes** associated with antibiotic resistance.			Y

Section 2: Specialised Cells

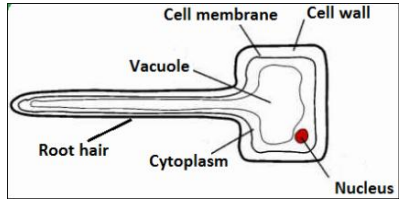
Specialised Cell	How structure relates to function
Sperm cell	**Acrosome** contains **enzyme** to break into egg; **tail** to swim; many **mitochondria** to provide **energy** to swim.
Nerve cell	**Long** to **transmit electrical impulses** over a distance.
Muscle cell	Contain **protein fibres** that can **contract** when energy is available, making the cells shorter.
Root hair cell (plants)	Long extension to **increase surface area** for water and mineral uptake; **thin cell wall**.
Xylem cell (plants)	**Waterproofed** cell wall; cells are **hollow** to allow water to move through.
Phloem cell (plants)	Some cells have lots of **mitochondria for active transport**; some cells have very little cytoplasm for sugars to move through easily.



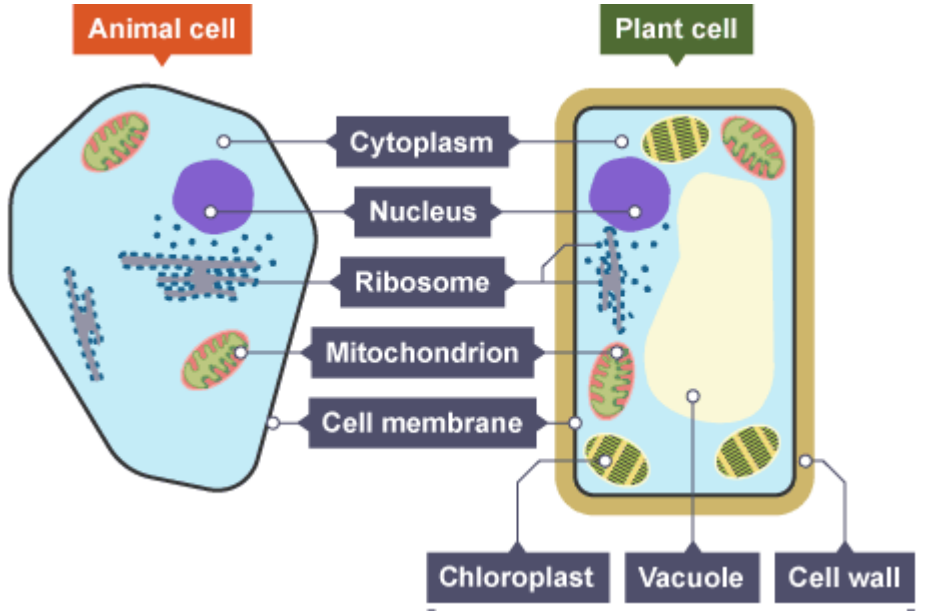
Sperm cell



Nerve cell



Root hair cell

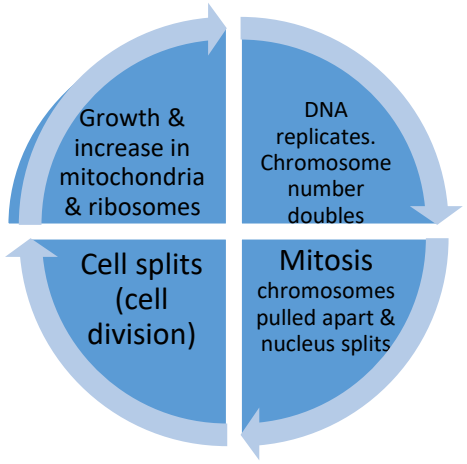


Section 3: Microscopy

Magnification	The degree by which an object is **enlarged**. **Magnification = size of image / size of real object**
Resolution	The ability of a microscope to **distinguish between 2 points**.
Light microscope	Basic microscope with a maximum magnification of 1500x. **Low resolution.**
Electron microscope	Microscope with a much **higher magnification** (up to 500 000x) and resolving power than a light microscope. This means that it can be used to study cells in much finer detail.

Section 4: Orders of Magnitude

Unit Prefix	Size in metres	Standard Form	Convert to metres by:
Centimetre (cm)	0.01m	10^{-2}m	÷100
Millimetre (mm)	0.001m	10^{-3}m	÷1000
Micrometre (μm)	0.000001m	10^{-6}m	÷1,000,000
Nanometre (nm)	0.000000001m	10^{-9}m	÷1,000,000,000



Cell cycle

Section 5: Mitosis and the Cell Cycle

1	Number of **sub-cellular structures** (e.g. **ribosomes** and **mitochondria**) **increase**.
2	DNA is replicated (copied) so the number of **chromosomes double**.
3	One set of **chromosomes** is **pulled** to each end of the cell.
4	The **nucleus divides**.
5	**Cytoplasm** and **cell membranes divide** to form two **genetically identical** cells

Section 6: Stem Cells

Stem Cell	Properties	Uses
Embryonic stem cell	Can divide into **most types** of cell.	**Therapeutic cloning** – embryonic stem cells produced with same genes as patient. **No rejection**.
Adult stem cell	Can divide into a **limited number of cells** e.g. bone marrow stem cells can form various blood cells.	
Meristem	Found in plants. Can differentiate (divide) into **any type** of plant cell.	**Clone** rare species to **prevent extinction**. **Crops** with **special features** can be clones

Pros and Cons of Using Stem Cells	
Pros	**Treatment of diseases** such as diabetes, dementia and paralysis.
Cons	Destroying a potential life. Embryos cannot give consent**.** Can **transfer viruses** held within cells.

Section 7: Transport Across Membranes

Cell Structure	Definition	Uses
Diffusion	**The spreading** out of the particles by random motion from an area of **higher concentration** to an area of **lower concentration.**	**Oxygen** and **carbon dioxide** in **gas exchange** (leaves and alveoli).
Osmosis	The movement of water from a more dilute solution to a more concentrated solution through a partially permeable membrane.	Movement of water into and out of cells.
Active Transport	The movement of substances **from an area of low concentration** to an area of high concentration (against a concentration gradient). Requires energy from respiration.	**Absorption** of **mineral ions** from soil into **plant roots** through root hair cells **Absorption** of **sugar molecules** from lower concentrations in the **gut** into the **blood** which has a higher sugar concentration.

Section 8: Factors Affecting Diffusion

Factor	Explanation
Difference in concentrations (**concentration gradient**)	The greater the difference in concentrations, the faster the rate of diffusion.
Temperature	Particles move more quickly at higher temperatures, so rate of diffusion increases.
Surface area of membrane	The greater the surface area the quicker the rate of diffusion.

Section 9: Adaptations of Exchange Surfaces

1	**Large surface area**
2	**Thin membrane** to provide a **short diffusion path**
3	**Ventilation** (in animals for gas exchange – maintains a steep concentration gradient)
4	**Efficient blood supply** (in animals – maintains a steep concentration gradient)

Biology 2: Organisation

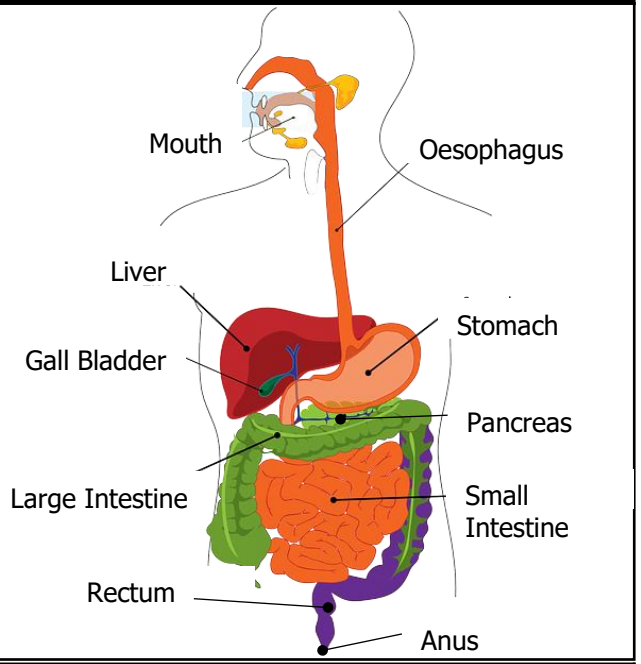
Section 1: Organisation

Tissue	A **group of cells** with a **similar structure and function** e.g. muscle tissue
Organ	A **group of tissues** performing a specific **function** e.g. heart, leaf
Organ System	A **group of organs** that perform a specific **function** e.g. digestive system.

Section 2: Human Digestive System

Order of movement of food through the digestive system:

Mouth	**M**any
Oesophagus	**O**rdinary
Stomach	**S**tudents
Small intestine	**S**truggle
Large intestine	**L**earning and
Rectum	**R**emembering
Anus	**A**nswers



Section 3: Enzymes Key Terms

Enzyme	A **biological catalyst** that can **speed up the rate of reaction** without being used itself. Made of a large **protein molecule**.
Substrate	The **chemical that fits into** the **active site** of an enzyme.
Lock and Key model	Only **one type of substrate** can **fit into the active site** of an enzyme, like a key fits into a lock.
Denatured	When the **active site of an enzyme changes shape** and the **substrate can no longer fit in**. Can be caused by **pH** or **temperature**.

Section 4: Testing for Biological Molecules

Molecule	Chemical Test	Positive Result
Starch	Add orange/brown **iodine solution**.	Colour turns to **blue/black**.
Sugar	Add blue **Benedict's solution**. Place in a **boiling water bath for 5 minutes**.	Colour turns **green/ yellow/ orange/ brick red**.
Protein	Add blue **Biuret solution**.	Colour turns to **lilac/ purple**.
Lipid	Add **ethanol** and decant into **water**.	**Cloudy white emulsion**.

Section 5a: Human Digestive Enzymes

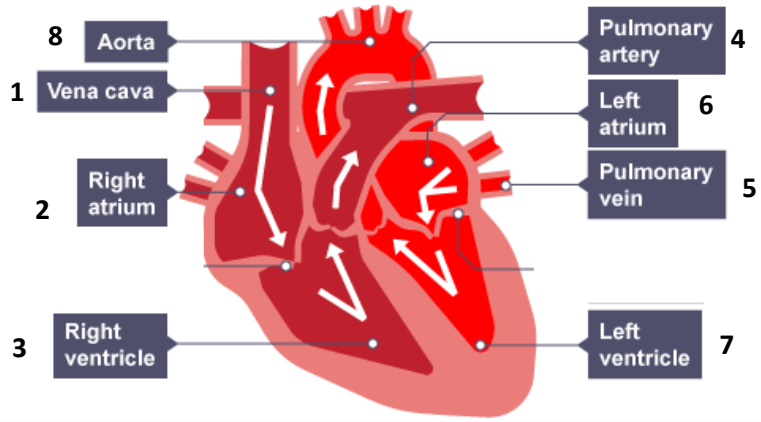
Enzyme	Function	Sites of production	Sites of action
Amylase	Breaks **starch** into **sugars.**	Salivary glands Pancreas Small intestine	Mouth Small intestine
Protease	Breaks **proteins** into **amino acids**.	Stomach Pancreas Small intestine	Stomach Small intestine
Lipase	Breaks **lipids (fats)** into **fatty acids and glycerol**.	Pancreas Small intestine	Small intestine

Section 5b: Other Chemicals

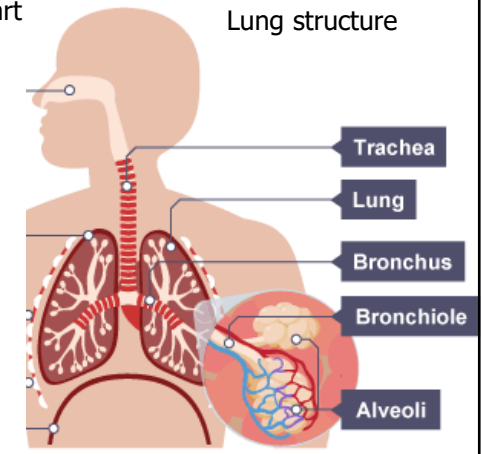
Hydrochloric Acid	Acid with pH of 2 produced by the stomach. **Kills bacteria**
Bile	**Emulsifies fats** (turns them into droplets to give a greater surface area). It is **alkaline** so **neutralises acid from the stomach**. **Produced in liver**, **stored in gall bladder** and is **released into the small intestine**.

Section 6: Heart and Lungs

Orders of numbers is the way in which blood flows through the heart



Lung structure



Section 6a: Structures in the Heart

Pacemaker	Group of cells in the **right atrium** that controls **resting heart rate**.
Right ventricle	Pumps **deoxygenated blood** to the **lungs** for **gas exchange**.
Left ventricle	Pumps **oxygenated blood** to the **body**. **Thick, muscular** wall.
Valve	Stops blood flowing the **wrong way**.

Section 6b: Structures in the Lungs

Alveoli	Small sacs where **gas exchange** occurs. **Surrounded by capillaries**. **Oxygen moves from the alveoli into the capillaries**, carbon dioxide moves from the capillaries into the alveoli
Trachea and Bronchi	Tubes through which gases move. **Lined with cartilage** so they don't collapse.

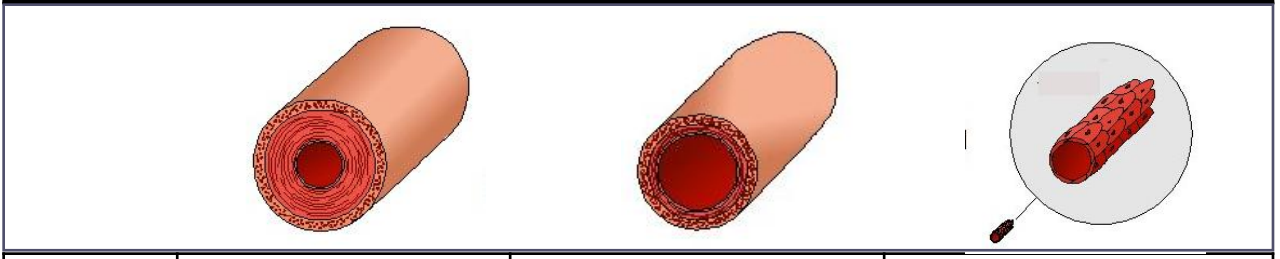
Biology 2: Organisation

Section 7: Heart Disease

Coronary Heart Disease	Build up of **fatty material in coronary arteries**. Can lead to a **blood clot** and a **heart attack**.

Treatment	What it is	Advantage	Disadvantage
Stent	**Wire mesh** that **opens up** a **blocked artery**.	Keeps artery open. Low-risk surgery.	Fatty material can rebuild. Risk of blood clot.
Statin	Drug that **reduces cholesterol**.	Reduces fat being deposited in arteries.	Side effects. Doesn't remove fat already there
Heart transplant	**Replacement heart** from a donor.	Long-term.	Major surgery. Could be rejected.
Artificial heart	**Man-made heart** used while **waiting for a transplant**.	Not rejected. Keeps patient alive.	Short life-time. Limited activity.
Mechanical heart valve	Mechanical replacement of faulty heart valve.	Can last a life-time.	Risk of blood clots
Biological heart valve	Biological replacement of faulty heart valve.	Doesn't damage red blood cells.	Valve hardens and may need replacing.

Section 8: Blood Vessels



	Artery	Vein	Capillary
Purpose	Takes blood **away from the heart**.	Takes **blood back to the heart**.	**Exchange of substances between blood and cells.**
Adaptations	**Thick wall** to **withstand high pressure**	Thin wall. **Valves to prevent backflow of blood**.	Wall is **one cell thick** to allow **quick diffusion** of substances.

Section 9: Components of the Blood

Plasma	**Liquid** part of the blood. Transports blood cells as well as **carbon dioxide**, **proteins**, **glucose**, **hormones** and **urea**.
Red Blood Cells	**Carries oxygen**. Packed with **haemoglobin**, a protein that binds to oxygen. **No nucleus** to create extra space for haemoglobin. **Biconcave shape** to give a **large surface area**.
White Blood Cells	**Destroy pathogens**. Some can produce **antibodies**.
Platelets	Cell fragments that help to **clot wounds**.

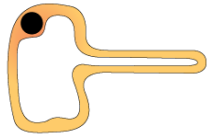
Section 10a: Movement within Plants

Transpiration	The **loss of water vapour** from the leaves by **evaporation from cells** and then out through the **stomata**.
Transpiration Stream	The **movement of water** from the **roots**, up the stem to the **leaves**.
Translocation	The **movement** of **dissolved sugars** around the plant.

Section 10b: Factors Affecting Transpiration

Temperature	**Higher** temperature **increases** the transpiration rate as water evaporates quickly.
Humidity	**Increasing** humidity **decreases** the rate of transpiration as water evaporates slowly.
Wind speed	**Increasing** wind speed **increases** the transpiration rate as water evaporates quickly.
Light	**Increasing** light **increases** the rate of transpiration as **stomata** open.

Section 11: Cell Adaptations for Movement Within Plants



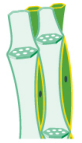
Root hair cell

Extension gives a **large surface area** to **absorb water and minerals**.

Xylem

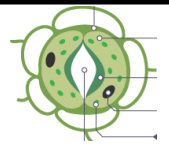
Vessels are **strengthened by lignin** to **withstand pressure.**

Cell walls are **waterproof.**



Phloem

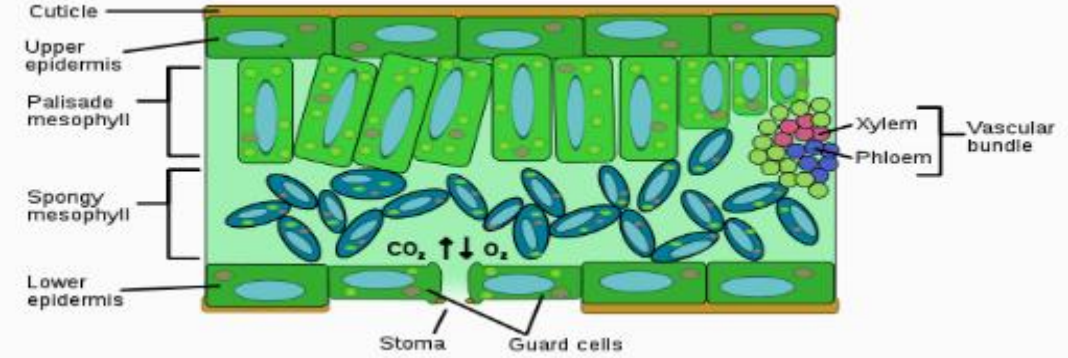
End of cells **contain pores to allow dissolved sugars to move** between cells.



Guard Cells and Stomata

Guard cells can **open** the stoma to allow **gas exchange** or **close** to **prevent water loss**.

Section 12: Leaf Structure and Plant Tissues



Epidermis	**Cover** the **surfaces** of the leaf; lets **light penetrate**.
Xylem	**Carries water** and **minerals** from the roots around the plant.
Phloem	**Carries dissolved sugars** made through photosynthesis around the plant.
Palisade mesophyll	Where **most photosynthesis** takes place. Cells contain **many chloroplasts**. **Absorbs light**.
Spongy mesophyll	**Some photosynthesis**. Has **air spaces** for **diffusion** of CO_2 and O_2.
Guard cells	Cells that **open** and **close stomata**.
Stomata	**Opening** that allows **CO_2 and O_2** to **diffuse** in and out of the leaf.

Biology 3: Infection and Response

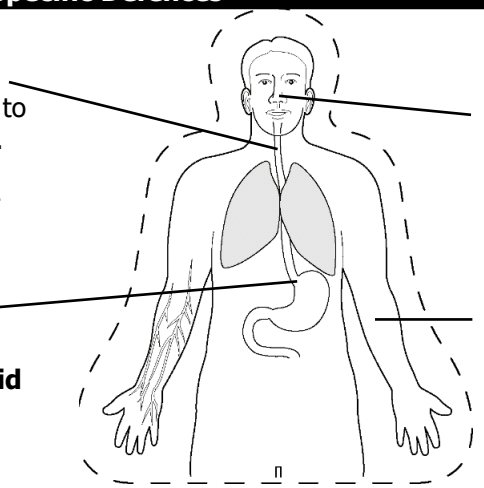
Section 1: Pathogens and Diseases

Disease	Pathogen	How it is spread	Effect	Prevention/ Control
Measles	**Virus**	**Droplets** from sneezes and coughs	Fever & red skin rash Can be **fatal**	**Vaccination** of children
HIV	**Virus**	**Sexual contact,** needle exchange	Flu-like illness, Damages **white blood cells** leading to **AIDS**	**Antiretroviral drugs** when infected
Tobacco Mosaic Virus (PLANTS ONLY)	**Virus**	**Direct contact**	Mottling of leaves**, reduces photosynthesis**	
Salmonella	**Bacteria**	Infected food, poor food hygiene	**Fever, abdominal cramps, diarrhoea, vomiting**	**Vaccination** of poultry (chickens).
Gonorrhoea	**Bacteria**	**Sexual contact**	**Discharge** from **penis/ vagina, pain** when **urinating**	Controlled by **antibiotics**. Spread prevented by **condoms**.
Rose Black Spot (PLANTS ONLY)	**Fungus**	**Spores** carried by **water** or **wind**	Leaves turn yellow, fall early. **Photosynthesis reduced.**	Treated by **fungicides** or **destroying affected leaves**.
Malaria	**Protist**	By a **vector – mosquito**	Recurrent episodes of **fever. C**an be **fatal.**	Preventing **mosquitos** from breeding, using **mosquito nets**.

Section 2: Non-Specific Defences

Trachea and Bronchi
Produces **mucus** to **trap pathogens**. Contains **cilia** to **move mucus** for swallowing

Stomach
Contains **hydrochloric acid** to destroy pathogens.



Nose
Contains **hairs** and **mucus** to **trap pathogens**

Skin
A **physical barrier** to pathogens.

Section 3: Key terms

Pathogen	A **microorganis**m that **causes disease**.
Bacteria	A type of **pathogen** that **produces toxins that damage tissues**.
Viruses	A type of **pathogen** that **lives and replicates within cells** and causes **cell damage**. It is **difficult to kill viruses without damaging cells**.
Antibodies	Some white blood cells (lymphocytes) produce antibodies. These **bind to pathogens** and **destroy them** or **stick them together**.
Antitoxins	Some white blood cells (lymphocytes) produce antitoxins. Antitoxins **neutralise toxins**.
Antibiotics	Antibiotics **kill bacteria**. **Specific antibiotics** should be used for **specific bacteria**. **Some bacteria are resistant** to antibiotics. **Do not kill viruses**.
Antigens	Unique molecules on the surface of pathogens that your white blood cells can recognise
Painkillers	Painkillers **relieve symptoms** but **don't kill pathogens**.
Phagocytosis	Some white blood cells (phagocytes) **engulf pathogens**.

Section 4: Drugs

Aspirin	Originates from the **willow** tree.
Digitalis	A **heart drug**. Originates from **foxglove** plants.
Penicillin	Discovered by Alexander Fleming from the ***Penicillium*** mould**.**
New drugs	Most new drugs are **synthesised by chemists in the pharmaceutical industry.** The **starting point** may be a **chemical extracted from a plant.**

Section 5: Clinical Trials

Trial Stage	Purpose
1. **Preclinical:** cells, animals	Test for **toxicity** and **efficacy** before testing humans
2. **Clinical:** Healthy volunteers	**Low doses** to test for **toxicity.**
3. **Clinical:** Patients	Larger groups. Test for **toxicity**, **efficacy** and **dose. Placebos** may be used in a **double-blind trial**.

Natural Immunity	Vaccination
Pathogen enters body	Dead or weakened pathogen is injected
The correct white blood cell is found	The correct white blood cell is found
Antibodies are produced	Antibodies are produced
The white blood cells remain as memory cells	The white blood cells remain as memory cells
If the pathogen returns, antibodies will be produced **quickly**	If the pathogen returns, antibodies will be produced **quickly**

Clinical Trial Key Terms

Placebo	A drug with **no active ingredients**, designed to **mimic a real drug**. Used to test if the effects of a drug on a patient are just **psychological**.
Double-blind trial	The volunteers do not know which group they are in, and neither do the researchers, until the end of the trial
Toxicity	How **harmful** the drug is. May have dangerous **side effects**.
Efficacy	How **effective** the drug is.
Dose	The **amount** of the drug given to the patient.

Biology 4: Bioenergetics

Section 1: Photosynthesis Equation

Carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Section 2: Key terms

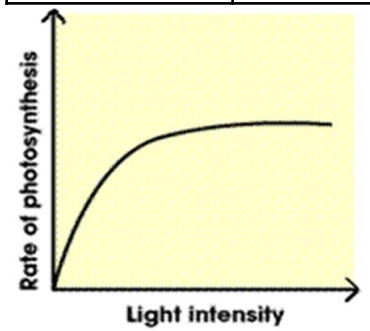
Chloroplast	The plant **organelle** where **photosynthesis** takes place.
Chlorophyll	The **green pigment** that **absorbs energy from light**.
Endothermic	Photosynthesis **takes energy** in (in the form of **light**). It is an endothermic reaction.

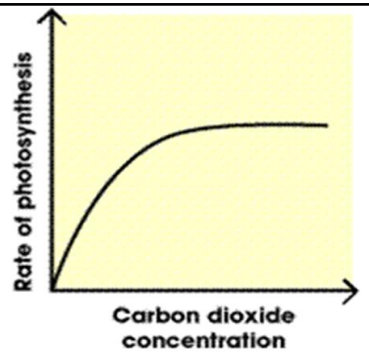
Section 3: Uses of Glucose

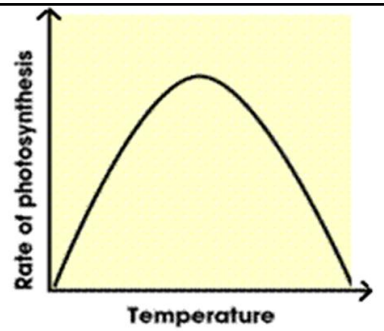
Used in **respiration** to provide **energy**.
Converted into **starch** for **storage**.
Converted into **fats** and **oils** for **storage**.
Used to produce **cellulose** to **strengthen** the **cell wall**.
Used to produce **amino acids** to **make proteins** (also needs nitrate ions from the soil)

Section 4: Limiting Factors

Limiting Factor	The factor that stops the rate of photosynthesis from increasing; could be light intensity, CO_2 concentration, temperature or amount of chlorophyll.







Light Intensity	**CO_2 concentration**	**Temperature**
Initially light is the limiting factor. When the graph plateaus something else (e.g. CO_2 concentration, temperature) is limiting the rate.	Initially CO_2 concentration is the limiting factor. When the graph plateaus something else (e.g. light intensity, temperature) is limiting the rate.	As temperature increases, the rate of photosynthesis increases. Above the optimum there is a decrease in photosynthesis. Enzymes needed for photosynthesis become denatured.

Section 5: Respiration

Energy	Energy in organisms is needed for **movement**, **keeping warm** and **chemical reactions to build larger molecules**.
Aerobic Respiration	Aerobic respiration **releases energy**. It requires **oxygen**. It is an **exothermic** reaction (produces heat). Takes place in **mitochondria**. **Glucose + oxygen → carbon dioxide + water** **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$**
Anaerobic Respiration (muscles)	**No oxygen** needed. Provides **less energy** than aerobic respiration as glucose **not fully oxidised**. Occurs during **intensive exercise**. In **cytoplasm**: **Glucose → lactic acid**
Lactic Acid	Produced in **anaerobic respiration in muscles**. **Build up** of lactic acid **causes fatigue**.
Oxygen Debt	The **amount of extra oxygen** the body needs **after exercise.**
Anaerobic Respiration (plant and yeast cells)	**No oxygen** needed. In yeast cells it is called **fermentation** – economically important for manufacture of **bread** and **alcoholic drinks**. In **cytoplasm: Glucose → ethanol + carbon dioxide**

Section 5: How the Body Responds to Exercise

Increase in breathing rate	Increases rate at which **oxygen** is taken into the lungs. More oxygen leads to more respiration, which releases more energy for exercise
Increase in heart rate	Oxygenated blood is pumped around the body at a faster rate. Carbon dioxide is removed at a faster rate. More respiration can occur, releasing more energy for exercise.
Increase in breath volume	A **greater volume** of oxygen is taken in with each breath. More oxygen leads to more respiration, which releases more energy for exercise

Section 6a: Metabolism

Metabolism	The **sum of all the reactions** in a **cell** or **body**. Some of these reactions **require the energy released from respiration**.

Section 6b: Metabolic Reactions

Conversion of glucose to starch, cellulose or glycogen.
Formation of lipids from glycerol and fatty acids
Use of glucose and nitrates to make amino acids (plants only)
Respiration
Breakdown of proteins to urea

Biology 5: Homeostasis and Response

Section 1: Key Terms

Homeostasis	Regulating **internal conditions** to keep them at an **optimum**, **despite** internal and external **changes**. Maintains optimum conditions for **enzymes**.

Section 2a: Nerve Reflexes Key Terms

Central nervous system (CNS)	The **brain** and **spinal cord** together. **Co-ordinates** the **response** of **effectors**.
Reflex action	A **fast, automatic** reaction. Does not involve thinking parts of the brain.
Coordination Centre	**Receives** and **processes information** from receptors e.g. brain
Synapse	The **gap between two neurons**. Allows many different neurons to connect.

Section 2b: The Reflex Arc

Stimulus – a change in the environment

↓

Receptor – detects a **stimulus**

↓

Sensory neuron – transmits **electrical impulse** to the **CNS**

↓

Relay neuron – in the **spinal cord**. Transmits electrical impulses from the **sensory** to the **motor neuron**

↓

Motor neuron – transmits impulses from **CNS** to **effector**

↓

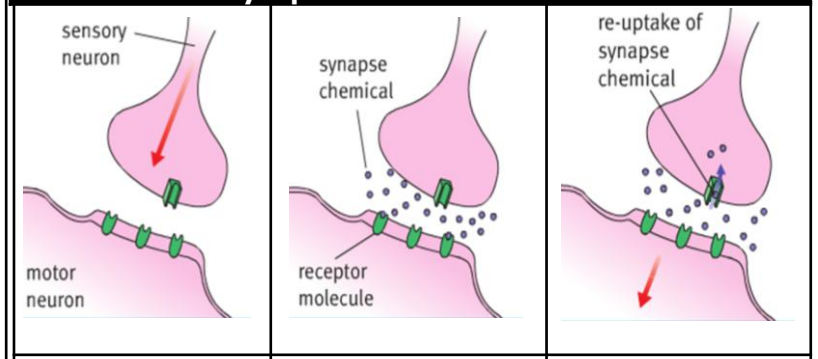
Effector – produces a **response**. Can be a **muscle** or **gland**

↓

Response – the change in response to the **stimulus**

The purpose of a reflex is to **protect** the body from **damage** by reacting more quickly. Example: If you pick up a hot pan, reflexes mean you will drop it more quickly and so burn yourself less

Section 2c: The Synapse

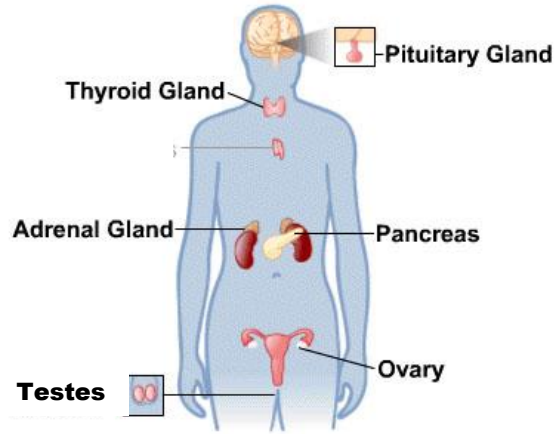


An **electrical impulse arrives** at the synapse.	**Neurotransmitter molecules are released** and **diffuse** across the synapse.	**Neurotransmitter molecules fill receptors** and **cause an electrical impulse in the next neuron**.

Section 3: Hormonal Control Key Terms

Endocrine System	The system of **glands** that **secrete hormones.**
Hormone	A **chemical messenger.** They are secreted by **glands** and travel in the **blood.** They effect a **target organ**. The effects are **slower and longer-lasting** than responses from the nervous system.
Pituitary Gland	A gland that **secretes several hormones** into the blood. These hormones control other glands to release hormones. Sometimes known as the master gland.
Testosterone	**Male hormone** produced by **testes. Stimulates sperm production.**

Section 4: Location of Endocrine Glands



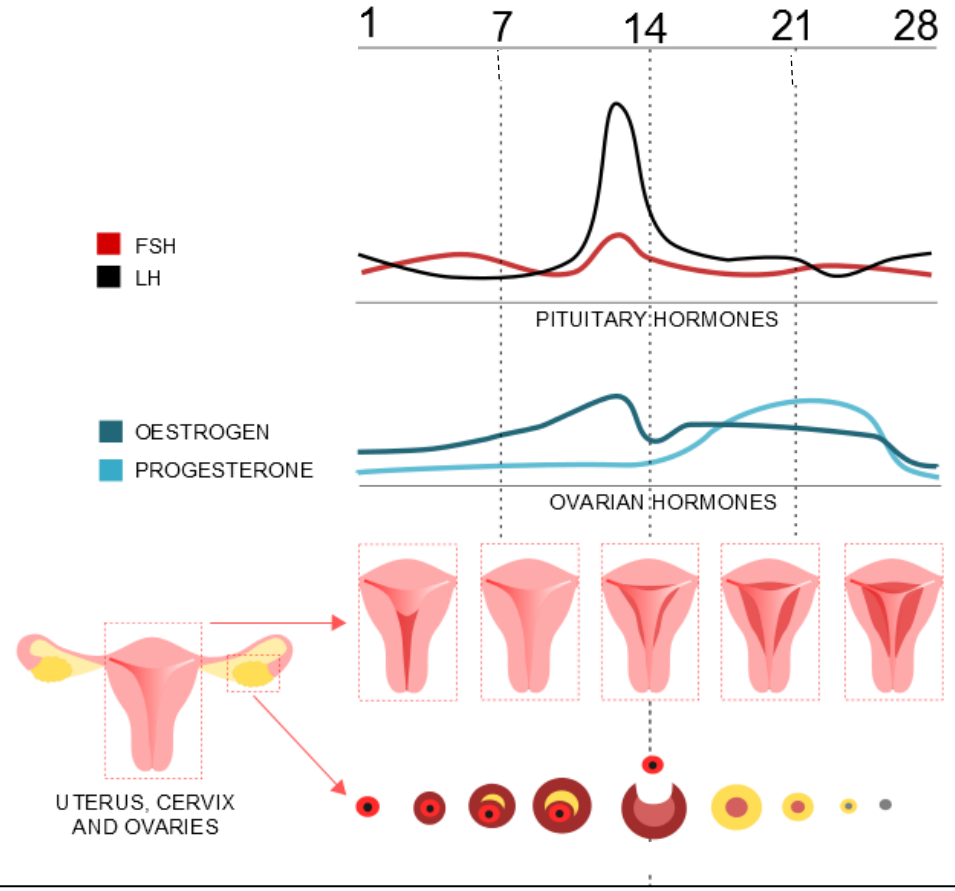
Section 5: Blood Glucose Control Key Terms

Pancreas	The gland that monitors and controls **blood glucose concentration**.
Insulin	A **hormone** produced when blood glucose concentration is **too high**. Causes **glucose** to move from the **blood into the cells**. In **liver** and **muscle** cells excess glucose is converted to **glycogen**.
Glycogen	A **storage molecule** made from many **glucose molecules bonded together**. Found in **liver** and **muscle** cells.
Type I Diabetes	Disorder in which the **pancreas fails to produce enough insulin**. Causes uncontrolled high blood glucose levels. Treated with **insulin injections**.
Type II Diabetes	Body cells **no longer respond to insulin** produced by the pancreas. A **carbohydrate controlled diet** and **exercise** are common treatments. **Obesity** is a **risk factor**.

Section 6: Menstrual Cycle (Some HT)

Ovulation	The **release of an egg cell**. Occurs approximately **every 28 days**.
FSH	Produced by the **pituitary gland**. A hormone that causes an **egg to mature in the ovary**.
Oestrogen	Produced by the **ovaries**. Causes **blood lining of uterus** to **develop**.
LH	Produced by the **pituitary gland**. A hormone that causes **ovulation**.
Progesterone	Produced by the **ovary**. **Maintains blood lining** in uterus.

Section 7: Changes in the Menstrual Cycle (HT)



Section 8: Methods of Contraception

Method	How it works	Pros (+) and Cons (-)
Oral contraceptives ('the pill')	The contraceptive pill. Contain **oestrogen to inhibit FSH production** so **eggs do not mature.**	+ 99% effective + Reduces risk of some cancers - Can cause side effects e.g. nausea
Progesterone	Injection, implant or skin patch of slow-release progesterone to stop **eggs maturing and being released**.	+ Fewer side effects than pill. + Doesn't need to be taken daily so less likely to be forgotten - Less effective than pill
Barrier methods	**Condom** or **diaphragm**. **Prevents sperm reaching the egg**.	+ 98% effective (when used correctly) + Prevent STIs - Can break or be used incorrectly
Spermicide	**Kills or disables sperm**. Used with diaphragms to make them more effective.	+ Increases effectiveness of some barriers - Can't be used on its own
'The Rhythm Method'	Avoiding intercourse when an egg might be in an oviduct.	- High risk of becoming pregnant
Sterilisation	**Undergoing surgery** to stop sperm or eggs being able to fertilise.	+ Permanently stops pregnancy - Risks from surgery - Expensive to reverse and may not work
Intra-uterine device (IUD)	An **implant into the uterus** that **prevents fertilised eggs implanting into the wall** of the uterus & **releases hormones**.	+ Long lasting but can be reversed - Small risk of infection or uterus damage when IUD is implanted

Biology 6: Inheritance, Variation & Evolution

Section 1a: Sexual and Asexual Reproduction

Sexual Reproduction	Reproduction involving the **fusion of gametes** from 2 parents
Gamete	A **sex cell** that contains **half the genetic information** of a body cell. E.g. **sperm** and **egg** in animals, **pollen** and **egg** in plants.
Meiosis	The type of **cell division** that **produces gametes**. Four daughter cells are produced from one original cell. Each cell is **genetically different**. Each daughter cell has **half** the genetic information of a body cell.
Fertilisation	**Fusion of gametes**. Restores the full number of chromosomes.
Asexual Reproduction	Reproduction involving **only one parent,** and **no gametes**. No mixing of genetic information so **genetically identical clones** are produced. Only **mitosis** is involved.
Mitosis	**Cell division** that produces two **genetically identical** daughter cells with the full set of chromosomes.

Section 1b: Mitosis and Meiosis

	Mitosis	Meiosis
Number of cells made	2	4
Variation in cells produced	Genetically identical to each other and parent cell	Different to each other and parent cell
Purpose	Growth, repair, asexual reproduction	Produce gametes for sexual reproduction
Number of chromosomes	Full amount (pairs of chromosomes)	Half (single chromosomes)

Section 1c: Advantages and Disadvantages of Different Types of Reproduction

	Advantages	Disadvantages
Sexual Reproduction	Produces **variation**. Offspring are more likely to **survive changes** to the environment and disease.	**Requires a mate**. **Slower** way of producing offspring.
Asexual Reproduction	Produce **lots of offspring quickly**. **No mate** needed.	Offspring are **less likely to survive environmental changes** or diseases.

Section 2: Genetic Diseases

	Polydactyly	Cystic Fibrosis
Symptoms	Extra fingers and toes	Disorder of cell membranes. Causes sticky mucus on lungs.
Caused by…	**Dominant** allele	**Recessive** allele
Genotype of people with disease	PP or Pp	cc
Genotype of people without disease	pp	CC or Cc
Does the disease have carriers?	No	Yes – genotype Cc

Section 3: Genetics Key Terms

DNA	**Genetic material**. DNA is a **polymer** made up of **two strands** forming a **double helix**. The DNA makes up chromosomes.
Gene	A gene is a **small section of DNA** on a chromosome. Each gene **codes for a particular sequence of amino acids**, which **make a protein**.
Chromosome	A **long coil of DNA**. Found in the nucleus.
Genome	The **entire genetic material of that organism**.
Allele	**Different versions of the same gene** – dominant and recessive.
Dominant	A dominant allele is **always expressed**. Only **one copy** is needed.
Recessive	Only **expressed if two copies are present**.
Homozygous	**Both alleles** for a gene are the **same** (i.e. both are dominant or both are recessive).
Heterozygous	**Both alleles** for a gene are **different** (i.e. one is dominant, the other is recessive).
Genotype	The **alleles present** for a **particular gene**.
Phenotype	The **physical feature** expressed for a **particular gene**.
Single gene characteristics	Some characteristics are controlled by only one gene e.g. fur colour in mice, colour blindness in humans. **BUT** most characteristics are controlled by several genes.

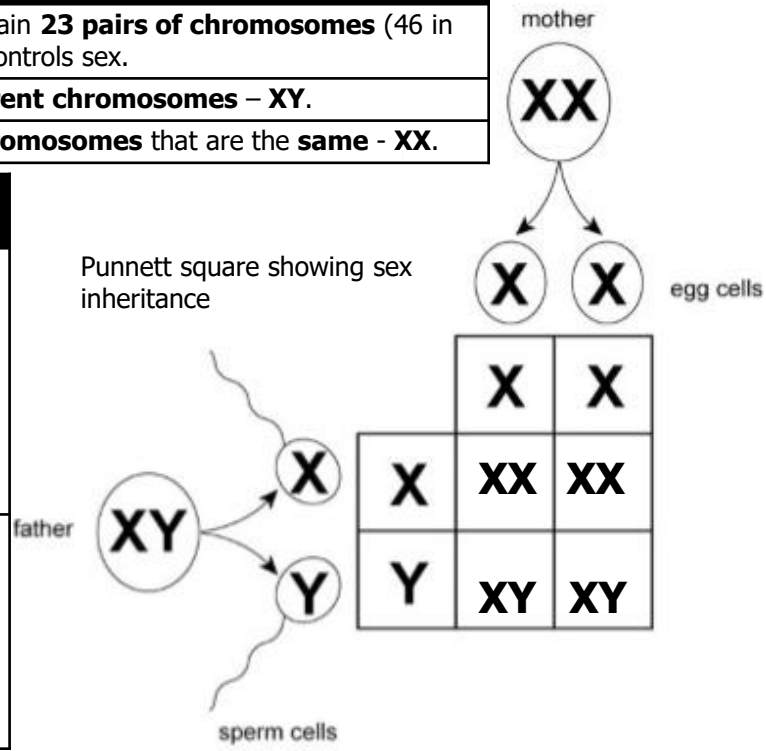
Section 4: Gender Inheritance

Human Chromosomes	Human body cells contain **23 pairs of chromosomes** (46 in total). Only one pair controls sex.
Males	Males have **two different chromosomes** – **XY**.
Females	Females have **two chromosomes** that are the **same** - **XX**.

Section 4a: Antibiotic Resistant Bacteria

Cause	• **Mutations** make some bacteria more resistant • **Antibiotics** kill non-resistant bacteria • Resistant bacteria **breed** and **spread** as there is no competition
How to reduce the spread	• Only prescribe antibiotics for serious **bacterial** infections • Patients must complete the **full course** of antibiotics • Restrict the use of antibiotics in **agriculture**

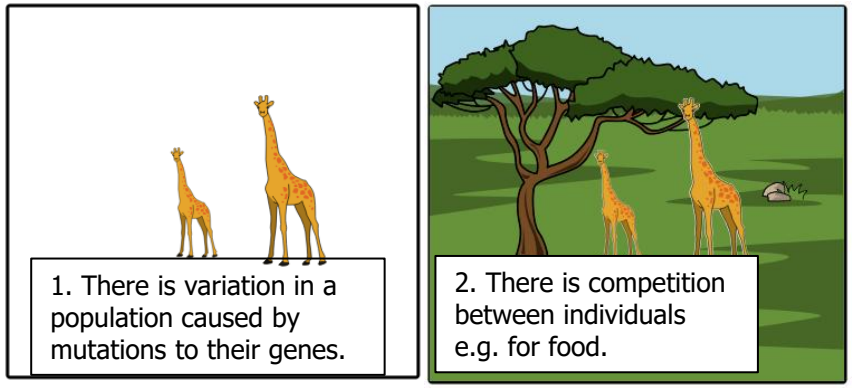
Punnett square showing sex inheritance

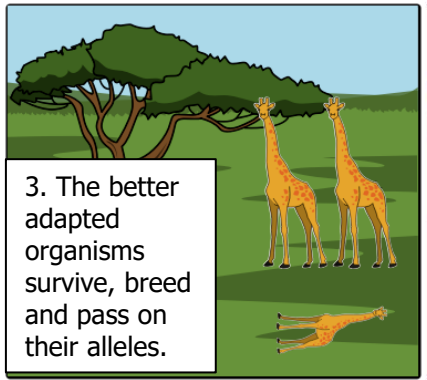


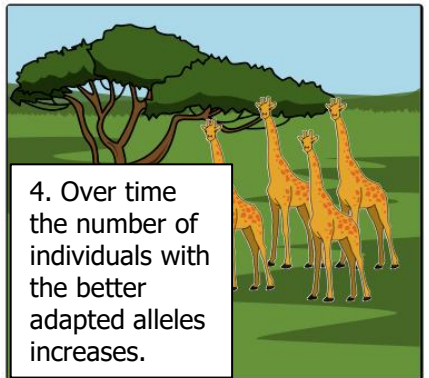
Section 5: Variation and Evolution Key Terms

Variation	The **differences** between organisms. Can be caused by **genes** (e.g. eye colour), the **environment** (e.g. scars) or **both the environment and genes** (e.g. weight). Variation in genes is caused by **mutations**.
Mutation	Mutations are **changes to genes**. **Most have no effect** on the phenotype. Occasionally mutations have a positive effect on phenotype and organisms with these mutations are more likely to survive.
Evolution	The **change in the inherited characteristics of a population over time**. Occurs through natural selection.
Natural selection	The process by which the **individuals best adapted to the environment survive** and **pass on their genes**.
Species	Members of a species can interbreed to produce fertile offspring. When organisms become so different they can no longer do this, two new species have been formed
Extinction	When no individuals of a species remain alive. Can be caused by a new disease, habitat loss or human activity

Section 5a: Darwin's Theory of Natural Selection







Section 5b: Fossils

Fossils: remains of organisms from millions of years ago.

Formed when:

- Parts of an organism don't decay
- Hard parts of an organism are replaced by minerals as they decay
- Traces of organisms are preserved e.g. footprints

Fossils show us how organisms have changed over time and provide **evidence for evolution**

Section 6: Selective Breeding

Selective Breeding (Artificial Selection)	The process by which **humans breed plants and animals for particular genetic characteristics.**
Inbreeding	Selective breeding can lead to 'inbreeding' where some breeds are particularly **prone to disease or inherited defects**.

Process of selective breeding:

1. Choose parents with correct characteristics from the population.
2. Breed them together.
3. Choose the offspring with the desired characteristics and breed them together.
4. Continue over many generations.

Examples of desired characteristics:

- Disease resistance in food crops.
- Animals which produce more meat or milk.
- Domestic dogs with a gentle nature.
- Large or unusual flowers.

Section 7: Genetic Engineering

Genetic Engineering	A process which involves **modifying the genome** of an organism by **introducing a gene** from another organism to give a desired characteristic.
GM Crop	Crops that have been produced by genetic engineering.

GM Crops – Pros (+) and Cons (-)

+ Increased yield of crops
- Could negatively effect wild populations of flowers and insects
- Effects on human health not fully explored

Examples of genetic engineering:

- Bacterial cells have human **insulin gene** inserted into them so that they produce insulin for diabetics.
- Plants that have had genes inserted that make them **resistant to disease, insects** or **herbicides**.

Section 8: Classification

Traditionally living things were classified into groups according to their structure and characteristics in a system developed by Carl Linnaeus:

As we gained more evidence due to improvements in microscopes and chemical analysis, Carl Woese developed a new system – the 3 Domain System. All organisms are classified as either:

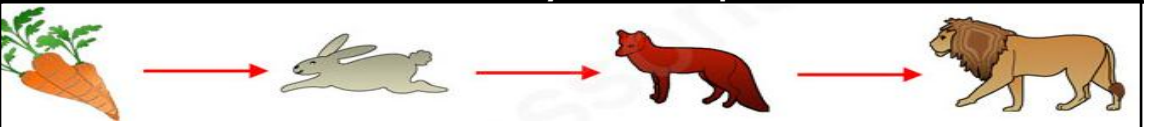
- Archaea (primitive bacteria – often living in extreme environments)
- Bacteria (true bacteria)
- Eukaryota (organisms made up of more complex cells, including plants, animals, fungi & protists)

Biology 7: Ecology

Section 1: Key terms

Ecosystem	The **interaction** of a **community of living organisms (biotic)** with the **non-living (abiotic)** parts of their environment.
Habitat	The **area** in which an organism **lives**.
Community	All the **species** in an ecosystem**.** A **stable** community is one where the species are **balanced** so that population sizes remain fairly **constant.**
Population	The **total number of organisms** of **one species** in an ecosystem**.**
Competition	**Plants** often compete for **light, space, water** and **mineral ions. Animals** often compete for **food**, **mates** and **territory**
Interdependence	Within a community each **species depends on other species** for **food, shelter, pollination** etc.
Adaptations	A **feature** that an organism has that allows it to **survive** in its ecosystem.
Biodiversity	The **variety** of all the **different species** of organisms **on Earth**, or **within an ecosystem.**

Section 3: Food Chains and Predator-Prey Relationships

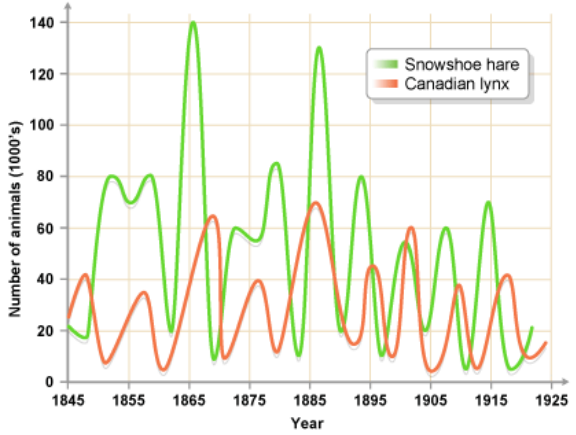


Producer – **Start** of a food chain. Produces **glucose** through **photosynthesis.**

Primary Consumer – Eats a **producer. Prey** of secondary consumer.

Secondary Consumer – Eats a **primary consumer. Predator** of primary consumer.

Tertiary Consumer – **Predates** on **secondary consumer.**



Predator-prey cycles

- The population of the **prey increases**
- **More food** is available for the **predators**, so their population increases.
- There are **more predators** so the **population of the prey decreases**.
- There is **less prey to feed on** so the population of **predators decreases.**
- The **cycle restarts** from the beginning.

Section 2: Biotic and Abiotic Factors

Biotic	Abiotic
Availability of **food**	**Light intensity**
New **predators** arriving	**Temperature**
New **pathogens**	**Moisture** levels
One species **outcompeting** another	**Oxygen** levels for aquatic animals
	Wind intensity and direction
	CO_2 levels for plants
	Soil pH & **mineral** content

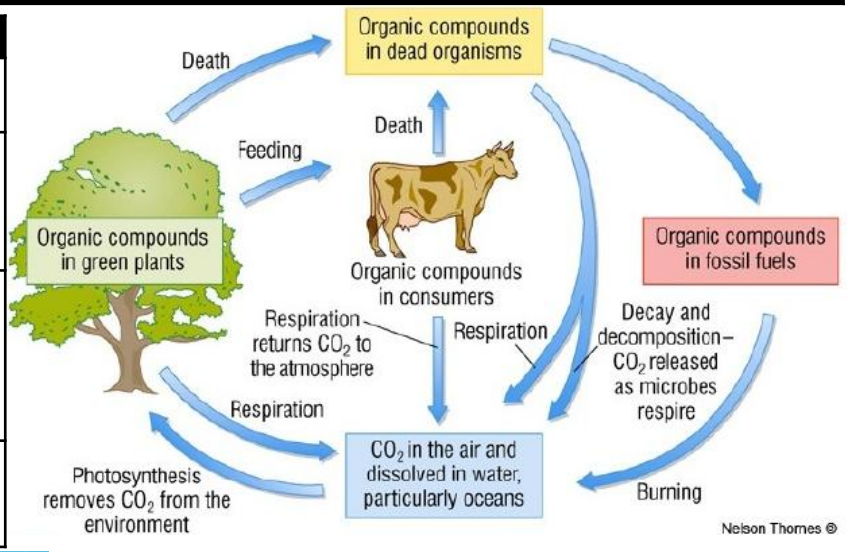
Section 4: Adaptations

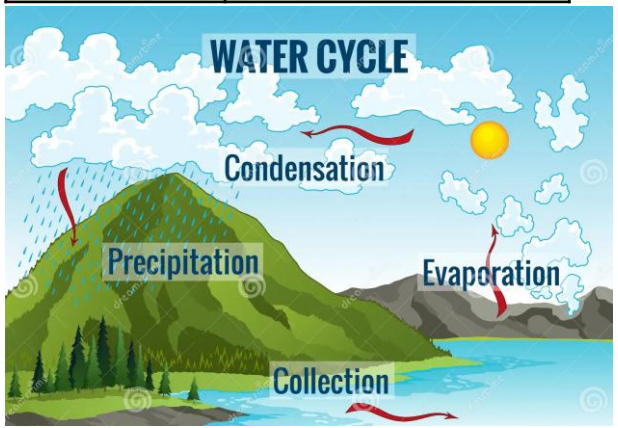
Structural Adaptations	Part of the **body** that helps the organism survive. e.g. polar bears have a thick layer of fat for insulation.
Functional Adaptations	How the **body operates** that helps the organism survive. E.g. camels do not sweat.
Behavioural Adaptations	A **behaviour** that helps the organism survive. e.g. desert rats stay in their burrows during the hottest parts of the day.

Section 5: Cycles

Section 5a: Carbon cycle steps

Photosynthesis	**Plants absorb CO_2** from atmosphere.
Respiration	**Animals**, **plants** and **micro-organisms** respire, **releasing CO_2** into the atmosphere.
Decay	The carbon in dead organisms is **released to the atmosphere** by **micro-organisms respiring**.
Combustion	Carbon locked in **fossil fuels** is **released** as CO_2 when fuels are **burned**.





Section 5b: Water cycle steps

Evaporation	**Liquid water** is **turned** into **water vapour** in the **atmosphere.**
Condensation	Water vapour **condenses** to **form clouds**.
Precipitation	Water is deposited from clouds as **rain**.

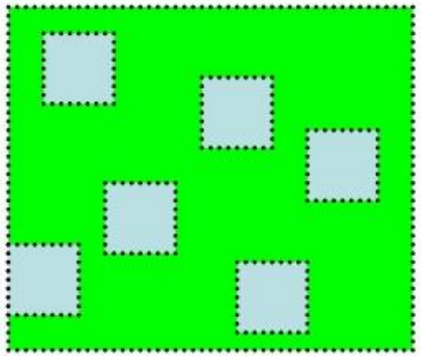
Biology 7: Ecology

Section 6: Human effects on biodiversity

Human activity	Why it happens	Effects
Polluting water with fertiliser and sewage	Farmers spread **fertiliser** on fields. **Rain** washes fertiliser into **rivers** and ponds. Sewage is released directly into rivers.	Fertilisers and sewage cause an **increase in growth of algae**. When the algae **die**, they are **decomposed by bacteria** that **use oxygen**. Other animals **die due to a lack of oxygen**. This is called Eutrophication
Using land	Humans **construct buildings**, create **quarries** and **farm**.	**Habitat** for plants and animals is **reduced**.
Destroying peat bogs	Humans **use peat to provide compost** to increase food production.	**Removes habitat, reducing biodiversity. Decay or burning of peat produces CO_2.** This contributes to **global warming.**
Deforestation	To provide **land for cattle and rice fields**. To **grow crops for biofuels**.	**Burning** or **decomposing trees releases CO_2. Fewer trees to remove CO_2 from the atmosphere.** This contributes to **global warming. Loss** of **biodiversity.**
Producing acidic gases	**Combustion** of **fossil fuels** releases **sulfur dioxide** and **nitrogen oxides.** These gases **dissolve in water** making it **acidic**.	**Acid rain. Damages plants.** Can cause **rivers** and **lakes** to become acidic, killing animals and plants.
Polluting water with toxic chemicals	**Pesticides** and other toxic chemicals (e.g. from **landfill**) are washed into rivers and lakes by **rain**.	**Toxic chemicals accumulate** in animals. The **further up** the **food chain**, the **greater the accumulation**. Top predators die or fail to breed.
Increasing temperature of the planet (global warming)	Humans release extra **greenhouse gases** (**CO_2** and **methane**) into the atmosphere and **less CO_2 is absorbed** by plants through photosynthesis. **Greenhouse gases absorb heat** and stop it escaping to space.	**Loss of habitat** as **sea levels rise**; animals and plants can **no longer survive** in certain areas; **reduced biodiversity**; **change in migration patterns** of animals.

Section 7: Maintaining biodiversity

- **Breeding programmes** for **endangered species.**
- **Protection** and **regeneration** of **rare habitats.**
- **Reintroduction of field margins** and **hedgerows** in agricultural areas where farmers grow only one type of crop
- **Reduction of deforestation**
- **Reduction of carbon dioxide** emissions by some **governments**
- **Recycling resources** rather than dumping waste in landfill.



Section 8: Measuring biodiversity

	Random Sampling	Systematic Sampling (transect)
Purpose	**Estimate the size of a population** in an area.	See how populations and communities **change over a distance**.
Method	1. Choose a suitable number of quadrats to use. 2. Assign **co-ordinates** to the area that you are sampling. **3. Randomly** choose co-ordinates. 4. Place the **quadrats** and count organisms present. 5. Calculate the mean number of organisms.	1. Use a **tape measure** to create a long line (**transect**). 2. Put **quadrats** at set distances. 3. Count organisms present. **4. Repeat** in a different place/ different time of year. 5. Draw graphs to see how communities change over a distance.