KNOWLEDGE

Biology Topic B1
Cell Structure and Transport

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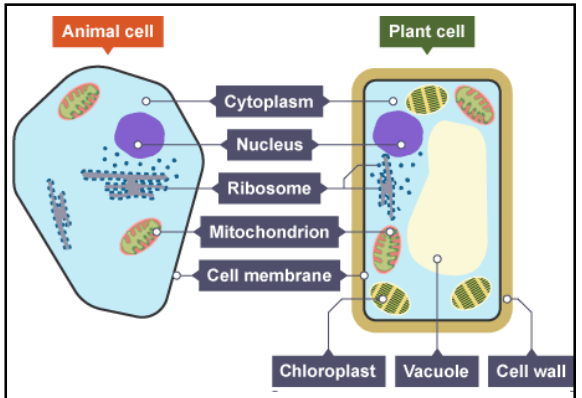
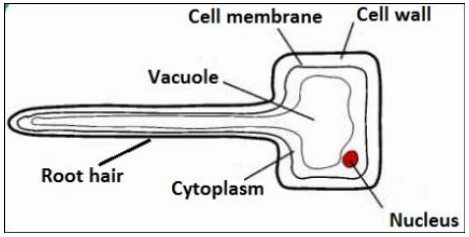
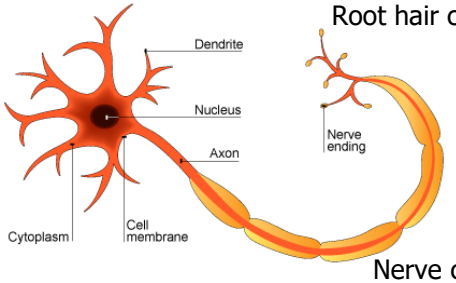
Section 1: Cell Structure		Eukaryotic		Prokaryotic
Cell Structure	**Function**	**Animal Cells**	**Plant Cells**	**Bacterial Cells**
Nucleus	Contains **genetic information** that **controls** the functions of the cell.	Y	Y	
Cell membrane	Controls what **enters** and **leaves** the cell.	Y	Y	Y
Cytoplasm	Where many **cell activities** and **chemical reactions** within the cell occur.	Y	Y	Y
Mitochondria	Provides **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
DNA loop	A loop of **DNA**, not enclosed within a nucleus.			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	Long extension to **increase surface area** for water and mineral uptake; **thin cell wall**.
Xylem cell	**Waterproofed** cell wall; cells are **hollow** to allow water to move through.
Phloem cell	Some cells have lots of **mitochondria for active transport**; some cells have very little cytoplasm for sugars to move through easily.

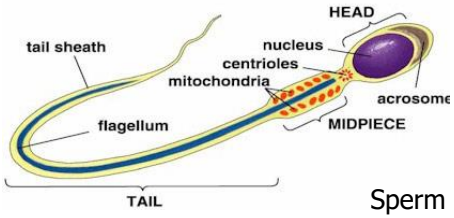




Root hair cell



Nerve cell



Sperm cell

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Biology Topic B1
Cell Structure and Transport

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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 detail**.
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**
Centimetre (cm)	0.01m	10^{-2}m
Millimetre (mm)	0.001m	10^{-3}m
Micrometre (μm)	0.000001m	10^{-6}m
Nanometre (nm)	0.000000001m	10^{-9}m

Section 7: Transport Across Membranes		
Cell Structure	**Definition**	**Uses**
Diffusion	**Spreading** out of the particles (gas/ solution) resulting in a **net movement** from an area of **higher concentration** to an area of **lower concentration.**	**Oxygen** and **carbon dioxide** in **gas exchange** (leaves and alveoli). **Urea** from **cells** into the **blood plasma** for excretion in the kidney.
Osmosis	The diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.	Movement of water into and out of cells.
Active Transport	The movement of substances from a more dilute solution to a more concentrated solution (against a concentration gradient). Requires energy from respiration.	**Absorption** of **mineral ions** (low concentration) from soil into **plant roots**. **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
Large surface area
Thin membrane to provide a **short diffusion path**
Ventilation (in animals for gas exchange – maintains a concentration gradient)
Efficient blood supply (in animals – maintains a concentration gradient)

KNOWLEDGE

Biology Topic B2 Cell Division

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Section 3: Microscopy

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Section 5: Mitosis and the Cell Cycle

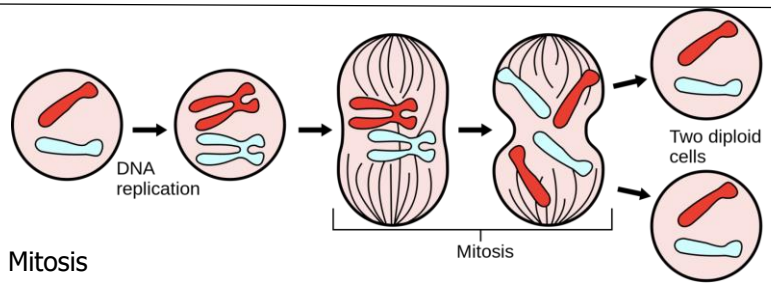
Number of **sub-cellular structures** (e.g. **ribosomes** and **mitochondria**) **increase**.

Number of **chromosomes double**.

One set of **chromosomes** is **pulled** to each end of the cell.

The **nucleus divides**.

Cytoplasm and **cell membranes divide** to form two **identical** cells



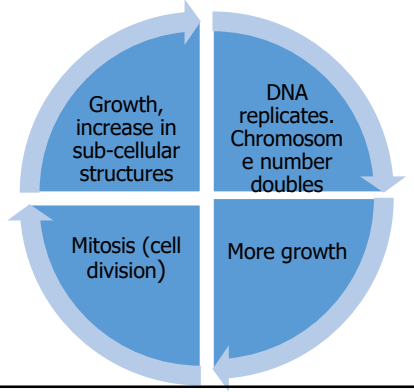
Mitosis

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	**Ethical** and **religious** objections. Can **transfer viruses** held within cells.



Cell cycle

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Biology Topic B3
Organisation and the digestive system

Section 1: Organisation

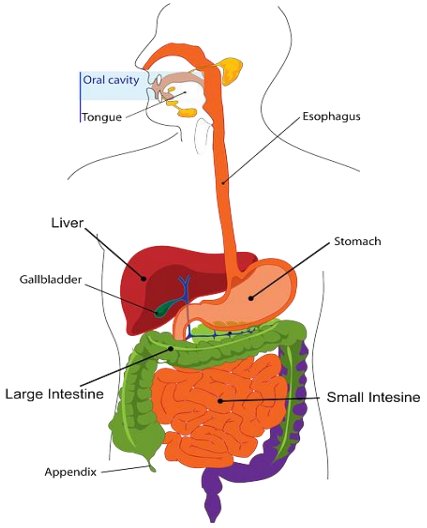
Tissue	A **group of cells** with a **similar structure and function** e.g. muscle tissue
Organ	A **group of tissues** performing a specific **function** e.g. heart, leaf
Organ System	A **group of organs** that perform a specific **function** e.g. digestive system.

Section 2: Human Digestive System

4 Order of movement of food through the digestive system:

Mouth
Oesophagus
Stomach
Small intestine
Large intestine
Rectum
Anus

Many
Ordinary
Students
Struggle
Learning and
Remembering
Answers



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 5b: Other Chemicals

Hydrochloric Acid	Acid with pH of 2 produced by the stomach. **Unravels proteins**.
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 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 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**.

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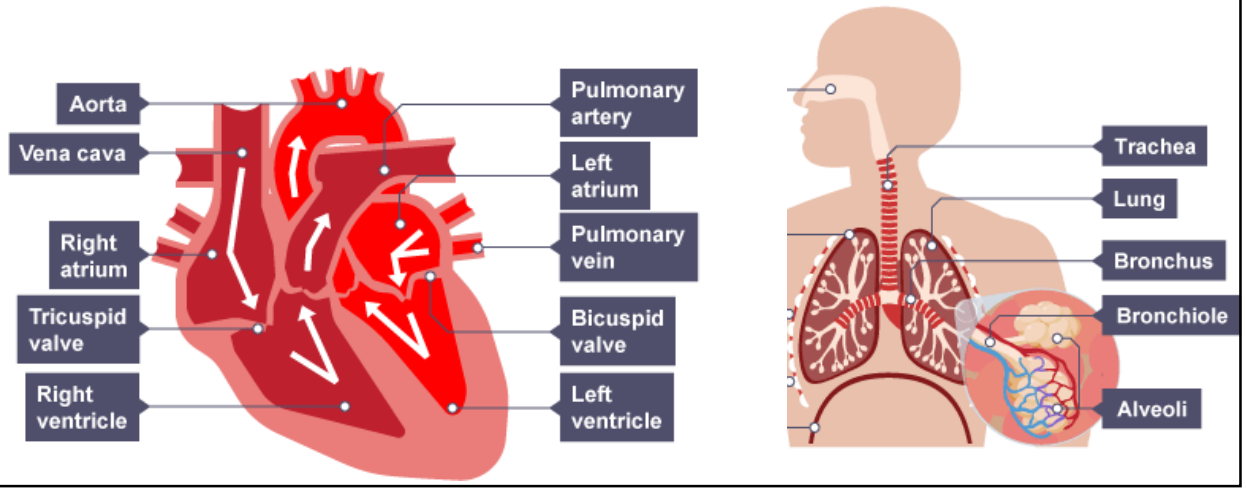
Biology Topic B4
Organising in Plants and Animals

Section 6: Heart and Lungs



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** / leaking.

Section 6b: Structures in the Lungs

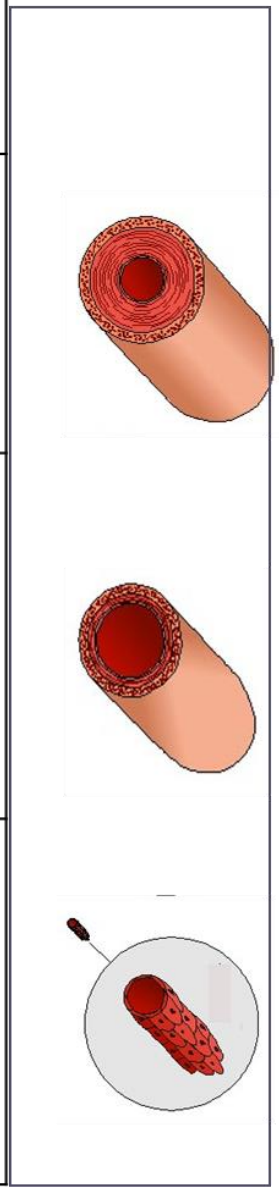
Alveoli	Small sacs where **gas exchange** occurs. **Surrounded by capillaries**. **Oxygen moves from the alveoli into the capillaries**, carbon dioxide moves from the capillaries into the alveoli
Trachea and Bronchi	Tubes through which gases move. **Lined with cartilage** so they don't collapse.

Section 8: 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 7: 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.



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Biology Topic B4
Organising in Plants and Animals

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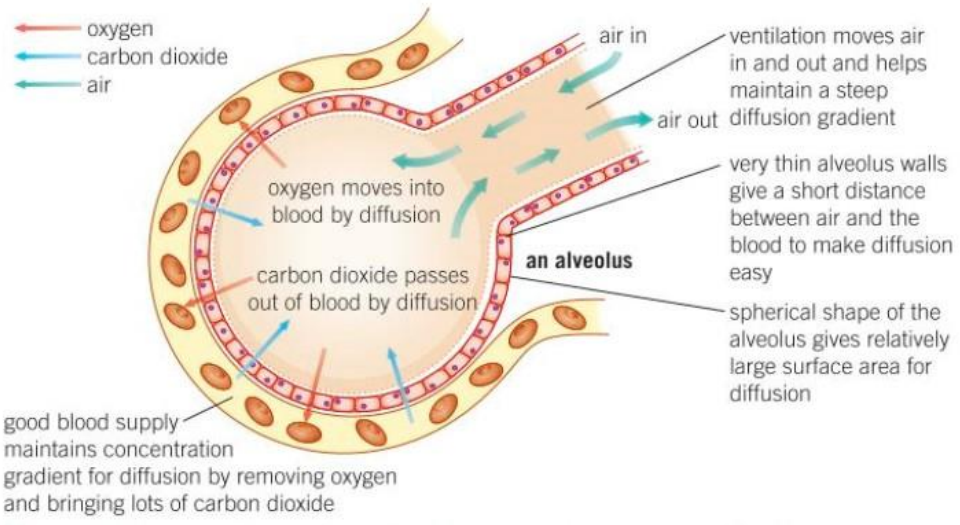
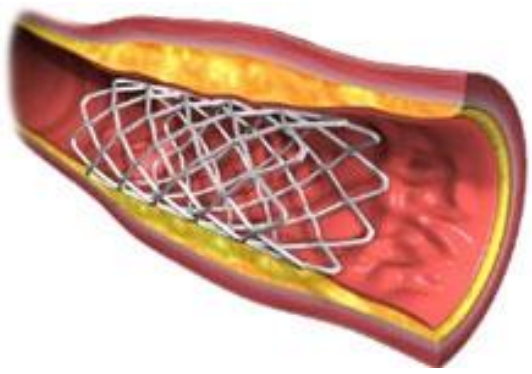
Section 9: How gases get exchanged in the alveoli.



Section 11: How a stent is positioned in an artery



Section 10: 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.
Statin	Drug that **reduces cholesterol**.	Reduces fat being deposited in arteries.	Side effects e.g. liver damage.
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. Battery has to be transported. Limited activity.
Mechanical heart valve	Mechanical replacement of faulty heart valve.	Can last a life-time.	Can damage red blood cells.
Biological heart valve	Biological replacement of faulty heart valve.	Don't damage red blood cells.	Valve hardens and may need replacing.

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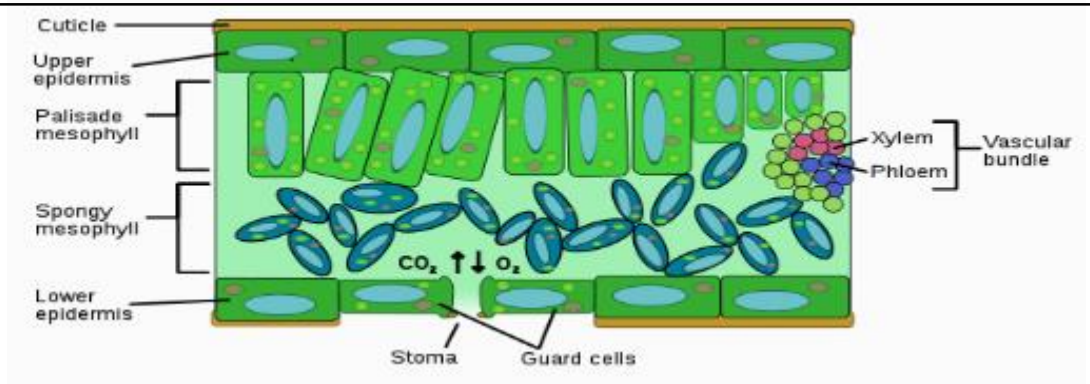
Biology Topic B4
Organising in Plants and Animals

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.

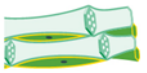
Section 10b: Factors Affecting Transpiration	
Temperature	Increasing temperature **increases the transpiration rate** as water evaporates quickly.
Humidity	Increasing humidity **decreases the rate of transpiration** as water evaporates slowly.
Wind speed	Increasing wind speed **increases the transpiration rate** as water evaporates quickly.
Light	Increasing light **increases the rate of transpiration** as **stomata open**.

Section 11: Leaf Structure and Plant Tissues



Epidermis	**Cover** the **surfaces** of the leaf; lets **light penetrate**.59
Xylem	**Carries water** and **minerals** from the roots around the plant.
Phloem	**Carries dissolved sugars** made through photosynthesis around the plant. 6
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**.
Stoma	**Opening** that allows **CO_2 and O_2** to **diffuse** in and out of the leaf.

Section 12: 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 Stoma Guard cells can **open** the stoma to allow **gas exchange** or **close** to **prevent water loss**.	

KNOWLEDGE

Biology Topic B5 + B6

Communicable Diseases

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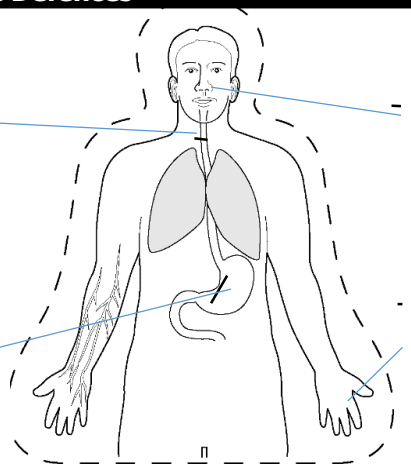
Section 1: Pathogens and Diseases

Disease	Pathogen	How it is spread	Effect	Prevention/ Control
Measles	**Virus**	**Droplets** from sneezes and coughs	Can be **fatal**	**Vaccination** of children
HIV	**Virus**	**Sexual contact, needle exchange**	**Damages** some **white blood cells**	**Antiretroviral drugs** when infected
Tobacco Mosaic Virus	**Virus**	**Direct contact**	Mottling of leaves, **reduces photosynthesis**	
Salmonella	**Bacteria**	**Infected food**	**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	**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**	**Fever,** can 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 **microorganism** 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**.
Painkillers	Painkillers **relieve symptoms** but **don't kill pathogens**.
Phagocytosis	Some white blood cells (phagocytes) **engulf pathogens**.

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Biology Topic B5 + B6

Communicable Diseases

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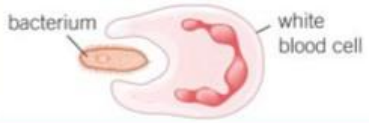
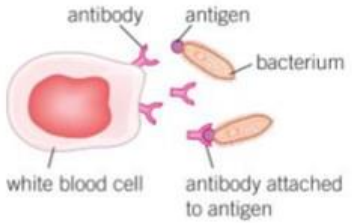
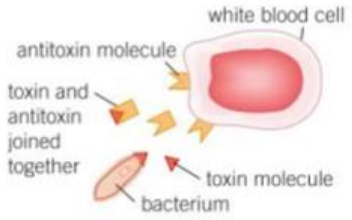
Section 4: Preventing Infections	
Hygiene	Hand washing, disinfectants on work surfaces, keeping raw meat away from food
Isolation of infected individuals	Infected individuals kept separate from healthy individuals
Destroying and controlling vectors	By killing or controlling vectors e.g. mosquitos, aphids, rodents etc the spread of disease is reduced
Vaccination	Body is injected with a small amount of inactive pathogen. If you are infected your body has developed immunity to the pathogen.

Section 6: Clinical Trials	
Trial Stage	Purpose
Preclinical – cells, animals	Test for **toxicity** and **efficacy** before testing humans
Healthy volunteers	**Very low doses** to test for **toxicity.**
Patients	Larger groups. Test for **toxicity**, **efficacy** and **dose. Placebos** may be used in a **double-blind trial**.
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.

Section 5: Ways in which white blood cells destroy pathogens	
Role of white blood cell	How it protects you against disease
Ingesting microorganisms 	Some white blood cells ingest (take in) pathogens, digesting and destroying them so they cannot make you ill.
Producing antibodies 	Some white blood cells produce special chemicals called antibodies. These target particular bacteria or viruses and destroy them. You need a unique antibody for each type of pathogen. When your white blood cells have produced antibodies once against a particular pathogen, they can be made very quickly if that pathogen gets into the body again. This stops you getting the disease twice.
Producing antitoxins 	Some white blood cells produce antitoxins. These counteract (cancel out) the toxins released by pathogens.

Section 7:	
Drugs from plants	Traditionally drugs were extracted from plants
Penicillin	Discovered from penicillium mould

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Biology Topic B5 + B6
Communicable Diseases (Separate Higher)

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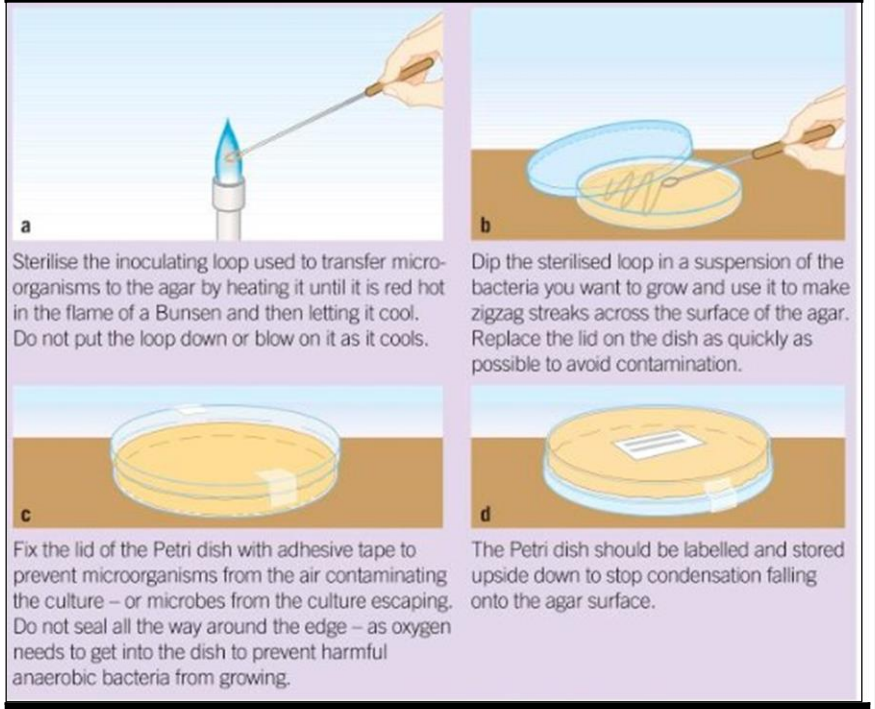
Section 1: Monoclonal antibodies

Monoclonal Antibodies	**Monoclonal antibodies** are identical copies of **one** type of **antibody** produced in a laboratory. **How to produce monoclonal antibodies:** 1. A mouse is **injected** with a pathogen 2. White blood cells called **lymphocytes** produce **antibodies** 3. Lymphocytes are removed from the mouse and **fused** with rapidly dividing mouse **tumour cells** 4. The new cells are called **hybridomas**. 5. The hybridomas divide rapidly and release lots of **antibodies** which are then collected

Uses of Monoclonal Antibodies

Used in treatment of diseases and monoclonal antibodies have been developed against the antigens on cancer cells.
Monoclonal antibodies are bound to radioactive substances (or toxic drugs and chemicals) that stop cells growing and dividing.
Monoclonal antibodies have side effects and are not as widely used in cancer treatment.
Monoclonal antibodies are used for diagnosis in pregnancy tests, in labs to measure levels of hormones and other chemicals in the blood to detect pathogens and to identify molecules in cells or tissues.

Section 2: Culturing microorganisms in the laboratory



Section 3: Preventing Bacterial Growth

Bacteria multiply by simple cell division if they have enough nutrients and a suitable temperature
You can investigate the effects of disinfectants and antibiotics on bacterial growth using agar plates and calculating the cross-sectional area of colonies grown or of clear areas of agar

KNOWLEDGE

Biology Topic B5 + B6
Communicable Diseases (Separate Higher)

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Section 4: More about Plant Diseases

Plants can be infected by a range of viral, bacterial and fungal pathogens as well as insect pests.

We cant detect a plant is diseased by looking for unusual growths, spots or discoloured leaves and malformed leaves and stems.

If a plant disease is suspected then it can be identified by:
Gardening manuals
Gardening websites
Test kits containing monoclonal antibodies
Taking infected plants to a laboratory to identify the pathogen

Monoclonal antibodies are used for diagnosis in pregnancy tests, in labs to measure levels of hormones and other chemicals in the blood to detect pathogens and to identify molecules in cells or tissues.

Section 6: Deficiency of Mineral Ions

Nitrate ions	Needed by plants for protein synthesis and growth. Lack of nitrate ions results in stunted growth of plants.
Magnesium ions	Needed by plants to produce chlorophyll. Lack of magnesium ions results in chlorosis (yellowing of leaves due to lack of chlorophyll)

Section 7: Plant defence responses

Type of plant defence used (mechanical, physical or chemical)	What is the plant being defended against?	Describe the defence being used
Mechanical	Herbivores eating it	Thorns or hairs
Chemical	Pathogens/bacteria Herbivores/animals	The chemical released is antibacterial or poisonous
Physical	Herbivores and pathogen entry	Dead bark coating which falls off
Physical	Insects such as aphids	Waxy cuticle/cellulose cell walls are hard to penetrate

The presence of pests

Stunted growth

Chlorosis

Thorns

KNOWLEDGE

Biology Topic B7
Non-communicable diseases

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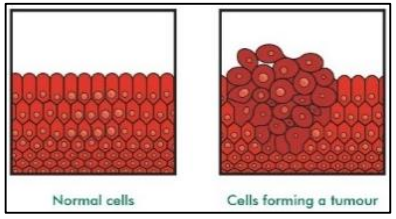
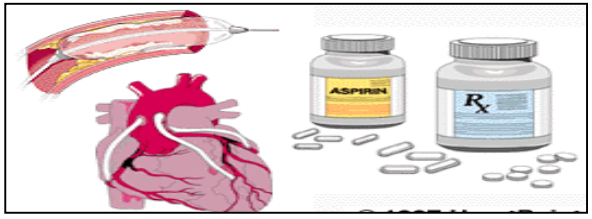
Section 1: Key Definitions	
Non-communicable disease	Long term or slow progressing disease not caused by infectious pathogens.
Risk factor	Characteristic or exposure that increases the likelihood if developing a disease.
Correlation	When one thing changes when the other one does. e.g more tomatoes eaten, less heart disease.
Casual Link/Cause:	When one factor changes, the other one changes as well an there is evidence to show that the change of one factor actually causes the other to change
Cancer	Non-communicable disease caused by uncontrolled cell division.
Causes of cancer	Ionizing radiation e.g Gamma Rays, Viral infection, Chemicals in food or cigarette, Inherited mutations in the gene.
Casual Link/Cause:	When one factor changes, the other one changes as well an there is evidence to show that the change of one factor actually causes the other to change
Causes of cancer	Ionizing radiation e.g Gamma Rays, Viral infection, Chemicals in food or cigarette, Inherited mutations in the gene.
Benign tumours	Form in one place and do not spread to other tissues
Malignant tumours	May spread to different tissues and form secondary tumours
Lifestyle risk factors for cancer	Smoking, obesity, common viruses and UV light. Genetic factors are also risks for some cancers.
Carcinogens	Agents that cause cancer or increase the risk of causing cancer
Ionizing radiation	Radiation that penetrates the cells and damages chromosomes, causing mutations in the DNA.
Treating cancer	Radiotherapy – cancer cells are destroyed by targeted doses of radiation Chemotherapy – chemicals are used to stop cancer cells dividing or causing the cancer cells to 'self destruct'.
Smoking	Can cause heart disease and lung cancer Fetus exposed to smoke has restricted oxygen, which can lead to premature birth, low birthweight, and stillbirth Tobacco smoke contains carbon monoxide (a poisonous gas) and nicotine (addictive chemical)
Diet	Affects risk of developing cardiovascular diseases through cholesterol levels and through obesity. Obesity is a risk factor for type 2 diabetes Lack of exercise is a risk factor for type 2 diabetes
Alcohol	Can damage the liver and cause cirrhosis and liver cancer Can cause brain damage and death Alcohol taken by pregnant women can affect the development of the unborn baby





KNOWLEDGE

Biology Topic B8
Photosynthesis

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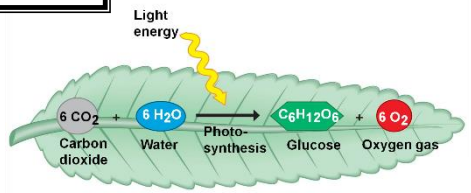
Section 1: Photosynthesis Equation

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

$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$



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.
Diffusion	**The spreading out of particles by random motion from where they are in high concentration to a low concentration. Occurs in gases and liquids.**

Section 3: Uses of Glucose

Used in **respiration** to release **energy**.

Converted into **starch** for **storage**.

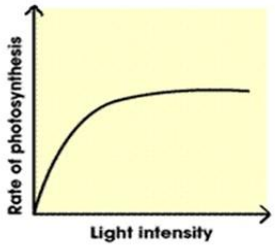
Converted into **fats** and **oils** for **storage**.

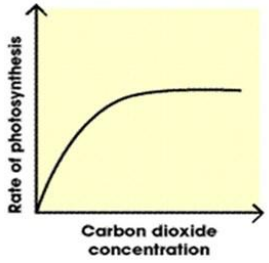
Produce **cellulose** to **strengthen** the **cell wall**.

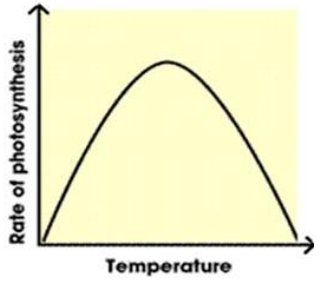
Produce **amino acids** to **make proteins** (also needs nitrate ions from the soil)

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
Initially light is the limiting factor. When the graph plateaus something else (e.g. CO_2 concentration, temperature) is limiting the rate.

CO_2 concentration
Initially CO_2 concentration is the limiting factor. When the graph plateaus something else (e.g. light intensity, temperature) is limiting the rate.

Temperature
As temperature increases, the rate of photosynthesis increases. Above the optimum there is a decrease in photosynthesis. Enzymes needed for photosynthesis become denatured.

KNOWLEDGE

Biology Topic B9
Respiration

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Section 5: Respiration	
Energy	Energy in organisms is needed for **chemical reactions to build larger molecules**, **movement** and **keeping warm**.
Aerobic Respiration	Aerobic respiration **provides energy**. It requires **oxygen**. It is an **exothermic** reaction (produces heat). In **mitochondria**. **Glucose + oxygen → carbon dioxide + water (+energy)** **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+energy)**
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**. Lactic acid must be **taken to the liver by the blood so** that it can be **oxidised back to glucose**.
Oxygen Debt	The **amount of extra oxygen** the body needs **after exercise** to **react with the lactic acid** and remove it.
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: Response to Exercise	
Increase in breathing rate	Increases rate at which **oxygen** is taken into the lungs.
Increase in heart rate	Oxygenated blood is pumped around the body at a faster rate. Carbon dioxide is removed at a faster rate.
Increase in breath volume	A **greater volume** of oxygen is taken in with each breath.

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

Section 6a: Metabolism in the liver (Higher)	
Liver	Detoxifies poisonous substances such as ethanol; passes broken down products in the blood so they can be excreted in the urine via the kidneys; converts lactic acid back into glucose.