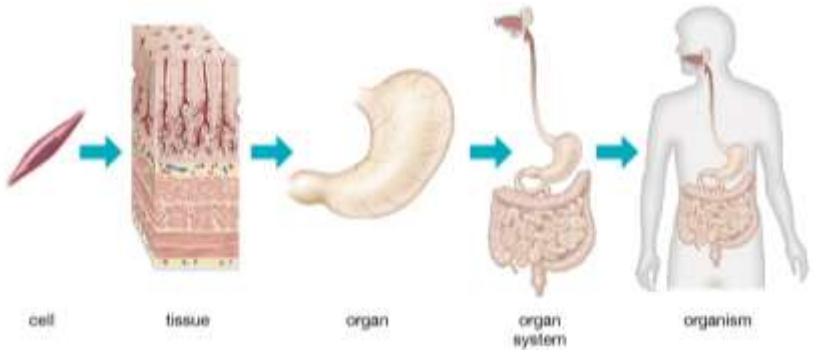
# Unit 1 Biology Knowledge Organiser

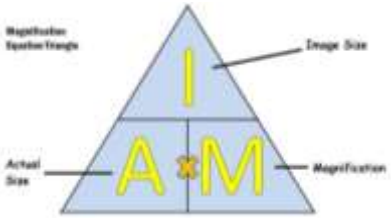
**SPECIALISED CELL:**
Cell with an altered structure for a specific function in a process called cellular differentiation.

**TISSUE:**
A group of specialised cells carrying out a specific function.

**ORGAN:**
A group of several tissues carrying out a specific function.




| Unit | Symbol | No of Metres | Standard Form |
|---|---|---|---|
| Metre | m | 1 | $10^{0}$ |
| Millimetre | mm | 0.001 | $10^{-3}$ |
| Micrometre | µm | 0.000001 | $10^{-6}$ |
| Nanometre | pm | 0.000000001 | $10^{-9}$ |
| Picometre | nm | 0.000000000001 | $10^{-12}$ |



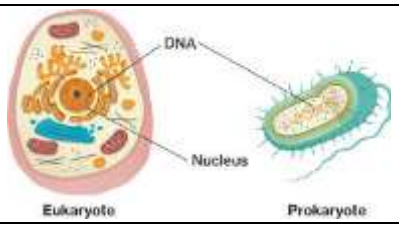

An image of a red blood cell is 33mm and its actual size is 8µm. Calculate the magnification.
- 33 x 1,000 = 33,000 µm;
- 33,000 ÷ 8;
- = x 4,100 (2sf);

A muscle cell has been magnified 4,000 times and looks 3.9cm. Calculate actual size in µm.
- 3.9 x 10,000 = 39,000;
- 39,000 ÷ 5,000;
- = 9.8 µm (2sf);

The width of a cell membrane is 7nm & is magnified 30,000,000x. Calculate the image size in cm.
- 7 x 30,000,000 = 210,000,000;
- 210,000,000 ÷ 10,000,000;
- = 21 cm (2sf);

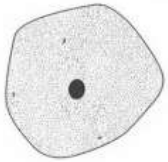
**EUKARYOTIC:**
Contains membrane-bound organelles such as a nucleus.

PROKARYOTIC:
Contains no membrane-bound organelles such as a nucleus.




MAGNIFICATION:
Number of times larger the image appears compared to the actual size.

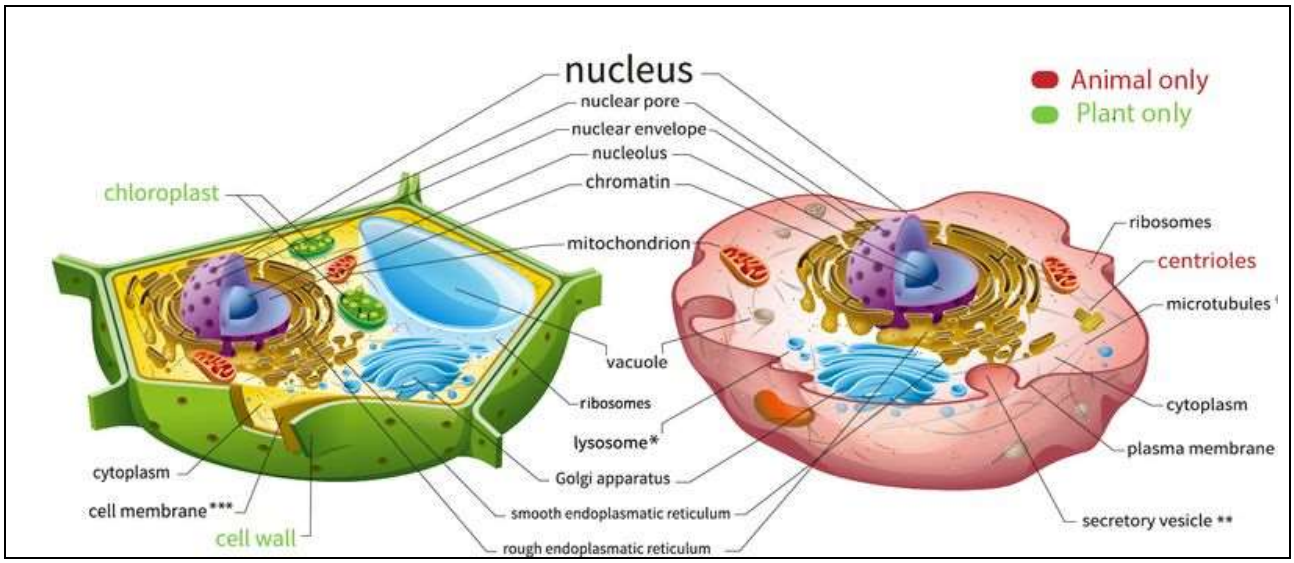
RESOLUTION:
The ability to distinguish between objects that are close together.

| | | | |
|---|---|---|---|
| Light Microscope  |  | **Advantages**<br>Cheap to purchase & operate.<br>Small & portable.<br>Quick & easy to prepare slides.<br>Unaffected by magnetic fields.<br>Stains are non-toxic.<br>Living specimens can be used.<br>Distortion of specimens rare.<br>Natural colour can be observed. | **Disadvantages**<br>Depth of field is restricted.<br>Has a low resolution.<br>Has a low magnification<br>Can't see small organelles. |
| Electron Microscope  |  | **Advantages**<br>Has a high magnification.<br>Great depth of view possible.<br>Has a high resolution.<br>Can see small organelles. | **Disadvantages**<br>Expensive to purchase & operate.<br>Very large, taking up a room.<br>Affected by magnetic fields.<br>Lengthy preparation of slides.<br>Specialist training required.<br>Specimens can be distorted.<br>Specimens must be dead.<br>Images are black & white. |

# Unit 1 Biology Knowledge Organiser

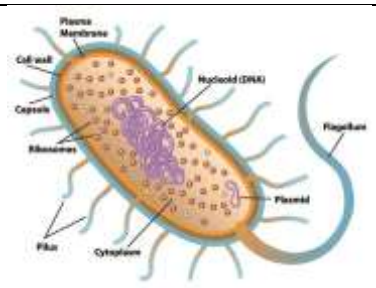
| Organelle | Function ANIMAL |
|---|---|
| Centrioles | Form spindle fibres during cell division. |
| Lysosomes | Break down waste material including old organelles. Digests pathogens. |

| Organelle | Function PLANT |
|---|---|
| Amyloplast | Responsible for the synthesis and storage of starch granules. |
| Cell wall | Protects and supports each cell and the whole plant. |
| Chloroplast | Site of photosynthesis. Light energy is trapped by the chlorophyll and used to produce carbohydrate molecules from water and carbon dioxide. |
| Pits | Allow water to enter and leave xylem vessels. |
| Plasmodesmata | Enable transport and communication between individual plant cells. |
| Tonoplast | Selectively permeable to allow small molecules to pass through. |
| Vacuole | Maintains turgor pressure to ensure a rigid framework in the cell. |



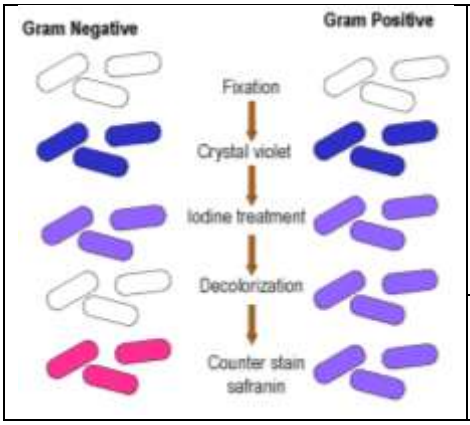

| Organelle | Function BOTH |
|---|---|
| Cytoplasm | Maintains cell shape and stores chemicals needed by the cell for metabolic reactions. |
| Golgi apparatus | Newly made proteins are received here from the rough ER. The Golgi apparatus modifies them and then packages the proteins into vesicles to be transported to where they are needed. It also transports lipids in cells & forms lysosomes. |
| Mitochondria | Site of the final stages of aerobic respiration. |
| Nucleolus | Makes RNA and ribosomes. |
| Nucleus | Controls / regulates cellular activity and houses genetic material called chromatin, DNA and proteins, which comes from the instructions for making proteins. |
| Plasma membrane | Selectively permeable and regulates the transport of materials into and out of the cell. Separates cell contents from the outside environment. |
| Ribosomes | Protein synthesis. |
| Rough endoplasmic reticulum | Protein synthesis takes place on the ribosomes. It forms vesicles so that newly synthesised proteins are transported to the Golgi apparatus.<br>RER = Rough Endoplasmic Reticulum |
| Smooth endoplasmic reticulum | Responsible for synthesis, metabolism and transport of lipids and carbohydrates. Makes steroid hormones.<br>SER = Smooth Endoplasmic Reticulum |
| Vesicles | Used to transport materials inside the cell or transport proteins that are to be secreted from the cell to the cell surface membrane. |

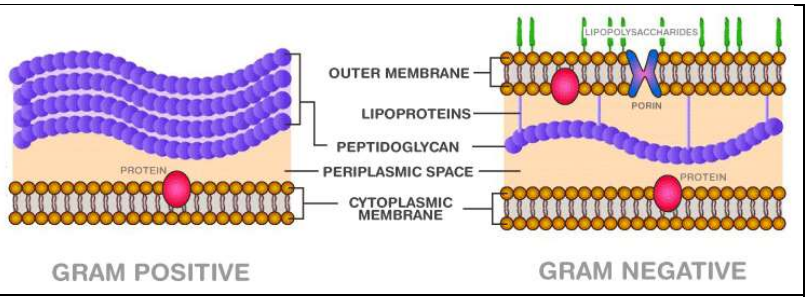
# Unit 1 Biology Knowledge Organiser




| **Eukaryotes** | **Prokaryotes** |
|---|---|
| DNA is linear | DNA is circular |
| DNA is attached to proteins | DNA is free |
| No plasmids | Can have plasmids in cytoplasm |
| Larger 80S ribosomes | Smaller 70S ribosomes |
| Membrane-bound organelles | No membrane-bound organelles |
| Cellulose cell wall in plants | Peptidoglycan cell wall |
| No capsule | May be covered by capsule |

| **Organelle** | **Function PROKARYOTES** |
|---|---|
| Capsule | Protects the cell and prevents desiccation as it is hydrophilic. |
| Cell wall | Protects and supports each cell. |
| Nucleoid | The region where genetic information can be found and controls cellular activity. |
| Pilus | Allow prokaryotic cell to attach to specific surfaces or other cells. |
| Plasmid | Carry beneficial genes that can be transferred to other bacteria. |
| Capsule | Protects the cell and prevents desiccation as it is hydrophilic. |



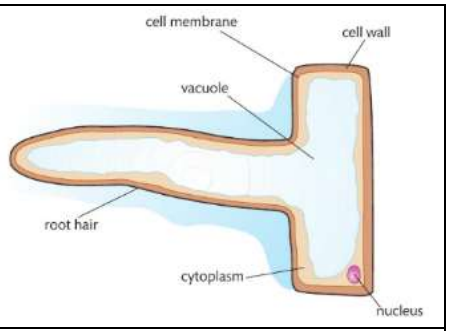




Gram-positive bacteria have a thick cell wall with lots of peptidoglycan. They only have an outer membrane so have a low lipid content surrounding the cell.

| | | |
|---|---|---|
| Penicillin is an antibiotic that kills some types of bacteria. It prevents the cross-linking of protein chains in peptidoglycan by inhibiting an enzyme. This means cell wall synthesis is disrupted & new cells grow abnormally. | **Gram Positive**<br>Penicillin enters the cell wall as there is no outer cell membrane to cross & disrupts cell wall synthesis. | **Gram Negative**<br>Penicillin cannot cross the outer cell membrane so cannot disrupt cell wall synthesis. |

Explain the structure & function of **root hair cells**.
Membrane semi-permeable & channels to transport water & ions;
Cell wall is thin for rapid diffusion of water;
Chloroplasts absent so more room for absorbed water;
Mitochondria gives ATP energy for active transport;
Vacuole provides low water potential to absorb water;

Explain how a large SA:V helps **root hair cells**.
More membrane;
More channels & carriers;
Increasing the efficiency of absorption;
Increases concentration of solutes;
Lowers water potential inside vacuole;
Increasing {diffusion / osmosis} of {minerals / water} from soil;
Increasing mineral availability for synthesis of amino acids;
Improving plant growth & health;




Explain why there are no chloroplasts in **root hair cells**.
No light in the soil;
Photosynthesis cannot take place;
Genes for chloroplasts switched off;
More space to absorb water;

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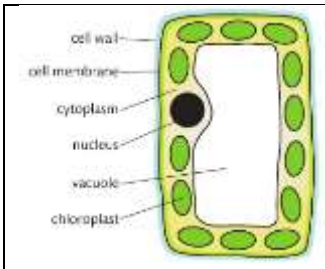
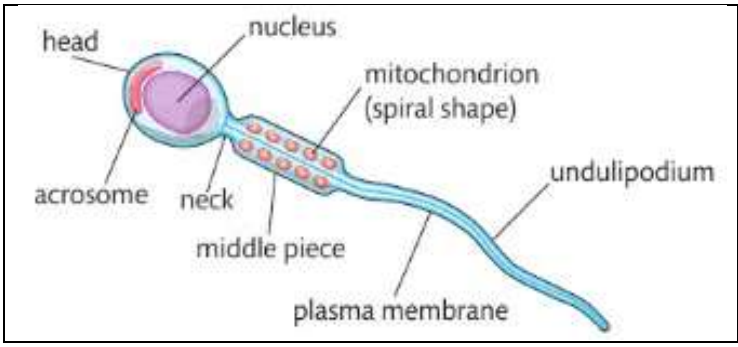
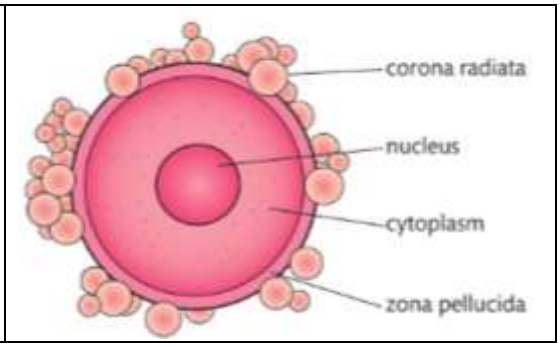
|  | **Vacuole**<br>Large vacuole so chloroplasts are pushed to the outer edges of the cell so they receive more light Gives a short diffusion distance for carbon dioxide. Stores water & dissolved substances from photosynthesis. | **Cytoskeleton**<br>Chloroplasts can be moved by the cytoskeleton upwards to absorb more sunlight on dull days and downwards to avoid damage if sunlight is too intense so they absorb the optimum level of light. |
| **Plasma Membrane**<br>Allows diffusion of water & carbon dioxide into the cell. Allows diffusion of oxygen & transport of glucose out of cell. | **Shape**<br>Elongated & cylindrical cell so many closely packed together to increase the surface area for absorption of light. There are air spaces between them for diffusion of gases. | **Mitochondria**<br>Mitochondria have a fluid filled space with folded membranes with electron carriers & enzymes to make ATP to support photosynthesis. |
| **Chloroplasts**<br>Contain chlorophyll to trap light that is needed for photosynthesis. | **Cellulose Cell Wall**<br>Clear cell walls to allow sunlight to penetrate. Sunlight needed for photosynthesis. | Explain how the structure of the **palisade mesophyll cell** is specialised to support the process of photosynthesis. |

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| Explain how the mid-piece of a human **sperm cell** is specialised to support the function of its tail.<br>The tail gives motility;<br>Which uses large quantities of ATP energy;<br>Provided by large numbers of mitochondria in the mid-piece; | Explain why an **egg cell** contains large amounts of mitochondria.<br>Aerobic respiration making lots of ATP energy for;<br>Cell division & growth;<br>Chemical reactions;<br>DNA replication & protein synthesis; |
| Explain significance of **sperm cell** nucleus in determining the characteristics of the offspring.<br>Contains genes / DNA / chromosomes;<br>Which contribute half the genes to the offspring / 23 chromosomes; | Explain what happens to the zona pellucida after the **egg cell** is fertilised.<br>Hardens / thickens / becomes impermeable;<br>Therefore prevents more than one sperm cell entering the egg cell / polyspermy; |

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|---|---|---|
| **Arteries** take blood away from the heart at high pressure. They have a layer of endothelial cells to reduce friction & allow the smooth flow of blood. They have a thick, elastic wall that stretches as the heart beats and contracts to allow a smooth flow. | **Capillaries** are between arteries & veins. Blood flows slowly at high pressure. There are many giving a large surface area. They consist of a single layer of endothelial cells for easy exchange of nutrients and oxygen into the tissues and the removal of waste products. | **Veins** take blood towards the heart. They have a thin flexible wall with a layer of endothelial cells as blood is at low pressure. Valves stop the blood from flowing the wrong way. Damaged endothelial cells release substances that cause blood vessels to constrict. |

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| **Erythrocyte** | Lots of haemoglobin to bind to $O_2$. | Each haemoglobin binds to 4x $O_2$. |
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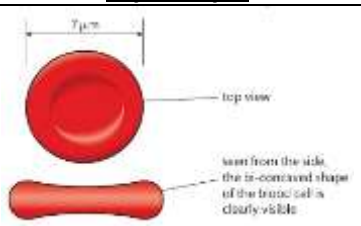
|  | No nucleus or organelles. | Increased space for haemoglobin. |
| | Biconcave, flexible discs. | Can squeeze through capillaries. |
| | High number of red blood cells. | Transports $CO_2$ in cytoplasm. |
| | Small biconcave shape. | Increases surface area : volume. |
| | Increased rate of diffusion. | Efficient transport of oxygen. |
| | Haemoglobin close to membrane | Short diffusion distance for $O_2$. |

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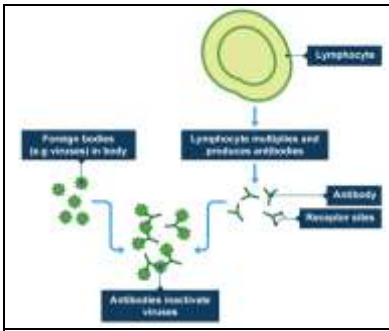
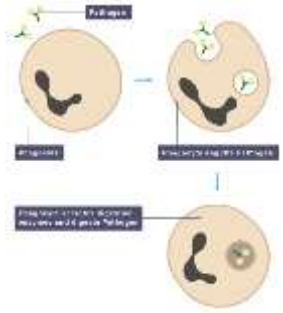
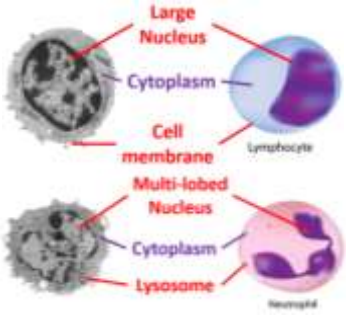
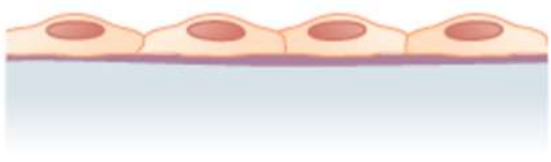
|  | **Specific Immune Response**<br>T-cell recognises an antigen on the surface of a pathogen.<br>T-cell signals to a B-cell with a complementary antibody.<br>B-cells divide – some stay as memory cells, some make antibodies.<br>T-cells destroy infected cells & cancer cells in the body. | White blood cells have this in common:<br>Involved in defence against pathogens;<br>Available / transported in blood plasma;<br>Migrate into tissue as required;<br>Present in lymphatic system; |
|  | **Non-Specific Immune Response**<br>Neutrophil recognises antigen on surface of pathogen.<br>Neutrophil engulfs pathogen in a phagosome.<br>Phagosome fuses with a lysosome containing enzymes.<br>Enzymes digest the pathogen inside the neutrophil. |  |

| **Squamous Epithelial Tissue** | **Columnar Epithelial Tissue** |
|---|---|
| A single layer of flattened cells that form a thin, smooth, flat layer. | Rectangular column-shaped cells that can have cilia on the exposed cell surface. |
| Found in alveoli & capillaries. | Found in trachea, bronchi & bronchioles. |
|  |  |
| One cell thick<br>Short diffusion pathway<br>Cells are thin & flat<br>Large surface area for diffusion of gases<br>Good blood supply<br>Maintains concentration gradient | Secretes mucus & enzymes<br>Protects from pathogens<br>Contains goblet cells that make mucus<br>To moisten & lubricate<br>Ciliated cells, rhythmic sweeping of cilia<br>Removes pathogens |

| COPD = Chronic Obstructive Pulmonary Disease = any lung condition causing breathing difficulties. | |
|---|---|
| **Bronchitis** is an infection of the airways causing irritation. It is caused by a virus that is spread in droplets that are coughed out. Most people with this condition are smokers who will cough regularly and have difficulty breathing. It can be treated with an inhaler or medicine. | **Emphysema** is an enlarging of the air sacs that is caused by inflammation of the alveoli. The main symptom is a shortness of breath. There is damage to the alveoli walls that reduces the surface area & reduces gas exchange. The alveoli are also not as stretchy as normal. |

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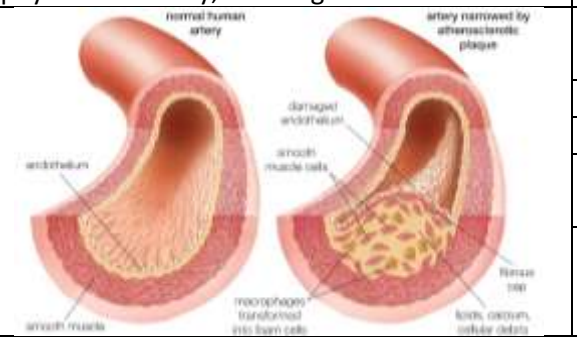
|---|---|
| ATHEROSCLEROSIS: A disease in which plaque builds up inside your arteries. | RISK FACTOR: A characteristic, condition, or behaviour increasing the chance of getting a disease. |
| **Life-style factors**<br>Alcohol, high saturated fat diet, obesity, physical inactivity, smoking & stress. | **Other factors**<br>Advancing age, diabetes, ethnicity, family history, high blood pressure, male gender. |
|  | **Cholesterol** combines with lipids, calcium & cellular debris to form a plaque;<br>**High blood pressure** damages endothelium of arteries;<br>**Saturated fats** contain high levels of LDL cholesterol;<br>Nicotine & carbon monoxide from **smoking** damages endothelium of arteries;<br>Fatty deposits build up to form a plaque;<br>Macrophage cells in artery wall multiply in response;<br>The artery lumen becomes narrower; |
| Calculate % decrease in lumen from 3.40mm to 2.72mm. | |
| Difference: 3.40 – 2.72 = 0.68 | Division: 0.68 ÷ 3.40 = 0.2 | Percentage: 0.2 x 100 = 20% |

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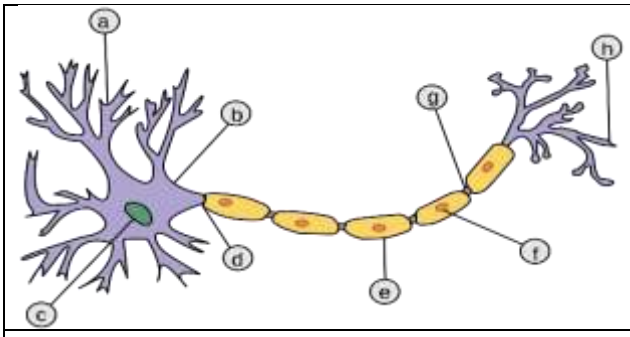
|  | **Myelinated Motor Neurone**<br>A Dendrites, B Cell body (soma), C Nucleus, D Axon, E Myelin sheath, F Swann cell nucleus, G Node of Ranvier, H Axon Terminal |
| | Describe the structure of the myelin sheath.<br>Made from flattened Schwann cells;<br>Have nucleus with little cytoplasm;<br>Wrapped around / insulates axon;<br>Has many layers with a high fat content; |
| Explain the role of myelin in the conduction of nerve impulses in myelinated axons.<br>Myelin insulates & makes nerve impulses faster;<br>Action potential generated only at nodes;<br>Impulse can jump by salutatory conduction;<br>Prevents loss of ions;<br>Helps to maintain electrochemical gradient; | Explain why the speed of conduction is slower in non-myelinated neurones.<br>Lack of insulation so no salutatory conduction;<br>Loss / leakage of ions;<br>Loss of electrochemical gradient;<br>Decrease in number of action potentials;<br>Impulse faster than membrane depolarisation; |

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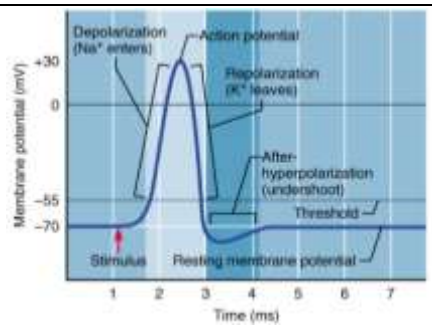
|  | **Resting Potential**<br>Resting potential at -70mV.<br>Sodium-potassium pump operating ($3Na^+$ out for every $2K^+$ in).<br>Concentration gradient of sodium ions greater outside axon.<br>Inside of axon more negative with respect to the outside.<br>Polarised. |
| **Depolarisation**<br>Sodium ion channels open.<br>Permeability to sodium ions increases.<br>Sodium ions enter axon by diffusion.<br>Increased membrane potential (-55mV).<br>Threshold reached.<br>Voltage-gated sodium ion channels open.<br>Sodium ion channels close (+30mV). | **Repolarisation**<br>Potassium ion channels close more slowly.<br>Permeability to potassium ions increases.<br>Potassium ions leave axon by diffusion.<br>Hyperpolarisation at -90mV.<br>Resting potential re-established.<br>By active transport of ions in sodium-potassium ion pump. |

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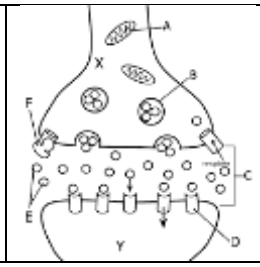
|---|---|---|
| A Mitochondria<br>B Synaptic vesicle<br>C Synaptic cleft<br>D Receptor<br>E Neurotransmitter<br>X Presynaptic neuron<br>Y Postsynaptic neuron |  | Describe the function of a synapse.<br>Transmit impulse;<br>Between neurones / across nerve endings / to other nerves / to receptors;<br>In one direction: presynaptic to post synaptic neurone;<br>Regenerates impulse;<br>Filters out low level stimuli; |

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|---|---|
| Explain how an impulse can only travel in one direction across a synapse.<br>Neurotransmitter released by presynaptic neurone;<br>Diffusion across synaptic cleft;<br>Receptors only on postsynaptic neurone; | Explain what happens to acetylcholine (ACh) after its function is complete.<br>Broken down by enzyme acetylcholinesterase;<br>Absorbed by presynaptic neurone;<br>Reused to resynthesize acetylcholine; |

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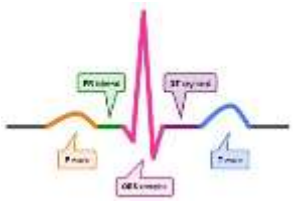
|  | ECG = ElectroCardioGram<br>Detects electrical signals in the heart.<br>P wave = atria depolarises.<br>PR interval = blood flows out of atria.<br>QRS complex = ventricles depolarise.<br>ST interval = blood flows out of ventricles.<br>T wave = repolarisation of ventricles. | What if ACh isn't broken down?<br>ACh remains in cleft;<br>Constant depolarisation of postsynaptic membrane;<br>Constant action potentials / impulses to muscles;<br>Muscles permanently contracted; |

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|---|---|
| Neurotransmitter complementary shape to receptors; So binds with receptors; | |
| Excitatory neurotransmitters **cause** depolarisation:<br>{Sodium / Na+} channels / gates open;<br>Influx of sodium ions into cell;<br>Postsynaptic membrane potential more positive; | Inhibitory neurotransmitters **inhibit** depolarisation:<br>{Chlorine / Cl-} channels / gates open;<br>Influx of chlorine ions into cell;<br>Postsynaptic membrane potential more negative; |

| | |
|---|---|
| **Agonists** like nicotine have a similar shape to acetylcholine and will bind to the acetylcholine receptors to **cause** an action potential. | **Antagonists** like curare have a similar shape to acetylcholine and will bind to the acetylcholine receptors to **inhibit** an action potential. |

| PARKINSONS | **Symptoms** | **Causes** | **Treatment** |
|---|---|---|---|
| | Poor balance<br>Slow movement<br>Speech problems<br>Tremors when moving | Do not produce enough Dopamine, which is a neurotransmitter that helps with smooth & normal movement.<br>Genetic environmental risk factors. | No cure / healthy lifestyle.<br>Medicine to ease symptoms & slow down the progression of the disease. |

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| Explain how L-dopa affects synaptic transmission in a person with Parkinson's disease.<br>L-dopa is a precursor of dopamine;<br>L-dopa increases the amount of dopamine {stored / released} by the presynaptic neuron;<br>So normal levels of dopamine stimulate the postsynaptic neuron; | What things make a good clinical trial?<br>Double blind trial / use of placebos;<br>Controlling sex / gender / ethnicity;<br>Same condition at start;<br>Long period of time;<br>Quantitative data;<br>Large group; |
| Explain how imbalances in serotonin in the brain may lead to depression.<br>Lower levels of serotonin;<br>Less receptors in brain are stimulated / less neurotransmission across synapses;<br>Fewer impulses in the brain; | Explain how imbalances in serotonin in the brain may lead to happiness.<br>Higher levels of serotonin;<br>More receptors in brain are stimulated / more neurotransmission across synapses;<br>More impulses in the brain; |

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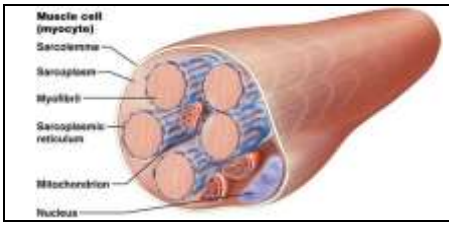


Mitochondria = Aerobic respiration making (ATP).
Myofibril = Protein fibres that enable contraction.
Nucleus = Controls & regulates muscle cell activity.
Sarcolemma = Cell surface membrane of muscle cells.
Sarcoplasm = Cytoplasm in muscle cells.
Sarcoplasmic reticulum = endoplasmic reticulum of muscle cells.

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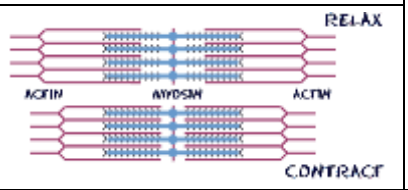
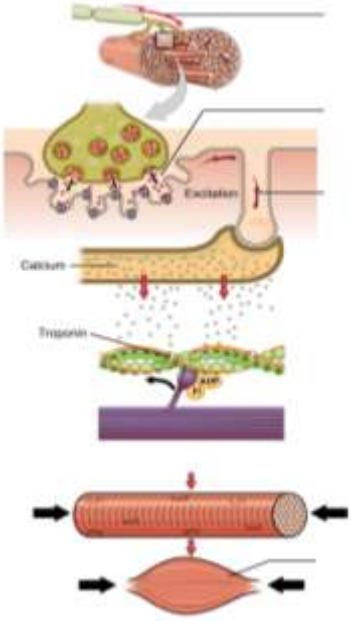
|---|---|
| Explain the function of the **sarcoplasmic reticulum** in skeletal muscle tissue.<br>Controls uptake & release of calcium ions $Ca^{2+}$;<br>Which controls ATPase activity;<br>And therefore the contraction of the muscle; | Explain the function of stores of **glycogen** in skeletal muscle tissue.<br>Glycogen is a store of glucose;<br>Which is used in respiration to produces ATP;<br>Which is used for muscle contraction & movement; |

| **Aerobic Respiration** | **Anaerobic Respiration** |
|---|---|
| Glucose + Oxygen → Carbon Dioxide + Water<br>$C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O$ | Glucose → Lactic Acid<br>$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3$ |
| **Slow twitch fibre** | **Fast twitch fibre** |
| Contain more myoglobin which stores oxygen;<br>More mitochondria so more ATP made;<br>More capillaries to deliver oxygen;<br>More aerobic respiration takes place;<br>Less lactic acid made;<br>Less muscle fatigue / can run for longer; | Contain less myoglobin which stores oxygen;<br>Less mitochondria so less ATP made;<br>Less capillaries to deliver oxygen;<br>More anaerobic respiration takes place;<br>More lactic acid made;<br>More muscle fatigue / can't run as long; |

| **Types of Muscle Tissue** |
|---|
| Cardiac = contracts involuntarily & found in the heart. |
| Skeletal = contracts voluntarily & found all over the body. |
| Smooth = contracts voluntarily & found lining internal organs. |
| Myofibrils are made of myofilaments that consist of 2 different proteins.<br>Thick **myosin** is in the middle.<br>Thin **actin** is around this. |
|  |




| **Sliding Filament Theory** |
|---|
| An action potential arrives at a neuromuscular junction. |
| Acetylcholine is released by neurone & binds to receptors on sarcolemma. |
| An action potential travels along a T-tubule to the sarcoplasmic reticulum. |
| The sarcoplasmic reticulum releases calcium ions into sarcoplasm. |
| Calcium ions bind to troponin to reveal actin binding site on myosin. |
| Myosin heads bind to actin filaments forming crossbridges. |
| Myosin heads bend & actin filaments slide causing muscle to contract. |
| ATP binds to myosin heads & ADP & $P_i$ is released to break crossbridge. |