Applied Science Unit 1 Biology Knowledge Organiser

Cell theory

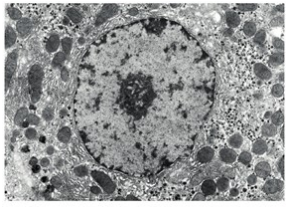
Organelle: Specialised structure found within a living organism.
Resolution: the ability to distinguish between objects that are close together.
Nucleus: an organelle found inside a cell which contains genetic information.
Chloroplast: A plant organelle where the stages of photosynthesis take place, found in plant cells, photosynthetic bacteria and algae.

Cell theory

Human cheek cells seen under a light microscope

Maximum magnification: x1500
Maximum resolution: 200 nm

Cell theory



Electron micrograph of animal cell

Maximum magnification: x500,000

Maximum resolution: 0.1 nm

Calculating magnification

Size of image refers to the length of the image when measuring with a ruler in millimetres.

We can use the equation below to work out magnification.

$$\text{Magnification } (M) = \frac{\text{size of image } (I)}{\text{actual size } (A)}$$

I
$A \times M$

Remember to convert all units to make them the same.
1000 nanometres (nm) = 1 micrometre (µm)
1000 micrometres (µm) = 1 mm
1000 mm = 1 m

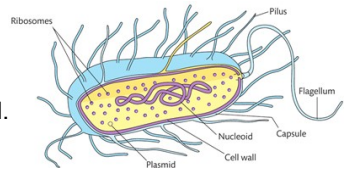
Prokaryotic cell

Bacterial cells produce and secrete toxins that have an effect on other organisms. DNA is free in the cytoplasm. Complementary base pairing occurs inside the cytoplasm where RNA nucleotides line up along the DNA and messenger RNA is formed. There are two groups of bacteria: Gram positive and gram negative.

To distinguish between gram positive and gram negative a staining technique which uses crystal violet and safranin is used.

Gram positive = purple stain

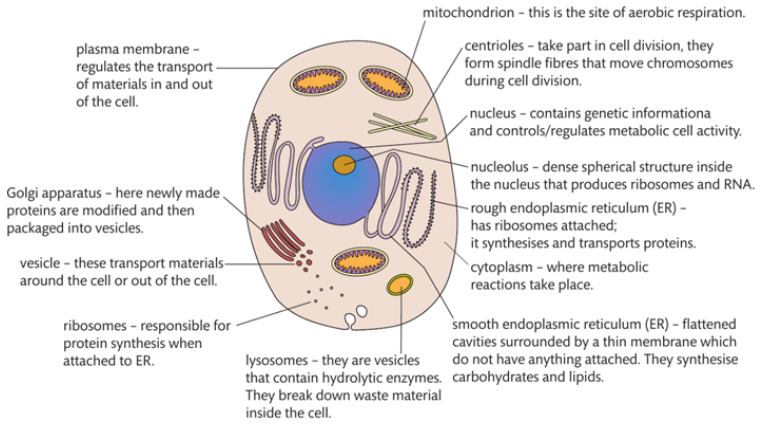
Gram negative = pink stain



Organelle	Structure	Function
Cell wall	Prokaryotic cells are surrounded by a cell wall made of peptidoglycan.	Protects and supports each cell.
Capsule	Slippery layer outside the cell wall of some species of bacteria.	Protects the cell and prevents dessication.
Ribosomes	Smaller than ribosomes found in eukaryotic cells. They consist of two sub-units and they are not surrounded by a membrane.	Protein synthesis occurs at the ribosomes.
Nucleoid	The nucleoid (meaning nucleus-like) is the irregularly shaped region that holds nuclear material without a nuclear membrane and where the genetic material is localised. The DNA forms one circular chromosome.	The nucleoid is the region where generic information can be found and controls cellular activity.
Plasmid	Small loops of DNA.	Plasmids carry genes that may benefit the survival of the organism.

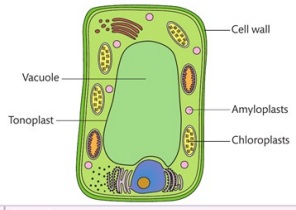
Eukaryotic animal cell

Key functions of a cell is to synthesise proteins for use inside the cell. Secretory vesicles will transport proteins that are to be released from the cell to the cell surface membrane where they will fuse with the membrane and release the protein via exocytosis.



Eukaryotic plant cell

Plan cells have all the cellular components that are listen in the animal cell except centrioles. Main function of a plant cell is to produce carbohydrates during photosynthesis



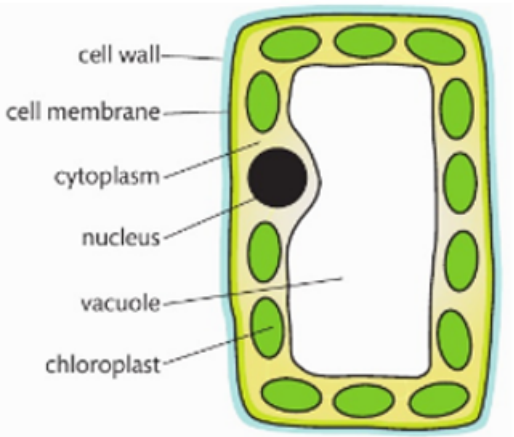
Plant cell structure	Structure	Function
Cell wall	Made of cellulose forming a sieve-like network.	Protects and supports each cell and the whole plant.
Chloroplast	Has a double membrane and is filled with a fluid called stroma. The inner membrane is a continuous network of flattened sacs called thylakoids. A stack of thylakoids is called a granum (grana is plural). Grana contain chlorophyll pigments.	Site of photosynthesis. Light energy is trapped by the chlorophyll and used to produce carbohydrate molecules from water and carbon dioxide.
Vacuole	Membrane-bound sac in cytoplasm that contains cell sap.	Maintains turgor to ensure a rigid framework in the cell.
Tonoplast	The partially permeable membrane of the vacuole.	Selectively permeable to allow small molecules to pass through.
Amyloplast	A double membrane-bound sac containing starch granules.	Responsible for the synthesis and storage of starch granules.
Plasmodesmata	Microscopic channels which cross the cell walls of plant cells.	Enable transport and communication between individual plant cells.
Pits	Pores in the cell walls of the xylem.	Allow water to enter and leave xylem vessels.

Applied Science Unit 1 Biology Knowledge Organiser

Pallisade mesophyll cell

Found in leaves and are rectangular box-shaped cells that contain **chloroplasts**.

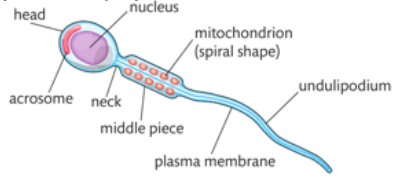
- Cells specialise in **photosynthesis**
- Full of **chloroplasts**
- Densely packed together
- Large **vacuole** to maintain **turgor** pressure



Sperm and egg cell

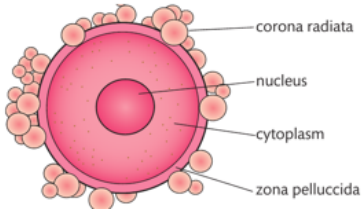
Sperm cells are male **gametes** (one set of chromosomes). Their function is to deliver genetic information to the egg cell – **fertilisation**.

- Tail-like structure for movement
- Many mitochondria to supply energy for movement
- Head contains digestive enzymes to digest protective player of ova.



Egg cells, or ova, are **female** gametes.

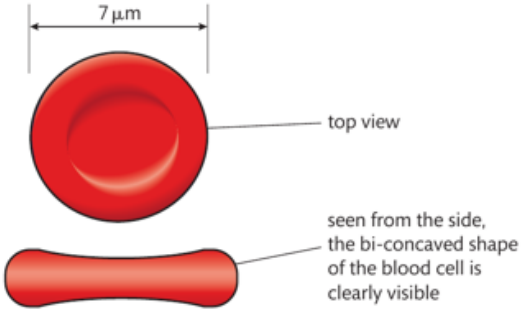
- zona pelluccida is the outer protective layer
- Corona radiata supplies proteins needed by the fertilised egg cell.



Red blood cells

Red blood cells are:

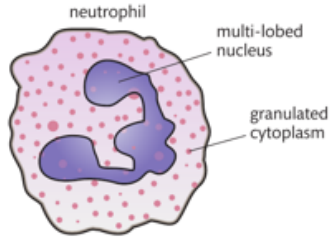
- **Biconcave shape** to increase **surface area to volume ratio** in order to transport oxygen
- No **nucleus** to increase space for **haemoglobin** (protein molecule that binds oxygen and carbon dioxide)



White blood cells

White blood cell plays an important part in the immune system. **Neutrophils** are an example of a white blood cell.

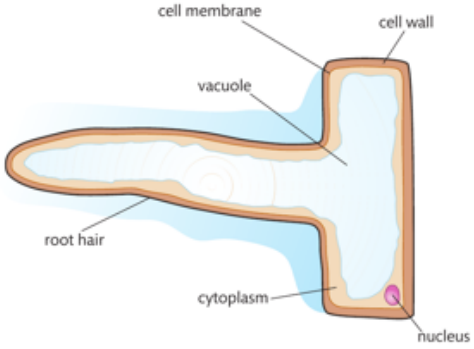
- **Multi-loved nuclei** allows to squeeze through small gaps
- **Lysosomes** contain **enzymes** that are used to **digest pathogens** (micro-organism that can cause disease



Root hair cell

Found in plant's roots.

- Root hairs to increase surface area for water and mineral movement
- Thin cellulose walls
- Vacuole to maintain low **water potential** (ability of water molecules to move in a solution



Applied Science Unit 1 Biology Knowledge Organiser

Epithelial tissue

Squamous epithelial tissue

Simple squamous epithelial tissue is a lining tissue and is **one cell thick** – example is the **alveoli** in the lungs. Figure (a). These cells form a thin, smooth, flat layer. Efficient when rapid diffusion is necessary. Can be damaged by **smoking**. Symptoms include:

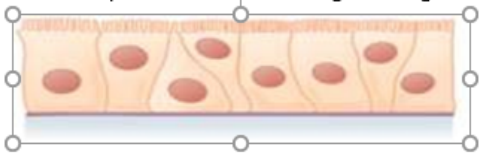
- Breathlessness
- Persistent coughing
- Phlegm

Symptoms are all associated with **C**hronic **O**bstructive **P**ulmonary **D**isorder (COPD).

Ciliated columnar epithelial tissue

Made up of column-shaped **ciliated cells** with hair-like structure called **cilia** covering the exposed cell surface (figure b). Ciliated epithelium line the **trachea** in the respiratory system in order to protect the lungs from infection.

Goblet cells are column shaped and are present in the respiratory system, they secrete mucus to help trap any unwanted particles from reaching the lungs.



Muscle tissue

Skeletal muscle is found attached to bones. You can control its contraction and relaxation.

Cardiac muscle is found only in the heart. It contracts at a steadily rate to make the heartbeat. It is **not** under **voluntary** control.

Smooth muscle is found in the walls of hollow organs such as the stomach and bladder. It is **not** under **voluntary** control.

Myofibril fibres are made from proteins called myofilaments, which enable contraction to take place

Slow twitch muscle fibres

Slow twitch muscle are more efficient at using oxygen to generate in the form of **ATP** (enzyme that transports chemical energy within cells) for **aerobic respiration**. Slow twitch fibres have:

- Less sarcoplasmic reticulum
- More mitochondria for sustained contraction
- More myoglobin
- A dense capillary network

Fast twitch muscle fibres

Fast twitch muscle fires can be divided into two kinds:

- Fast twitch oxidative muscle fibres are similar in structure to slow twitch muscle fibres. They are able to **hydrolyse** ATM much more **quickly** and therefore **contract quickly**.
- Fast twitch glycolytic muscle fibres have relatively less myoglobin, few mitochondria and few capillaries. They contain large concentration of **glycogen** that provides fuel for **anaerobic respiration**.

Endothelial tissue

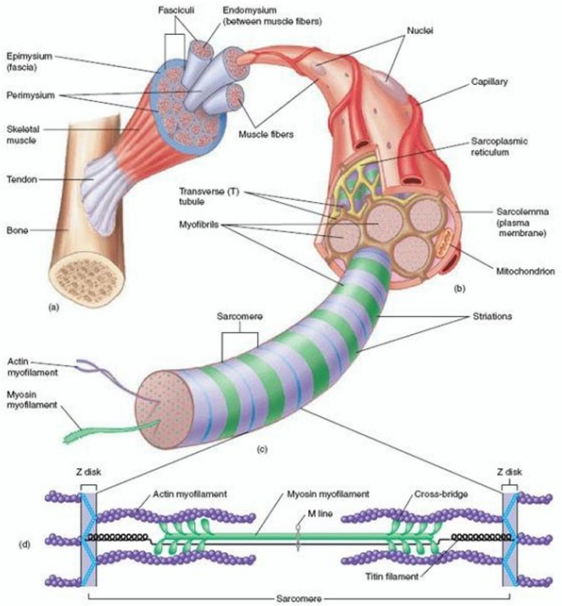
Endothelial tissue consists of a layer of flattened cells, one cell thick. Found in the lining of heart, blood vessels and lymphatic vessels. The cells provide a short diffusion pathway for the movement of various substances.

•Carbon monoxide and high blood pressure can damage the inner lining of the arteries.

•**Atherosclerosis** can occur due to cholesterol being deposited under the endothelium lining of the arteries.

Preparative methods for samples

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 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 cross-bridges.
Myosin heads bend & actin filaments slide causing muscle to contract.
ATP binds to myosin heads & ADP & P_i is released to break cross-bridge.



Applied Science Unit 1 Biology Knowledge Organiser

Nervous tissue

The central nervous system (CNS) consists of the brain and spinal cord. It is made up of billions of non-myelinated nerve cells and longer, myelinated axons and **dendrons** that carry nerve impulses. Nervous tissue is made of nerve cells called neurons.

Information travels along neurons in the form of **electrical signals** called nerve **impulses**. A nerve impulse in know as an **action potential**, they arise from a change in the ion balance in the nerve cell which spreads rapidly from one end of the neurone to the other.

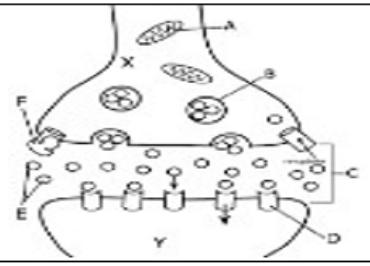
Neurones are bundled together to form nerves and nerves form a network all around the body. **Sensory** neurones receive information from **receptors** (e.g. ears) and take this information to the CNS. The brain processes the information, then motor neurones take the information from the brain to the effector e.g. muscle.

Resting potential is the term given to a neurone that is not transmitting an action potential.

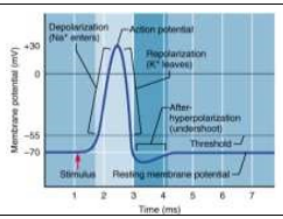
Neurotransmitter

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

Synapse

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

Impulse

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

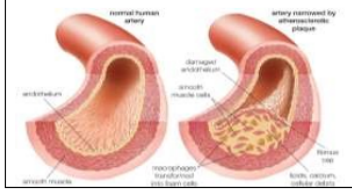
Health problems

Parkinson's disease is a genetic disease that affects the nervous system. Parkinson's sufferers are not able to produce the naturally occurring chemical dopamine, a neurotransmitter that helps smooth and normal movements. Symptoms include:

- Slow movement
- Speech problems
- Tremors when moving
- Poor balance

The drug, L-dopa, replaces the dopamine that is lost in people with Parkinson's disease.

Serotonin is another of the body's naturally occurring neurotransmitter. It is normally active in the brain and can cause problems if not produced. Some forms of depression are caused by a reduced amount of serotonin in the brain.

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 Alcohol, high saturated fat diet, obesity, physical inactivity, smoking & stress.	**Other factors** Advancing age, diabetes, ethnicity, family history, high blood pressure, male gender.
	**Cholesterol** combines with lipids, calcium & cellular debris to form a plaque;
	High blood pressure damages endothelium of arteries;
	Saturated fats contain high levels of LDL cholesterol;
	Nicotine & carbon monoxide from **smoking** damages endothelium of arteries;
	Fatty deposits build up to form a plaque; Macrophage cells in artery wall multiply in response; The artery lumen becomes narrower;