CAIE Biology IGCSE

2: Organisation of the Organism

Notes

(Content in **bold** is for Extended students only)

Cell Structure

Comparing the structure of animal cells and plant cells:

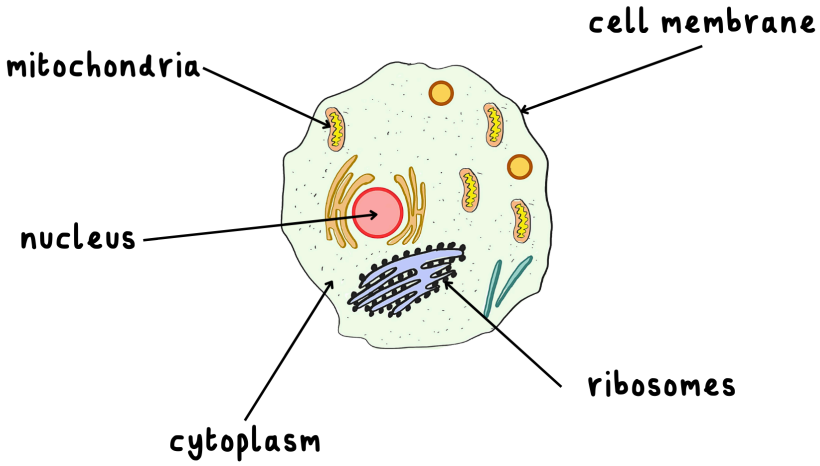
Similarities:

- They both contain a **nucleus**, **cytoplasm**, **mitochondria**, **ribosomes** and a **cell membrane**.

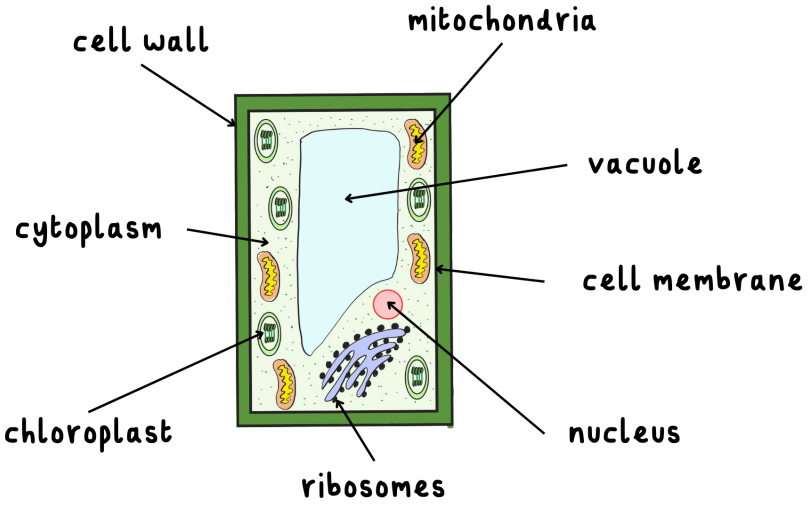
Differences:

- Plant cells contain a **cell wall**, **vacuole** and **chloroplasts**.
- Plant cells have a **more regular** shape and are **larger**.

Animal cells



Plant cells



Functions of cell structures in animal and plant cells:

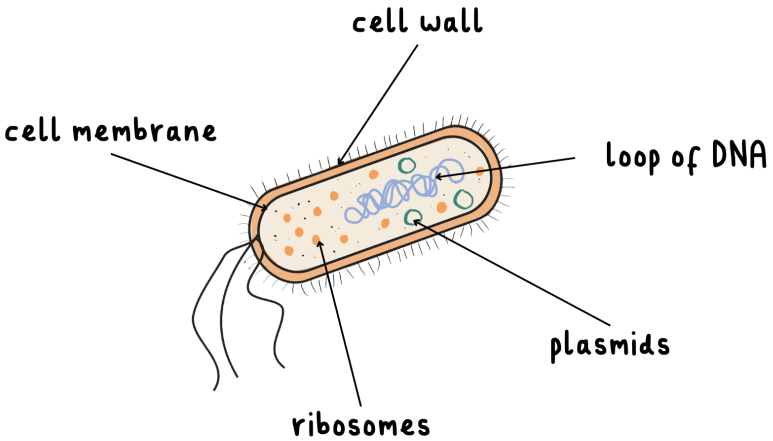
- **Cytoplasm** - A jelly-like material within the cell in which reactions occur. The cytoplasm contains structures such as ribosomes and vesicles.
- **Cell membrane** - a thin membrane that surrounds the cell, controls entry and exit of substances.
- **Nucleus** - the nucleus contains genetic material in the form of DNA which codes for proteins. DNA replication also occurs in the nucleus.
- **Ribosomes** - Ribosomes are the site of protein synthesis.
- **Mitochondria** - site of respiration. Provides energy for the cell to function.

In plants only:

- **Vacuole** - is a fluid-filled sac containing mineral salts, sugars, amino acids, waste substances and **pigments** which colour the cell and **attract pollinating insects**.
- **Chloroplasts** - the site of **photosynthesis**, which allows plants to **convert light energy to glucose**.
- **Cell wall** - gives the cell **structure** and **prevents bursting**. It is made of **cellulose**.

Bacterial cells:

- Bacterial cells contain a **cell wall**, **cell membrane**, **cytoplasm** and **ribosomes**.
- The cell wall of a bacterial cell is made of a different material than in plant cells. This material is called **peptidoglycan**.
- Bacterial cells do not have a nucleus but instead contain **circular DNA** - a loop of DNA which floats in the cytoplasm.
- The **circular DNA** contains most of the genetic material in the cell.
- These cells also lack **mitochondria** and **chloroplasts**.
- Bacterial cells contain **plasmids**. Plasmids are small rings of **DNA**.

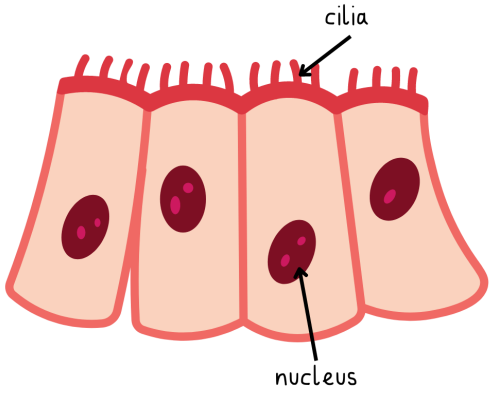


New cells are produced by the **division** of existing cells.

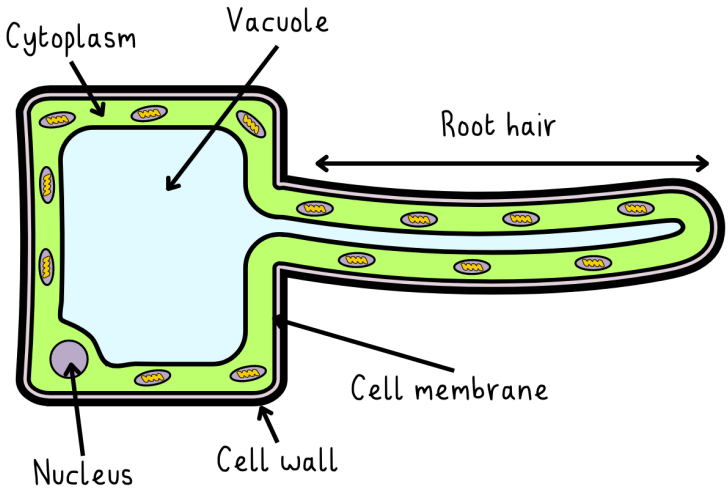
Specialised cells:

Cells and tissues are **specialised** to carry out their particular function. Examples of specialised cells are:

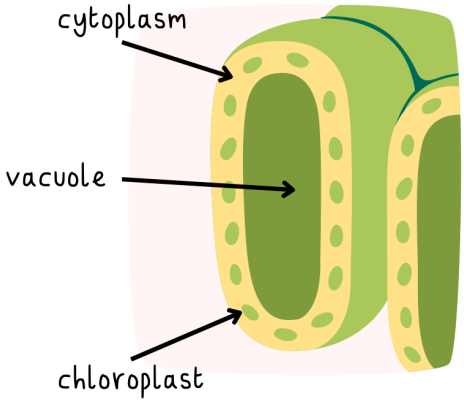
- **Ciliated cells** - ciliated cells are found lining the **trachea**. They have hair-like projections called **cilia** which move together to **transport mucus, dust and bacteria upwards** to the throat.



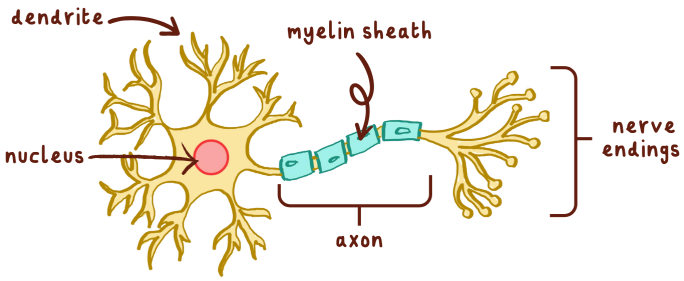
- **Root hair cells** - are adapted to have a **large surface area**. This speeds up the rate of osmosis and mineral ion uptake in plants.



- **Palisade mesophyll cells** - this is where photosynthesis occurs. Mesophyll cells are **tall and closely packed** to efficiently absorb light and **contain lots of chloroplasts** for photosynthesis. They are also placed at the top of the leaf where most of the light hits, enabling them to absorb as much light energy as possible.

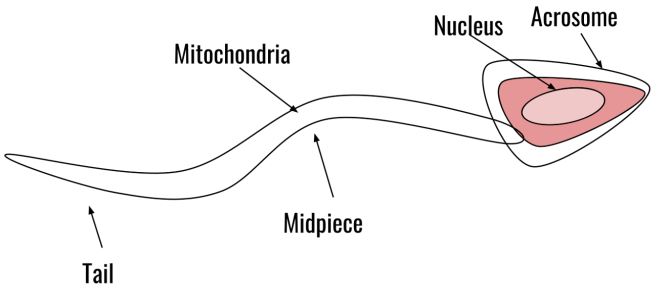


- **Neurones** - nerve cells are adapted to rapidly transmit electrical impulses. Nerve cells are **myelinated**, which **insulates** the cell and prevents the impulse weakening and slowing down. They also contain **lots of mitochondria** to provide energy. **Dendrites** have a **large surface area and are branched** to receive impulses from many other neurons.

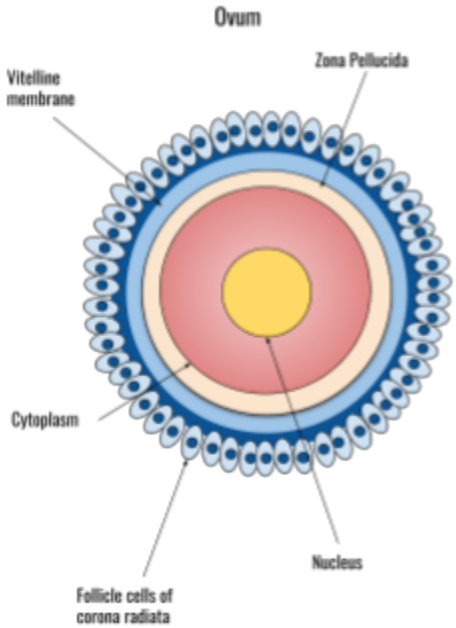


- **Red blood cells** - red blood cells contain **haemoglobin** which allows them to carry oxygen around the body. They have a **biconcave shape** which increases their surface area, allowing for rapid diffusion. They also have **thin cell membranes** to decrease the diffusion distance. They **do not contain a nucleus**, thus have more space for oxygen.

- **Sperm cells** - sperm cells are **gametes**. **Gametes** are the reproductive cells of organisms with half the chromosomes of normal cells. Sperm cells are adapted by containing **lots of mitochondria** so that the cell has enough energy to reach the egg cell. It has a **tail to allow movement** and contains **digestive enzymes** to help penetrate the egg cell membrane.



- **Egg cells** - egg cells are also **gametes**. Egg cells have **nutrients** in their cytoplasm which help the growth of the embryo. After fertilisation, the cell membrane **changes** to prevent any more sperm from penetrating the egg. Egg cells are **haploid**, meaning they contain only half the number of chromosomes of normal cells. Thus, when the sperm fertilises the egg cell, the embryo will have the right number of chromosomes.



Levels of organisation:

Key terms:

- **Cell** - the basic building block of all living organisms
- **Tissue** - a group of similar cells working together to carry out a particular process
- **Organ** - a group of tissues working together to carry out a specific function
- **Organ system** - a group of related organs working together to carry out functions in the body.

Size of specimens

Cells can be viewed using a **microscope** to study their structure.

To calculate the size of a specimen under a microscope, we use the following formula:

$$Actual\ size = \frac{Image\ size}{Magnification}$$

Where the **image size** is the size of the specimen which appears when viewed through the microscope. The **actual size** is the specimen's real size.

The image size should be measured in **millimetres**.

Example:

A student measures the image of a cell under a microscope and it is 32mm wide. The image has been magnified by a factor of x 100. What is the actual width?

Using the formula above:

Actual size = Image size / Magnification

32/100 = 0.32 mm

You may be asked to give the answer in micrometres. To convert between millimetres and micrometres, you need to multiply by 1000.

1mm = 1000 µm

µm is the symbol used to represent micrometres.

Example:

A student measures the image of a cell under a microscope and it is 54mm wide. The image has been magnified by a factor of x 500. What is the actual width in µm?

Actual size = Image size / Magnification

54/500 = 0.108 mm

0.108 mm x 1000 = 108 µm

Actual width = 108 µm