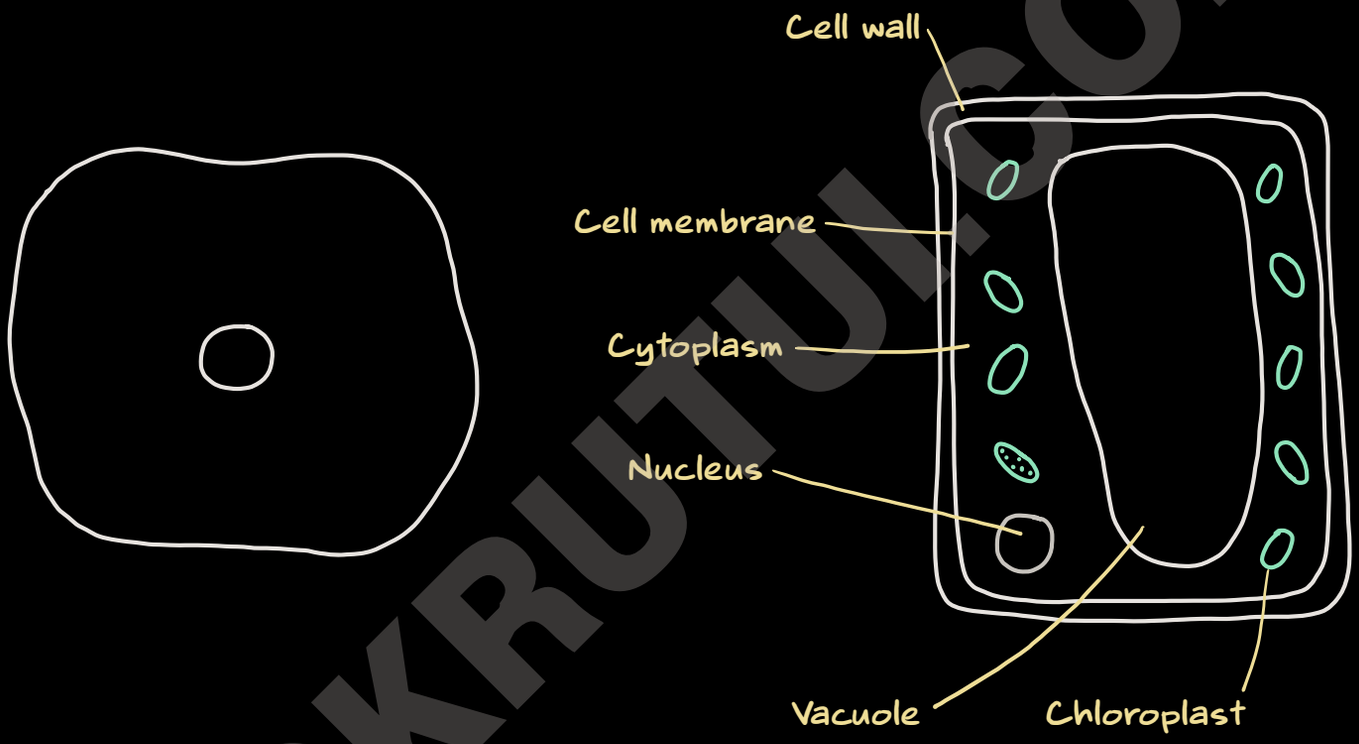
Cells

- ☑ Structure of plant and animal cells
- ☑ Structure of prokaryotic cells
- ☑ Specialisation of cells
- ☑ Organisation of cells
- ☑ Magnification

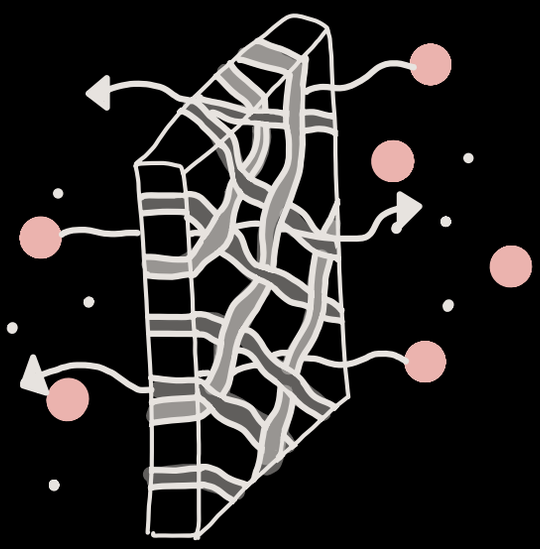
Animal vs. Plant cell



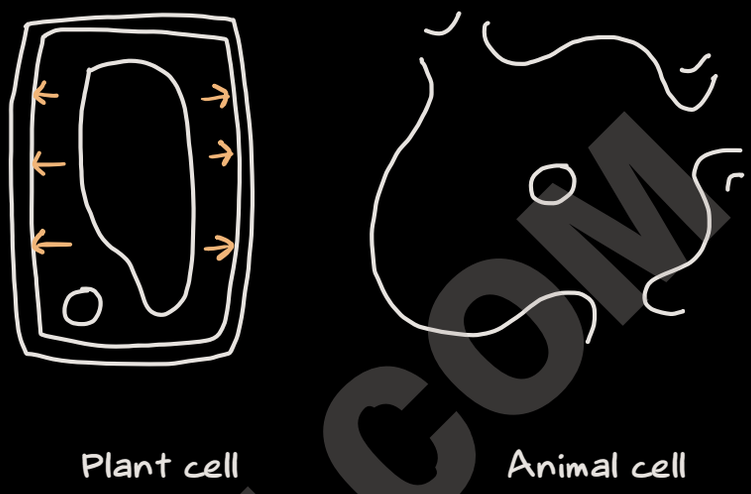
Cell wall

- Features:
  - Made of cellulose
  - Completely permeable
  - Rigid structure
    - The cell wall of a plant cell is made of cellulose fibres that crisscross to form a rigid structure. The cell wall is completely permeable due to the presence of many large gaps, allowing many substances to pass through.
- Functions:

- The cell wall serves two main functions: to protect the cell and to maintain its shape. The cell wall is strong and rigid, which helps to withstand turgor pressure and prevents the cell from bursting.



The cell wall is composed of cellulose fibres arranged in a rigid, permeable structure.



Plant cell Animal cell

When placed in distilled water, a plant cell will not burst due to its cell wall. However, an animal cell will swell and burst because it lacks a cell wall.

Cell membrane

- Features:
  - Partially permeable membrane
  - Allows selective passage of substances in and out of the cell.
- Functions:
  - Defines the boundaries of the cell.
  - Regulates the flow of substances into and out of the cell.

Particles that cannot pass through the cell membrane

Particles that can pass through the cell membrane

Cytoplasm

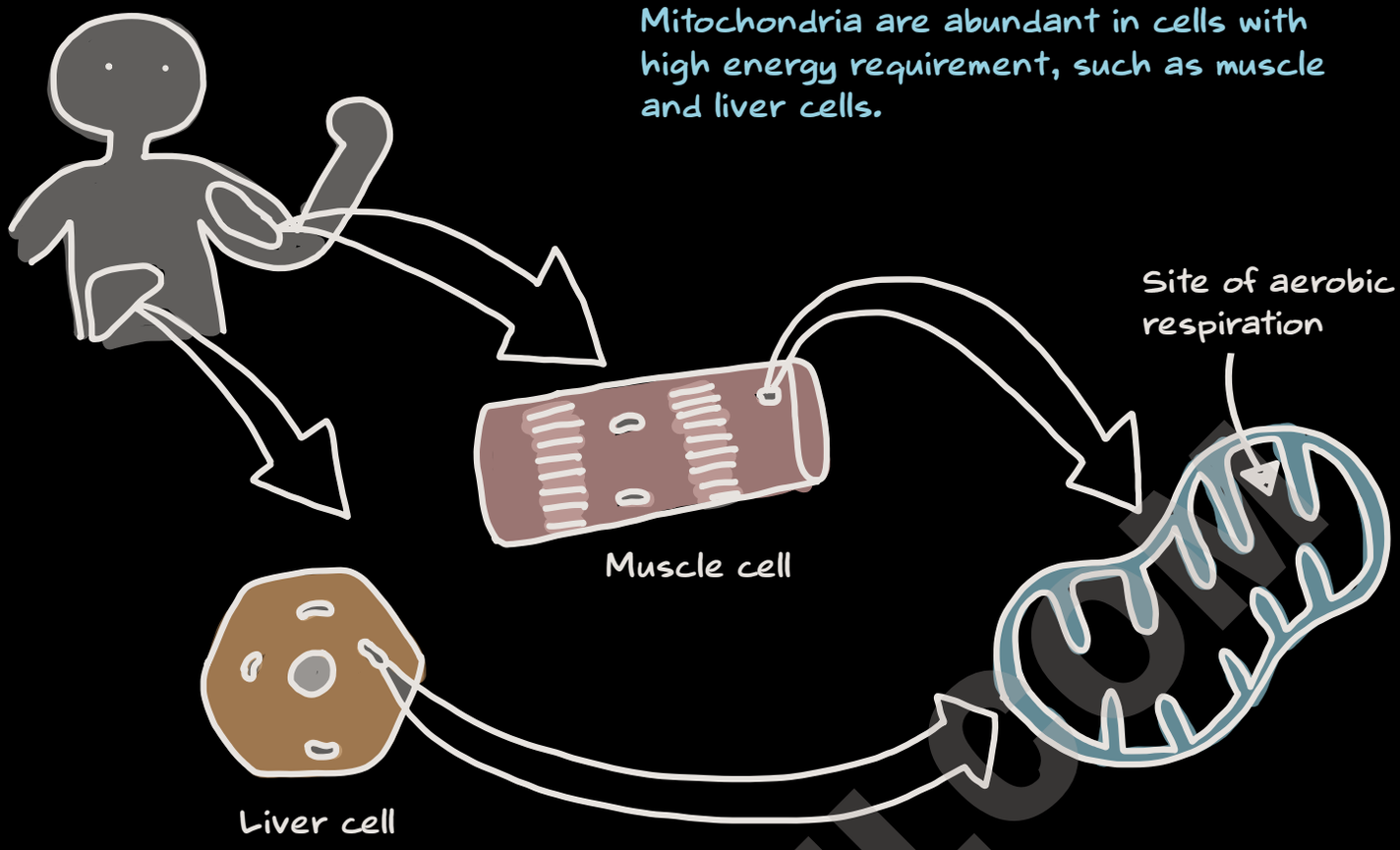
- Feature:
  - A jelly-like substance
- Function:
  - A site for chemical reactions in the cell.
    - E.g., protein synthesis or anaerobic respiration.

Nucleus

- Feature:
  - Contains DNA
- Function:
  - Control cellular activities such as cell division

Mitochondria

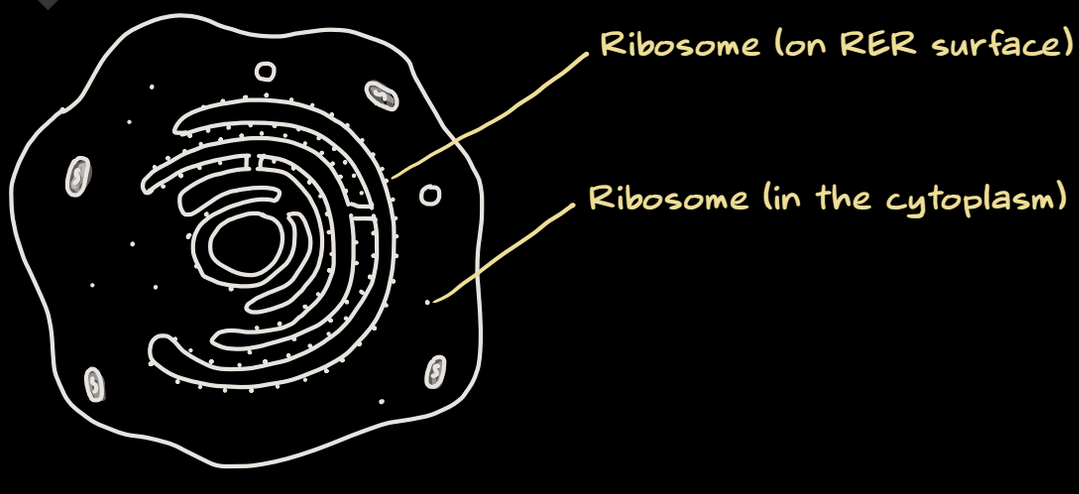
- Features:
  - Rod shape with double membrane
  - Folded inner membrane
  - Contains enzymes for aerobic respiration
- Function:
  - Site for aerobic respiration to produce ATP to run cellular work such as protein synthesis.



Muscle cells require energy for muscle contraction, while liver cells need energy for the production of plasma protein and cholesterol.

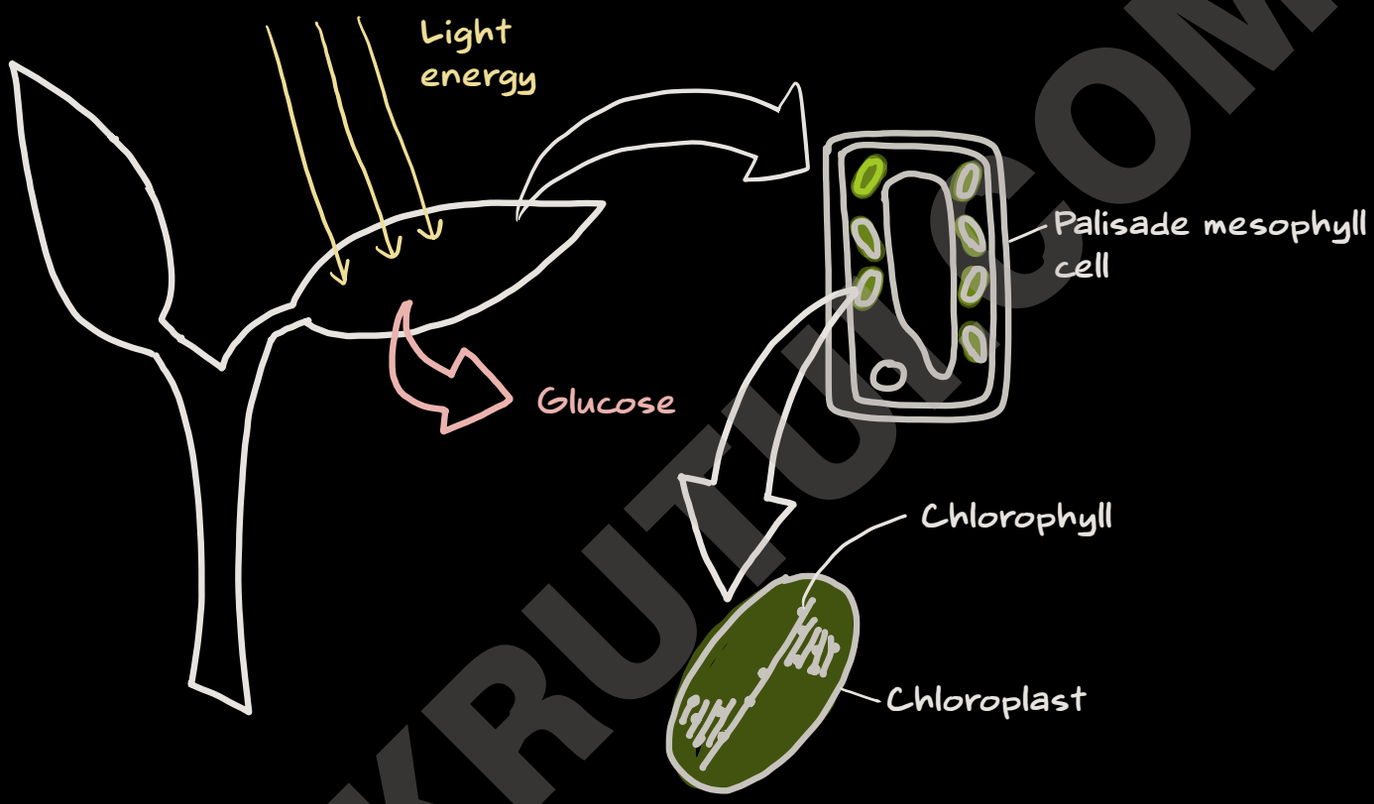
Ribosome

- Feature:
  - It is a spherical structure located in the cytoplasm and on the surface of nucleus and RER.
- Function:
  - Its functions is to assist in the assembly of amino acids into a polypeptide chain.



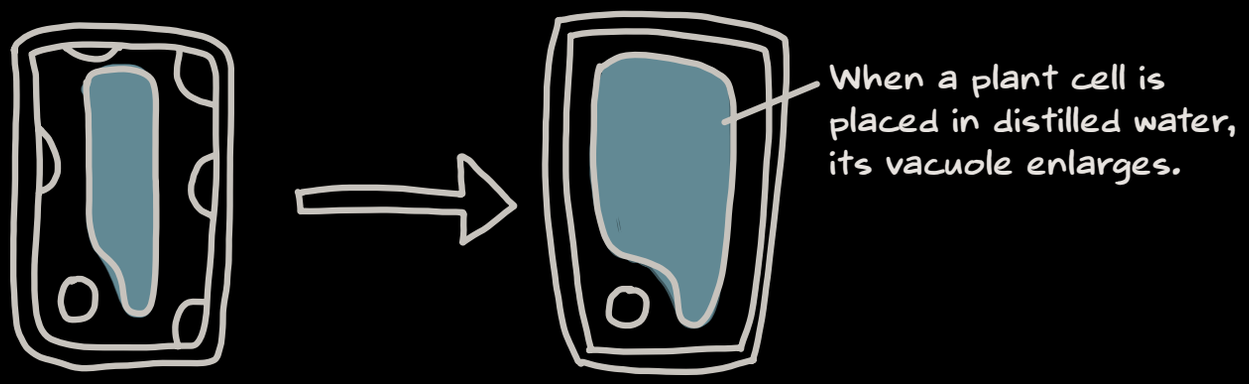
Chloroplast

- Feature:
  - It contains chlorophyll, a green pigment used to absorb light energy and transfer light to chemical energy stored in glucose.
- Function:
  - Its function is as a site of photosynthesis, the process by which plants produce organic molecules using light energy.



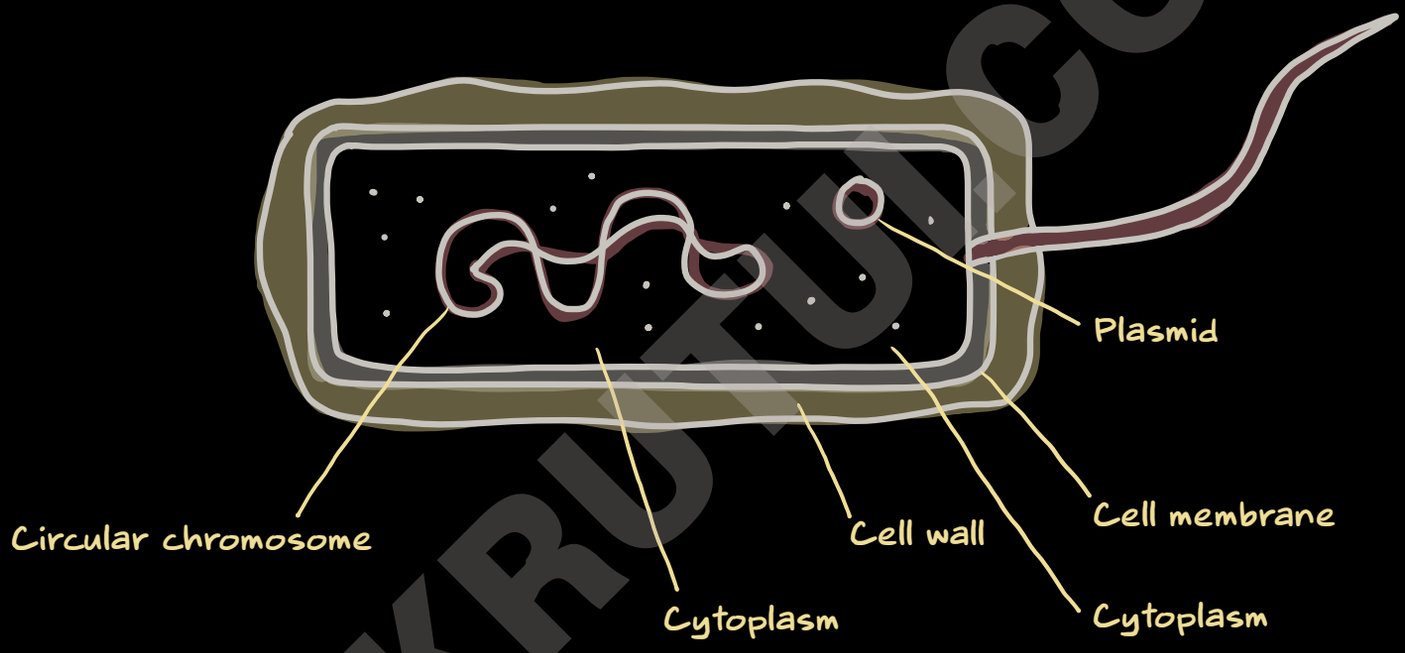
Vacuole

- Features:
  - A sac containing a watery solution called cell sap
  - The vacuole membrane is partially permeable and is known as tonoplast.
- Functions:
  - Site for storage
    - Stored water, minerals, wastes, pigments, and toxins.
  - Maintains cell shape.
  - When water enters a plant cell, the vacuole will expand and exert pressure on the cell wall, making the cell turgid.



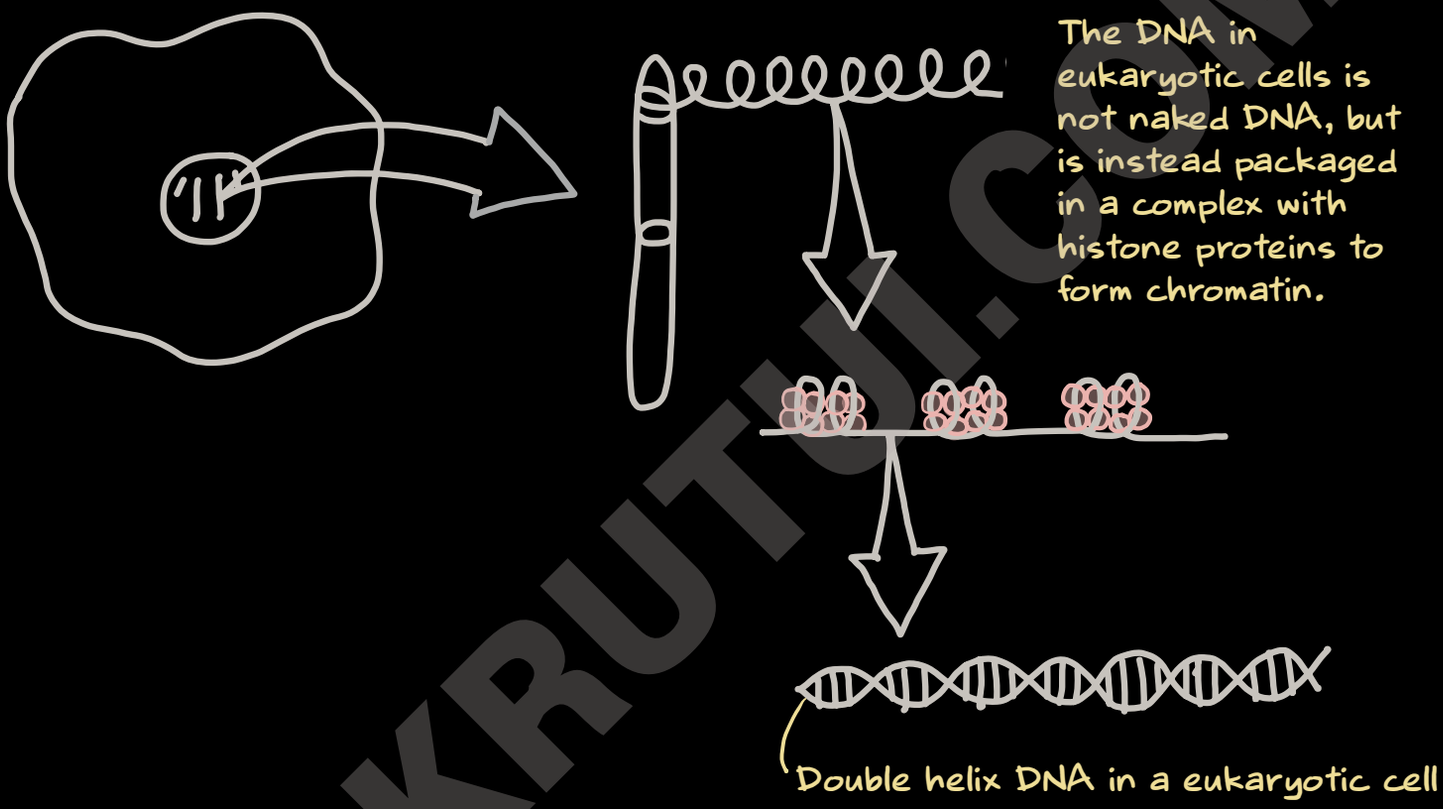
Turgid plant cell

Prokaryotic cell



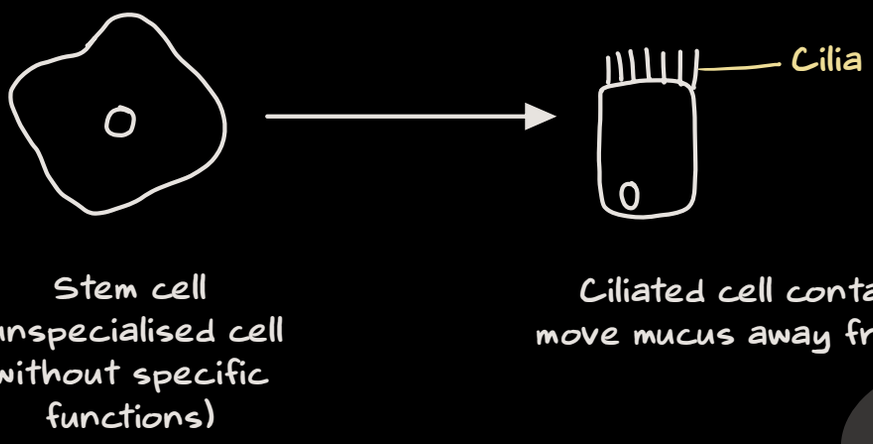
- Prokaryotic cells are the simplest type of cells, lacking a nucleus and other membrane-bound organelles.
- They are usually smaller in size and have a simple structure.
- The genetic material of prokaryotic cells:
  - Single circular chromosome with naked DNA in the nucleoid region
  - Double helix DNA but doesn't wrap around histone proteins
  - Presence of plasmids: tiny circular pieces of DNA
    - Often contain antibiotic-resistant genes
    - Easily transferred between cells
    - Serve as gene vectors in genetic engineering

Genetic material in prokaryotic and eukaryotic cells



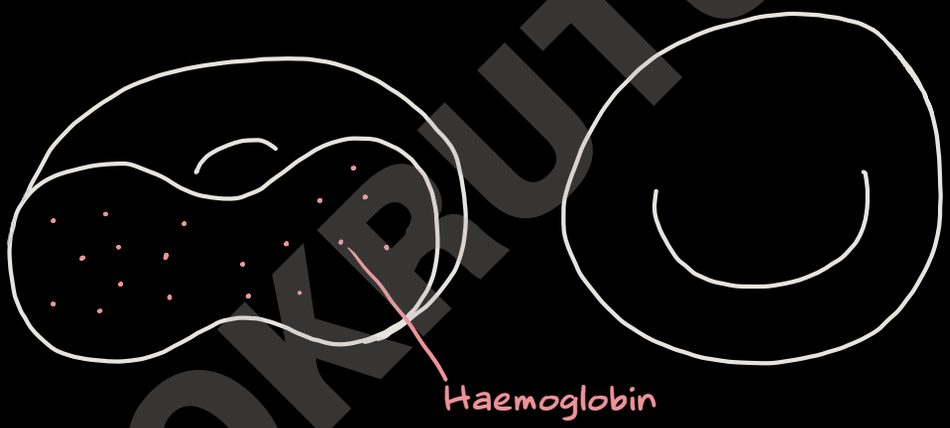
Specialisation of cells

- Specialisation or differentiation = a change in the structure and shape of cells to match their functions



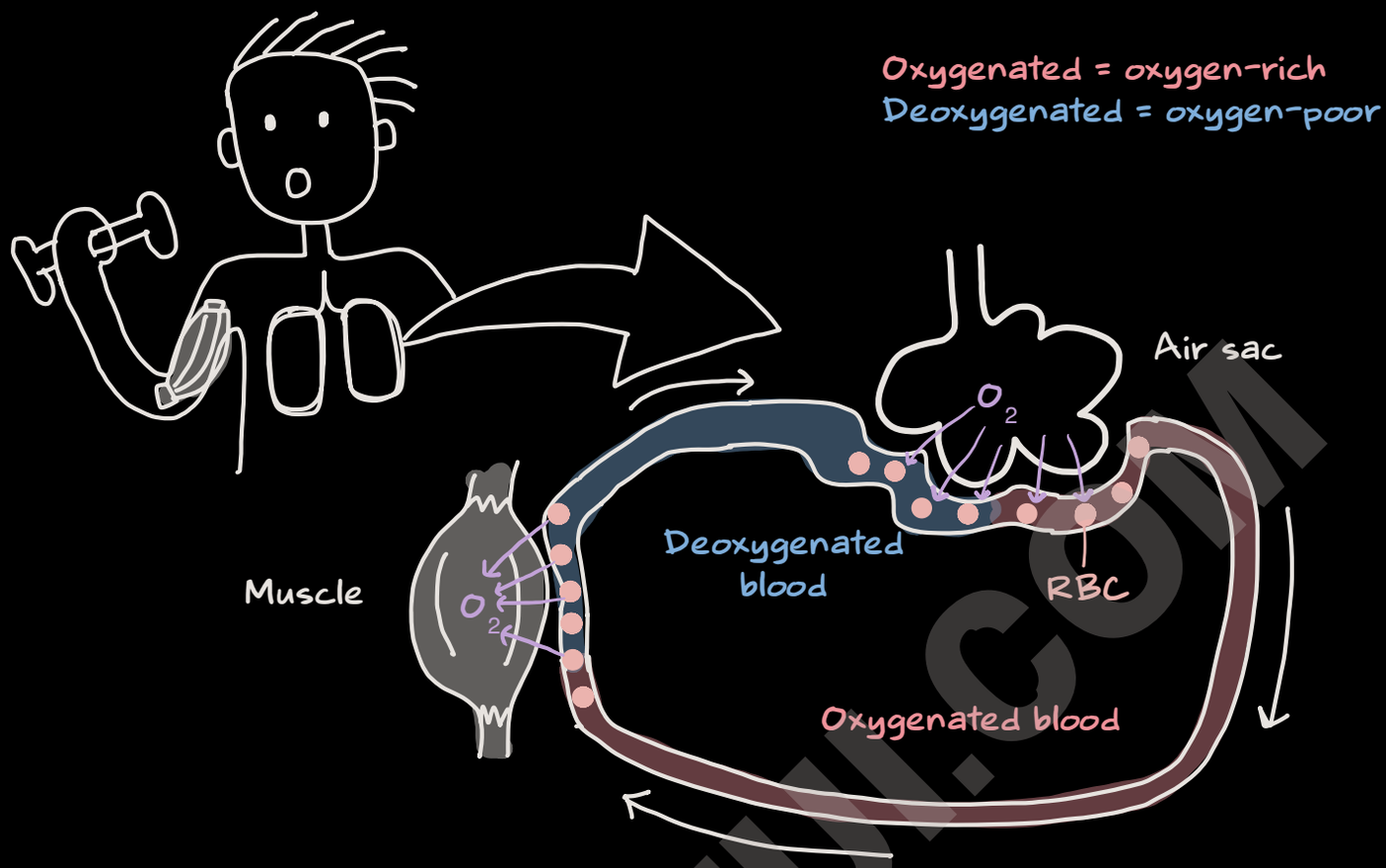
Specialised cells and their functions

Red blood cell

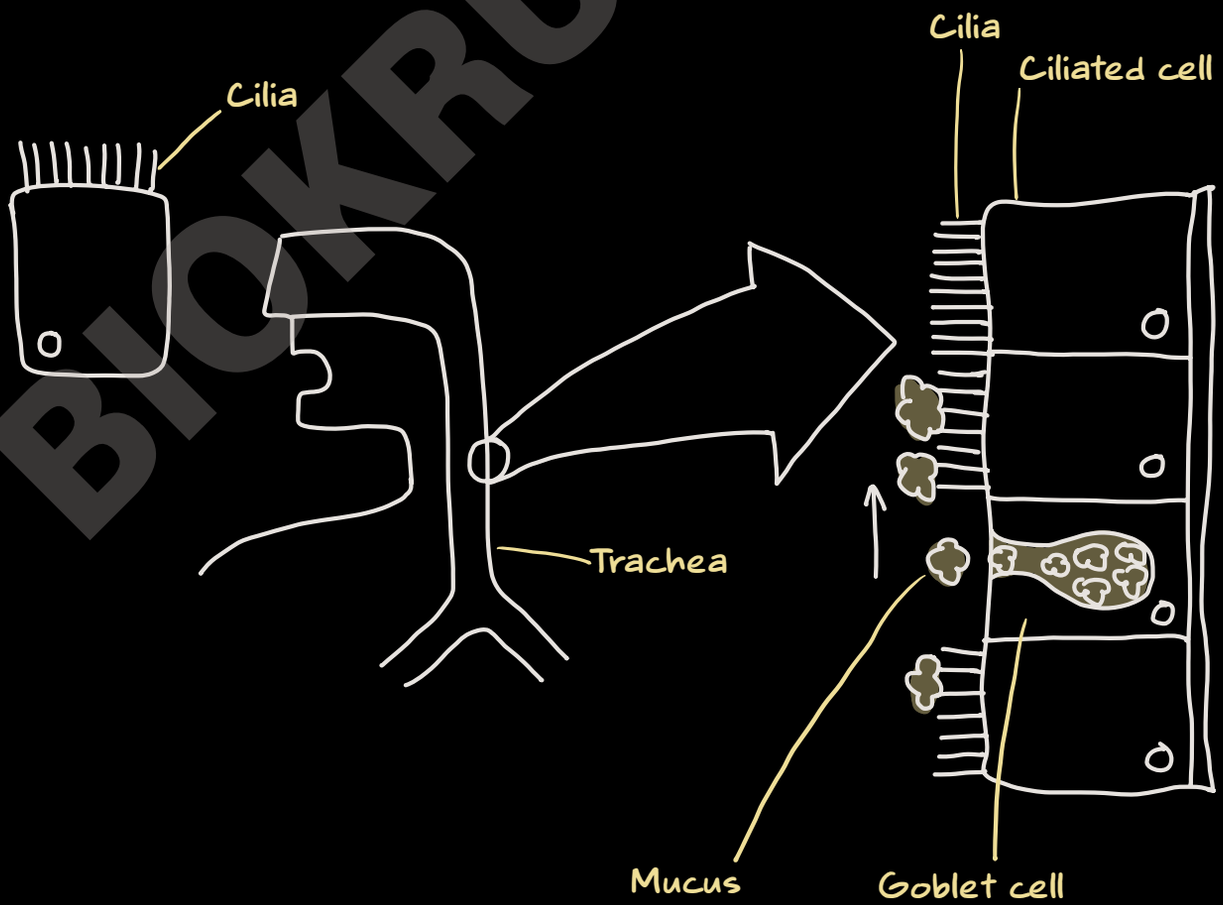


- Function: carries oxygen
- Adaptations:
  - ① Red blood cells contain haemoglobin, which is a red pigment that can trap oxygen.
  - ② It contains no nucleus, allowing more space for haemoglobin.
    - This results in a biconcave shape, which increases the surface area for the absorption of oxygen.

Oxygen delivery by red blood cells

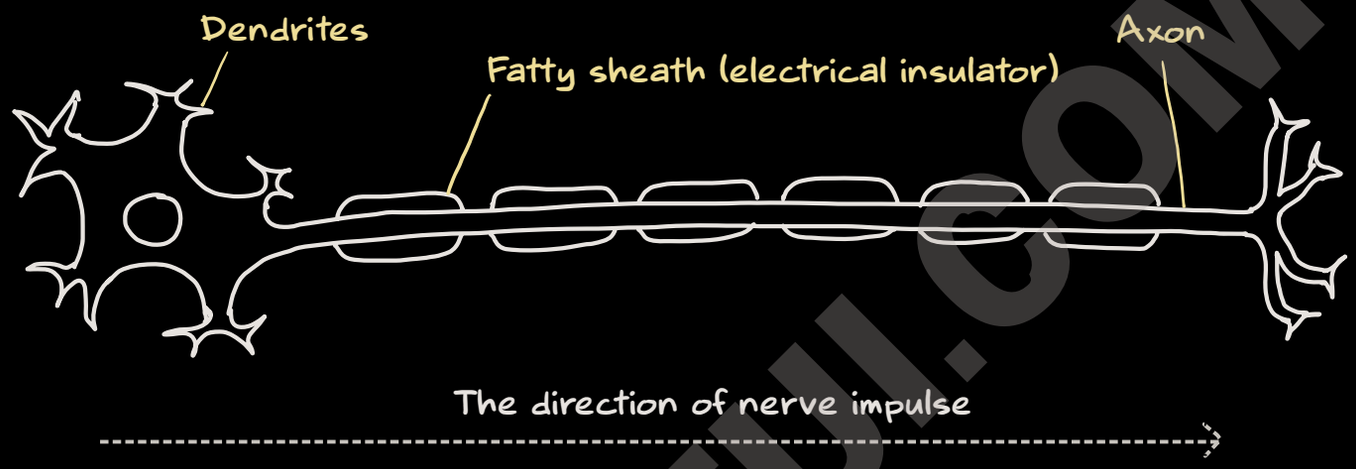


Ciliated cell



- Goblet cells produce mucus to trap dust and pathogens inhaled into the airways. Ciliated cells beat their cilia synchronously to move the mucus from the lungs towards the throat, where it can be swallowed or expelled. This mechanism helps prevent lung infections by keeping pathogens out.

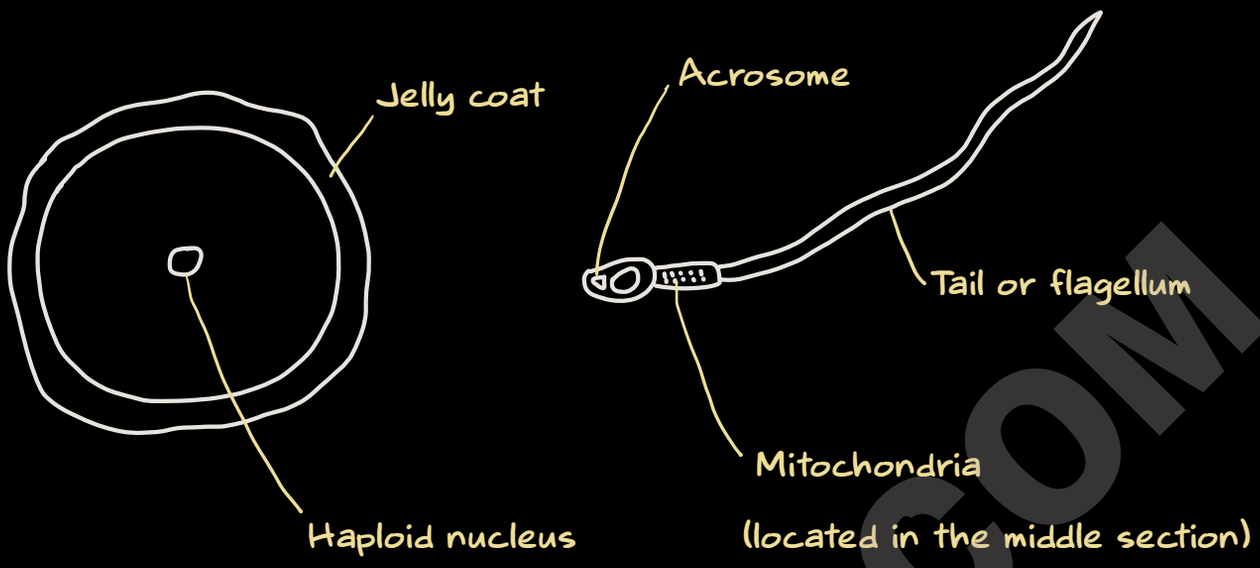
Neurone



- Adaptations:
  ① Neurones have many branches of dendrites, allowing them to connect with many other neurones.
  ② They have a long axon to transmit nerve impulses over long distances.
  ③ The fatty sheath helps insulate the axon, preventing the leakage of nerve impulses and increasing the speed of transmission.

Gametes (sex cells)

- Male gametes: sperm
- Female gametes: egg cells



- Adaptations of egg cells:
  - ① Egg cells have a haploid nucleus, which means they contain half the number of chromosomes compared to body cells. However, this is beneficial because once it fuses with a sperm, another haploid, a diploid number of chromosomes is obtained in a zygote.
  - ② Egg cells are surrounded by a jelly coat that hardens after fertilisation to block entry of additional sperm, thus preventing polyspermy.
  - ③ Egg cells contain a food store, such as proteins and fats, in the cytoplasm.
    - Proteins are materials for producing enzymes and organelles in new cells.
    - Fats are used as an energy source for cell division.

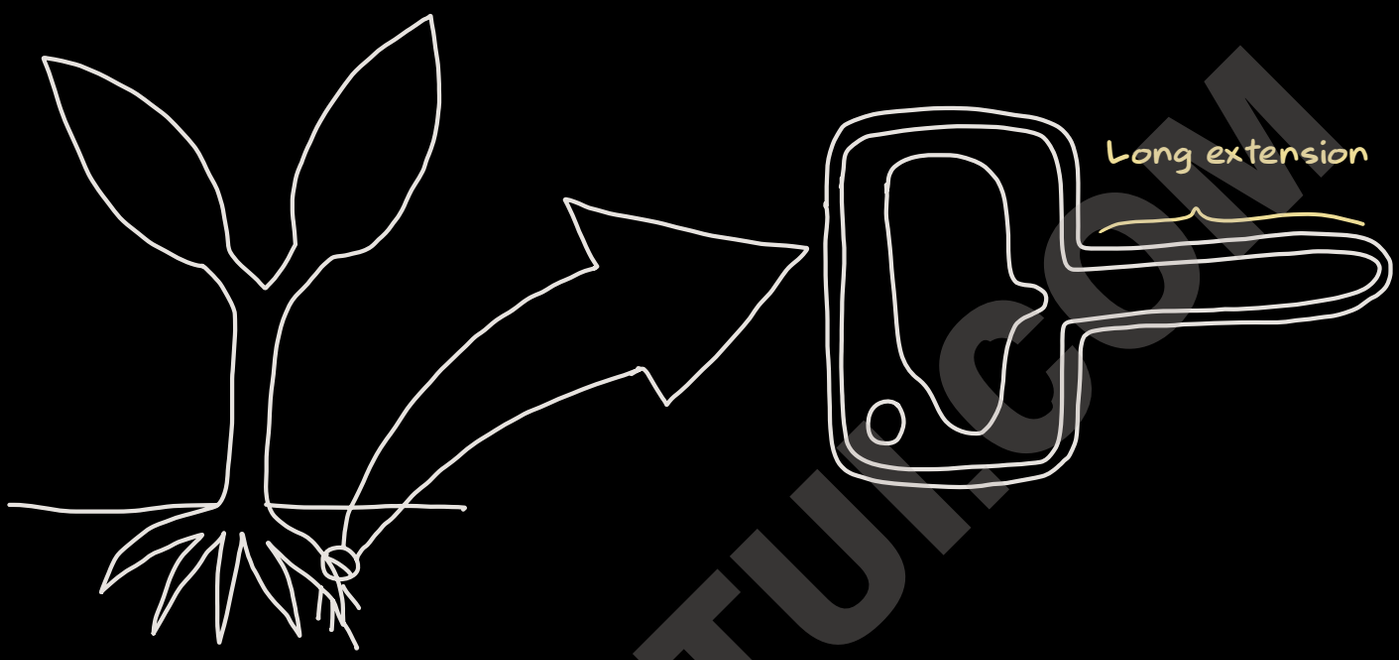
- Adaptations of sperm cells:
  - ① Acrosome
    - Acrosome is a sac containing digestive enzymes located at the head of sperm.
      - The digestive enzymes will be released to digest a jelly coat of the egg cell once the sperm reaches it.
  - ② Presences of many mitochondria
    - Mitochondria are located in the middle section of the sperm.

- They are a site of aerobic respiration to release energy for the sperm to swim.

③ Flagellum for swimming

④ Streamlined body to reduce resistance while swimming

Root hair cell



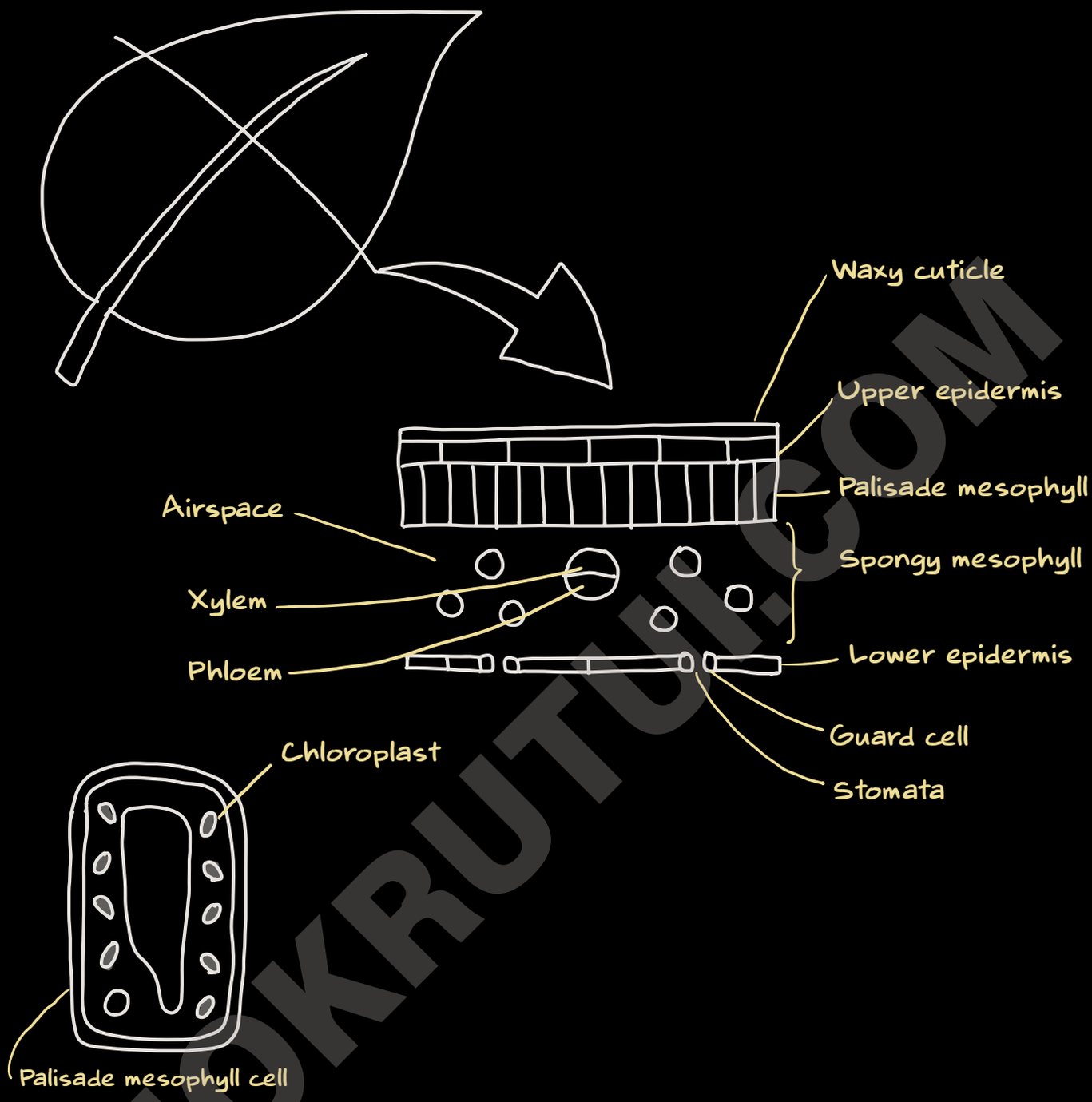
- Functions:
  - To absorb water through osmosis and minerals through active transport.
- Adaptations:

① Presence of a long extension to increase the surface area for water and mineral absorption

② Many mitochondria to supply energy for active transport of minerals

③ A low water potential in cell sap facilitate osmosis

Palisade mesophyll cell



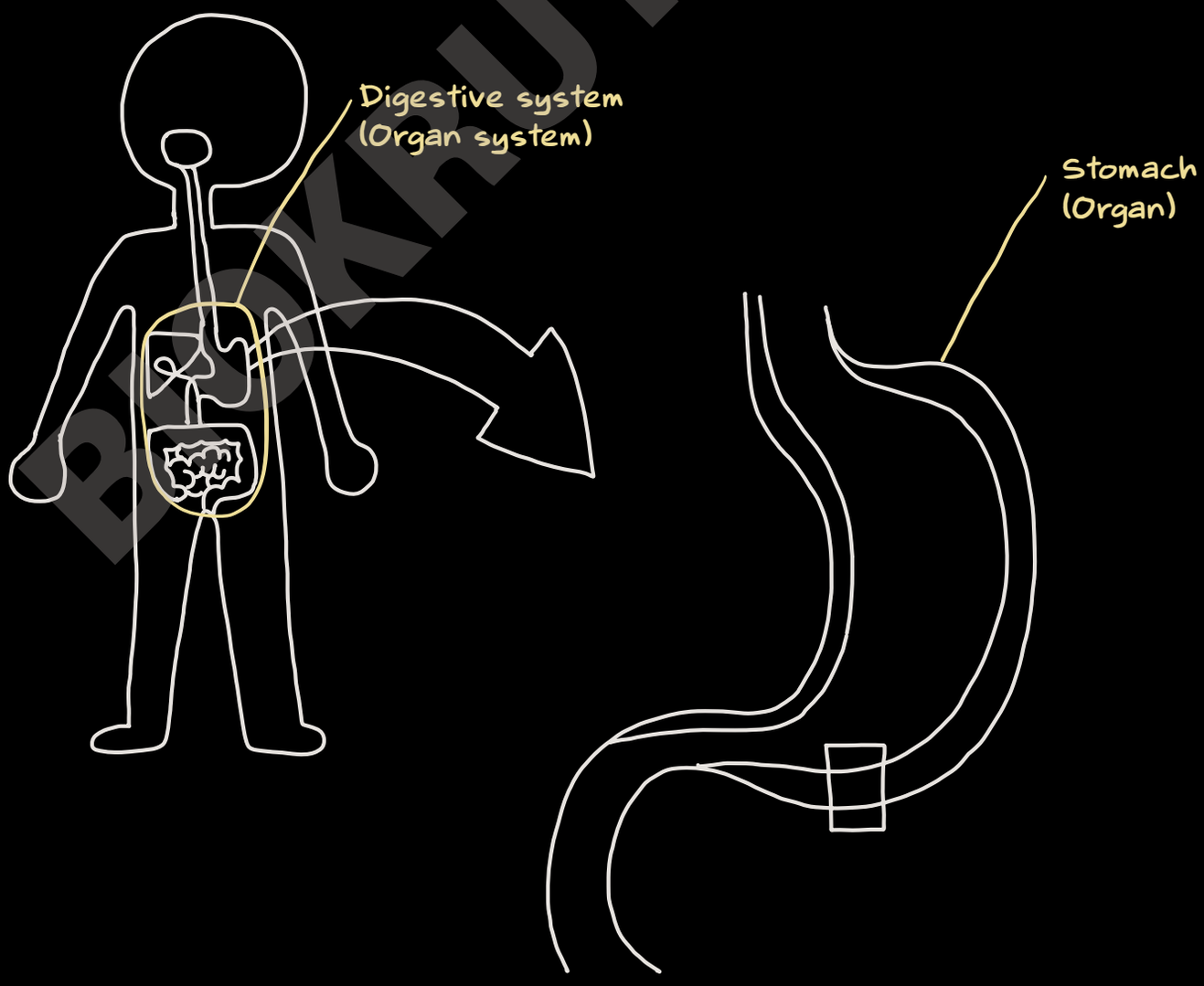
- Function:
  - To perform photosynthesis.
- Adaptations:
  - ① Many chloroplasts are present to maximise sunlight absorption for a high rate of photosynthesis.
  - ② The cell is thin to allow for tight packing with other cells, providing increased access to sunlight for many cells at once.

Organisation of cells

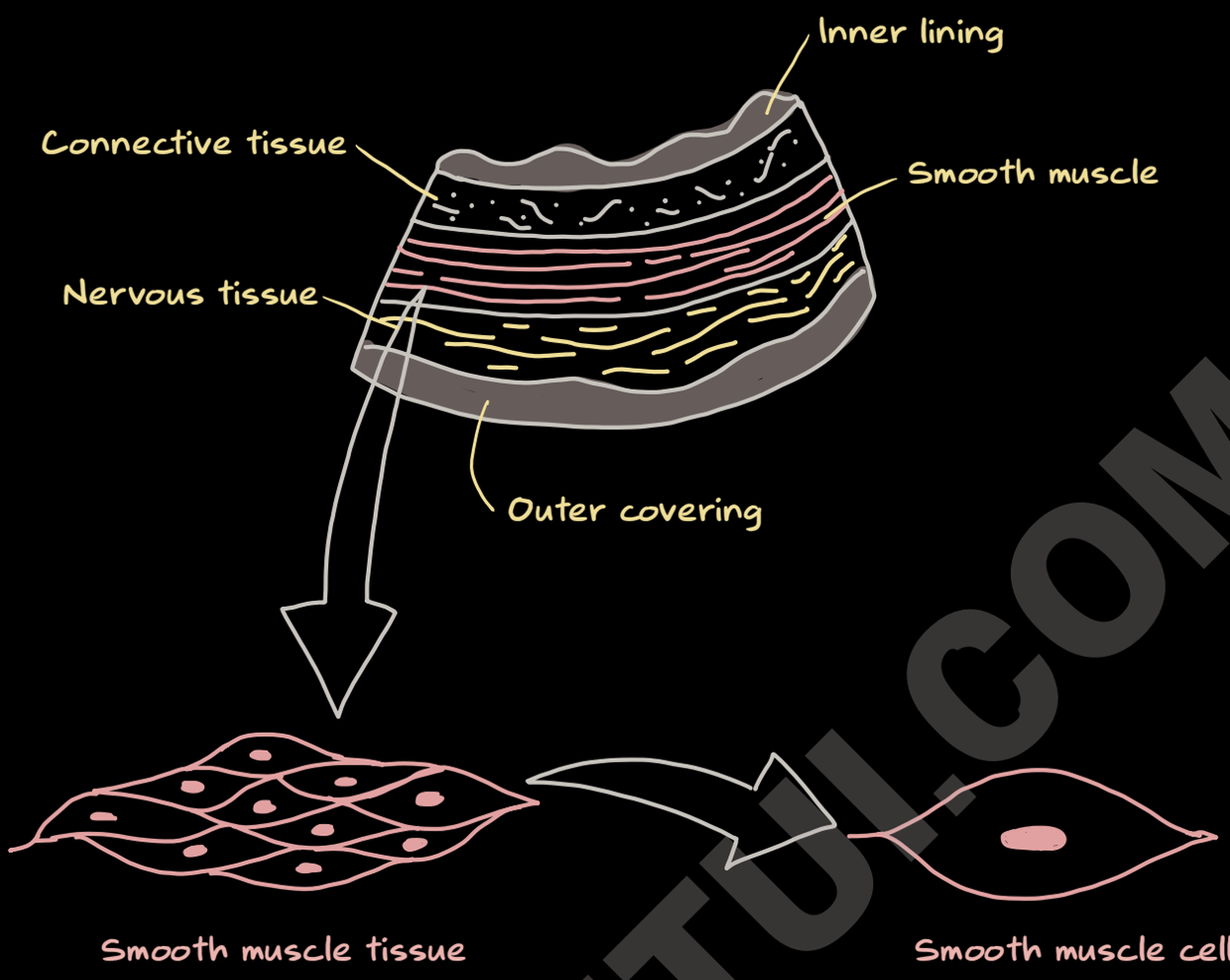
- Multicellular organisms have complex structures made up of cells, tissues, organs, and systems.
- Cell organisation refers to the arrangement of cells within these structures.
- Proper cell organisation is crucial for the functioning and survival of the organism.
    - Examples of functions supported by cell organisation include digestion, circulation, and movement in animals.

Cells ➜ Tissues ➜ Organs ➜ Organ systems

- Tissue = a group of cells with similar structures, working together to perform a shared function
- Organ = a structure made up of a group of tissues, working together to perform specific functions
- Organ system = a group of organs with related functions, working together to perform body functions

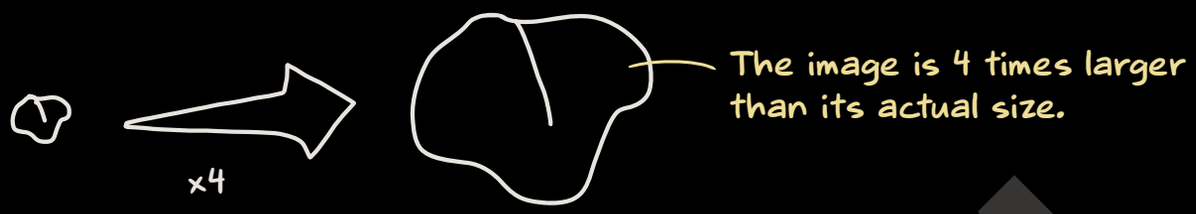


Different tissues in stomach

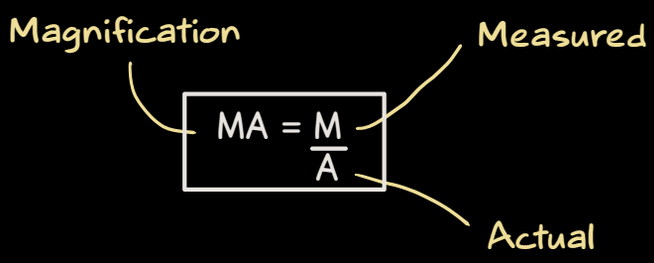


Magnification

- Magnification = a measurement of the extent to which the size of an image is increased compared to its actual size



The specimen is magnified 4 times.

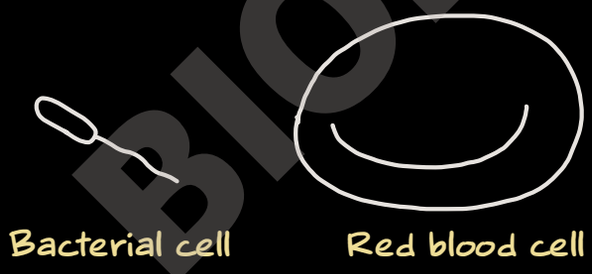


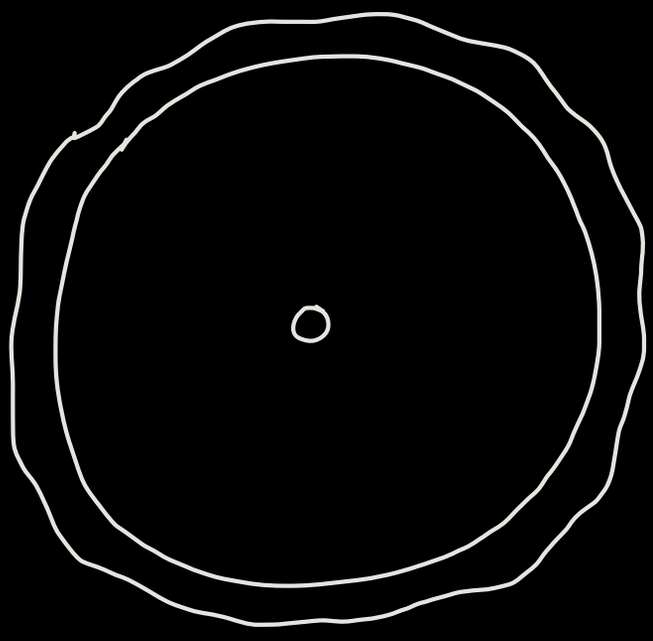
Size of specimens

A typical bacterial cell ~ 1 µm.

A red blood cell ~ 6 µm.

A human egg cell ~ 100 µm.





- 1 cm. = 10 mm.
- 1 mm. = 1,000 µm.