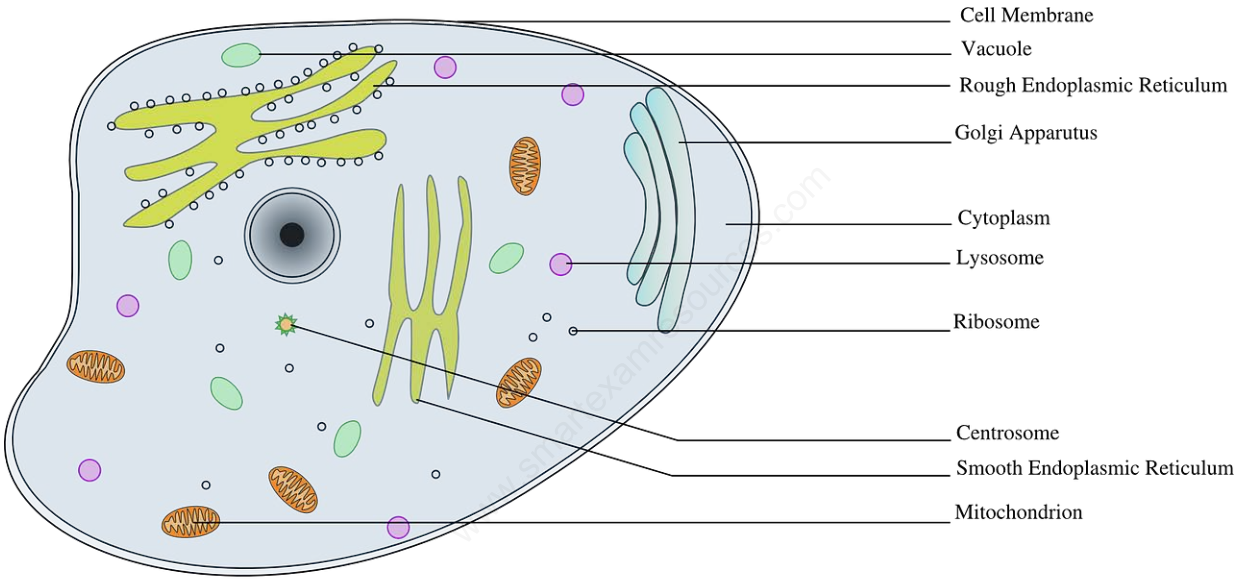
CELL STRUCTURE

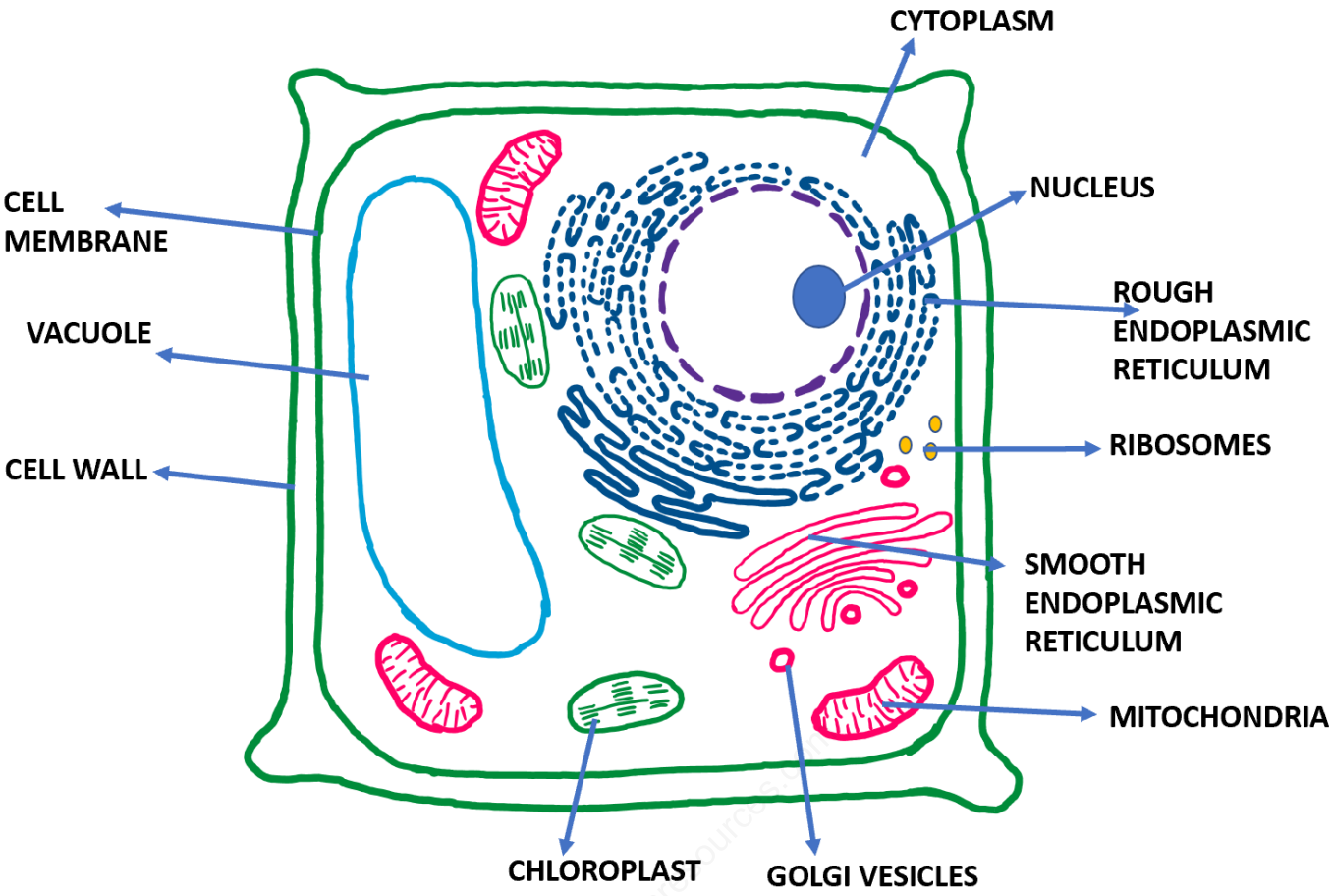
Cells

Cells are the small building blocks that make up all living organisms. Very small living things such as bacteria are made of only one cell.

ANIMAL CELL



PLANT CELL



Differences between plant and animal cells

The differences between plant and animal cells are summarized in the table.

Feature	Plant cell	Animal cell
Cellulose cell wall	present	absent
shape	Permanent shape determined by the cell wall; shapes can be nearly spherical, box-like or cylindrical	Shapes vary as there is no cell wall
Chloroplasts	Present in some cells	Absent
Vacuole	Large permanent vacuole containing cell sap	Small vacuoles, do not contain cell sap
Nucleus	Present (often at the side of the cell close to the cell wall)	Present (found anywhere within the cell)
Cytoplasm	present	present
Cell membrane	present	present

Functions of cell structures

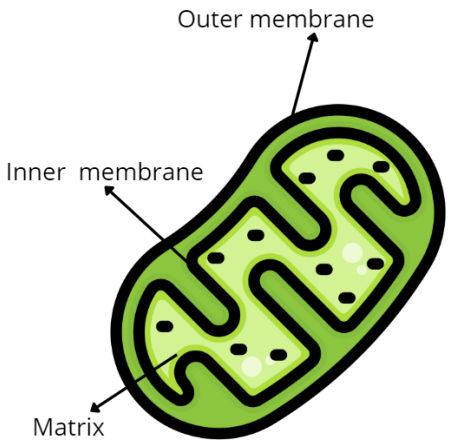
Cell structure	Functions
Cell membrane	• Forms a barrier between the cells and its surroundings • Keeps contents of cells inside • Allows simple substances to enter and leave the cell, e.g. oxygen, carbon dioxide and water • Controls movement of other substances into and out of cell, e.g. glucose • Often described as partially permeable
Nucleus	• Controls all activities in the cell • Controls how cells develop
Cytoplasm	• Place where many chemical reactions take place, e.g. respiration and making proteins for the cell
Chloroplast	• Photosynthesis • Stores starch
Cell wall	• Stops cells from bursting when they fill with water • Gives shape to cells • Allows water and dissolves substances to pass through freely (often described as freely or fully permeable)
Sap vacuole	• Full of water to maintain shape and 'firmness' of cell • Stores salts and sugars

Cytoplasm:

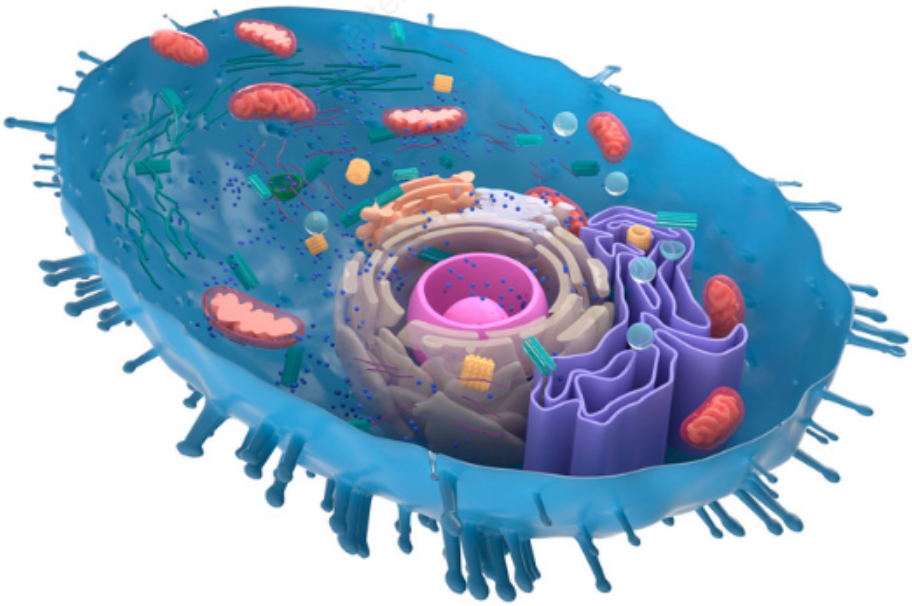
- The cytoplasm of a cell consists of all of the contents outside of the nucleus and enclosed within the cell membrane of a cell. It is clear in color and has a gel-like appearance.
- Cytoplasm is composed mainly of water but also contains enzymes, salts, organelles (ribosomes on the rough endoplasmic reticulum and the vesicles), and various organic molecules.

Mitochondria :

- Mitochondria, (singular: mitochondrion) are found in all living cells except bacteria or archaea.
- These are organelles within eukaryotic cells that produce adenosine triphosphate (ATP), the main energy molecule used by the cell. For this reason, the mitochondrion is sometimes referred to as "the powerhouse of the cell".

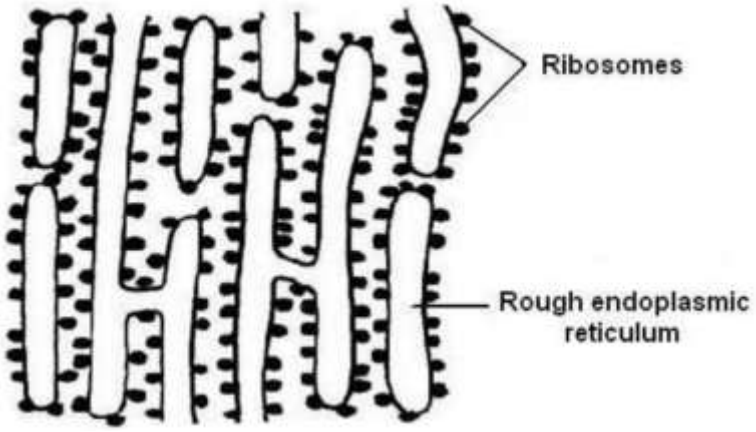


- Almost all cells, except prokaryotes, have mitochondria and rough endoplasmic reticulum.
- Aerobic respiration occurs in mitochondria.
- Cells with high rates of metabolism require large number of mitochondria to provide sufficient energy.

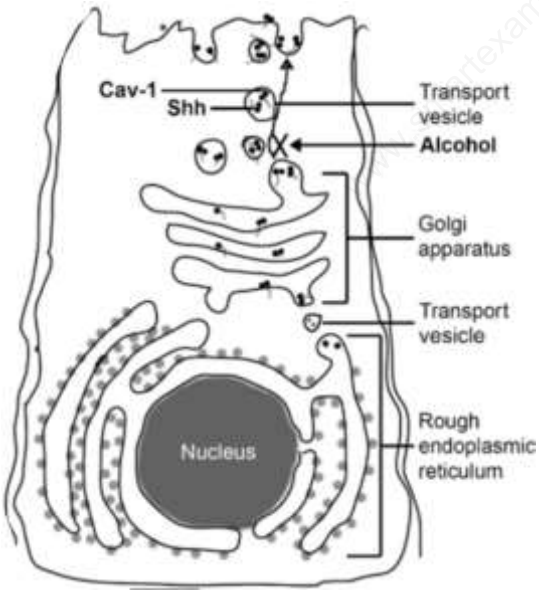


Rough endoplasmic reticulum :

- The endoplasmic reticulum is a multi-fold membranous structure within eukaryotic cells.

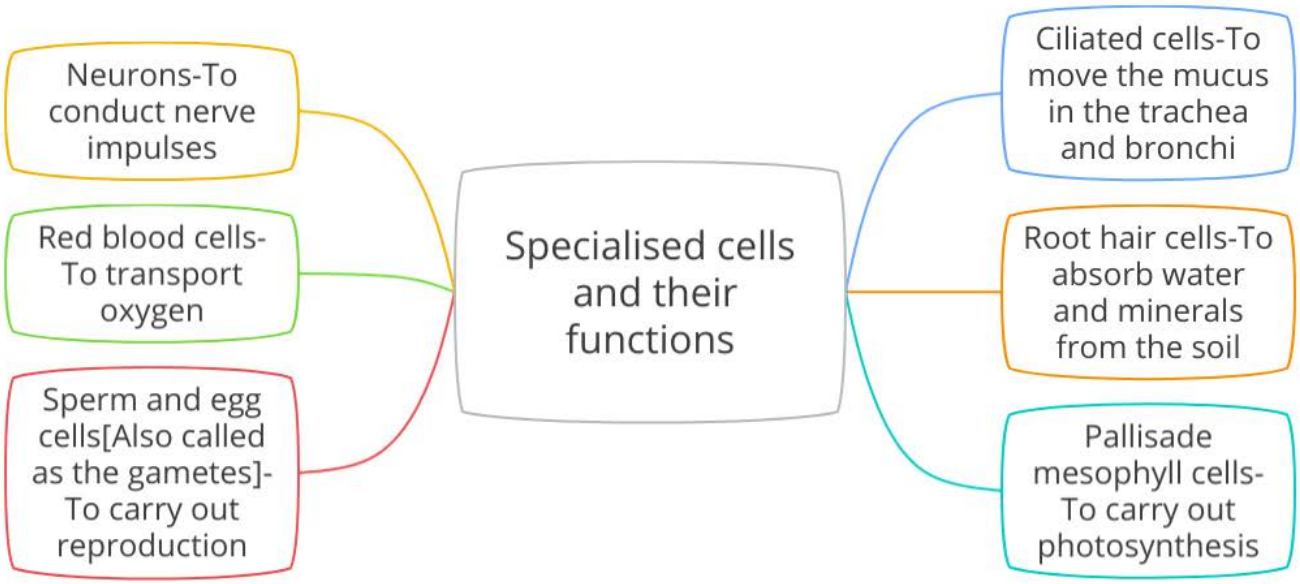


  - It plays a major role in the synthesis of the complex molecules required by the cell and the organism as a whole.
  - When the membranes of these structures are lined with ribosomes on their outer surfaces, giving them a rough appearance ,they are called as the rough endoplasmic reticulum .
- The smooth endoplasmic reticulum has no ribosomes attached to them .
- The ribosomes on the rough endoplasmic reticulum manufacture proteins which enter the channels of the endoplasmic reticulum. They then move to places where they can create pockets. These pockets can then break off as vesicles to transport their protein to the Golgi complex for distribution.

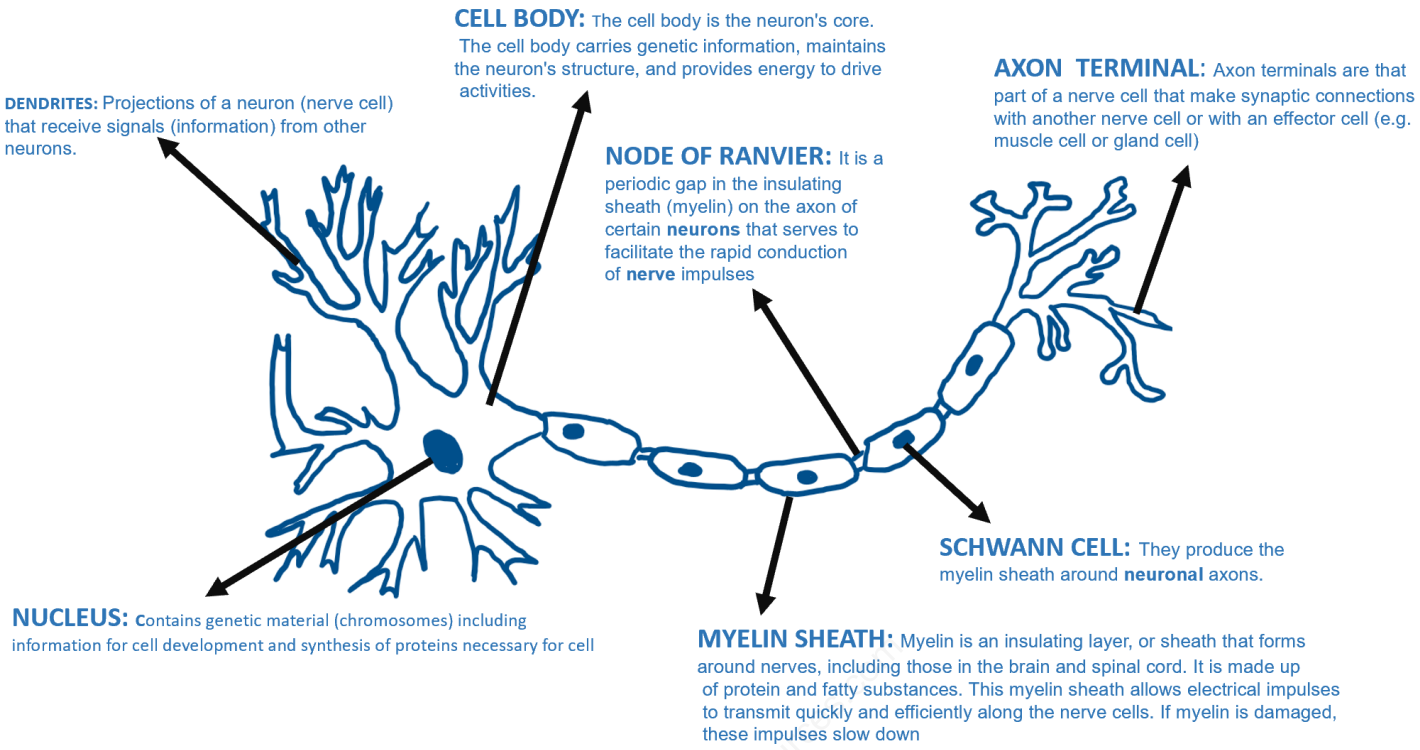


  - Examples of protein synthesis include the proteins produced in secretory cells. These include the digestive enzymes produced in the stomach and the protein hormones like insulin produced in the pancreas. Organ systems which produce many proteins have cells with a large amount of rough endoplasmic reticulum.

SPECIALISED CELLS



STRUCTURE OF A TYPICAL NEURON



1.Nervous system cells are called neurons.
2.A neuron varies in shape and size depending upon their function and location.
3.They have three distinct parts, including a cell body, axon, and dendrites.

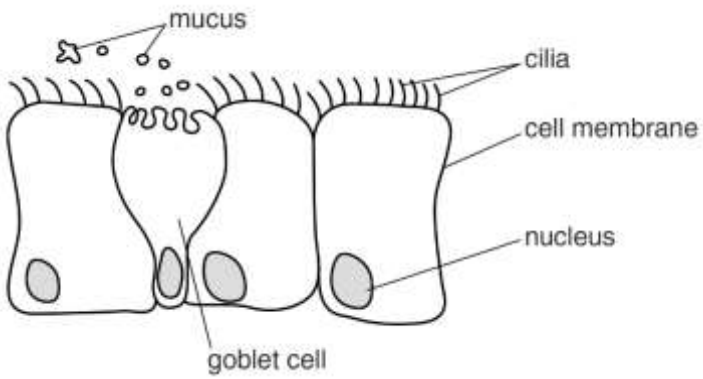
4.Some axons are covered with myelin, a fatty material that acts as an insulator and helps to speed up the process of communication.

5.Dendrites are branch-like structures extending away from the cell body and their job is to receive messages from other neurons and allow those messages to travel to the cell body.
6.The cell body contains a nucleus, smooth and rough endoplasmic reticulum, Golgi apparatus

7.Axon carries an electrical impulse from the cell body (or from another cell's dendrites) to thestructures at opposite end of the neuron—axon terminals
8.Some axons are covered with myelin. Myelin sheath is a fatty material that acts he electrical signal as it travels down the axon.
9.Also due to this sheath, the electrical signals are conducted at a faster rate

NOTE:This insulation provided by the myelin sheath is important, as the axon from a human motor neuron can be as long as a meter—from the base of the spine to the toes.

CILIATED CELLS



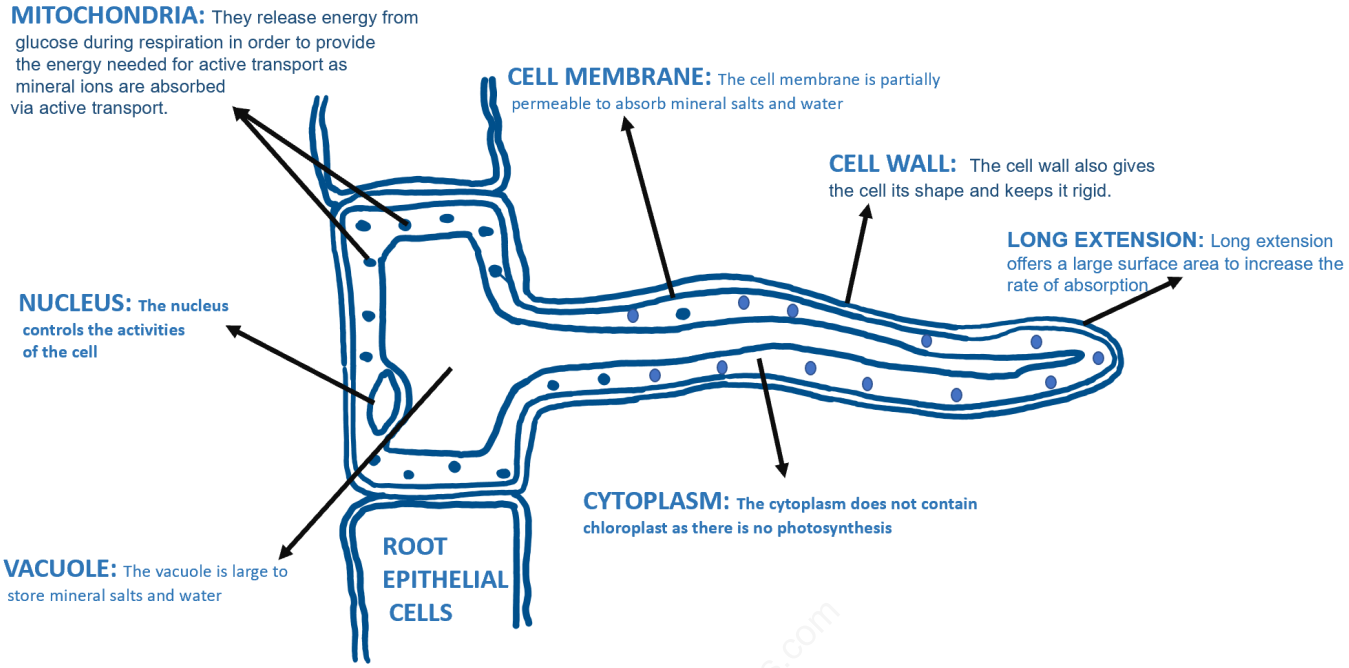
Found in :

The air passages in the lungs (trachea and bronchi) and in the oviducts in the female reproductive system.

Cilia:

- Cilia beat back and forth
- In the airways, cilia move the mucus that traps dust and pathogens up to the nose and throat.
- In the oviducts, cilia move the egg from the ovary to the uterus.

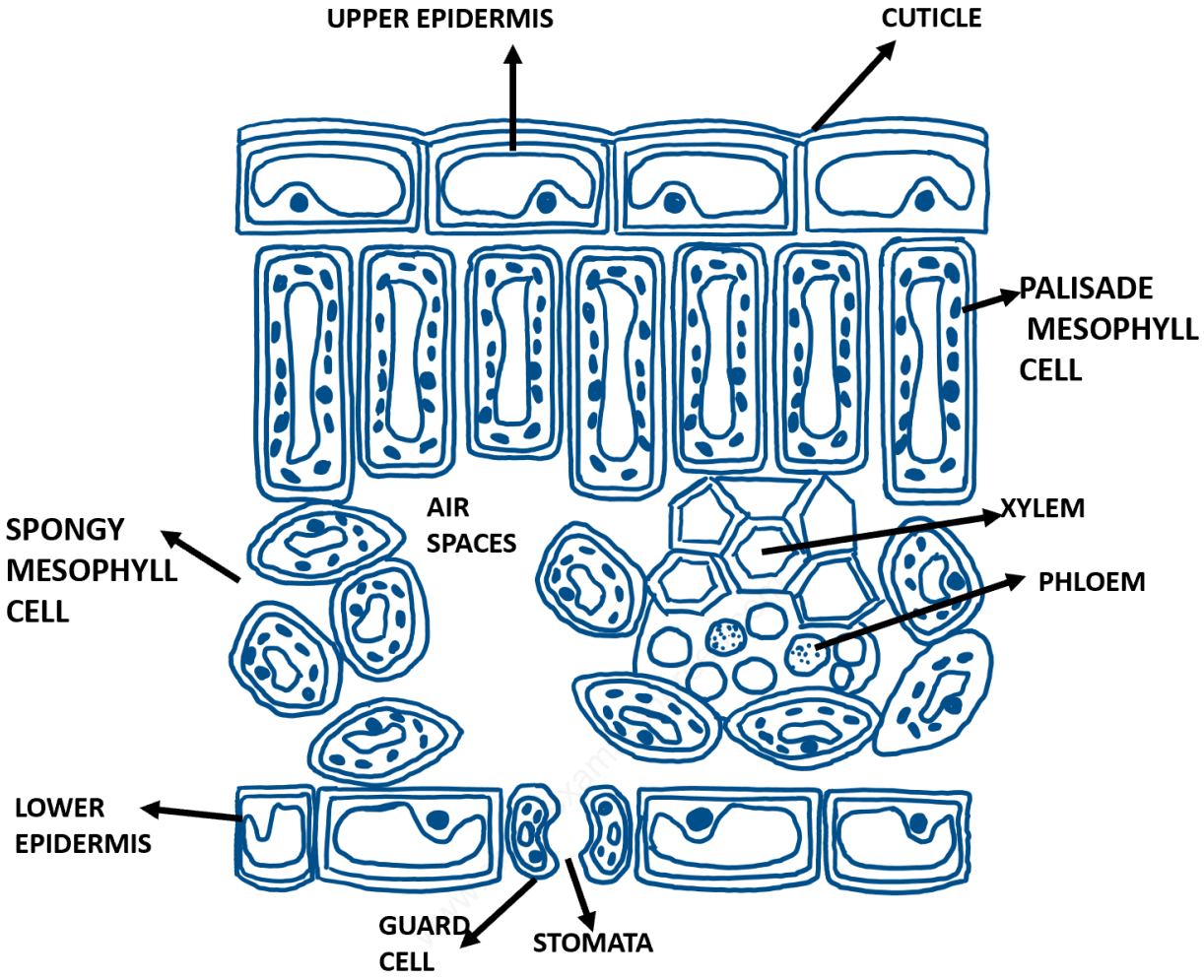
LABELLED DIAGRAM OF A ROOT HAIR CELL



Root hair cells

- They have have long extensions that give them a large surface area to absorb water and ions from the soil.
- Plants absorb water from the soil by osmosis. They absorb mineral ions by active transport, against the concentration gradient.
- Root hair cells are adapted for taking up water and mineral ions by having a large surface area to increase the rate of absorption.
- They also contain lots of mitochondria, which release energy from glucose during respiration in order to provide energy needed for active transport.

PALLISADE MESOPHYLL CELL



- They contain maximum number of chloroplasts and hence are the primary site of photosynthesis

RED BLOOD CELLS

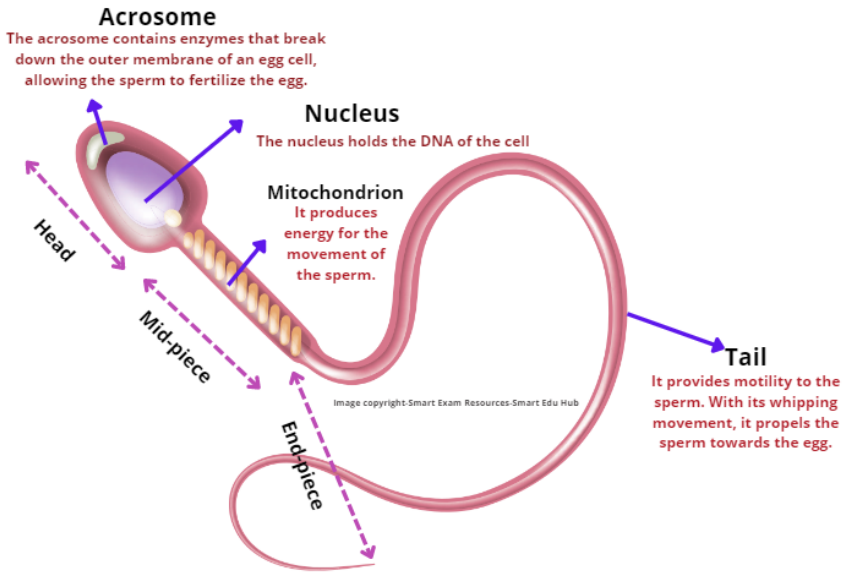
- Red blood cells (RBCs), also referred to as red cells, red blood corpuscles, haematids, erythroid cells or erythrocytes .
- They are biconcave flattened disc shaped like . This shape provides a large surface area compared with their volume which makes for efficient absorption of oxygen.
- They contain the protein haemoglobin that carries oxygen. Blood appears red because of the large number of red blood cells, which get their color from the hemoglobin.
- Red blood cells start as immature cells in the bone marrow and after approximately seven days of maturation are released into the bloodstream.

Red blood cells

- Unlike many other cells, red blood cells have no nucleus and can easily change shape, helping them fit through the various blood vessels in your body. However, while the lack of a nucleus makes a red blood cell more flexible, it also limits the life of the cell as it travels through the smallest blood vessels, damaging the cell's membranes and depleting its energy supplies. The red blood cell survives on average only 120 days.

SPERM AND EGG CELLS-GAMETE CELLS

Sperm Cells:



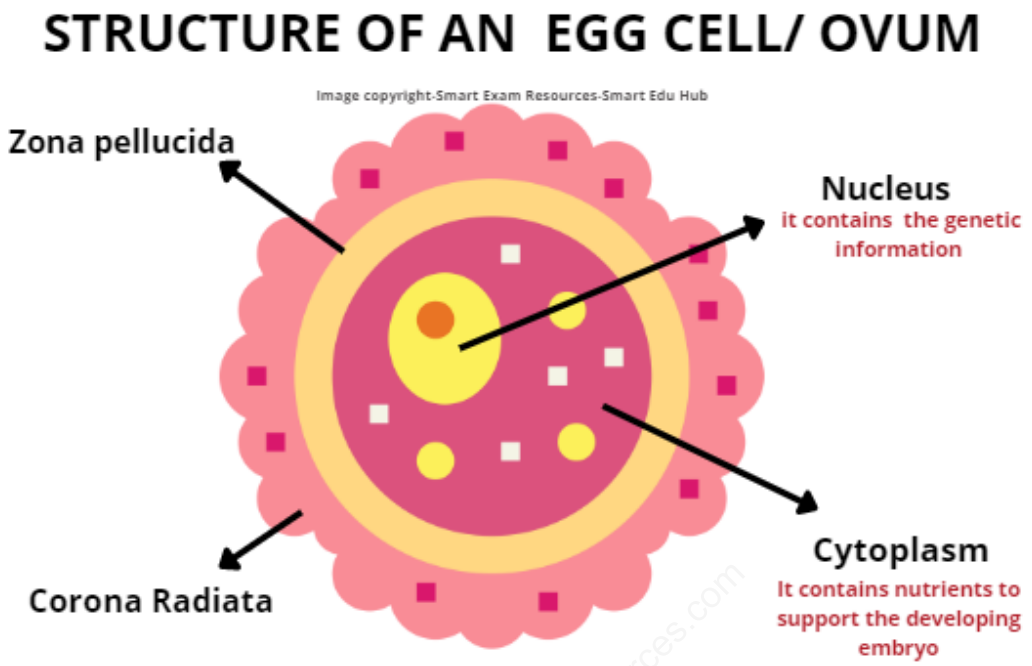
STRUCTURE OF A SPERM CELL

- Sperm cells are gametes (sex cells) that are produced in the testicular organ (gonad) of male human beings and animals.
- They have 23 chromosomes
- A sperm cellconsists of the following parts namely: a distinctive head, a middle piece (body) and a tail
- The sperm head is the part of the cell that contains the nucleus and makes up about 10 percent of the entire cell.
- The nucleus takes up 65 percent of the head and consists of 23 chromosomes.
- The midpiece contains tightly packed mitochondria that provide the energy requires for swimming. In addition to providing the energy required for swimming, mitochondria is also suggested to play a role in controlled cell death known as apoptosis.
- The sperm tail is a thin, elongated structure that makes up about 80 percent of the entire length of the sperm. It provides motility to the cell. Sperm cells have been shown to swim at an average rate of 3mm a minute.

Adaptations of the sperm cell:

- The sperm has a streamlined body that allows it to move rapidly to reach the target egg cell.
- The midpiece of a sperm carries about 70 mitochondria, which is the source of energy (ATP). This provides sufficient energy required for propulsion as the cell travels towards the female gamete. The mitochondria of sperm cells is discarded once the sperm head penetrates the egg.
- The acrosome identifies target female gamete and contains lysosomal enzymes that degrade the thick membrane of the egg. The acrosome therefore helps promote fertilization.

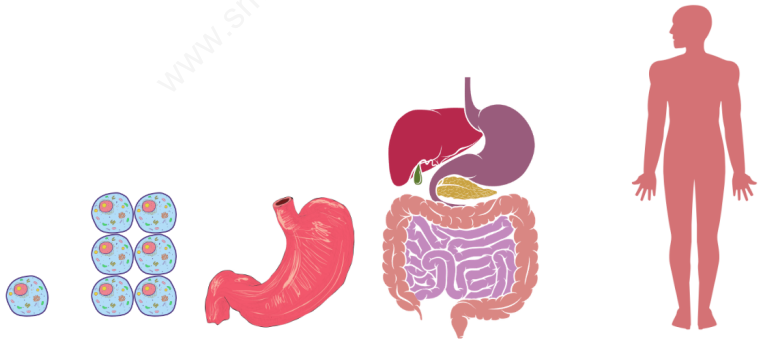
EGG CELL [OVUM]



- The ovum itself has a central nucleus that contains the female's genetic material; this, with the genetic material in the sperm cell, determines the inherited characteristics of the child.
- Surrounding the nucleus is a cell plasma, or yolk, that contains nutritional elements essential to the developing egg cell.

Important definitions:

- **Tissue :** It is a group of cells with similar structures, working together to perform a shared function :
  Examples of animal tissues : Smooth muscle tissue, cardiac muscle tissue , skeletal muscle tissue, nervous tissue, blood
  Examples of plant tissues: Xylem, phloem, parenchyma, collenchyma, sclerenchyma, epidermis and meristematic tissue.
  - ✓ The tissue that carries out photosynthesis in leaves is called **mesophyll**.
  - ✓ The palisade cells make up the **palisade mesophyll tissue**.
- **Organ:** It is a structure made up of a group of tissues, working together to perform specific functions.
  Examples of animal organs: Brain, Lungs, Liver, Bladder, Kidneys, Heart ,Stomach, Intestine
  Examples of plant organs: The leaf, stem, root, and reproductive structures
- **Organ system :** It is a group of organs with related functions, working together to perform body functions
- **Examples of animal organ systems**: Respiratory, Circulatory, Nervous, Digestive, Endocrine, Reproductive, Lymphatic, Muscular, Immune, Skeletal, Urinary and the Integumentary system
  Examples of plant organ systems: Shoot and the root organ system.



More about the organ systems and organ examples(Humans):
The digestive system is made up of a gullet, stomach, pancreas, liver and intestines.

- The excretory system is made up of the kidneys, uterus and bladder.
- The nervous system is made up of the brain, spinal cord and nerves.
- The reproductive system in females is the ovaries, oviducts, uterus and vagina; in males it is the testes, sperm ducts, prostate gland and penis.

All the different organ systems make up a living organism.

Note:New cells are produced by the division of existing cells