

O-Level Biology Notes

First Edition

M.Abid Aziz.

(0333-4460887)

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Chapter - 1

Cell Structure and Organisation

Content

- 1.1 Plant and animal cells
- 1.2 Specialised cells, tissues and organs

Learning outcomes

Candidates should be able to:

- (a) *examine under the microscope an animal cell (e.g. from fresh liver) and a plant cell (e.g. from Elodea, a moss, onion epidermis, or any suitable, locally available material), using an appropriate temporary staining technique, such as iodine or methylene blue;*
- (b) *draw diagrams to represent observations of the plant and animal cells examined above;*
- (c) *identify, from fresh preparations or on diagrams or photomicrographs, the cell membrane, nucleus and cytoplasm in an animal cell;*
- (d) *identify, from diagrams or photomicrographs, the cell wall, cell membrane, sap vacuole, cytoplasm, nucleus and chloroplasts in a plant cell;*
- (e) *compare the visible differences in structure of the animal and the plant cells examined;*
- (f) *state the function of the cell membrane in controlling the passage of substances into and out of the cell;*
- (g) *state, in simple terms, the relationship between cell function and cell structure for the following:*
 - *absorption – root hair cells;*
 - *conduction and support – xylem vessels;*
 - *transport of oxygen – red blood cells;*
- (h) *identify these cells from preserved material under the microscope, from diagrams and from photomicrographs;*
- (i) *differentiate cell, tissue, organ and organ system as illustrated by examples covered in sections 1 to 12, 15 and 16.*

ABID AZIZ

1.1 Plant and Animal Cells

(a) examine under the microscope an animal cell (e.g. from fresh liver) and a plant cell (e.g. from *Elodea*, a moss, onion epidermis, or any suitable, locally available material), using an appropriate temporary staining technique, such as iodine or methylene blue;

Preparation of a microscopic slide:

Preparation of an onion epidermal slide

- Cut a piece of onion with the help of a razor.
- Remove the epidermis with the help of forceps.
- Place the epidermis in the center of a slide.
- Pour few drops of dye/stain on it.
- Place a cover glass on the mounted material in such a way that the cover glass is held on the pointed tip of a needle and gradually lower it down so the air bubbles are not trapped
- Remove the extra stain using blotting paper

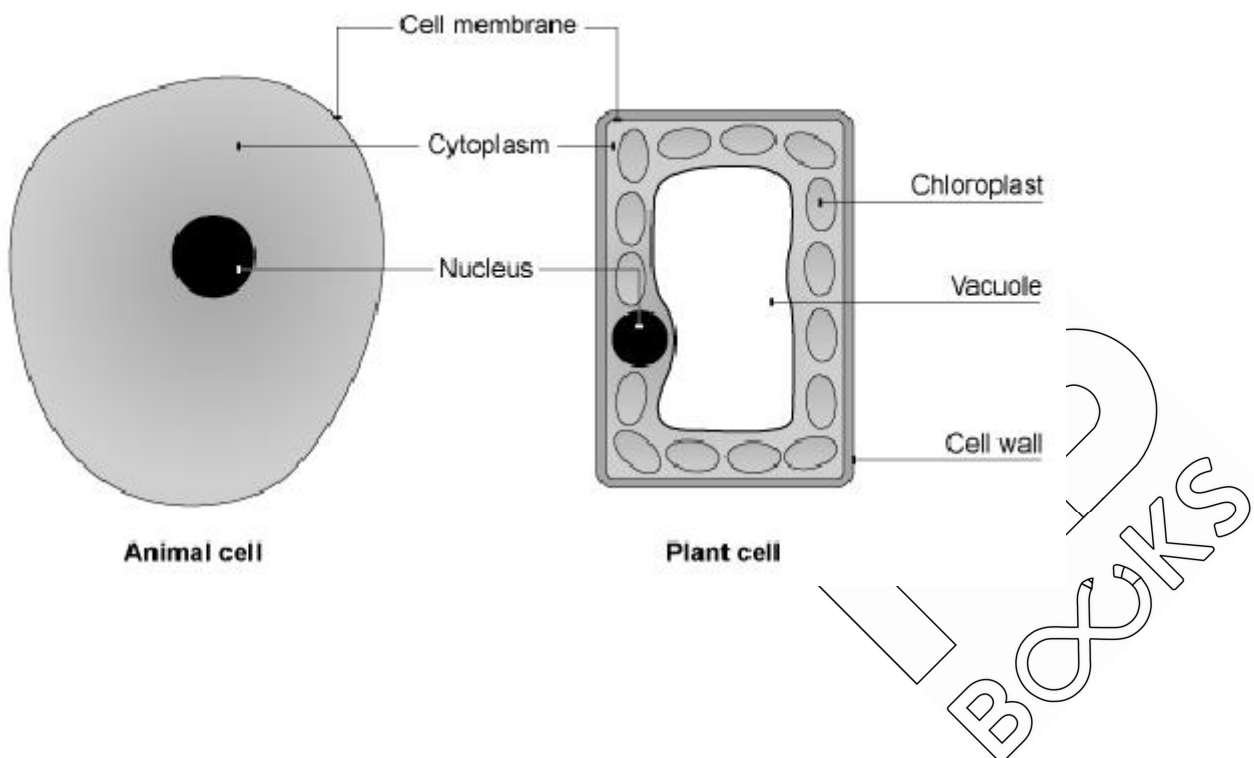
Viewing under a microscope:

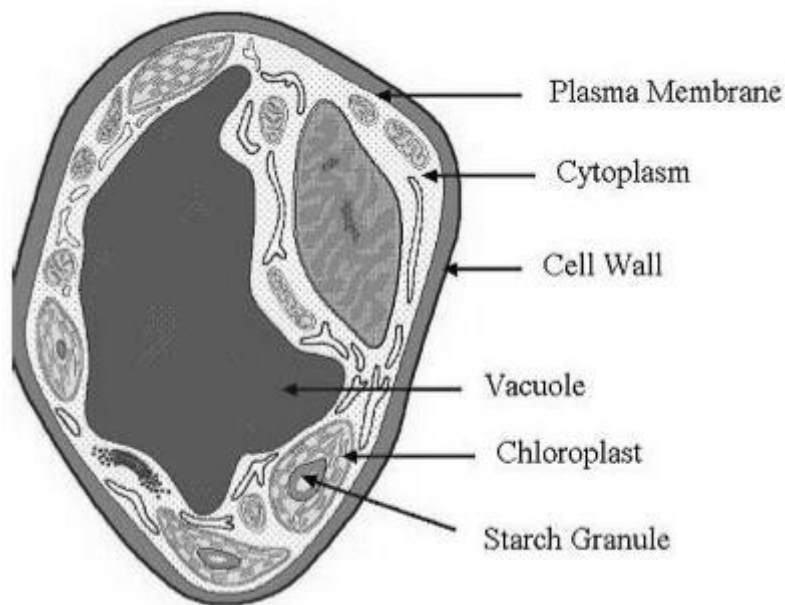
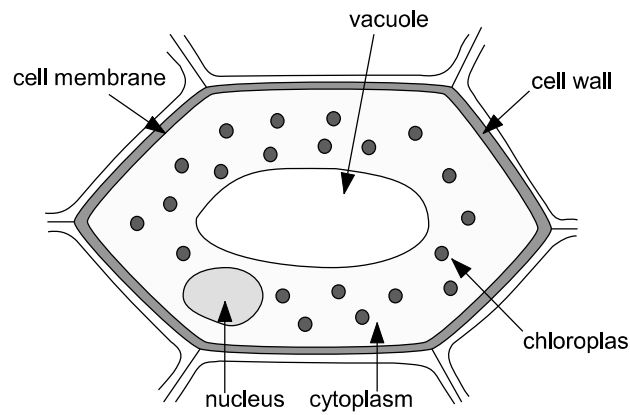
- Place the slide on the stage.
- Turn on the lamp.
- Adjust the power of the objective.
- Looking through the eye piece focus the image by moving adjustment knobs.

(b) draw diagrams to represent observations of the plant and animal cells examined above;

(c) identify, from fresh preparations or on diagrams or photomicrographs, the cell membrane, nucleus and cytoplasm in an animal cell;

(d) identify, from diagrams or photomicrographs, the cell wall, cell membrane, sap vacuole, cytoplasm, nucleus and chloroplasts in a plant cell;





Cell is the basic unit of structure and function of all living things.
A living organism can either be a single celled or multicellular.

Cells are generally too **small** to be seen with the naked eye, so we need **microscopes** to see them and their organelles. But some cells are too large as nerve cells.

Cell membrane, **cytoplasm** and **nucleus** are the common structures found in all types of cells. Plant cells in addition to above structures also have

- a **cell wall** of variable thickness
- **chloroplasts** in photosynthetic cells
- a large **vacuole** containing cell sap.

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Cell wall

It is the outer most covering found only in plant cells, bacteria and fungi.

Cell wall in	Substance that makes the wall
Plants	Cellulose
Bacteria	Peptidoglycan (protein + carbohydrates)
Fungi	Chitin

It has pores through which materials can pass quite easily that make it a fully permeable structure. Being dead and hard it gives shape to the plant cell and protects it from bursting when placed in a solution having higher water potential and protects the cell from mechanical injuries.

(f) state the function of the cell membrane in controlling the passage of substances into and out of the cell;

Cell membrane/Plasma membrane:

- It is the outer most covering found in animal cells.
- In plants, bacteria and fungi it is located next to cell wall.
- It is made up of lipids and proteins.
- It is called as semi-permeable/Partially permeable or selectively permeable membrane because it allows selective materials to pass through.
- It controls the movement of substances into and out of the cell.

Cell Membrane:

Location	outer most covering in animal cells but located next to cell wall in plants
Composition	made up of lipids and proteins.
Function	controls the movement of substances into and out of the cell.

Differentiate between Cell Wall and Cell Membrane

	Features	Cell wall	Cell membrane
1	Status	Dead	Living
2	Location / occurrence	Outermost covering	Next to cell wall or outermost in animals
3	Composition	Cellulose, peptidoglycan, chitin	Lipids and protein
4	Permeability	Fully permeable	Selectively permeable
5	Support / Strength	Provides support and strength	Not applicable
6	Thickness	Variable	Fixed

Cytoplasm

- It is a colorless, transparent and watery part of the cell that is surrounded by cell membrane.
- It contains the organelles present in the cell.
- It is the site where most of the metabolic reactions take place.
- It stores food substances and large amount of water.

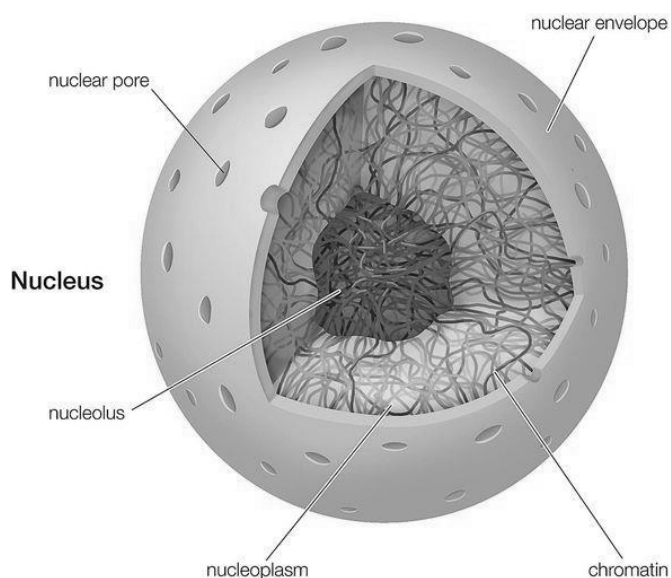
Vacuole/Sap vacuole/Large central vacuole

- Vacuoles in animal cells are small, numerous and temporary.
- Plant cells have a large central vacuole containing cell sap.
- They contain food substances and water.

Nucleus

The organelle that controls the activities of the cell.

- Cells are classified on presence or absence of nucleus.
 - **Prokaryote** (pro means before & karyo means nucleus) – cell without true nucleus as in **bacteria**.
 - **Eukaryote** (Eu means true & karyo means nucleus) – cells with true nucleus as the cells found in plants and animal
- The nucleus controls cell reproduction, growth of the cell, repair of worn-out parts and other activities of the cell.
- The nucleus consists of the nuclear envelope surrounding the nucleoplasm, which contains chromatin and one or more nucleoli.

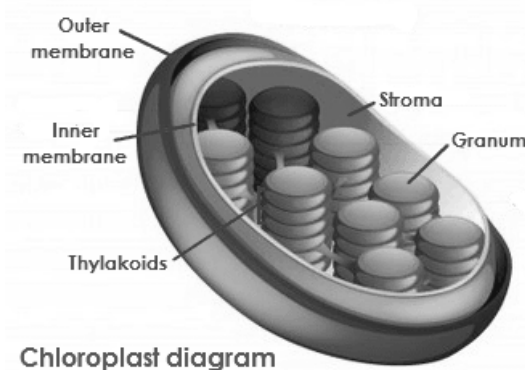


Structure of Nucleus

Nuclear envelope (nuclear membrane)	The membrane around the nucleus, which inhibits the nuclear contents to mix with cytoplasm.
Nucleopore	The pores in the membrane through which larger molecules and structures can pass across. (mRNA, ribosomes, ATP molecules)
Nucleoplasm	The nucleoplasm is one of the types of protoplasm, and it is enveloped by the nuclear membrane or nuclear envelope. The nucleoplasm includes the chromosomes and nucleoli.
Chromatin	In the nucleus, the DNA double helix is packaged by special proteins (histones) to form a complex called chromatin. The chromatin is a lower order of DNA organization.
Chromosome	The chromatin undergoes further condensation to form the chromosome . Chromosomes are the higher order of DNA organization. An organism's genetic content is counted in terms of the chromosome pairs present. e.g. humans have 23 pairs (46) of chromosomes.
Nucleoli	Helps in formation of ribosomes that take part in protein synthesis.

Chloroplasts

- Chloroplasts are present only in the cells that are present in green photosynthetic parts of the plant.
- Chloroplasts** contain a green pigment **chlorophyll**, which absorbs sunlight for **photosynthesis**.
- There may be **starch grains** inside the chloroplasts as stored food.



(e) compare the visible differences in structure of the animal and the plant cells examined;

Differences between plant cells and animal cells

	Features	Plant cell	Animal cell
1	Cell wall	Present	Absent
2	Chloroplast	Present	Absent
3	Vacuole	Single, Large & permanent	Many, Small & temporary
4	General cell size	Larger	Smaller

Some other important organelles

1	Endoplasmic Reticulum (ER) - an internal membrane system	Rough ER (RER) transports proteins from the ribosomes to the Golgi apparatus for secretion out of the cell. Smooth ER (SER) is involved in producing fats and steroids and in detoxification.
3	Ribosomes	Are involved in protein synthesis. Most are attached to RER but some lie freely in the cytoplasm.
4	Golgi apparatus	Secretes substances made by the ER out of the cell. It also stores and modifies substances of secretion.
5	Mitochondria	Provide energy when food substances are broken down by oxidation during cell respiration.
6	Vesicles	Transport substances within the cell.
	Centriole	Plays a part in cell division. They are present only in animal cells.

Comparison of plant and animal cell

	Organelle	Animal cell	Plant cell	Function
1	Cell wall	X	✓	Protection against bursting and strengthen
2	Cell membrane	✓ ✓	✓	Controls movement of materials move across it.
3	Cytoplasm	✓	✓	Holds large number of chemical reactions
4	Chloroplast	X	✓	Absorbs light for photosynthesis
5	Nucleus	✓	✓	Controls the activities of the cell
6	Vacuole	✓ (small, many)	✓ (large, single)	Stores water and minerals for the plant cell.