

THE CELL

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Introduction

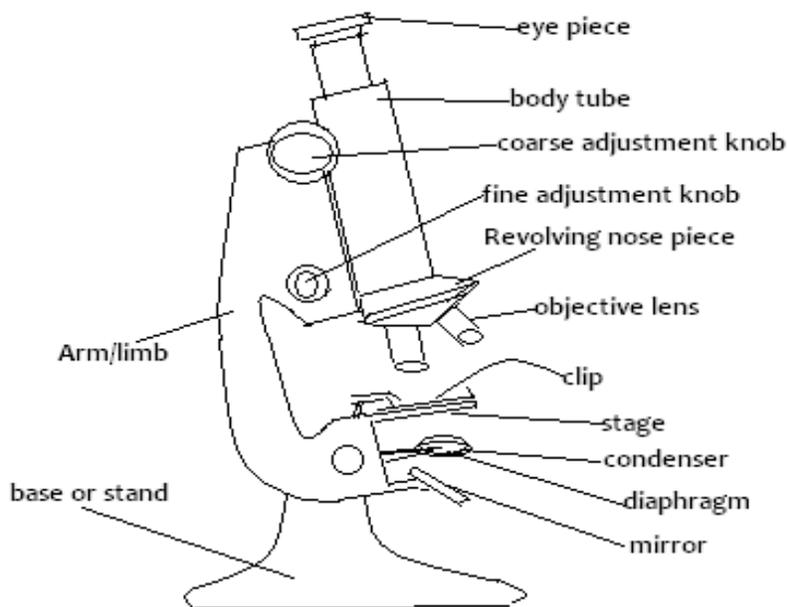
- ✓ The cell is the basic unit of an organism.
- ✓ All living organisms are made up of cells.
- ✓ Some organisms are made up of one cell and others are said to be multicellular.
- ✓ Other organisms are made of many cells and are said to be multicellular.
- ✓ Cells are too little to see with the naked eye.
- ✓ They can only be seen with the aid of a microscope.

The microscope

The microscope is used to magnify objects.

Magnification

- ✓ The magnifying power is usually inscribed on the lens.
- ✓ To find out how many times a specimen is magnified, the magnifying power of the objective lens is multiplied by that of the eye piece lens.
- ✓ If the eye piece magnification lens is x10 and the objective lens is x4, the total magnification is x40.
- ✓ Magnification has no units.
- ✓ It should always have the multiplication sign.e.g.x40



The light microscope

FIGURE 1: MICROSCOPE

Microscope parts and their functions

<i>Parts</i>	<i>Function(s)</i>
Eye piece	Has a lens which contributes to the magnification of the object under view.
Coarse adjustment knob	Moves the body tube up and down for long distances and it brings the image into focus.
Fine adjustment knob	Moves the body tube and brings the image into fine focus.
Body tube	Holds the eye piece and the revolving nose piece. It directs light from objective lenses to the eye piece lens.
Revolving nose piece	Holds and brings objective lenses into position.
Objective lens	Contributes to the magnification of the object.
Arm/limb	It is for handling the microscope and also tilting it.
Stage	Is the flat platform onto which the slide with the object is placed?
Clips	They hold the slide firmly onto the stage
Condenser	Concentrates light onto the object.
Diaphragm	Regulates the amount of light passing through the object.
Mirror	Reflects light into the condenser.
Hinge screw	Fixes the arm to the base and allows for tilting of the arm.
Base/stand	Provides support to the microscope

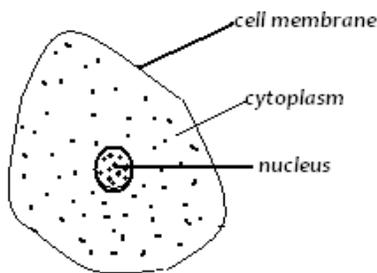
To View the Object

- ✓ Turn the low power objective lens until it clicks into position.
- ✓ Looking through the eye piece, ensure that enough light is passing through by adjusting the mirror.
- ✓ This is indicated by a bright circular area known as the field of view.
- ✓ Place the slide containing the specimen on stage and clip it into position.
- ✓ Make sure that the specimen is in the centre of the field of view.
- ✓ Using the coarse adjustment knob, bring the low power objective lens to the lowest point.
- ✓ Turn the knob gently until the specimen comes into focus.
- ✓ If finer details are required, use the fine adjustment knob.
- ✓ When using high power objective always move the fine adjustment knob upwards.

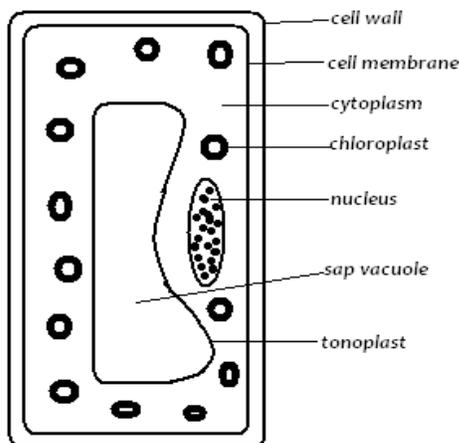
Care of a Microscope

- ✓ Great care should be taken when handling it.
- ✓ Keep it away from the edge of the bench when using it.
- ✓ Always hold it with both hands when moving it in the laboratory.
- ✓ Clean the lenses with special lens cleaning paper.
- ✓ Make sure that the low power objective clicks in position in line with eye piece lens before and after use.
- ✓ Store the microscope in a dust-proof place free of moisture.

Cell Structure as Seen Through the Light Microscope



A typical animal cell



Generalised plant cell

The cell as seen above has the following:

Cell membrane (Plasma membrane):

- ✓ This is a thin membrane enclosing cell contents.
- ✓ It controls the movement of substances into and out of the cell.

Cytoplasm:

- ✓ This is a jelly-like substance in which chemical processes are carried out.
- ✓ Scattered all over the cytoplasm are small structures called organelles.
- ✓ Like an animal cell, the plant cell has a cell membrane, cytoplasm and a nucleus.

Vacuole:

- ✓ Plant cells have permanent, central **vacuole**. It contains cell sap where sugars and salts are stored.

Cell wall:

- ✓ This is the outermost boundary of a plant cell.
- ✓ It is made of cellulose.
- ✓ Between the cells is a middle lamella made of calcium precipitate.

Chloroplasts;

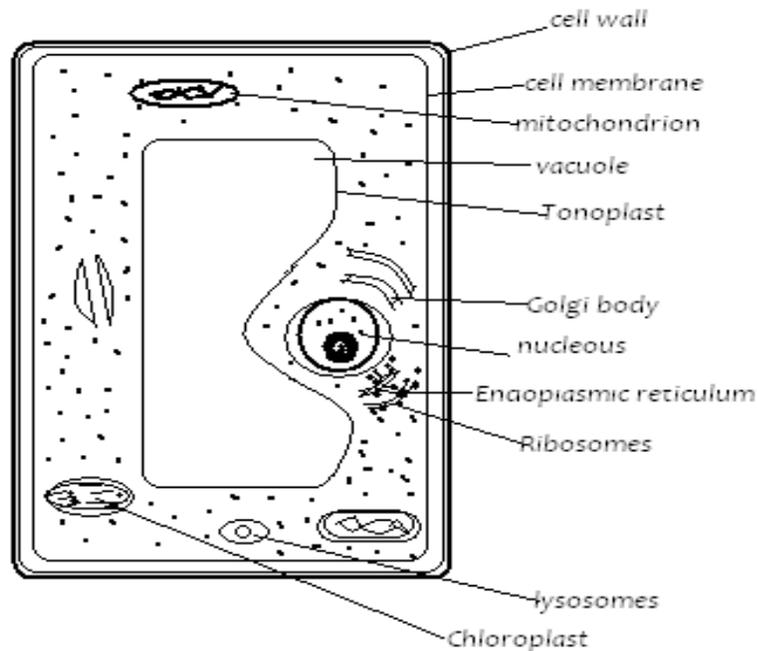
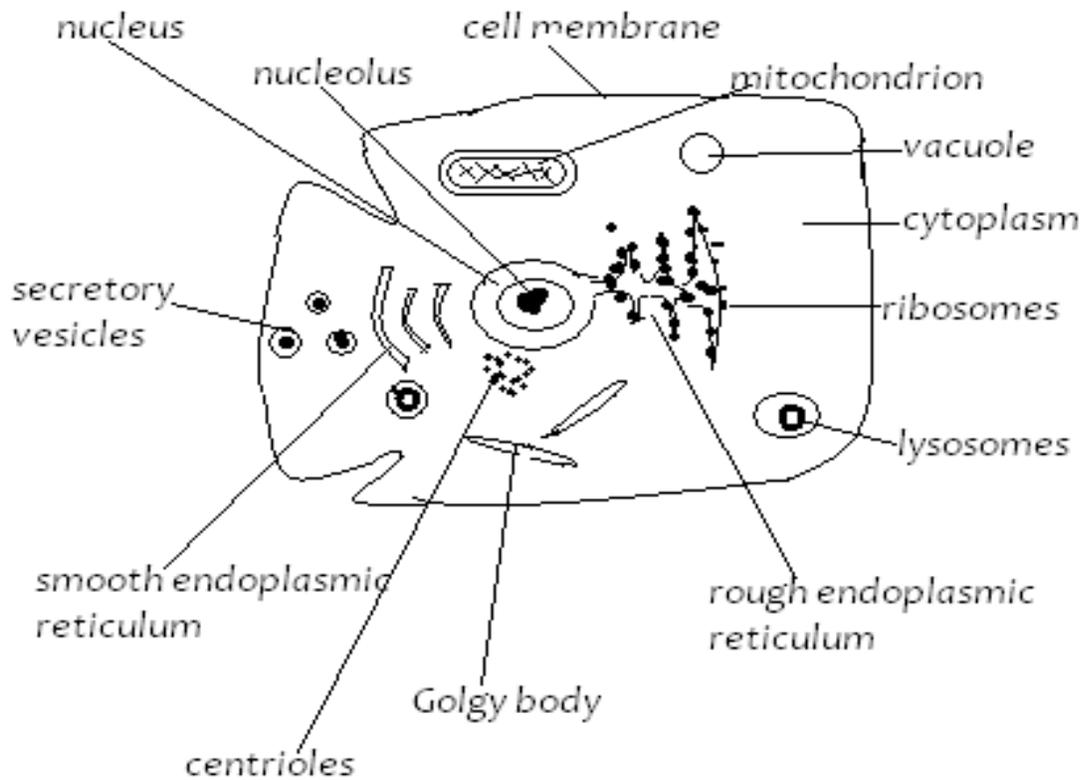
- ✓ With special staining techniques it is possible to observe chloroplasts.
- ✓ These are structures which contain chlorophyll, the green pigment responsible for trapping light for photosynthesis.

The Electron Microscope (EM)

- ✓ Capable of magnifying up to 500,000 times.
- ✓ The specimen is mounted in vacuum chamber through which an electron beam is directed.
- ✓ The image is projected on to a photographic plate.
- ✓ The major disadvantage of the electron microscope is that it cannot be used to observe living objects.
- ✓ However, it provides a higher magnification and resolution (ability to see close points as separate) than the light microscope so that specimen can be observed in more detail.

Cell Structure as Seen Through Electron Microscope

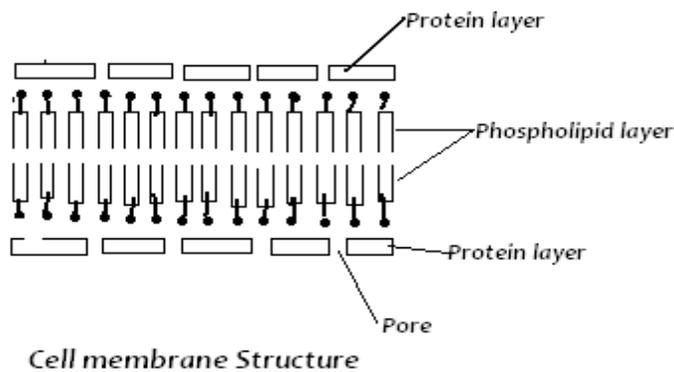
A generalised animal cell as seen under Electron microscope



A generalised plant cell as seen under the electron microscope

The Plasma Membrane

- ✓ Under the electron microscope, the plasma membrane is seen as a double layer.
- ✓ This consists of a lipid layer sandwiched between two protein layers.
- ✓ This arrangement is known as the unit membrane and the shows two lipid layers with proteins within.
- ✓ Substances are transported across the membrane by active transport and diffusion.



The Endoplasmic Reticulum (ER)

- ✓ This is a network of tubular structures extending throughout the cytoplasm of the cell.
- ✓ It serves as a network of pathways through which materials are transported from one part of the cell to the other.
- ✓ An ER encrusted with ribosomes it is referred to as rough endoplasmic reticulum.
- ✓ An ER that lacks ribosomes is referred to as smooth endoplasmic reticulum.
- ✓ The rough endoplasmic reticulum transports proteins while the smooth endoplasmic reticulum transports lipids.

The Ribosomes

- ✓ These are small spherical structures attached to the ER.
- ✓ They consist of protein and ribonucleic acid (RNA).
- ✓ They act as sites for the synthesis of proteins.

Golgi Bodies

- ✓ Golgi bodies are thin, plate-like sacs arranged in stacks and distributed randomly in the cytoplasm.
- ✓ Their function is packaging and transportation of glycol-proteins.
- ✓ They also produce lysosomes.

Mitochondria

- ✓ Each mitochondrion is a rod-shaped organelle.
- ✓ Made up of a smooth outer membrane and a folded inner membrane.
- ✓ The folding of the inner membrane are called cristae.
- ✓ They increase the surface area for respiration.
- ✓ The inner compartments called the matrix.
- ✓ Mitochondria are the sites of cellular respiration, where energy is produced.

Lysosomes

- ✓ These are vesicles containing hydrolytic enzymes.
- ✓ They are involved in the breakdown of micro-organisms, foreign macromolecules and damaged or worn-out cells and organelles.

The Nucleus

- ✓ The nucleus is surrounded by a nuclear membrane which is a unit membrane.
- ✓ The nuclear membrane has pores through which materials can move to the surrounding cytoplasm.
- ✓ The nucleus contains proteins and nucleic acid deoxyribonucleic acid (DNA) and RNA.
- ✓ The chromosomes are found in the nucleus.
- ✓ They are the carriers of the genetic information of the cell.
- ✓ The nucleolus is also located in the nucleus but it is only visible during the non-dividing phase of the cell.

The Chloroplasts

- ✓ These are found only in photosynthetic cells.
- ✓ Each chloroplast consists of an outer unit. Membrane enclosing a series of interconnected membranes called lamellae.
- ✓ At various points along their length the lamellae form stacks of disc like structures called grana.
- ✓ The lamellae are embedded in a granular material called the stroma.
- ✓ The chloroplasts are sites of photosynthesis.
- ✓ The light reaction takes place in the lamellae while the dark reactions take place in the stroma.

Comparison between animal cell and plant cell

<i>Plant Cell</i>	<i>Animal Cell</i>
Has a cell wall and a cell membrane	Has cell membrane only
Nucleus at periphery	Nucleus at the center
Have chloroplasts	Have no chloroplasts
Are usually large	Are usually small
Has a large central vacuole	Has no vacuoles, they are small and scattered
Are regular in shape	Irregular in shape
Has no centriole	Has centrioles
Stores starch, oils and protein	Store glycogen and fats

Cell Specialization

Cells are specialized to perform different functions in both plants and animals.

Example;

-
- ✓ Palisade cells have many chloroplasts for photosynthesis.
 - ✓ Root hair cells are long and thin to absorb water from the soil.
 - ✓ Red blood cells have haemoglobin which transports oxygen.
 - ✓ Sperm cells have a tail to swim to the egg.

- ✓ Multicellular organisms cells that perform the same function are grouped together to form a tissue.
- ✓ Each tissue is therefore made up of cells that are specialised to carry out a particular function.

Animal Tissues

Examples of animal tissues

<i>Type of tissue</i>	<i>Functions</i>	<i>Characteristics</i>
1. Epithelial Tissue a. Squamous epithelium b. Columnar epithelium c. stratified epithelium d. Cuboidal epithelium	Covering, allowing movement of materials Covering of internal organs, lining for body cavity. Secretion, absorption e.g. in the alimentary canal. Covering surfaces, protection e.g. the skin. Absorption e.g. in the kidney tubules.	Thin flat cells. Cells that are longer than they are wide. Several layers of epithelial cells (either squamous. cuboidal or columnar). Cube like cells.
2. Muscular Tissue a. Striated (skeletal or voluntary muscle) b. Smooth (visceral or involuntary muscle) c. Cardiac muscle	Contraction, bringing about movement of body parts. Contract and allow movement. Cover internal organs; allow movement e.g. peristalsis. Cause contraction of the heart.	Consists of units called myofibrils. Are multinucleated; have transverse striations; Controlled by voluntary nervous system. Are spindle-shaped. mononucleated; Controlled by involuntary nervous system. contract rhythmically; are myogenic (ability to contract is within)
3. Supporting Tissue a. Cartilage b. Bone	Support the body. provide a rigid Framework, protect soft tissue.	Cells that produce hard materials.
4. Blood	Transport of materials, protection against disease.	A complex tissue consisting of three types of cells suspended in a fluid medium (Plasma)
5. Nerve Tissue	Receive stimuli and transmit impulses; co-ordinate body activities	Consists of cells called neurons which are interconnected through axons to enable transmission of impulses

Plant Tissues

Example of plant tissues

<i>Type of Tissue</i>	<i>Functions</i>	<i>Characteristics</i>
1. Meristematic	Undergo division and cause growth, e.g. increase in length and girth	Small thin-walled cells, contain a lot of cytoplasm; found mostly at the tip of shoots and roots.
2. Parenchyma	Photosynthesis gaseous exchange; support; storage.	Thin walled cells; vary in shape and size; many intercellular spaces.
3. Collenchyma	Strengthening	Thickened walls; no intercellular spaces; found in cortex of stems.
4. Sclerenchyma	Strengthening	Vary in shape; thick cell walls; are usually dead.
5. Vascular a. Xylem b. Phloem	Transport materials. Transport of water and mineral salts. Transport of organic materials (manufactured food).	Tubular vessels and tracheids joined end to end. Sieve elements joined to each other through sieve pores.

Organs

- ✓ An organ is made up of different tissues e.g. the heart, lungs, kidneys and the brain in animals and roots, stems and leaves in plants.

Organ systems

- ✓ Organs which work together form an organ system.
- ✓ Digestive, excretory, nervous and circulatory in animals and transport and support system in plants.

Organism

- ✓ Different organ systems form an organism.

Practical Activities

Observation and Identification of parts of a light microscope and their functions

- ✓ A light microscope is provided.
- ✓ Various parts are identified and observed.
- ✓ Drawing and labelling of the microscope is done.
- ✓ Functions of the parts of the microscope are stated.
- ✓ Calculations of total magnification done using the formula.
- ✓ Eye piece lens magnification \times objective lens magnification.

Preparation and Observation of Temporary Slides of Plant Cells

- ✓ A piece of epidermis is made from the fleshy leaf of an onion bulb. It is placed on a microscope slide and a drop of water added.
- ✓ A drop of iodine is added and a cover slip placed on top.
- ✓ Observations are made, under low and medium power objective.
- ✓ The cell wall and nucleus stain darker than other parts.
- ✓ A labelled drawing is made.
- ✓ The following are noted: Nucleus, cell wall, cytoplasm and cell membrane.

Observation of permanent slides of animal cells

- ✓ Permanent slides of animal cells are obtained e.g. of cheek cells, nerve cells and muscle cells.
- ✓ The slide is mounted on the microscope and observations made under low power and medium power objectives.
- ✓ Labelled drawings of the cells are made.
- ✓ A comparison between plant and animal cell is made.

Observation and Estimation of Cell Size and Calculation of Magnification of Plant Cells.

- ✓ Using the low power objective, a transparent ruler is placed on the stage of the microscope.
- ✓ An estimation of the diameter of the field of view is made in millimeters.
- ✓ This is converted into micrometres (1mm=1000u)

- ✓ A prepared slide of onion epidermal cells is mounted.
- ✓ The cells across the centre of the field of view are counted from left and right and top to bottom.
- ✓ The diameter of field of view is divided by the number of cells lying lengthwise to give an estimate of the length and width of each cell.