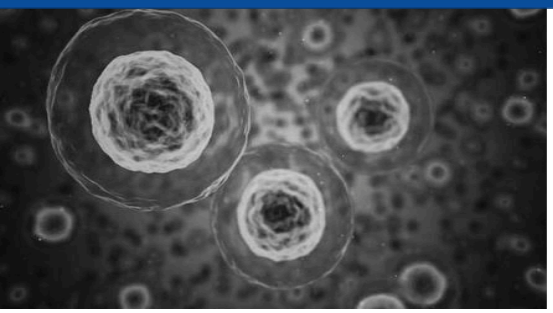


CELL – STRUCTURE AND FUNCTIONS

Concepts Covered

- Basic Discoveries, Theories, Structure, and Functions of Cell Organelles.

Introduction

A cell is the structural and functional unit of life. It is the basic unit of life".
Cytology: It is a branch of science that deals with the study of cells with their components and functions.

Story of Microscope

Anton van Leeuwenhoek- The first man to make and use a real microscope.
There are broadly two types of microscopes:

- Compound microscope and
- Electron microscope

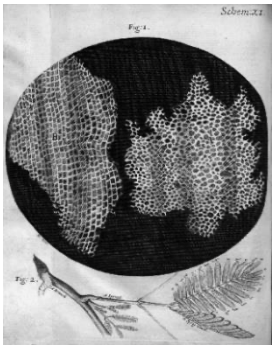
Compound Microscope

An optical instrument that consists of two convex lenses of short focal lengths is known as a compound microscope.
Magnification: 1000X

Electron Microscope

A microscope that uses electron beams to illuminate a specimen object is known as an electron microscope.
Magnification: 2, 00,000 times more than that of an ordinary compound microscope.

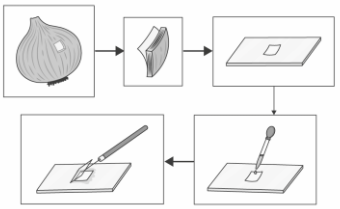
Discovery of Cell



Robert Hooke discovered the cell in 1665. Robert Hooke observed a piece of bottle cork under a compound microscope and noticed minuscule structures that reminded him of small rooms. Consequently, he named these "rooms" cells. However, his compound microscope had limited magnification, and hence, he could not see any details in the structure. Owing to this limitation, Hooke concluded that these were non-living entities.
Later Anton Van Leeuwenhoek observed cells under another compound microscope with higher magnification. This time, he had noted that the cells exhibited some form of movement (motility). As a result, Leeuwenhoek concluded that these microscopic entities were "alive." Eventually, after a host of other observations, these entities were named animalcules. In 1883, Robert Brown, a Scottish botanist, provided the very first insights into the cell structure. He was able to describe the nucleus present in the cells of orchids.

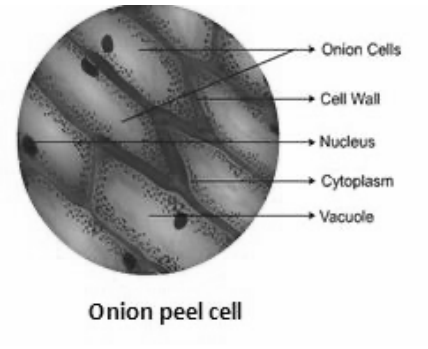
Activity: 1

Observation of plant cells.



Method
(1) Separate a thin onion scale from an onion.
(2) Tear it from the concave side to get a transparent, thin, and membranous onion peel piece called the epidermis.
(3) Now keep this onion peel piece in a watch glass containing water.
(4) Cut out a small portion of this peel and place it flat on a glass slide on a drop of water with the help of a thin camel-h paintbrush.
(5) Add a drop of safranin.

(6) Drain out the excess stain and mount the onion peel in a drop of glycerin under a coverslip.
(7) Examine the slide under the low and high powers of a compound microscope.



Onion peel cell

Observation
The epidermal cells of onion peel can be seen as regularly arranged linear or rectangular compartments with rigid cell walls.
The nucleus is pushed towards the periphery due to the presence of a central vacuole.

Precautions
(1) Immediately put the peel of the onion bulb in a water-containing Petri dish to avoid it's folding and drying.
(2) Spread the peel uniformly on the slide.
(3) Excess stain should be drained off.
(4) There should be no air bubble under the coverslip.

Basic Staining Techniques
- Use dilute stain for staining.
- Avoid the formation of air bubbles while placing the coverslip on the slide.
- Take a very thin peel of onion to get a single layer of cells. No overlapping of cells should be seen.
- Use a dry and clean slide, and wipe out extra stains or water present on the sides of the slide.

The Cell Theory
- Matthias Jakob Schleiden (1838) and Theodar Schwann (1839) gave the 'cell theory'.
- However, the cell theory failed to explain how new cells arise.
- Rudolf Virchow (1855) stated in Latin- 'Omnis cellula e cellula'. It meant that new cells come from pre-existing cells.

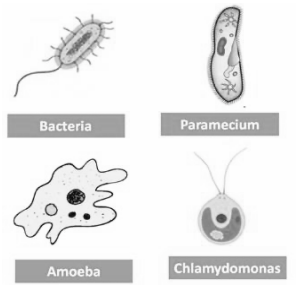
The Three Postulates of Cell Theory are:
- All living organisms are made of cells.
- A cell is the fundamental unit of living organisms.
- All cells arise from pre-existing cells.

Exceptions to Cell Theory are:
Viruses: They contain only genetic material. Protoplasm is absent. Active or show signs of life only in a living cell.

Types of Organisms:
(1) Unicellular Organisms: These organisms are single-celled. In which a single cell performs all the functions.

Example:

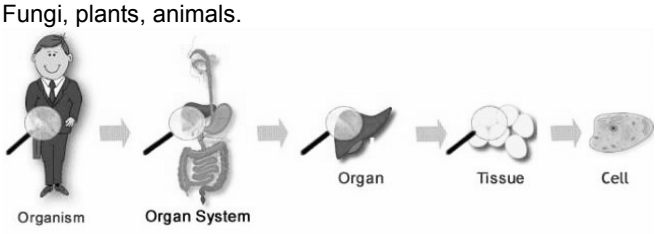
Amoeba, paramecium, bacteria.



(2) Multicellular Organism: Many cells are grouped to perform different functions in the body and also form various body parts.

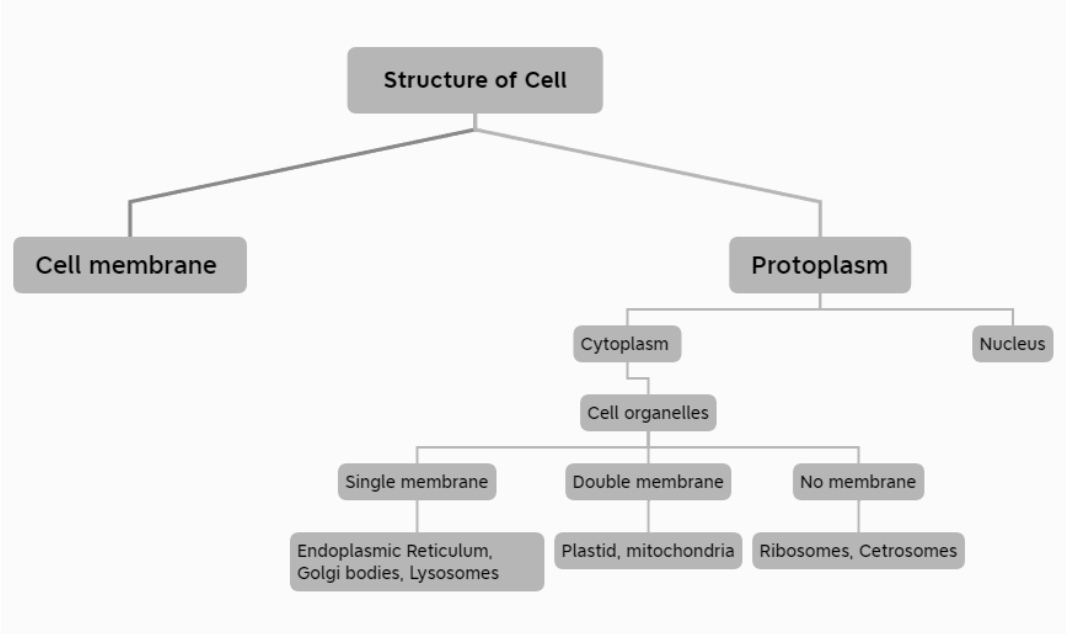
Example:

Fungi, plants, animals.

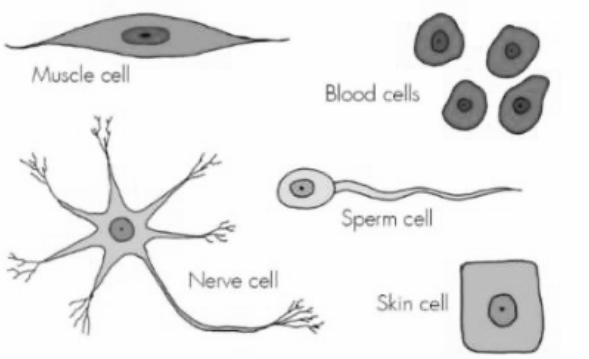


Shape and Size of Cell:

(1) Cells vary in shape and size. They may be oval, spherical, rectangular, spindle-shaped, or irregular like the nerve cell.
(2) The size of cells also varies in different organisms. Most of the cells are microscopic size like red blood cells (RBCs) while some cells are fairly large like nerve cells.



The longest living cell in the body are nerve cells (or neuron) which can live for an entire lifetime.

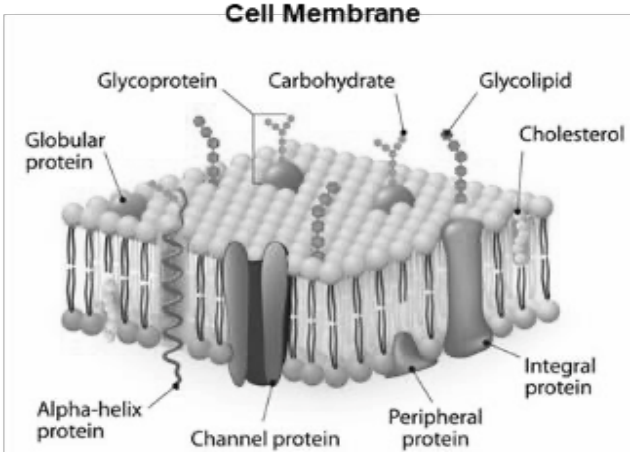


Extended Learning

Between 1632 and 1723 the first protozoans and bacteria were observed by Antonie van Leeuwenhoek.

Plasma Membrane or Cell Membrane:

- The outermost covering of the cell separates the contents of the cell from the external environment.
- It regulates the entry and exit of substances through the cell (selectively permeable membrane).
- It is made up of lipid and protein.



Extended Learning:

Fluid Mosaic Model:

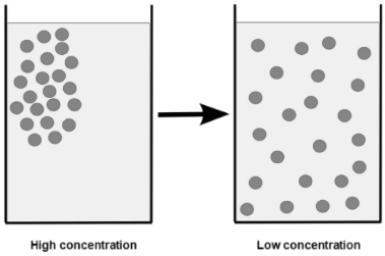
- The fluid mosaic model was proposed by S.J. Singer and Garth L. Nicolson.
- This model explains the structure of the plasma membrane of animal cells as a mosaic of components such as phospholipids, proteins, cholesterol, and carbohydrates.
- These components give a fluid character to the membranes.

Description:

- A phospholipid bilayer comprises two layers of phospholipid.
- Each phospholipid is composed of a hydrophilic head and a hydrophobic tail.
- Hydrophilic head: Attracted to the water in the cytoplasm of the cell as well as to the water of the surroundings of the cell.
- Hydrophobic tail: Repelled by water and attracted to each other.
- It is because of this attraction and repulsion that the bilayer is stable despite its fluidity.
- The model is called mosaic as it suggests that the membrane is made up of many different constituents like proteins, carbohydrates, and lipids which resemble the tiles of an ordinary mosaic.

Transfer of Substances through Plasma Membrane:

The passage of substances across the cell membrane takes place by three modes listed as follows.

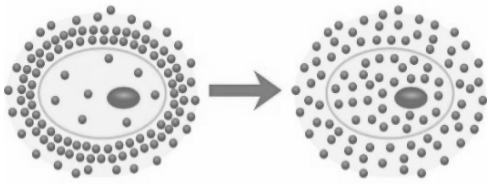


(1) Passive Transport:

Passive transport is a mode of transport that takes place without the expenditure of energy: It takes place either by diffusion or osmosis.

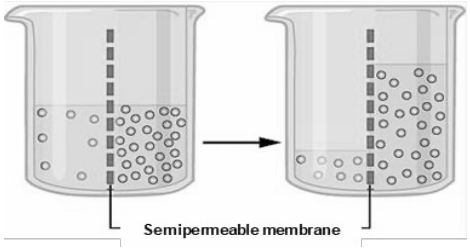
(a) Diffusion: The process of movement of substances (solid, liquid & gas) from the region of its higher concentration to the region of its lower concentration to spread uniformly in the given space is called diffusion.

Diffusion across Cell Membrane:



- Metabolic gases CO_2 and O_2 move out and into the cells through diffusion.
- Respiration of the cell produces carbon dioxide. As the concentration of CO_2 (which is cellular waste) increases inside the cell as compared to the outside, CO_2 diffuses out of the cell into the external medium.
- Similarly, the concentration of oxygen is always higher in the external medium as compared to the cell where it is being consumed in respiration. Therefore, oxygen +diffuses from the outside to the inside of the cell.

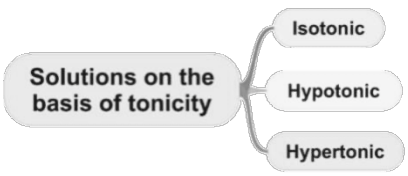
(b) Osmosis: Osmosis is the movement of a water molecule or solvent across a semi-permeable membrane from the region of lower concentration to the region of higher concentration. Osmosis is a selective process since the membrane does not allow all molecules to pass through it. Water is usually the only free-flowing molecule across this membrane.



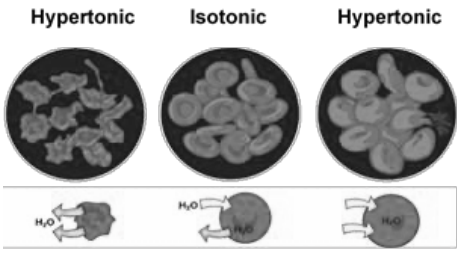
Cell Placed in Solution:

Plant and animal cells placed in salt or sugar solution will behave in one of the following ways depending upon the concentration of an external solution:

- Isotonic solutions are those which have the same solute and pH concentration as the surrounding body fluid or the cytoplasm.
- Hypotonic solutions contain a lesser amount of solute concentration compared to the surrounding fluid and can force the cell to rupture due to excess input of water into the cell.
- Hypertonic solutions contain a higher concentration of solute compared to the surrounding fluid and thus push water out of a cell, shrinking it.



S.no	Name of the solution	Result
(1)	Hypotonic Solution	▪ The cell will gain water by osmosis and is likely to swell up.
(2)	Isotonic Solution	▪ Water crosses the cell membrane in both directions. ▪ The cell will stay the same size.
(3)	Hypertonic Solution	▪ Water crosses the cell in both directions, but more water leaves the cell than enters it.



Example of Osmosis in Red Blood Cell

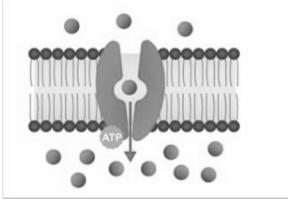
Shrinking of protoplasm, In plant cell → plasmolysis, In animal cell → crenation

(2) Active Transport:

Active transport is the movement of ions and electrolytes, which takes place across the membrane by using energy produced by the cell.

Example: movement of ions into or out of the cell.

- In general, molecules move from an area of their higher concentration to an area of their lower concentration without the expense of energy by diffusion or osmosis.
- Active transport occurs when molecules move across a cell membrane from a region of their lower concentration to a region of their higher concentration.
- To get molecules, to move against the concentration gradient, work must be done, hence energy is required.

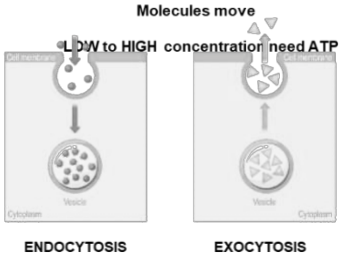


Molecules move LOW to HIGH concentration need ATP

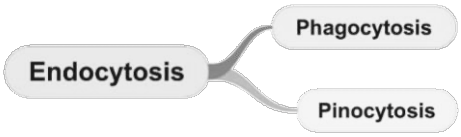
(3) Bulk Transport:

Bulk transport involves the movement of macronutrients such as proteins and polysaccharides which can pass only through a ruptured plasma membrane.

- Exocytosis: The process by which materials move from inside to outside of the cell is known as exocytosis. This is useful in releasing the secretory and excretory materials from the cell. For example, the release of the proteins and other materials formed in the cell to outside the cell.
- Endocytosis: The process by which materials move into the cell by engulfing the food and other substances from the external environment is known as endocytosis. For example, engulfing foreign substances, dead cells, pathogens, etc.



Endocytosis is an umbrella term that describes two processes: Phagocytosis and Pinocytosis.



(1) Phagocytosis: It means 'cell eating'. In this process, large particles, such as cells or macromolecules, are taken in by a cell. For example, when microorganisms invade the human body, neutrophils (type of WBCs) will engulf and eventually destroy them.

(2) Pinocytosis: It means 'cell eating'. In this process, the bulk transport of fluid matter takes place across the cell membranes by forming small vesicles.

Activity: 2

Demonstration of endosmosis and Exosmosis.

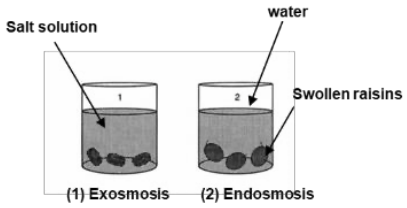
Method:

Put dry raisins or apricots in a petri dish having plain water.

Observe after about 30 minutes.

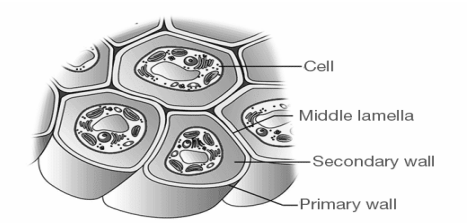
Observation:

Raisins or apricots swell up due to endosmosis. Some swollen raisins can be placed in concentrated sugar or salt solution. After some time, the raisins will shrink to their previous form. It is due to exosmosis.



Cell Wall:

The cell wall is the most prominent part of the plant's cell structure. It is made up of cellulose, hemicellulose, and pectin. The cell wall is present exclusively in plant cells. It protects the plasma membrane and other cellular components. The cell wall is also the outermost layer of plant cells.
It is a rigid and stiff structure surrounding the cell membrane. It provides shape and support to the cells and protects them from mechanical shocks and injuries.



Cellulose is a complex fibrous carbohydrate which cannot be digested by human beings and several other animals, but can be digested by ruminant cattles due to the presence of bacteria in their gut which secretes cellulase enzyme.

Functions:
- A cell wall provides a framework and definite shape to the cell.
- It gives rigidity and support to the tissues in plants.
- The cell wall gives mechanical strength to the cell to facilitate the plant to support its long and tall body.
- It helps in balancing and maintaining osmotic pressure and prevents the bursting of cells.
- It protects protoplasm against infections.
- It helps in the transport of water and minerals over long distances.

Plasmolysis:

When a living plant cell loses water, osmosis causes shrinkage or contraction of the cell away from the cell wall. This phenomenon is known as plasmolysis.

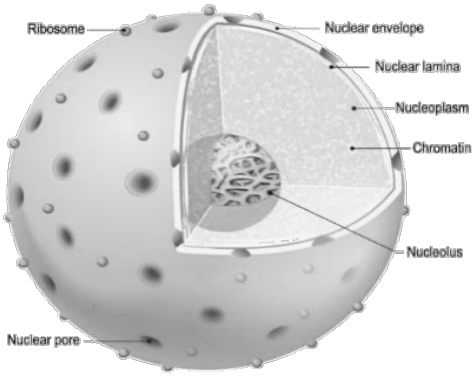
Protoplasm:

Protoplasm is the colorless material containing the living content of the cell. The living content includes the nucleus and the cytoplasm. Various cell organelles are found floating in the cytoplasm. These organelles are responsible for carrying out various cellular activities. Substances called cytoplasmic inclusions are also present in it.

Nucleus:

Discovered by - Robert Brown (1831)
- The nucleus is a double membrane-bound dense protoplasmic body, which controls all cellular metabolism and encloses the genetic information of a cell.
- The nucleus is considered the controller or director of the cell.

Location:
The nucleus is a large spherical body centrally located generally.



Structure:

(1) Nuclear membrane:
- Double layered, porous.
- Made up of lipids and proteins.
- Separates the nucleus from the cytoplasm.
- Transparent, dense, and ground substance of the nucleus.

(2) Nucleoplasm:
- Chromatin fibres and nucleoli are suspended in it; Surrounded by a nuclear membrane.

(3) Nucleolus:
- Spherical, non- membranous, and vary in number; Rich in proteins and RNA molecules; Site for the formation of ribosomes.

The function of the Nucleus:
- Main controlling center of a cell.
- Major role in cell division.
- Regulate metabolic activities controlled by enzymes.

Nucleus is the largest cell structure. Human RBC lacks a nucleus. Sieve tube in plants also lack a nucleus.

(4) Chromatin material:
- Contains fine thread-like structures called chromatin fibres.
- Contain heredity material.

Chromosomes:

Chromosomes are thread-like structures in which DNA is tightly packaged within the nucleus.

Functional segments of DNA are called genes.

Functions of Chromosomes:

- Chromosomes contain hereditary information.
- DNA molecules contain the information necessary for cellular activity.

Nucleoid:

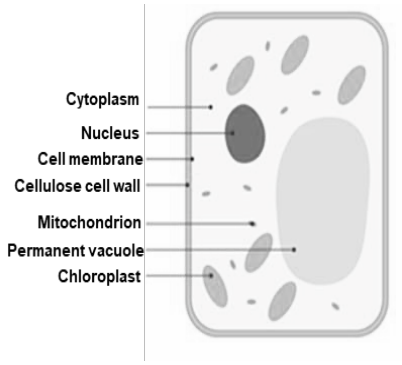
In some organisms like bacteria, the nuclear region of the cell may be poorly defined due to the absence of a nuclear membrane. Such an undefined nuclear region containing only nucleic acids is called a nucleoid.

Extended Learning

The cytoplasm can be divided into two parts – the ectoplasm and the endoplasm. The ectoplasm covers the peripheral area of the cell, whereas the endoplasm contains the central portion with all the organelles.

Cytoplasm:

- The cytoplasm is a living, colorless, semi-liquid, homogeneous substance.
- It occupies a major part of the cell and is constantly moving.
- It is limited on the outside of the cell by the cell membrane.
- About 90% component of cytoplasm is water and the remaining are amino acids, vitamins, enzymes, fats, and carbohydrates.
- Contains many specialized living cell organelles.
- 90% component of cytoplasm is water.
- Part of the cytoplasm excluding the cell organelles is called cytosol.
- Also contains non-living cell inclusions known as Ergastic bodies.



Various Cell Organelles:

Check your Concept

(1) What is the name of thread-like structure present in nucleoplasm?
(2) Describe the microscopic structure of the cell.
(3) Why is endocytosis found in animals only?
(4) Who discovered the cell -
(A) Robert hooke (B) Purkinje
(C) Robert brown (D) Davson
(5) When was the cell theory propounded?

Cell Organelles:

Organelles are small structures within the cytoplasm that carry out functions necessary to maintain homeostasis in the cell. They are involved in many processes, for example, energy production, building proteins and secretions, destroying toxins, and responding to external signals. The various types of cell organelles are as follows:

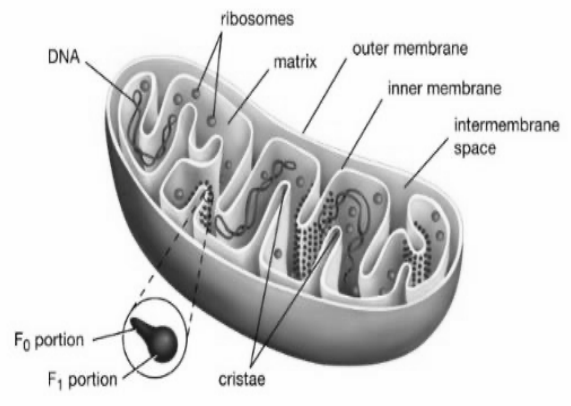
(1) Mitochondria:

- Mitochondria were first observed by Köliker. However, it was Benda in 1898 who named them so.
- Mitochondria are double membrane-bound organelles of eukaryotic cells.

Location:
Mitochondria are found in the cytoplasm of both plants and animals.

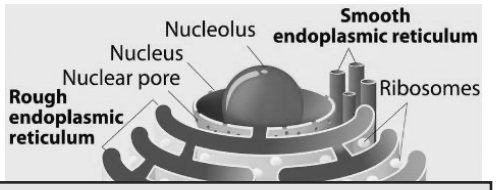
Structure:

- Mitochondria are rod-shaped structures surrounded by a double-membrane covering. The outer membrane is smooth and porous.
- The inner membrane is thrown into the finger-like projections called cristae. The cristae provide the increased surface area for more efficient metabolic activities to take place.
- Cristae bear minute, regularly spaced tennis racket-shaped particles known as F1 particles or oxysomes. The membrane of oxysomes has various respiratory enzymes.
- The mitochondria contain enzymes that catalyze the biochemical reactions involved in respiration. The mitochondria contain their DNA known as mitochondrial DNA.



Functions of Mitochondria:

- Mitochondria provide a site for cellular respiration thus, releasing energy in the process. Therefore, mitochondria are known as the "Power Houses of the cell."
- The cells use this energy for performing cellular functions.
- Mitochondria synthesize respiratory enzymes. These specialized enzymes and substances help in the generation of energy in the form of ATP.
- Mitochondria also regulate the calcium ion concentration in the cells by storing them and releasing them as per the need.



Mitochondria are the sites where aerobic part of respiration called Kreb's cycle is performed.

(2) Endoplasmic Reticulum (ER):

The endoplasmic reticulum (ER) is a large network of membrane bound sheets.
It looks like long tubules or round or oblong bags (vesicles).

Structure:

- The endoplasmic reticulum is a complex network of membrane-bound channels or sheets, tubules, and vesicles.
- The ER works closely with the Golgi apparatus and ribosomes.
- It creates a network of membranes found throughout the whole cell.
- The ER may also look different from cell to cell, depending on the cell's function.

Types of Endoplasmic Reticulum:
(1) Rough endoplasmic reticulum (RER)
(2) Smooth endoplasmic reticulum (SER)

Functions of Endoplasmic Reticulum:

- RER has ribosomes attached to its surface. The ribosomes are the main site of protein synthesis.
- The SER helps in the synthesis of lipids.
- Some of these proteins and lipids help in building the cell membrane. This process is known as membrane biogenesis.
- Some other proteins and lipids function as enzymes and hormones.
- One function of the ER is to serve as a channel for the transport of materials.
- In the liver cells, SER plays a crucial role in detoxifying many poisons and drugs.

Extended Learning

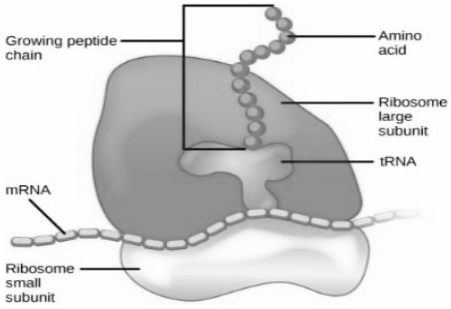
When there are lots of toxins present, the smooth endoplasmic reticulum can double its surface area to help clear them out.

Difference between RER & SER:

Basis for Comparison	Smooth Endoplasmic Reticulum	Rough Endoplasmic Reticulum
Meaning	Smooth ER appears like containing many circular marks which are the interlocking tubular sheets and they may be varied in look and function as well.	Rough ER looks like the arrangement of the double membranes which are spotted with the ribosomes all over. They appear to consist of parallel sheets of the membrane.
Found near	Smooth ER is found near the cell membrane.	Rough ER is found near the cytoplasm.
Originates from	Rough endoplasmic reticulum by giving off the ribosomes.	From nuclear membrane.
Ribosomes	They do not have ribosomes.	They have ribosomes.
Composed of	Tubules.	Cisternae.
It mainly produces	Lipids and proteins.	Proteins.

(3) Ribosomes:

Ribosomes are small ribonucleoprotein particles. They were first observed by the cell biologist George Emil Palade, using an electron microscope. The term, 'ribosome' was proposed by scientist Richard B. Roberts in late 1950.

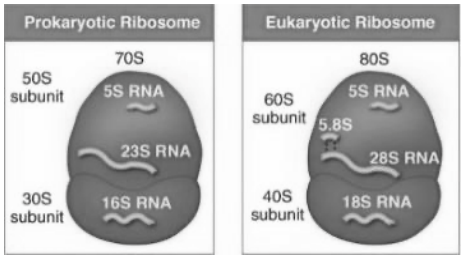


Location:

- Ribosomes are found attached to the rough ER and in free form in the cytoplasm of the cell.
- Ribosomes are synthesized in the nucleolus inside the nucleus. After synthesis, they move out through the nuclear pores of the nuclear membrane into the cytoplasm.

Structure:

- They occur as small granules.
- They are single-walled dense, spherical bodies. Each ribosome is made up of two sub-units. One is a smaller sub-unit and the other one is a larger subunit.
- Each subunit is made up of ribonucleic acid (RNA) and proteins called ribonucleoproteins.



Functions of Ribosomes:

- Ribosomes are involved in the process of protein synthesis.
- They provide a site for the synthesis of proteins and hence are called protein factories of the cell.

The 60-S and 40-S model works fine for eukaryotic cells. Prokaryotic cells have ribosomes made of the 50S and 30S sub-units.

(1) What are the ribosomes? where it present?

(2) What are the stacked particles present in inner surface of mitochondria?

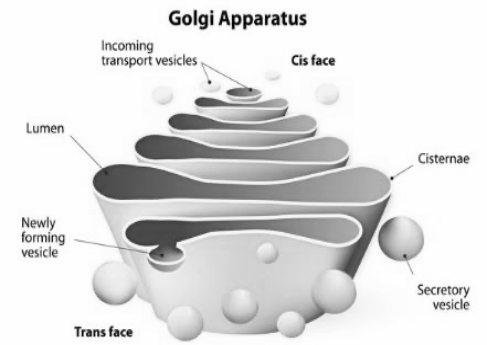
(3) How RER is different from SER?

(4) Mitochondria are site of -
(A) Electron transport (B) Cellular respiration
(C) ATP formation (D) All of these

(5) Protein synthesis occurs on -
(A) Ribosome (B) Lysosome
(C) Nucleus (D) Chloroplast

(6) Kreb's cycle occurs in -
(A) Matrix of mitochondria (B)Nucleoplasm
(C) Cytoplasm (D) Protoplasm

(4) Golgi complex or Golgi apparatus:



Golgi apparatus was one of the first organelles to be observed in detail. It was discovered in 1898 by Camillo Golgi (Italian physician) and was named after him.
Golgi apparatus is a membranous structure that originates from smooth ER. It is also formed of cisternae, vacuoles, and vesicles.
Golgi complex has a convex, forming face (cis) and a concave, maturing face (trans). The forming face receives vesicles from ER and maturing face secretes vesicles.

Location:
It is located near the nucleus. Golgi bodies are pleomorphic structures because components of the Golgi body are different in structure and shape in different cells.

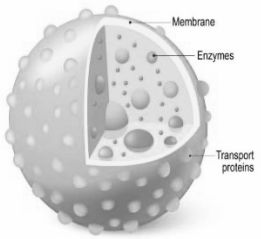
Structure:
- They are stacks of flattened double-walled membrane sacs.
- Fluid is present between both membranes.
- Sacs are called cisternae.
- Cisternae are packed one above the other.
- They consist of tubules, vesicles, and vacuoles.
- These are absent in the RBC of mammals and sieve tubes (transporting cells) of plant cells.
- These are known as dictyosomes in a plant cell.

Functions of Golgi complex:
- Golgi apparatus is chiefly concerned with the function of secretion of enzymes and other substances.
- It transports the synthesized substances from the cell to the outside of the cell.
- It is involved in the formation of lysosomes, cell walls, and plasma membranes.
- It produces vacuoles that contain cellular secretions. For example, enzymes, proteins, cellulose,
- melanin pigment, lactoprotein (milk protein), etc.

The cytoplasm surrounding Golgi body have fewer or no other organelles. It is called Golgi ground substance or zone of exclusion.

(5) Lysosomes:

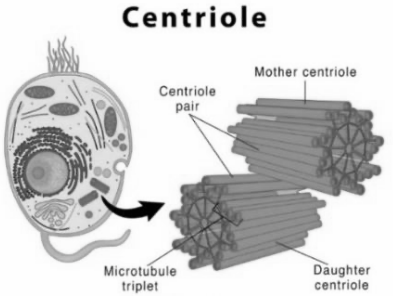
- Lysosomes are spherical bag-like structures covered by a single membrane.
- Lysosomes hold enzymes that were created by the cell. The purpose of the lysosome is to keep the cell clean by digesting any foreign materials as well as worn-out cell organelles.



Functions of Lysosomes:
- Lysosomes break foreign materials entering the cell.
- They might be used to digest food or break down the cell when it dies.
- When a cell gets damaged, lysosomes may burst and the enzymes digest their cell.
- Therefore, lysosomes are also known as the 'suicide bags' of a cell.

The acrosome is a specialised vesicle present in the head of sperm-filled with lytic enzymes which dissolve egg membrane at the time of fertilization.

(6) Centrosome and Centriole:



A centrosome is a cellular structure involved in the process of cell division. Before cell division, the centrosome duplicates, and then, as division begins, the two centrosomes move to opposite ends of the cell.

Structure:
Each centrosome contains "paired barrel-shaped organelles" called centrioles.
All centrioles are made of protein strands called microtubules.
- A centriole is typically made up of nine sets of short microtubule triplets, arranged in a cylinder.
- During cell division, two centrioles come together with some special proteins and form the centrosome.
- The role of a centrosome is to organize microtubules and provide structure for the cell, as well as assist to pull chromatids apart during cell division.

Location:
- They are located close to the nucleus.
- They are present only in animal cells.
- In-plant cells, there are polar caps instead of centrioles.

Functions:
- Centrosome initiates and regulates cell division in animal cells.
- During cell division, the centrioles move to the poles of the cell.
- They develop many spindle fibres with the help of asters.
- Aster is a cellular structure shaped like a star, formed around each centrosome during cell division in an animal cell

Extended Learning

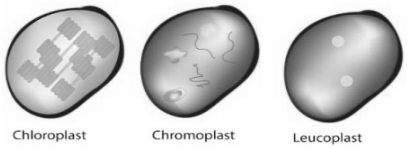
Centrioles are among the largest protein-based structures found in most cell types, measuring approximately 250 nm in diameter and approximately 500 nm long in vertebrate cells.

(7) Plastids:

Plastids are present only in plant cells.
There are three types of plastids:
(1) Chromoplasts (colored plastids)
(2) Leucoplasts (white or colorless plastids)
(3) Chloroplasts (contains chlorophyll)

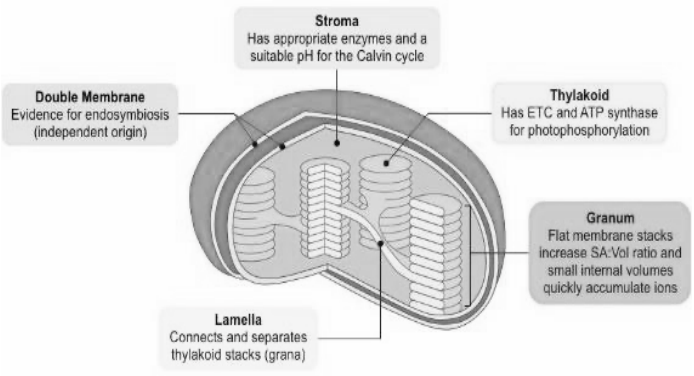
Structure:
- The internal structure consists of numerous membrane layers embedded in the stroma.
- Plastids also have their DNA and ribosomes like mitochondria and are similar to their structure.

The function of Plastids:
- Chloroplasts are important for photosynthesis in plants.
- Leucoplasts are primarily organelles in which materials such as starch, oils, and protein granules are stored.



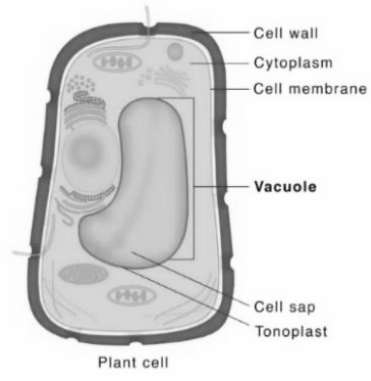
Types of Plastids	Structure	Location	Function
Chloroplasts	Contain green pigment called chlorophyll.	Present in parts of plants exposed in sunlight .	Photosynthesis
Chromoplasts	Contain fat-soluble red, orange, and yellow pigments such as carotenoids.	Present in flowers and fruits and impart color to them.	Impart colors to flowers and fruits.
Leucoplasts	Colorless plastids	Present in seeds, tubers, rhizomes, etc.	Storage of food materials.

Structure of Chloroplast:
- Double-membrane structure in which the outer membrane is more permeable than the inner membrane.
- The inner membrane contains more proteins.
- Contain a green pigment called chlorophyll.
- Matrix /Stroma – semi-fluid, colorless, and colloidal.
- The matrix contains DNA and RNA.
- Thylakoids: Membrane-bound sac-like structure that runs through the stroma, chloroplasts present within it.
- Grana: Stalk of thylakoids where they are arranged one above the other.



(8) Vacuoles:

Vacuoles are membrane-bound organelles that are present in all plant and fungal cells. Vacuoles are enclosed compartments that are filled with water containing inorganic and organic molecules. Dujardin coined the term 'vacuole'.



Structure:

Vacuoles are single-membrane-bound storage sac-like structures. Membrane of vacuoles is called tonoplast.

Location:

- In-plant cells, are large and occupy almost 90% of the cell.
- They are small or even absent in animal cells.

Functions:

- They store dissolved material, such as amino acids, sugars, various organic acids, and some proteins. In single-celled organisms, for example, amoeba, they store the food material ingested by the organism.
- They provide turgidity and rigidity to the cell.
- They help to maintain the osmotic pressure of the cell.

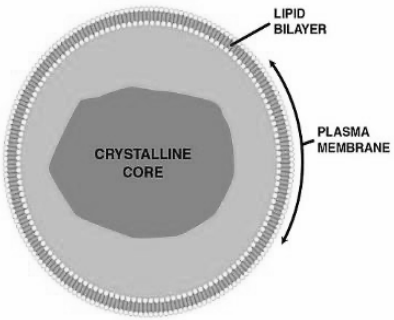
Extended Learning

Vacuoles and their contents are considered to be distinct from the cytoplasm, and are classified as ergastic.

(1) What are asters and spindle fibres?
(2) Why are the Golgi bodies found in large numbers in the cells which secrete digestive enzymes?
(3) What is cytosol and cytoskeleton?

(9) Peroxisomes:

A peroxisome is a type of organelle known as a microbody, found in eukaryotic cells. They are involved in the catabolism of fatty acids. Peroxisomes were identified as organelles by the Belgian cytologist Christian de Duve.



Structure:

- Peroxisomes are small spherical organelles. They are bound by a single membrane. The inner contents are finely granular.
- Sometimes a crystalline core is visible at the center. The crystalline core contains a protein called the catalase enzyme.

Location:

- They are found in the cytoplasm of animal cells.
- They are mostly located in the liver and kidney cells.

Function:

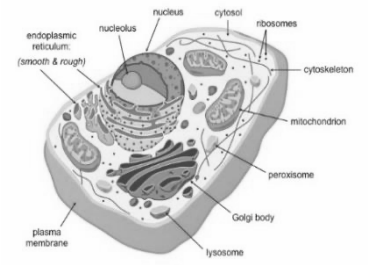
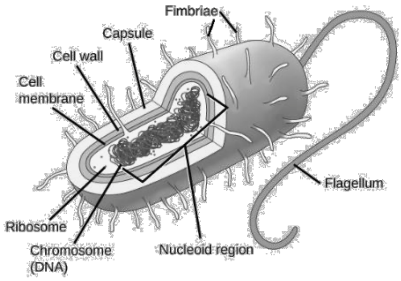
They are specialized in the detoxification of toxic substances from the cell.

Extended Learning

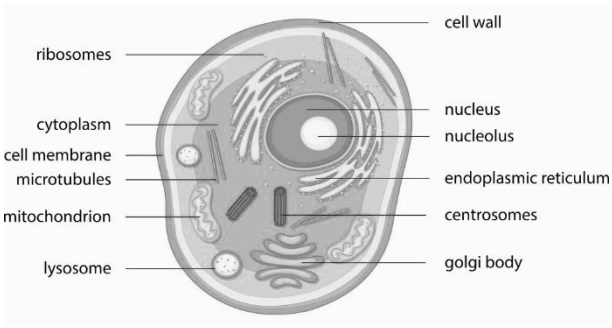
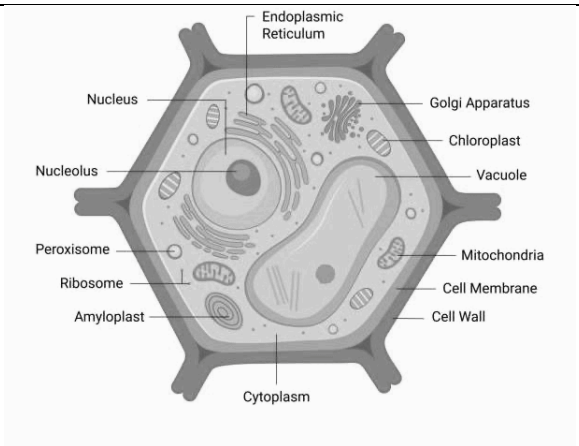
Peroxisomes contain enzymes that oxidize certain molecules normally found in the cell, notably fatty acids and amino acids. Those oxidation reactions produce hydrogen peroxide, which is the basis of the name peroxisome.

Types of Cells

There are two types of cells: (1) Prokaryotes and (2) Eukaryotes

Prokaryotes	Eukaryotes
Cells of organisms lack nuclear membranes.	Cells of an organism have a nuclear membrane.
The nucleolus is absent.	The nucleolus is present.
Single chromosomes.	Single or multi chromosomes
Reproduction is always asexual.	Reproduction is both sexual and asexual.
Always unicellular.	Often multicellular.
Membrane-bound cell organelles are absent.	Membrane-bound organelles are present like mitochondria.
The centriole is absent.	The centriole is present only in animals' cells.
Cell division is by binary fission.	Cell division is by mitosis or meiosis.
Example: Bacteria, Blue green algae, etc. 	**Example:** Fungi, Plant cells, Animal cells, etc. 

Difference between Plant cells and Animal Cell

Animal Cell	Plant Cell
The cell wall is absent.	A cell wall is present.
Plastids are absent.	Plastids are present.
Centrioles are present.	Centrioles are absent.
Golgi bodies are present.	Golgi bodies are present and called dictyosomes.
Vacuoles are absent. If present, they are small.	Vacuoles are present and large.
The centrosome is present with one or two centrioles.	Centrosome is absent
	

Extended Learning

Plant cells are typically larger than animal cells. An animal cell can have a size between 0.01 and 0.03 millimeters while a plant cell can have a size between 0.01 and 0.1 millimeters.

Solved Examples

(1) A student used water as a medium in a temporary blood slide. He could observe only ruptured cells under the microscope. Why did this happen?

Answer: When blood cells are dipped in water or hypotonic solution, they absorb water by osmosis (endosmosis). The cell membrane is thin and elastic and expands but ruptures due to larger extension.

(2) While preparing a temporary slide of onion peel, it is separated from the scale leaf and immediately placed in water. Water is also used as a mounting medium? What is the reason?

Answer: When plant cells are dipped in water or hypotonic solution, they absorb water by osmosis (endosmosis). Plant cells have a cell wall that does not allow plant cells to expand too much.

(3) Why is osmosis a special type of diffusion?

Answer: Osmosis is a special type of diffusion because both involve the movement of molecules of substance from the region of its higher concentration to the region of its lower concentration. In osmosis, water moves across a semi-permeable membrane.

(4) What would happen if there were no Golgi bodies?

Answer: Golgi bodies are involved in the packaging, storage, and transport of materials synthesized in the cell. In the absence of Golgi bodies, digestive enzymes and other products of the cell will not be enclosed in membranous vesicles like lysosomes. Accumulation of these materials within the cell can kill the cell itself.

(5) How can fungi and bacteria withstand much greater pressure than animal cells?

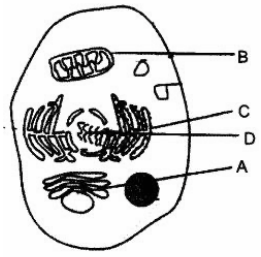
Answer: The cell wall present in fungi and bacteria permits these cells to withstand a very dilute external medium without bursting. The cells take up water by osmosis, swell, and build the pressure against the cell wall. The wall exerts equal pressure against the swollen cell. It is because of the cell wall, that such cells can withstand much greater changes in the surrounding medium than animal cells.

(6) Why lysosomes are called suicidal bags?

Answer: Lysosomes contain digestive enzymes in them and help in the cleaning of a cell by digesting any foreign materials entering the cell, such as bacteria, food, and old cell organelles. When the lysosomes burst, the digestive enzyme digests its cell. Hence it is called a suicidal bag.

(7) Label the figure and answer the questions:

(i) A – It is the packaging organelle
(ii) B – Provides energy
(iii) C – Helps in the transport of material
(iv) D – Carries the information.



Animal Cell

Answer:
(i) A – Golgi body
(ii) B – Mitochondria
(iii) C – Endoplasmic reticulum
(iv) D – Nucleus

(8) Explain the following terms:
(A) Plasma membrane
(B) Cytoplasm
(C) Nucleus

Answer: (A) Plasma membrane: It is a thin membrane that controls the passage of materials in and out of the cell. It is also called a selectively permeable membrane. It makes the outer boundary of the cell and is made up of lipo-protein,
(B) Cytoplasm: It is a transparent jelly-like thick substance present in the cell. It makes the ground of the cell in which all the cell organelles are suspended.
(C) Nucleus: It is a double-layered membrane structure that contains chromosomes required for the inheritance of characteristics from one generation to the other.

(9) Give Differences between plant cells and animal cells.

Answer:

S.No	Plant Cell	Animal Cell
1	Size is usually larger than an animal cell.	Size is usually smaller than plant cells.
2	A cell wall is present.	The cell wall is absent.
3	Plastids are present.	Plastids are absent.
4	Vacuoles are large in number and bigger in size.	Vacuoles are small in size and less in number.
5	The centriole is absent.	The centriole is present.

(10) Name the cell organelle for the following:
(A) Present only in a plant cell, provides strength and rigidity to the cell.
(B) It is the site for lipids synthesis and helps in the detoxification of drugs.
(C) The inner membrane is folded to form cristae, it has its DNA and proteins.
(D) It helps in the formation of lysosomes.
(E) It imparts colour to the fruit and flowers.

Answer:
(A) Cell wall
(B) Smooth endoplasmic reticulum
(C) Mitochondria
(D) Golgi apparatus
(E) Chromoplast

Exercise

FILL IN THE BLANKS

(1) Cells of a few cms are found in _____ of animals or _____ of plants.
(2) The smallest cell is observed in _____
(3) The shape of cells is generally _____
(4) Red blood cell has a size of _____
(5) The term cell was coined by _____
(6) Basic structural unit of living organism is known as _____
(7) Cell wall is present in _____ only.
(8) The largest cell is _____
(9) Cells having branched structure _____
(10) The minimum size that can be seen with a microscope is _____

TRUE OR FALSE

(1) Organs are formed from two or more specialized tissues working together to perform a job.
(2) Cells are not alive and are the basic living units of organization in all organisms.
(3) All cells have a cell wall that regulates the passage of molecules into and out of the cell.
(4) Rudolf Virchow developed the hypothesis that cells only come from other cells.
(5) Unicellular organisms have a one-celled body.
(6) Muscle cells are branched.
(7) The basic living unit of an organism is an organ.
(8) Amoeba has an irregular shape.
(9) All cells have a cell wall that regulates the passage of molecules into and out of the cell.
(10) The phenomenon by which the protoplast of a cell shrinks from the wall is diffusion.

OBJECTIVE TYPE QUESTIONS

(1) Does eukaryotic cell range in size?
(A) 5-100 micrometer
(B) 1-10 micrometer
(C) 5-100 nanometer
(D) 1-10 nanometer

(2) While we have always been made of cells, it took us a long time to see them. What innovation below was critical to the discovery of cells, showing the relationship between science and technology?
(A) Dissatisfaction with the theory of spontaneous generation.
(B) Electricity, to power the microscope.
(C) Glass lenses, to magnify tiny things.
(D) The light bulb, to provide light for the microscope.

(3) Van Leeuwenhoek called the organisms he viewed in a microscope “little animals” and parts like legs, fins, and heads, showing that these organisms have a nucleus. What kind of cells did he likely view?
(A) Prokaryotic, single-celled organisms
(B) Prokaryotic, multi-celled organisms
(C) Eukaryotic, single-celled organisms
(D) Eukaryotic, multi-celled organisms

(4) Which of the following statement tells whether a cell is prokaryotic or eukaryotic?
(A) The presence or absence of a rigid cell wall
(B) Whether or not the cell has organelles
(C) The presence or absence of ribosomes
(D) Whether or not the cell contains DNA

(5) A researcher made a protein made by the rough ER and used it to build a cell's plasma membrane. The protein is slightly different from the ER. The protein was probably changed in the?
(A) Golgi apparatus.
(B) Smooth ER.
(C) Mitochondrion.
(D) Nucleus.

(6) What is the power house of cell?
(A) Lysosome
(B) Ribosome
(C) Mitochondria
(D) Vacuole

(7) Who discovered the cell?
(A) Robert Hooke
(B) Purkinje
(C) Robert brown
(D) Davson

(8) Mitochondria are site of?
(A) Electron transport
(B) Cellular respiration
(C) ATP formation
(D) All

(9) Golgi body take part in?
(A) Lipid synthesis
(B) Carbohydrate synthesis
(C) Protein synthesis
(D) Oxidative phosphorylation

(10) Protein synthesis occurs on:
(A) Ribosome
(B) Lysosome
(C) Nucleus
(D) Chloroplast

Answer Key

FILL IN THE BLANKS

(1) Muscles, fibres
(2) Mycoplasmas
(3) Round
(4) Micrometer
(5) Robert Hooke
(6) Cell
(7) Plants
(8) Ostrich egg
(9) Nerve cell
(10) 10^{-6} m

TRUE OR FALSE

(1) True
(2) False
(3) False
(4) True
(5) True
(6) False
(7) False
(8) True
(9) False
(10) False

OBJECTIVE TYPE QUESTIONS

(1) A
(2) C
(3) C
(4) B
(5) A
(6) C
(7) A
(8) D
(9) D
(10) A