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Cell- The structure and Functions:Discovery of cell, Microscope and parts of compound microscope, Cell theory

Period 1

SUBJECT : (Science)
CHAPTER NUMBER: 3
CHAPTER NAME : Cell- The structure and Functions

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What is a Cell?

- A cell is the structural and fundamental unit of life. The study of cells from its basic structure to the functions of every cell organelle is called Cell Biology. Robert Hooke was the first Biologist who discovered cells.

Discovery of Cells

- Discovery of cells is one of the remarkable advancements in the field of science. It helps us know that all the organisms are made up of cells, and these cells help in carrying out various life processes. The structure and functions of cells helped us to understand life in a better way.
- Who discovered cells?
- 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” as 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 as animalcules.

- Every living organism is composed of one or more cells.
- The cell is the fundamental unit of life.
- Cells are the structural and functional organization in organisms.
- All cells arise from pre-existing cells.
- All biochemical processes are carried out by cells.
- https://www.youtube.com/watch?v=1oil93pYKhY

Working Mechanism Of The Compound Microscope

- View into the eyepiece. Rearrange the mirror such that adequate light passes into the microscope.
- The mirror, lenses, stage, and slides should be cleared of dust and be clean.
- Place the slide in the middle of the stage.
- Firmly secure the slide with clips at two edges of the slide to ensure that the slide cannot move.
- The nose piece is adjusted in such a way that the low power objective is aligned with the object of focus placed on the slide.
- The coarse adjustment knob can be shifted upwards or downwards such that the slide is well under focus.
- Turn the fine adjustment knob by moving upwards or downwards to get a clear and sharp image of the object under focus.
- All minute details of the object are observed under low power objective. Necessary diagrams are sketched.
- The nose piece is now turned to bring the high power objective aligning with the object. The fine adjustment knob is tuned as much as possible to get a bright and precise view of the object.
- In high power, the details of the object are observed. Draw the necessary diagrams. The coarse adjustment knob should not be used when the object is being examined in high power as it can crush the slide.
- https://www.youtube.com/watch?v=4x-2GHBel0A&t=125s

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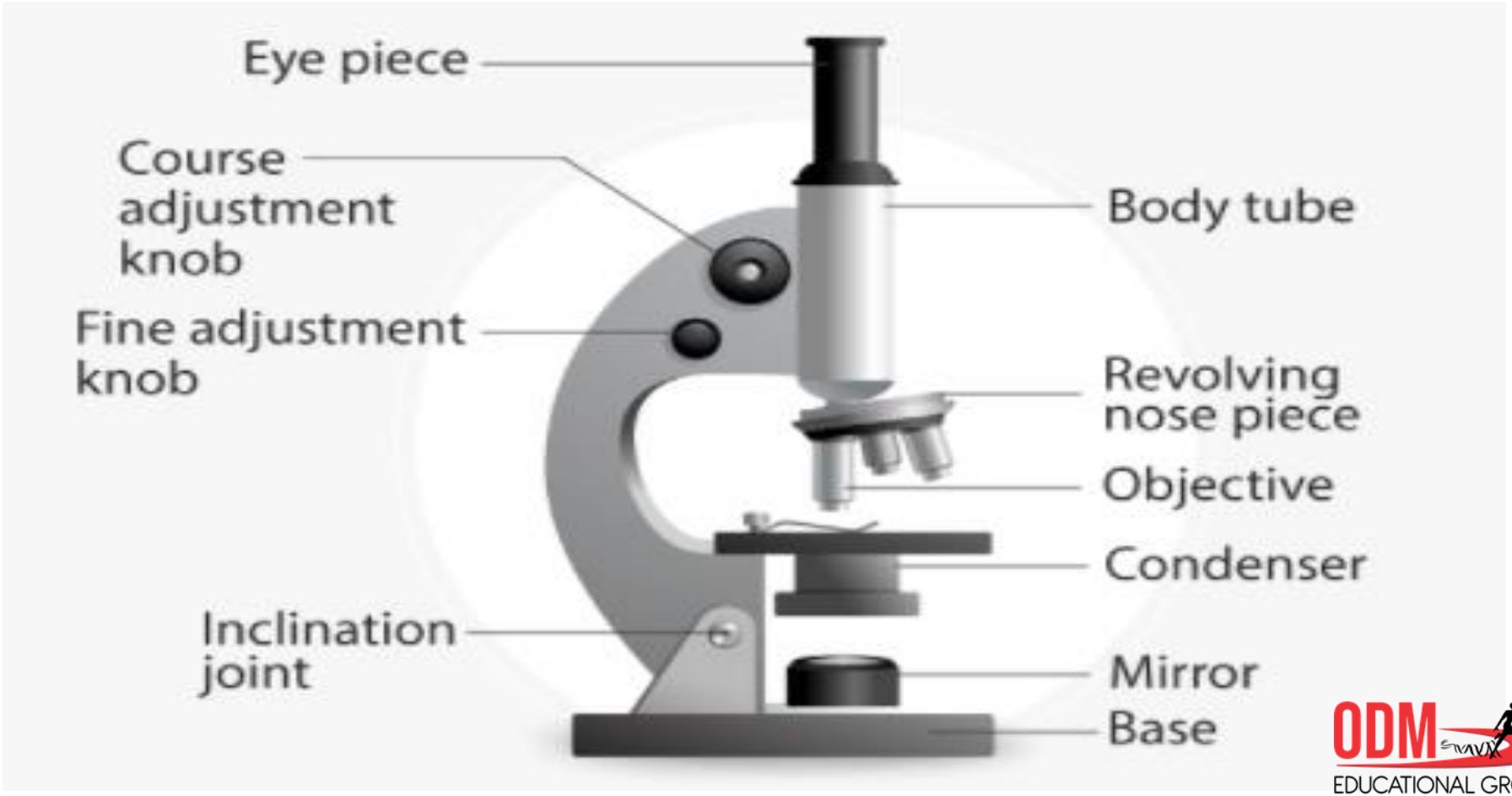

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CELL- their numbers, shapes and sizes, CellStructural unit of life(Activity 1 and Activity 2 - study of onion peel)

Period 2

SUBJECT : (Science)
CHAPTER NUMBER: 3
CHAPTER NAME : Cell- The structure and Functions

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CELLS- HOW NUMEROUS?

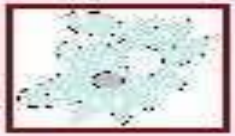
On the basis of the number of cells, the organisms have been categorised as unicellular or multicellular.

ORGANISMS

Unicellular Organism

Organism that only have a single cell

- Amoeba



- Bacteria

- Paramoecium

Multicellular Organism

Organism consisting of many cells

- Plants

- Animals

CELL SHAPE

Usually, the cells are round, elongated or spherical. There are also some cells which are long and pointed on both the ends. Such cells exhibit spindle shape. In some cases, the cells are very long.

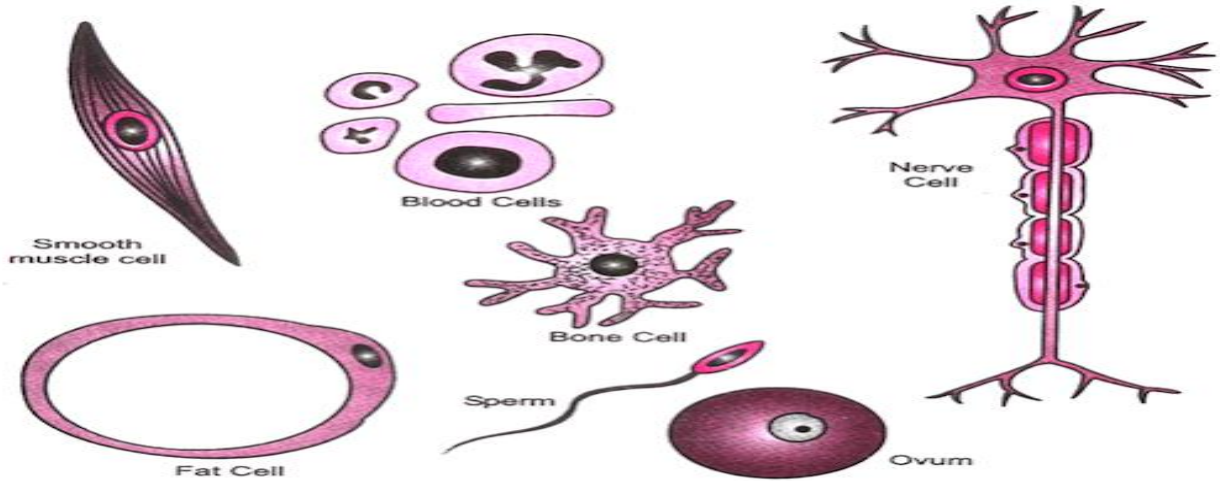
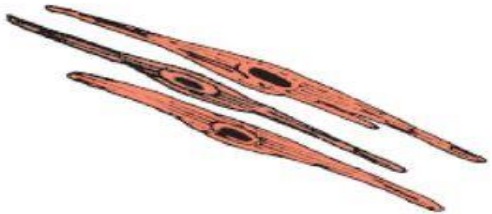
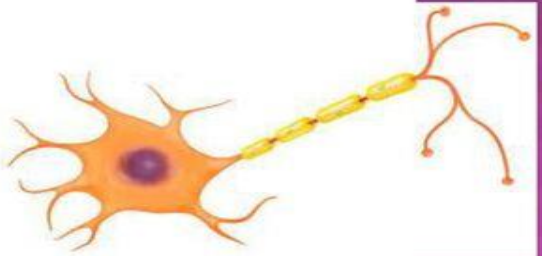


Figure : VARIOUS CELLS FROM THE HUMAN BODY

SHAPE OF CELL

- Spherical shape
  - 

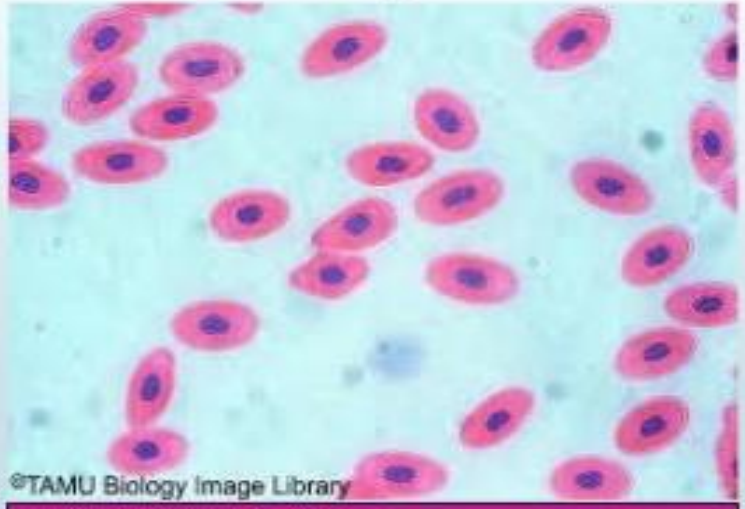
  - RBC
- Spindle shape
  - 
  - MUSCLE CELL
- Long branched shape
  - 
  - NERVE CELL

SPERICAL SHAPE

2. Oval

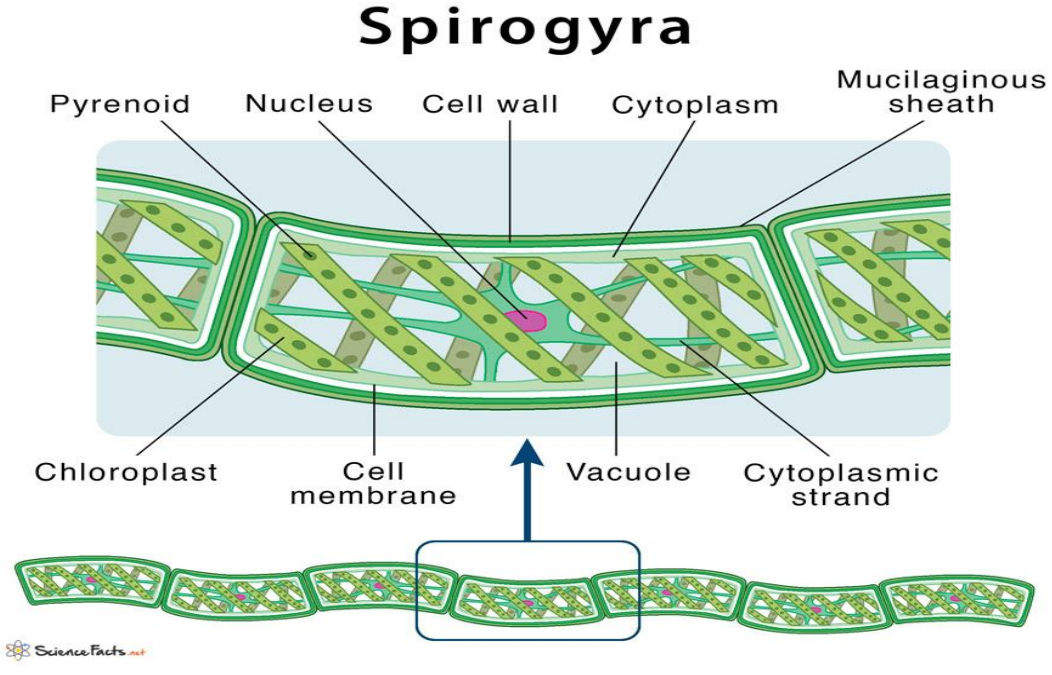
- Human sperm cells (Oval & flagellated to propel the movement of the sperm along reproductive tract of the female).

Human Sperm Cells

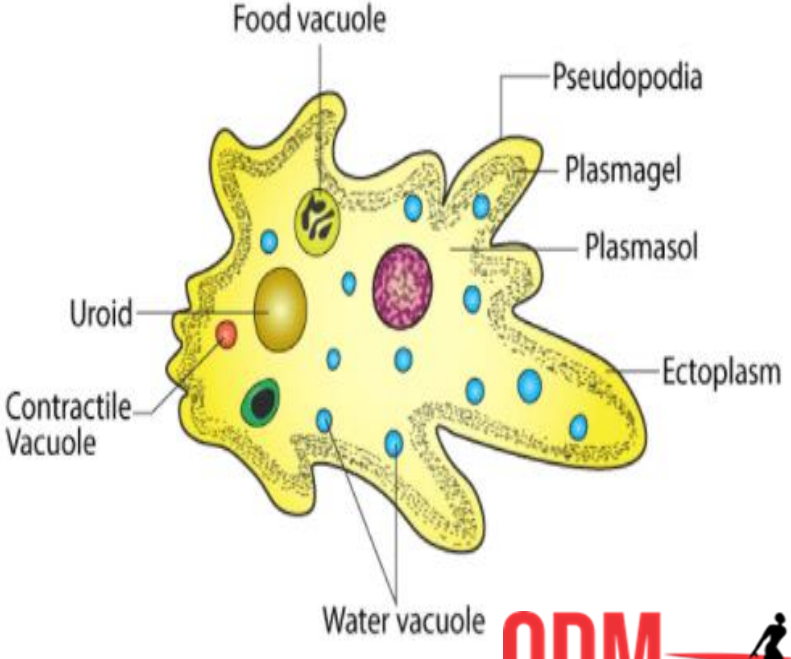


Frog Erythrocytes

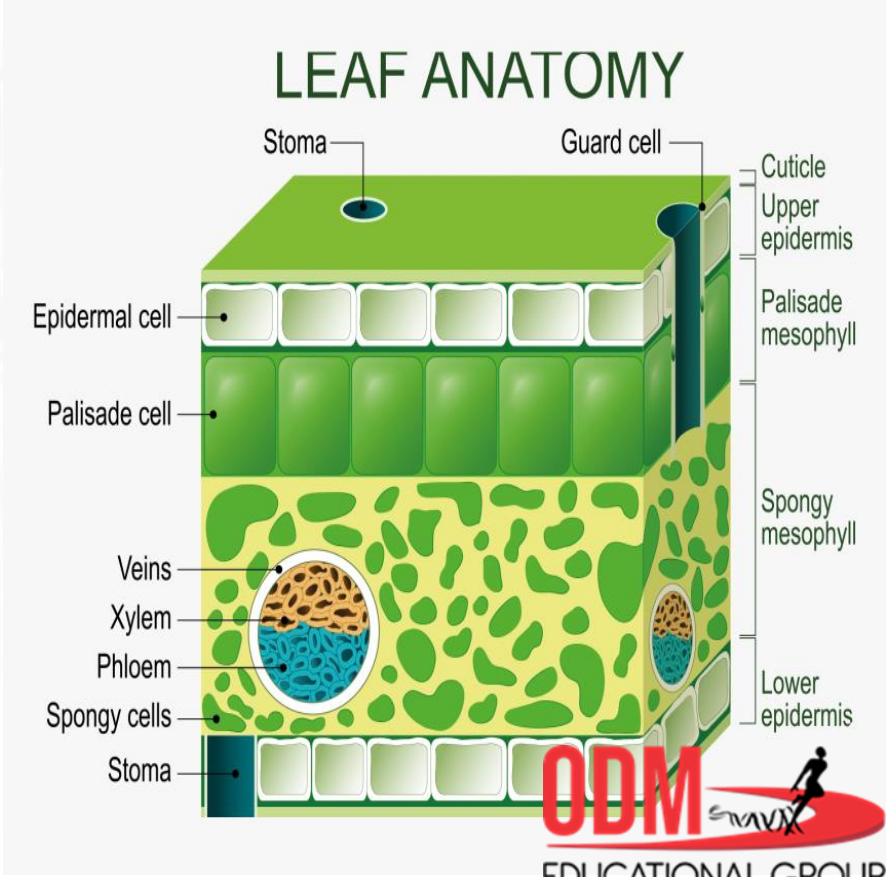
CYLINDRICAL SHAPE



Amoeboid : The single-celled body of the fresh water Amoeba, has no definite shape. Hence, it is said to be irregular in shape. The white blood cells in our body are also amoeboid as they have no definite shape.



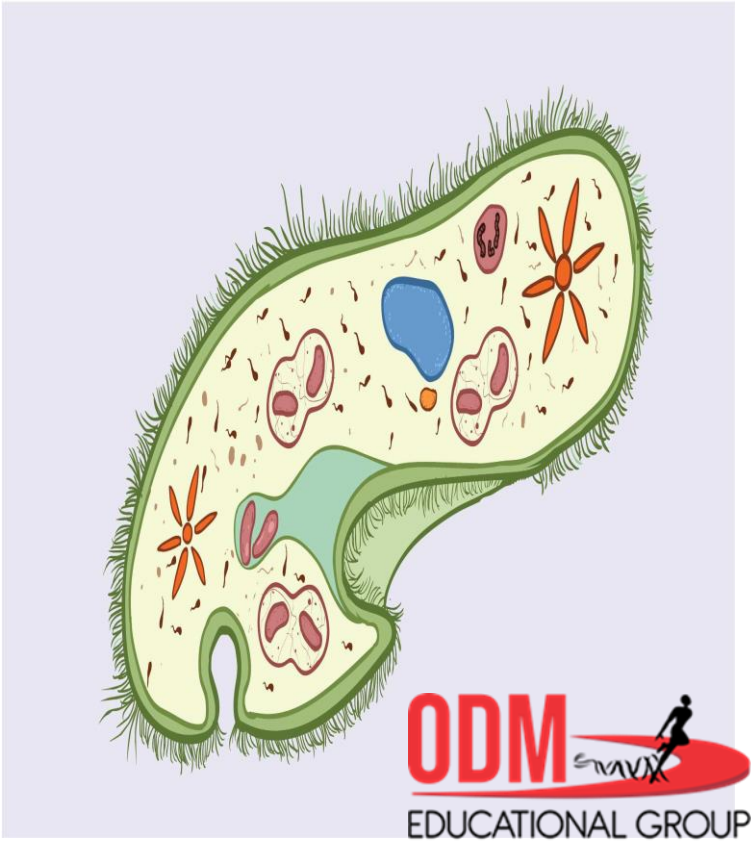
Cubical/rectangular : The cells of the leaf are cubical or rectangular. In fact, plants also have a variety of cell shapes from cubical to polygonal as well as elongated and tubular.

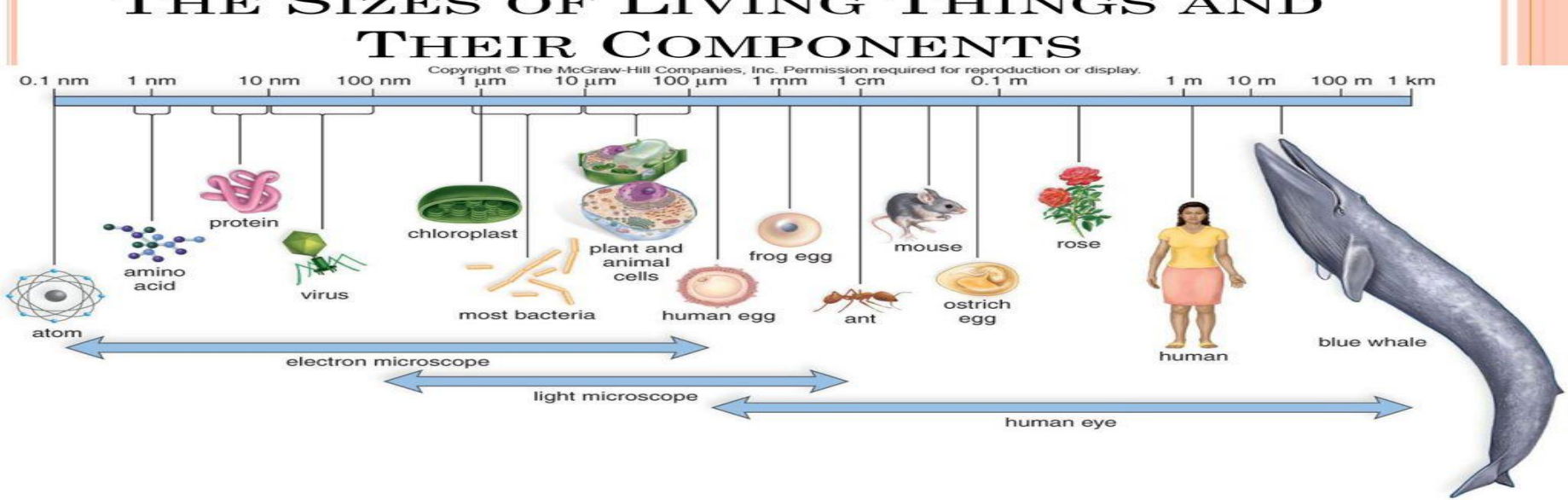


Some cells are uniquely shaped :

(i) **Slipper-shaped – *Paramecium*** : The body of this single-celled organism is in the shape of a slipper. Hence, it is often called the "slipper-shaped animalcule".

ii) **Spindle-shaped** : The smooth muscles in our body are thin, long and tapering at the ends, resembling a spindle.





Q. What is the smallest and the largest cell?

Ans. The smallest cell varies from 0.1 to 0.5 micrometre and is found in bacteria. On the other hand, the largest cell measures 170 mm × 130 mm and is the egg of an ostrich.

Cell Theory

Three scientists, Schleiden, Schwann and Virchow formulated the cell theory as —

1. Every living organism is made up of one or many cells.
2. The cell is the structural unit of all living organisms.
3. The cell is the functional unit of all living organisms.
4. All cells arise from the pre-existing cells.

- https://www.youtube.com/watch?v=tmRa8uTG7eQ
- https://www.youtube.com/watch?v=cmnhBJKfvNw

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Cell- The functional unit of life: In plants and in animals, Structure of a cell-cell membrane

Period 3

SUBJECT : (Science)
CHAPTER NUMBER: 3
CHAPTER NAME : Cell- The structure and Functions

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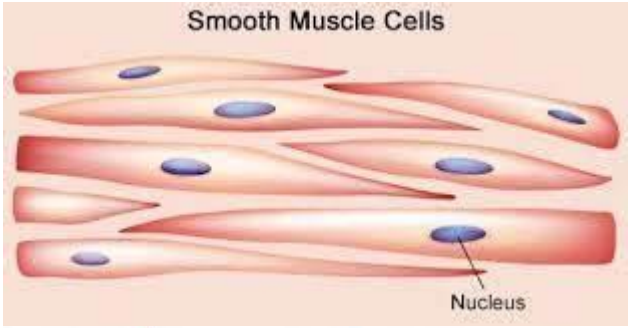
CELL- THE FUCTIONAL UNIT OF LIFE

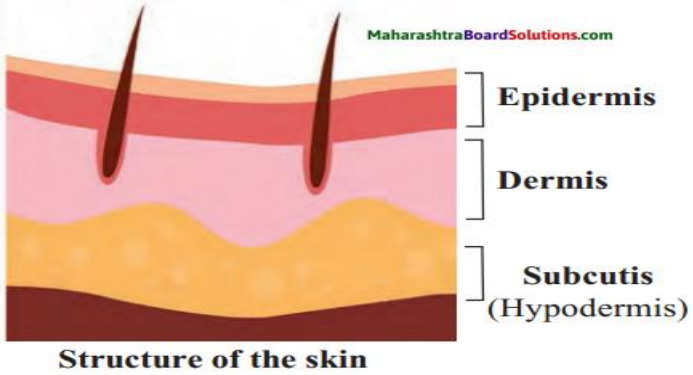
- ROOT CELLS-They take the nutrients from the surrounding soil that the plant needs to stay healthy, and they also absorb the water that gets into the soil either when people water the plants or through rainfall. **Roots** can then either store those essential nutrients for later, or transport them to the stem of the plant
- LEAF CELLS-Plants produce their own food through the chemical reactions of photosynthesis in the leaves. Chlorophyll, the green pigment, is located in cell organelles – chloroplasts – that reside in plant cells. The majority of a plant's chloroplasts are going to be found in the leaves since this is the primary place where photosynthesis occurs.

In Animals

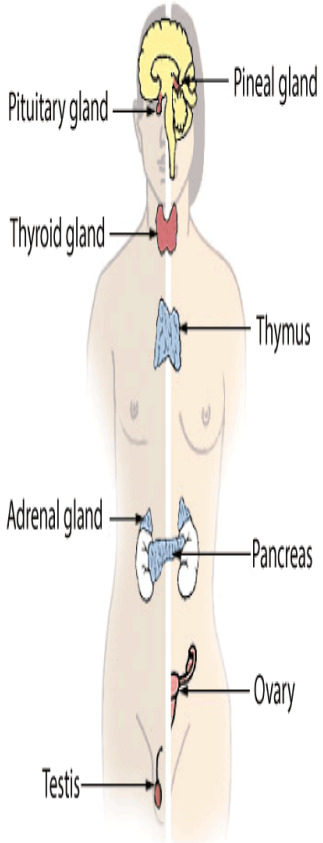
- **Muscle cells** : Movement of body parts. It is the ability of the muscle cells to contract and relax.
- **Nerve cells** : Conduction of messages in the form of impulses.
- **Gland cells** : It is the cells of various glands which secrete enzymes that digest the food.
- **Skin cells** : The skin being the outermost covering of the body protects our body from various external factors such as germs and ultraviolet rays. It also helps in regulating the body temperature.

ENDOCRINE GLANDS

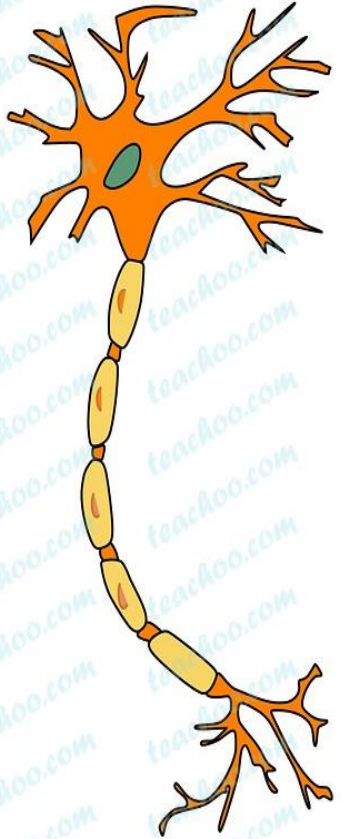




Structure of the skin



Human Nerve Cell



STRUCTURE OF A CELL

- The cell structure comprises individual components with specific functions essential to carry out life’s processes. These components include- cell wall, cell membrane, cytoplasm, nucleus, and cell organelles

Cell Membrane

- The cell membrane supports and protects the cell. It controls the movement of substances in and out of the cells. It separates the cell from the external environment. The cell membrane is present in all the cells.
- The cell membrane is the outer covering of a cell within which all other organelles, such as the cytoplasm and nucleus, are enclosed. It is also referred to as the plasma membrane.
- By structure, it is a porous membrane (with pores) which permit the movement of selective substances in and out of the cell. Besides this, the cell membrane also protects the cellular component from damage and leakage.
- It forms the wall-like structure between two cells as well as between the cell and its surroundings.
- Plants are immobile, so their cell structures are well-adapted to protect them from external factors. The cell wall helps to reinforce this function.

- 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.

- Cytoplasm
- The cytoplasm is a thick, clear, jelly-like substance present inside the cell membrane.
- Most of the chemical reactions within a cell take place in this cytoplasm.
- The cell organelles such as endoplasmic reticulum, vacuoles, mitochondria, ribosomes, are suspended in this cytoplasm.
- Nucleus
- The nucleus contains the hereditary material of the cell, the DNA.
- It sends signals to the cells to grow, mature, divide and die.
- The nucleus is surrounded by the nuclear envelope that separates the DNA from the rest of the cell.
- The nucleus protects the DNA and is an integral component of a plant’s cell structure.

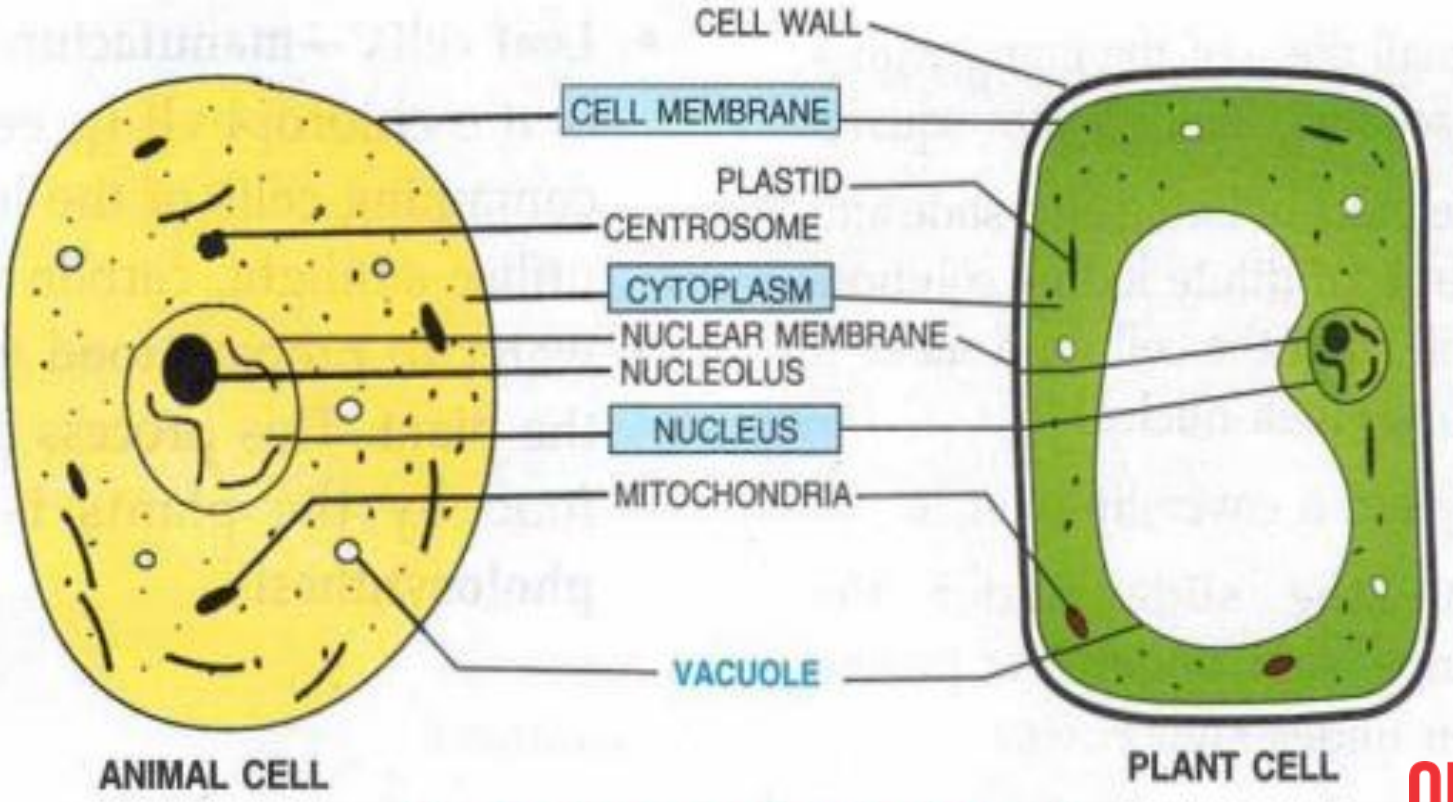


Fig. 3.6 Animal cell and plant cell

- https://www.topperlearning.com/icse-class-6-videos/biology/the-cell/plant-cell-and-animal-cell/77084

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Cell- Cell organelles(brief idea), Plastids and vacuoles, Cell division

Period 4

SUBJECT : (Science)
CHAPTER NUMBER: 3
CHAPTER NAME : Cell- The structure and Functions

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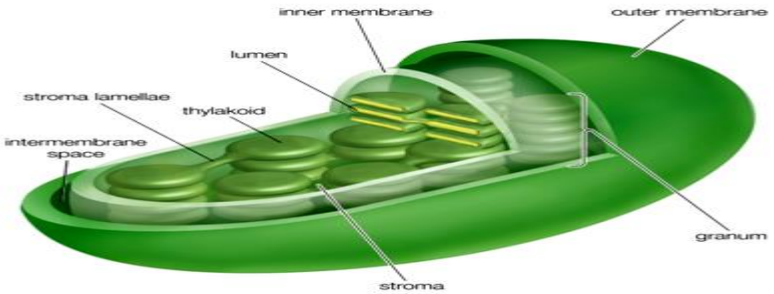
CELL ORGANELLES

- An organelle is a tiny cellular structure that performs specific functions within a cell. You can think of organelles as a cell's internal organs. For example, the nucleus is the cell's brain, and the mitochondria are the cell's hearts. Organelles are often enclosed by their own membranes, which divide the cell into many small compartments for different biochemical reactions.
- Cell organelle is a specialized entity present inside a particular type of cell that performs a specific function.
- There are various cell organelles, out if which, some are common in most types of cells like cell membranes, nucleus, and cytoplasm. However, some organelles are specific to one particular type of cell-like plastids and cell walls in plant cells.

- **Ribosome**
- Ribosomes are the places where proteins are synthesized in our cells.
- **Mitochondrion**
- Mitochondrion (plural: mitochondria) is a rod-shaped organelle that is considered the power generators of the cell.
- Mitochondrion performs cellular respiration, which converts glucose and oxygen to adenosine triphosphate (ATP). ATP is the biochemical energy “currency” of the cell for all activities.

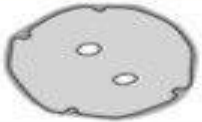
What are Plastids?

- Plastids are double-membrane organelles which are found in the cells of plants and algae. Plastids are responsible for manufacturing and storing of food. These often contain pigments that are used in photosynthesis and different types of pigments that can change the colour of the cell.



Types of Plastids

- **Chloroplasts**:- are the green plastids which contain chlorophyll pigments for photosynthesis.
- **Chromoplasts:**- are the coloured plastids for pigment synthesis and storage.
- **Leucoplasts:** are the colourless plastids for monoterpene synthesis found in non- photosynthetic parts of the plants.

Chloroplast		• Contain **chlorophyll** (green pigment) that absorbs sunlight in **photosynthesis** • Produce and store glucose
Chromoplast		• Contain carotenoids (red, orange, and yellow pigments) • Found in flowers and fruit
Leucoplast		• Contain no pigment • Used to store starch

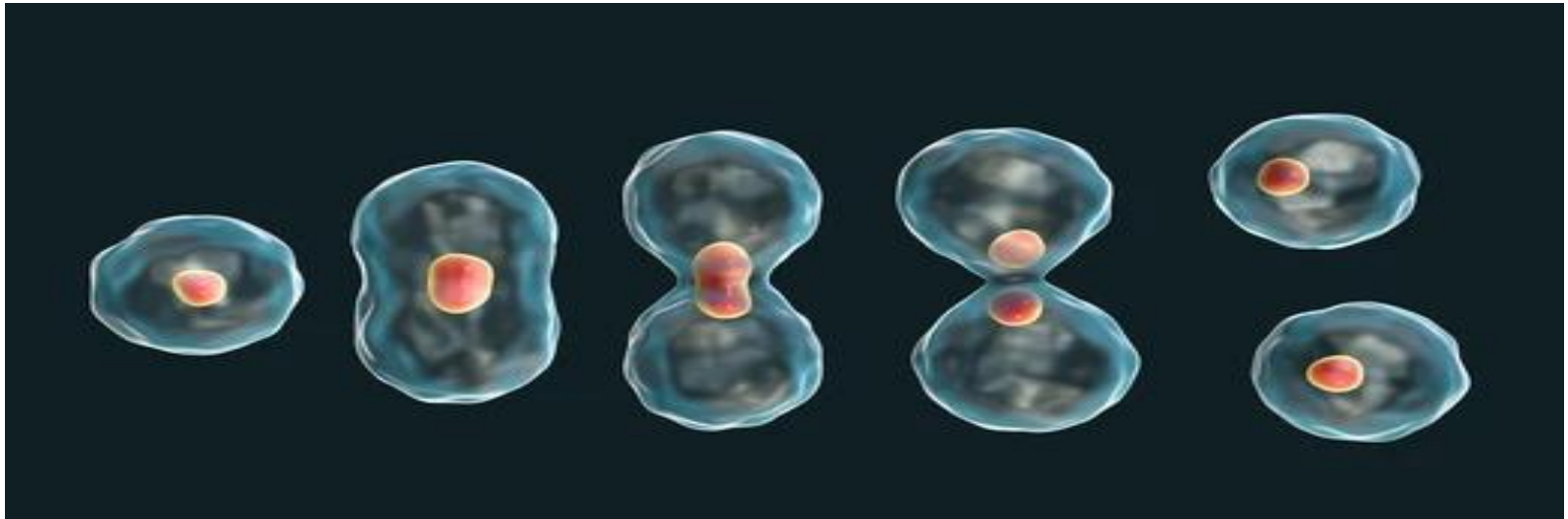
Vacuole

- **Vacuole** is a membrane-bound organelle that contains a mass of fluid.
- Large, central vacuole is only present in the plant cells.
- Vacuole serves as a storage space for plant cells. It can store a variety of nutrients (including sugars, minerals, amino acids, nucleic acids, ions, and special chemicals) that a cell might need to survive.
- https://www.youtube.com/watch?v=26-L7fYYV3k

CELL DIVISION

The cell division is important because of the following reasons:

- It helps in the survival and growth of organisms.
- Maintanence of chromosome number.
- Renewal of damaged cells



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CELL-Recapitulation & Question Answer Discussion

Period 5

SUBJECT : (Science)
CHAPTER NUMBER: 3
CHAPTER NAME : Cell- The structure and Functions

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Multiple Choice questions:

1. Tick (√) the appropriate answer.

(i) Identify the part which contains pigment.

(a)	Cell membrane		(b)	Plastid	√
(c)	Centrosome		(d)	Cell wall	

(ii) The organelle that controls all activities in a cell

(a)	Nucleus	√	(b)	Vacuole	
(c)	Plastids		(d)	Cytoplasm	

(iii) A cell that is spherical in shape is

(a)	White blood cell		(b)	Nerve cell	
(c)	Red blood cell	√	(d)	Amoeba	

(iv) The vacuole contains

(a)	Water		(b)	Cell sap	√
(c)	Salts		(d)	Food	

Short Answer questions

1. Name the scientist who invented the first microscope. Antonie Van Leeuwenhoek developed the first microscope.

2. Who coined the term cell?

   Robert Hooke coined the term cell.

3. Briefly describe the three essential parts of a cell.

   The three essential parts of a cell are

   i) Cell membrane: This is the outer most part of a cell. It is also called as plasma membrane. It is very thin, delicate and flexible. It is presented

both in animals and plants. It has fine pores in it, through which only certain substances can pass in and out.

i) Cytoplasm: It is a semi-liquid substance, which is colourless and translucent. It is found between the nucleus and the cell membrane.

ii) Nucleus: It is a small spherical mass mostly located towards the centre of the cytoplasm. It is the most important part of the cell. It regulates and coordinates various life processes of the cell and plays an important role in cell division.

2. The cell membrane is called selectively permeable. Why?

The cell membrane is called selectively permeable because it allows the entry of certain molecules only, while holding back the others

1. State the difference between:
(i) Nucleus and Nucleolus (ii) Cytoplasm and Protoplasm
(iii) Cell wall and Cell membrane

(i) Nucleus and Nucleolus

Nucleus	Nucleolus
It is the central organelle of a cell.	It is a component of nucleus
It is surrounded by cytoplasm and the cell membrane.	It is surrounded by nucleoplasm and nuclear membrane.
It is the most important part of the cell.	It is an important part of the nucleus.

(ii) Cytoplasm and Protoplasm

Cytoplasm	Protoplasm
It is found between the nucleus and the cell membrane. It has many parts like Golgi bodies, mitochondria and plasma membrane.	It is the living substance of the cell which includes cytoplasm and nucleus and nuclear membrane.
It is a colourless and translucent semi liquid substance.	It is a jelly like substance.

Cell wall and Cell membrane

Cell wall	Cell Membrane
It is a nonliving structure.	It is a living structure.
It is present only in the plant cell and lies outside the cell membrane.	It is present in both plant and animal cells.
It is made up of cellulose.	It is very thin delicate and flexible.
It is freely permeable and allows substances to enter and leave the cell without any hindrance.	It is selectively permeable and allows the entry of certain molecules only.

1. List the measure difference between a plant cell and an animal cell.

Plant cell	Animal cell
Size is usually larger	Size is usually smaller.
Plant cell has a definite cell wall.	It has no cell wall.
Cytoplasm is not so dense. Only a thin layer of cytoplasm.	Cytoplasm is denser and more granular. It fills almost the entire cell.
Vacuoles are prominent, fewer in number.	Vacuoles are small, numerous and concerned with excretion or secretion.
Contains plastids.	Does not contain plastids.

1. Briefly discuss the importance of chromosomes in an organism.

Chromosomes are contained in the nucleoplasm. In the chromosomes there are units called genes. These genes are responsible for transmitting characteristics from parents to offsprings. The number of chromosomes are defined for each species. Every cell of a human body contains 46 chromosomes which occur in 23 pairs.

1. Fill up the blanks with the terms given below in the box.

Pigments, wall, pre-existing, cell, vacuoles

(i) The _____is the structural unit of all living things.

(ii) All cells arise from _____cells.

(iii)Animal cells have no cell_____.

(iv)Plastids contain_____.

(v) _____are filled with water and dissolved substance.

Ans. (i) cell, (ii) pre-existing (iii) wall, (iv) pigments, (v) vacuoles

2. Try to find the names of four cell organelles hidden in this maze. (Hint: The hidden words can appear horizontally or vertically; forward or backward or even mixed up). Write them in the lines provided. For example: "NUCLEUS" in the last row, seven backward letters.

A	J	F	B	H	E	M	O	E	L	O	U	C	A	V
H	V	L	E	U	C	O	P	L	A	S	T	N	O	E
C	H	R	O	M	O	P	L	A	S	T	X	T	E	R
S	U	E	L	C	U	N	W	P	L	A	S	T	I	D

(i) Vacuole

(ii) Chromoplast

(iii) Plastid

(iv)Leucoplast

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Long Answer questions

1. Briefly describe the structure of nucleus and mention it's any two function.

Nucleus is a small spherical mass mostly located towards the centre of the cytoplasm. It is the most important part of the cell.
It has the following structure.

- A delicate porous nuclear membrane which encloses the nucleoplasm
- Inside the nucleoplasm there is a small darker body known as nucleolus. The nucleoplasm contains chromosomes and the chromosomes contain genes which are responsible for transmitting characteristics from the parents to offsprings.

The two functions of nucleus are

- It regulates and coordinates various life process of the cell.
- It plays and important part during cell division.

2. Name the scientist who coined the term "cell". How many lenses did he use in his microscope? What did he observe under his microscope?

In 1665 Robert Hooke coined the term "cell". He used two lenses in his microscope. While examining a very thin slice of a dead cork, he observed a cluster of box like cubicles piles up together. This reminded him of "cells" of monks living in a monastery. So he named them cells.

3.Name the three essential parts of a cell. Briefly describe the structure of cell membrane.

The three essential parts of a cell are:

- The outermost cell membrane or the plasma membrane.
- The cytoplasm
- The nucleus

Structure of cell membrane:

1. It is a living structure present in both plant and animal cells.
2. It is very thin, delicate and flexible.
3. It has very fine pores in it, through which only certain substance can Pass in and out. The cell membrane is selectively permeable.

Extra Questions and Answers

A. Objective Questions

1. Fill in the blanks:

a) Nucleus was discovered by Antonie Van Leeuwenhoek.

b) Robert Hooke first coined the term cell.

c) A cell is the basic structural and functional unit of all living things.

d) The word cell is derived from the Latin word cella.

e) The branch of biology which deals with the study of cells is called cytology.

f) The type of microscope we use in our school laboratory is known as compound microscope.

g) A cell is called living when it contains a jelly like substance called protoplasm.

h) On the basis of the number of cells, the organisms have been categorized as unicellular and multicellular.

i) The red blood cells are spherical or disc shaped.

J) The smooth muscles of the heart are cylindrical in shape for easy contraction and relaxation.

k) Paramecium is a single celled organism whose shape is like a slipper.

l) Spirogyra is a multicellular green algae, whose cells are cylindrical in shape.

m) Chlamydomonas is a unicellular green algae, whose cells are oval in shape.

n) Three scientists Schleiden, Schwann and Virchow formulated the cell theory.

o) Nerve cells conduct the messages in the form of impulses.

p) The gland sells secrete enzymes that digest food.

k) Skin cells helps in regulating the body temperature.

l) Each cell is surrounded by a cell membrane, also called plasma Membrane.

m) The cell membrane is called selectively permeable.

n) The cell wall is made up of cellulose.

o) Cytoplasm is found between the nucleus and the cell membrane.

p) The human body has 46 chromosomes which appear in 23 pairs.

q) Vacuoles are the non-living inclusions in the cytoplasm bound by a membrane.

r) In animal cells the vacuoles are larger in number and smaller in size and in plant cell the vacuoles are fewer in number but quite larger in size.

s) The cell wall is freely permeable.

t) The cell shape is determined by the function of the cell.

1. Give one word for the following.

a) Rounded body inside nucleus– Nucleolus.

b) A small darker body inside the nucleoplasm – Nucleolus.

c) The transparent substance in the nucleus is – Nucleoplasm.

d) The cavity of vacuoles are filled with – Water.

e) The unit for measuring cells – Micrometer.

f) The longest cell – Nerve cells.

g) The largest cells – Ostrich eggs

h) The smallest cells are found in – Bacteria

i) The shape of the cells of onion peel – Rectangular.

j) The smooth muscles in our body is – Spindle shaped.

k) Slipper shaped animalcule – Paramecium

l) The structural and functional unit of all living organism – Cell

m) It protects the cell from the entry disease causing agents – Cell wall

n) Green plastids that trap the solar energy for photosynthesis – Chloroplast

a) They impart varied colours to flowers and fruits — Chromoplast

b) Colourless plastids which occur in seeds — Leukoplasts

c) Covering of the vacuole — Vacuolar membrane or Tonoplast

A. Short Questions And Answers.

1. Why cell wall is called freely permeable?

Cell wall is called freely permeable because it allows substances in solution to enter and leave the cell without any hindrance.

2. Differentiate between Chloroplast and Chromoplast.

Chloroplast	Chromoplast
These are green plastids.	Contain yellow and red pigments.
Traps the solar energy for photosynthesis.	Responsible for varied colours to fruits and flowers as well as causing pollination by attracting insects.

3. What are the functions of a cell wall?

The main function of cell wall are

i) It gives shape and rigidity to plant cell.

ii) It protects the cell from the entry of diseases causing agents.

iii) It protects the plasma membrane and protoplasm against mechanical injury.

4. Define cell. When a cell is called a living cell?

A cell can be defined as the basic structural and functional unit of an organism. A cell is said to be living when it contains a jelly like substance called protoplasm.

5. Define protoplasm.

Protoplasm is the living substance of a cell. It is made up of cytoplasm and nucleus.

1. **Define unicellular organisms with example.**

The organisms having just a single cell are called unicellular organism. Example: Bacteria, Yeast, Amoeba and Paramecium etc.

2. **Define multicellular organisms with example.**

Multicellular organism are made up of millions and billions of cells. Example: All organism we can see around us like, Rose, Peepal, fish, lion and human beings etc.

3. **Why cell division is so important?**

Cell division is necessary for replacement, repair, reproduction and growth of the cells. It is necessary for the existence of all living beings including the plants.

4. **Define vacuole.**

Vacuoles are the non-living inclusions in the cytoplasm. These are filled with water and other substances in solution form called cell sap. These are present both in animal and plant cells. Vacuoles are fewer and quite large in size in plant cells and in animal cells vacuoles are large in numbers but smaller in size.

A. Long Questions And Answers.

Answer the following:

1. **Define the cell theory. Name the scientists who formulated it.**

Three scientists, Schleiden, Schwann and Virchow formulated the cell theory. The cell theory is described as follows.

i) Every living organism is made up of one or many cells.
ii) The cell is the structural unit of all living organism.
iii) The cell is the functional unit of all living organism.
iv) All cells arise from the pre-existing cells.

1. **Classify and define the different cells according to their size.** According to their size the cells are classified as largest cells, longest cells and smallest cells.

Largest cells: The ostrich eggs are example oflargest cell.
Longest cells: The nerve cells are the longest cells, which are up to 3 metre of length.
Smallest cells: The smallest cells are between 0.2 – 0.5 micrometre and found in bacteria,

2. **Define the different cells present in animals.**

The different cells present in the animals are
i) Muscle cells: Muscle cells has the ability to contract and relax. It helps in the movement of different body parts.
ii) Nerve cells: It helps in conducting the messages in the form of impulses.
iii) Gland cells: These are present in the various glands and secret enzymes that digest the food.
iv) Skin cells: It is present in the skin, which is the outermost covering of the body and protects from various external factors like germs and ultraviolet rays. It also helps in regulating the body temperature.

3. **What are plastids ? State its different types.**

Plastids are organelles which are present only in the plant cells. These are mainly three types depending upon the pigment they contain.
These are Chloroplasts, Chromoplasts and Leukoplasts.

Chloroplasts: These are green plastids that trap the solar energy for photosynthesis.
Chromoplasts: These contains yellow and red pigments. They impart colours to flowers and fruits. They also attracts the insects for pollination.
Leukoplasts: These are colourless plastids which are present in the seeds. They store starch, fat and proteins.

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