Cell – Structure and Functions

Cell as the Basic Unit of Life

- The cell is the basic structural and functional unit of all living organisms.
- It is the smallest part of the body of an organism, is capable of independent existence and is able to perform the essential functions of life.

Discovery of the Cell

- **Robert Hooke** observed cork cells under a simple microscope designed by him.
- He observed compartments resembling honeycombs and each compartment was separated by a wall.
- He termed each compartment as a '**cell**'.
- It was the first indication that living organisms are made of cells.

Cell Theory

- In 1838, Matthias Schleiden and Theodor Schwann proposed the basic cell theory. In 1858, another scientist Virchow made an addition to the existing cell theory.
- The postulates of the modern cell theory are
  1. The cell is the smallest unit of structure of all living things.
  2. The cell is the unit of function of all living things.
  3. All cells arise from pre-existing cells.

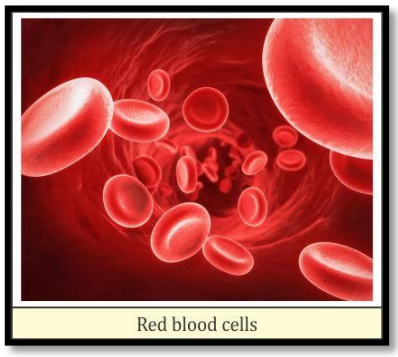
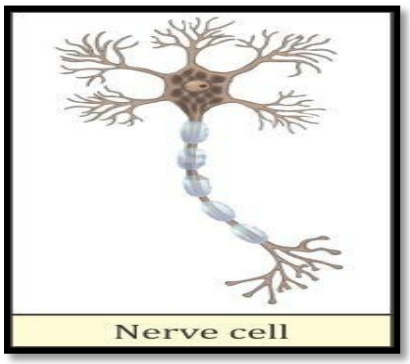
Variety in Cells

On the basis of the number of cells

Single-celled	Few-celled	Multi-celled
• Organisms made of a single cell. They are called unicellular organisms. • Examples: Bacteria, Yeast, *Chlamydomonas*, *Amoeba*, *Paramoecium*	• **Organisms** made of a few hundred to few thousand cells. • Examples: *Spirogyra*, *Volvox*	• Organisms made of millions to billions of cells. They are called multicellular organisms. • Examples: Man, cow, mango tree, crow

On the basis of size of cells

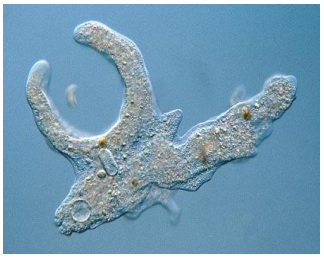
- Smallest cell: Examples: Bacteria (0.3–5.0 µm), red blood cells (7 µm)
- Longest cell: Example: Nerve cell in the neck of a giraffe (>3 m long)
- Largest cell: Example: Ostrich egg (170 mm × 130 mm)

Smallest cell	Longest cell	Largest cell
 Red blood cells	 Nerve cell	 Ostrich egg

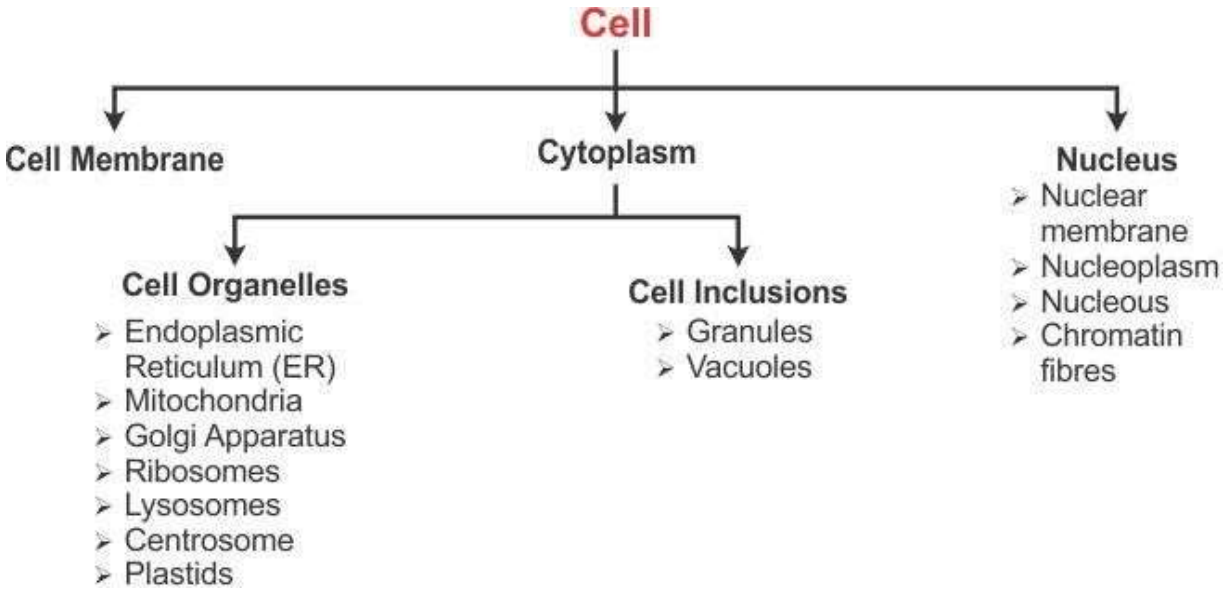
On the basis of shape of cells

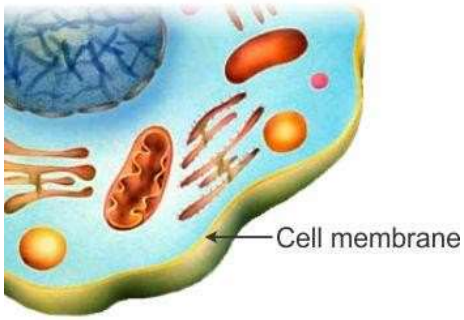
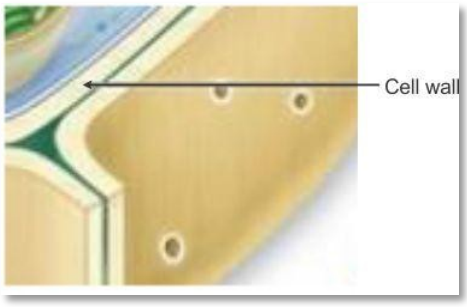
- Columnar: Epithelial cells
- Spherical: Human ovum
- Oval: Fat cells
- Spherical, biconcave: Red blood cells
- Rectangular: *Spirogyra*
- Spiral: Sperm cell
- Rod-shaped: Bacteria
- C-shaped: Cartilage cells
- Cylindrical: Striated muscle fibre cells
- Branched: Nerve cells
- Spindle-shaped: Smooth muscle cells
- Bean-shaped: Guard cell from a plant leaf
- Irregular: *Amoeba*

Amoeba is irregular in shape. It changes its shape continuously due to the presence of pseudopodia. The change in shape helps *Amoeba* in movement and in capturing food.



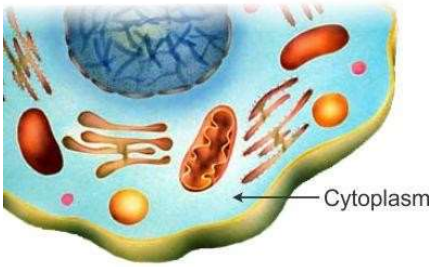
Structural Organisation of a Cell



CELL ORGANELLES		
NATURE AND OCCURRENCE	**MAIN CHARACTERISTICS**	**MAIN FUNCTIONS**
1. Plasma membrane/Cell membrane	• Forms the outermost covering in animal cells • Lies next to the cell wall in plant cells • Separates cellular material from its surroundings • Acts as an effective barrier and regulates the entry of substances in and out of the cell	
2. Cell wall (in plant cells only)	• Found in plant cells • Situated just outside the plasma membrane • Mainly composed of cellulose • Provides protection • Gives rigidity and shape to plant cells	

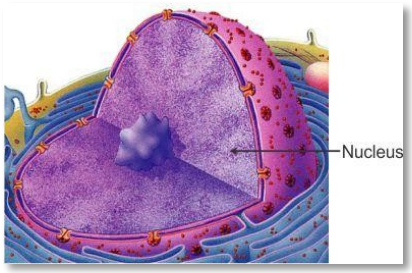
3. Cytoplasm

- Transparent jelly-like material
- Centre of all metabolic activities
- Different organelles contained in it perform different functions



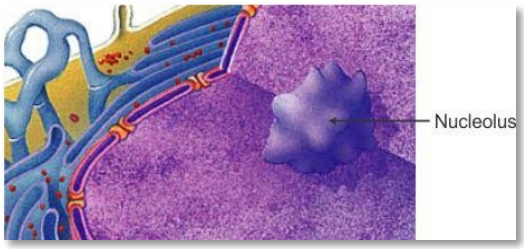
4. Nucleus

- Largest cell organelle
- Mostly spherical and dense
- Nuclear membrane with pores, which allow substances to enter and leave the nucleus
- Regulates cell functions
- Contains chromosomes, made of genes, which control hereditary characteristics



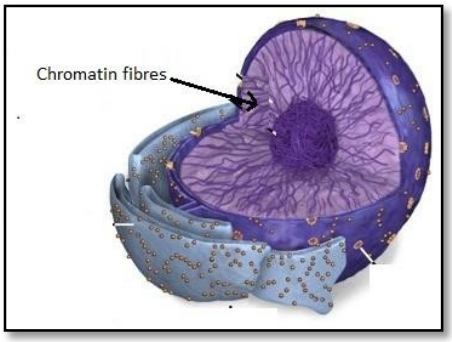
5. Nucleolus

- Embedded within the nucleus of the cell.
- One or more in number
- Produces ribosomes
- Participates in protein synthesis by forming and storing RNA



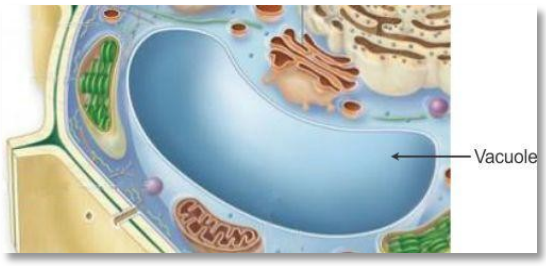
6. Chromatin fibres

- Network of thread-like structures made of DNA
- Chromosomes carry hereditary information or Genes



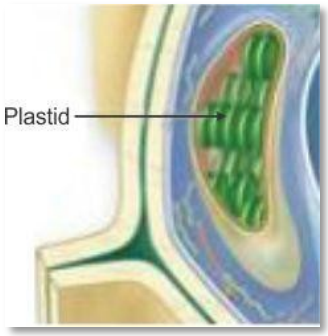
7. Vacuoles

- Fluid-filled membrane bound spaces
- Larger and permanent in plant cells
- Small and temporary in animal cells
- Storage of water and other substances, food, pigments and waste products
- Provides turgidity to the cells



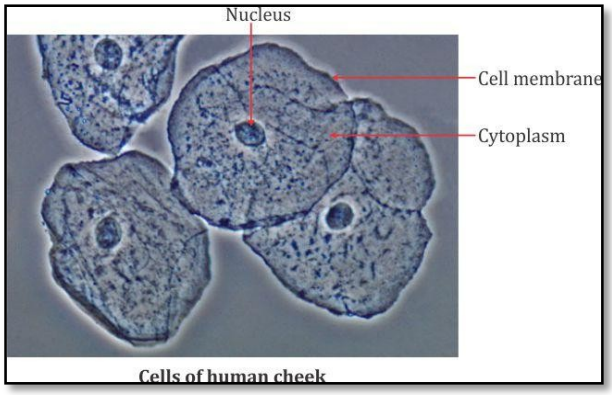
8. Plastids

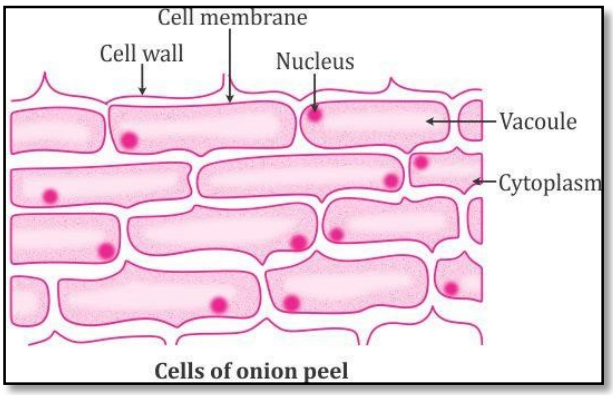
- Three kinds of plastids.
- Chromoplasts: Impart colour to flowers and fruits
- Chloroplasts: Trap solar energy for photosynthesis
- Leucoplasts: Store starch
- Chloroplasts are chromoplasts which are disc-shaped and are filled with green colour chlorophyll.



The gene is a unit of inheritance in every living organism. It is responsible for the transfer of hereditary characteristics from parents to offspring. However, the offspring may receive different characteristics due to a different combination of genes from parents.

Study of Plant and Animal Cells

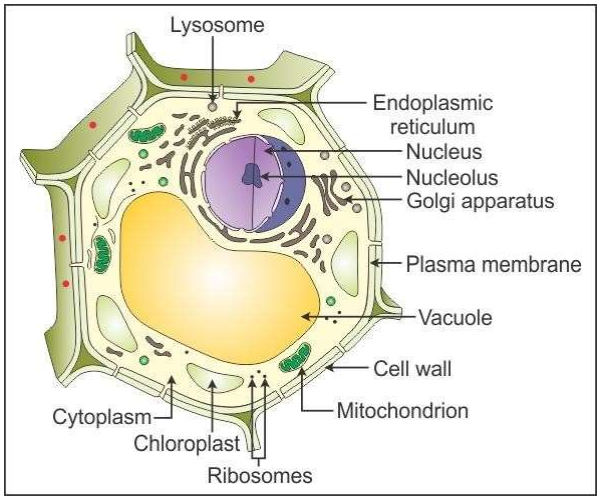


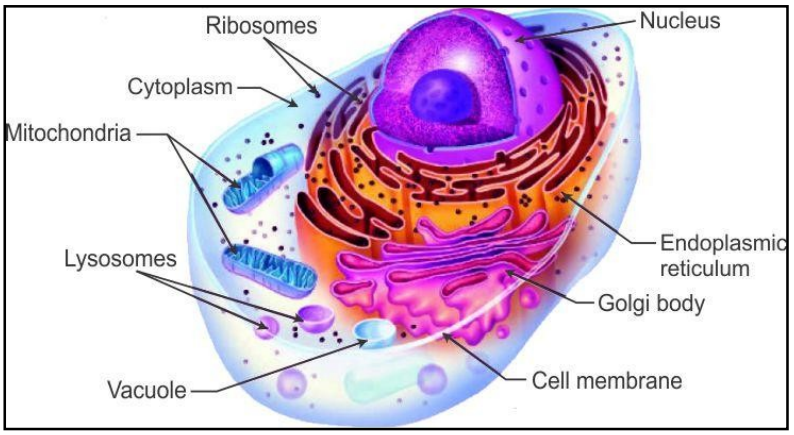


Similarities between Plant and Animal Cells

- Presence of cell membrane
- Presence of cytoplasm
- Presence of nucleus
- Presence of nuclear membrane
- Presence of mitochondria

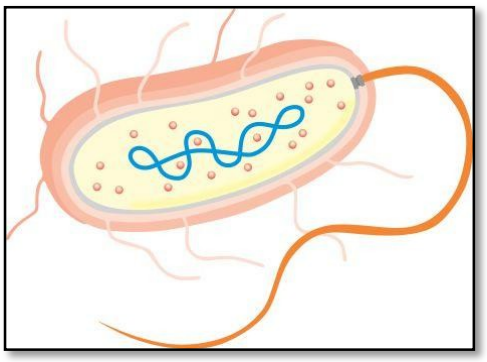
Differences between Plant and Animal Cells





PLANT CELL	FEATURE	ANIMAL CELL
Structural differences		
Presence of a definite cell wall made of cellulose	Cell wall	Absence of cell wall
Present internal to the cell wall	Cell membrane	Forms the boundary of the cell
Presence of one or more prominent vacuoles	Vacuoles	Presence of small and temporary vacuoles
Presence of plastids	Plastids	Absence of plastids
Functional differences		
Usually larger with distinct outlines	Size	Usually smaller with less distinct boundaries
Not so dense	Cytoplasm	Denser and more granular
Only a thin lining of cytoplasm, which is mostly pushed to the periphery	Arrangement of cytoplasm	Cytoplasm fills up almost the entire cell
Other differences		
Rectangular	Shape	Spherical
Starch	Storage material	Glycogen

Prokaryotic and Eukaryotic Cells

PROKARYOTIC CELL	FEATURE	EUKARYOTIC CELL
		
Absence of well-defined nucleus	Nucleus	Presence of well-defined nucleus with a nuclear membrane
Absent	Nucleolus	Present
Presence of a single length of only DNA	Genetic material	Presence of several lengths of DNA wound around certain proteins
Presence of smaller ribosomes	Ribosomes	Presence of larger ribosomes
Absence of other cell organelles	Cell organelles	Presence of several other cell organelles such as mitochondria, ER, chloroplasts etc.
Cell division occurs by fission or budding but not by mitosis	Cell division	Cell division occurs by mitosis or meiosis
Bacteria, blue green algae	Examples	*Euglena*, *Amoeba*, plants, animals