**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.

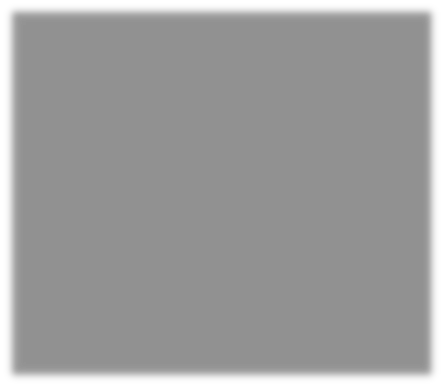
# Variety in Cells

### On the basis of the number of cells

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| **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**

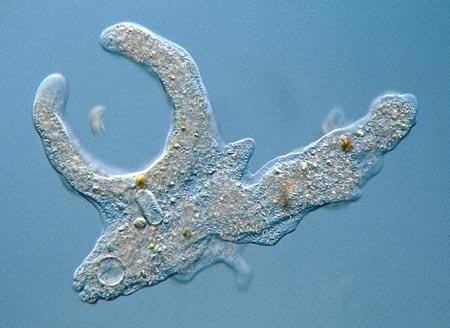
* Smallest cell: Examples: Bacteria (0.3–5.0 µm), red blood cells (7 µm)
* Longest cell: Example: Nerve cell in the neck of a giraffe (˃3 m long)
* Largest cell: Example: Ostrich egg (170 mm × 130 mm)



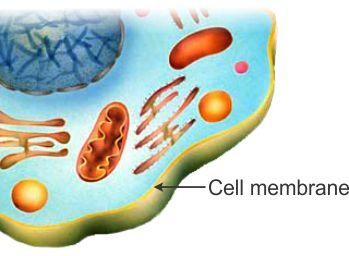
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| **Smallest cell** | **Longest cell** | **Largest cell** |
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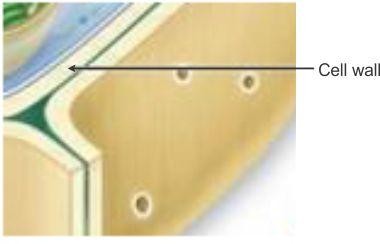
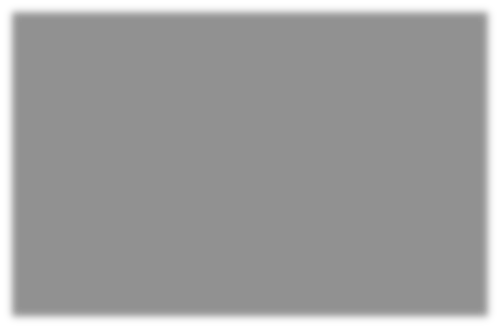
### On the basis of shape of cells

* 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*

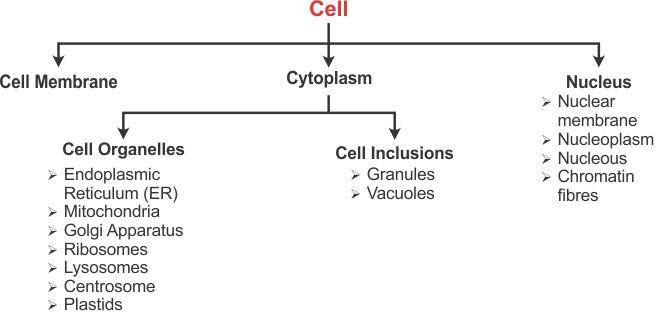


*Amoeba* is irregular in shape. It changes its shape continuously due to the presence of pseudopodia. The change in shape helps *Amoeba* in movement and in capturing food.

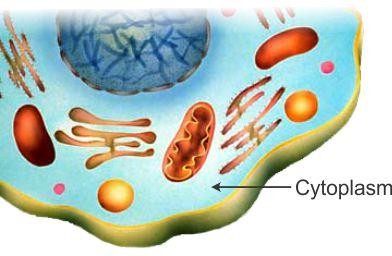


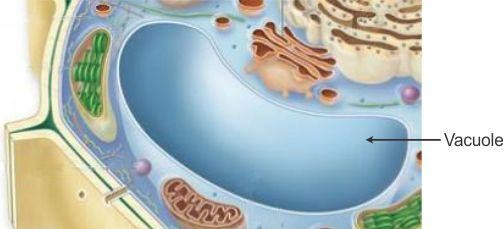
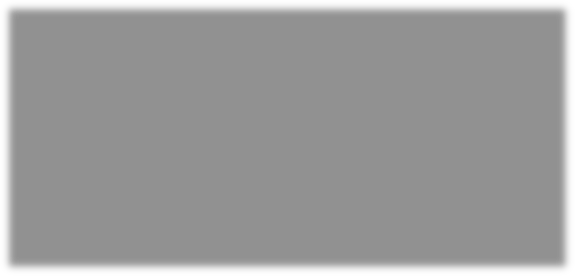
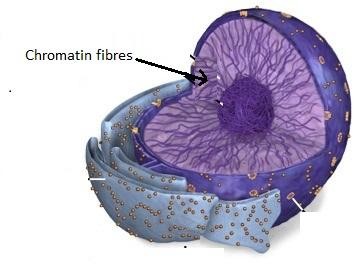
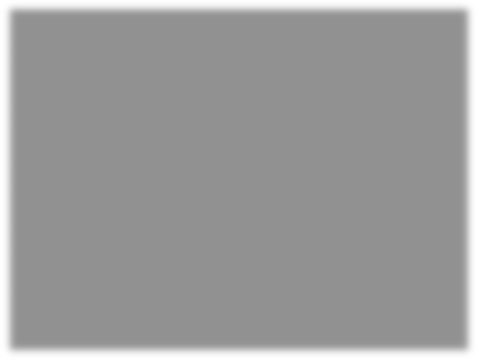
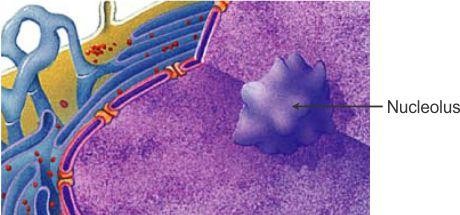
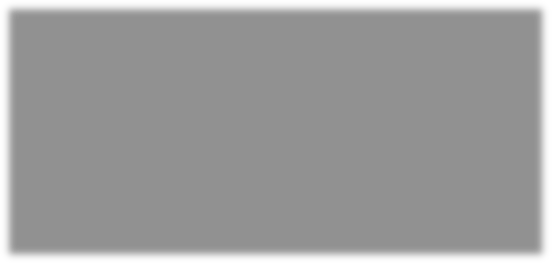
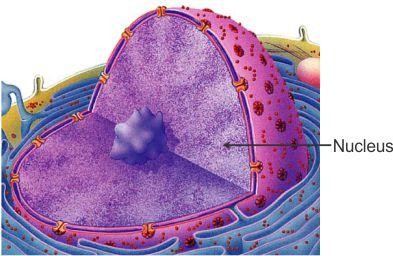
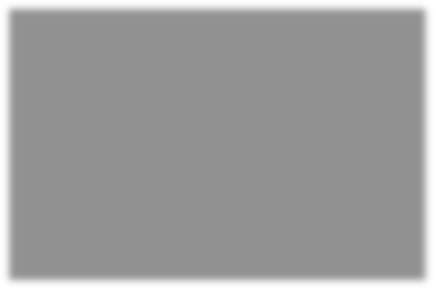


# Structural Organisation of a Cell

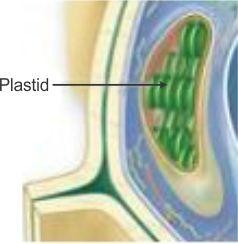
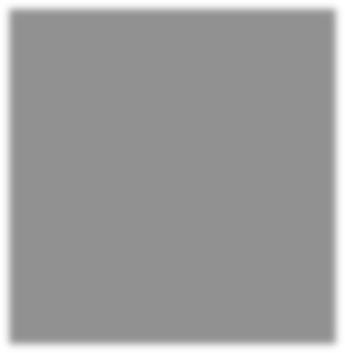


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| **CELL ORGANELLES** | | |
| **NATURE AND**  **OCCURRENCE** | **MAIN CHARACTERISTICS** | **MAIN FUNCTIONS** |
| 1. **Plasma membrane/Cell membrane**    * Forms the outermost covering in animal cells    * Lies next to the cell wall in plant cells    * Separates cellular material from its surroundings    * Acts as an effective barrier and regulates the entry of substances in and out of the cell | | |
| 1. **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 | | |





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| 1. **Cytoplasm**    * Transparent jelly-like material    * Centre of all metabolic activities    * Different organelles contained in it perform different functions |
| 1. **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 |
| 1. **Nucleolus**    * Embedded within the nucleus of the cell.    * One or more in number    * Produces ribosomes    * Participates in protein synthesis by forming and storing RNA |
| 1. **Chromatin fibres**    * Network of thread-like structures made of DNA    * Chromosomes carry hereditary information or Genes |
| 1. **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 |



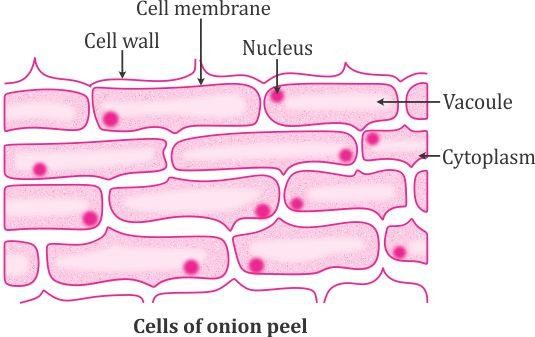
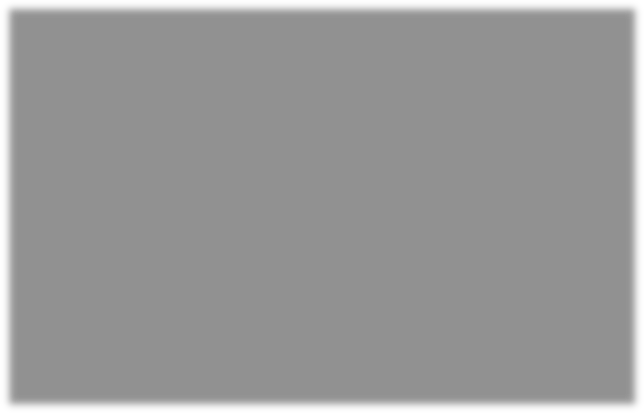
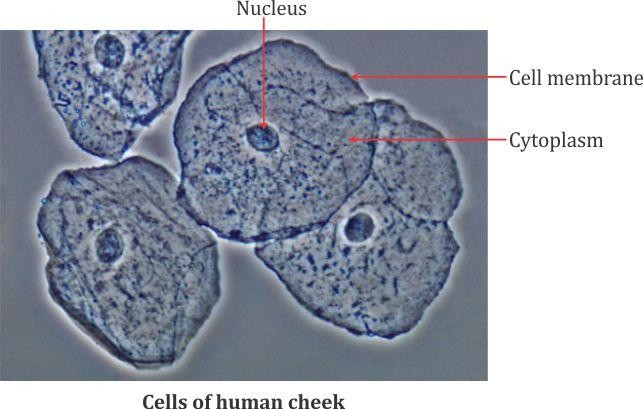
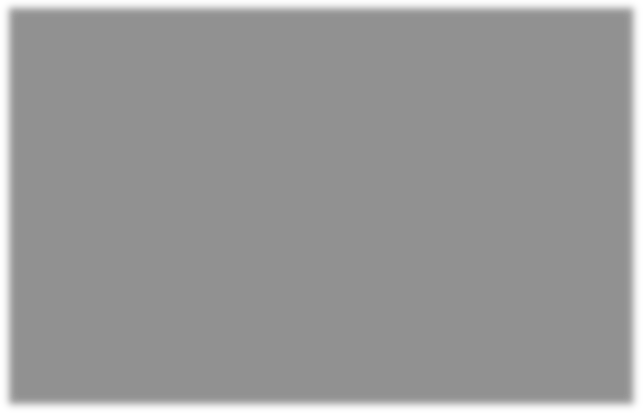
1. **Plastids**
   * Three kinds of plastids.
   * Chromoplasts: Impart colour to flowers and fruits
   * Chloroplasts: Trap solar energy for photosynthesis
   * Leucoplasts: Store starch
   * Chloroplasts are chromoplasts which are disc-shaped and are filled with green colour chlorophyll.



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**

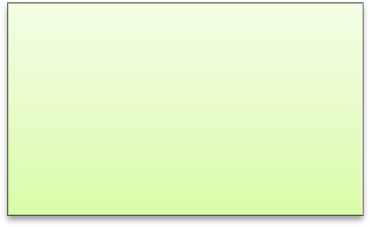


## Similarities between Plant and Animal Cells



Presence of cell

membrane



Presence of cytoplasm



Presence of nucleus

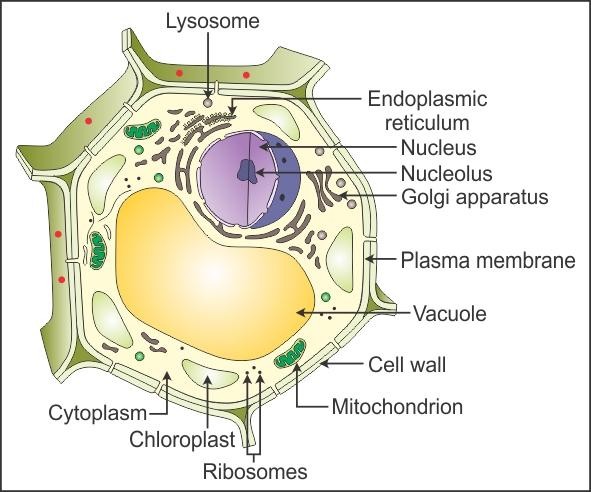


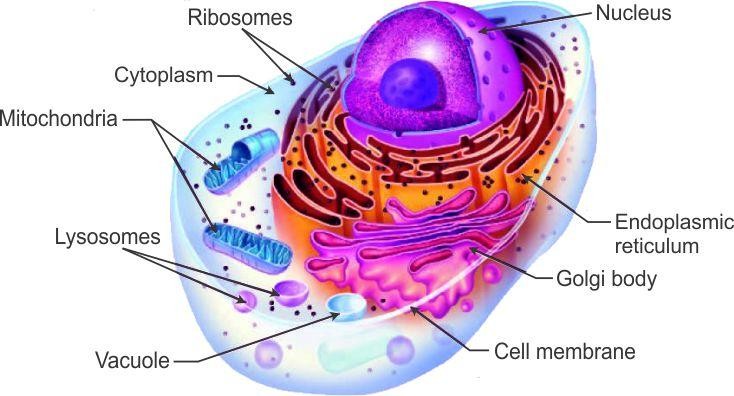
Presence of nuclear membrane



Presence of mitochondria

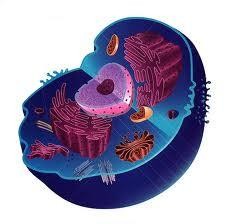
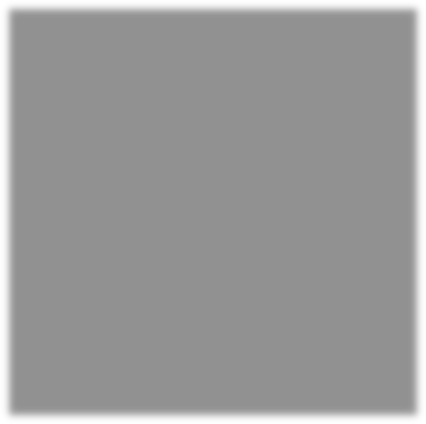
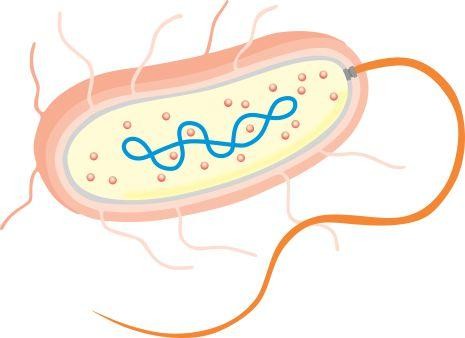
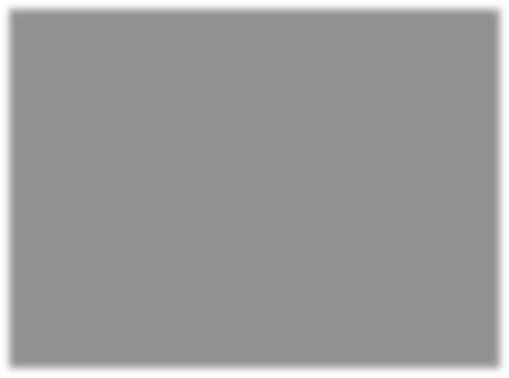
**Differences between Plant and Animal Cells**





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| **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**



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| **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 |