

Lecture 1: Principles of Cell Biology

By Lecturer
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Objectives

- The term of biology and cell biology.
- The history of cell discovery.
- Different characters of living cell
- Size and shape of different types of the cells
- Different term of cell structure
- The chemistry of cell

Cell Biology

- **Biology** is a scientific study of the living organisms, which grow, reproduce and respond to stimuli of the environmental factors.
- The science of medical biology mainly concerns with studying of human **body, its structure, functions and the organization** of the body parts.
- **Anatomy** and **physiology** are two complementary branches of medical biology provides concepts that helps in understanding the body parts and the relationship between these structure to perform the body functions.
- **Microanatomy** is a science provides information concerns body structures too small to be seen by naked eye and its is of two subdivision, histology and cell biology.
- **Histology** is a science of studying the structure and function of different types of tissue, while the cell biology deals with studying of the ultra-structure of the body cells and the functions of their organelles.
- **Parasitology** is the study of parasites, their hosts, and the relationship between them.

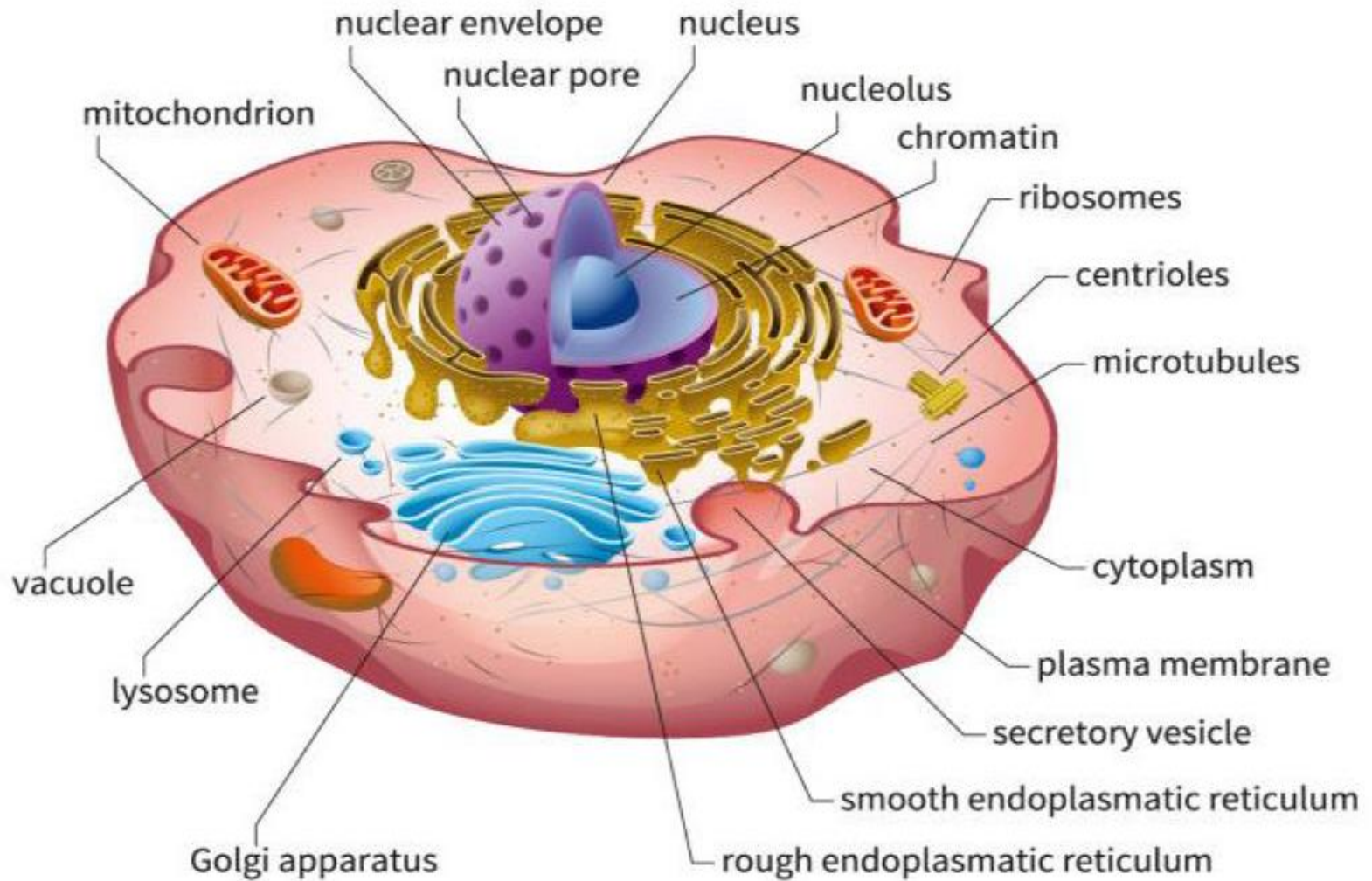
The Cell

- ❑ **Cells** are the structural and functional unit of all living organisms, from the unicellular organisms, like **amoeba**, which are the body made up of one cell to the multicellular organisms, such as **human** beings, whom their body made up of 50-100 trillion cells.
- ❑ The cell has been known in the **6th century** by **Robert Hook** with the discovery of the light microscope.
- ❑ A typical cell under light microscope consists of two major parts are **nucleus** and **cytoplasm**

Cell Theory

- All living things are composed of **one or more cells**.
- Cells are the **basic units of structure and function in an organism**.
- Cells come only from the **replication of existing cells**.

The Cell



The Cell

- ❑ **The Cells** which represents the structural and functional unit of body, consists of mass of **protoplasm** surrounded by **plasma membrane**.
- ❑ The **protoplasm is a living material of the cell, which considered as the life itself, has two compartments, the cytoplasm and nucleoplasm.**
- ❑ **Protoplasm** is mainly composed of six basics substances including **water, electrolytes, protein, lipids, and carbohydrates**

Water

Water is the most abundant component of the living cells, which represent 70-85% of the total chemical components.

Electrolytes

Electrolytes represent 2-3% of the chemical components are dissociated as anions, such as Cl^- , and cations, such as Na^+ and K^+ . The anion and cation are important in maintaining the osmotic pressure and acid-base equilibrium of the cell.

Protein

Protein represent 10-20% of the chemical component of a dry cell and composed chains of different types of amino acids.

Lipids

Lipids (15%) are insoluble in water, the most important lipids in the cell including phospholipids, cholesterol, neutral fat (triglyceride), glycolipids, steroids, and terpenes.

Carbohydrates

Carbohydrates (1%) are group of poly saccharides, contain C, H, O in a ratio of 1:2:1. The smallest carbohydrates are the simple sugar (trioses, pentoses and hexoses), depending on the number of the carbon atoms.

Nucleic acid

Nucleic acid (2%) are of two types DNA and RNA, which are formed of repeating units called nucleotides. Each nucleotide is composed of nitrogen base, pentose sugar, and a phosphate group.

The living properties of the protoplasm

1- Conductivity:

It is the transmission of waves of excitation throughout the cell from the point of stimulus, as that of the nerve and muscle cells.

2- Contraction:

Contraction is a property of change in size to achieve locomotion of an organism as that of contraction of skeletal muscle tissue.

3- Respiration:

Respiration is a process whereby oxygen and food substances within the cell interact chemically to produce energy, carbon dioxide and water.

4- Absorption:

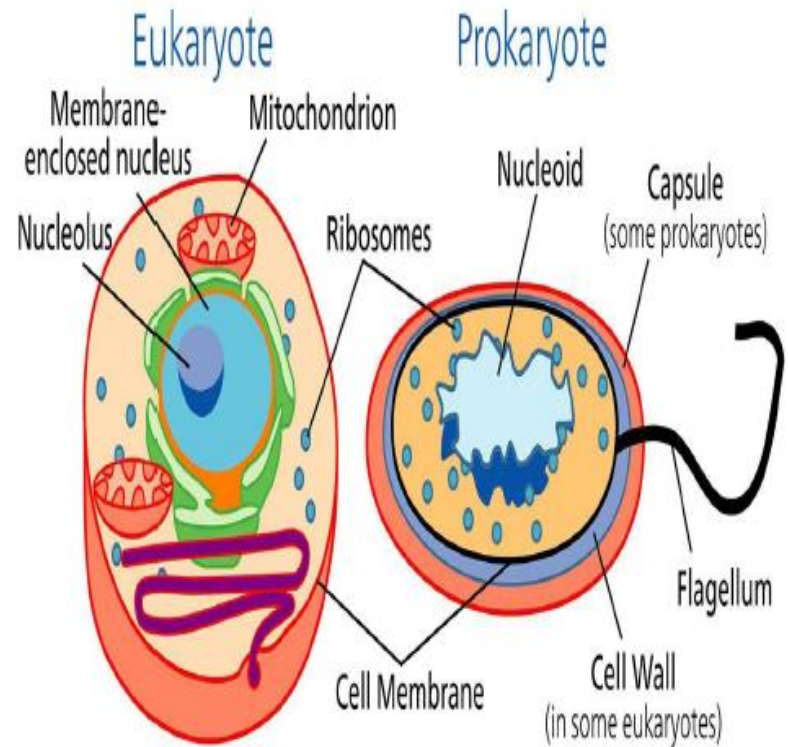
Is the capacity of the living cell to get in a substance from its environment (columnar epithelium of small intestine).

5- Secretion:

It is a process by which a cell extrudes materials. These materials may be a useful (secretion) or useless product (excretion) e.g. digestive enzymes and hormones or urea.

Eukaryotic and Prokaryotic cells

Prokaryotic Cells	Eukaryotic Cells
Very minute in size	Fairly large in size
Nuclear region (nucleoid) not surrounded by a nuclear membrane	Nuclear material surrounded by a nuclear membrane
Single chromosome present	More than one chromosome present
Nucleolus absent	Nucleolus present
Membrane bound cell organelles are absent	Membrane bound cell organelles are present
Cell division by fission or budding (no mitosis)	Cell division by mitosis or meiosis



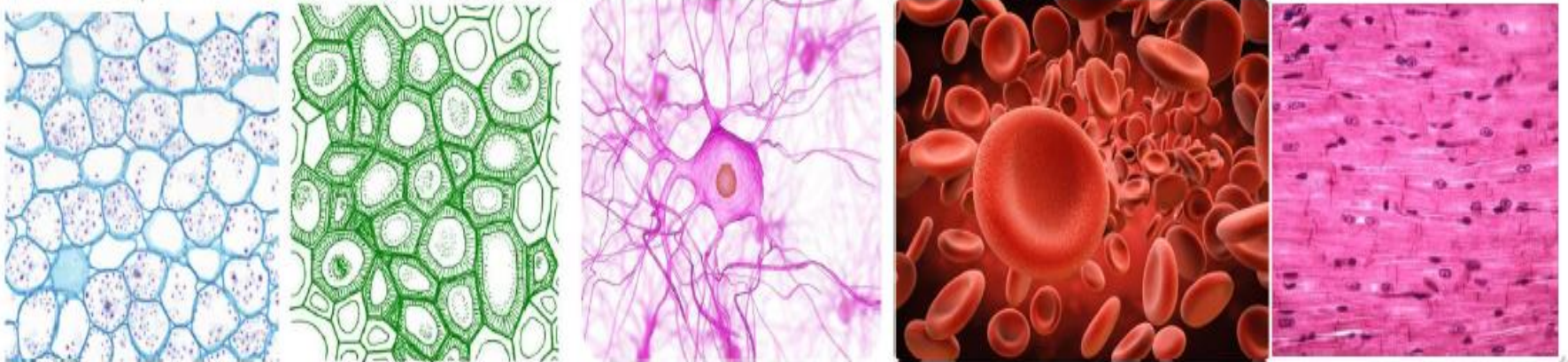
Cell , Number, Shape, Size, Growth and Metabolism

Cell Number

- **Unicellular organisms** – Organisms with single cell, capable of independent existence and carries all functions like digestion, excretion, respiration, growth & reproduction (Acellular). Examples , Amoeba, Euglena
- **Multicellular organisms** – Organisms with more than one cell
- **Cells in multicellular organisms** vary in size & shape depending on function

Cell Shape

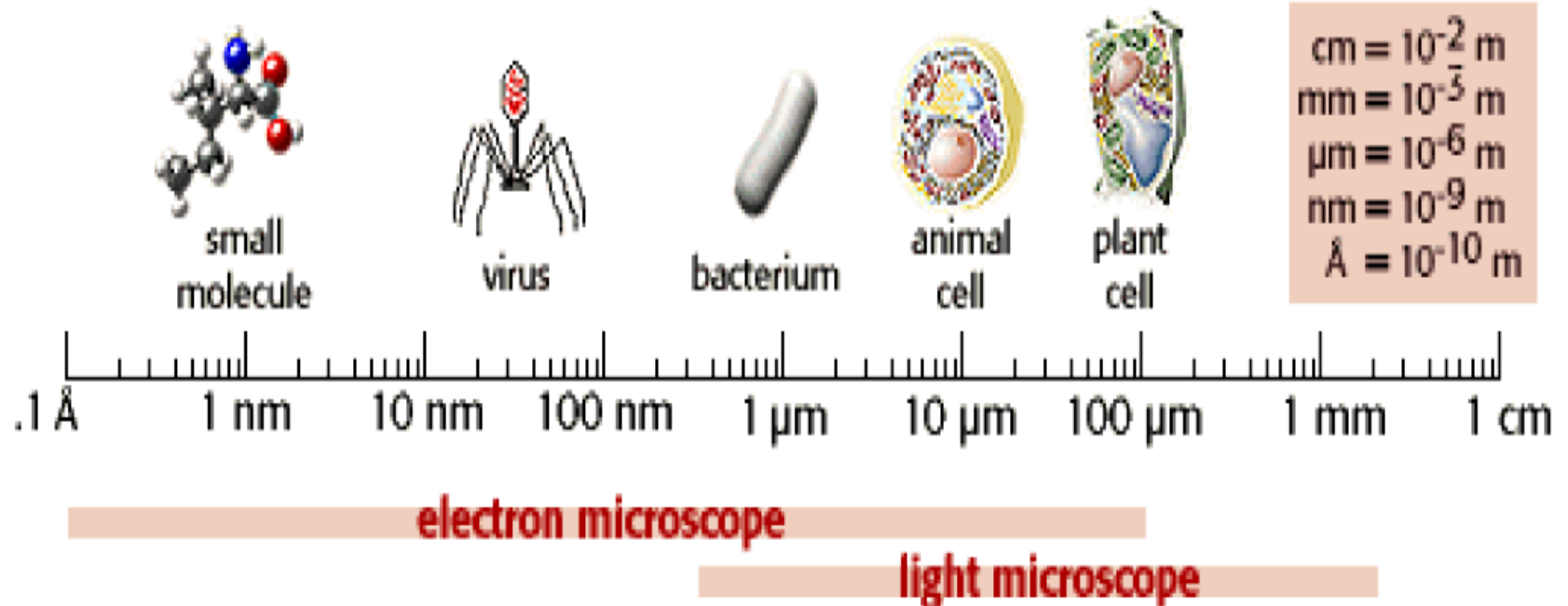
- ❑ **Parenchyma** - Polyhedral cells performs storage.
- ❑ **Sclerenchyma** - spindle shaped cells & provides mechanical support
- ❑ **Nerve cells**- long and branched cells conducting nerve impulses
- ❑ **RBC** -Biconcave & helps in carrying oxygen
- ❑ **Muscle cells**- cylindrical or spindle shaped concerned with the movement of body parts



Cell Size

- ❖ **Size**: varies from few microns ($1\text{cm} = 10\text{mm}$; $1\text{mm} = 1000\mu\text{m}$) to few cms
- ❖ **Smallest** living cell is PPLO (Pleuro Pneumonia Like Organism) - $0.1\ \mu\text{m}$
- ❖ **Largest** living cell is Egg of an Ostrich , 170 to 180 mm in diameter.
- ❖ **Bacteria** – 0.1 to $0.5\ \mu\text{m}$
- ❖ **Scierenchyma** fibre upto 60 cms in length

Relative sizes of cells and their components



Cell Growth and metabolism

- **Growth** means an increase in the size of the cell as a result of increasing the amount of protoplasm.
- Reproduction of a Prokaryotic cells is achieved by **binary fission**
- Reproduction of a Eukaryotic cells is achieved by division of a mature cell either by **mitosis** in **somatic** cells or **meiosis** in a **sex** cells.
- **Metabolism** is a chemical process of a living cell by which nutrient material is effected, and it is two types:
 - Catabolism**: this process involves the breakdown of the food material (protoplasm of other cells) brought into the cell. Energy will be released by this process to be used by the cell in different activities
 - Anabolism**: in this process energy released by catabolism is utilized by the cell to produce materials that are retained or released from cell

Movement of the cells

Movement of unicellular organisms is necessary for defense or for obtaining a food.

Cellular locomotory mechanisms may be achieved by :

- 1- Activity cellular appendages: cilia and flagella as in some bacteria and protozoa.
- 2- Streaming movement of the cellular cytoplasm as in amoeboid movement.
- 3- Movement of human being, is achieved by contraction of a muscle fiber as of the striated and smooth muscle.

Thank you