Department of biology

2025-2026

((Theoretical Histology))

Stage (-3-)

LEC- ((2))

Cell Structure and Function

By

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Cytology: Is the science deals with study of the Cell, (cytoplasm and Nucleus).

Cell : the basic structural and functional units of an organism.

Eukaryotic cells

The cell is composed of two basic parts: cytoplasm that surrounds the nucleus. The outermost component of the cell, separating the cytoplasm from its extracellular environment, is the **plasma membrane** (plasmalemma).

In contrast, the smaller prokaryotic cells of bacteria typically have a cell wall and lack nuclei and membranous cytoplasmic structures.

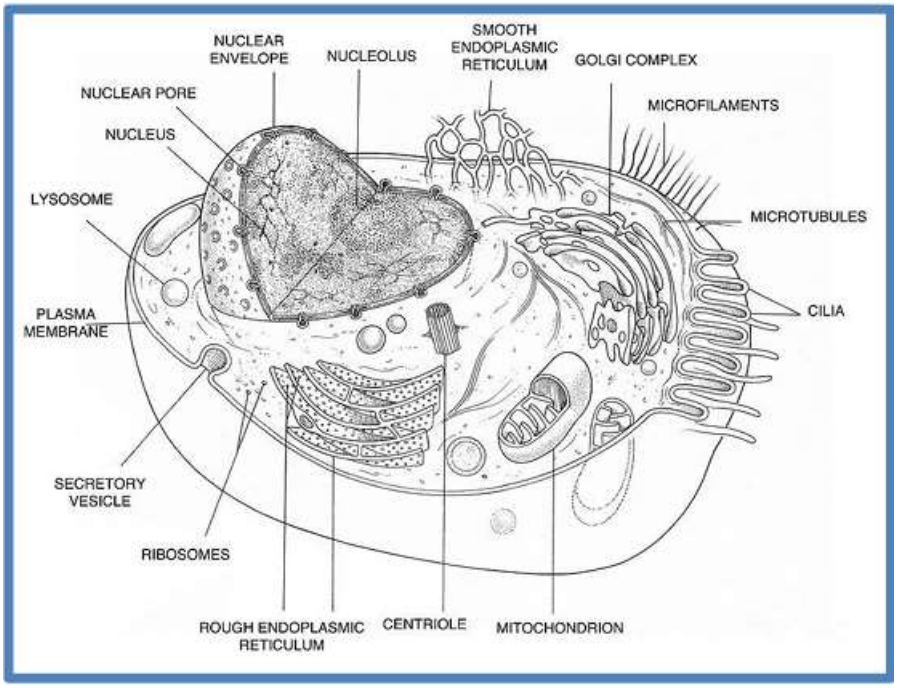
The cytoplasm consists largely of a fluid component, cytosol and the organelles.

The contents of cells between the plasma membrane and nuclear envelope responsible for many cellular processes.

Cytosol:-Viscous fluid medium with dissolved solutes (eg, ions, proteins, carbohydrates, lipids). It is provides support for organelles; serves as the viscous fluid medium through which diffusion occurs.

The cytoplasm includes organelles can be classified into membranous and non-membranous organelles.

*** Membranous organelles** include (Cell membrane, RER, SER, Golgi, Lysosomes, Endosomes, Mitochondria).



*__Non-membranous organelles__ include (Ribosomes, Centrioles, Microtubules, Glycogen)

Cell membrane: It is not visible by the light microscope, seen only by electronic microscope (E M). Its consist from two layers are inner and outer.

Each layer is composed of a single layer of phospholipids and associated proteins.

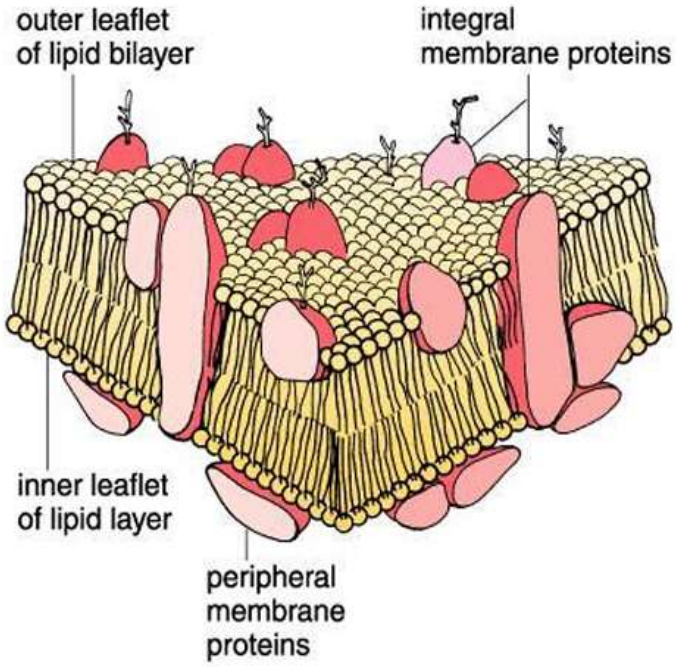
The function of cell membrane are:

1- Keep the structural integrity of the cell.

2- Control of movement substances in and out the cell by Passive diffusion Facilitated diffusion Active transport Selective transport.

3- Act as interface between the cytoplasm and the external environment.

4- Regulate the cell to cell interaction by special type of cell junctions.

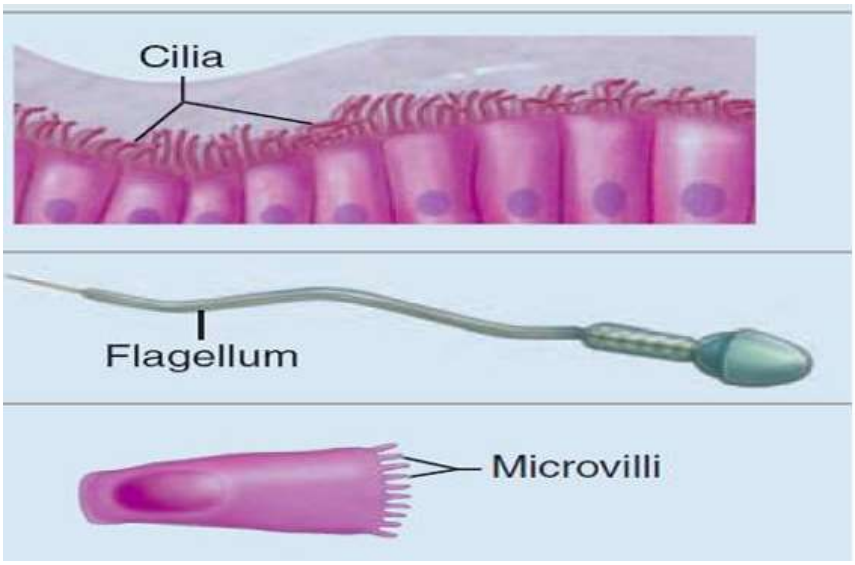


Some Modification of cell membrane:- Some cells have membrane extensions such as cilia, flagellum and microvilli perform some function.

Cilia:-Short, numerous membrane extensions supported by microtubules, which occur on exposed membrane surfaces of some cells (ciliated cell in respiratory tract). Act as move substances (eg, mucus, and dissolved materials) over the cell surface.

Flagellum:- It is long, singular membrane extension supported by microtubules; present on sperm cells. Act as Propels sperm

Microvilli:- Numerous thin membrane folds projecting from the free cell surface; supported by microfilaments. Act as increase membrane surface area for greater absorption.



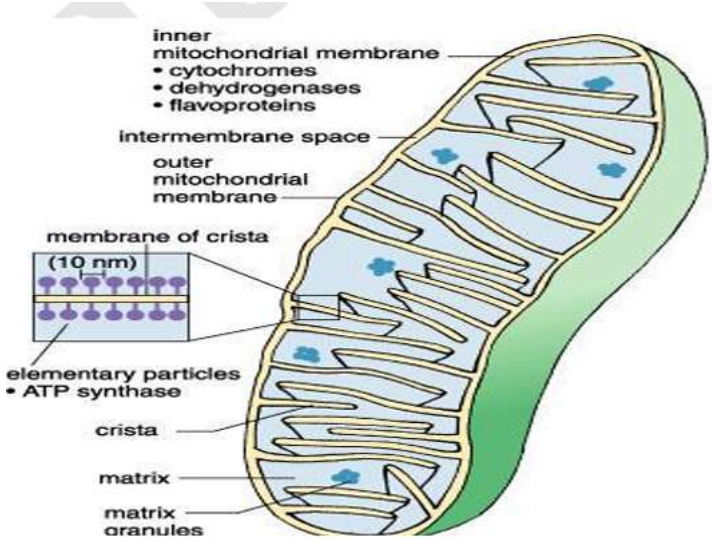
Mitochondria - the are flexible, rod-shape organelles.

- ❖ The number of mitochondria the variables in cells

e.g. they are abundant in liver cell

(hepatocytes) and muscles.

- ❖ Each mitochondrion possesses an smooth outer membrane and folded inner membrane (Cristae) with a narrow space between them is called inter-membrane space.
- ❖ The matrix space contains also mitochondrial ribosomes, mRNA, tRNA, and dense spherical matrix granules.



Ribosomes :- They are small, non-membranous particles composed.of protein and ribosomal RNA. Each ribosome is composed of large subunit and small subunit.

Endoplasmic Reticulum (ER) - It is the largest membranous system in the cell, its consist from interconnection

tubules and vesicles whose lumen is referred as cistern. - ER have 2 types smooth and rough ER. –

The Functions of endoplasmic reticulum are:-

1. Production of all membranes of the cell.
2. Protein synthesis and modification.
3. Lipid and steroid synthesis.
4. Detoxification of certain toxic compounds.

The Endoplasmic Reticulum are two type:-

A. Smooth Endoplasmic Reticulum (SER)

B. **Rough Endoplasmic Reticulum (RER)**

SER is a system of anastmosing tubules and flattened membrane-bound vesicles. The lumen of SER is continuous with that of RER.

- Their surface is free from ribosomes so it is called smooth.

- Their membranes possess integral proteins that function in recognizing and binding ribosomes to their surfaces and maintain their flattened shape.

Golgi complex :

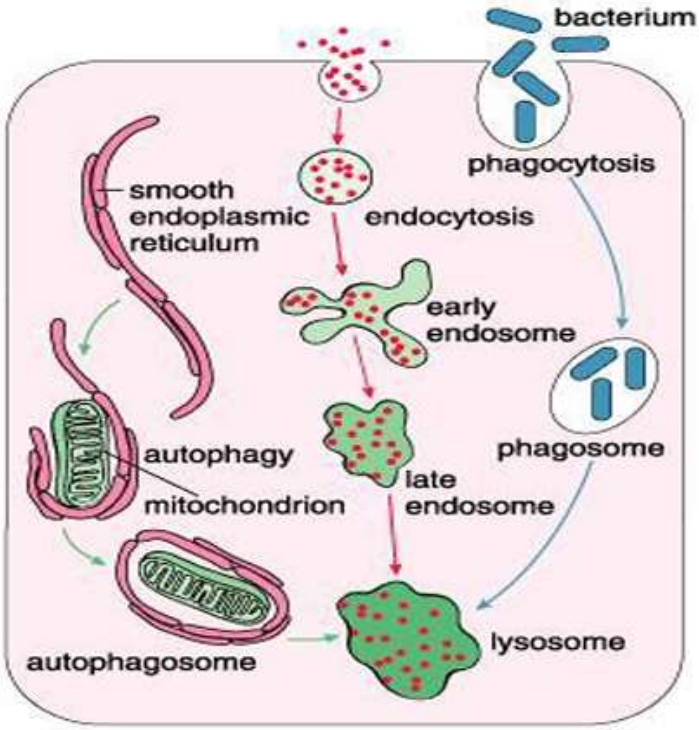
- Proteins synthesis in the RER go to Golgi apparatus for post-translational modification and packaging.

- Golgi is composed of one or more series of flattened, slightly curved membrane-bound cisternae.

Lysosomes - Lysosomes are small rounded or polymorphic in shape.

- Lysosomes have an acidic pH, and contain hydrolytic enzymes.

- Lysosomes help in digesting macromolecules, phagocytosed micro-organisms, cellular debris, cells, and senescent organelles such as mitochondria & RER.



Endosomes - Endosomes are divided into early and late compartments:

- Early endosomes are situated near the periphery of the cell near the Golgi apparatus.

- Late endosomes are situated deeper in the cytoplasm.

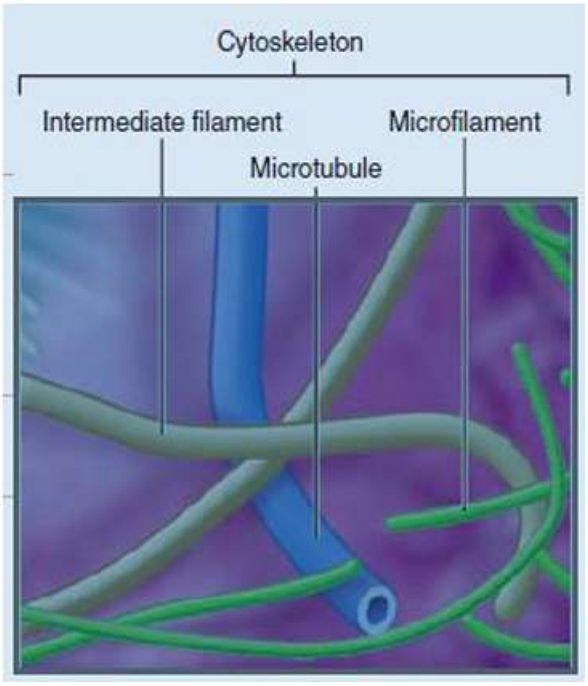
Cytoskeleton- They are meshwork of protein filaments responsible for maintenance of cellular morphology, and participate in cellular motion,

- The cytoskeleton has three major components:

1- Microfilaments (Actin)

2- Intermediate

3- Microtubules



1- Microfilaments:- actin protein is intertwined protein filaments (actin filaments), Maintain cell shape; support microvilli, facilitate change in cell shape; participate in muscle contraction.

2- Intermediate filaments: Various protein components, Provide structural support; stabilize junctions between cells.

3-Microtubules: Hollow cylinders composed of tubulin protein, Maintain cell shape and rigidity; organize and move organelles; support cilia and flagella; separate chromosomes during the process of cell division.

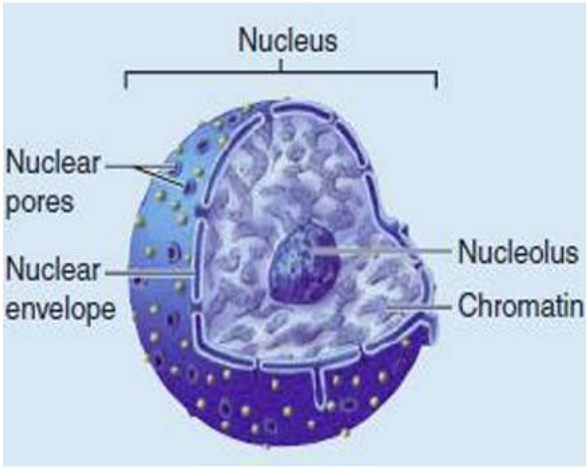
Centromere and Centrioles -Centromere is present in all dividing cells near the nucleus, and is composed of 2 perpendicular

centriols. The centriols duplicated during cell division. - Centriol is cylindrical in shape. – Each centriol composed of nine sets of triplet microtubules.

The nucleus:

is a membrane-limited compartment that contains genome (genetic information) in eukaryotic cells. The nucleus consists of the following components:

1- Nuclear envelope is a membrane that surrounds the nucleus of the cell. It consists of inner and outer membranes separated by a perinuclear cisternal space and perforated by nuclear pores. The outer membrane of the nuclear envelope is continuous with that of the RER.



2- Nucleolus a small dense area within the nucleus that contains RNA and proteins. The nucleolus is the site of rRNA synthesis.

3- Chromatin nuclear material contains DNA, histones, and various nuclear proteins. It is responsible for the characteristic basophilia of the nucleus.

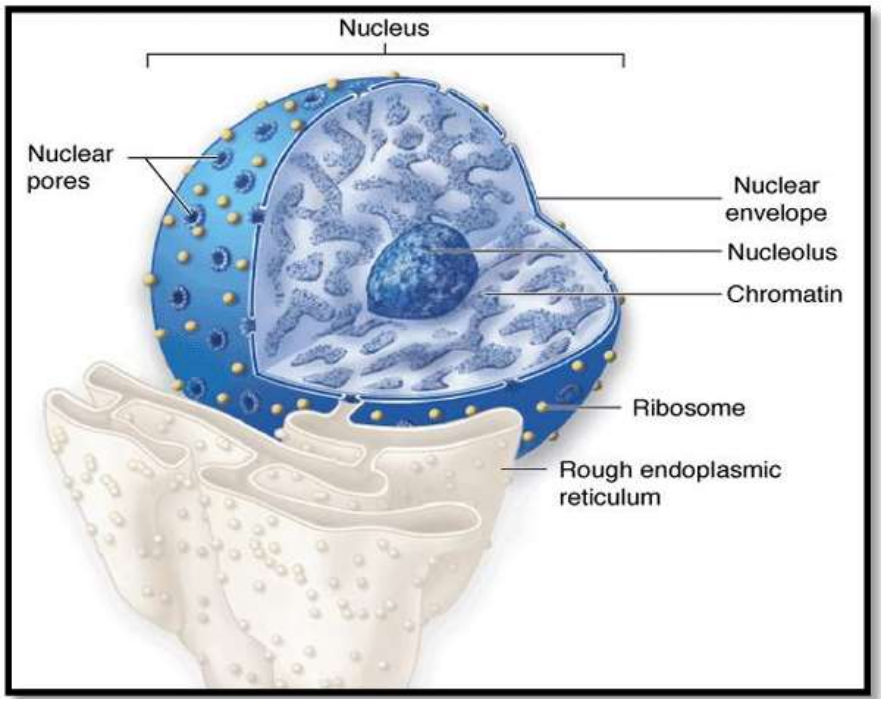
4- Nucleoplasm, the nuclear contents other than the chromatin and nucleolus.

- All human and animal cells contain nucleus except the mature red blood corpuscles.

- Normally each cell contains a single nucleus, but sometimes contains two as liver cells or more (multinucleated) as skeletal muscle cells, and osteoclasts.

- Nucleus take spherical, oval, flattened, or lobulated.

- Also, nucleus take central, basal or peripheral in location.



The nuclear envelop and structure