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PART ONE :

CELL

ORGANELLES

HISTOLOGY (MICROSCOPIC ANATOMY):- the study of cell structure, tissues and organs using microscopes.

STAINING FOR Light microscope(L/M):-

- 1) Hematoxylin: A basic dye. It stains the acidic components of the cell dark blue. So they are called basophilic structures. Such as: DNA & RNA.
- 2) Eosin: An acidic dye. It stains the basic components of the cell pink. So they are called acidophilic structures. Such as secretory granules and cytoplasm in steroid-hormone secreting cells.

Electron microscopy:-

Transmission E/M: Resolving power 0.2 nm.

- * Electron-dense structure
- * Electron-lucent structure

THE CELL

THE CELL NUCLEUS (INTERPHASE NUCLEUS):-

It is the largest organelle in the cell

L/M:

Appearance (Type):

- Light nucleus (vesicular) (open face)
- Dark nucleus (deeply-stained)

Number:

1, 2, or more.

Position:

Central, eccentric, peripheral, basal.

Size:

Small, medium, large
(Nucleus/cell ratio)

Shape:

e.g. Rounded, oval, rod-shaped

E/M:

(1) Nuclear envelope

Inner nuclear membrane.

Outer " " .

Nuclear pores:- Interruptions in the nuclear envelope where inner and outer membrane fuse with each other.

Nuclear pore complex.

Perinuclear cisterna.

Nuclear lamina.

N.B. The outer nuclear membrane is continuous with the Rough Endoplasmic reticula.

(2) Chromatin: (Classification):

According to Metabolic activity:

- a- Euchromatin(Extended chromatin) :- an active and light nucleus
- b- Heterochromatin(Condensed chromatin.) inactive , condensed and dark nucleus .

According to Position:

- a- Peripheral chromatin.
- b- Nucleolus-associated chromatin.
- c- Chromatin islands.

(3) Nucleolus:

L/M: 1-5 basophilic bodies

N.B. Nucleolus is a non-membranous structure.

Function of nucleolus: rRNA synthesis.

CYTOPLASM:-

1)Inclusions:-

- 1- Glycogen.
- 2- Lipids.
- 3- Pigments: e.g. lipofuscin pigments, melanin.
- 4- Crystals.
- 5- (Secretory granules

2)Organelles:-

A- membranous:-

- 1- Cell Membrane.
- 2- Endoplasmic Reticulum.
- 3- Golgi Apparatus.
- 4- Lysosomes.
- 5- Peroxisomes.
- 6- Mitochondria.
- 7- proteasomes

B- non-membranous:-

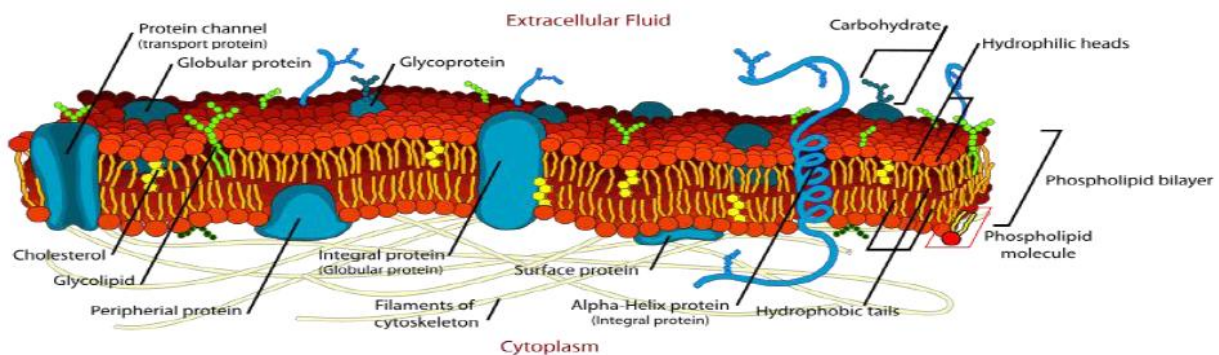
- 1. Ribosomes
- 2. Centrioles.
- 3. Cytoskeleton:-
 - 3.a. thin filaments (actin filaments).
 - 3.b. Intermediate filaments.
 - 3.c. Microtubules.

C- Specializations of cell membranes

- (1) Microvilli.
- (2) Cilia & flagella
- (3) Intercellular junctions.

(1)CELL MEMBRANE:-

- **Under L/M:** Invisible.
- **Under E/M:** Trilaminar structure:
 - 1- Outer electron-dense layer.
 - 2- Middle electron-lucent layer.
 - 3- Inner electron-dense layer.



Types of proteins in cell membrane:

- Integral proteins
- Peripheral proteins

Glycocalyx (cell coat): Carbohydrate chains that are attached to proteins (glycoprotein) or phospholipids molecules (glycolipid). Could be seen by E/M or L/M.

• Functions:

- o Contact inhibition of cells..
- o Cell recognition.
- o Cell adhesion.

• Functions of cell membrane:

- Endocytosis (Phagocytosis (cell eating) and pinocytosis(cell drinking)).
- Control the transport of materials in and out of cell.
- Cell to cell recognition.
- Protection of the cell.
- Formation of cilia, flagella and microvilli.

(2) Microvilli:-

- **Function:** Increase surface area for transport and absorption.
- Contain core of actin filaments (microfilaments).
- **Stereosilia:** Long microvilli found in epididymis and hair cells of cochlea. They are not motile.

(3) Mitochondria:-

- **Function:** Produce ATP through oxidative phosphorylation.
- Composed of two membranes: Inner folded membrane and outer smooth membrane, between them is the intermembranous space.

(4) The Endoplasmic Reticulum:-

- Largest membranous system of the cell.
- It has two components:

1. Smooth Endoplasmic Reticulum (SER) :-

Abundant in cells active in synthesis of fats and cells that do detoxification.

2. Rough Endoplasmic Reticulum (RER):-

Ribosomes bind to the surface of RER at integral proteins.

- Function: synthesis of proteins mainly for secretion.

Golgi Apparatus:-

Functions:

- 1- Synthesis of carbohydrates.
2. Modification and sorting of protein.
3. Formation of lysosomes.

Lysosomes:-

- **Function:** Digest macromolecules, phagocytosed microorganism, cellular debris, excess of senescent organelles (mitochondria, RER).

Cilia:-

- **Function:** Propelling mucus and other substances over the surface.
 - The core of the cilia consists of microtubules (axoneme).
 - Shaft of cilium: Composed of 9 doublets of microtubules (9x2) and two centrally placed microtubules (singlets).
 - Pairs are attached by dynein molecules.

CENTRIOLES:-

located near the nucleus. (2 perpendicular in each cell).

- Formed of 9 triplets, each formed of 1 complete and 2 incomplete microtubules fused together.
- Important during cell division and for the formation of cilia and flagella.

Cytoskeleton:

Functions: Maintenance of cellular morphology and participation in cellular motion

Consist of:

1. Thin Filaments (microfilaments):

- Myosin filaments are thicker (15nm) and are usually attached to actin especially in muscles.

2. Intermediate Filaments:

- **Functions:** Provide structural support to for the cell and anchor the nucleus in place..

3. Microtubules:

- **Functions:** Provide rigidity, establish intercellular compartments and form the core of cilia and flagella.

INTERCELLULAR JUNCTIONS:-

1- Occludent junction.:-

Forms impermeable barrier, apically located, belt-like junctions.

• Functions:

1. Prevents the movement of membrane proteins.
2. Fuse membranes to prohibit water-soluble molecules from passing.

2- Adherent junction:-

A- Zonulae Adherentes:

- The intercellular space between joining cells is occupied by the extracellular cadherins (Ca dependent integral proteins) that attach to intracellular actin filaments.

B. Desmosomes (Maculae Adherents):

- Weld-like junctions that appear randomly along the lateral cell membrane.
- The intercellular space contains filamentous materials (a family of cadherins).

3- Gap junction (Nexus).

Widespread in epithelial tissues, cardiac muscle, smooth muscle and neurons.

- They are built by transmembrane proteins that have aqueous pores (connection).

• **Function:** Cellular sharing of molecules.