Cell structure

Red: important.
Black: in male|female slides.
Gray: notes|extra.

Editing File

غيـــداء آل مصـمـع
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Revised by

➢ OBJECTIVES

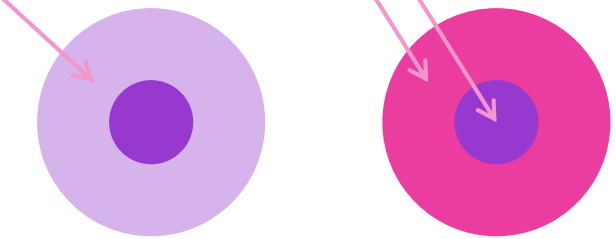
- What is histology and how it is studied?
- Composition of the cell: Light microscopic (L/ M) and electron microscopic (E/M) .
- Function of each component: Nucleus, Cytoplasm, Organelles: membranous and non membranous & Inclusions.

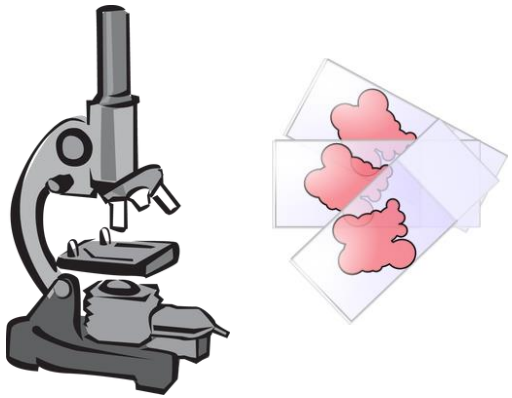
➢ INTRODUCTION

- Histology is the microscopic study of normal tissues.
- Types of microscopes: LM & EM.
- Organs are made of tissues and tissues are made of cells.
- Thin sections are cut and mounted on glass slides.

Sections are stained with Haematoxylin (H) and Eosin (E).

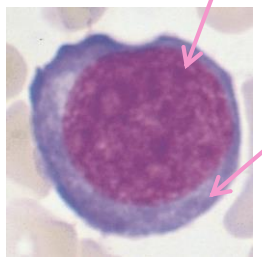
- Nucleus is always blue (basophilic)
- Cytoplasm may be red (acidophilic) or blue (basophilic).

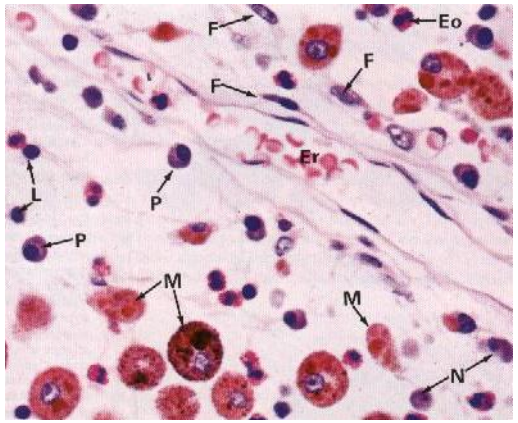




➢ THE CELL

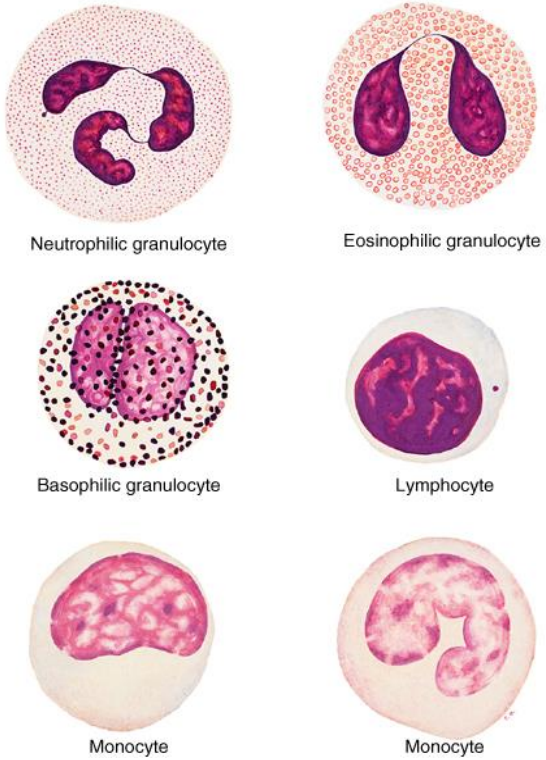
- it is the structural & functional unit of all living tissues.
- cells have different shapes & sizes.
- the cell is made of: 1-nucleus 2- cytoplasm.





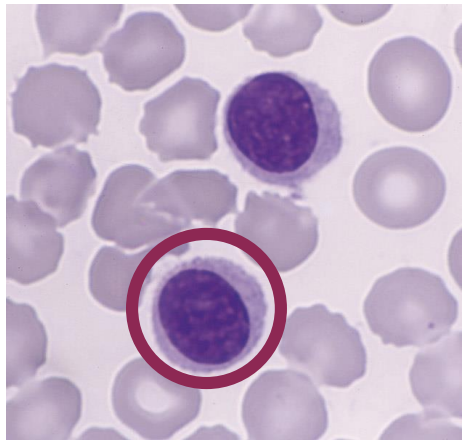
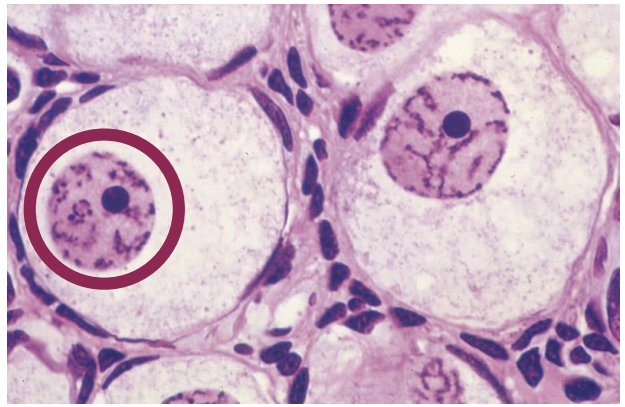
➢ NUCLEUS (L\M)

- Shapes of nuclei.



➢ THE CELL

Appearance of nuclei :

DARK NUCLEUS (DEEPLY-STAINED NUCLEUS) DEEPLY BASOPHILIC NUCLEUS	VESICULAR (OPEN FACE) NUCLEUS.
	

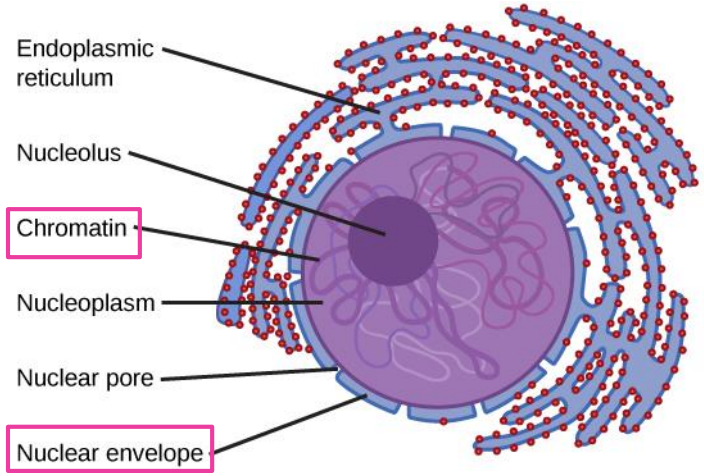
➢ THE CELL (NUCLEUS)

Formed of:

1) Nuclear Envelope:

A double membrane with many pores.

- Outer membrane.
- Inner membrane.
- Nuclear pores: (function) provide communication between nucleus and cytoplasm.



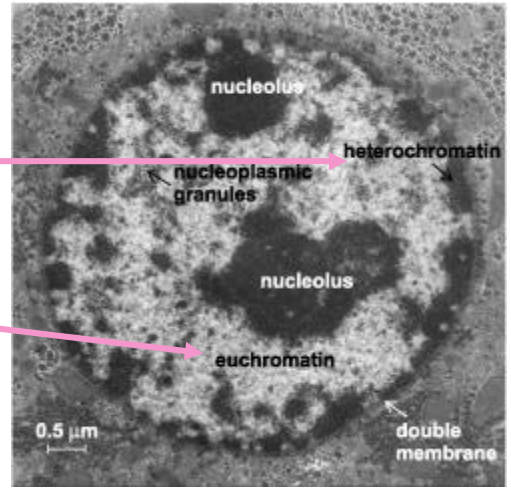
2) Chromatin

- Formed of DNA.
- 2 Forms:

– Heterochromatin: condensed inactive chromatin
(dark = electron dense areas)

– Euchromatin: extended active chromatin
(pale= electron-lucent areas)

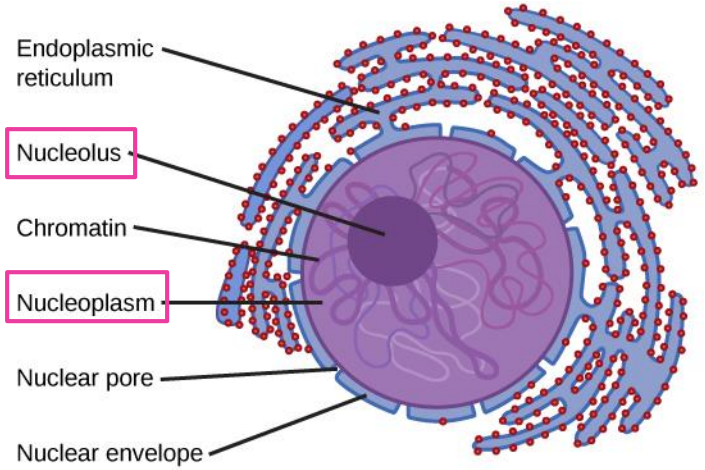
- **Functions:**
  - Carries genetic information.
  - Directs protein synthesis.



➢ THE CELL (NUCLEUS)

3) Nucleolus :

- E/M: It is mostly dark mass (electron-dense) not surrounded by a membrane.
- Usually one.
- L/M: It is a spherical dark basophilic mass.
- **Function:** formation of ribosomal RNA (rRNA),which is responsible for protein synthesis in the cytoplasm.



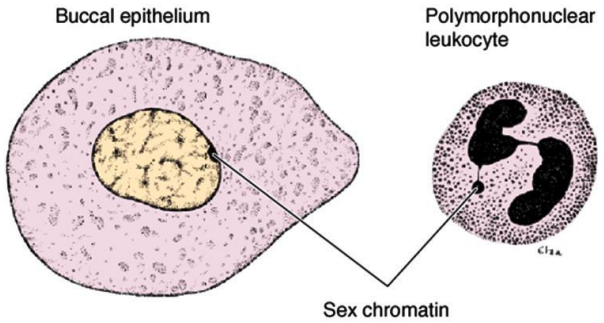
4) Nucleoplasm

- It is a clear fluid medium in which all the contents of the nucleus are embedded.
- **Function:** Provides a medium for movement of 3 types of RNA (ribosomal, messenger and transfer RNA) from the nucleus to the cytoplasm.

➢ THE CELL (NUCLEUS)

***Sex chromatin (Barr Body)**

- A dark stained of chromatin , usually adherent to the inner aspect of the nuclear envelope of female somatic cells. e.g buccal epithelial cells.
- A drumstick mass protruding from the nucleus of neutrophils.
- Represents one of two X chromosomes witch is inactive (condensed) in the normal female.
- Seen in the normal female cells.
- Absent in the females with turner's syndrome XO.
- Seen in males with Klinefelter's syndrome XXY.



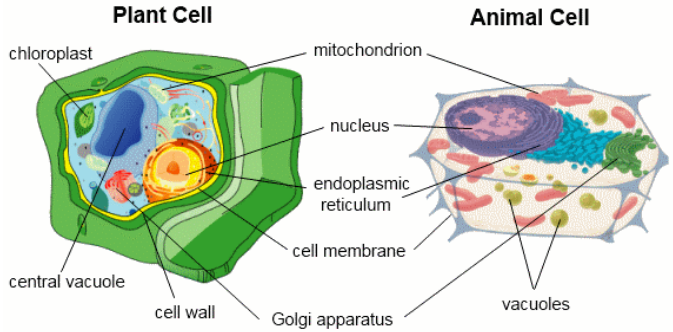
➢ THE CELL (NUCLEUS)

Function of nucleus:

- It is essential for the vitality and division of the cell.
- It is the site of storage of genetic information.
- It is the site of formation of the three types of RNA.

➢ CYTOPLASM

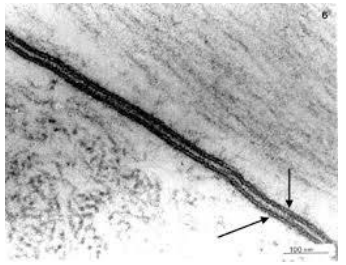
- is formed of:
  1-ORGANELLES: They are specialized structures, ESSENTIAL for vital processes of the cell.
  2-INCLUSIONS: They are not essential for vitality of cells, may be present or absent.
- Examples are lipids, glycogen and pigments like melanin & lipofuscin.

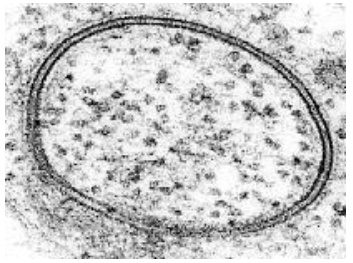


➢ CYTOPLASMIC ORGANELLES

A) MEMBRANOUS	B) NON-MEMBRANOUS
1. Cell membrane. 2. Mitochondria. 3. Golgi apparatus. 4. Endoplasmic reticulum: (rough & smooth). 5. Lysosomes. 6. Secretory vesicles.	1. Ribosomes. 2. Centrioles. 3. Cilia & Flagella. 4. Filaments: (Actin, Intermediate filaments & Myosin). 5. Cytoskeleton: (actin, intermediate filaments & microtubules).

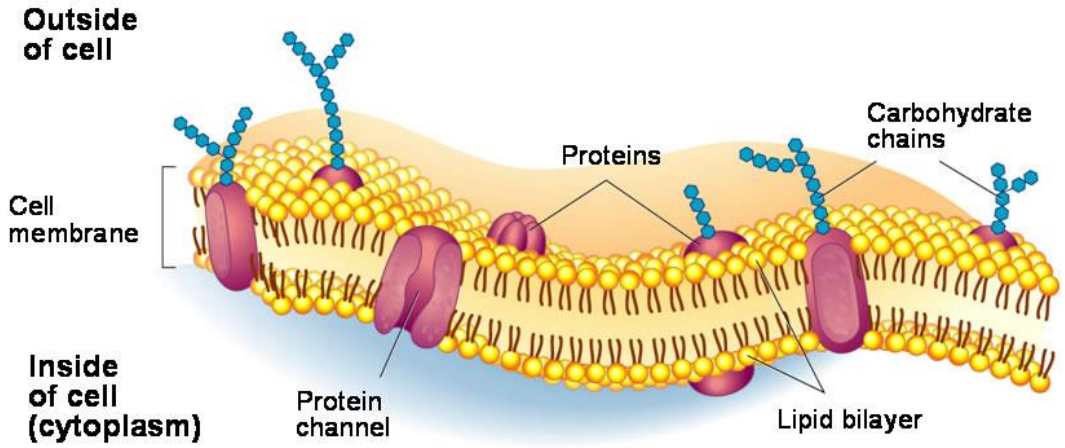
➢ CELL MEMBRANE





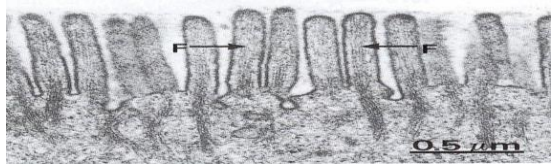
- A very thin membrane that surrounds the cell.
- **LM:** Not visible.
- **EM:** appears as 2 dark lines (electron dense), separated by a light one (electron-lucent) (trilaminar appearance).
- **Function:** selective barrier.

- **Chemical Structure:**
  1- Phospholipid molecules: arranged in 2 layers.
  2- Protein molecules: a) Peripheral protein | b) Integral protein
  3- Carbohydrate molecules: attached to either proteins or lipids (glycoproteins and glycolipids), forming the surface or cell coat (Glycocalyx).
- **Function** of (Glycocalyx):
  - Protection of the cell.
  - Cell recognition and adhesion.

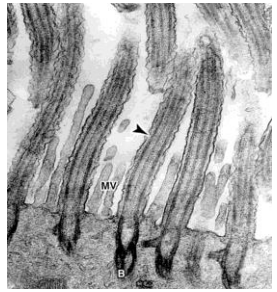


➢ CELL MEMBRANE (SPECIALIZATIONS)

- **CILIA**
  - Long motile hair-like structures surrounded by cell membrane.
  - Their core is formed of microtubules.

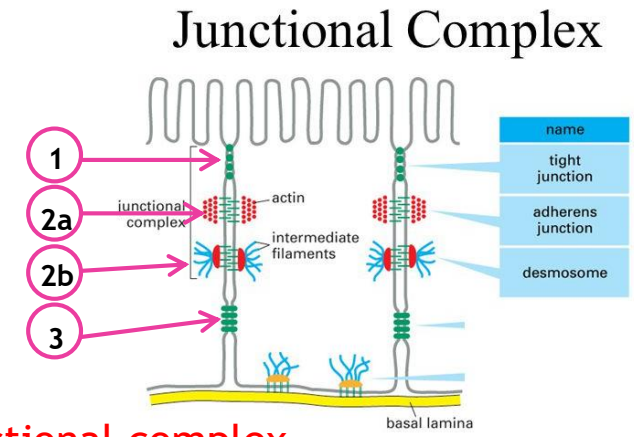


- **MICROVILLI (BRUSH BORDER)**
  - Cylindrical cytoplasmic projections of apical surface to increase surface area.
  - Their core contains actin filaments.



- **INTRACELLULAR JUNCTIONS**
  1. Occluding (Tight) Junction: seals the intercellular space.
  2. Adherening Junction: fixes adjacent cells together:
     - 2a Zonula Adhering Junction.
     - 2b Desmosome (Macula Adherening Junction).
  3. Gap junction: Allow free communication between the cells.

*When a combination of 1 , 2a and 2b is present, this is called a junctional complex.

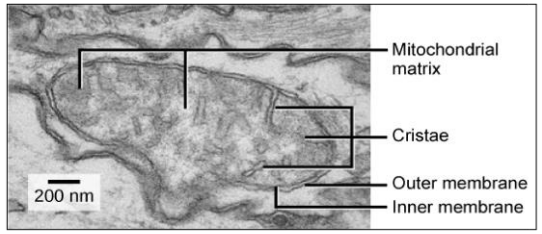


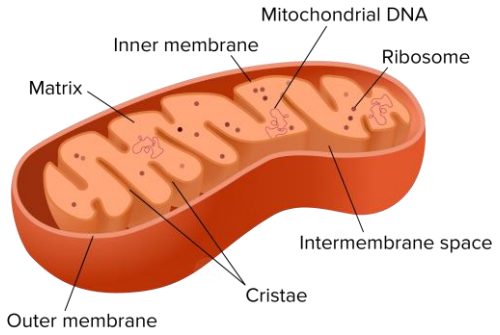
➢ MITOCHONDRIA

- Each mitochondrion is rod-shaped .
- The wall is composed of 2 membranes.
- The outer is smooth, the inner is folded to form cristae.
- The cavity is filled with mitochondrial matrix, which contains enzymes. Also contains its own DNA.
- **Functions:**

1- Generation of ATP which is the source of energy for the cell , They are called the power-house of the cell.

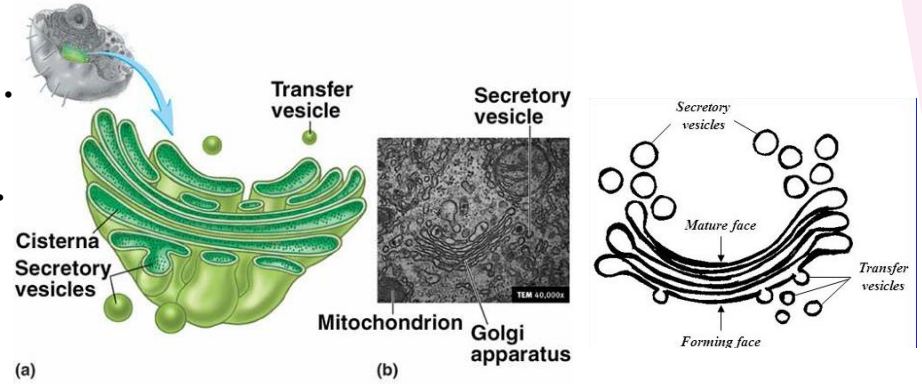
2- They can form their own proteins and undergo self replication.



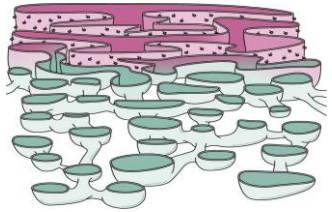


➢ GOLGI APPARATUS

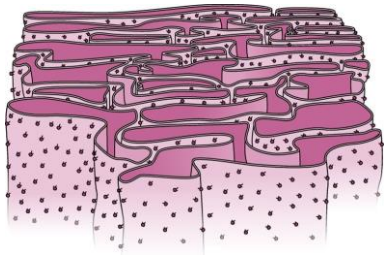
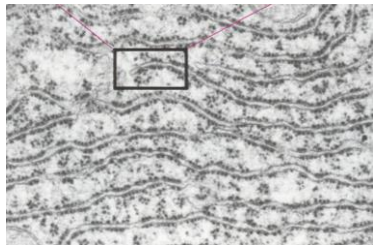
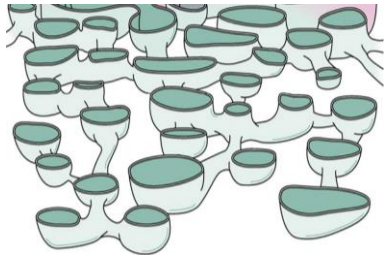
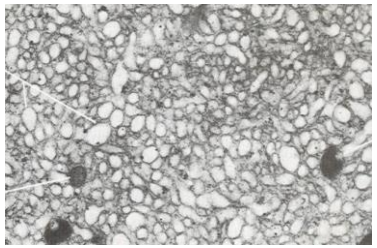
- The secretory apparatus of the cell.
- Consists of stacked saucer-shaped flattened vesicles.
- Each vesicle has two faces:
  1- Convex (forming) face: receives transfer vesicles.
  2- Concave (mature) face: forms secretory vesicles.
- **Functions:**
  1- Sorting, modification & packaging of proteins.
  2- Secretory vesicles formation.
  3- Formation of lysosomes.



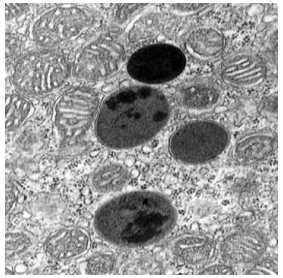
➢ ENDOPLASMIC RETICULUM

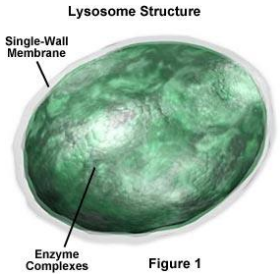


- It is a system of communicating membranous tubules, vesicles & flattened vesicles (cisternae).

ROUGH ENDOPLASMIC RETICULUM	SMOOTH ENDOPLASMIC RETICULUM
 	 
Membranous sheets of flattened tubules & vesicles with ribosomes on the surface.	Membranous tubules and vesicles, with NO ribosomes on the surface.
FUNCTION: 1) Synthesis of <u>proteins</u> by ribosomes on its outer surface. 2) Transfer vesicles transfer the formed protein to Golgi.	**FUNCTION:** 1) Synthesis of <u>lipids</u> & <u>cholesterol</u>. 2) Synthesis of <u>steroid hormones</u>, e.g. cortisone. 3) Helps <u>muscle contraction</u>, by acting as a calcium pump. 4) <u>Detoxification</u> of drugs & toxins.

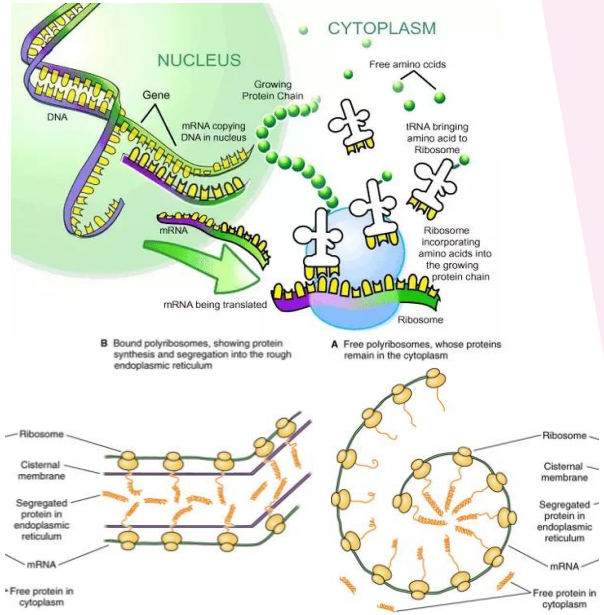
➢ LYSOSOMES





- The digestive apparatus of the cell.
- E/M: Spherical membranous vesicles.
- Contain hydrolytic enzymes.
- Originate from mature surface of the Golgi apparatus, while their hydrolytic enzymes are formed in the rough endoplasmic reticulum.
- **Functions:**
  intracellular digestion of ingested material or old organelles.

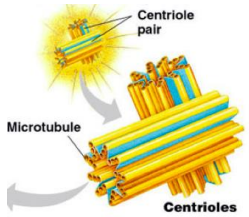
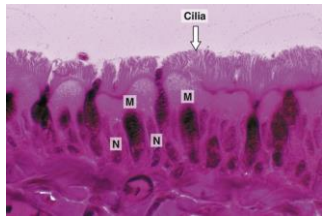
➢ RIBOSOMES



- Formed in the nucleolus.
- LM: Basophilic cytoplasm is due to numerous ribosomes.
- Consist of ribosomal RNA (rRNA), combined with proteins.
- EM: Formed of 2 subunits.
- Free in the cytoplasm (may form polyribosomes) or attached to rER.
- **Function:**
  Protein synthesis.

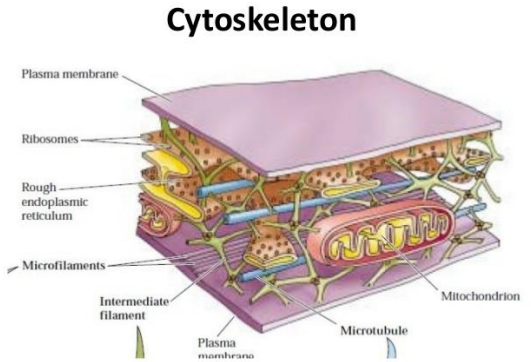
HISTOLOGY TEAM 437

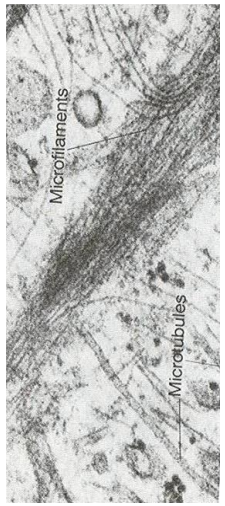
➢ MICROTUBULES-CONTAINING ORGANELLES

CENTRIOLES	CILIA	FLAGELLA
		
- 2 cylinders, perpendicular to each other. - Wall is made of 9 triplets of microtubules, i.e. 27 microtubules.	- Hair-like striations on the free surface of some cells. - Basal body is similar to centriole. - Shaft is formed of 9 doublets and 2 central singlets of microtubules, i.e. 20 microtubules.	- Longer and larger than cilia. - Form the tails of sperms.
Functions: 1- Essential for cell division. 2- Formation of cilia and flagella.	**Function:** Movement of particles or fluids on the free surface of the cell in one direction.	**Function:** Important for movement of the sperms.

➢ CYTOSKELETON

- It is the structural skeleton of the cell.
- Consists of:
  1- Microfilaments (actin).
  2- Intermediate filaments, e.g. Keratin.
  3- Microtubules.
- **Functions:**
  1- Maintains shape of the cell.
  2- Helps transport of material within the cel





➢ CLINICAL APPLICATION

Immotile cilia syndrome:

- Disorder that causes infertility in male and chronic respiratory tract infection in both sexes.
- caused by immobility of cilia and flagella induced by deficiency of dynein.
- Dynein protein is responsible for movements of cilia and flagella.

➢ QUESTIONS:

Q1:what basic unit of all living organisms?

A) organ B) cell membrane C) tissue D) cell

Q2: What is the main function of cell membrane?

A) provide communication between organelles B) selective barrier

C) directs protein synthesis D) carries genetic information

Q3: If you see the cytoplasm in microscope with blue color (basophilic), that means the cytoplasm stained with?

A) Haematoxylin(H) B) Aldehyde fuchsine C) Cresyl violet D) Eosin(E)

Q4: If sex chromatin (Barr body) absent in the females, that means female with?

A) Down syndrome B) Triple x syndrome C) Turner's syndrome XO D) klinefelter's syndrome XXY

Q5: What cause of immotile cilia syndrome?

A) cilia have a lot of hair like organelles B) deficiency of dynein

C) cilia don't have hair like organelles D) deficiency of RBC

1- D
2- B
3- A
4- C
5- B

HISTOLOGY TEAM 437

Q6: Which one of these cytoplasmic organelles is non-membranous?

A) ribosome B) lysosome C) mitochondria D) Golgi apparatus

Q7: Which one of these organelles form their own proteins?

A) ribosome B) lysosome C) mitochondria D) Golgi apparatus

Q8: Detoxification of drugs & toxins is function of ?

A) smooth endoplasmic reticulum B) rough endoplasmic reticulum C) ribosome D) lysosome

Q9: What special enzyme the lysosomes contain?

A) Amylase enzyme B) Hyperlytic enzyme C) Pepsin enzyme D) Hydrolytic enzyme

Q10: Wall is made centrioles is made of ?

A) 3 central singlets of microtubules B) 9 doublets and 2 central singlets of microtubules

C) 9 triplets of microtubules D) 3 doublets microtubules

Q11: Which organelle is responsible for protein synthesis?

A) lysosome B) ribosome C) mitochondria D) Golgi apparatus

6- A
7- C
8- A
9- D
10- C
11- B

" لنكن يداً بيد ليرى العالم إنجازاتنا
وتحمّلوا شقاء اليوم لأجل حلم الغد "

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