جامعة الملك سعود
King Saud University

MED438
KING SAUD UNIVERSITY

Lecture 1 :

Introduction to Histology and Cell Structure

King saud university
Histology team med438

Reviewed by Razan AlRabah & Khalid Alkhani

- Colour index :
Red : important
Grey : doctors notes

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 :

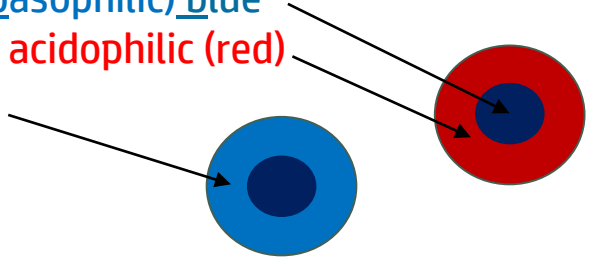
Histology : is the microscopic study of normal tissues.

Types of microscopes: LM & EM

Cells ⇨ Tissues ⇨ Organs ⇨ Systems

• Thin sections are cut and mounted on glass slides. Sections are stained with **Haematoxylin (H)** and **Eosin (E)**.

*Nucleus is always (basophilic) blue
*Cytoplasm could be acidophilic (red) or basophilic (blue)



LM : Produce colourful images .
EM : Produce black and white images .

❑ The Cell

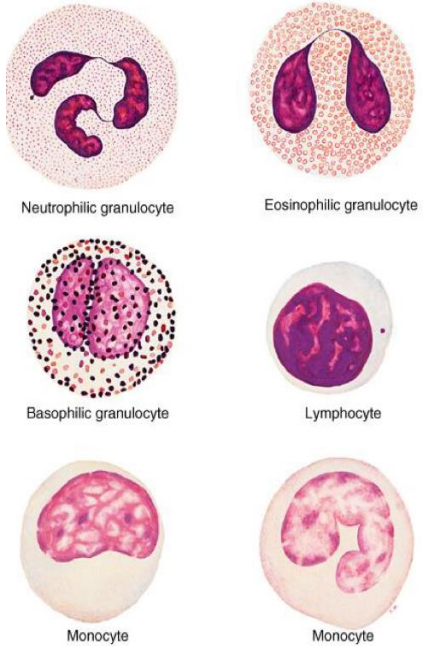
It Is the structural & functional unit of all living tissues.

Cells have different shapes & size.

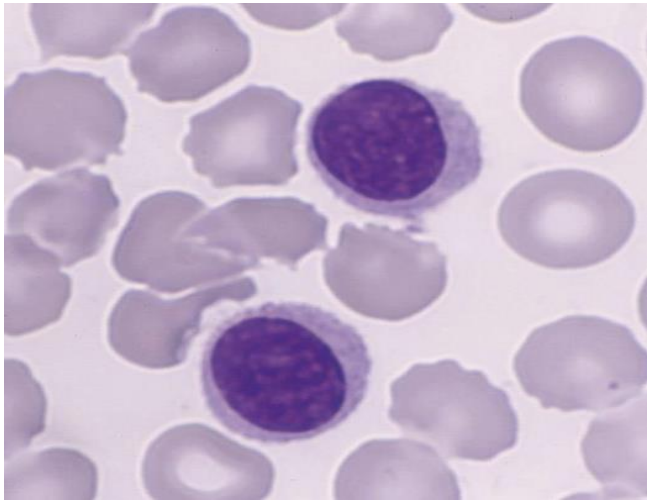
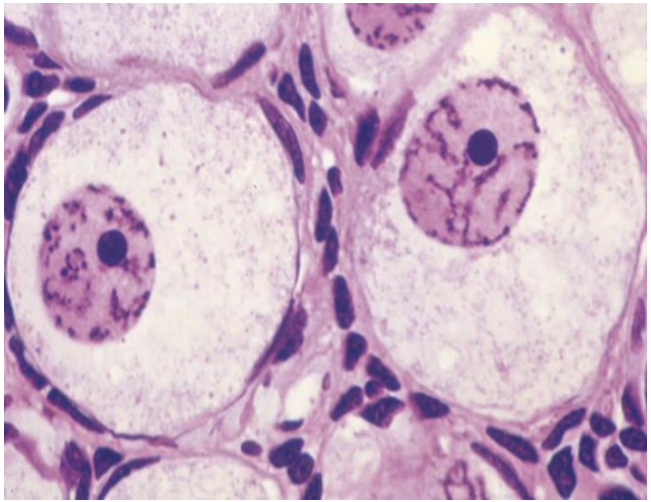
The Cell is made of:
1- Nucleus
2- Cytoplasm

❑ Nucleus (L/M)

Shape of nuclei :



Appearance of nuclei :

Dark Nucleus (Deeply-stained Nucleus) Deeply Basophilic Nucleus	Vesicular (Open Face) Nucleus.
	

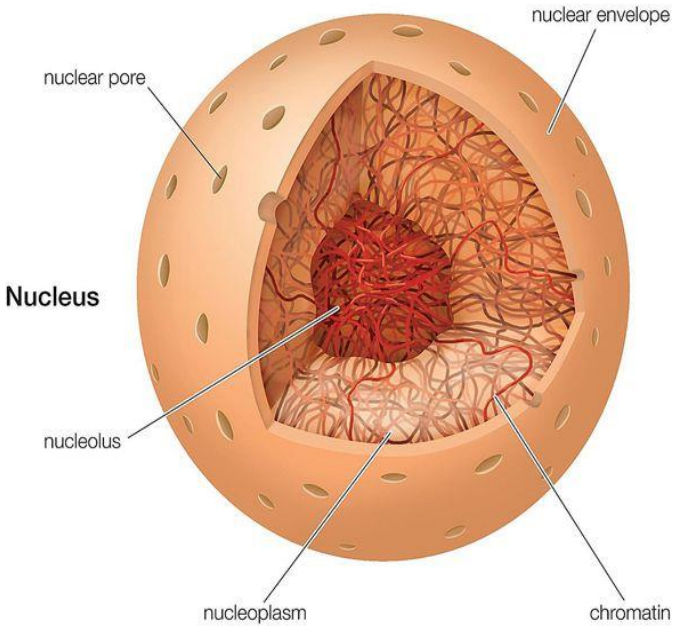
The Nucleus

Formed of:

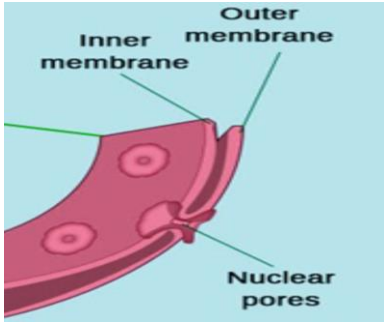
1. Nuclear envelope
2. Chromatin
3. Nucleolus
4. Nucleoplasm

Function of the 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.



1- Nuclear envelope



Definition:

A double membrane with many pores surroundings the Nucleus .

Formed of :

1- Outer membrane

2- Inner membrane

3- Nuclear pores (provide communication between nucleus and cytoplasm)

* the only double membrane surrounded structures in the cell are Nucleus and Mitochondria .

2- Chromatin

-Formed of DNA and protein

Two forms :

Euchromatin :

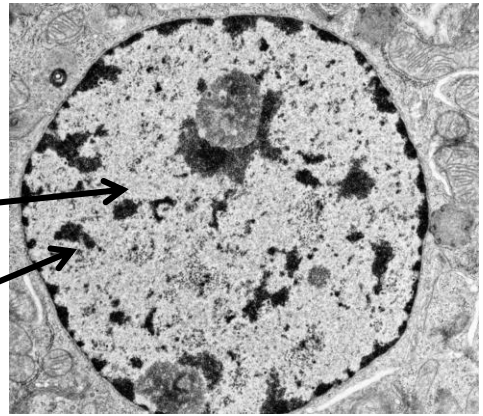
extended **active** chromatin

electron-lucent areas =(pale)

Heterochromatin :

condensed **inactive** chromatin

electron-dense areas (dark)



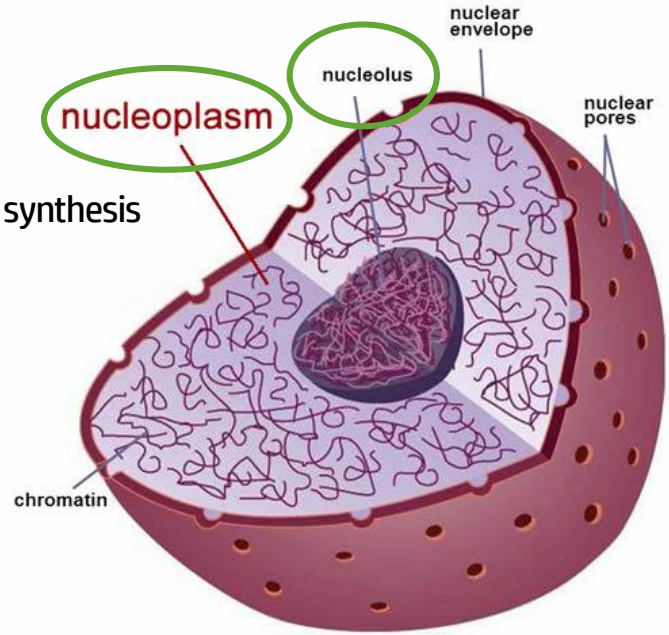
-Functions of chromatin :

- Carries genetic information .
- Directs protein synthesis .

3- Nucleolus

- E/M : appear mostly as dark mass (electron-dense) (the largest one).
- L/M : appear as spherical dark basophilic mass.
- Usually one .
- Not surrounded by a membrane .

Function : formation of ribosomal RNA (rRNA) witch responsible for protein synthesis in the cytoplasm .



4- Nucleoplasm

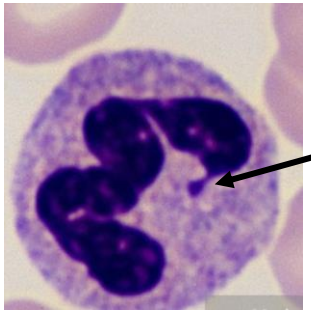
- It is a clear fluid medium in which all the contents of the nucleus are embedded.

Function: Provides a medium for movement of 3 types of RNA (ribosomal , messenger and transfer RNA) from the nucleus to the cytoplasm.

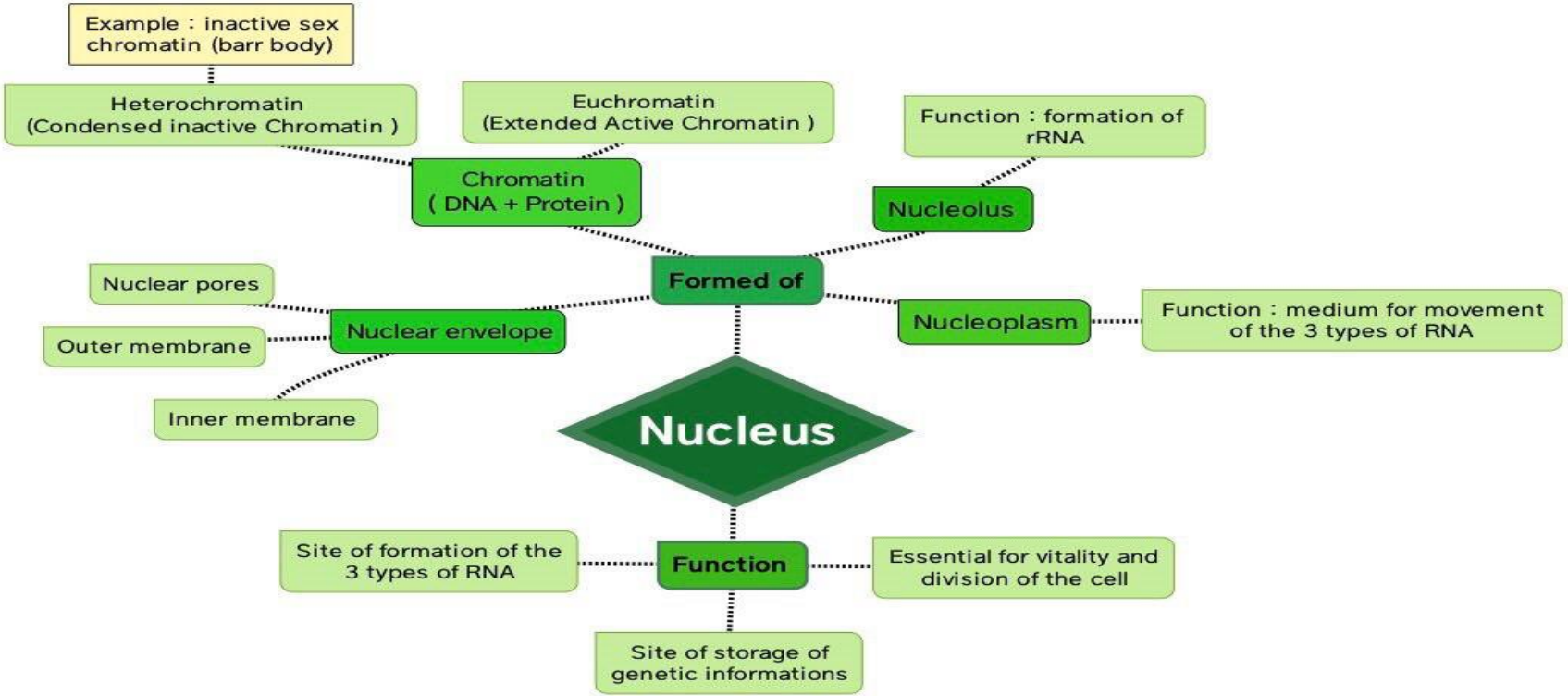
Sex chromatin (Barr body) :

- A dark stained mass 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 the two X chromosomes which is inactive (condensed) in normal female (heterochromatin).
- Seen in normal female cells.
- Absent in normal males cells .
- Absent in females with Turner's syndrome XO.
- Seen in males with Klinefelter's syndrome XXY.

XX female	X ← active X • ← Barr body
XY male	X ← active X (the only X) Y
XXY male (Klinefelter)	X ← active X Y • ← Barr body
Extra XXX female (triple X)	X ← active X • ← Barr bodies •



Summary :


Example : inactive sex chromatin (barr body)
Heterochromatin (Condensed inactive Chromatin)
Euchromatin (Extended Active Chromatin)
Chromatin (DNA + Protein)
Function : formation of rRNA
Nucleolus
Nuclear pores
Nuclear envelope
Outer membrane
Inner membrane
Formed of
Nucleoplasm
Function : medium for movement of the 3 types of RNA
Nucleus
Site of formation of the 3 types of RNA
Function
Essential for vitality and division of the cell
Site of storage of genetic informations

○ Cytoplasm :

is formed of:

- Organelles: They are specialized structures , essential for vital processes of the cell.
- 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 :

- cell membrane.
- mitochondria .
- endoplasmic reticulum.
- Golgi apparatus.
- lysosomes .
- secretory vesicles .

B) Non-Membranous :

- Ribosomes.
- Centrioles .
- cilia and Flagella .
- Filaments (actin, myosin, intermediate filaments).
- Cytoskeleton (Actin, Intermediate filaments, Microtubules).

A) Membranous :

❑ Cell membrane:

A very thin membrane surrounding the cell.

Function :

Selective barrier.

Chemical structure:

- Phospholipid molecules :

arranged in two layers.

- Protein molecules:

peripheral and integral proteins.

- Carbohydrate molecules:

attached to either proteins or lipids (glycoproteins and glycolipids) forming the surface or **cell coat.**

Function of (Glycocalyx).

1- protection of the cell

2- cell recognition and adhesion.

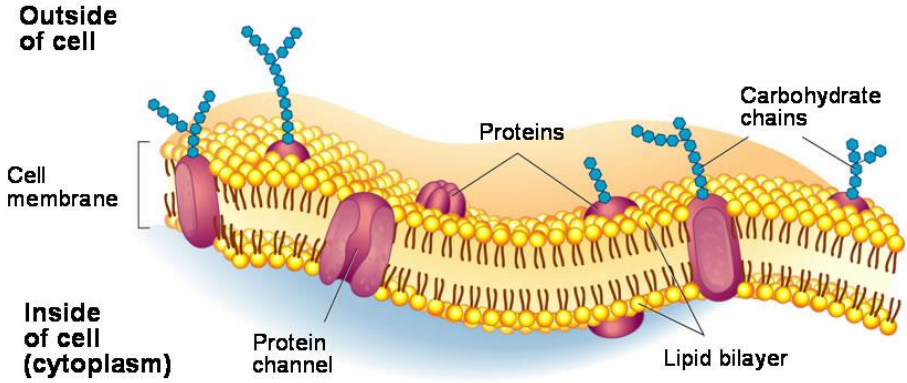
How does it appear ?

LM (Light Microscope)

Not visible.

EM (Electron Microscope)

2 dark lines separated by a light line (Trilaminar appearance).



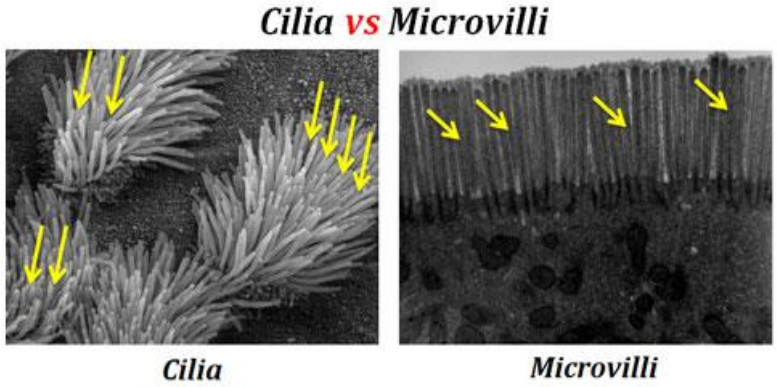
➢ Specializations of Cell Membrane :

❖ Cilia:

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

❖ Microvilli (Brush border) :

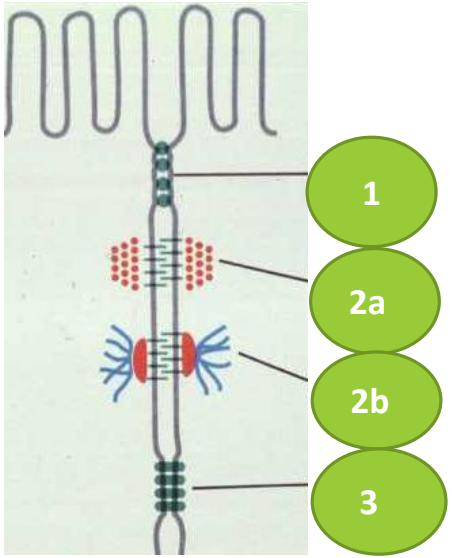
Cylindrical cytoplasmic projection of apical surface to increase surface area . Their core contains actin filaments.



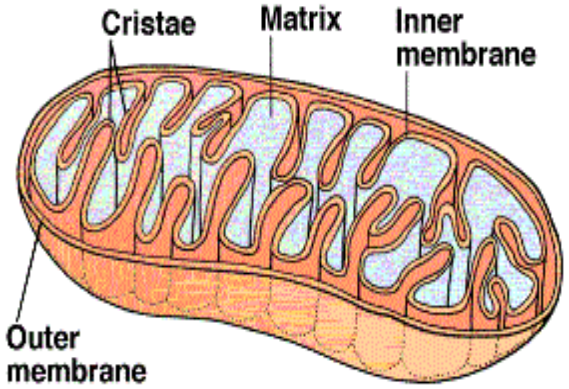
❖ Intercellular junctions

1. **Occluding (Tight) Junction:** seals the intercellular space.
2. **Adherening Junction:** fixes adjacent cells together:
   a) Zonula Adhering Junction.
   b) 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:



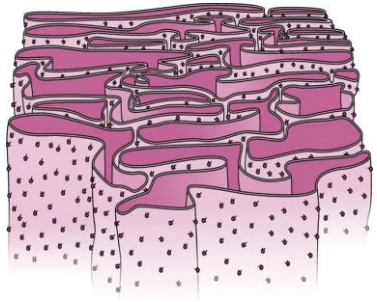
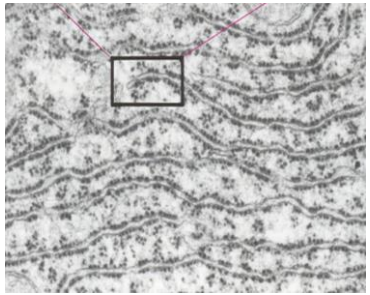
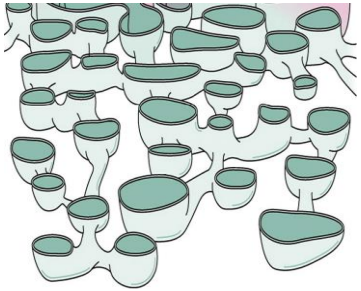
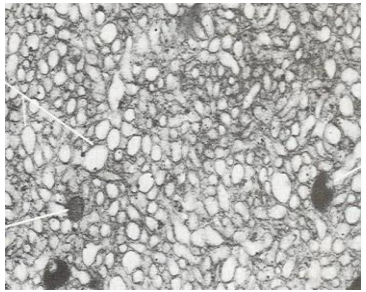
- Each mitochondrion is rod-shaped .
- The wall is composed of 2 MEMBRANES.
- The outer is smooth, the inner is folded to form CRISTAE.
- The cavity is filled with mitochondrial matrix, which contains enzymes. Also contains it's own DNA .

Function:

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.

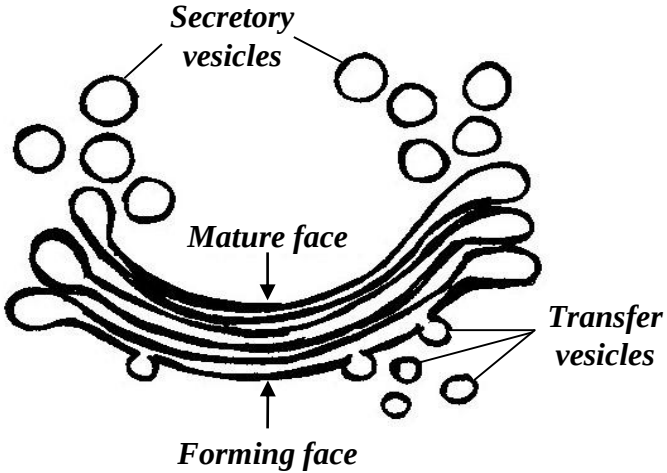
❑ Endoplasmic reticulum

It is a system of communicating membranous tubules, vesicles, and 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 proteins by ribosomes on its outer surface. 2) Transfer vesicles , transfer the formed protein to Golgi.	**Function:** 1) Synthesis of lipids & cholesterol. 2) Synthesis of steroid hormones, e.g. cortisone. 3) Helps muscle contraction, by acting as a calcium pump. 4) Detoxification of drugs & toxins.

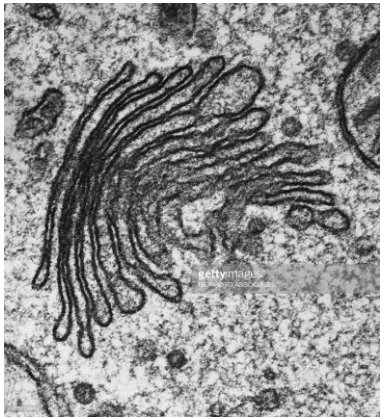
❑ Golgi apparatus

- 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.

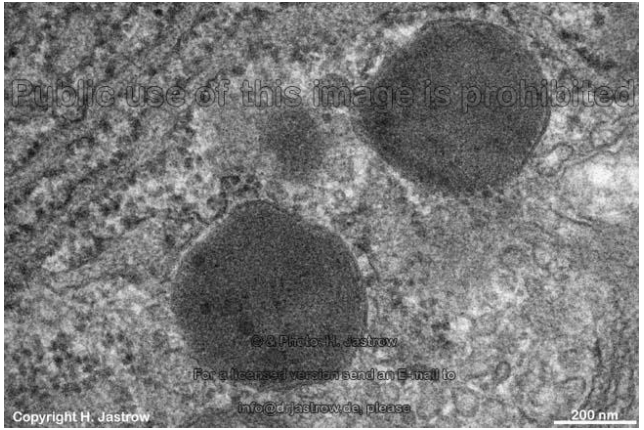


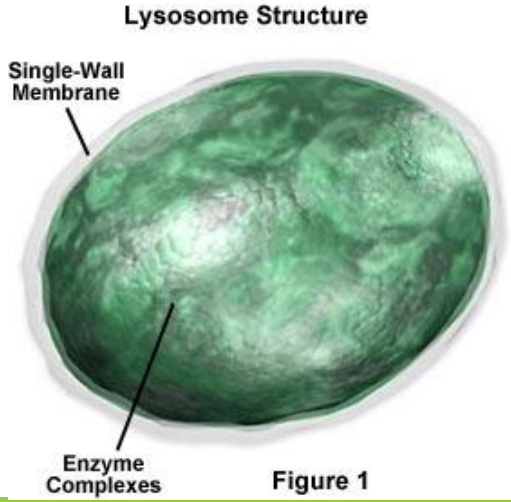
❑ Lysosomes

- 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**.

Function:

intracellular digestion of ingested material or old organelles.





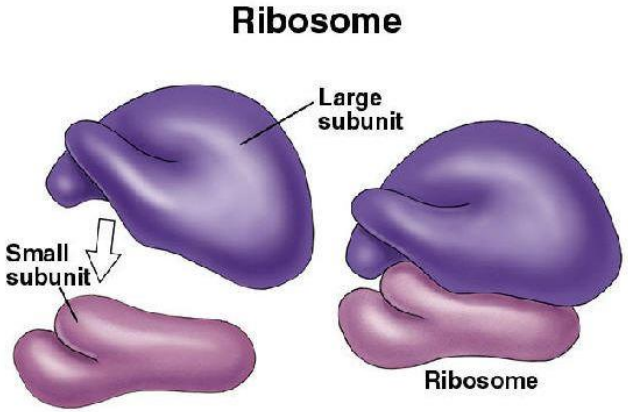
B) Non-Membranous

❑ Ribosomes

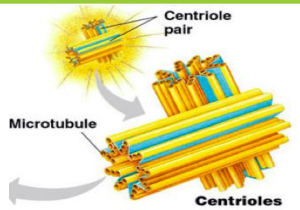
- LM: Basophilic cytoplasm is due to numerous ribosomes.
- Consist of ribosomal RNA (rRNA), combined with proteins.
- EM: Formed of 2 subunits.
- Free in the cytoplasm (may form polyribosomes) or attached to rER
- Formed in the nucleolus.

Function:

Protein synthesis.

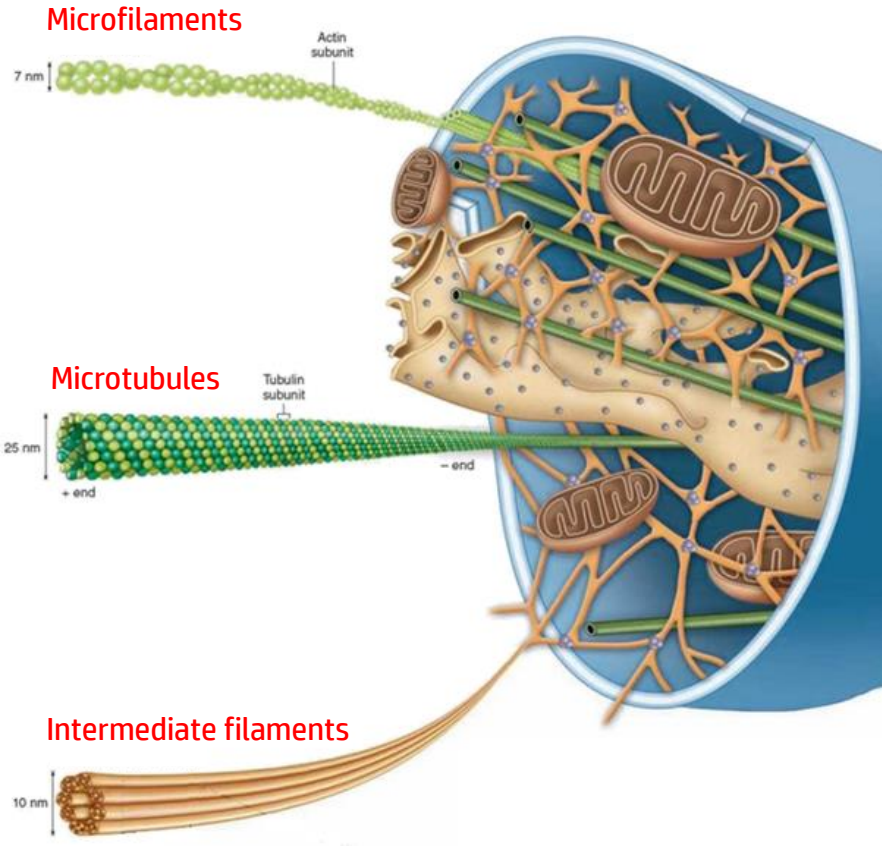


❑ Microtubules-containing organelles :

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 cell.



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.

MCQs :

1- Which organelle sorts and packages proteins within a cell?
A) Rough endoplasmic reticulum
B) Smooth endoplasmic reticulum
C) Lysosome
D) Golgi apparatus

2- Which organelle is considered the powerhouse of the cell?
A) Rough endoplasmic reticulum
B) Smooth endoplasmic reticulum
C) Mitochondrial
D) Lysosome

3- Which of the following is NOT a membranous organelle?
A) microtubules
B) lysosomes
C)mitochondria
D) endoplasmic reticulum

4- Microfilaments are composed mainly of a protein called
A) tubulin
B) actin
C) myosin
D) Chitin

5- In Golgi apparatus Which face receiving transfer vesicles ?
A) Convex face
B) Concave face
C) Both
D) Neither

6- Smooth endoplasmic reticulum is the site of
A) protein synthesis
B) carbohydrate synthesis
C) amino acid synthesis
D) Lipid synthesis

7- If you see the cytoplasm in microscope with blue color (basophilic), that means the cytoplasm stained with?
A) Hematoxylin(H)
b) Aldehyde fuchsine
C) Cresyl violet
D) Eosin(E)

8- If you see electron-lucent areas (pale) in microscope, that means the form of chromatin is ?
A) Euchromatin
B) Heterochromatin
C) A & B
D) Barr body

1	2	3	4	5	6	7	8
D	C	A	B	A	D	A	A

Team members :

- Abdullah alassaf
- Abdullah altuwaijri
- Talal jamal aldeen
- Faisal alqifari
- Alhanouf alhaluli
- Rawan alzayed
- Renad alkanaan
- Nouf albrikan
- Roaa aljohani

Team leaders :

Noura alnasser

Abdullah shadid

King saud university
Histology team med438