Histology
Foundation Block

1 Cell Structure

Editing File

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Objectives:

In this lecture you are expected to learn:

- What is **Histology** and how it is studied.
- Components of The Cell: Light microscopic **(LM)** and Electron microscopic **(EM)**.
- Function for each component:
    - Nucleus.
    - Cytoplasm.
    - Organelles **(their functions in slides no. 25-26)**:
        - Membranous and Nonmembranous.
            - Inclusion.

Introduction

Histology: is the microscopic study of Normal tissues. (In pathology it's abnormal tissues).

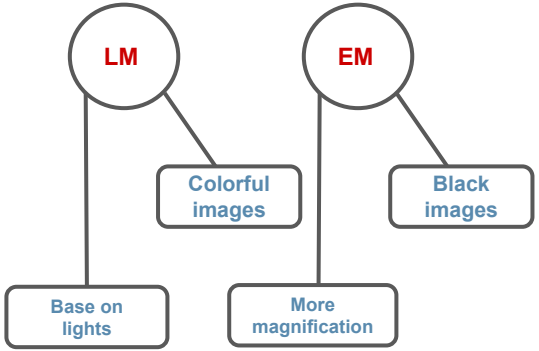
- **Organs** are made of **tissues** and **tissues** are made of **cells.**

- **Types of Microscopes:** LM (Light microscope) + EM (Electronic microscope).

- **Preparation to see the tissues under microscope:**

1. Thin sections are cut and mounted on glass slides.

2. Sections are stained with Hematoxylin (H) and Eosin (E).

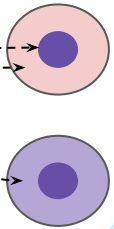


- **Important examples:**

Nucleus is **always** blue (Basophilic)

Cytoplasm may be **red** (Acidophilic), or **blue** (Basophilic)

Cytoplasm appears basophilic **only** when it's full of ribosomes.



The cell

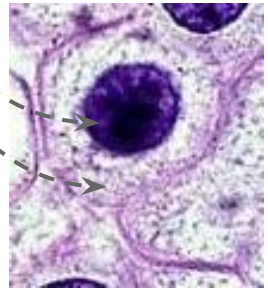
Cell: is the Structural & Functional Unit of all living tissues.

- Cells have different **shapes & sizes**. According to their function.

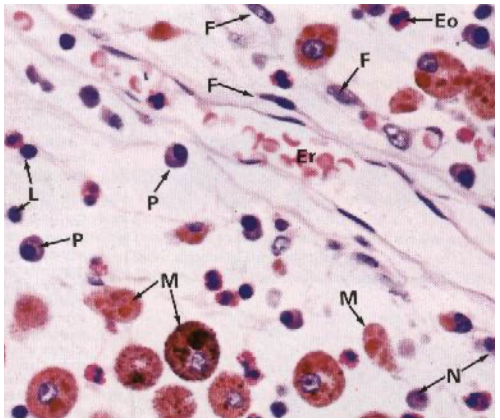
- The cell is made of:

● Nucleus

● Cytoplasm

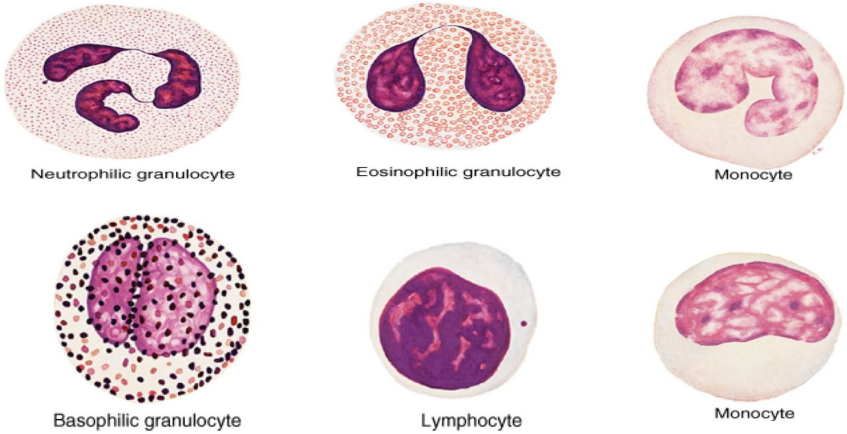


Notice how one tissues have different shapes and sizes of cells.



Nucleus L/M

Shapes of nuclei



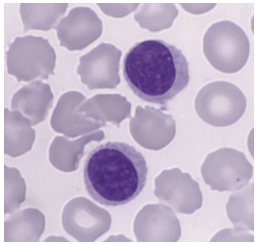
*These are white blood cells

439: Nucleus has many shapes as well few cells are dinucleotide.

Appearance of nuclei

1- Dark nucleus
(Deeply-stained nucleus)
Deeply basophilic Nucleus

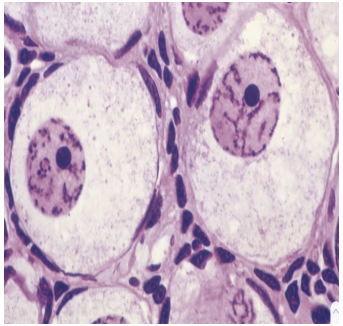
Inactive cell because the color of nucleus is dark



2- Vesicular nucleus
(open face)

Active cell because the color of nucleus is pale

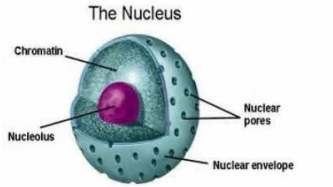
Note: It looks like a grape and its seed.



Nucleus (E/M)

The nucleus is Formed of:

- **Nuclear Envelope**
- **Chromatin**
- **Nucleolus**
- **Nucleoplasm**



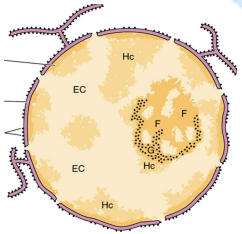
Notes:

-There are four chromosomes that form the nucleolus (13 , 14 , 15 , 20).

- Sometimes there is more than one nucleus.

-The only structures with double membrane in the cell are **Nucleus and Mitochondria**.

1. Nuclear Envelope:



Is a double membrane with many pores.

- Outer membrane
- Inner membrane.
- Nuclear pores:

Provide communication between nucleus and cytoplasm.

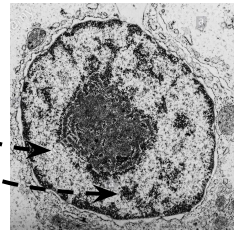
2. Chromatin:

●Chromatin is formed of DNA.

-It has two forms:

○ Euchromatin: extended **active** chromatin (pale= electron-lucent areas).

○ Heterochromatin: condensed **inactive** chromatin (dark = electron dense areas).



Functions:

- Carries genetic information.
- Directs protein synthesis.

Note: it controls the production of protein but do not produce them.

Nucleus (E/M)

3.Nucleolus:

- **EM**: It is mostly dark mass (electron-dense), not surrounded by a membrane.

- **LM**: It is a spherical dark basophilic mass, usually one. Which means there are more sometimes.

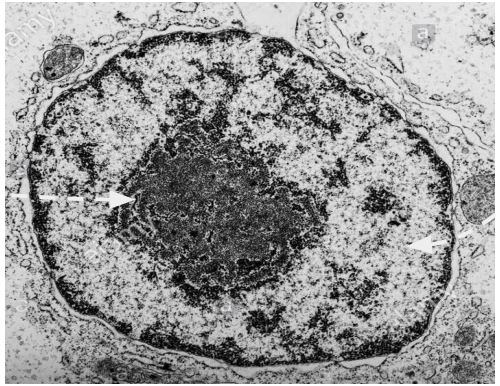
Function:
Formation of **Ribosomal RNA** (rRNA), which is responsible for **Protein Synthesis** in the cytoplasm. (usually one or two nucleoli are found)

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.

Nucleolus



Nucleoplasm

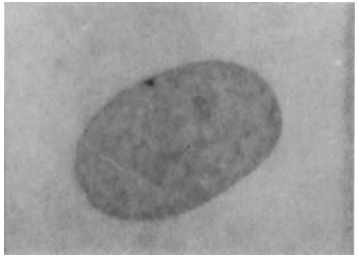
Functions of Nucleus

- 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**.

Sex Chromatin (Barr Body)

● **Sex chromatin:** A dark stained mass of chromatin, usually adherent to the **inner** aspect of the nuclear envelope of female somatic cells

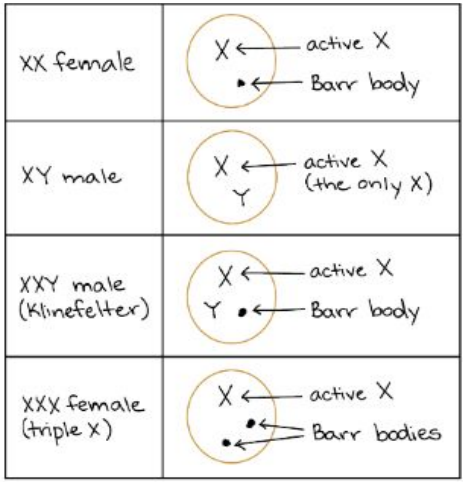
E.g. Buccal epithelial cells.



● **A drumstick** mass protruding from the nucleus of neutrophils.

● Represents one of the two X chromosomes which is Inactive (**Condensed**) in normal Female.

- **Seen** in normal female cells **XX.**
- **Absent** in females with Turner's syndrome **XO.**
- **Seen** in males with Klinefelter's syndrome **XXY.**



Cytoplasm

Formed of

INCLUSIONS:

Not-Essential for vitality of Cells.
may be present or absent.

- Lipids
- Glycogen
- Pigments: Melanin & Lipofuscin

ORGANELLES:

Specialized structures, ESSENTIAL for Vital processes of the cell.

●Membranous:
- ○Cell membrane.
- ○Mitochondria.
- ○Endoplasmic Reticulum (Rough & Smooth).
- ○Golgi Apparatus.
- ○Lysosomes.
- ○Secretory vesicles.

●Non-membranous:
- ○Ribosomes.
- ○Centrioles.
- ○Cilia & Flagella.
- ○Filaments: (Actin-Intermediate filaments-Myosin).
- ○Cytoskeleton: (Actin-intermediate filaments-Microtubules).

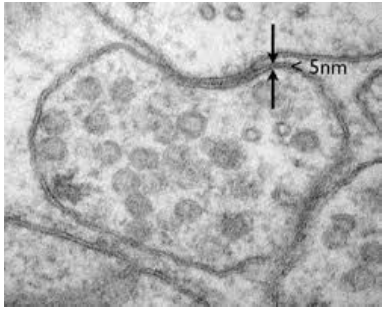
Cell Membrane

Details:

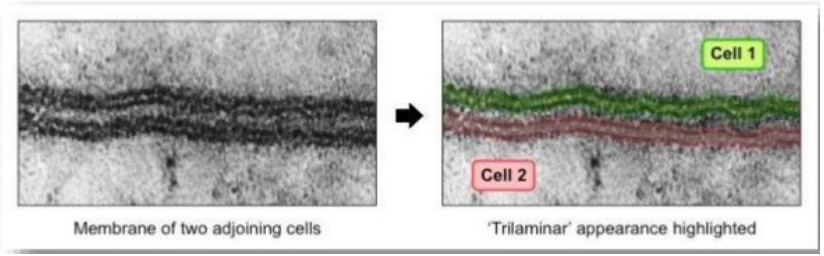
A very thin membrane that surrounds the cell.

- **LM**: Not visible.
- **EM**: Visible - Appears as 2 dark lines (electron dense).

separated by a light one (electron-lucent) (trilaminar appearance).



Trilaminar = 3 layers (two dark outer layers and a lighter inner region)



Picture taken by EM called the (electron micrograph):
1)The innermost and outermost layer are electron Dense
2)The Middle layer is electron lucent

Cell Membrane

Chemical Structure of cell membrane:

● Phospholipid molecules:

Arranged in 2 layers.

● Protein molecules:

A. Peripheral protein

B. Integral protein

● Carbohydrate molecules:

Attached to Proteins **(Glycoproteins)**

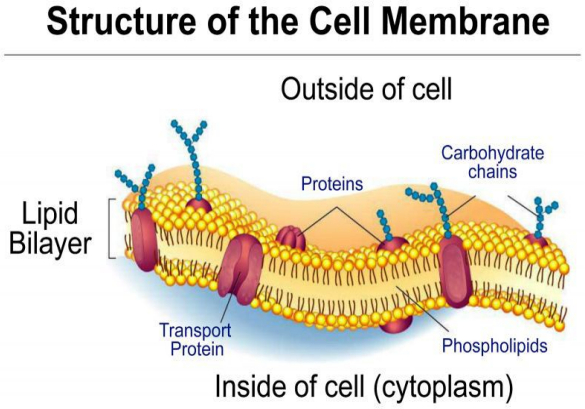
Attached to Lipids **(Glycolipids)**

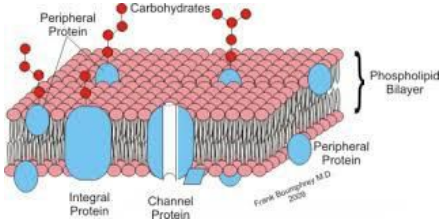
Forming The:

Surface or cell coat **(Glycocalyx)**:

-Protection of the cell.

-Cell Recognition and Adhesion.





Cell Membrane

- Phospholipid Molecules
  - Phospholipid Molecules (Two Layers)
- Protein Molecules
  - Integral Protein
  - Peripheral Protein
- Carbohydrate Molecules
  - Glycoproteins
  - Cell Coat (Glycocalyx)
  - Glycolipids

Cell Membrane

Specializations

Cilia

- Long motile **Hair-like** structures surrounded by cell membrane.

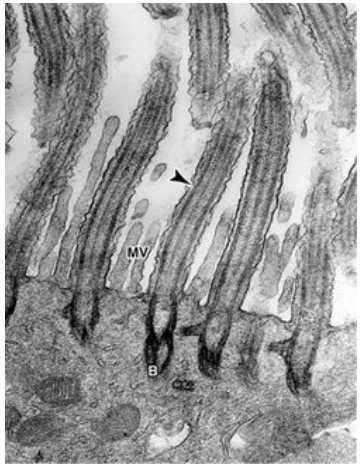
- Their **Core** is formed of **Microtubules.**

Microvilli

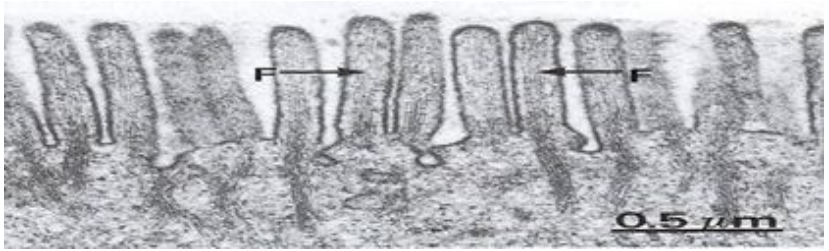
- **Cylindrical** cytoplasmic projections of apical surface to increase surface area.

- Their **Core** contains **Actin Filaments.**

Cilia



Microvilli

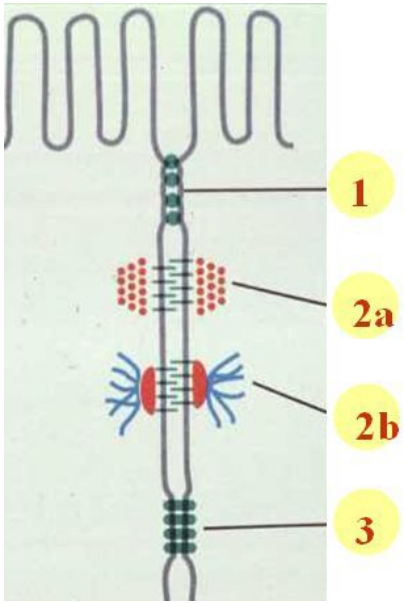


Cell Membrane

Intercellular Junctions:

- **(1) Occluding (Tight) Junction:** seals the intercellular space. To prevent any entry.
- **(2) Adherening Junction:** fixes adjacent cells together:
  - **(2a) Zonula Adherening Junction.** مثل الحزام
  - **(2b) Desmosome (Macula Adherening Junction).** مثل الزرّار
- **(3) Gap junction:** Allow free communication between the cells.

A combination of (1) + (2a) + (2b) Is called a **Junctional Complex.**



Mitochondria

- Each mitochondrion is **rod-shaped**.
- The wall is composed of 2 membranes. (
  the only organelle with 2 membranes with the nuclear envelope)
- The outer is smooth, the inner is folded to form **cristae**. (Where oxidative phosphorylation Occurs to Make ATP)
- with cavity Is filled with mitochondrial Matrix.
- Contain its **own DNA.**
- (DNA is cyclic in shape).

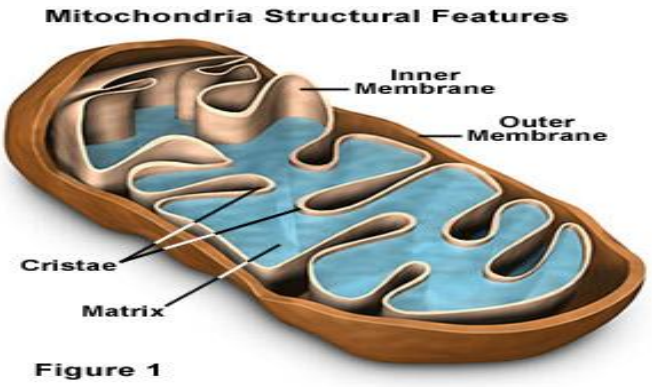


Figure 1

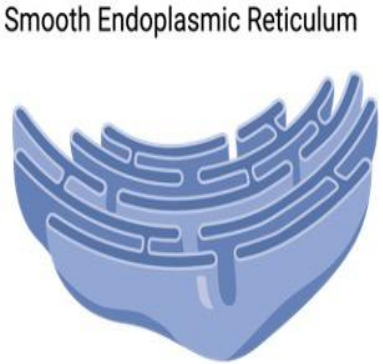
Endoplasmic Reticulum (ER)

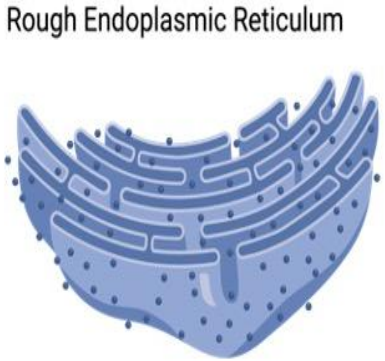
- It is a system of communicating membranous tubules, vesicles, and flattened vesicles **(cisternae).**

- **There are two types:**

  1- Rough (rER).

  2- Smooth (sER).





Endoplasmic Reticulum (ER)

- **Rough endoplasmic reticulum (rER):**

  Membranous sheets of flattened tubles & vesicles with **ribosomes on the surface.**

- **Smooth endoplasmic reticulum (sER):**

  Membranous tubules and vesicles, with **no ribosomes on the surface.**

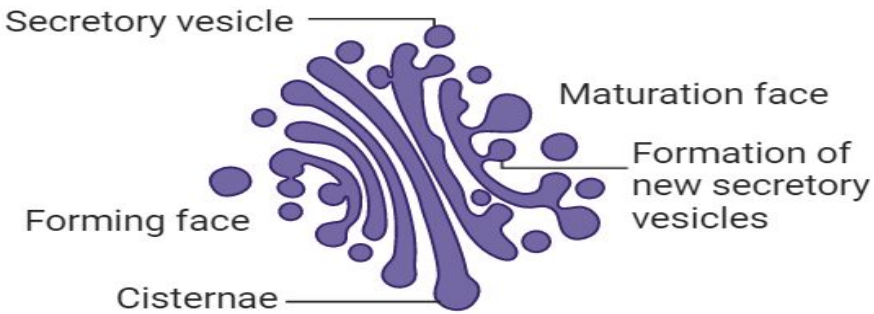
Golgi Apparatus

- **The Secretory apparatus** of the cell.
- Consist of stacked saucer-shaped flattened vesicles.
- Each vesicles has two faces:

1- **Convex (forming) face:** receives transfer vesicles.

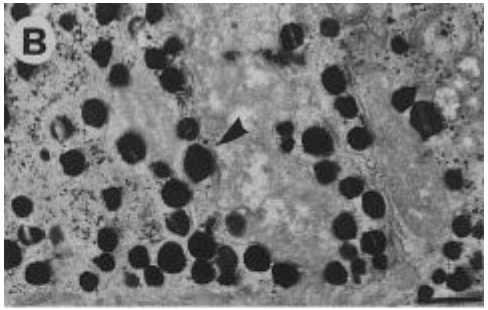
2- **Concave (mature) face:** Forms secretory vesicles.

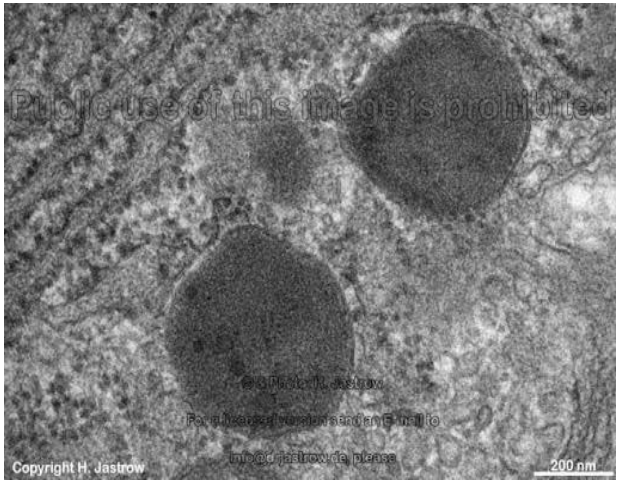
Stacked saucer-shaped



Lysosomes

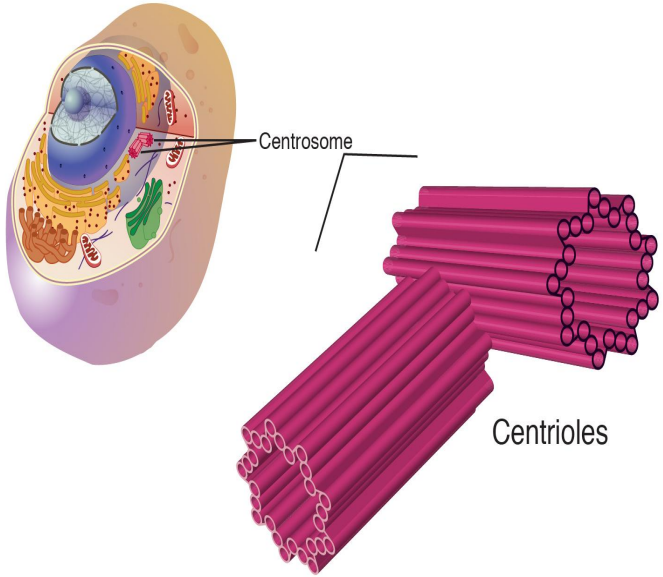
- **The digestive apparatus** of the cell.
- E/M: Spherical membranous vesicles.
- Contain **hydrolytic enzymes.** (Obtained from rER)
- Originate from mature service of the **Golgi apparatus.**





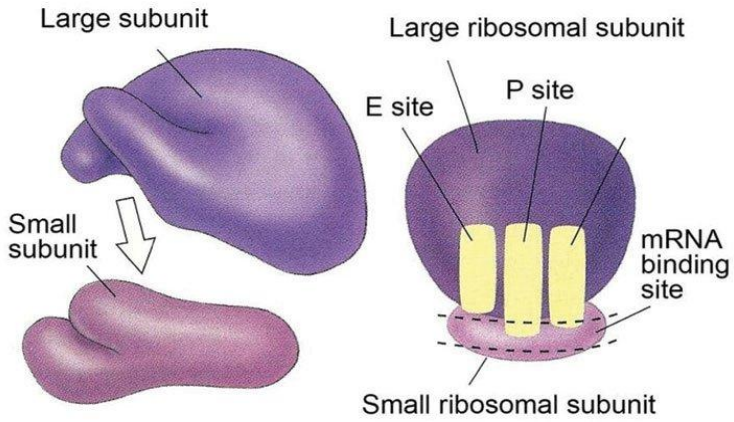
Centrioles

- **2 cylinders**, perpendicular to each other.
- Contain **Hydrolytic enzymes.**
- Originate from mature surface of the Golgi apparatus while their hydrolytic enzymes are forme **in the rER.**
- Wall is made of nine triplets of microtubules, i.e 2 microtubules



Ribosomes

- Consist of **ribosomal RNA**, combined with **proteins**.
- Free in cytoplasm (may form polyribosomes) or attached to rER.
- Formed in nucleolus.
- Wall is made of **9 Triplets.**
- L/M: **Basophilic** cytoplasm is due to numerous ribosomes.
- E/M: Formed of **2 subunits**.



Microtubules-containing organelles

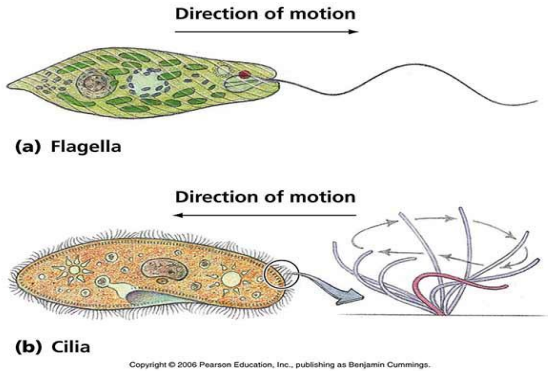
1- Centrioles: slide number 18.

2- Cilia:

- Hair like striations on the free surface of some cells.
- Basal body is similar to centriole.
- Shaft is form of **9 doublets** and **two central singles** of Microtubules, i.e. 20 Microtubules

3- Flagella:

- **Longer** and **larger** than Cilia
- Forms the **tales of sperms.**



Cytoskeleton

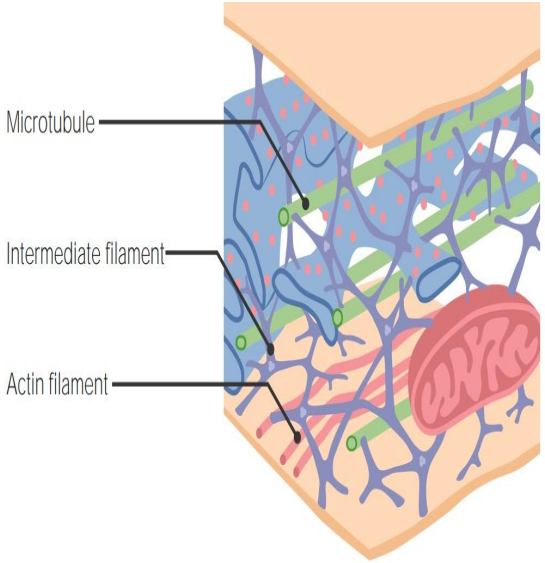
- **It is the structural skeleton of the cell.**
- Consists of:

  1- Microfilaments → Actin

  2- Intermediate filaments → E.g. Keratin

  3- Microtubules

  4- Myosin Filament (Thick).



Functions of cell organelles

Organelles	*Functions*
Cell membrane	Selective barrier (Controls what goes in and out of the cell)
Mitochondria	Generation of ATP which is the source of energy for the cell they are called the powerhouse of the cell. They can form their own proteins and undergo self replication.
Rough Endoplasmic Reticulum	1- Synthesis of proteins by ribosome on its outer surface. 2- Transfer the formed proteins to Golgi.
Smooth Endoplasmic Reticulum	1- Synthesis of lipids and cholesterol. 2- Synthesis of steroid hormones, e.g. cortisone. 3- Helps muscle contraction, by acting as a calcium pump. 4- **Large amount** of smooth ER are found in the **liver** for Detoxification of drugs and toxins.

Functions of cell organelles

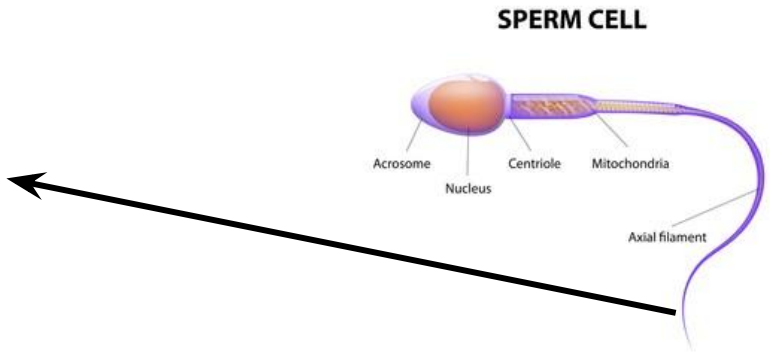
Organelles	*Functions*
Golgi Apparatus	1- Sorting, modification and packaging of proteins. 2- secretory vesicles formation. 3- Formation of lysosomes.
Ribosomes	Protein synthesis.
centrioles	1- Essential for cell division. 2- Formation of cilia and flagella.
Cilia and flagella	Cilia: Movement of particles or fluids on the free surface of the cell in one direction. Flagella: Important for movement of the sperms.
Lysosomes	Intracellular digestions of ingested material or old organelles.
Cytoskeleton	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.**
- Is caused by immobility of cilia and flagella used by **deficiency of dynein.**
- Dynein protein is responsible for movement of cilia and flagella.

Sperms won't be able to arrive at the Ovum because it's lack dynein protein and that will lead to immovable flagella.



MCQs

1- Which of the following is not an example of a membranous organelle?

A- Lysosomes	B- Centrioles	C- Endoplasmic Reticulum	D- Mitochondria

2- ……. Is a part of the cell that can form their own proteins and undergo self replication.

A- Ribosomes	B- Golgi Apparatus	C- Mitochondria	D- Cilia

3- Which of the following structures is responsible for the basophilic stain in the cytoplasm?

A- Golgi Apparatus	B- Mitochondria	C- Ribosomes	D- Secretory vessels

4- If the cytoplasm appears blue in the microscope, it means that it is stained with:

A- Hematoxylin	B- Aldehyde fuchsine	C- Crystal violet	D- Eosin

5- What is the cause of immotile cilia syndrome?

A- Cilia has a lot of hair like organelles	B- Deficiency of dynein	C- Cilia doesn't have hair like organelles	D- Deficiency of RBC

6- If the sex chromatin (Barr body) is absent in female, it means that the female is with:

A- Down syndrome	B- Triple X syndrome	C- Turner's syndrome XO	D- Klinefelter's syndrome XXY

Answers:
1-B 2-C 3-C 4-A 5-B 6-C

Meet The Team

Team Leaders:

سندس الكريديس

عبدالرحمن القرشي

Team Members:

أثير الكنهل
ثراء الهويش
شهد المرشد
هيفاء العمري

الجازي البابطين
ريناد آل عايض
ليان البريكان
مشاعل الأسمري

أحمد باحميد
ريان العتيبي
عزام العتيبي
مازن قدري
محمد العريض

تركي العتيبي
عبدالله القرني
فهد مبيريك
محمد الدوسري

442Histology@gmail.com