



MED441
KING SAUD UNIVERSITY

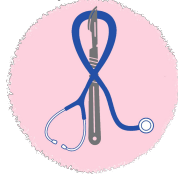


Histology team

Cell Structure

- Color index :
- Main text
- Important
- Female slide
- Male slide
- DR.Notes
- extra

Revised & Reviewed
by
Abdulaziz & Bahammam
Faye Wael Sondi



1



Objectives :

- 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 :**
 - **Membranous and Non-Membranous**
 - **Inclusion**

Introduction :

Histology: 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

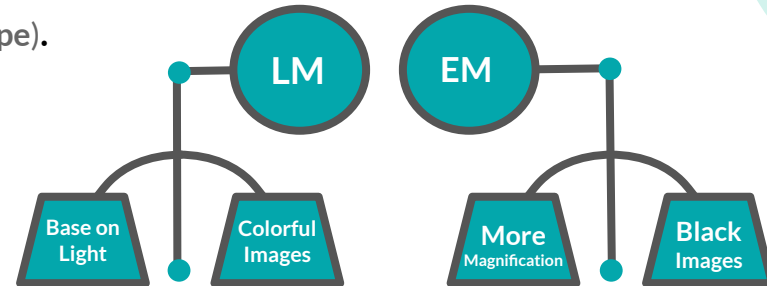
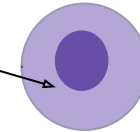
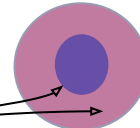
Thin sections are cut and mounted on glass slides.

Sections are stained with **Hematoxylin (H)** and **Eosin (E)**:

-Nucleus is always blue (**Basophilic**).

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

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



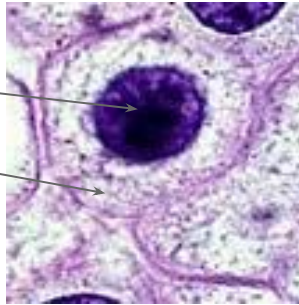
The cell

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

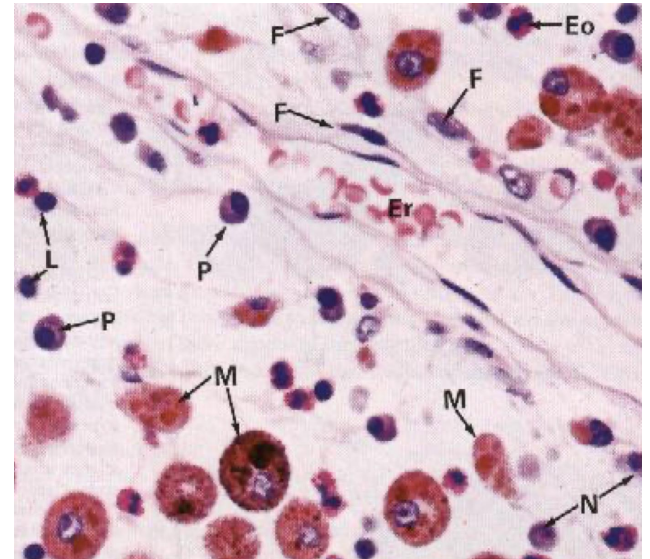
Cells have different shapes & sizes. According to their function.

The cell is made of:

- Nucleus
- Cytoplasm



Notice how one tissues have different shapes and sizes of cells

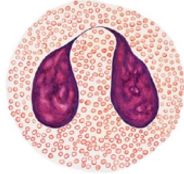


NUCLEUS (L/M)

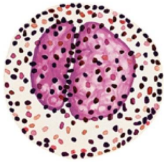
Shapes of nuclei



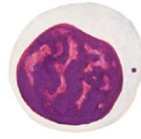
Neutrophilic granulocyte



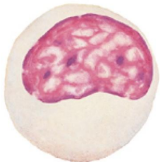
Eosinophilic granulocyte



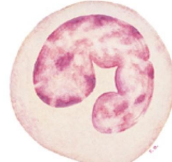
Basophilic granulocyte



Lymphocyte



Monocyte



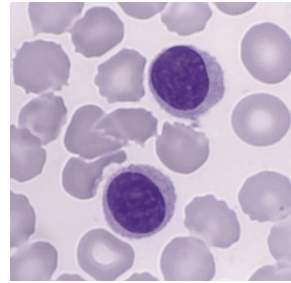
Monocyte

These are white blood cells

Appearance of nuclei

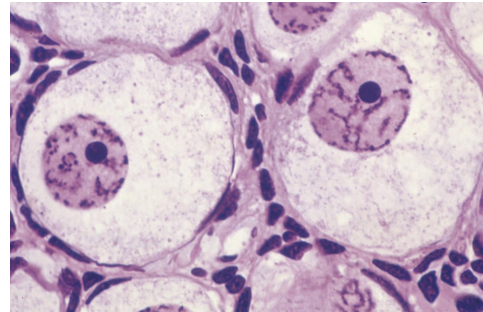
1-Dark nucleus (Deeply-stained nucleus)

Deeply basophilic Nucleus



Inactive cell because
the color of nucleus is
dark

2-Vesicular (open face) nucleus



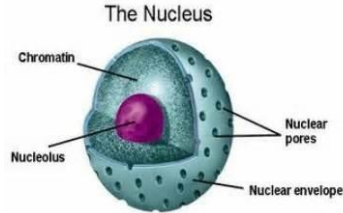
Active cell because the
color of nucleus is pale

Note: It looks like a grape
and its seed

Nucleus (E/M)

The nucleus is Formed of:

- Nuclear Envelope
- Chromatin
- Nucleolus
- Nucleoplasm



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.

Notes: There are four chromosomes that form the nucleolus 13, 14, 15, 20.
Sometimes there is more than one nucleus.

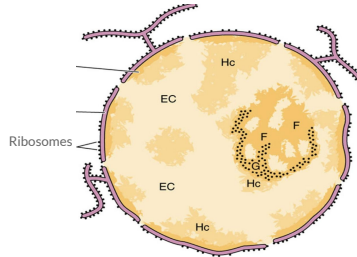
The only structures with double membrane in the cell are Nucleus and Mitochondria.

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).

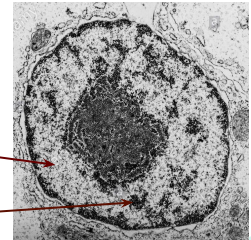
Function

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

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

There are three types of **Heterochromatin** based on location.

- Nucleolus based
- Peripheral
- Island

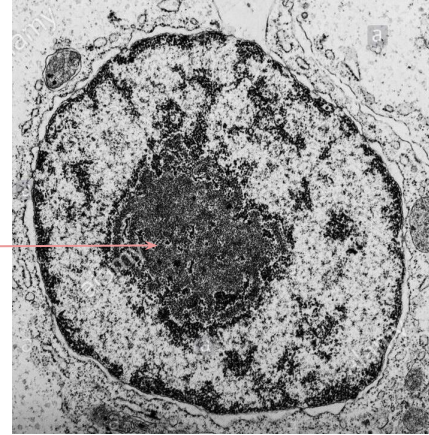


3. Nucleolus

- **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.

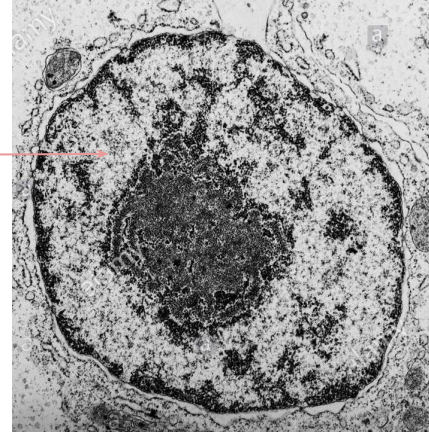


4. Nucleoplasm

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

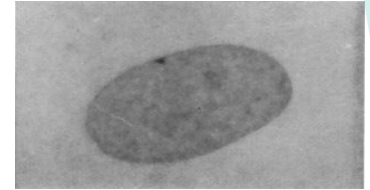
Function:

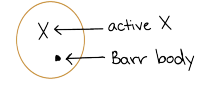

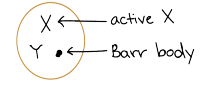

Provides a medium for movement of 3 types of RNA (Ribosomal, Messenger and Transfer RNA) from the nucleus to the cytoplasm.



Sex Chromatin (Barr Body)

- **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**.



XX female	 <p>X ← active X ● ← Barr body</p>
XY male	 <p>X ← active X (the only X) Y</p>
XXY male (Klinefelter)	 <p>X ← active X Y ● ← Barr body</p>
XXX female (triple X)	 <p>X ← active X ● ● ← Barr bodies</p>

Cytoplasm

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

- Lipids
- Glycogen
- Pigments:
Melanin & Lipofuscin

• Membranous:

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

• Non-membranous:

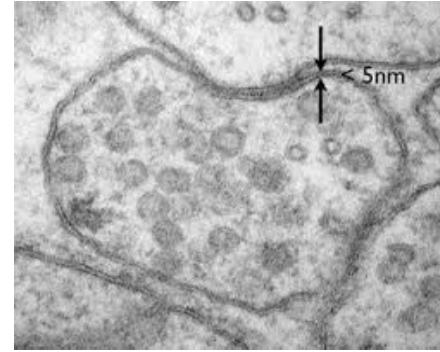
- Ribosomes.
- Centrioles.
- Cilia & Flagella.
- Filaments: (Actin-Intermediate filaments-Myosin)
- Cytoskeleton: (Actin-intermediate filaments-Microtubules)

Cell Membrane

Details

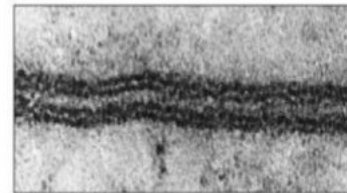
A very thin membrane that surrounds the cell.

- **LM:** Not visible.
- **EM:** Visible - Appears as 2 dark lines (electron dense) separated by a light one (electron-lucent) (trilaminar appearance).

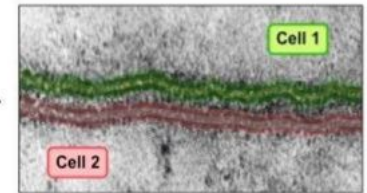


Function: selective barrier
(controls what goes in and out of the cell)

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



Membrane of two adjoining cells



'Trilaminar' appearance highlighted

- 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**)

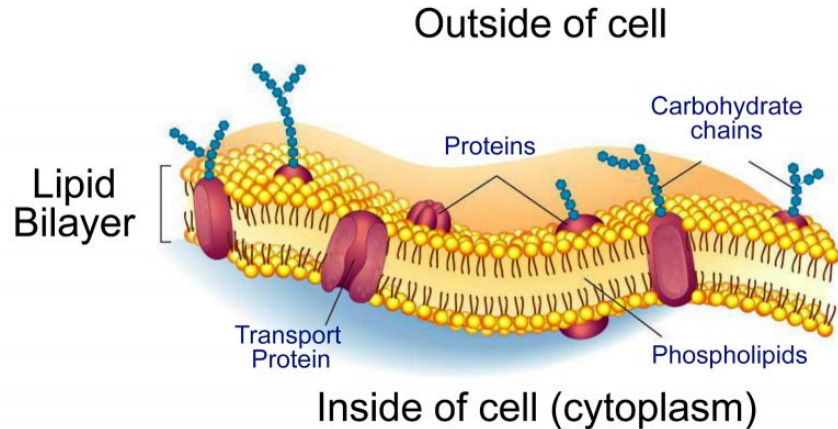
Forming The

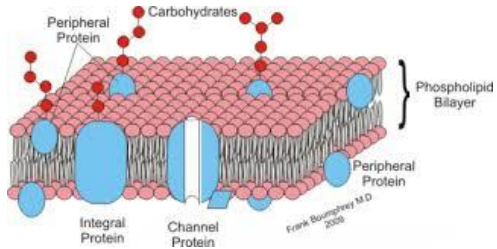
Surface or cell coat (Glycocalyx):

Protection of the cell.

Cell Recognition and Adhesion.

Structure of the Cell Membrane





Cell Membrane

Phospholipid Molecules

Two Layers

Protein Molecules

Peripheral Protein

Sides of Cell Membrane

Integral Protein

Through Cell Membrane

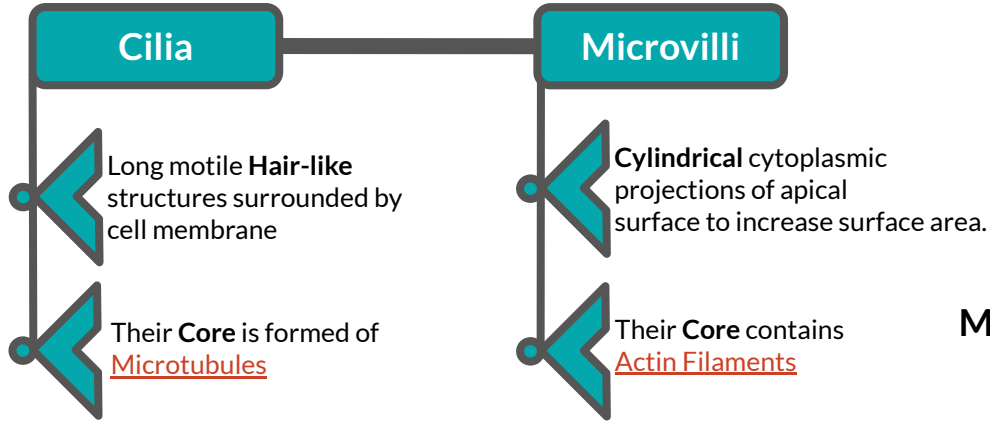
Cell Coat (Glycocalyx)

Carbohydrate Molecules

Glycoproteins

Glycolipids

Cell membrane Specializations



Cilia



Microvilli

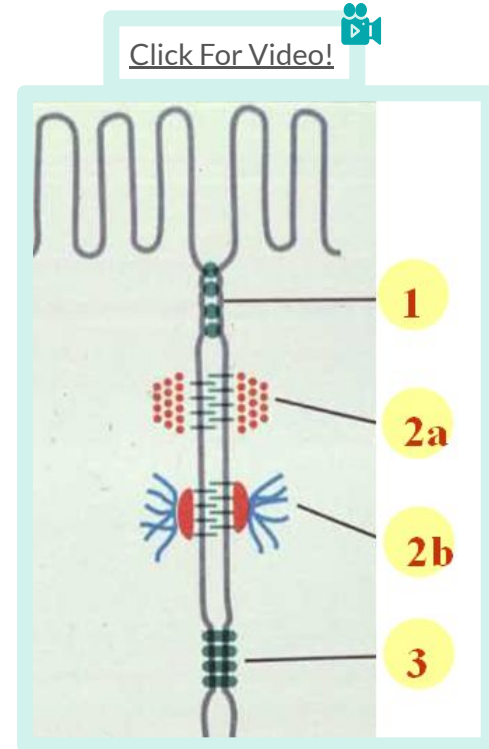


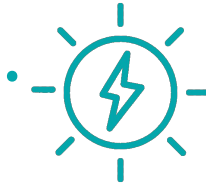
Cell membrane

Intercellular Junctions:

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

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





Mitochondria

The Source Of Energy For The cell

Details:

- Each Mitochondrion is **Rod-shaped**.
- The Mitochondria has a wall composed of **2 Membranes**.
- **The outer is smooth the inner is folded** to form **Cristae**.
(Where oxidative phosphorylation Occurs to Make **ATP**)
- The cavity is filled with mitochondrial **Matrix**, which contains enzymes. Also contains its **own DNA**.

-Mitochondria Has Circular DNA While Nucleus Has Straight DNA.

-Neural cells have large amounts of Mitochondria

Functions:

- **Generation of ATP:** They Are Called The Powerhouse Of The Cell
- They can form their **own proteins** and undergo **self replication**.

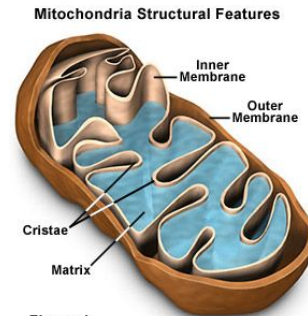


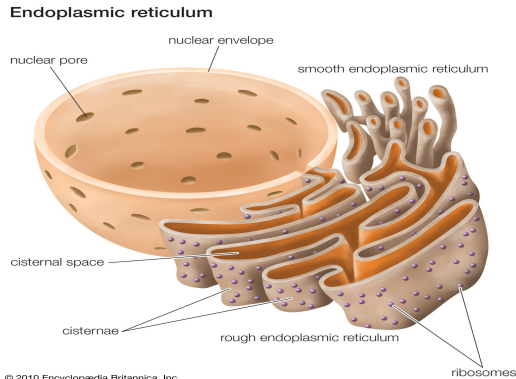
Figure 1



Endoplasmic Reticulum

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

- There are 2 types:
 - 1- Rough (rER).
 - 2- Smooth (sER).



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Rough ER

Flattened Tubules (Sheets)

Has Ribosomes

Synthesis of Protein in outer surface

Transfer the formed protein to Golgi for packaging

Smooth ER

Regular Tubules

NO Ribosomes

Synthesis of Lipids and Cholesterol
(cholesterol causes **Arteriosclerosis**)

Synthesis of steroid hormones
eg. cortisone

Contraction of muscle by
Acting as a calcium pump.

Detoxification of drugs and toxins



Golgi Apparatus

The Secretory Apparatus of the Cell

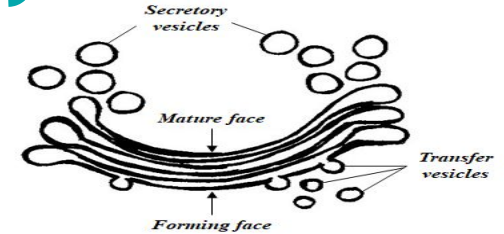
It packages vesicles from (R-ER)
So we can transfer it without leakage

Details

- Consists of Stacked saucer-shaped flattened vesicles.
- Each vesicle has two faces:
 - **Convex (forming) face:** Receives transfer vesicles.
 - **Concave (mature) face:** Forms secretory vesicles.



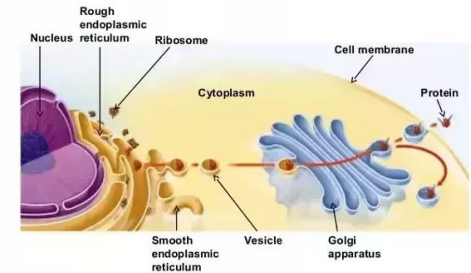
(Stacked saucer shaped)



Functions:

- **Sorting, modification & packaging of proteins.**
- **Secretory vesicles formation.**
- **Formation of Lysosomes.**

Making Proteins: Review





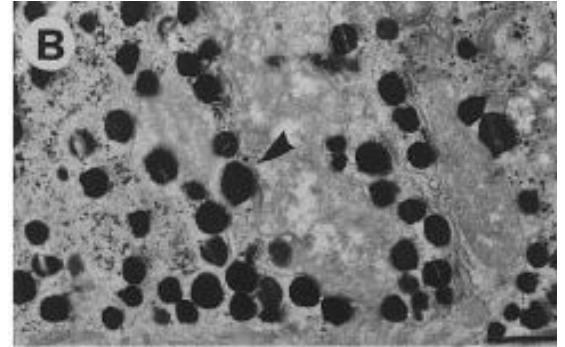
Lysosomes

The digestive apparatus of the cell

EM: Spherical membranous vesicles.(electron dense)

- Contain **Hydrolytic enzymes**.
- Originate from mature surface of the Golgi apparatus while their hydrolytic enzymes are formed in the rER

Function: intracellular digestion of ingested material or old organelles.



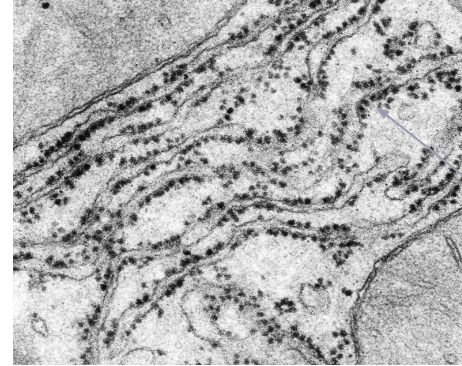
Ribosomes

Details

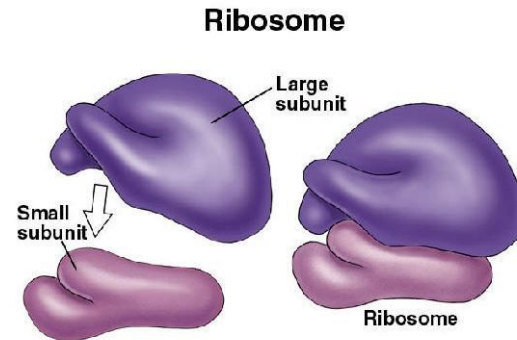
- **LM:** Basophilic cytoplasm is due to numerous ribosomes
(Only LARGE amount of ribosomes cause basophilic Cytoplasm and cytoplasm by itself is invisible under LM).
- Consist of ribosomal RNA (rRNA), combined with proteins.
- **EM:** Formed of 2 subunits.
- **Free** in the cytoplasm (may form polyribosomes) or **attached** to rER.
- Formed in the nucleolus.

Function:

Protein synthesis



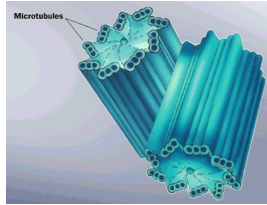
Ribosomes in Rough -ER



Microtubules-Containing Organelles

Centrioles:

- 2 Cylinders pairs, Perpendicular to each other
- Wall is made of **9 Triplets**
- Microtubules = 27 Microtubules



Functions:

- Essential for Cell division.
- **Formation** of Cilia and Flagella

Flagella:

- Longer and larger than Cilia.
- **Form** the tails of **Sperms**.

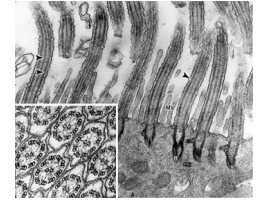
Function:

- Movement of the **Sperms**.



Cilia:

- **Hair-like** striations on the free surface of some cells.
- **Shaft** is formed of **9 Doublets** and 2 central singlets of Microtubules = 20 Microtubules
- Basal body is similar to **Centriole**.



Function:

- Movement of Particles or Fluids on the free surface of the cell in One Direction.

Microtubules-Containing Organelles

Immotile cilia syndrome:

- **Dynein** protein is responsible for movements of **Cilia** and **Flagella**.
- deficiency of **Dynein** will cause immobility of **Cilia** and **Flagella**.
- **Disorder** that causes infertility in **Male** and chronic Respiratory tract infection in both **Sexes**.

Cytoskeleton

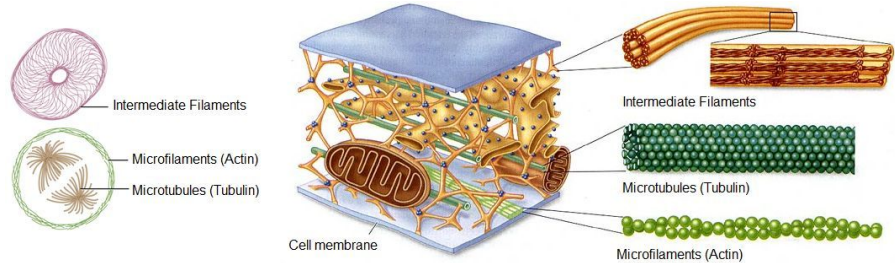
The Structural Skeleton Of The Cell

Functions:

- Maintains shape of the cell.
- Helps transport of material within the cell.

Consists of:

- Microfilaments (**Actin**) ;(contractile) + (Thin)
- Intermediate filaments (**Keratin**) ;(non-contractile)
- Microtubules (non-contractile)
- Myosin Filament (Thick)



Summary

Credits to Njood 





Quiz!

Answers

1
2
3
4
5
6

D
C
A
D
C
B

Q(1): Sex chromatin (Bar body) is seen in ?

A XX female

B XY male

C XXY Klinefelter's

D Both A & C

Q(2):An example of a membranous organelle ?

A Ribosomes

B Cilia

C Lysosomes

D Cytoskeleton

Q(3):Clear fluid medium in which all the contents of the nucleus are embedded?

A Nucleoplasm

B Nuclear Envelope

C Nucleolus

D None

Q(4):inner smooth folded layer of the mitochondria is called ?

A Chromatin

B Nucleosome

C Cisternae

D Cristea

Q(5):Which of the Following has hydrolytic enzymes?

A Rough ER

B Golgi body

C Lysosomes

D Smooth ER

Q(6):How many layers are in the cell membrane when using The electron microscope?

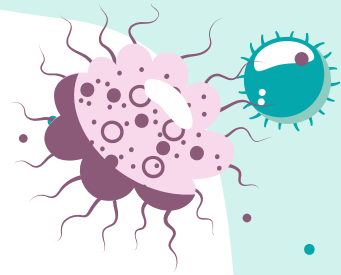
A Not visible

B 3

C 1

D 2

The Creative Crew!



Foundation Block | Histology Team (441)



Boys Captain

Alwaleed Alnasser



Girls Captain

Norah Alawlah



- Abdullah Alqarni
- Abdulrahman Mukhtar
- Abdulmajeed Alharbi
- Mansor Aldoajy
- Mohammed Alhaqbani
- Ziyad Al-Abduljabbar

- Iyah Alhasan
- Hussah Alshareef
- Lobna Altimimy
- Zahraa Alsultan
- Fay Alluhaidan
- Sarah Al-homaydy
- Sarah Al-Majed