

Introduction To Histology And Cell Structure



MEDICINE

KING SAUD UNIVERSITY



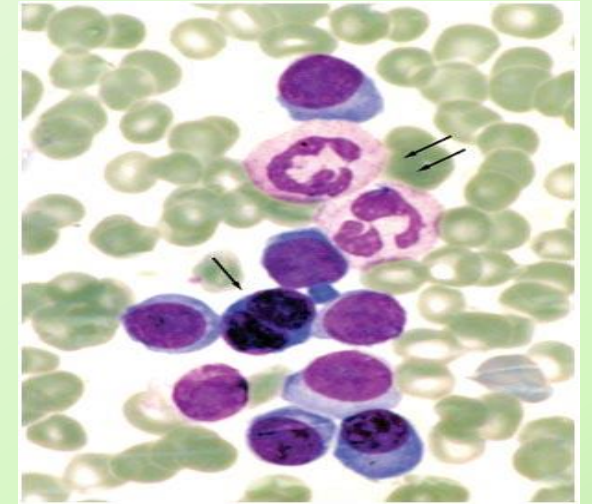
Content & Objectives :

In this lectures you are expected to learn :

- *What is Histology and how it is studied ?*
- *Composition of the cell :*
 - *Light microscopic (L/M) & 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 :*
 - *Light microscope (colored)*
 - *Electron microscope (black & white)*
- *Thin sections are cut and mounted on glass slides, sections are then stained with hematoxylin (H) and eosin (E).*
 - *Nucleus is always blue (basophilic).*
 - *Cytoplasm may be red (acidophilic) or blue (basophilic).*



THE CELL

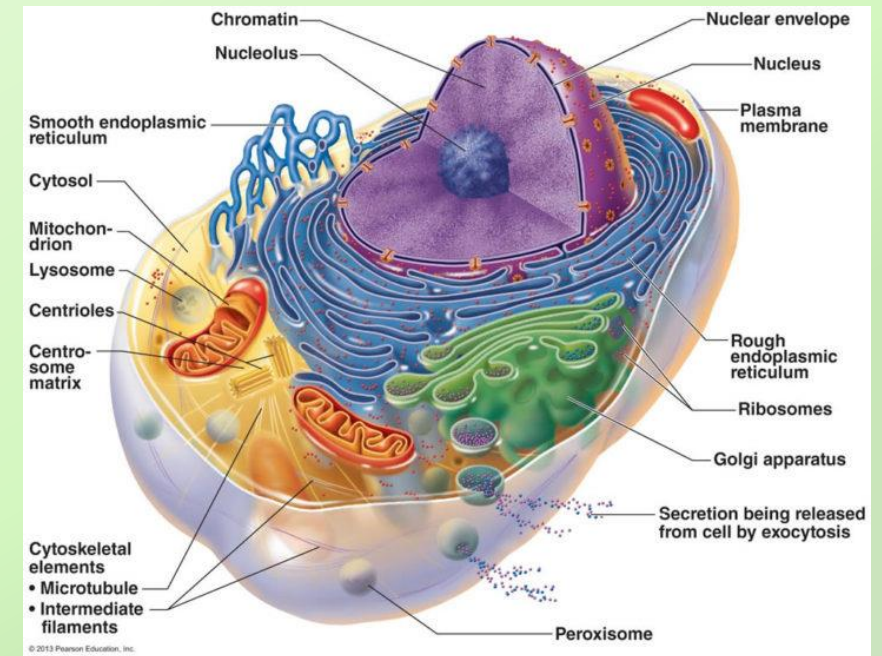
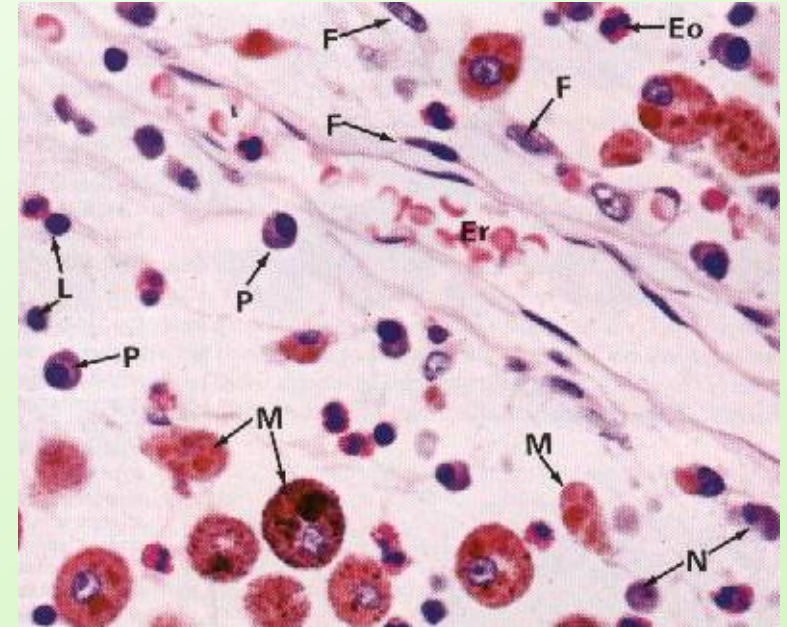
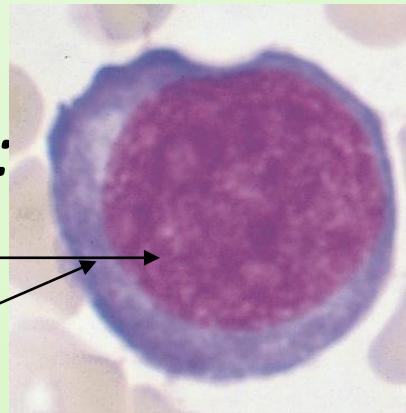
- Is the *structural & functional* unit of all living tissues.

- Cell have *different* shapes & sizes .

- The cell is made of :

- *Nucleus.*

- *Cytoplasm.*

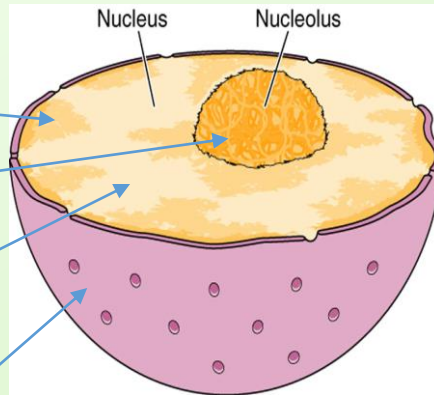


Body → System → Organ → Tissue → Cell

Nucleus (E/M)

- *Formed of :*

- *Chromatin .*
- *Nucleolus .*
- *Nucleoplasm .*
- *nuclear envelope*

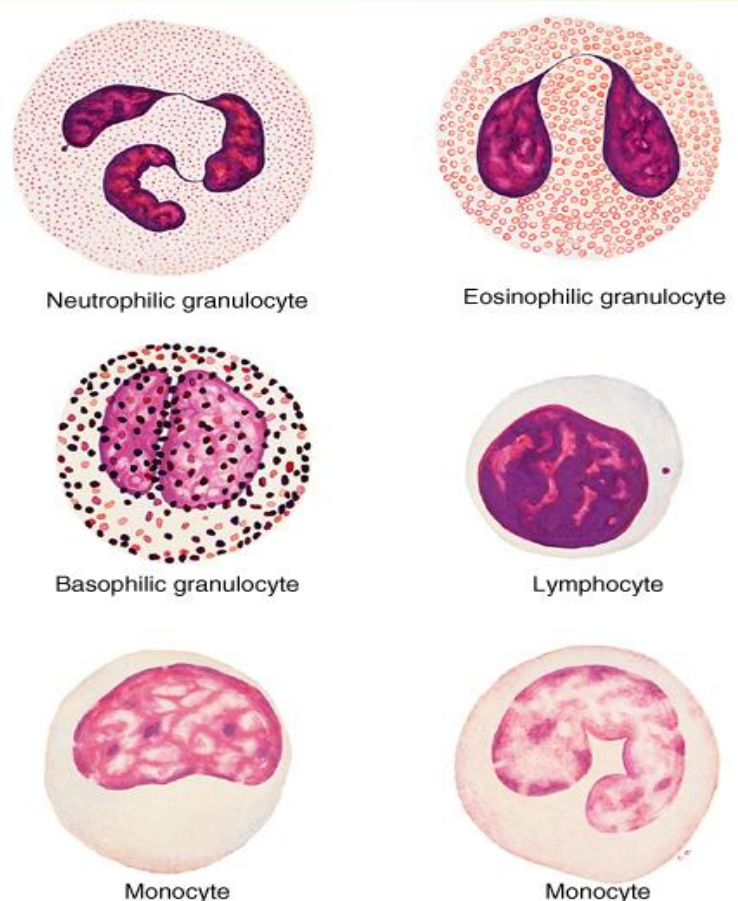


- *Functions:*

- *it is essential for **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** .*

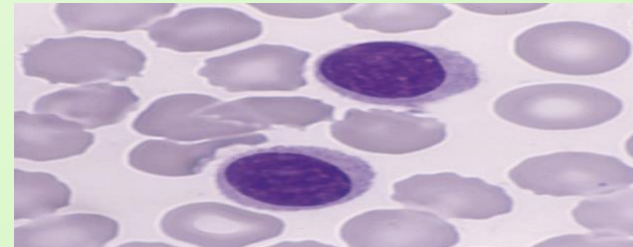
Nucleus

- *Shapes of Nuclei :*

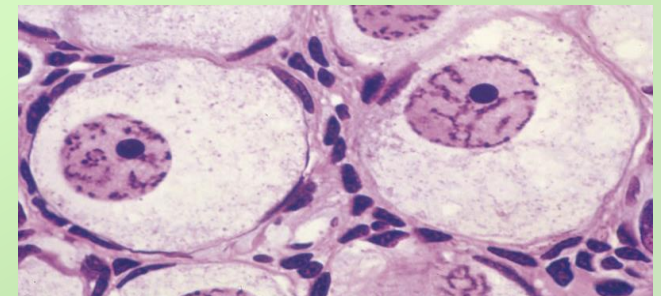


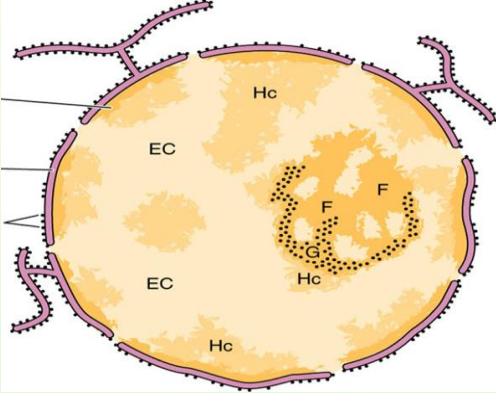
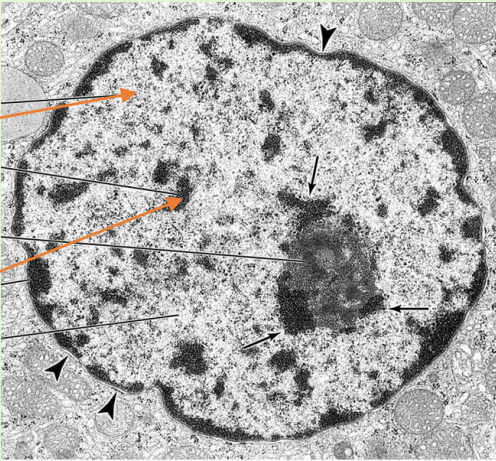
- *Appearance of Nuclei:*

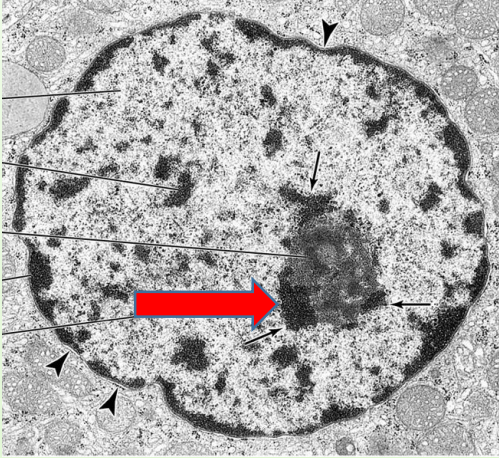
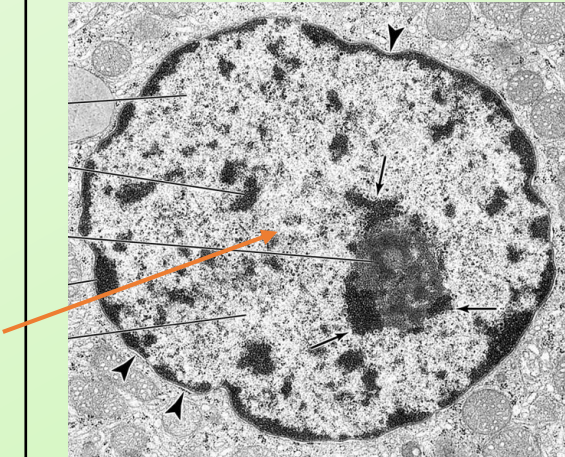
- (1) Dark Nucleus (*Deeply-stained nucleus*) **Deeply basophilic Nucleus.**



- (2) *Vesicular (open face)* Nucleus.

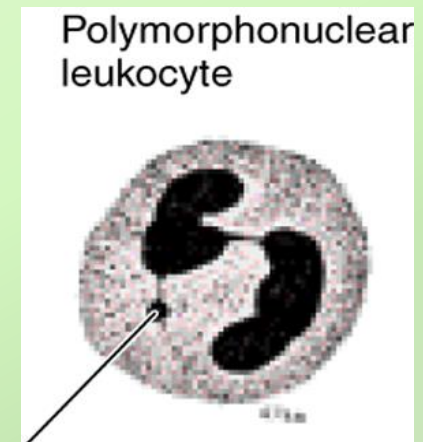
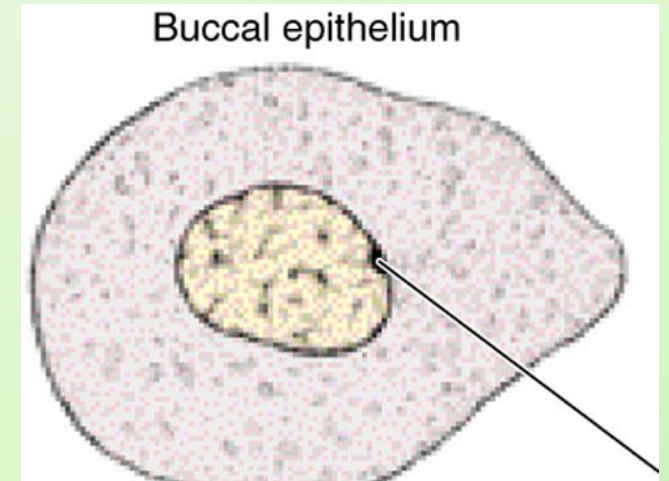


	<h1>Definition</h1>		<h1>Function</h1>
<h2>Nuclear Envelope</h2>	<p>A double membrane with many pores.</p> <ol style="list-style-type: none"> <u>Outer membrane.</u> <u>Inner membrane.</u> <u>Nuclear pores:</u> 		<p>❖ <u>Functions: (pores)</u></p> <p>provide communication between nucleus and cytoplasm.</p>
<h2>Chromatin</h2>	<p>Formed of <u>DNA</u>.</p> <ul style="list-style-type: none"> <u>2 Forms:</u> <ul style="list-style-type: none"> <u>Euchromatin</u>: extended active chromatin (pale= electron-lucent areas). <u>Heterochromatin</u>: condensed inactive chromatin (dark = electron dense areas). 		<p>❖ <u>Functions:</u></p> <ul style="list-style-type: none"> – Carries genetic information. – Directs protein synthesis.

	<i>Definition</i>		<i>Function</i>
NUCLEOLUS	<ul style="list-style-type: none"> • E/M: It is mostly dark mass (<i>electron-dense</i>) not surrounded by a membrane. • <u>Usually</u> one. • L/M: It is a spherical dark <i>basophilic</i> mass. 	 <p>An electron micrograph of a nucleus. A prominent, dark, spherical nucleolus is located in the center. A red arrow points directly to this nucleolus. The surrounding nucleoplasm is lighter and contains various organelles and structures. Several black arrows point to different parts of the nucleus, and black arrowheads point to the nuclear envelope.</p>	<ul style="list-style-type: none"> ❖ Function: formation of ribosomal RNA (rRNA), which is responsible for protein synthesis in the cytoplasm.
NUCLEOPLASM	<p>It is a clear fluid medium in which all the contents of the nucleus are embedded.</p>	 <p>An electron micrograph of a nucleus, similar to the one above. An orange arrow points to the clear, fluid medium of the nucleoplasm. The dark nucleolus is visible in the center. Black arrows and arrowheads are also present, pointing to various nuclear components and the envelope.</p>	<ul style="list-style-type: none"> ❖ Function: Provides a <i>medium for movement</i> of 3 types of RNA (ribosomal, messenger and transfer RNA) from the nucleus to the cytoplasm.

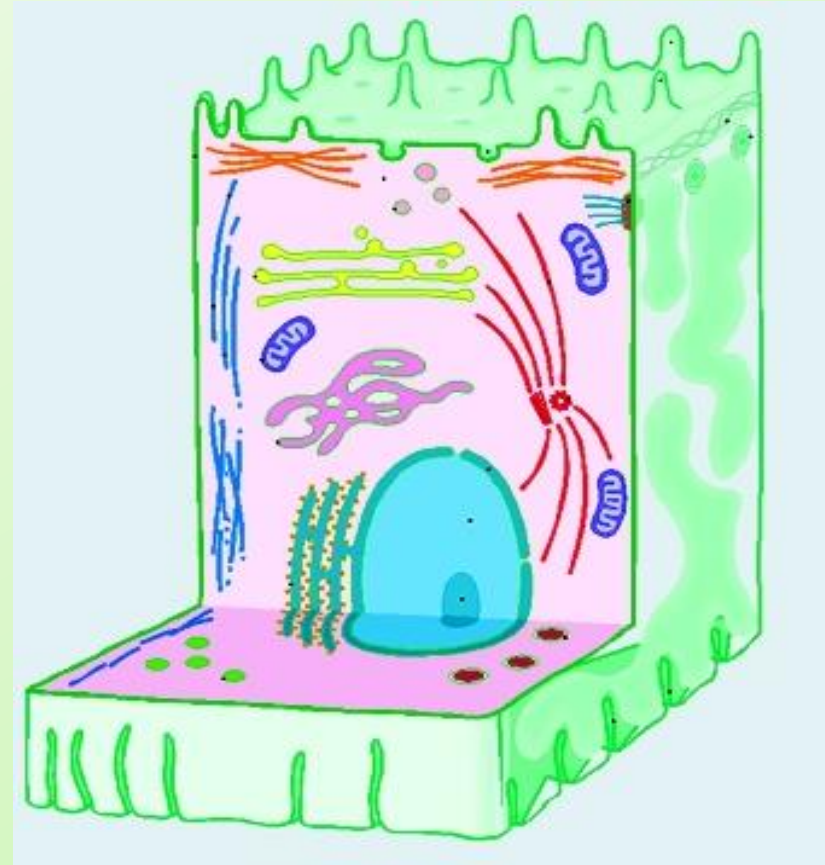
SEX CHROMATINS (*Barr Body*)

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



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.



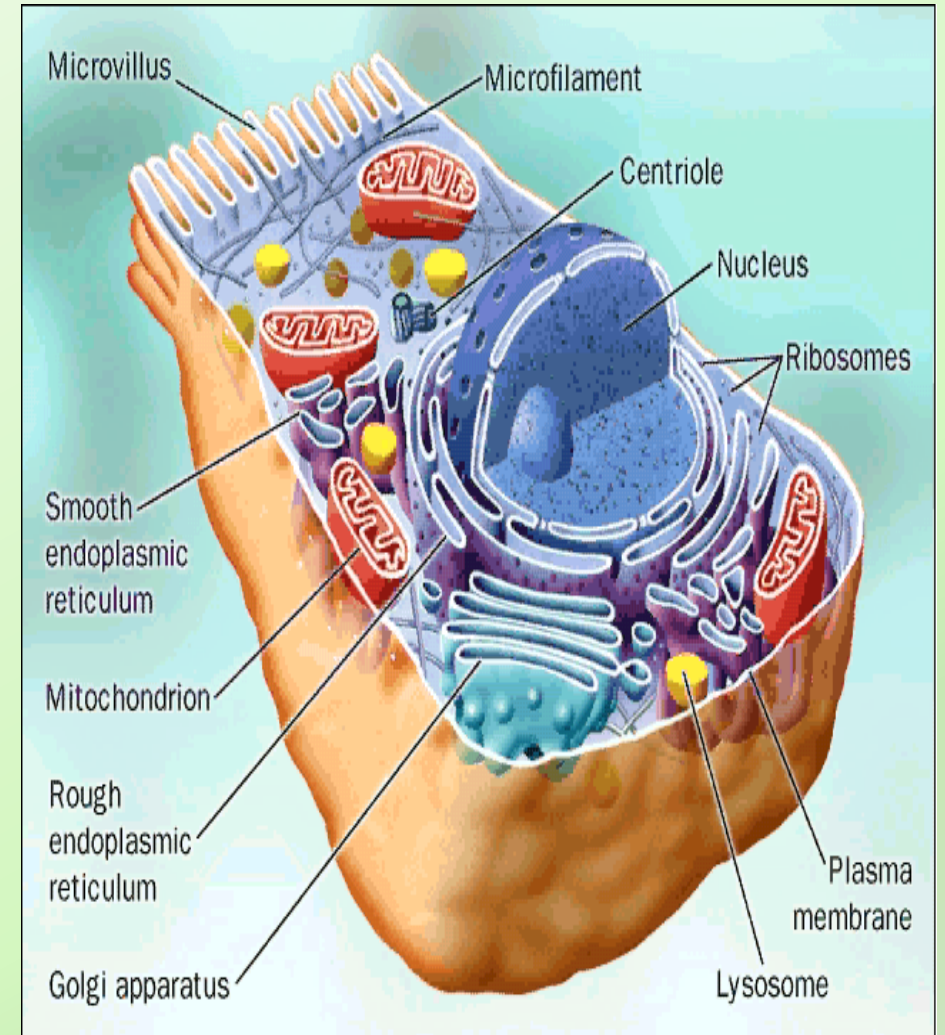
CYTOPLASMIC ORGANELLES

Membranous:

1. Cell membrane.
2. Mitochondria.
3. Endoplasmic reticulum
(*rough & smooth*).
4. Golgi apparatus.
5. Lysosomes.
6. Secretory vesicles.

Non-membranous:

1. Ribosomes.
2. Centrioles.
3. Cilia & Flagella.
4. Filaments:
Actin, Myosin & Intermediate filaments.
5. Cytoskeleton (*actin, intermediate filaments & microtubules*).



Cell Membrane

IS:

- 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):

a) *Protection of the cell.*

b) *Cell recognition and adhesion.*

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*.

Intercellular Junctions:

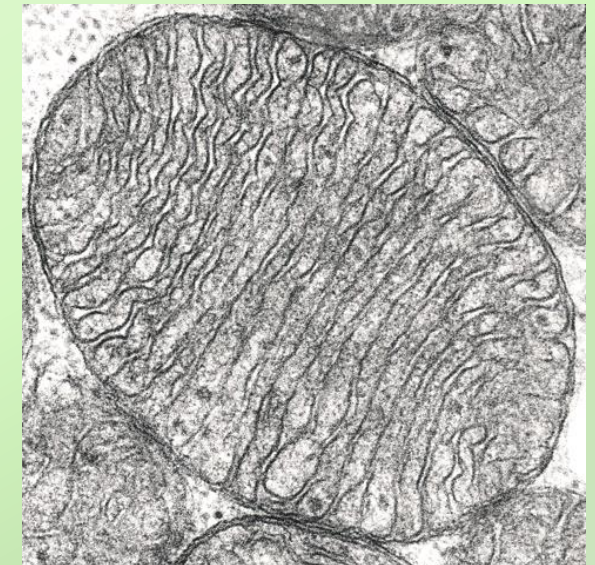
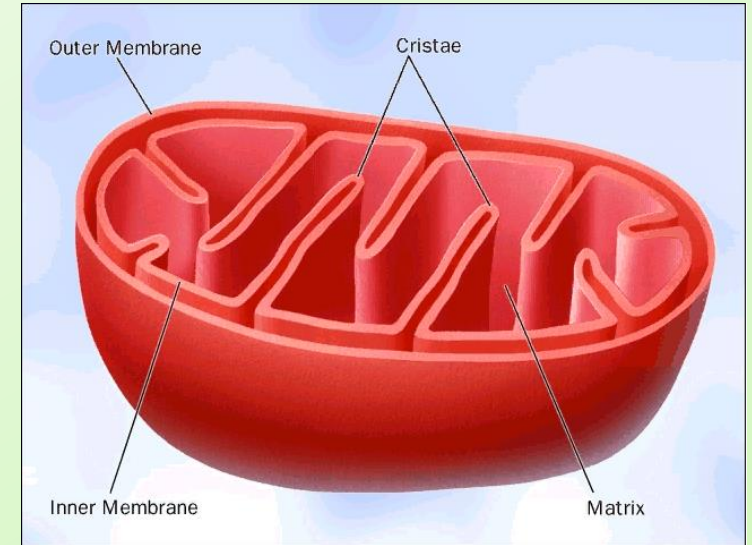
- *Occluding (Tight) Junction:* seals the intercellular space.
- *Adhering Junction:* fixes adjacent cells together:
 - Zonula Adhering Junction.
 - Desmosome (Macula Adhering Junction).
- *Gap junction:* Allow free communication between the cells.

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**.

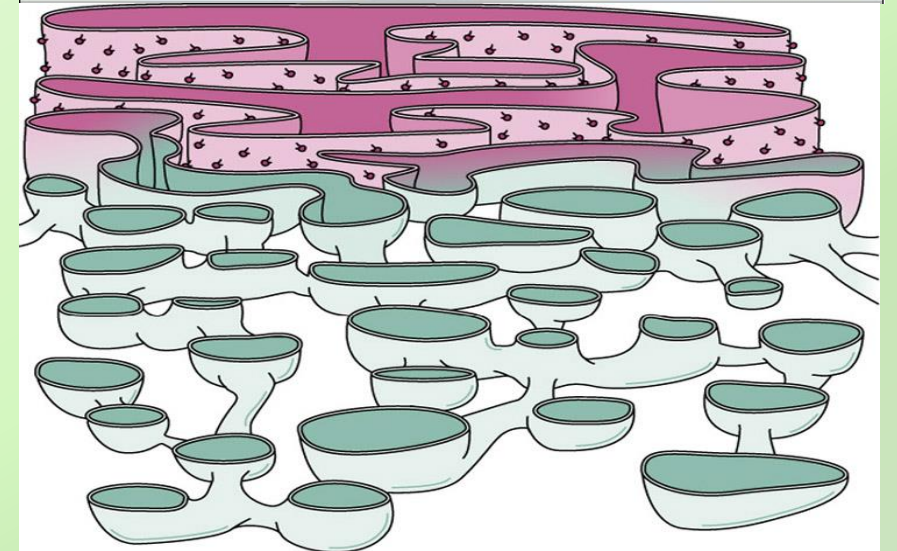
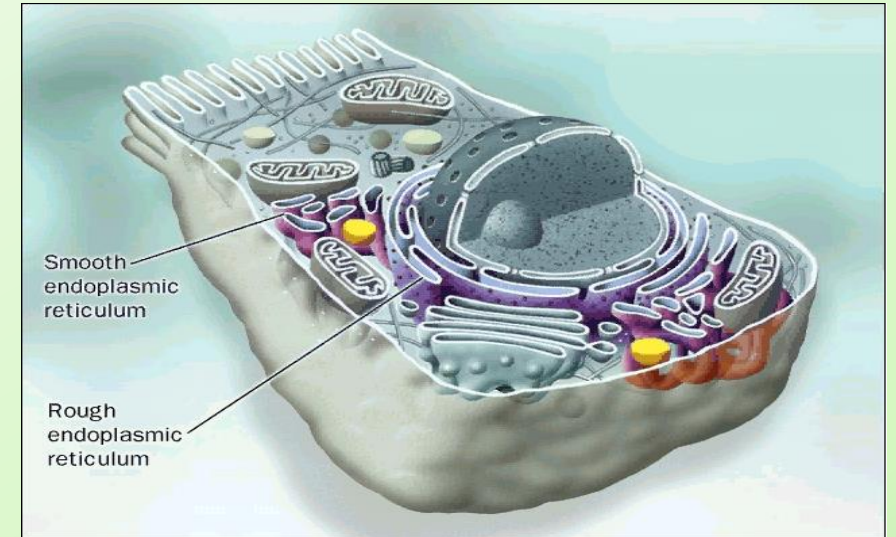
Functions:

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**.



Endoplasmic Reticulum (ER)

- It is a system of communicating membranous tubules, vesicles, and flattened vesicles (*cisternae*).
- There are 2 types:
 - Rough (rER).
 - Smooth (sER).

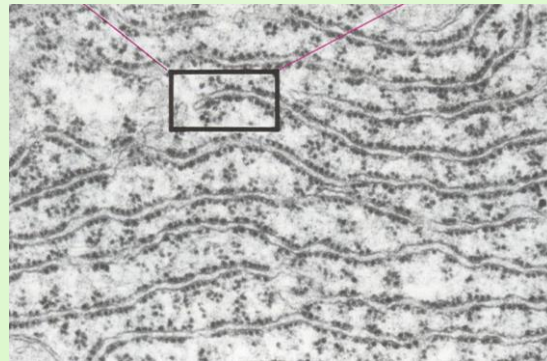
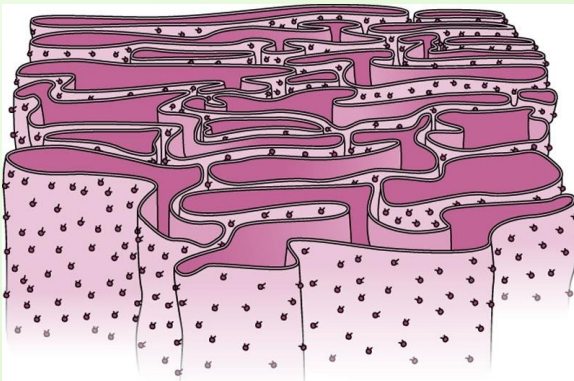


Rough Endoplasmic Reticulum

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

❖ Functions:

1. **Synthesis of proteins** by ribosomes on its outer surface.
2. **Transfer vesicles** transfer the formed protein to Golgi.

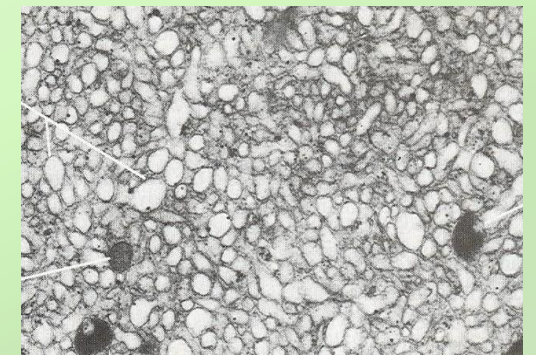
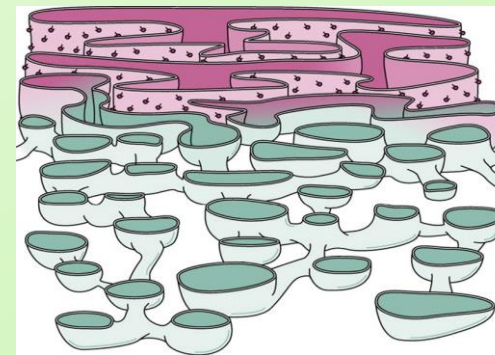


Smooth Endoplasmic Reticulum

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

❖ Functions:

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.

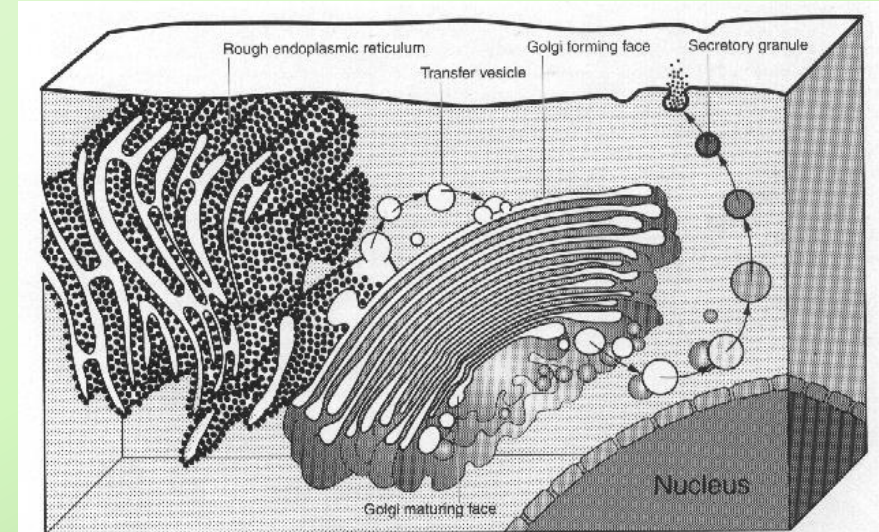
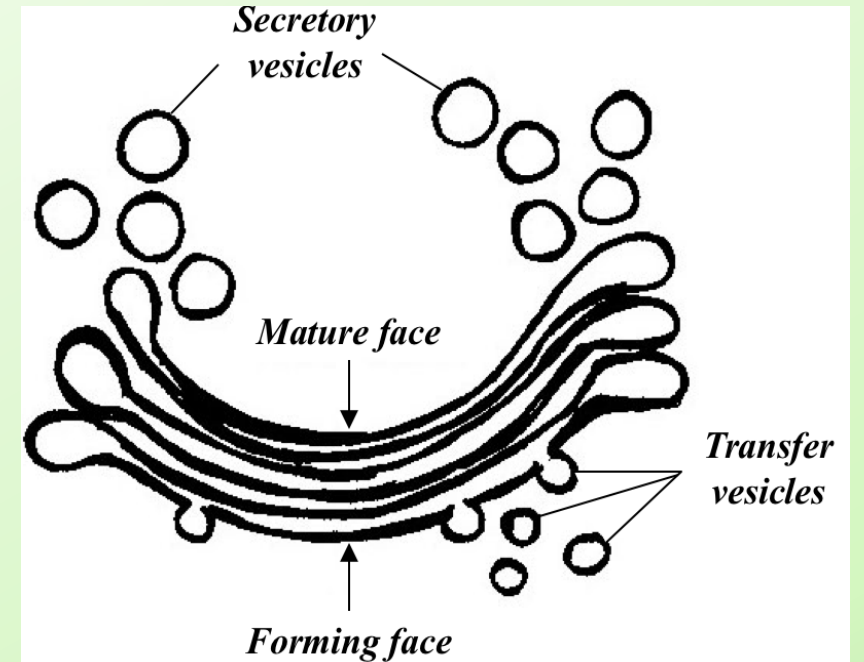


Golgi Apparatus

- The secretory apparatus of the cell.
- Consists of stacked saucer-shaped flattened vesicles.
- Each vesicle has two faces:
Convex (forming) face, receives transfer vesicles.
Concave (mature) face, forms secretory vesicles.

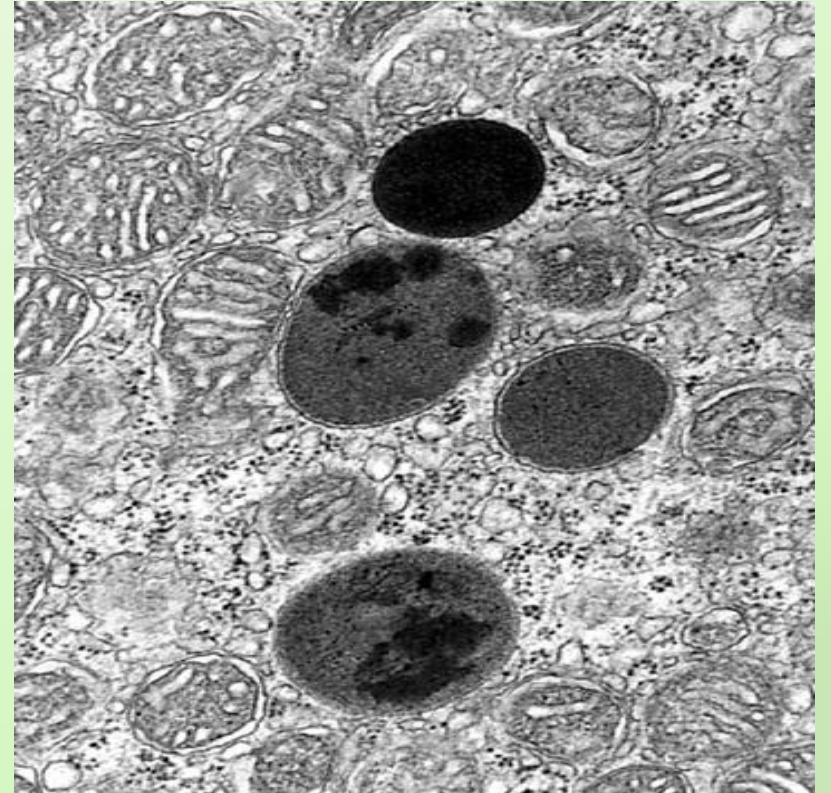
Functions:

1. Sorting, modification & packaging of proteins.
2. Secretory vesicles formation.
3. Formation of lysosomes.



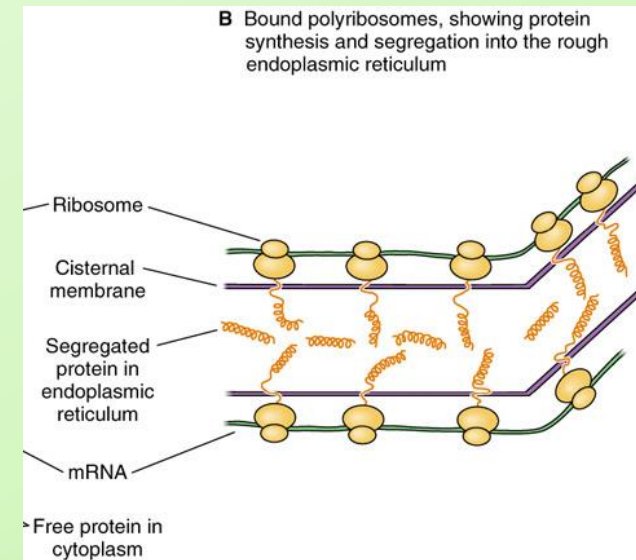
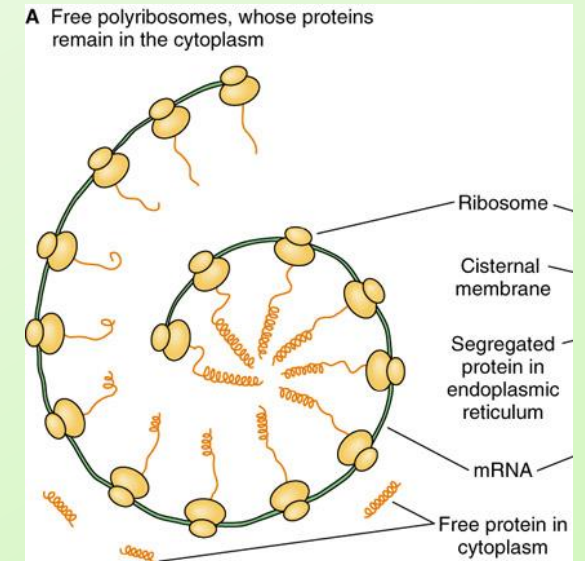
Lysosomes

- 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.



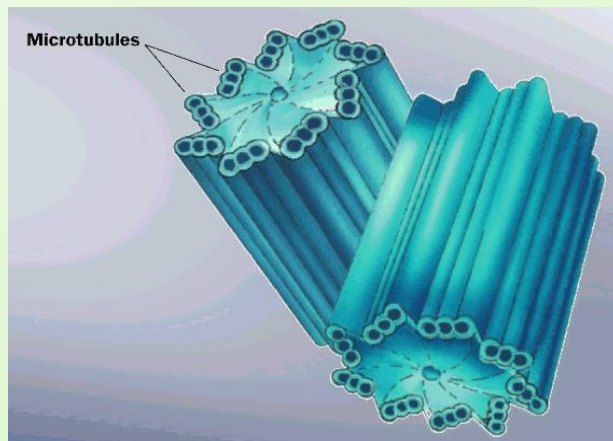
Ribosomes

- **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



Centrioles

- **2 cylinders**, perpendicular to each other.
 - Wall is made of 9 triplets of microtubules, i.e. **27 microtubules**.
- ❖ **Functions:**
- 1- Essential for **cell division**.
 - 2- Formation of **cilia and flagella**.



Microtubules-Containing Organelles

1. **Centrioles:**

2. **Cilia:**

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**.

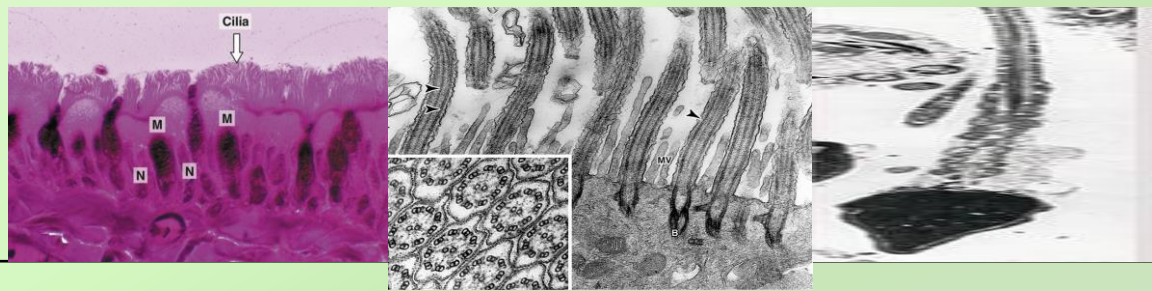
❖ **Function:** movement of particles or fluids on the free surface of the cell in one direction.

3. **Flagella:**

Longer and larger than cilia.

Form the tails of sperms.

❖ **Function:** important for movement of the sperms.



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 induced by deficiency of dynein.*
- *Dynein protein is responsible for movements of cilia and flagella.*

Cytoskeleton

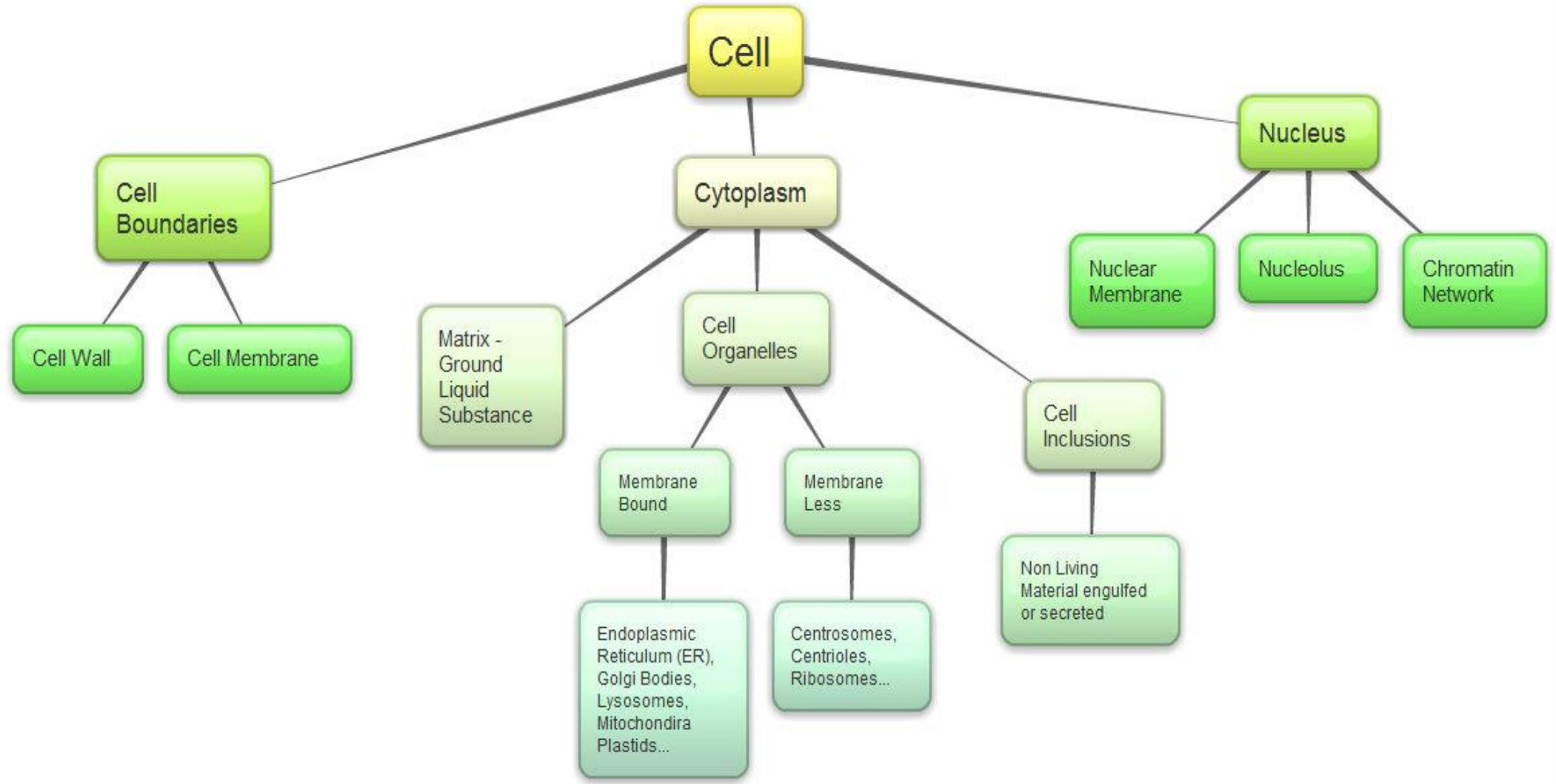
It is the structural skeleton of the cell.

❖ Functions:

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

❖ Consists of:

- *Microfilaments (**actin**).*
- *Intermediate filaments, e.g. **Keratin**.*
- *Microtubules.*



References:

- Cell organelles
 - <https://youtu.be/URUJD5NEXC8>
- Cell junctions :
 1. <https://www.youtube.com/watch?v=YwpDA4drn8&feature=share>
 2. https://youtu.be/pVWQm-GYK_Y
- Centrioles , cilia and flagella
 - <https://youtu.be/5D5Jt7NZB8I>
- Euchromatin and Heterochromatin
 - <https://youtu.be/5D5Jt7NZB8I>
- Microvilli
 - <https://youtu.be/hPyn-Gym5XE>

THANK YOU !

“Some people dream of success while others wake up and work hard at it”

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