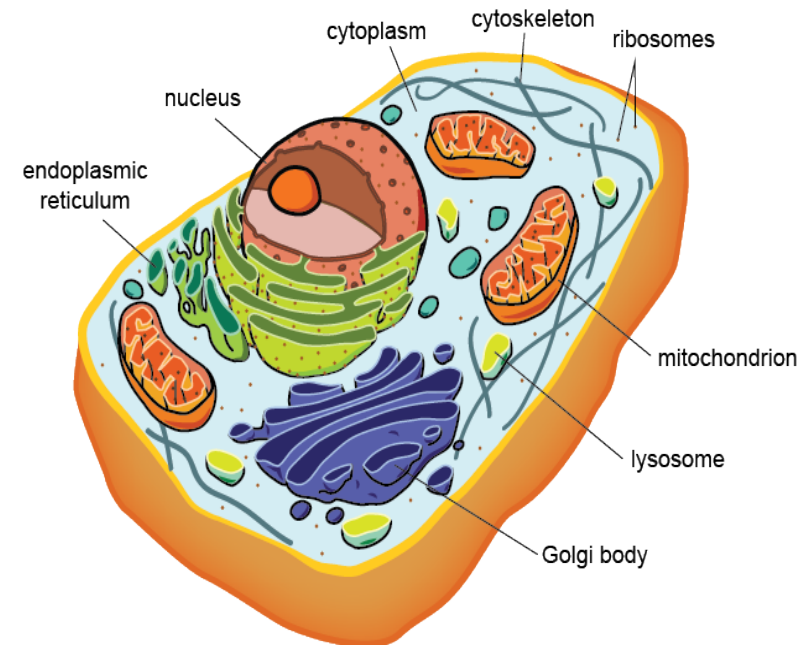


Introduction to Histology and Cell Structure

OBJECTIVES:

- What is histology and how it is studied?
- Composition of the cell and function of each component:
 - Nucleus.
 - Cytoplasm:
 - Organelles: membranous and non-membranous.
 - Inclusions.



Color Index:

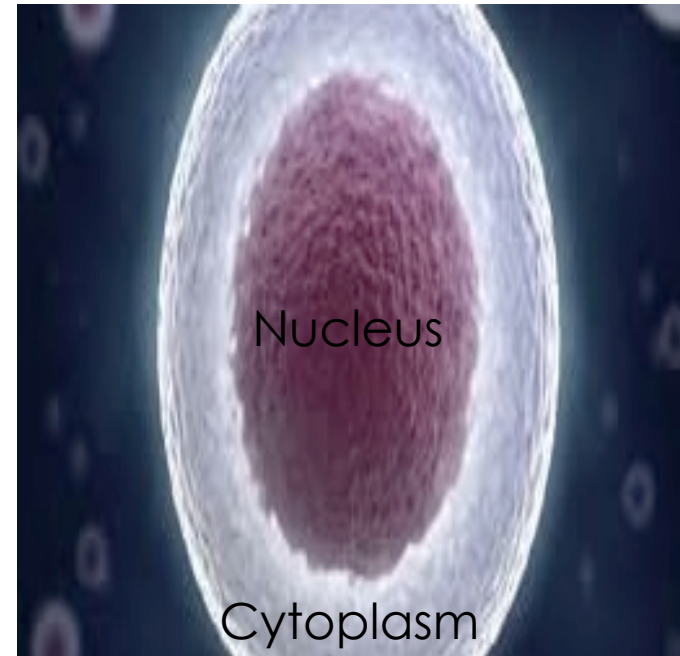
Red = Important Notes Orange = Further Explanation Purple = Additional Notes

INTRODUCTION

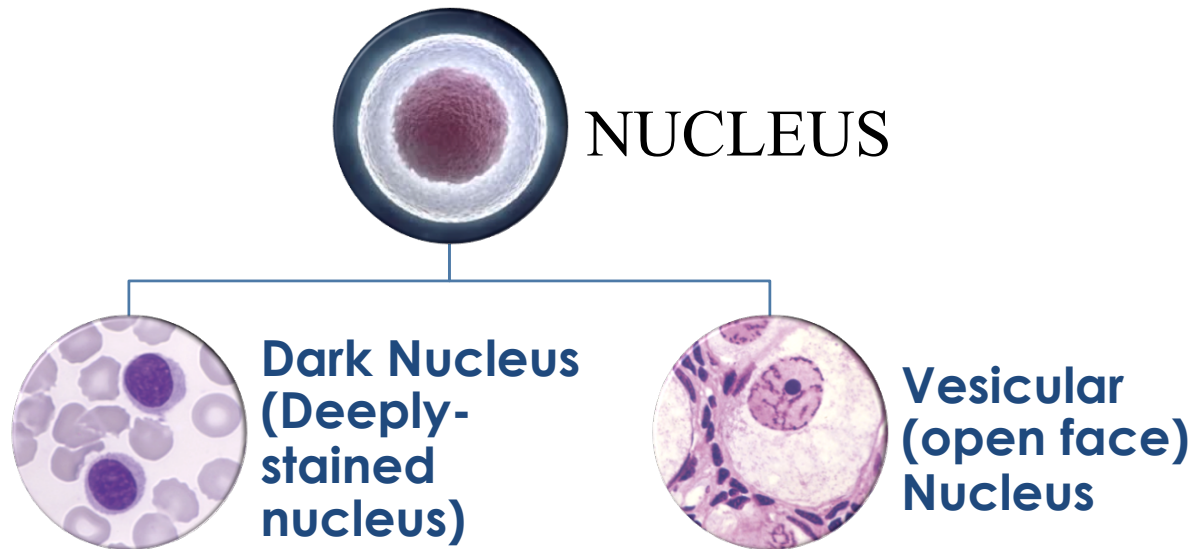
- ▣ Histology is the science dealing with the microscopic study of normal tissues and organs.
- ▣ Organs are made of tissues and tissues are made of cells.
- ▣ Types of Microscopes:
 - 1- Light microscope (LM).
 - 2- Electron Microscope (EM).
- ▣ Thin sections are cut and mounted on glass slides. Sections are stained with **Hematoxylin (H)** and **Eosin (E)**.
- ▣ H is a basic stain while E is an acidic stain. Structures that accept the blue colour of H are called basophilic, while those that accept the red colour of E are acidophilic. Nuclei are always basophilic, while the cytoplasm may be acidophilic or basophilic, according to cell activity.

The Cell

- It Is the **structural & functional unit** of all living tissues.
- Cells have **different shapes & sizes**.
- THE CELL is made of:
 - **Nucleus**
 - **Cytoplasm**



Nucleus

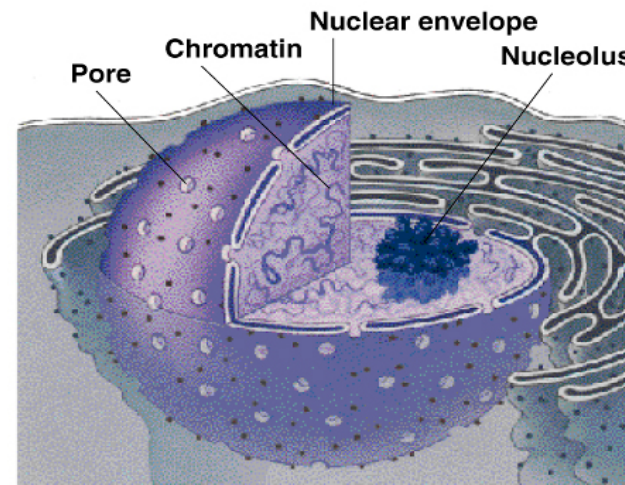


Function:

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

■ Formed of:

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



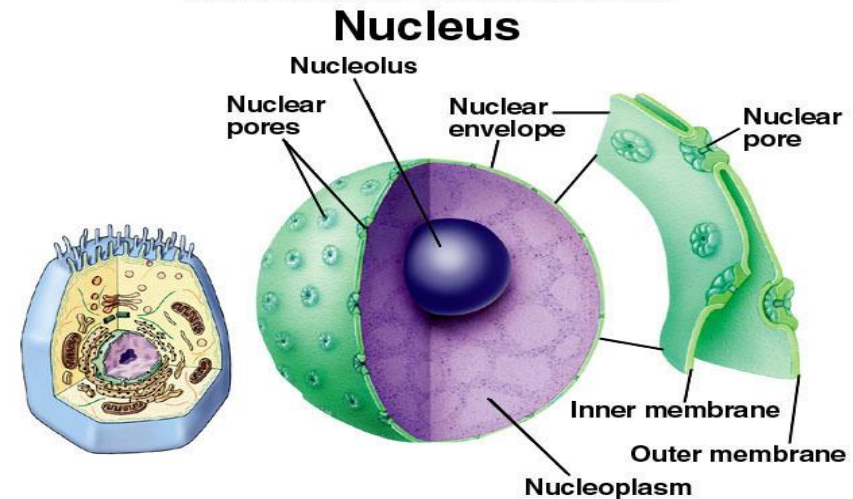
©Addison Wesley Longman, Inc.

1- Nuclear Envelope

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A double membrane with many pores.

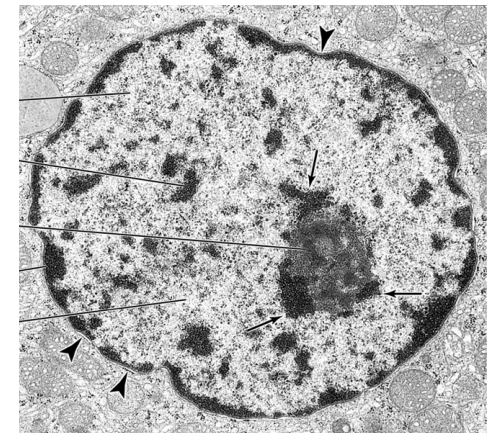
- Outer membrane.**
- Inner membrane.**
- Nuclear pores:** provide communication between nucleus and cytoplasm.



2- Nucleolus

- Through EM (electron microscope) It is mostly dark mass (electron-dense) **not surrounded by a membrane.**
- Through LM It is a spherical dark **basophilic** mass.
- Usually one.

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



3- Chromatin

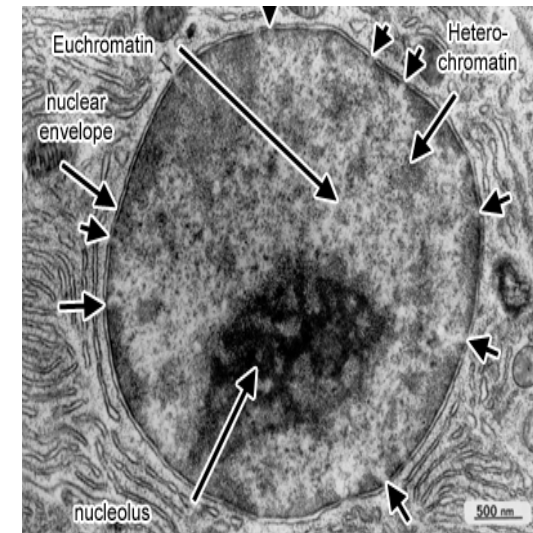
- Chromatin material is formed mainly of DNA, which contains the code of genetic information.
- Chromatin has two forms :
 - 1) **Euchromatin:**
extended or active and It appears pale(**electron-lucent areas**).
 - 2) **Heterochromatin**
condensed or inactive, It is dark (**electron dense areas**).

Function:

Carries genetic information

Directs protein synthesis.

- via the formation of the 3 types of RNA (ribosomal rRNA, messenger mRNA, and transfer tRNA)

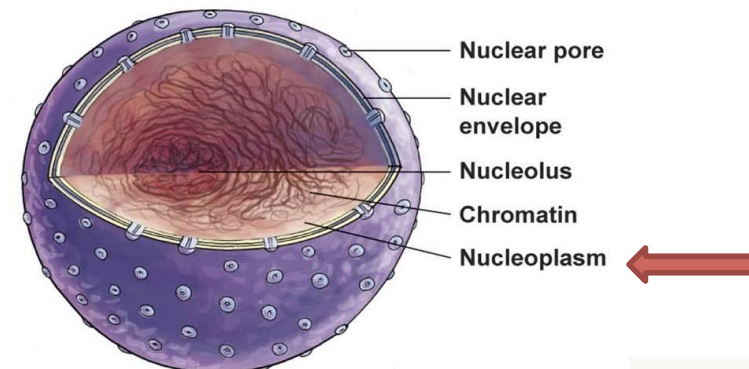


4- Nucleoplasm

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

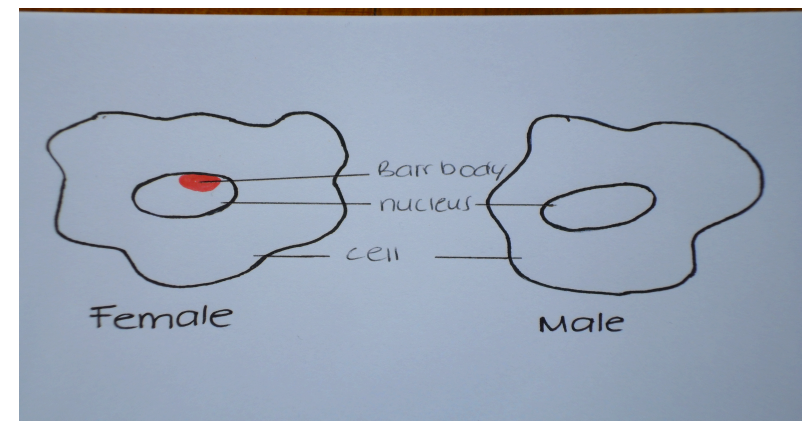
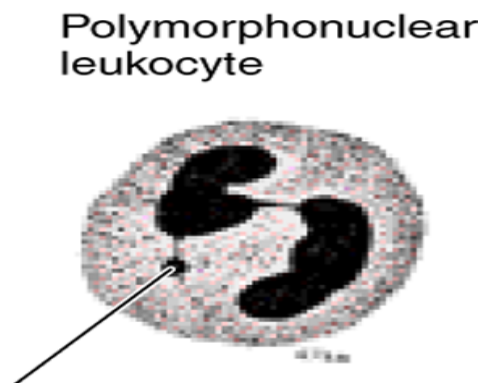
Function:

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

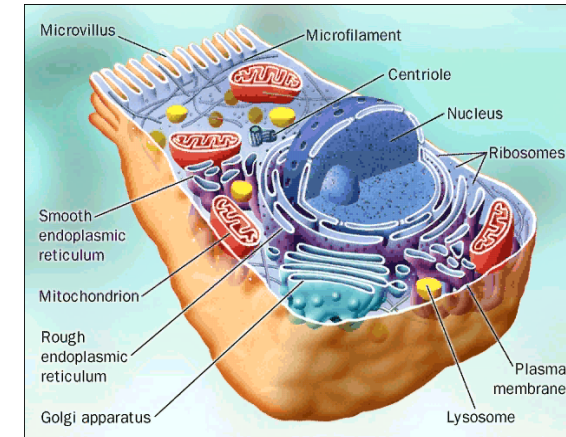


Cytoplasm

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.

Note: It is IMPORTANT to know the difference between Organelles and Inclusions



Cytoplasmic Organelles	
Membranous	Non-Membranous
Cell Membrane	Ribosomes
Mitochondria	Centrioles
Endoplasmic Reticulum	Cilia & Flagella
Golgi Apparatus	Filaments
Lysosomes	Cytoskeleton
Secretory Vesicles	

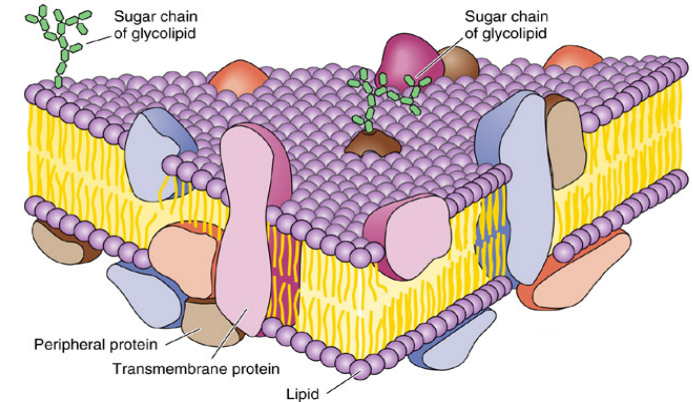
Cell Membrane

A very thin membrane that surrounds the cell. Acts as a **Selective Barrier**

LM: Not visible.

EM: appear as **trilaminar appearance** 2 dark lines (electron dense), separated by a light one (electron-lucent).

The Cell Membranes is Made of



Phospholipids Components

- It consists of Phospholipid molecules arranged into 2 layers (bilipid layer). Each molecule has a head and a tail.

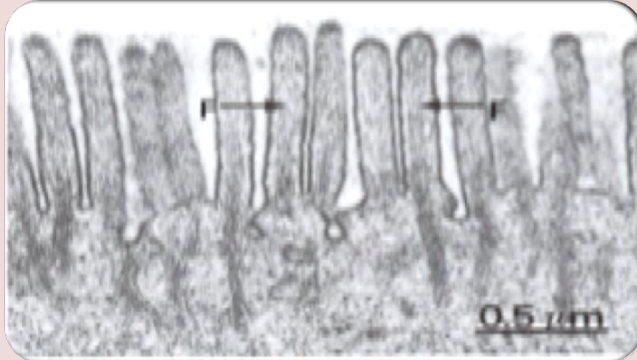
Protein Components

- It consists of:
 - **a) Peripheral protein:** It is formed of loosely attached protein molecules, found on both surfaces of the cell membrane.
 - **b) Integral protein:** It protein molecules, that span the entire lipid bilayer (transmembrane protein)

Carbohydrates Components

- It consists of short chains of polysaccharides conjugated with either proteins or lipids of the external surface of the cell membrane (glycoproteins and glycolipids), forming the surface coat (Glycocalyx) that has the FUNCTION of
 - Protection of the cell
 - Cell recognition and adhesion

Cell Membrane

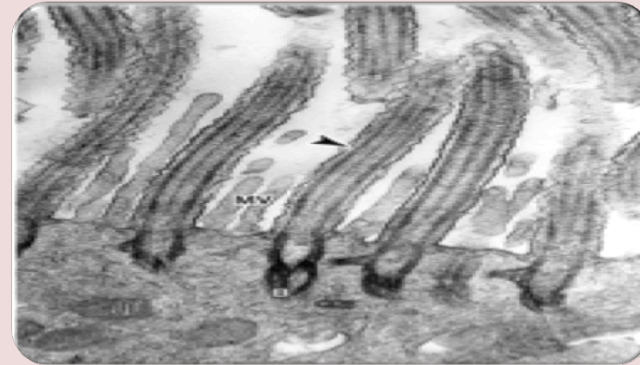


Microvilli

visible in EM, and brush border in the LM)

Cylindrical cytoplasmic projections of apical surface to increase surface area.

Their core contains actin filaments (microfilaments).



Cilia

Long motile hair-like structures surrounded by cell membrane.

Their core is formed of microtubules.

Note: Doctor skiped Intercellular Junctions so it is not that important.

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.**

Function:

1) Generation of ATP

“ they are called the power house “

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

because they have their own DNA

Mitochondria Structural Features

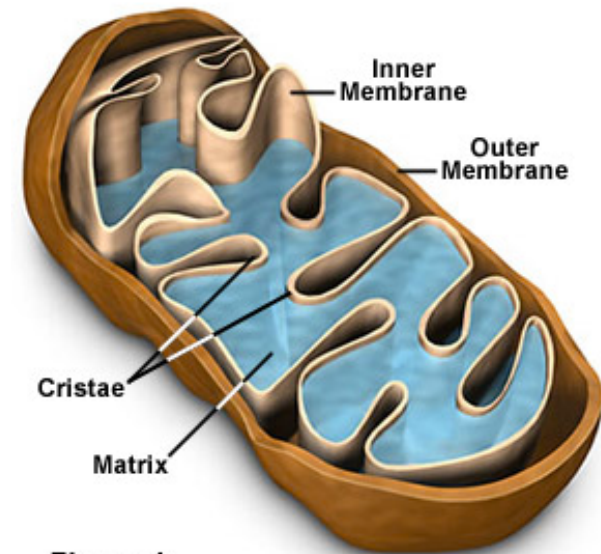


Figure 1

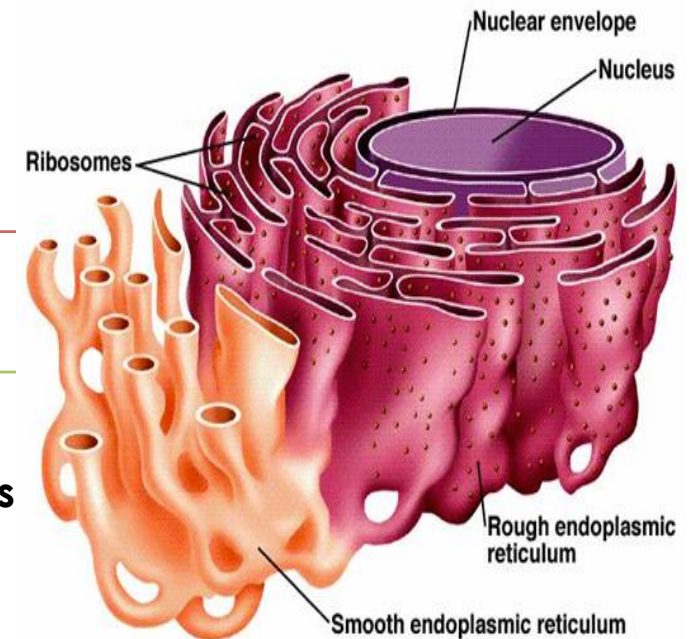
Endoplasmic Reticulum

Rough Endoplasmic Reticulum

- **Membranous sheets of flattened tubules & vesicles with ribosomes on the surface.**
- **Functions:**
 - Synthesis of proteins by ribosomes on its outer surface.
 - Transfer vesicles transfer the formed protein to Golgi.
 - It produces the enzymes of the lysosome

Smooth Endoplasmic Reticulum

- **Membranous tubules and vesicles, with **no** ribosomes on the surface**
- **Functions:**
 - Synthesis of lipids & cholesterol
 - Synthesis of Steroid hormones. E.g. Cortisol
 - Helps muscle contraction by acting as a calcium pump
 - Detoxification from drugs and toxins

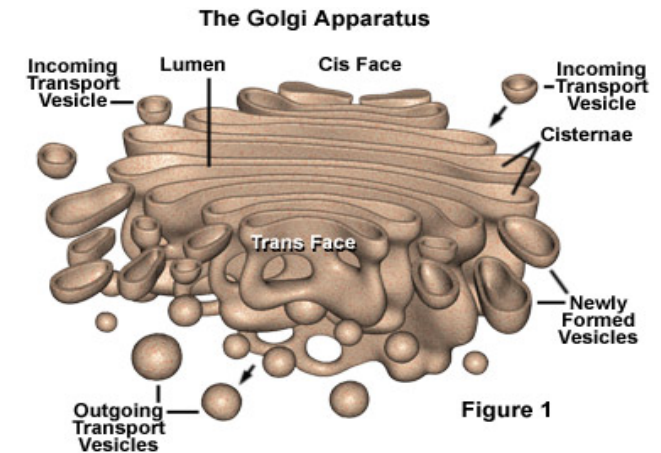


Golgi Aparatus

- **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

Function:

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

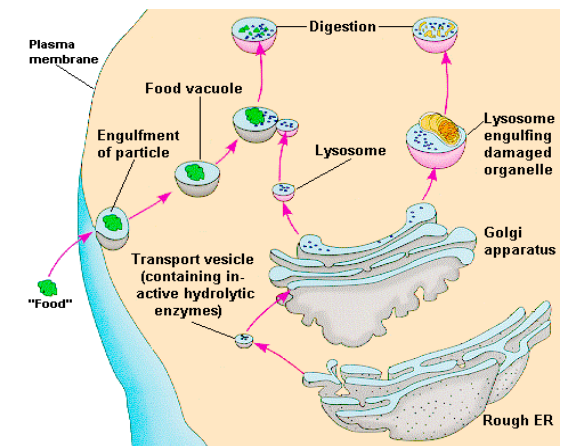


Lysosomes

- The digestive apparatus of the cell.
- Under Electronmicroscope: 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



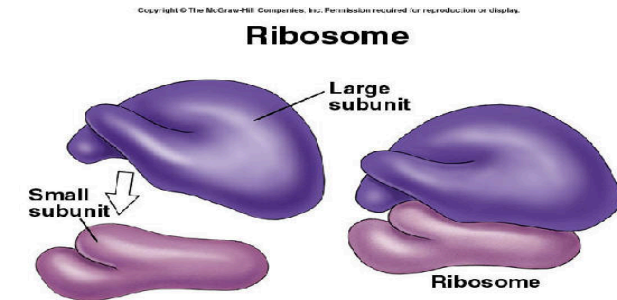
Ribosomes

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.



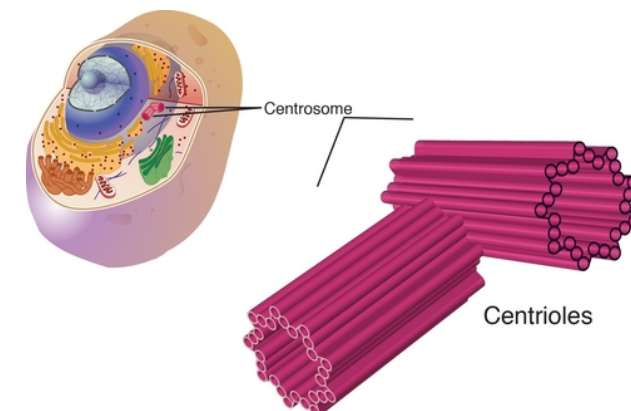
Function:
Protein Synthesis

Centrioles

- **2 cylinders**, perpendicular to each other.
- Wall is made of **9 triplets** of microtubules, i.e. **27 microtubules**.

Function:

- 1- Essential for cell division
- 2- Formation of **Cilia** & **Flagella**



Microtubules

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:

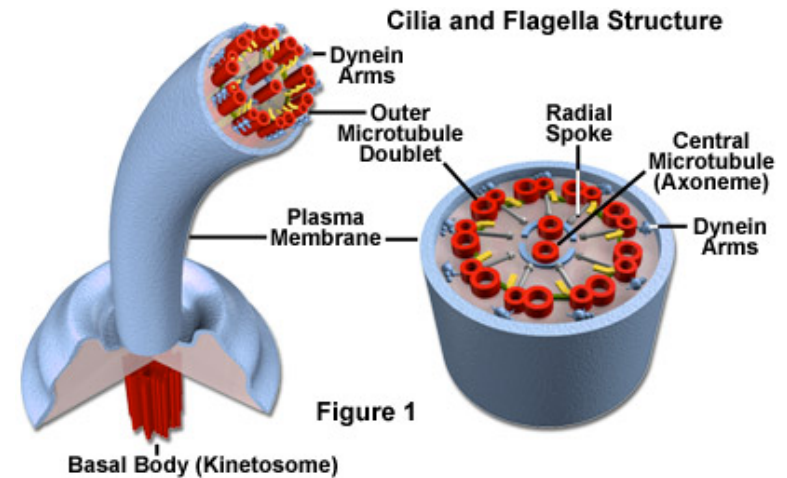
Movement of particles or fluids on the free surface of the cell in one direction

Flagella:

- Longer and larger than cilia.
- Form the tails of sperms.

Function:

important for movement of the sperms".



Cytoskeleton

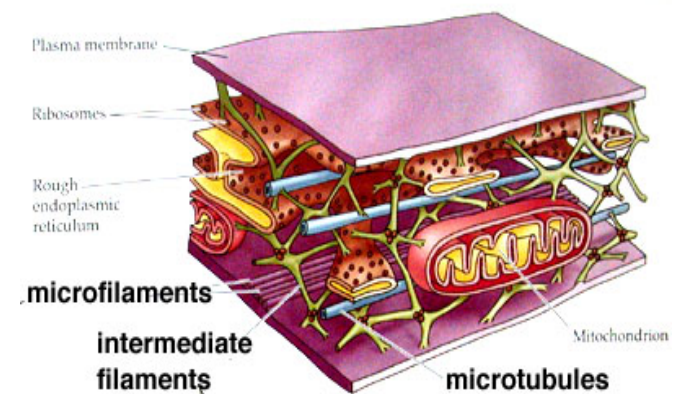
It is the structural skeleton of the cell.

Consists of:

- 1- Microfilaments (actin).
- 2- Intermediate filaments, e.g. Keratin.
- 3- Microtubules.

Function:

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



Clinical Application

Immotile Cilia Syndrome:

(cilia cannot move)

- 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.

Summary

- **Histology is the microscopic study of normal tissues.**
- **The cell is the structural & functional unit of all living tissues.**
- **Cells are made of organelles and each organelle has its own function .**
- **We can see the bar bodies just in females or males with Klinefelter's syndrome.**
- **Organelles is subdivided into two membranous and non-membranous.**

MCQ's

1) Which one of the organelles has 9 doublets of microtubules:

- a) Cilia
- b) Mitochondria
- c) Centrioles
- d) lysosome

2) Euchromatin appears pale which is electron dense areas:

- a) True
- b) False

3) Under the light microscope we can see that ribosomes is made of 2 subunits :

- a) True
- b) False



Thank you for checking our work...

▣ Done By:

- Moath Al Eisa
- Amal Afrah
- Ouf Al-Oufi
- Rawa Al-Ohali

▣ MOTIVATION CORNER:

The past is behind, learn from it. The future is ahead, prepare for it. The present is here, LIVE IT. – Thomas S. Monson

For any correction, suggestion or any useful information do not hesitate to contact us: **Histology434@gmail.com**