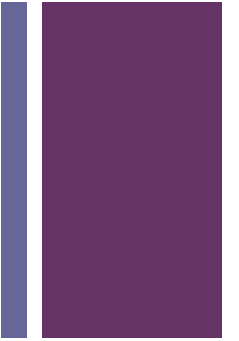




# Introduction to Histology and Cell Structure



# Objectives:



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

# + Introduction

**Histology:** it is the microscopic study of normal tissue.

**Types of microscopes:**

- Light Microscope (LM) image appears colored
- Electron Microscope (EM) image appears black & white

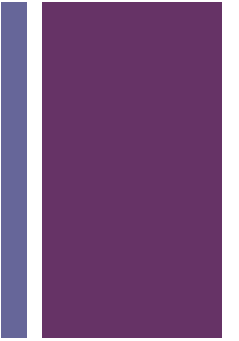
Cells → Tissues → Organs → Systems

Basophilic: Appears **Blue**

Acidophilic: Appears **Red**

**\*nucleus is always basophilic**

**\*cytoplasm could be basophilic OR acidophilic**





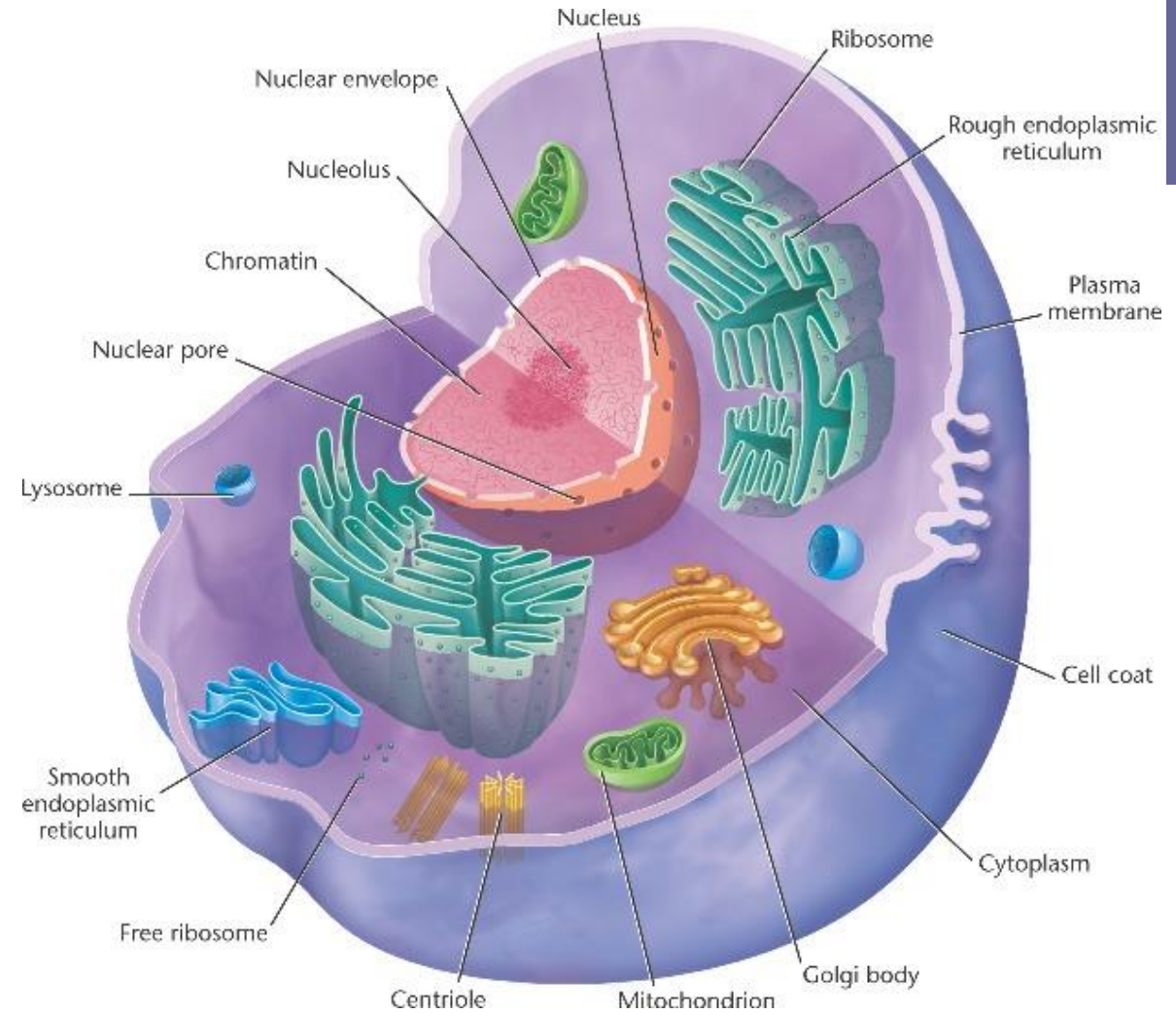
# Cell

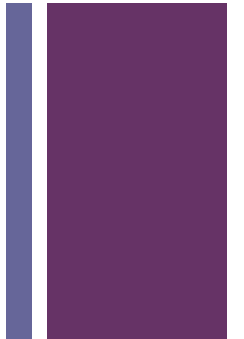
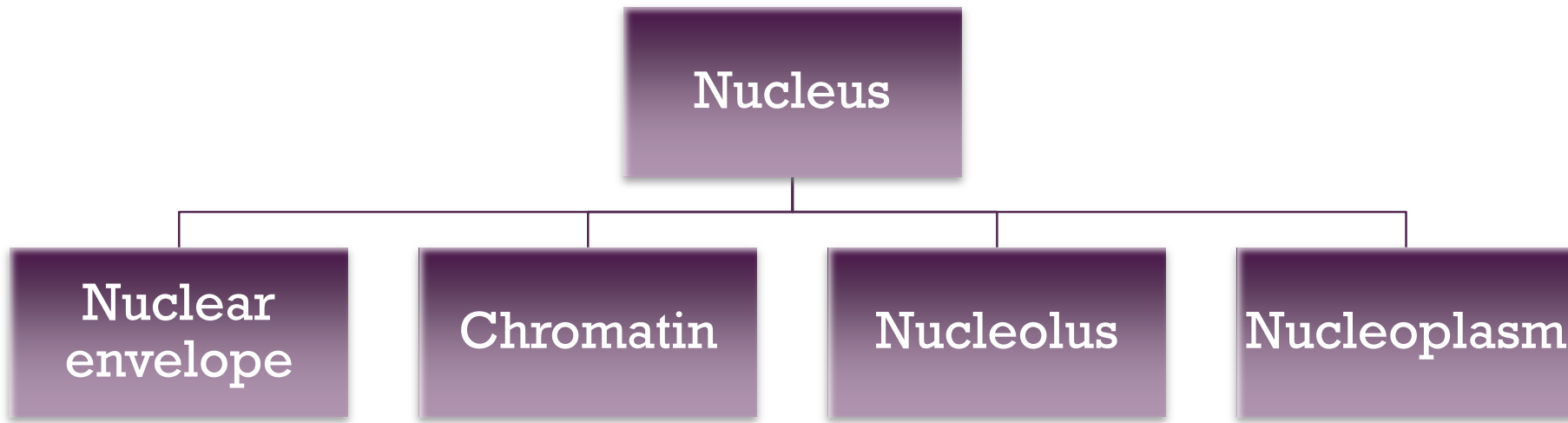
It is the functional unit of all tissue.

It differs in size and shape.

The cell is formed of

- 1) Nucleus
- 2) Cytoplasm





### **FUNCTION of the Nucleus:**

- Essential for vitality and division of the cell
- The site of storage of genetic material
- The site of formation of the 3 RNAs (mRNA, rRna, tRNA)

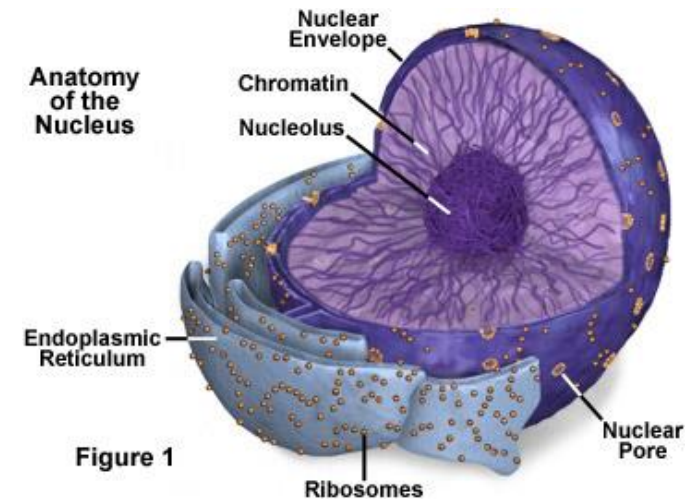
### Nuclear Envelope:

Double membrane with pores

- Outer Membrane
- Inner Membrane
- Nuclear Pores

### **FUNCTION of the Nuclear Envelope:**

- Provides communication between nucleus and cytoplasm



**Chromatin:**  
Formed of DNA

- a. Euchromatin: Extended, active, pale.
- b. Heterochromatin: Condensed, inactive, dense.

**FUNCTIONS of Chromatin:**

- Carries genetic information.
- Directs protein synthesis

**FUNCTIONS of the Nucleolus:**

- Formation of rRNA which is responsible for protein synthesis in cytoplasm

**Nucleolus:**(usually one)

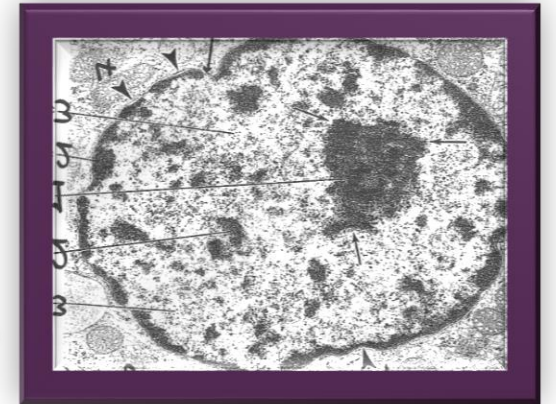
- EM: Appears as a dark mass, not surrounded by a membrane.
- LM: Appears as a spherical dark basophilic mass.

**FUNCTIONS of the Nucleoplasm:**

- Provides medium for movement of the 3 types of RNA from the nucleus to the cytoplasm

**Nucleoplasm:**

- Clear fluid medium
- contents of the nucleus are embedded in it.



# + Sex Chromatin (Barr Body)

Dark stained mass of chromatin, usually adherent to the inner aspect of the nuclear envelope of the female somatic cells.

**Example: Buccal epithelial cells**

## Characteristics:

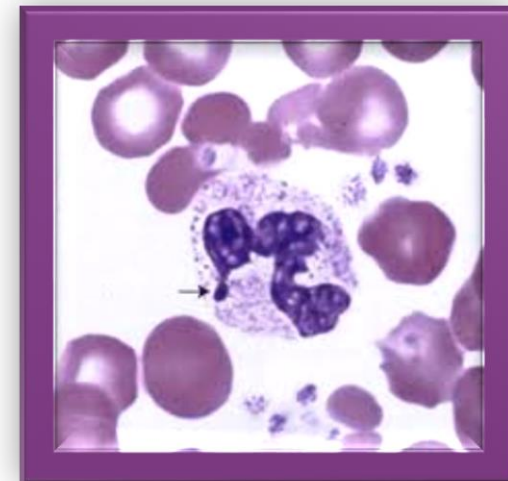
-Drum stick mass protruding from the nucleus of neutrophils

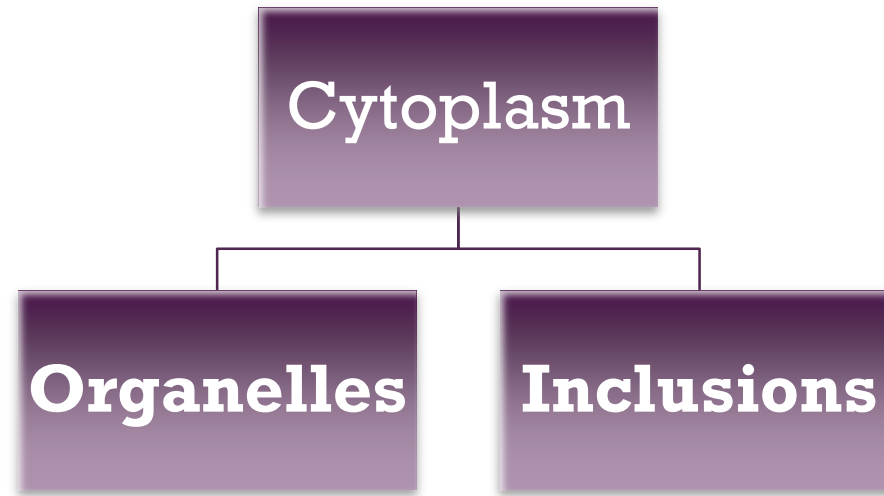
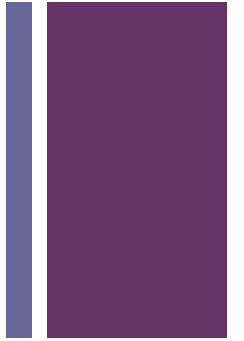
📖 Represents one of the two X chromosomes which is inactive in normal female.

📖 Seen in normal female cells

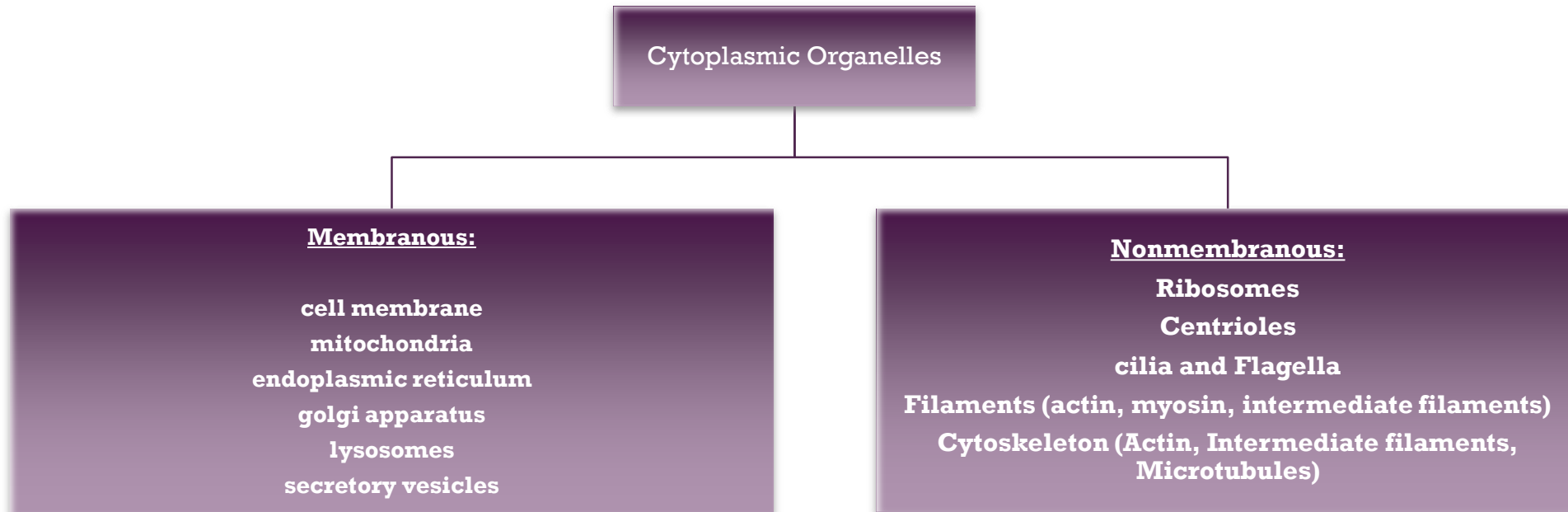
📖 **Absent in females with Turner's Syndrome (X0)**

📖 **Seen in males with Klinefelter's Syndrome (XXY)**





**Organelles:** Specialized structures essential for vital process of the cell.

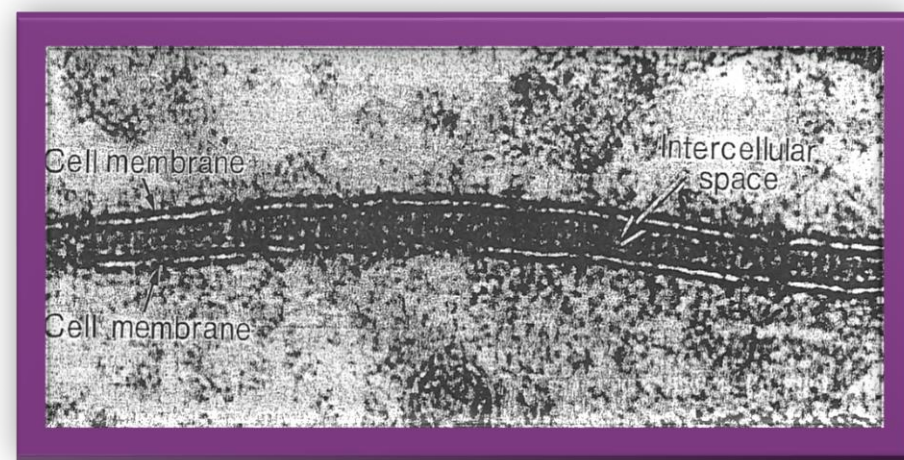




**Inclusions:** Not essential for cells vitality, may be present or absent.

**examples:**

- lipids
- glycogen
- pigments (melanin and lipofuscin)



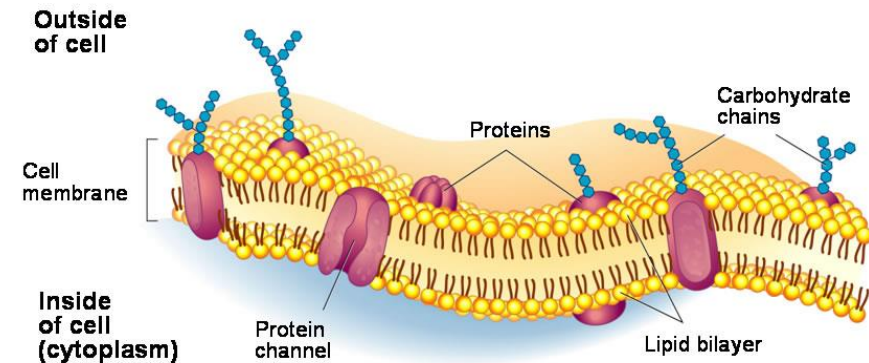
**Cell membrane:** A very thin membrane surrounding the cell.

\*how it appears under:

LM (Light Microscope)	EM (Electron Microscope)
Not visible	2 dark lines separated by a light line. (Trilaminar appearance)

**FUNCTION of The CM:**

- 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) and forming the surface or cell coat.

**FUNCTION of Cell Coat:**

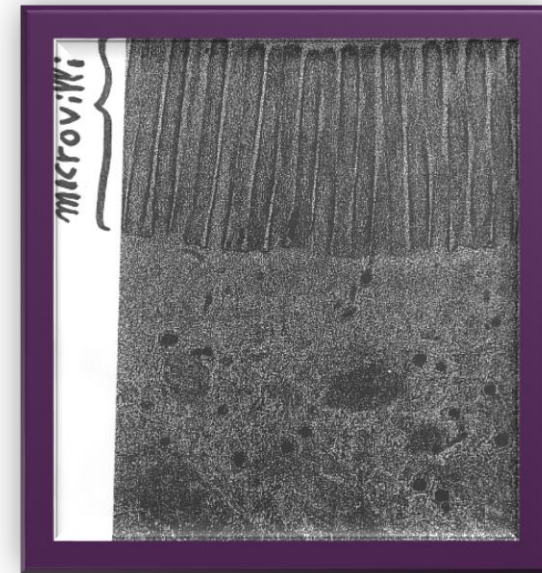
- Protection of the cell.
- Cell recognition and adhesion.

# + Cell Membrane: (continued)

## Specialization of cell membrane:

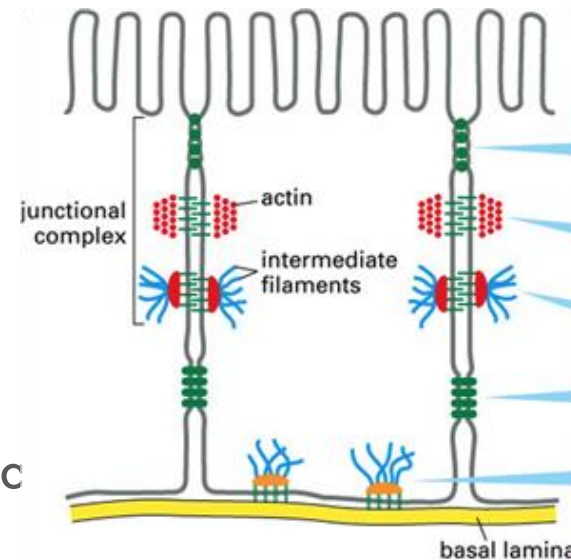
**Cilia:** Long motile hair-like structures surrounded by cell membrane. **Their core is made of microtubules.**

**Microvilli (brush border):** Cylindrical cytoplasmic projections of apical surface to increase surface area. **Their core contains actin filaments.**



## Intercellular junctions: composed of:

- 📖 Occluding (tight) junction: seals the intercellular space.
- 📖 Adhering junction: fixes adjacent cells together
- 📖 Gap junction: Allows free communication between the c



name	function
tight junction	seals neighboring cells together in an epithelial sheet to prevent leakage of molecules between them
adherens junction	joins an actin bundle in one cell to a similar bundle in a neighboring cell
desmosome	joins the intermediate filaments in one cell to those in a neighbor
gap junction	allows the passage of small water-soluble ions and molecules
hemidesmosome	anchors intermediate filaments in a cell to the basal lamina

NOTE:  
When a combination of occluding and adhering junctions (zonula and desmosome adhering junctions) is present, it is called a Junctional Complex.



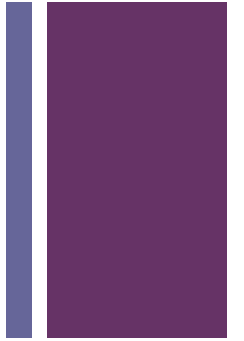
**Mitochondria:** Rod-shaped. Its wall is composed of 2 membranes, the outer is smooth while the inner is folded, **these folds form Cristae**

The cavity is filled with mitochondrial matrix, which contains enzymes and its own DNA



**Functions:**

- Generates ATP (the source of cell's energy)
- They're called the powerhouse of the cell
- It forms its own proteins and undergo self replication





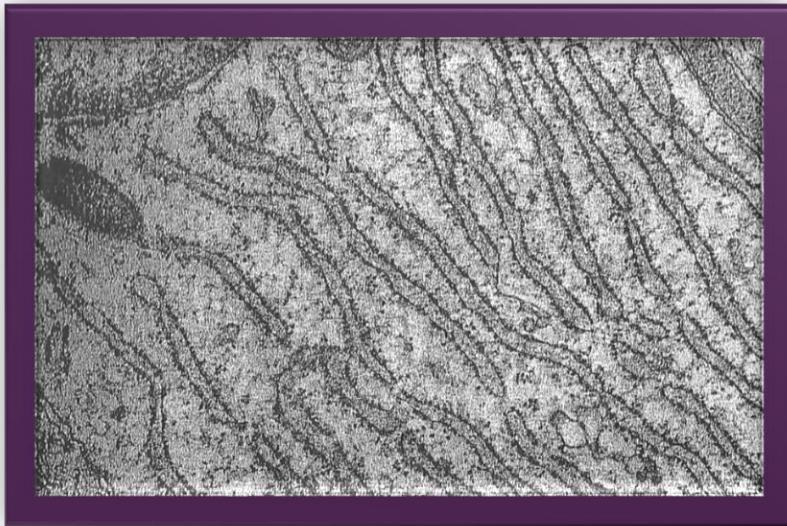
## Endoplasmic Reticulum (ER):

System of communicating membranous tubules, vesicles and flat vesicles (cisternae)

**Rough ER:** Membranous sheets of flat tubules and vesicles with ribosomes on the surface

### Functions:

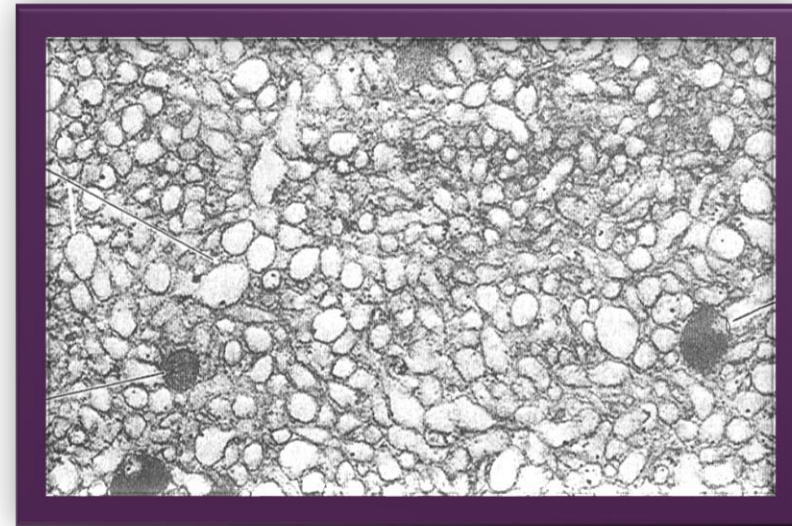
- Synthesis of protein by ribosomes
- Transfer vesicles that transfer protein to golgi



**Smooth ER:** Membranous tubules and vesicles with NO ribosomes on the surface

### Functions:

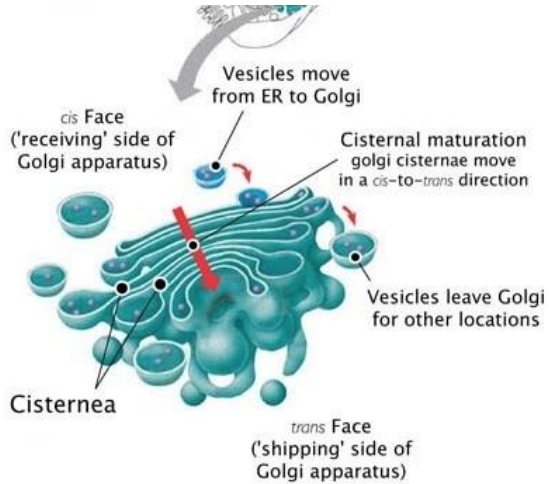
- Synthesis of lipids, cholesterol and steroids
- Detoxification
- Helps muscles contracting by acting as calcium pump





## **Golgi Apparatus:** The secretory apparatus of the cell.

Consists of stacked saucer shaped flat vesicles



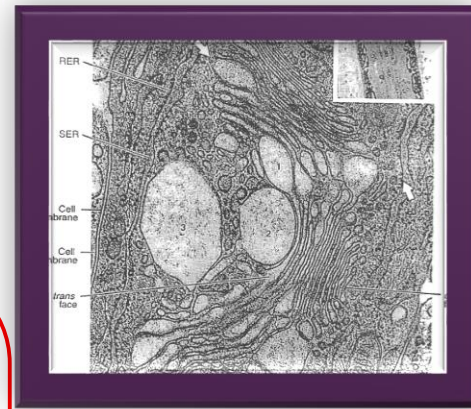
Each vesicle has two faces:

**Convex:** (forming face) that receives transfer vesicles

**Concave:** (mature face) that forms secretory vesicles

### **FUNCTIONS of Golgi Apparatus:**

- sorting, modification and packing of proteins
- secretory vesicles formation
- formation of lysosomes



## **Lysosomes:**

The digestive apparatus of the cell.

Contains hydrolytic enzymes.

Originates from the mature surface of Golgi (Hydrolytic enzymes are formed in rough ER)

Appearance: EM > Spherical membranous vesicles

### **FUNCTIONS of Lysosomes:**

- Intracellular digestion of ingested materials or old organelles.



## Ribosomes:

Consist of ribosomal RNA combined with protein.

Formed in the nucleolus

### Function:

Protein synthesis

### Appearance:

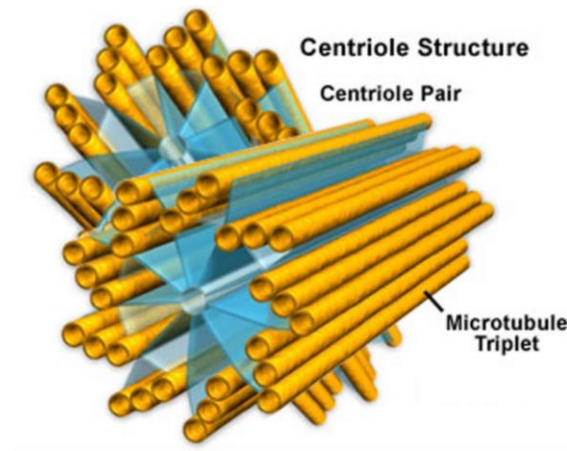
- EM > 2 subunits that are free in the cytoplasm (may form polyribosome)
- LM > Basophilic cytoplasm due to numerous ribosomes

## Centrioles:

2 cylinders which are perpendicular to each other.

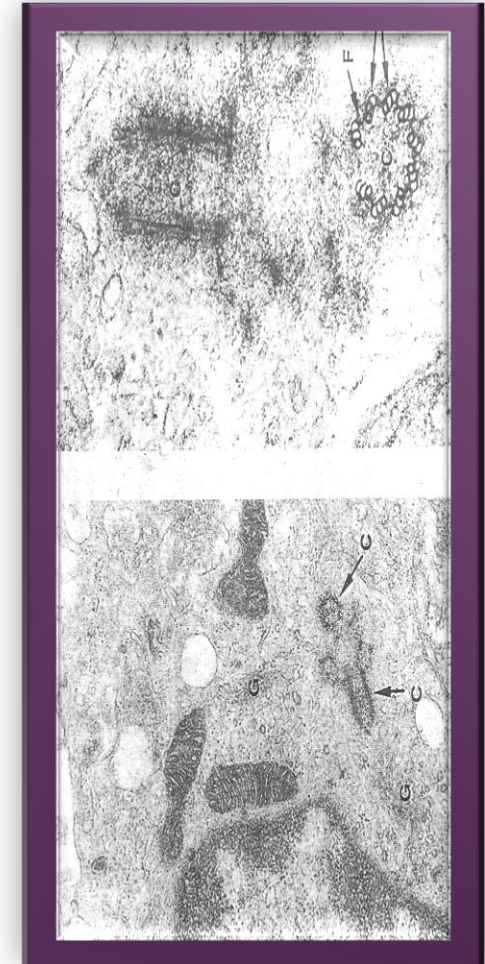
Their wall is made of 9 triplets of microtubules

( $9 \times 3 = 27$  microtubules)



### Function:

- Essential for cell division
- Formation of cilia and flagella





# Cilia and Flagella

## Cilia:

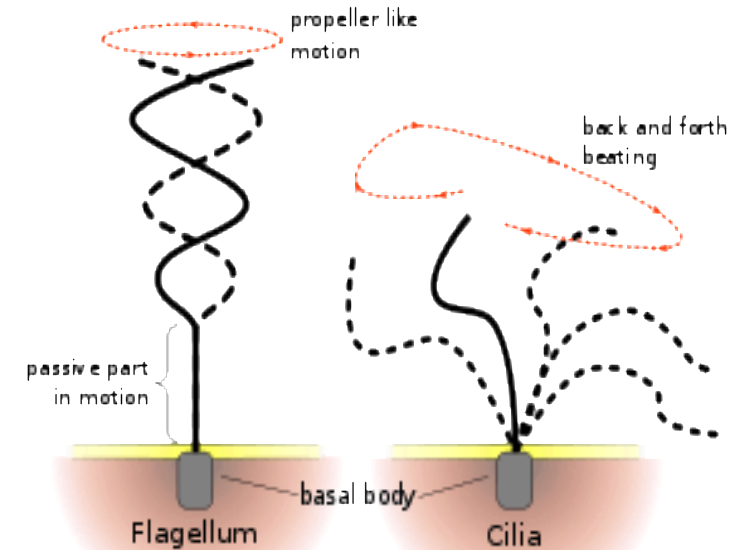
- hair like striations on the free surface of some cells. (basal body is similar to centriole)
- **Shaft form of 9 doublets and 2 central singlets of microtubules** ( $9 \times 2 + 2 = 20$ )

**Function:** Movement of particles or fluids on the cell's free surface in one direction

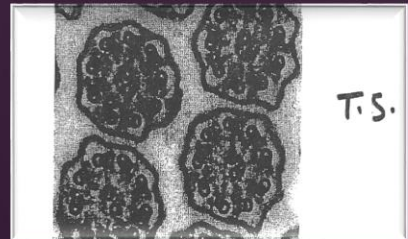
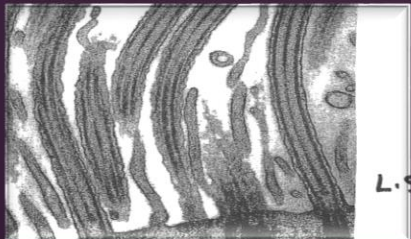
## Flagella:

- Longer and larger than Cilia
- Forms the tails of sperm

**Function:** Important for movement of the sperm



**Centrioles, Cilia and Flagella are all microtubules-containing organelles**





# Cytoskeleton:

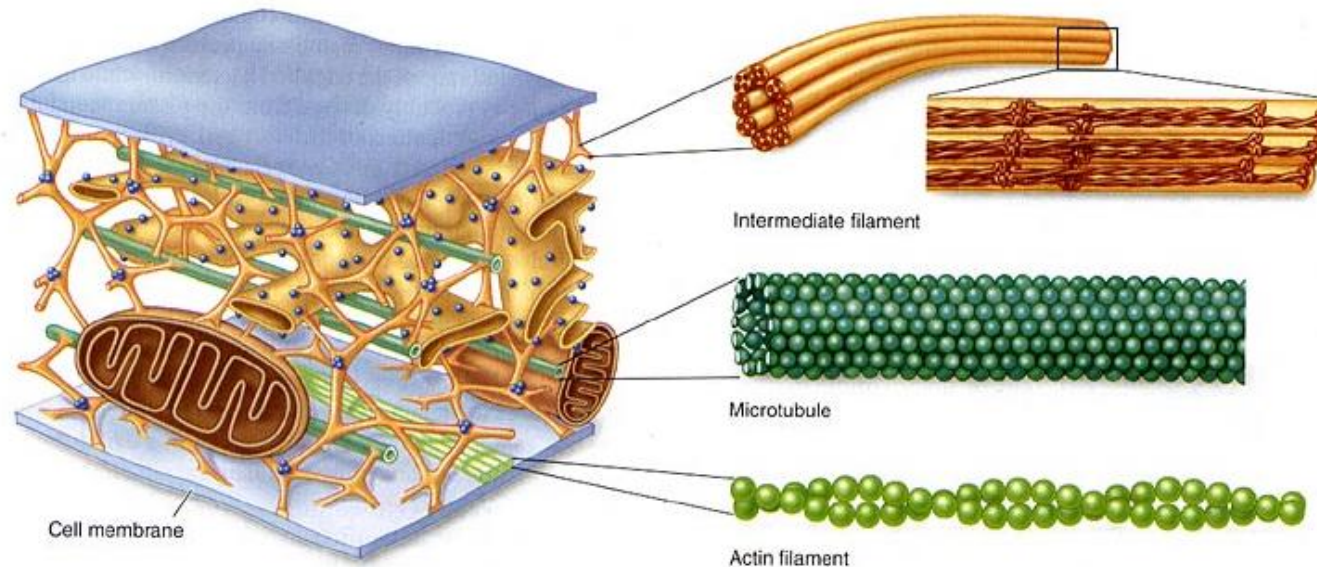
- The structural skeleton of the cell

## Functions:

- Maintaining the cell's shape
- Helps transport materials within the cell

## Consists of:

- Microfilaments
- Microtubules
- Intermediate filaments







# H & E Stains

## H:

**If the structure turns blue:**  
The structure is BASOPHILIC

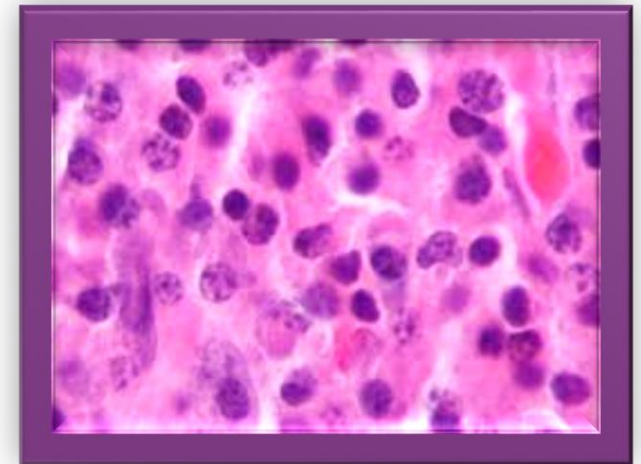
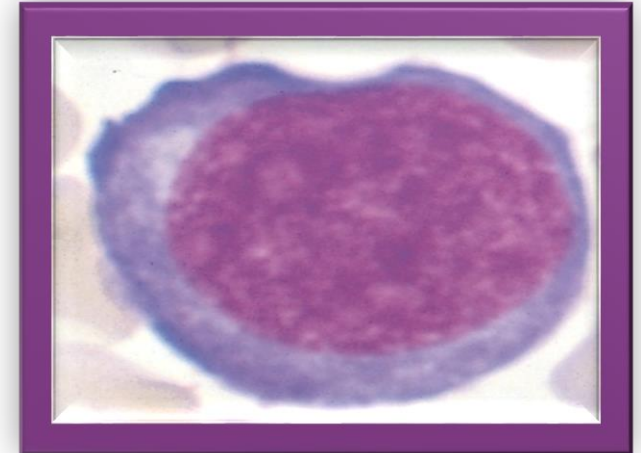
**If nothing happen:**  
The structure is not basophilic

## E:

**If the structure turns red:**  
The structure is ACIDOPHILIC

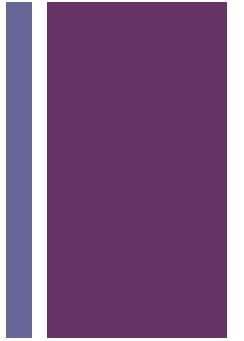
**If nothing happens:**  
The structure is not acidophilic

- The sections are cut and mounted on glass slides
- The sections are then stained with **Hematoxylin(H)** and **Eosin(E)**
- H > Basic stain > If the structure reacts with H it turns **blue** > **Basophilic**
- E > Acidic stain > If the structure reacts with E it turns **red** > **Acidophilic**





# Extra Links



## ■ Videos:

- Cell Organelles  
[https://www.youtube.com/watch?v=fKEaTt9heNM&feature=iv&src\\_vid=Lp7xAr2FDFU&annotation\\_id=annotation\\_219283](https://www.youtube.com/watch?v=fKEaTt9heNM&feature=iv&src_vid=Lp7xAr2FDFU&annotation_id=annotation_219283)
- EUCHROMATIN and HETEROCHROMATIN (forward 50 seconds)  
<https://www.youtube.com/watch?v=sUFLjHCc8bY>
- Intracellular Junctions  
<https://www.youtube.com/watch?v=mbiM-y7k6Ok>

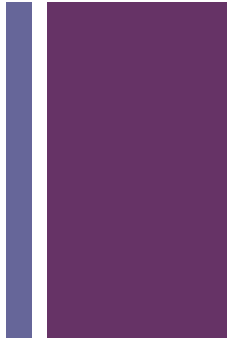
## Quiz:

<https://www.onlinequizcreator.com/histology/quiz-114735>

**Study while others are sleeping**  
**Work while others are loafing**  
**Prepare while others are playing**  
**DREAM while others are wishing**



# Credit



## TEAM MEMBERS:

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- Shadn Alomran
- Shahad Albeshr
- Sadeem Alqahtani
- Nouf Alabdulkarim
- Muneerah AlOmari
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- Anas Ali
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- Areeb AlOkaiel
- Hazim Bajri

**Thanks for checking our work,  
Good luck.**

**-Team histology.**

