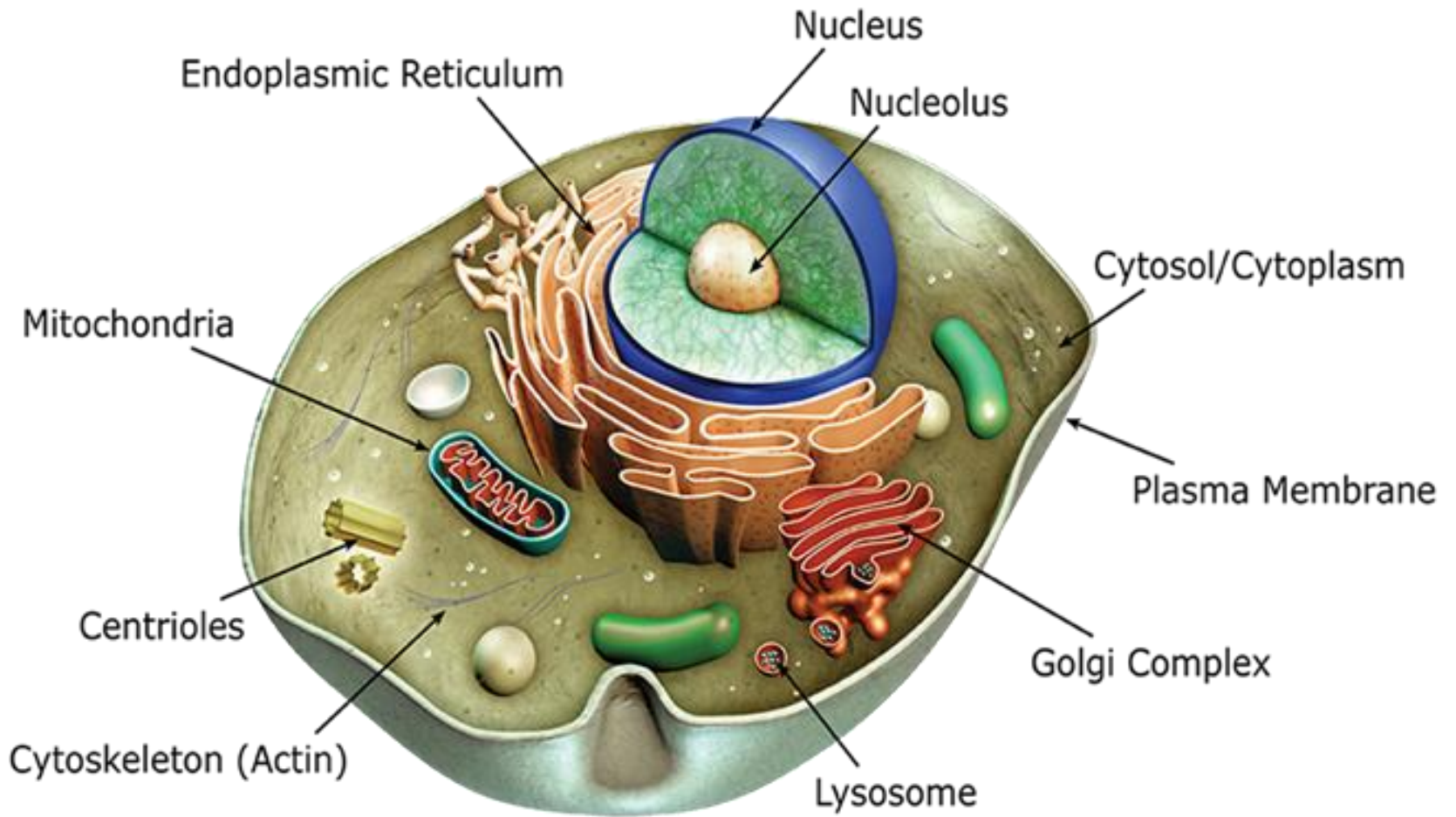


CELL



The cytoplasm

Composed of:

1- Cytosol:

jelly like fluid matrix, its primary component is water

2- Organelles

They are specialized structures, **Essential** for vital processes of the cell

3- Inclusion

They are **Not essential** for vitality of cells. may be present or absent.

Examples are lipids, glycogen and pigments like melanin & lipofuscin

4- Cytoskeleton

Network of filaments and microtubules responsible for cell motility, cell shape, and movement

Organelle

- ❖ Living structures
- ❖ Essential
- ❖ Metabolically active
- ❖ Perform certain functions
- ❖ Always present in all cell

• Inclusion


- ❖ Stored material
- ❖ Not essential
- ❖ Metabolically inert
- ❖ Not Perform functions
- ❖ May or may not present

Organelles

- Little organs:

- Living structures
- Metabolically active
- Perform certain functions
- Always present in all cell types

Types:

- Membranous organelles (All organelles **Except**)
 - Non-membranous organelles (Ribosomes, Centrosome)
- 

Organelles

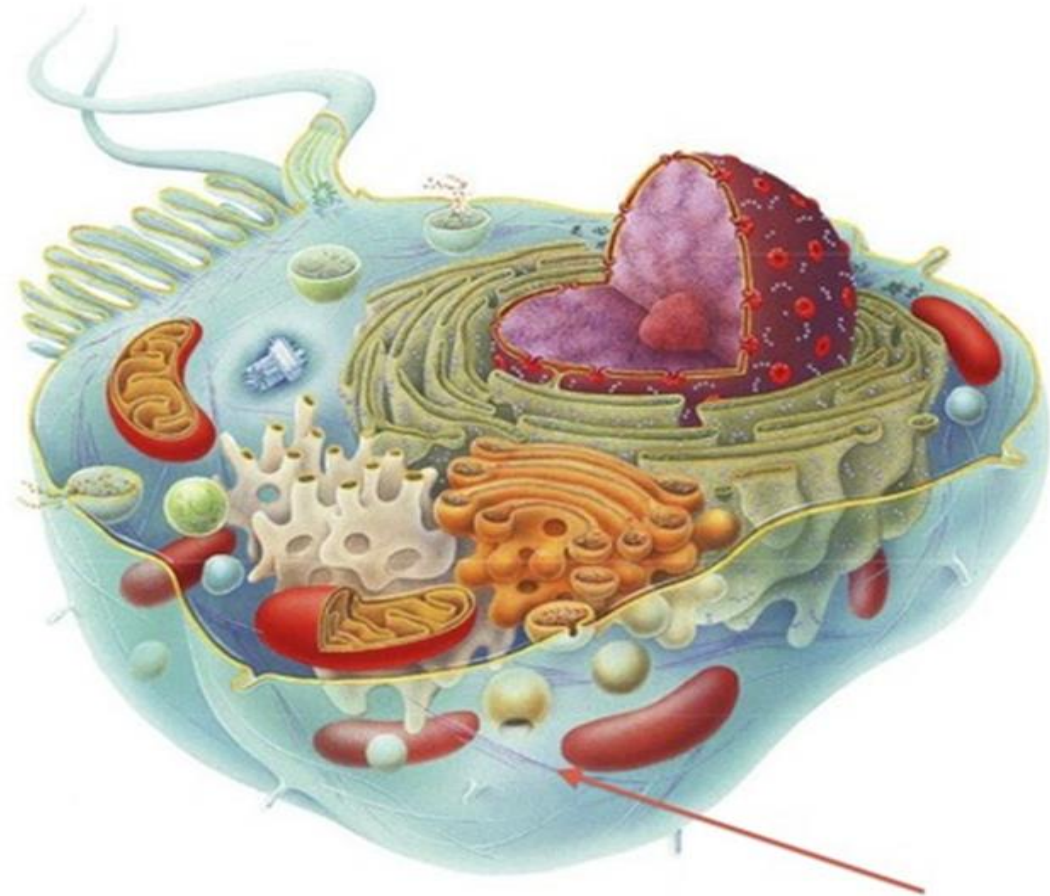
Structure

LM

EM

Types

Function



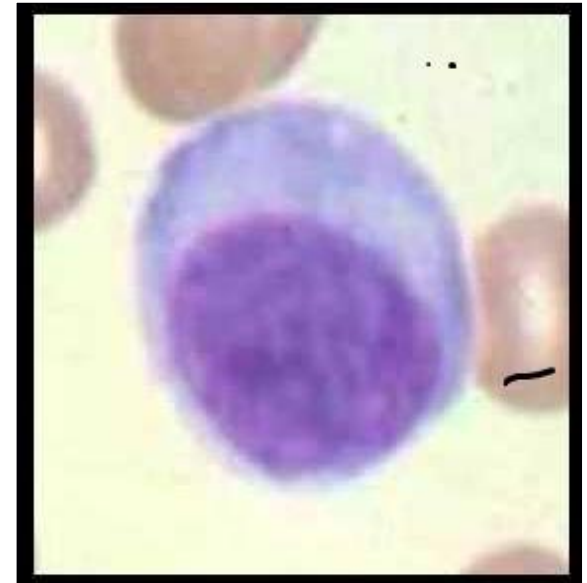
Ribosomes

- Non-membranous organelles
- Chemical nature: nucleoproteins consist of proteins conjugated with ribosomal RNA (r RNA)
- ★ Nucleolus is involved in the synthesis of ribosomes

Structure:

LM:

- By H&E stain: not seen
- if large in number they impart cytoplasmic basophilia



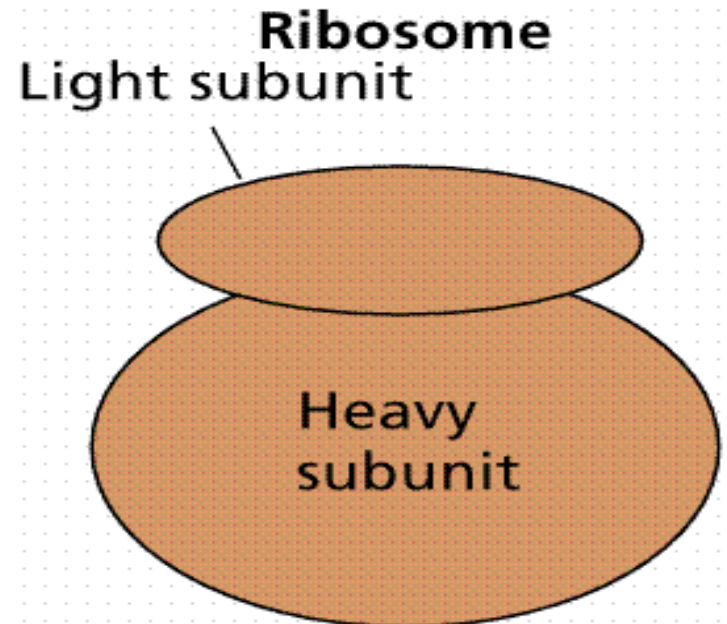
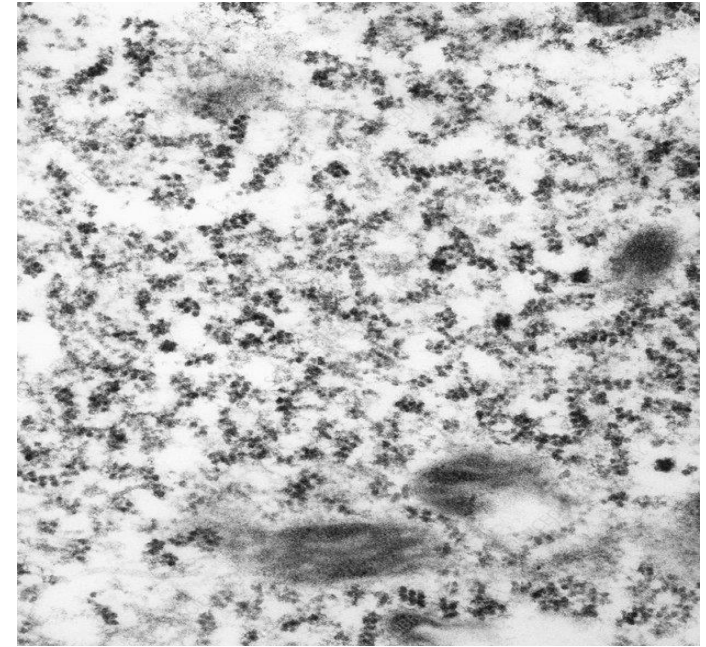
EM :

Low magnification = Electron dense granules

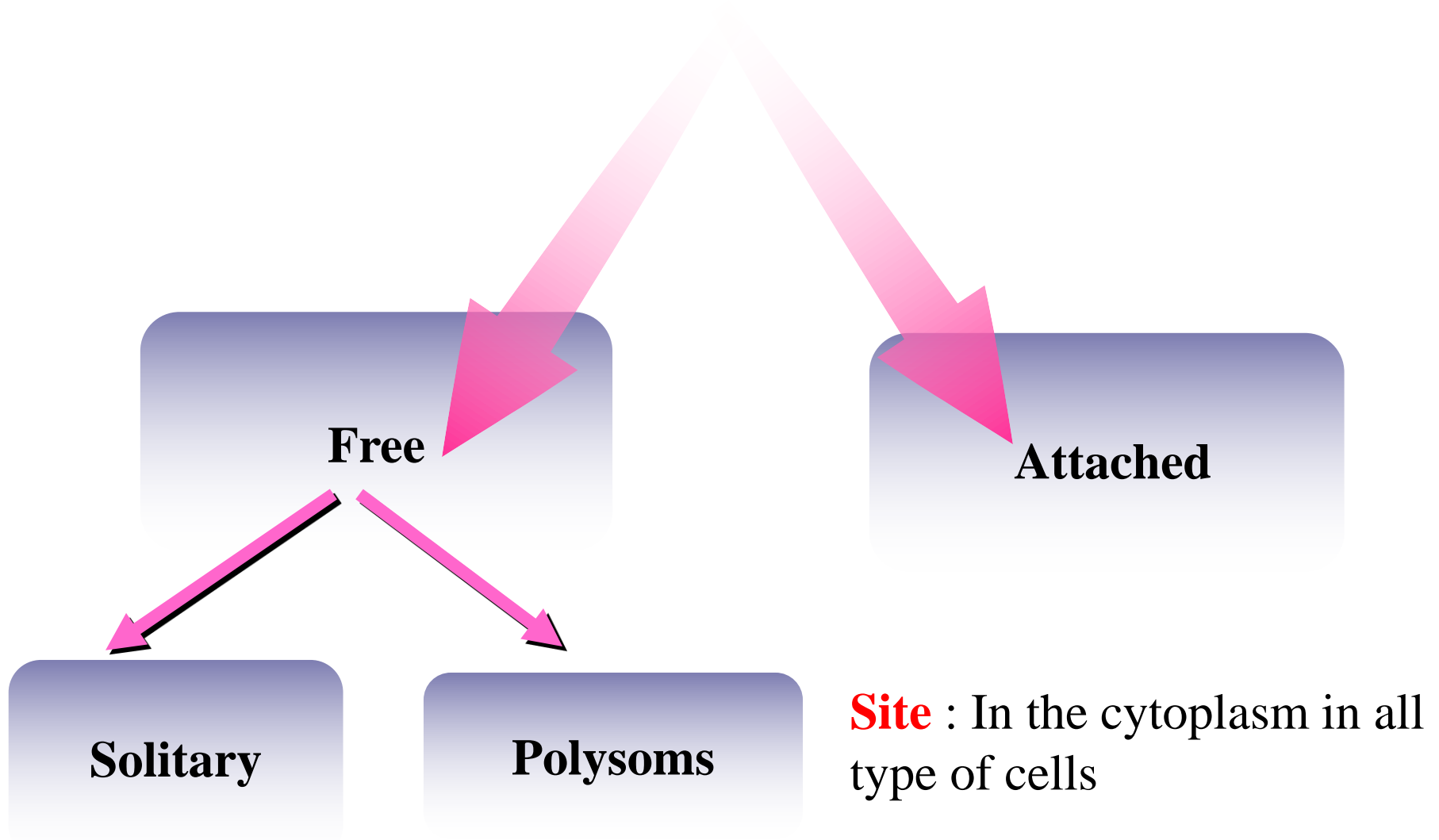
High magnification 2 subunits

Small subunit (RNA+30 Protein)

large subunit (2RNA+40 Proteins)

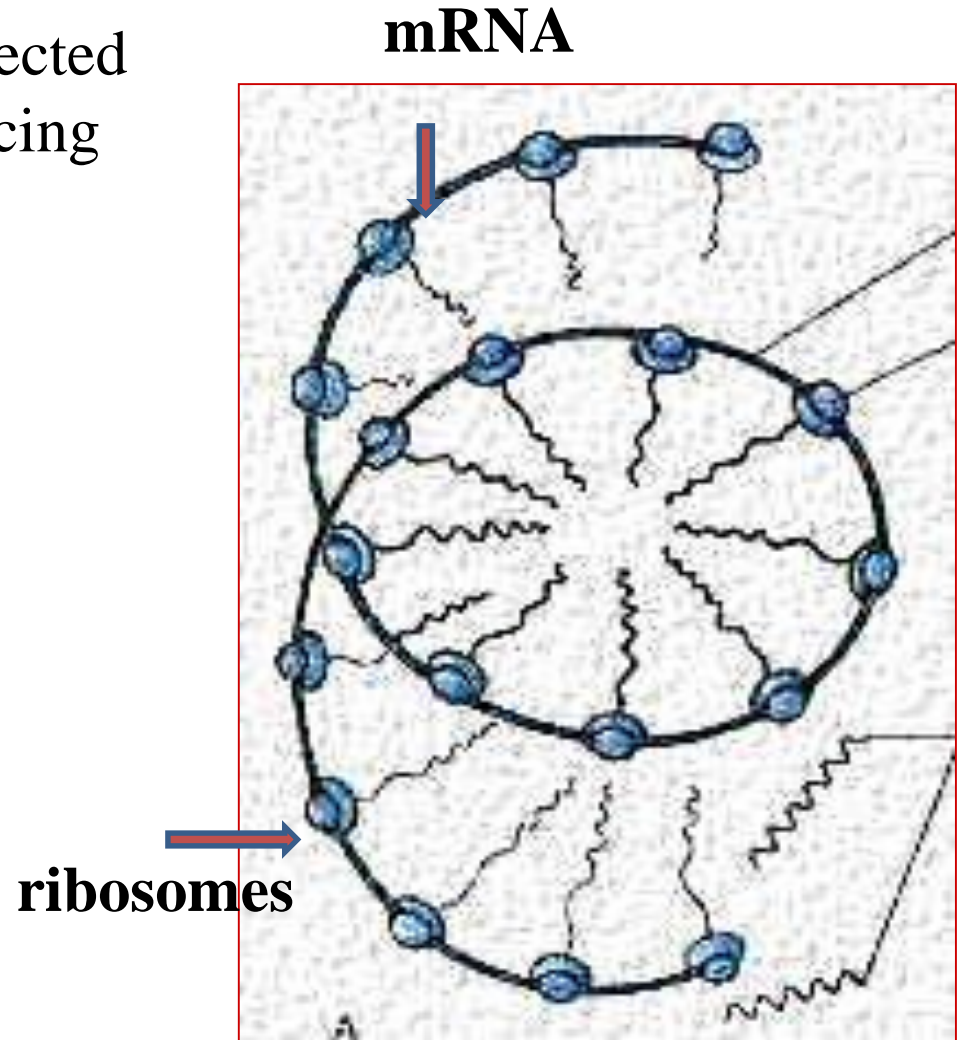
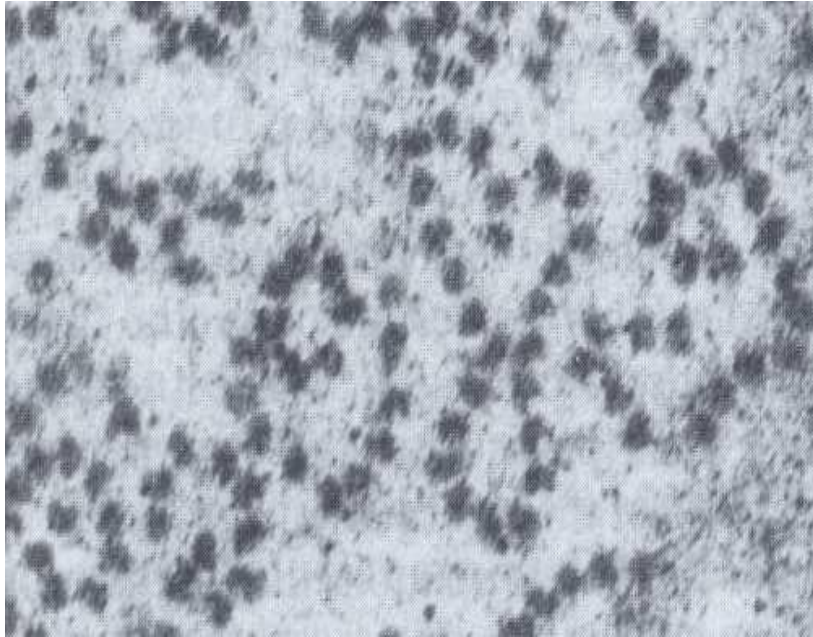


Types of ribosomes



Polysoms

- Clusters of ribosomes connected by **mRNA thread** & producing proteins



Function of ribosomes

Ribosomes are the sites of protein synthesis:

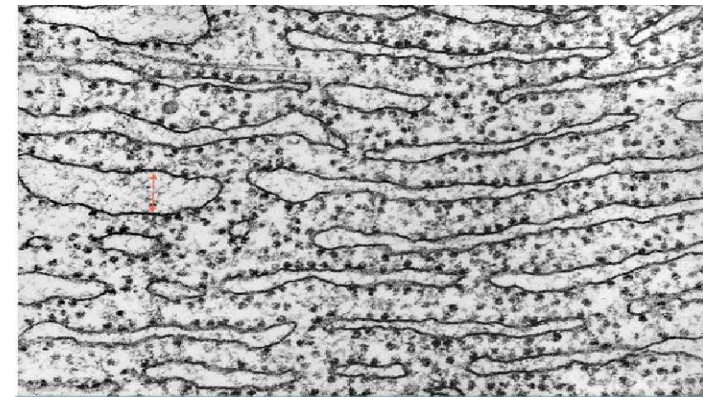
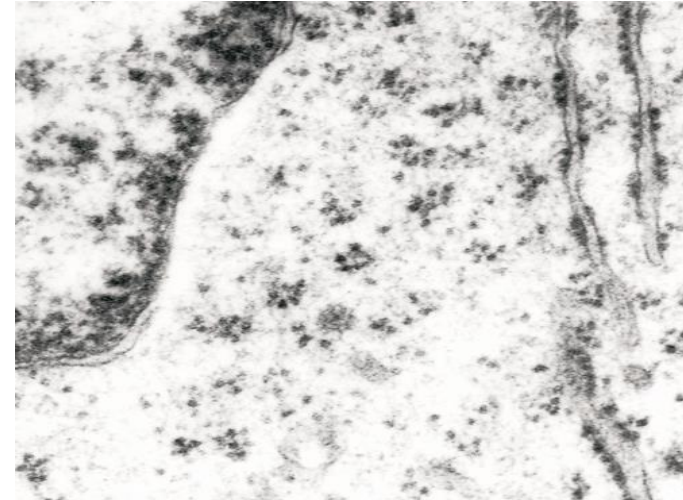
Solitary: reserve

Polysoms: proteins used by the cell

Attached: proteins for secretion outside the cell

- ❑ Ribosomes receive instructions for protein synthesis from mRNA
- ❑ Ribosomes are responsible for decoding genetic information by **translating mRNA into proteins**

EM of free ribosome



EM of attached ribosome

Endoplasmic reticulum

- Membranous organelle
- Network of interconnecting tubules and cisternae
- Two types (Rough –Smooth)
- LM : Not seen



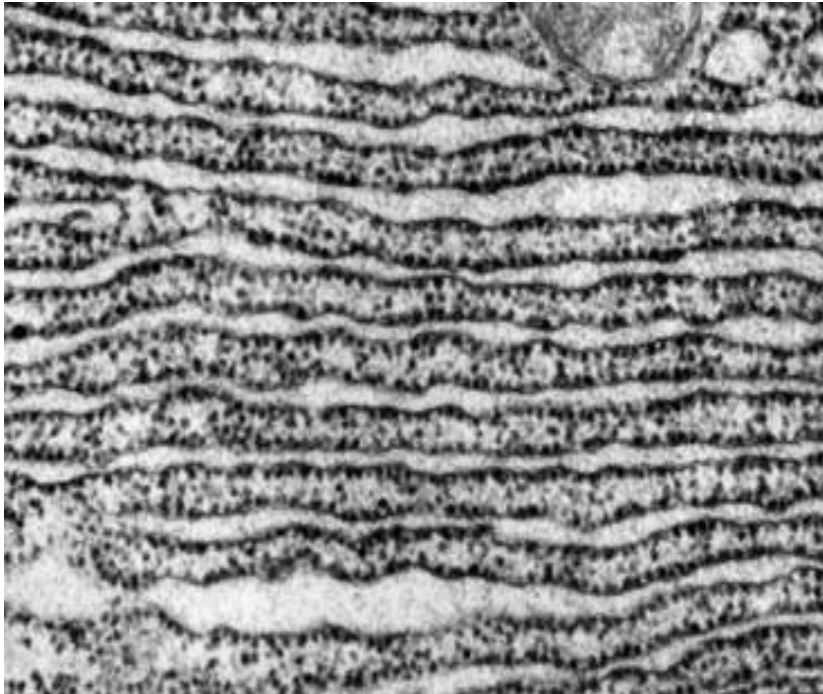
Endoplasmic reticulum

Rough (rER)

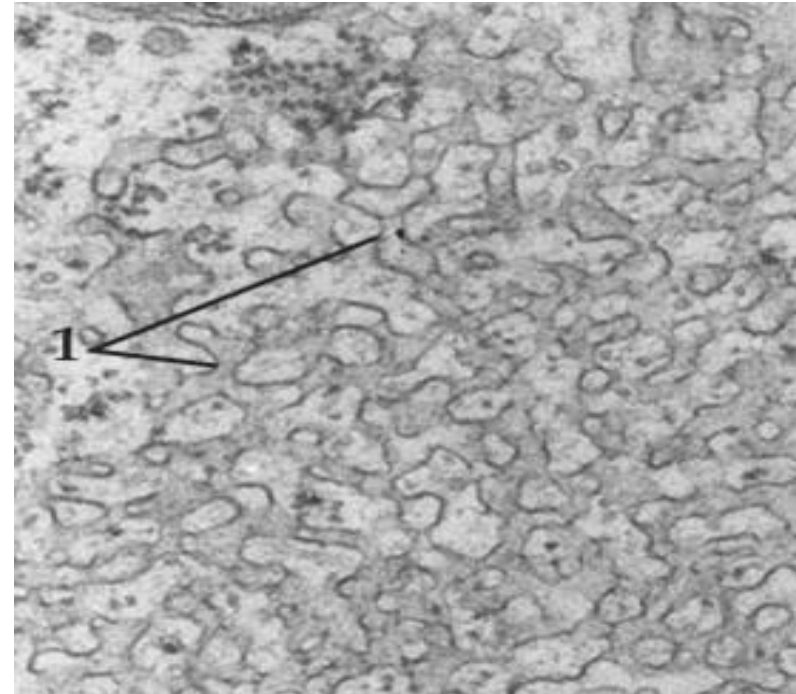
- ❑ Interconnected cisternae
- ❑ Has attached ribosomes

Smooth (sER)

- ❑ Interconnected short tubules
- ❑ Lacks ribosomes



EM



Function

rER

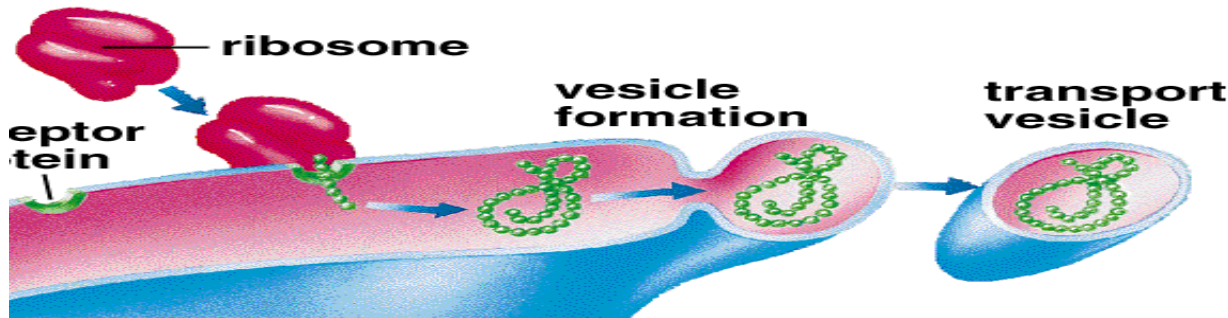
- Participates in protein synthesis.

Role of rER in protein synthesis

- 1- receiving of polypeptide chains in ER lumen
- 2- storage
- 3- protein transport

sER

- Lipid synthesis (fatty acids , cholesterol & steroid hormones)
- Detoxification of toxic substance
- Muscle contraction control calcium ions (storage) =sarcoplasmic reticulum
- Glycogen synthesis



Golgi apparatus

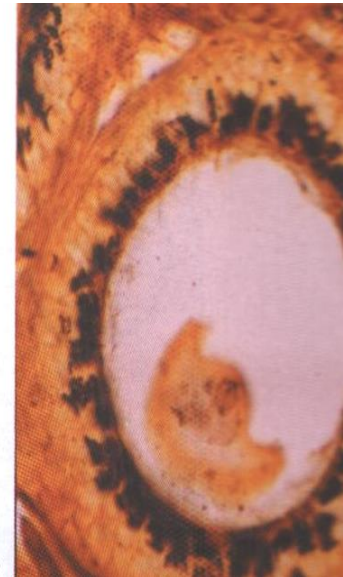
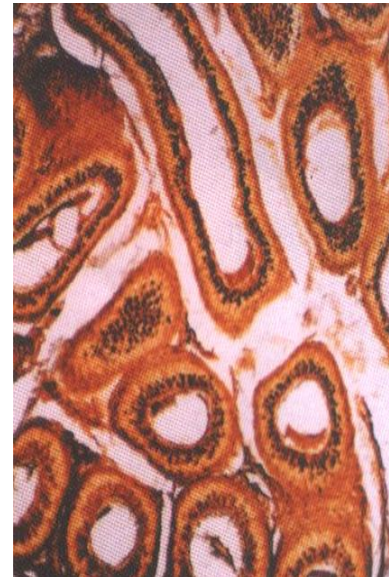
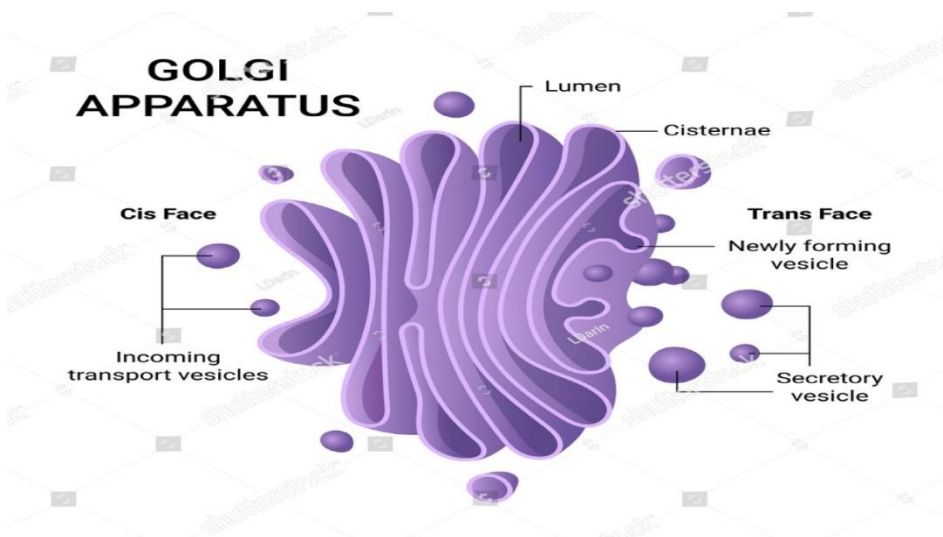
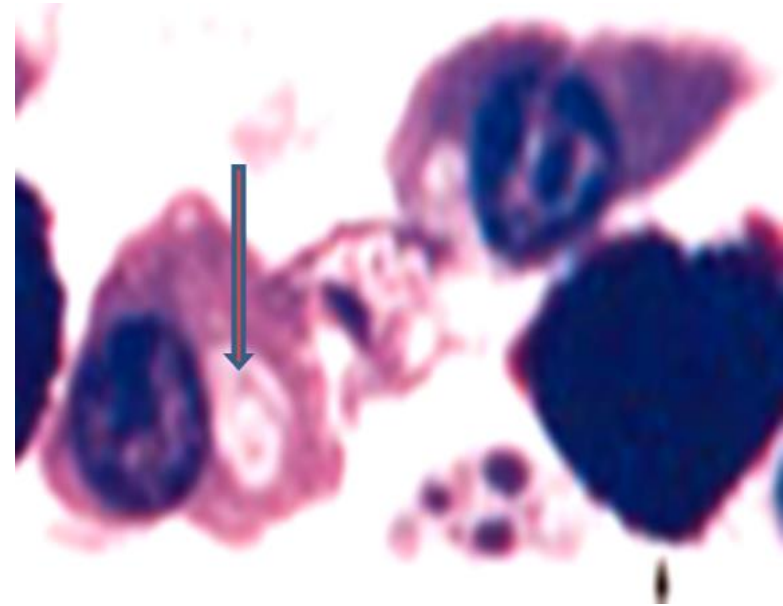
Membranous organelle

LM:

- ❑ H&E stain: not apparent (-ve image)
- ❑ Special stain: silver stain

E.M.

- Transport vesicles
- Cisternae
- Secretory vesicles



Functions of Golgi apparatus

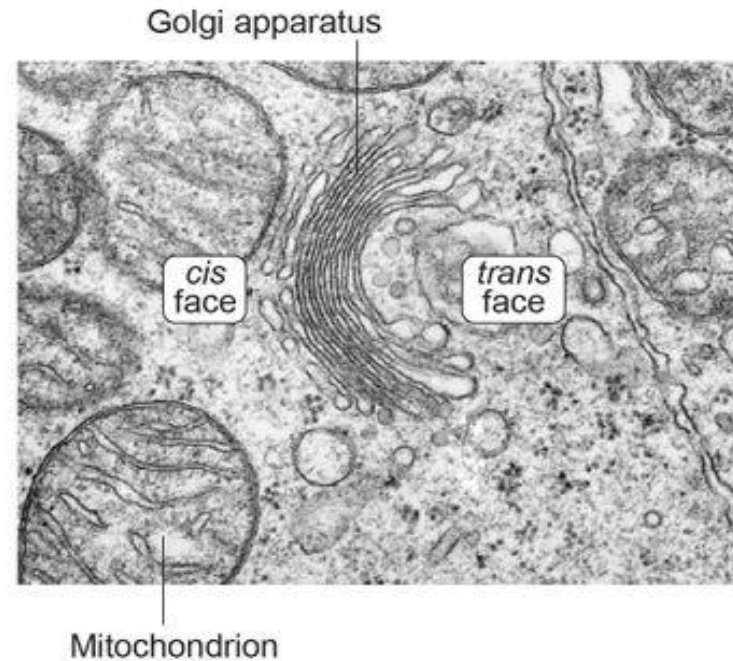
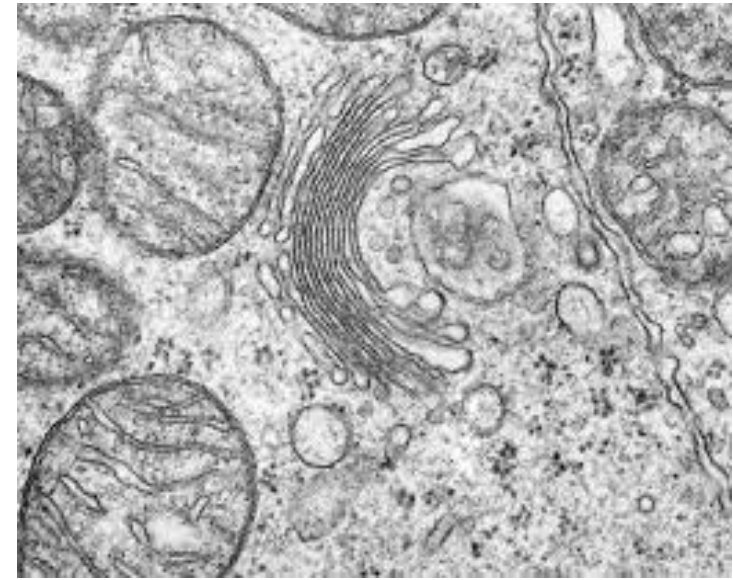
- 1- modification of proteins
- 2- Formation of primary lysosomes
- 3- Secretion of cell products
- 4- Renewal of the cell membrane

The endoplasmic reticulum (ER) along with Golgi bodies are the main organelles responsible for the synthesis of the plasma membrane.

Enzymes of endoplasmic reticulum utilize the substrates present in the cytosol to synthesize new phospholipids.

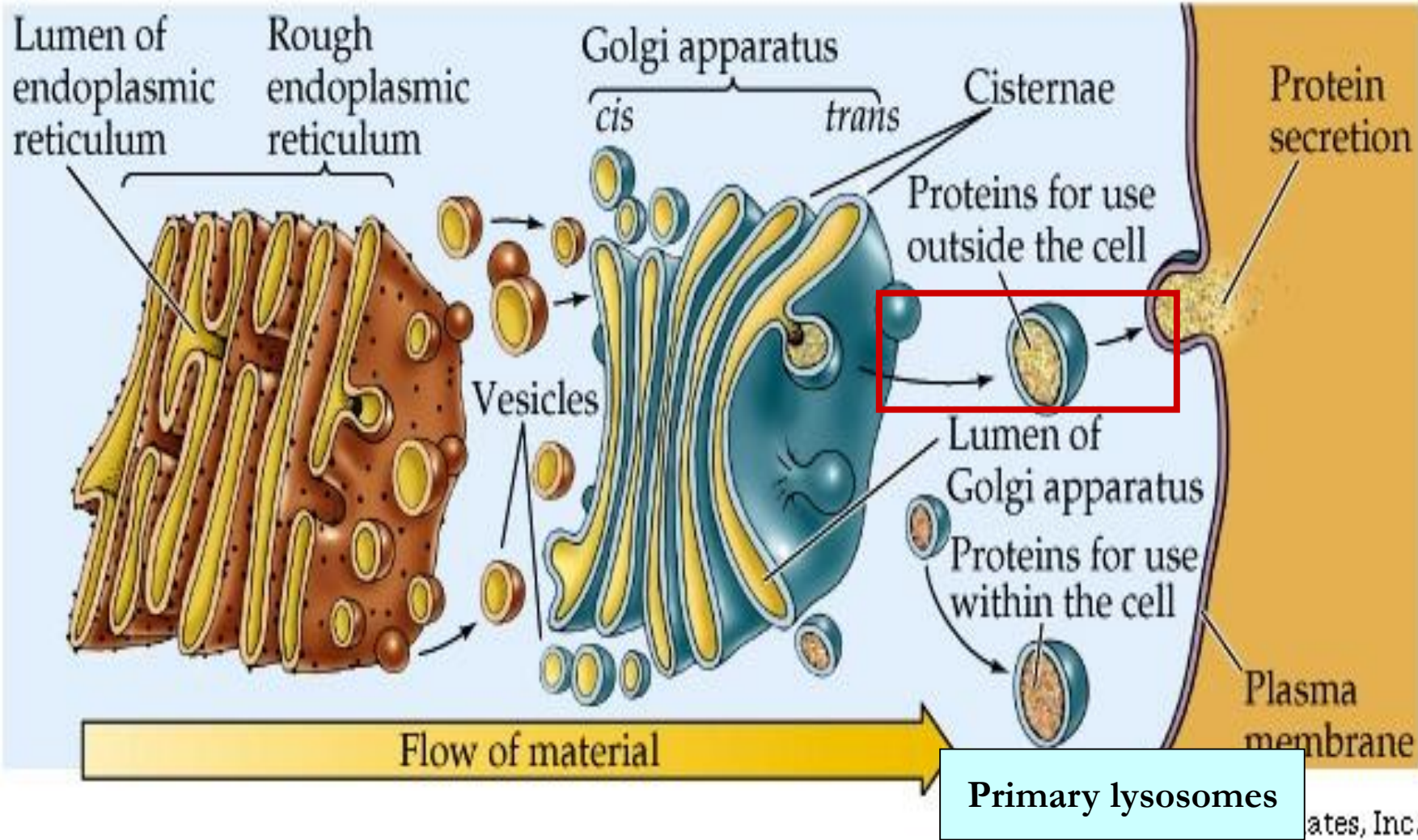
Organelles that participate in protein synthesis

- Nucleus
- Ribosomes
- Rough endoplasmic reticulum
- Golgi apparatus
- Mitochondria



Fate of protein transported by rER

(b)



Mitos= thread

Mitochondria

chondros= granule

Membranous organelles

LM:

- H&E stain: not seen
- Special stain: silver stain

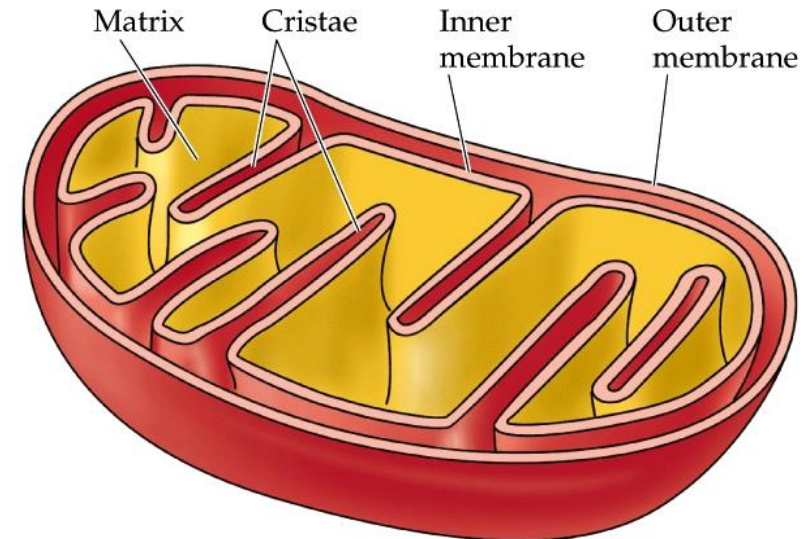
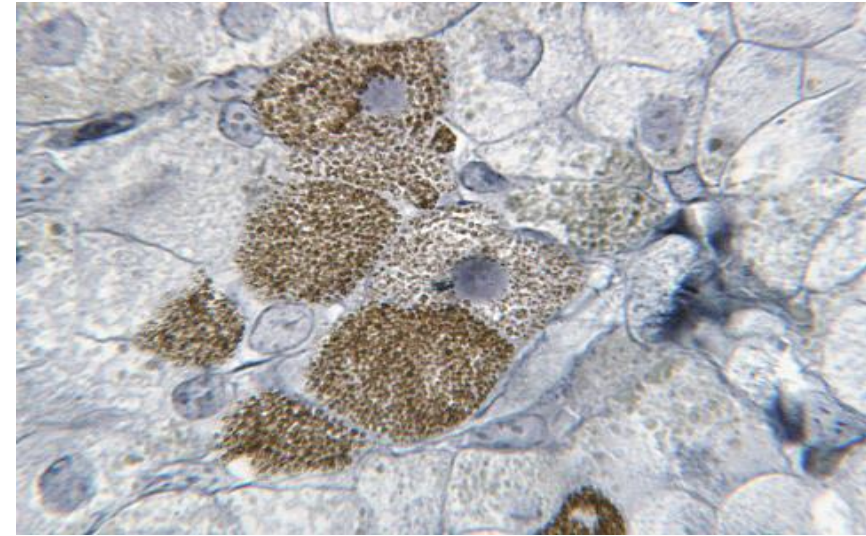
EM

Double membranes:

- Outer smooth
- Inner folded forming cristae

Double spaces:

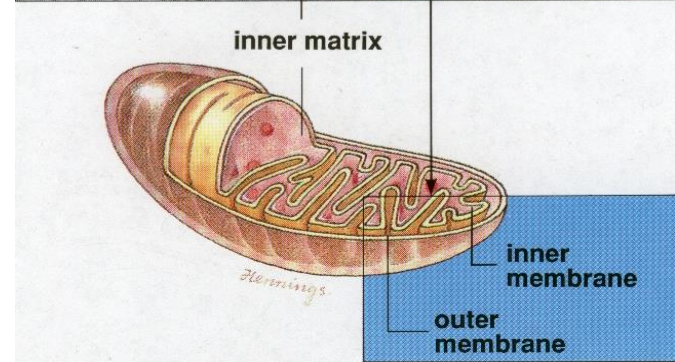
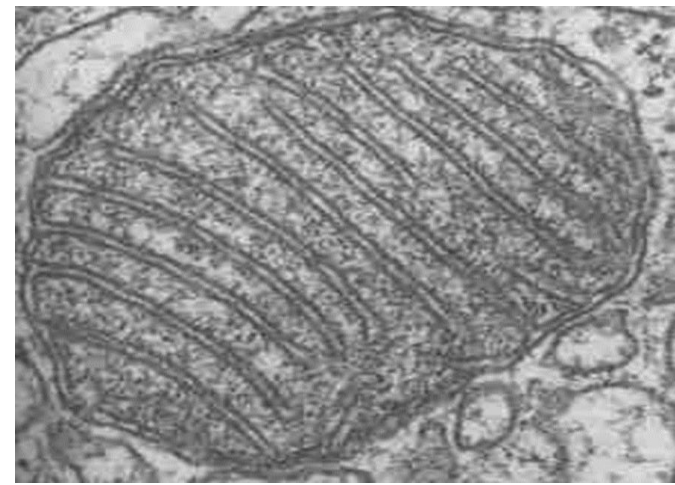
- -intermembranous space
- - intercrystal space (matrix space)



- 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:

- ❑ Generation of ATP which is the source of energy for the cell. They are called the power-house of the cell.
- ❑ **Cellular respiration**
- ❑ They can form their own proteins and undergo self replication.



Mitochondria

Peroxisome

E.M	Variable shape & surrounded by 2 membrane	Spherical surrounded by a single membrane
Function	Responsible for ATP synthesis	<ul style="list-style-type: none">➤ No ATP synthesis so unable to store energy➤ Contain enzyme for B oxidation of fatty acid , energy released as heat for maintenance of body temperature➤ Contain enzymes for regulation of hydrogen peroxide➤ Synthesis of cholesterol & bile acid➤ Detoxification of alcohol
Abundant in	All tissues particularly cardiac muscle	Particularly in the liver

Lysosomes

Structure:

- Small membrane-bound organelles
- **Larger** than ribosomes

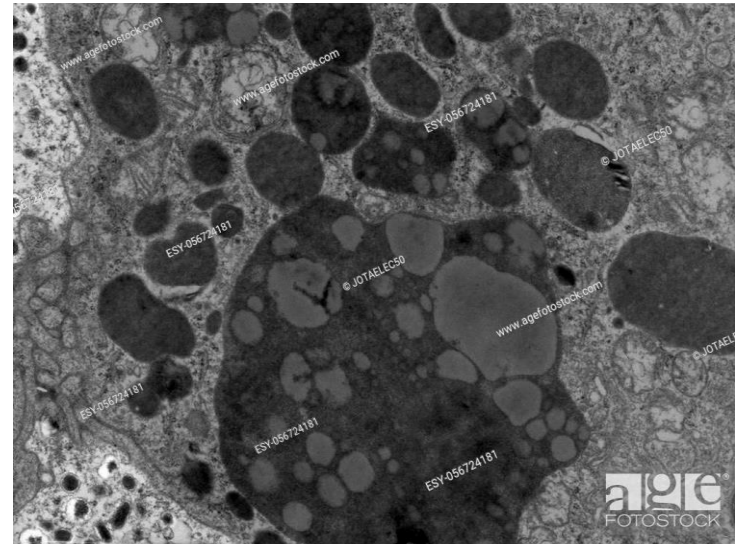
Contains 40 hydrolytic enzymes that break down materials in a cell

Types of lysosome:

- Primary lysosome (Small, regular, homogenous)
- Secondary lysosome (large , irregular , heterogenous)

Function :

- Breaks down (**digests**) food, bacteria and waste
- Autophagy** – breakdown of old and damaged organelles
- Programmed for cell death** break down the cell when it dies, called “**suicidal bags**” of the cell



Centrosome

Non membranous organelle

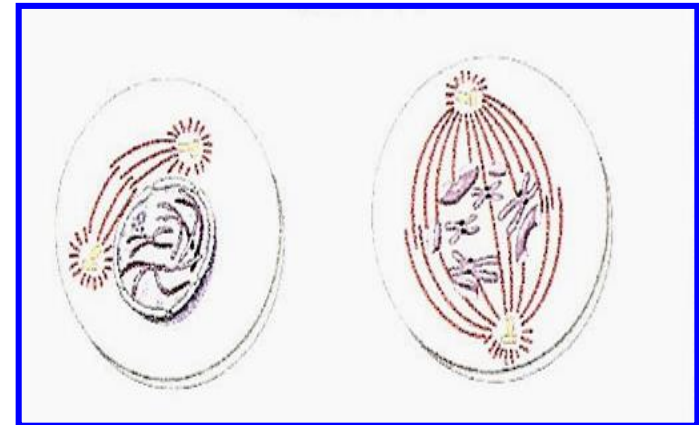
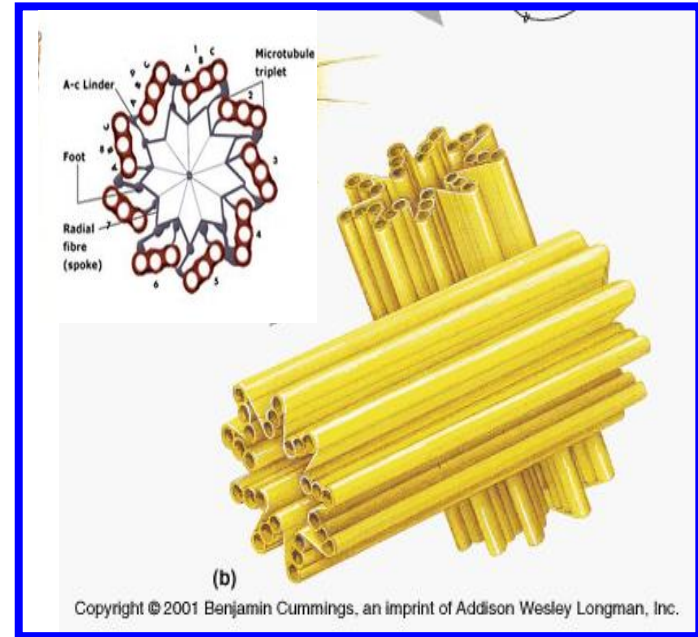
Structure:

- An associated **pair** of centrioles, arranged **perpendicularly** to each other
- each composed of sets of **microtubules** arranges to form a cylinder.
- The walls of each centriole are usually composed of **nine triplets** of microtubules

Function:

It is called microtubules organizing center

Microtubules that help divide the cell during cell division via **mitotic spindle**



Cilia & Flagella

Cilia (cilium) :

- project from cell surface, cylindrical in shape & enclosed by membrane.
- Contain microtubules.
- **Numerous** in certain cells e.g. cells that line **respiratory tract**



Flagella (flagellum) :

Structure similar to cilia but longer (whip-like) in certain cells e.g. **sperm**

Microtubules wrapped in an extension of the plasma membrane (**9 + 2 double** arrangement of microtubules) (**axoneme**)

Function: provides **movement** for the **cell** or **objects** moving by the cell



Cilia

Plasma membrane

Outer dynein

Inner dynein

Nexin

Spoke head

radial Spoke

Subfiber B

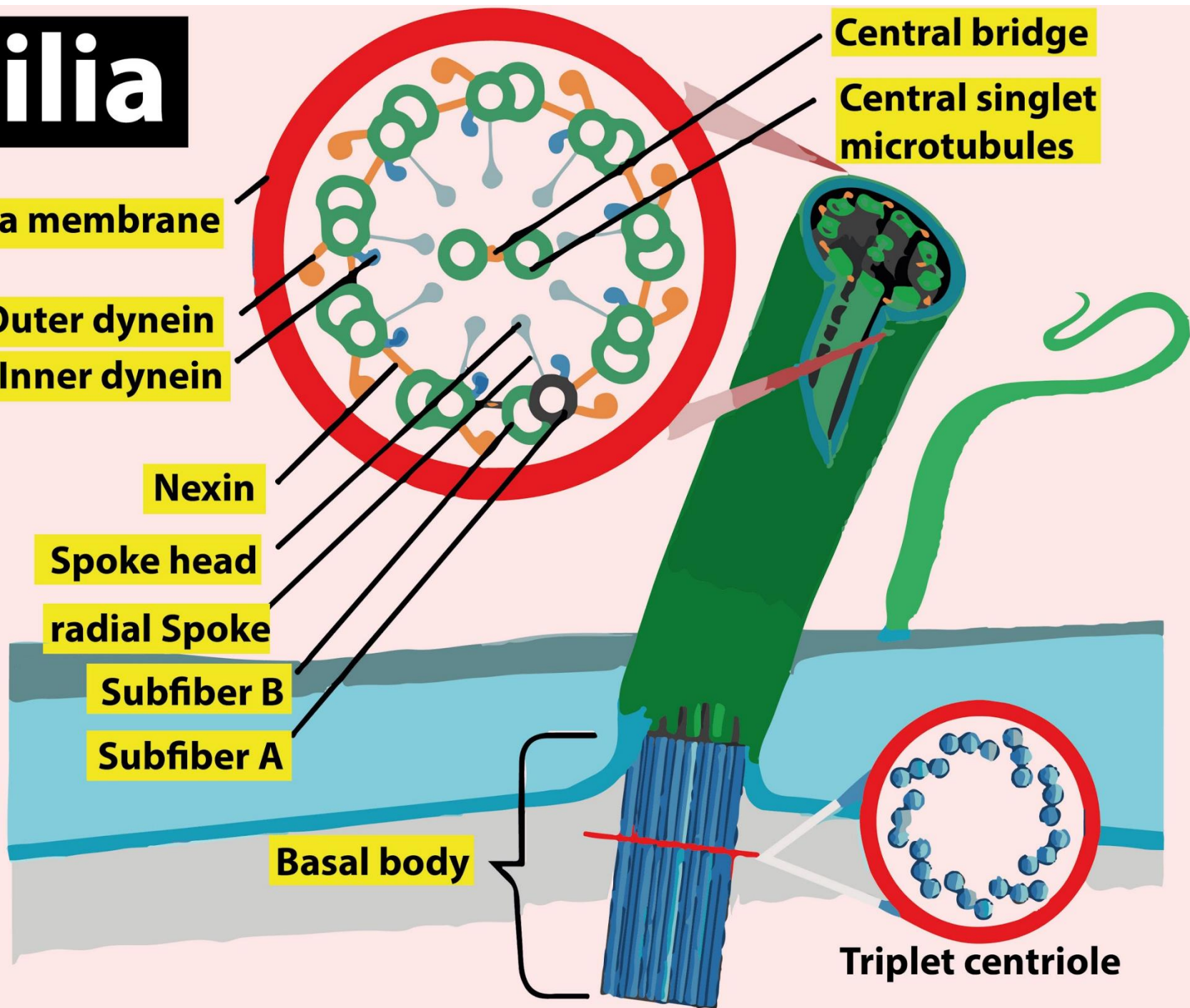
Subfiber A

Basal body

Central bridge

Central singlet
microtubules

Triplet centriole



Cytoskeleton

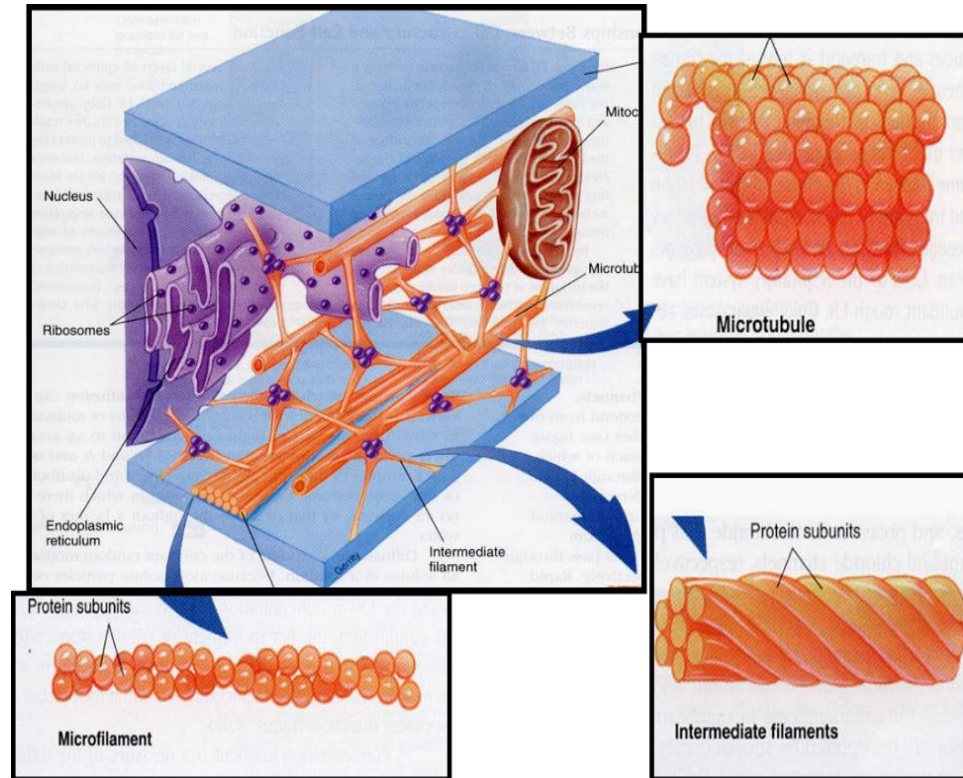
Proteins that **support** the cell, **hold** organelles in place, enable cell to **change** shape

Types according to the size:

- ❑ Microfilaments = 7 nm (actin)
- ❑ Microtubules = 25nm
- ❑ Intermediate Filaments

Function

- Support
- Motility
- Regulation of internal structure



The cytoskeleton of eukaryotic cells is **not stable**, but is always being **assembled & disassembled**

Microfilaments:

threadlike composed of the proteins **actin**

. Provide for structural **support**.

Involved in **cell movement** , **muscle cell contraction**,

changes in cell membrane **shape**- amoeboid

Movement of cilia & flagella

Microtubules: are **tube-like &** made of **TUBULIN** i.e.

hollow structures helps provide **support** to

cytoplasm. **Forms** organelles such as **cilia & flagella**

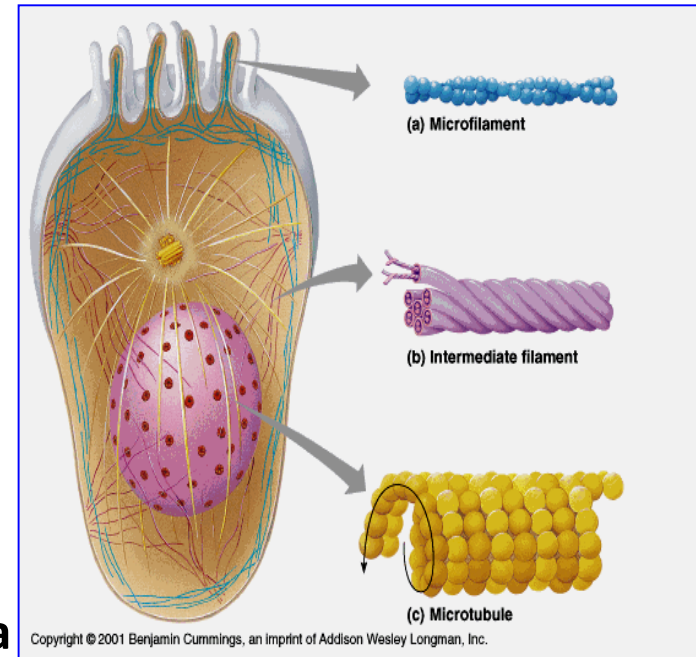
& centrioles.

Intermediate Filaments: Bigger than microfilaments

but smaller than microtubules, provides **tension**

bearing Permanent fixtures of cells (**do not move**)

Present only in **animal cells** of certain tissues



Microvilli :

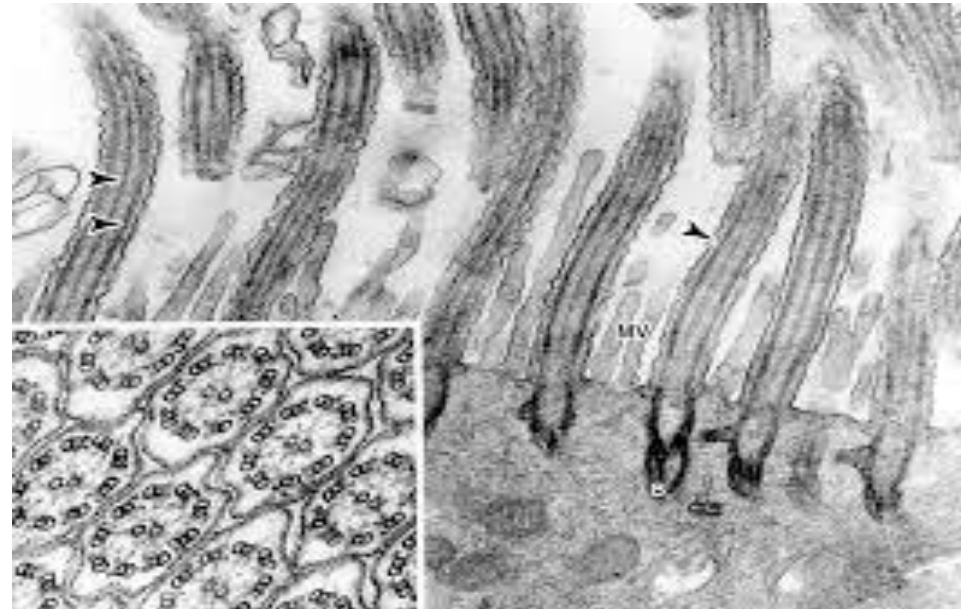
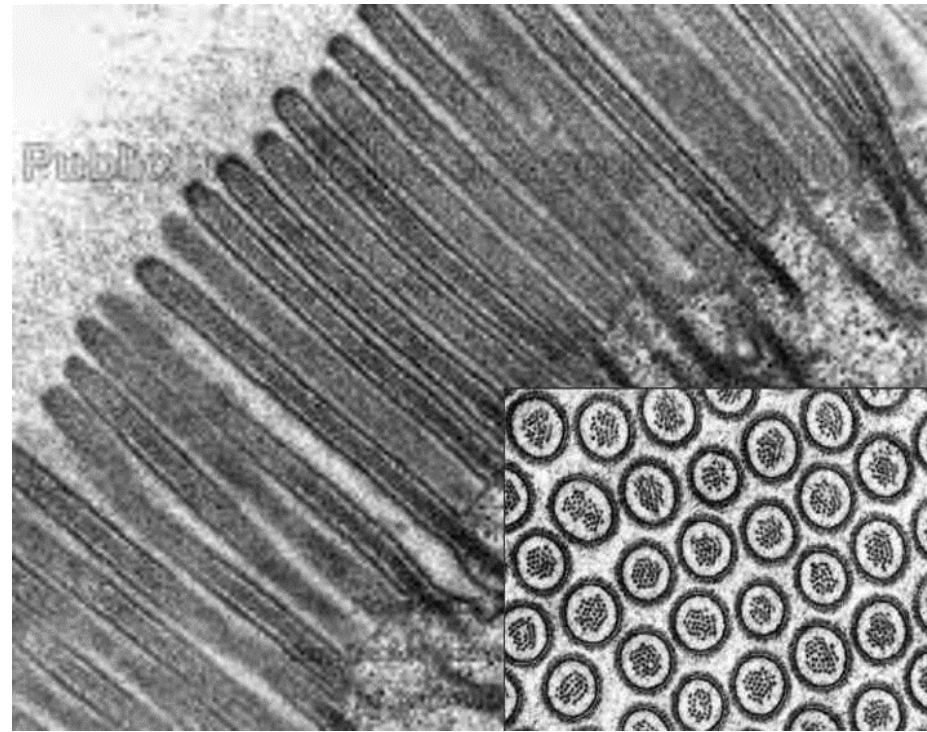
- ❖ specialized extensions of cell membrane
- ❖ contain microfilaments
- ❖ Do not move.

Function :

is to **increase surface area** esp. in cells that are used to **absorb**
e.g. **intestines, kidney**

Sterocilia

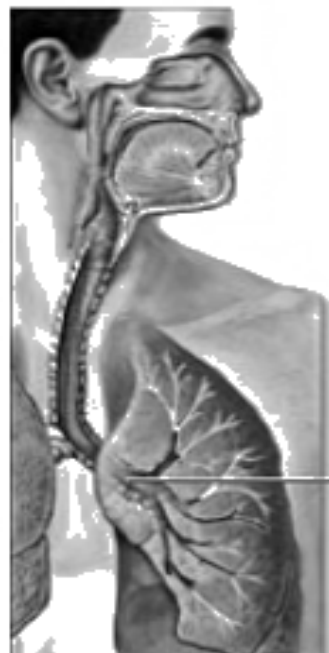
- Long
- Non motile
- Contain actin filaments
- In male genital ducts



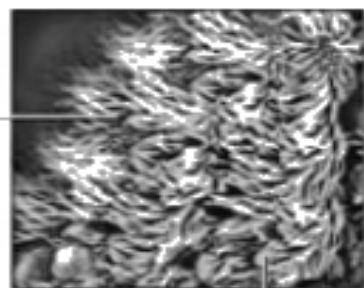
Cilia vs Microvilli

Cilia

Hair-like projections called cilia line the primary bronchus to remove microbes and debris from the interior of the lungs



Cilia

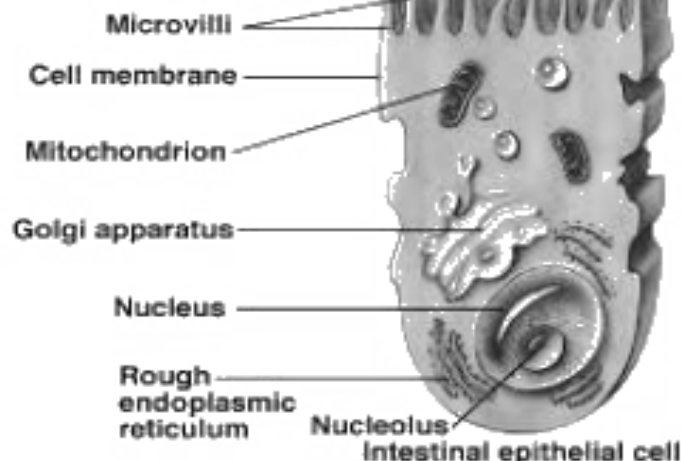


Primary bronchus

Goblet cell

Microvilli

Microvilli



Occur in cells of respiratory and reproductive tracts.

Found in intestine; where absorption and secretions are the major activities

Arise from the basal granules

Basal granules are absent

Motile

Non motile

Cilia has 9+2 ultra structure

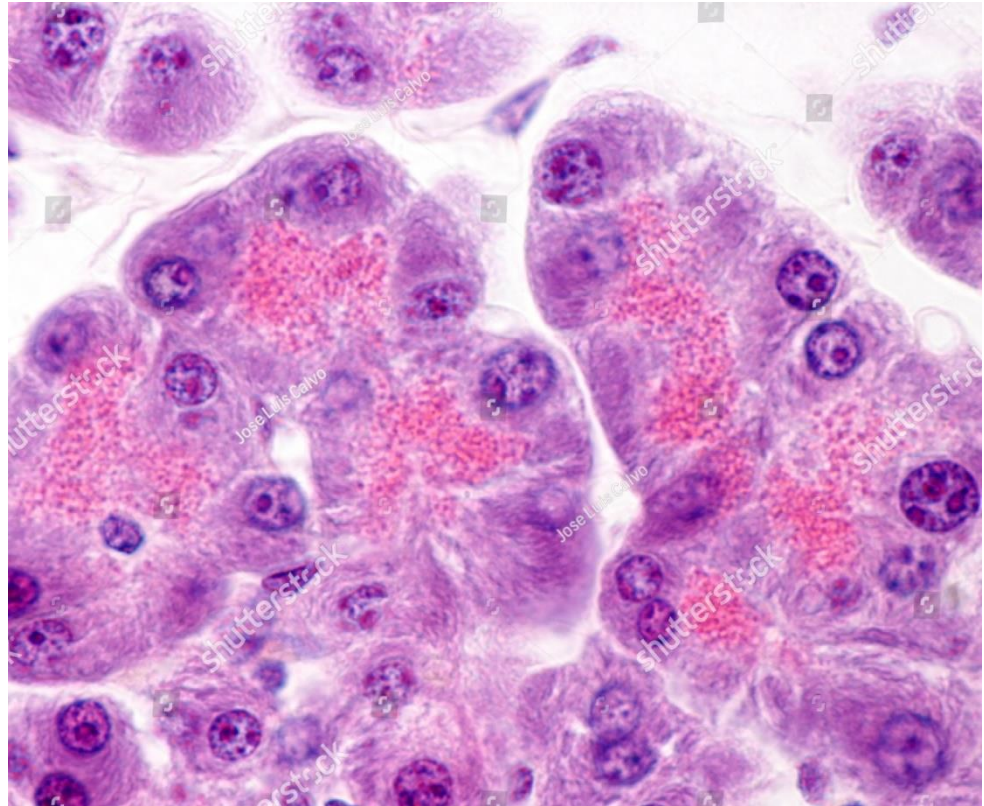
9+2 ultra structure absent

They taper distally

They are extremely thin and short structures

Cytoplasmic inclusions

- ❖ Stored material
- ❖ **Not essential**
- ❖ Metabolically inert
- ❖ Not Perform functions
- ❖ May or may not present



Cytoplasmic inclusions



1. Stored food:

- ❑ Carbohydrate storage = glycogen energy storage

Stored in liver & muscle

- ❑ Lipids : fat storage
- ❑ Protein



2. Pigments:

❑ Endogenous:

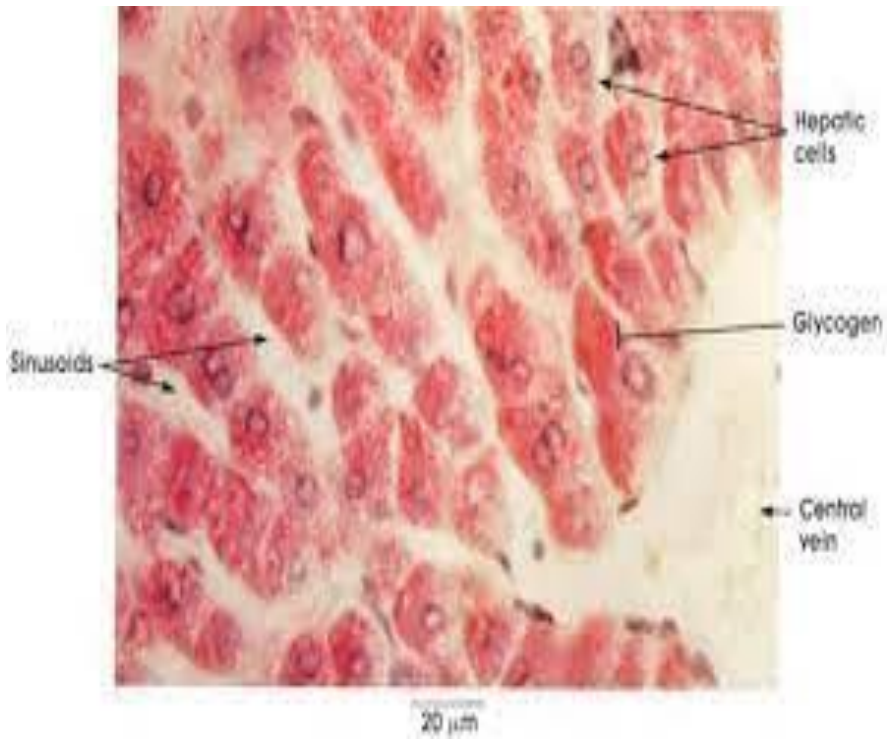
- e.g. Melanin storage of pigment
- Lipofuscin **age pigment or waste product accumulation**

Hemosiderin storing excess iron

❑ Exogenous :

e.g. Carotene, carbon particles

Glycogen



Lipid

