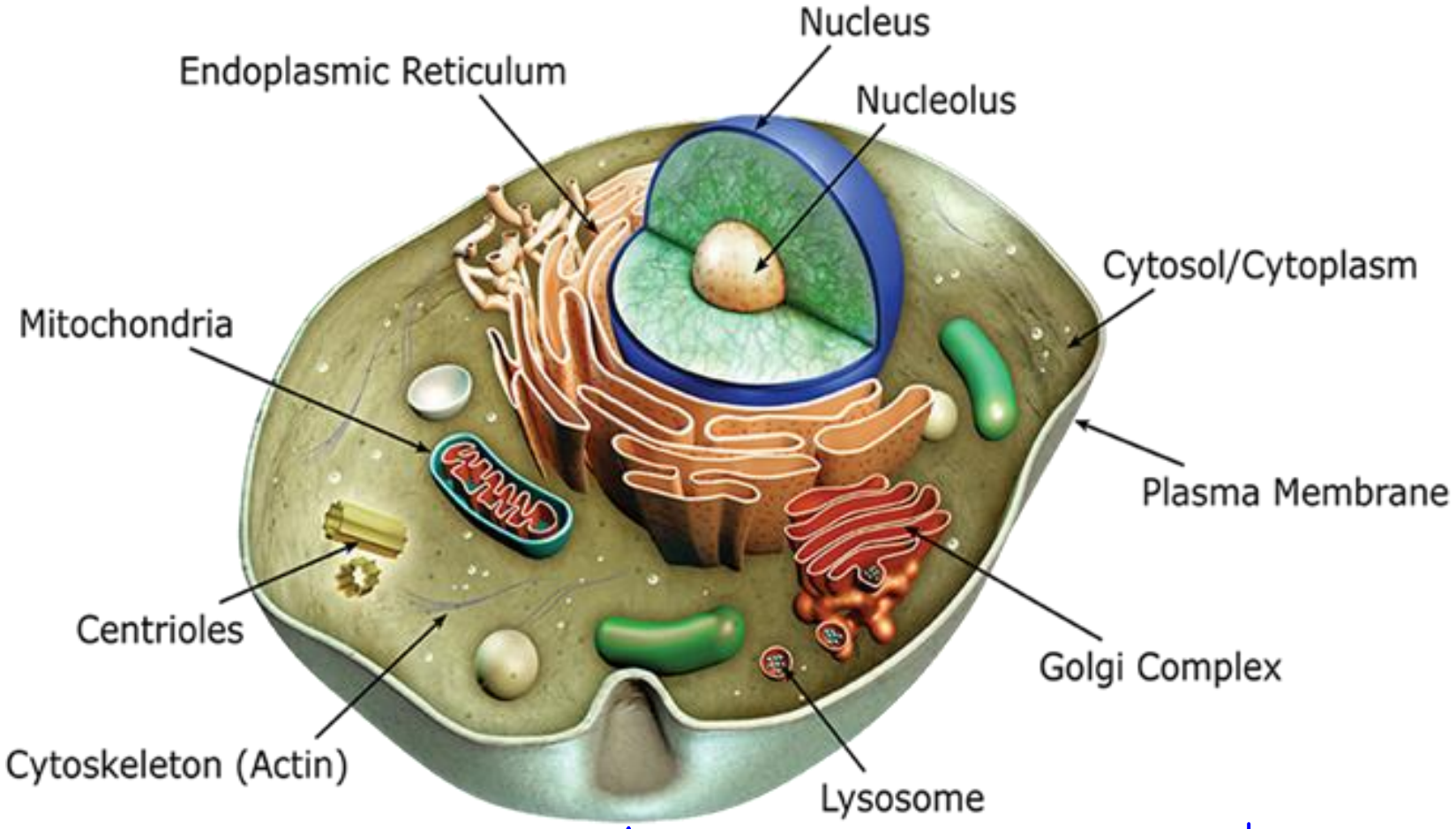
CELL



Unit Structure and function of the organisms

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 mvement

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

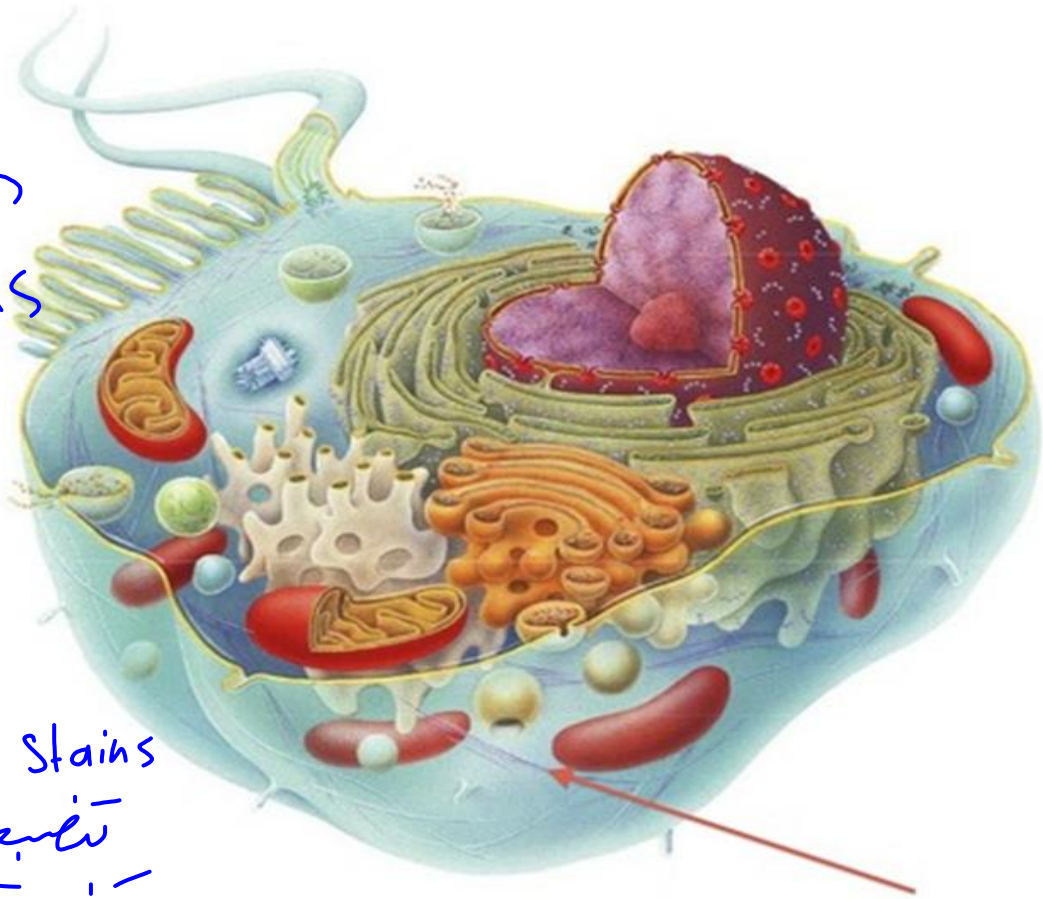
Types: حسب وجود membrane

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

نفس عدد الخلية يختلف اختلاف كبير

Organelles

- ❑ Structure
- ❑ LM H & E Stains
- ❑ EM Special Stains
- ❑ Types
- ❑ Function



* Osmic acid (black) stains
  - Electron dense
  - Electron lucent (white)

Ribosomes

- Non-membranous organelles
- Chemical nature: nucleoproteins consist of proteins conjugated with ribosomal RNA (r RNA)

tRNA
rRNA
mRNA

- Nucleolus is involved in the synthesis of ribosomes

Structure:

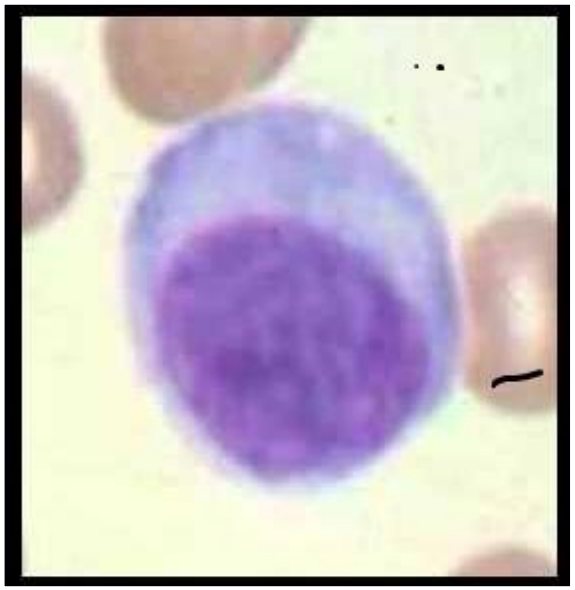
LM:

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

basic dye

amino acids

amino acid



EM :

Low magnification = Electron dense granules ((black))

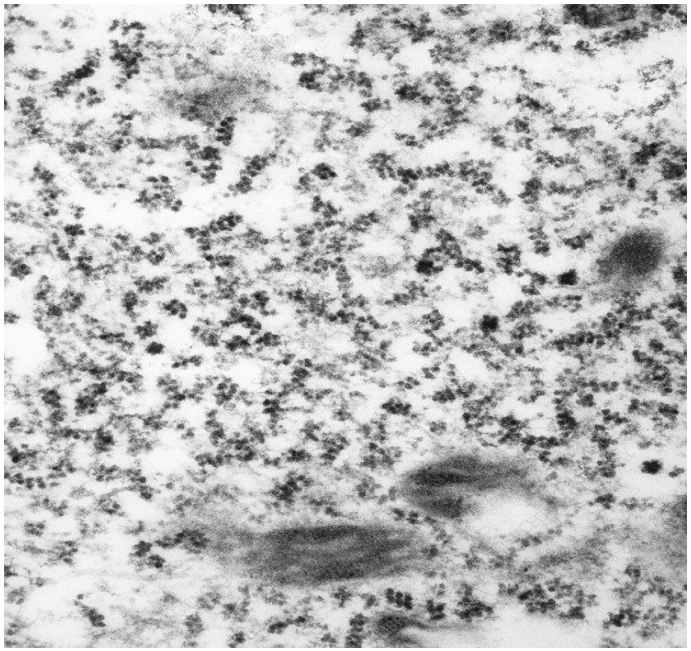
High magnification 2 subunits

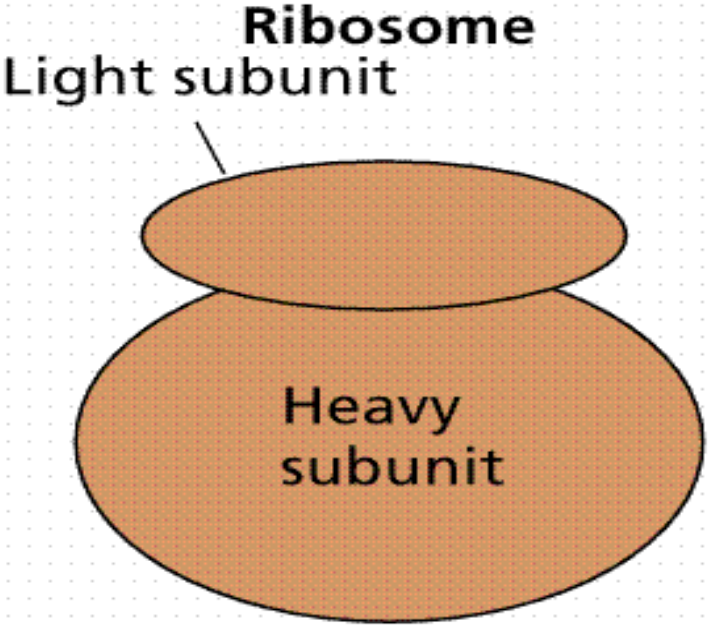
Small subunit (RNA+30 Protein)

rRNA

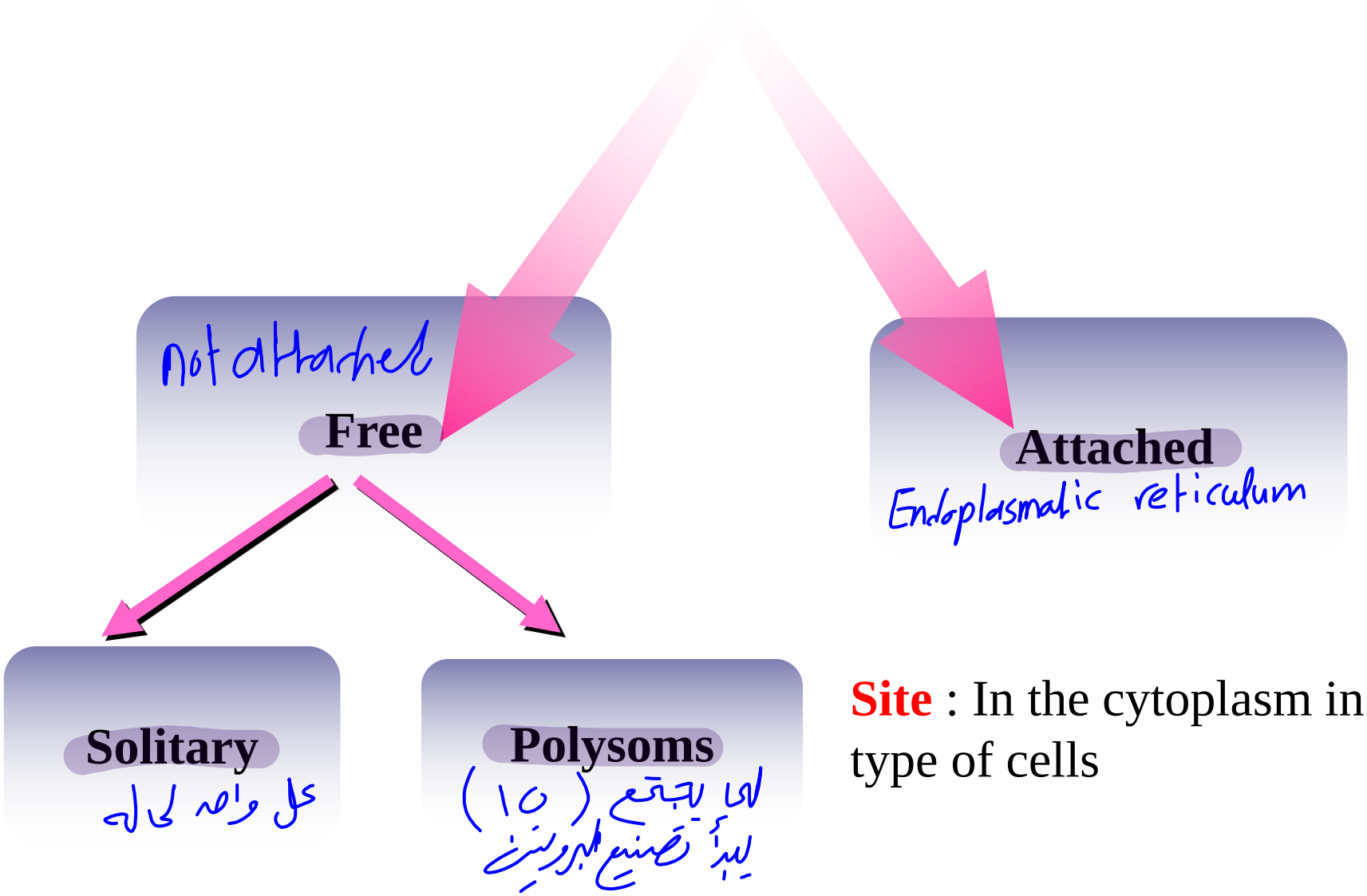
large subunit (2RNA+40 Proteins)

rRNA





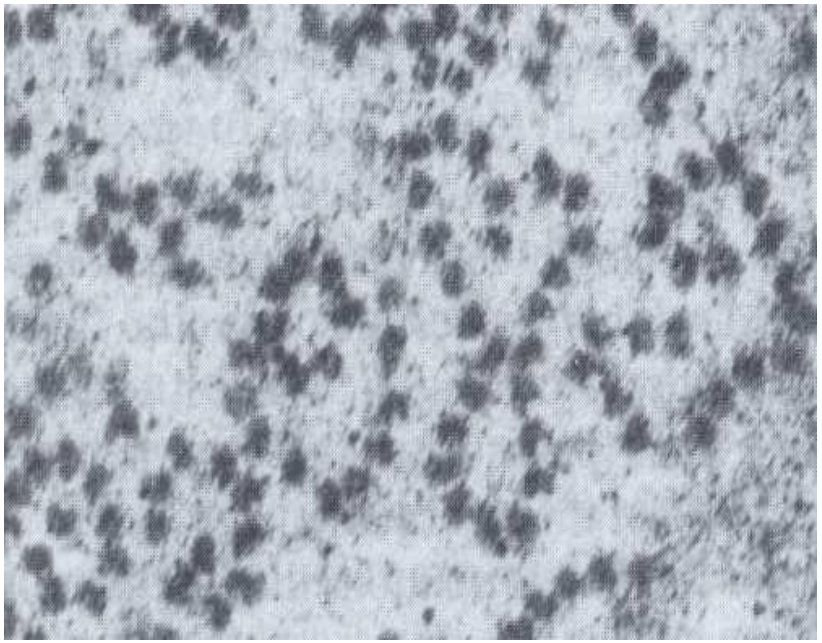
Types of ribosomes

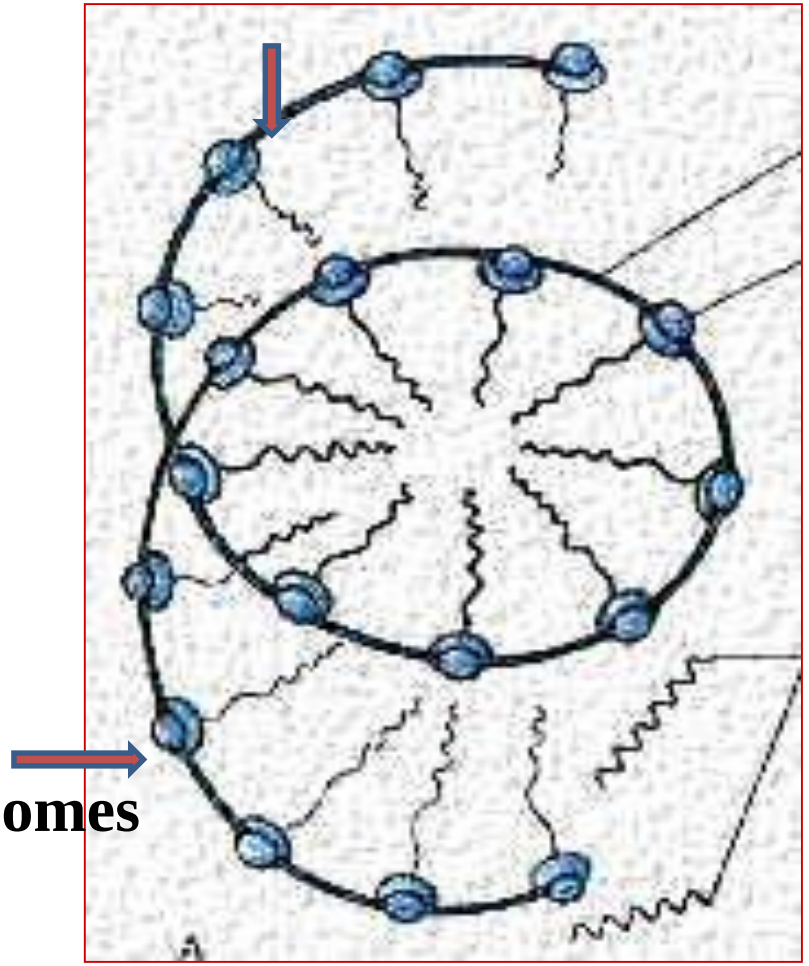


Site : In the cytoplasm in all type of cells

Polysoms

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





Function of ribosomes

Ribosomes are the sites of protein synthesis:

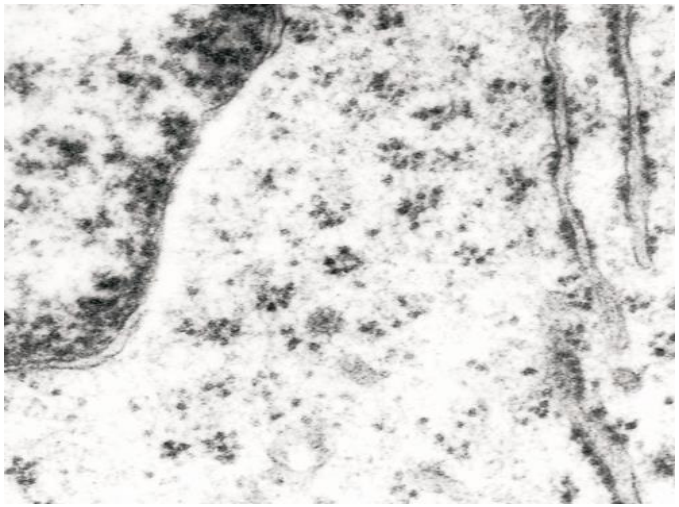
Solitary: reserve

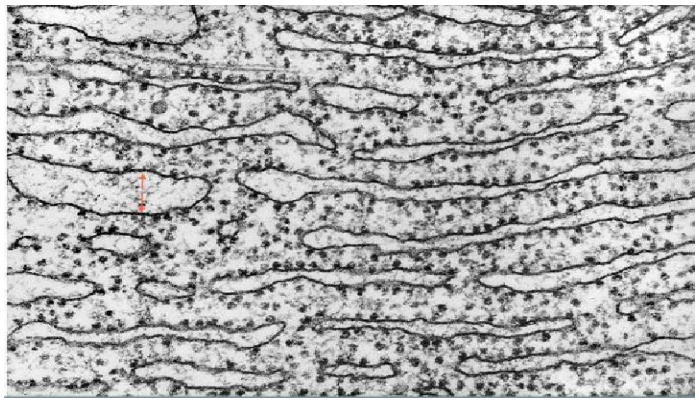
Polysoms: proteins used by the cell

Attached: proteins for secretion outside the cell

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

EM of free ribosome





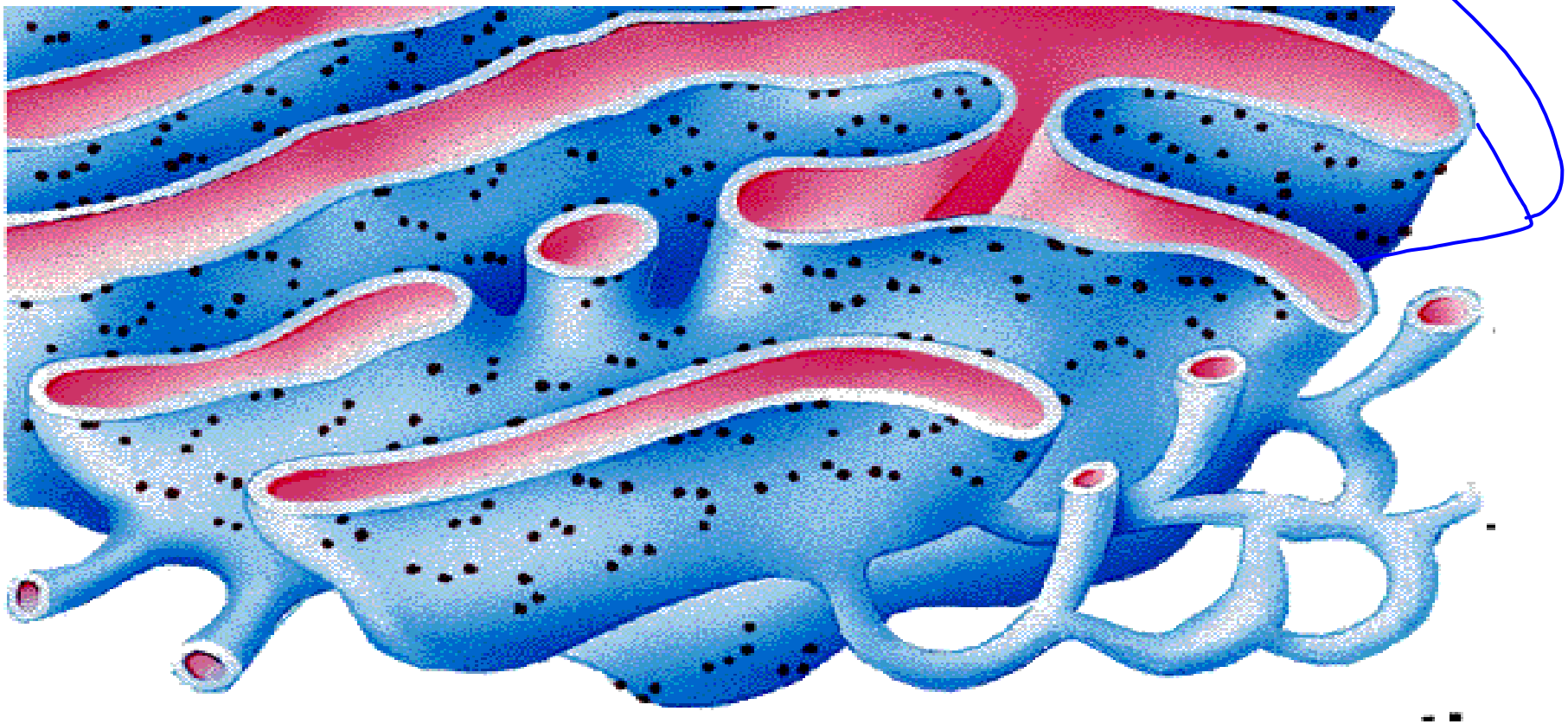
EM of attached ribosome

Endoplasmic reticulum

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

(integral part)

Flattened membrane vesicle



Endoplasmic reticulum

حسب وظيفة الخلية
* تصنيع البروتين Rough اكثر واكبر
* تصنيع Smooth lipids اكثر واكبر

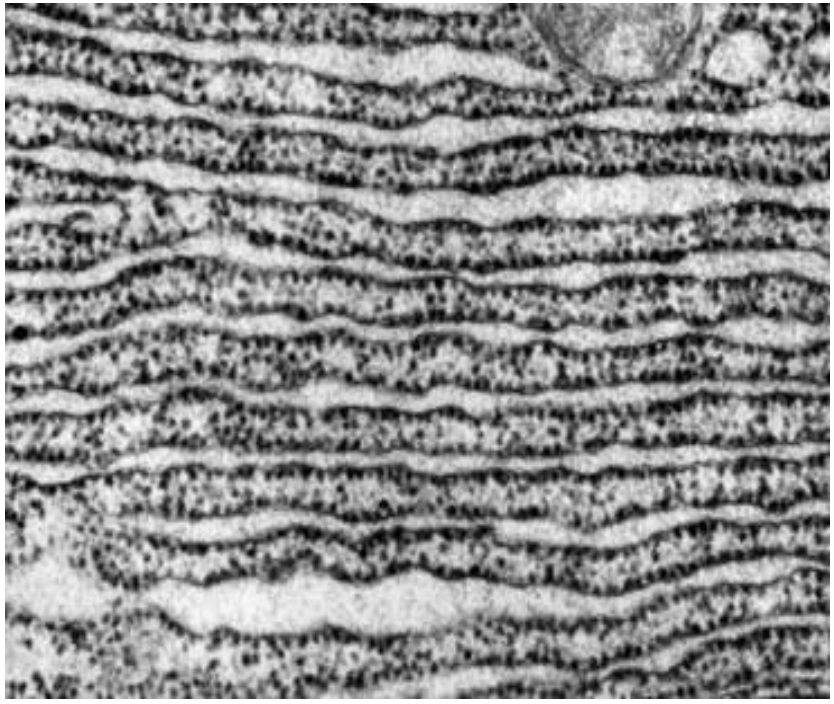
Rough (rER)

- Interconnected cisternae
- Has attached ribosomes

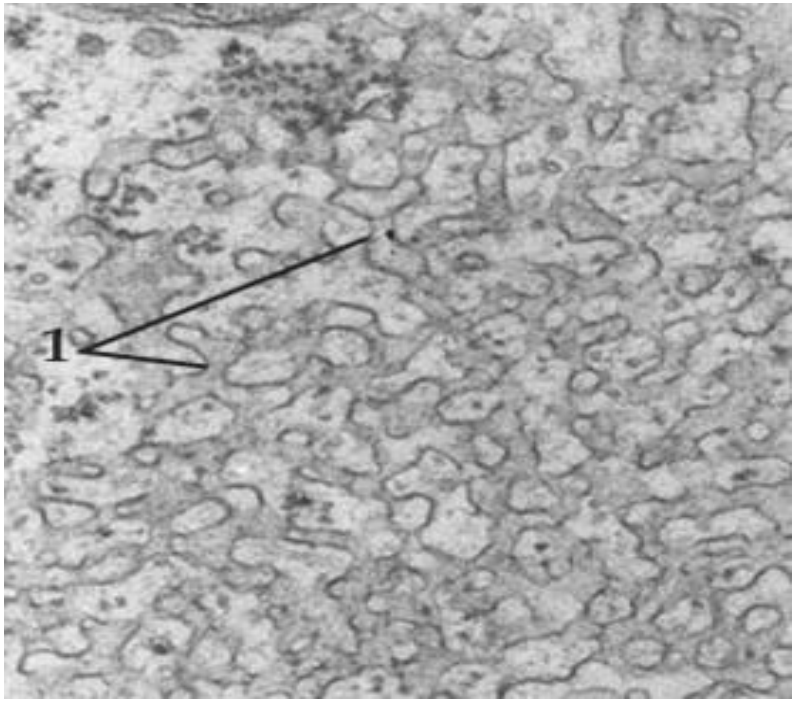
Smooth (sER)

- Interconnected short tubules
- Lacks ribosomes

موصلين مع بعض (شبكة داخلية)



EM



Function

rER

- Participates in protein synthesis.

Role of rER in protein synthesis

1- receiving of polypeptide chains in ER lumen

2- storage

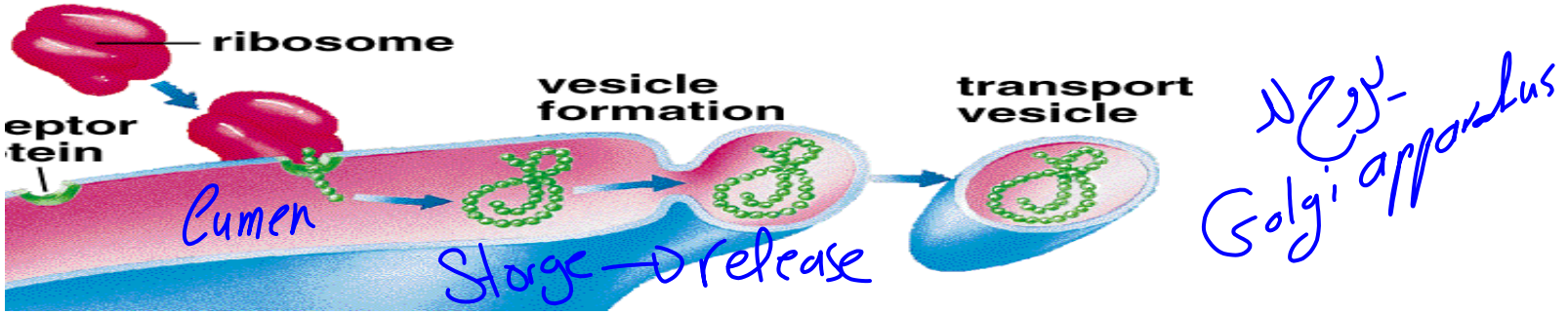
3- protein transport

sER

- ❑ Lipid synthesis (fatty acids , cholestrol & steroid hormones)
- ❑ Detoxification of toxic substance (liver)
- ❑ Muscle contraction

control calcium ions (storage) =sarcoplasmic reticulum

- ❑ Glycogen synthesis



Golgi apparatus

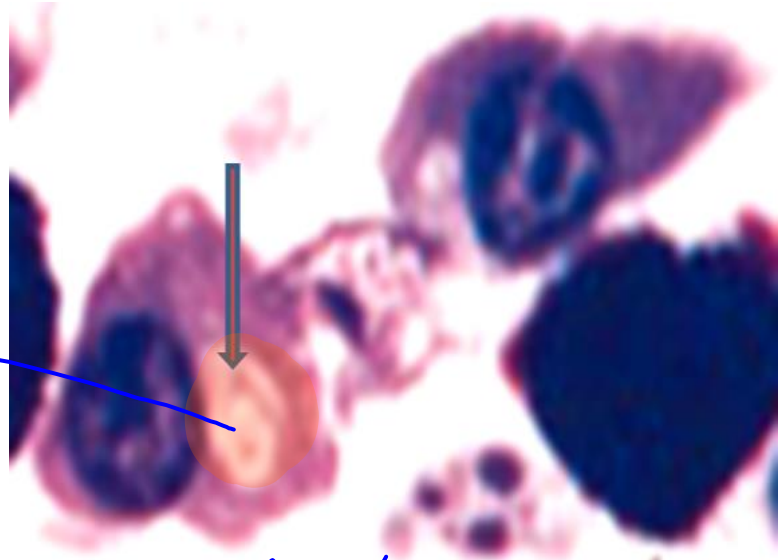
Membranous organelle

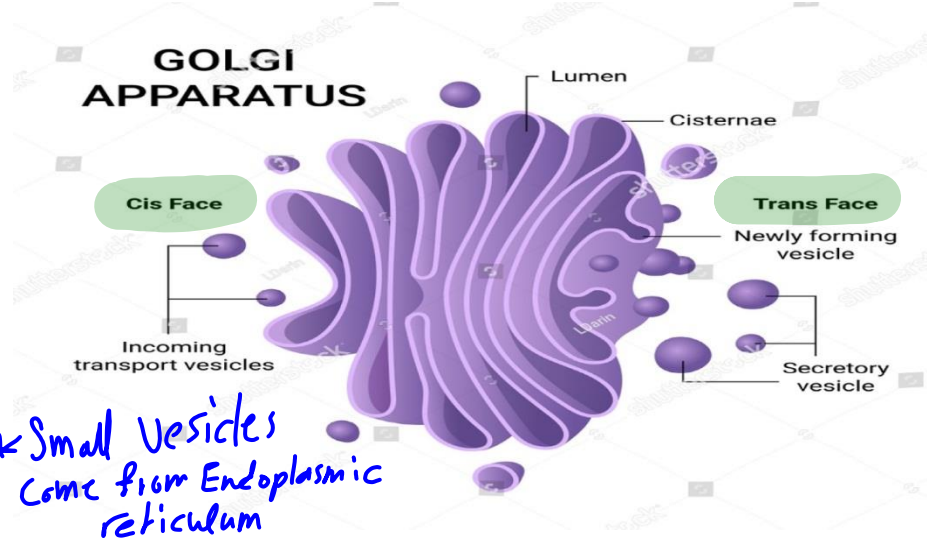
LM:

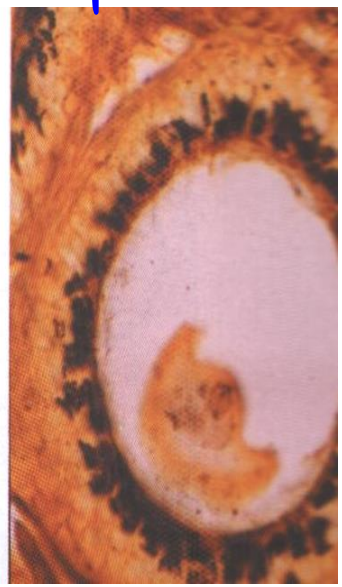
- H&E stain: not apparent (-ve image)
- Special stain: silver stain

E.M.

- Transport vesicles
- Cisternae
- Secretory vesicles







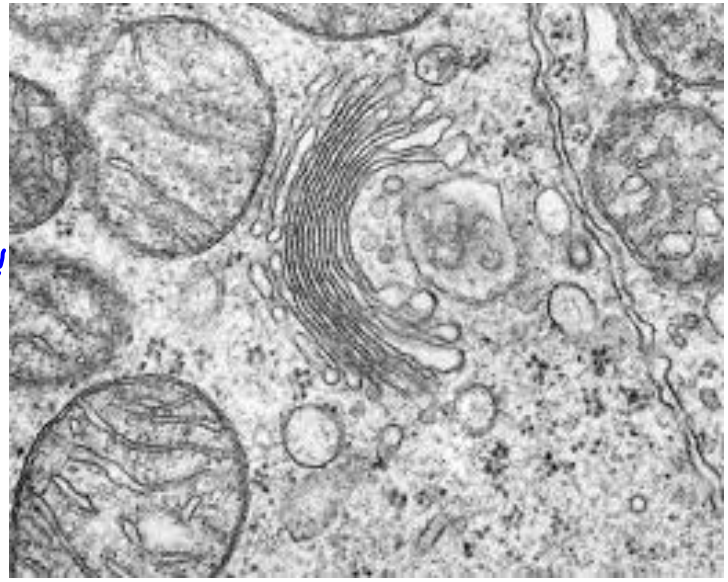
Functions of Golgi apparatus

1- modification of proteins

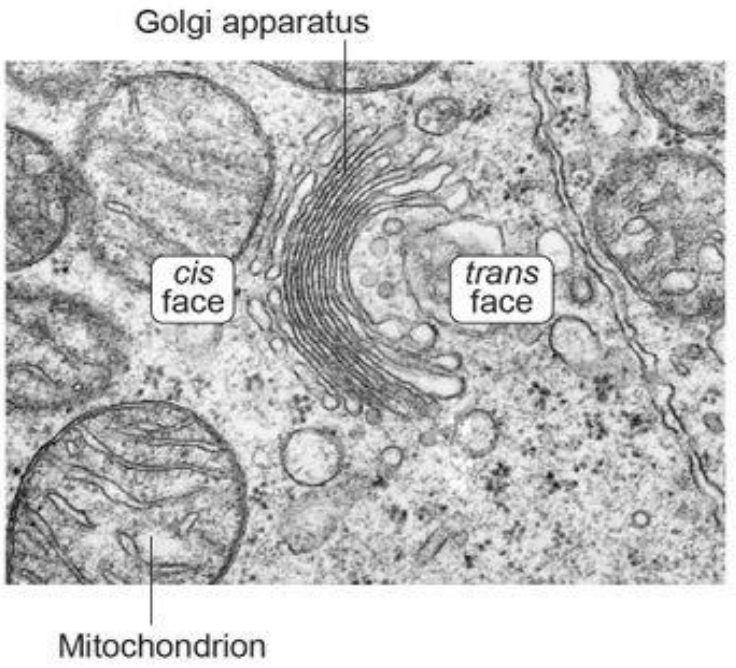
2- Formation of primary lysosomes

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.

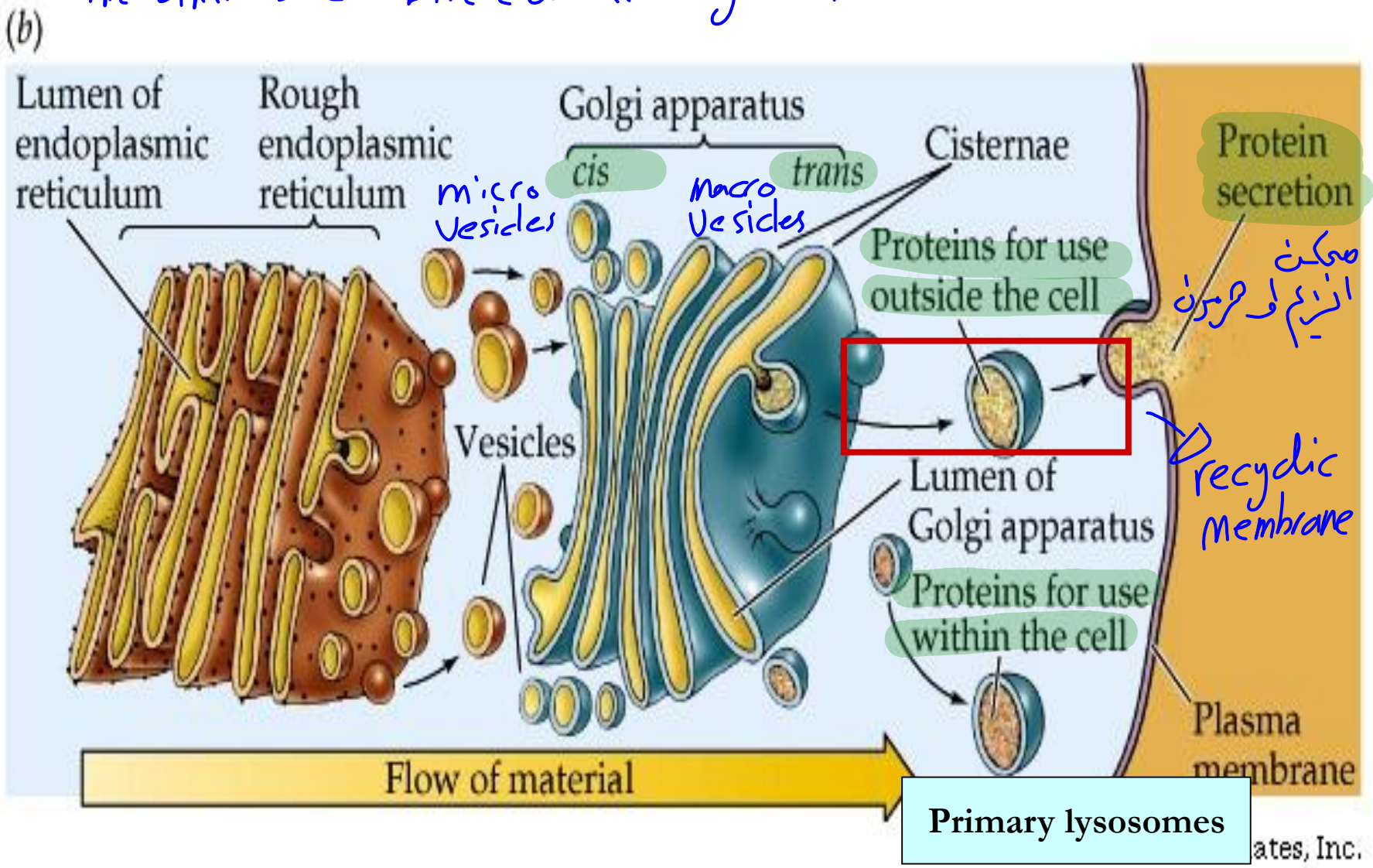


Organelles that participate in protein synthesis

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

Fate of protein transported by rER

* protein leaves the Golgi apparatus to the other side of the cell (exocytosis)

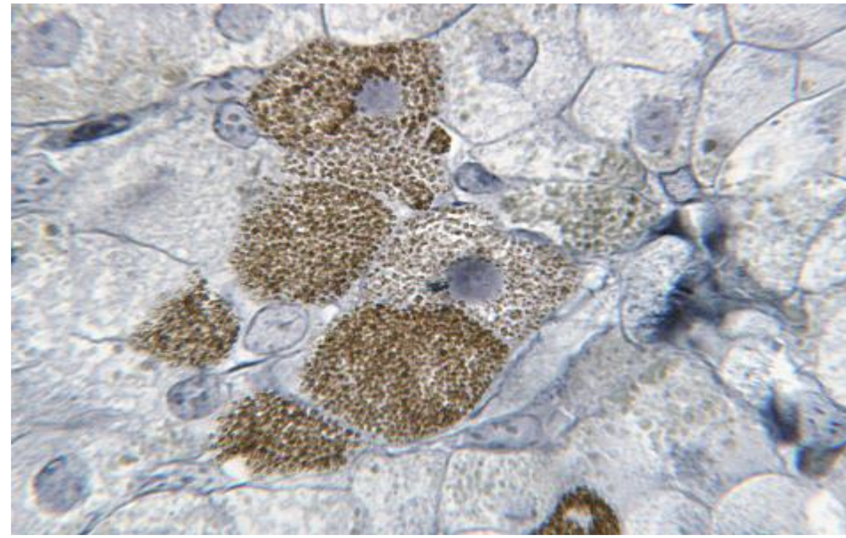


يمكن انزيم او هرمون

Recyclic membrane

Mitochondria

Mitos= thread   chondros= granule



Membranous organelles

LM:

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

EM

Double membranes:

-Outer smooth (large number of enzymes)

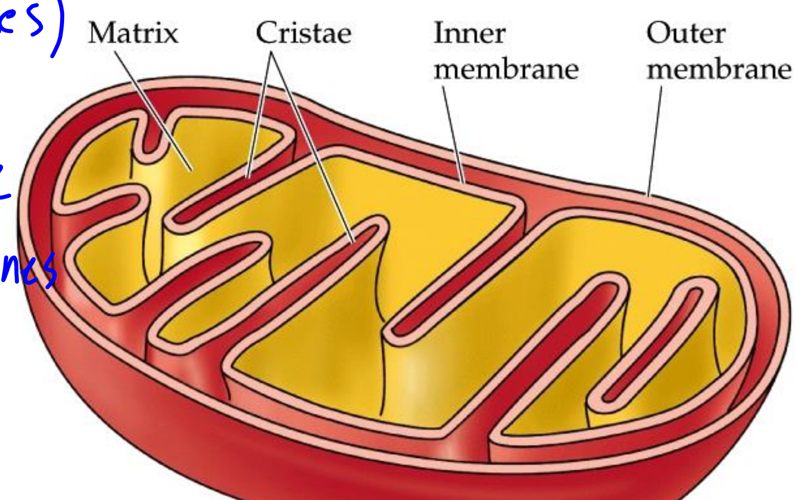
-Inner folded forming cristae to increase the Surface

Double spaces:

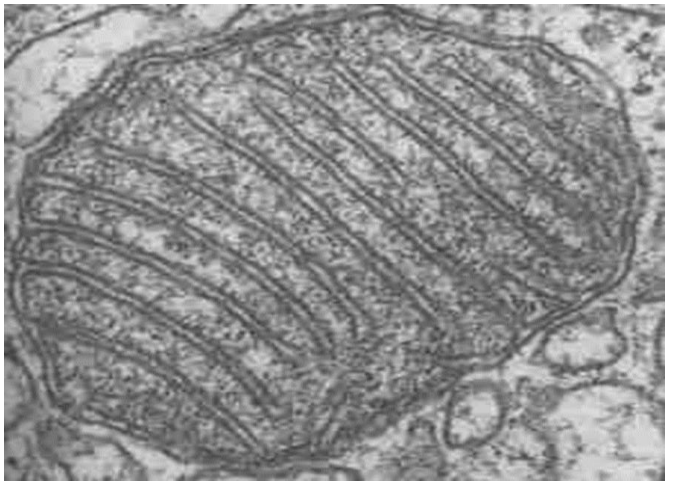
- -intermembranous space between two membranes
- - intercristal space (matrix space)

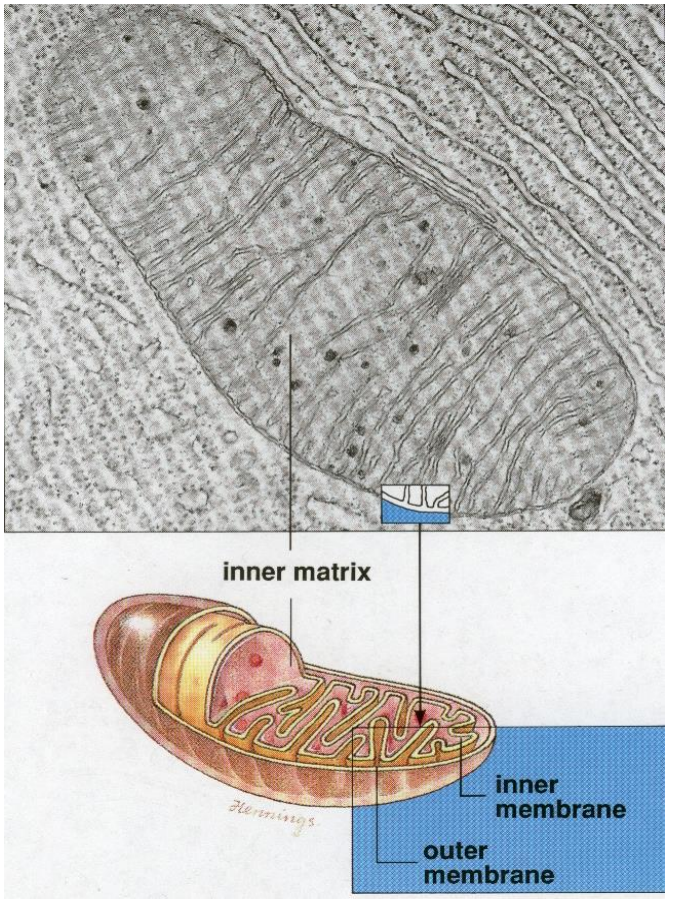
enzymes فيها موجودة

own DNA



- 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.

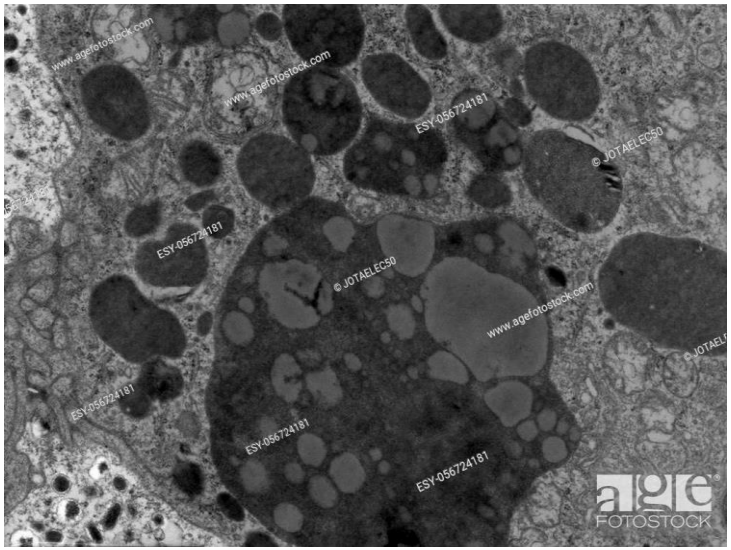
	Mitochondria	Peroxisome
E.M	Variable shape & surrounded by 2 membrane	Spherical surrounded by a single membrane
Function	Responsible for ATP synthesis highly active cell	➢ **No ATP** synthesis so unable to store energy ➢ Contain enzyme for B oxidation of fatty acid, energy released as heat for maintenance of body temperature ➢ Contain enzymes for regulation of hydrogen peroxide ➢ Synthesis of cholesterol & bile acid ➢ Detoxification of alcohol H_2O_2
Abundant in	All tissues particularly cardiac muscle	Particularly in the liver Smooth endoplasmic } peroxisome

Lysosomes (digestive System)

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 inside the cell
- **Programmed for cell death** break down the cell when it dies, called **"suicidal bags"** of the cell

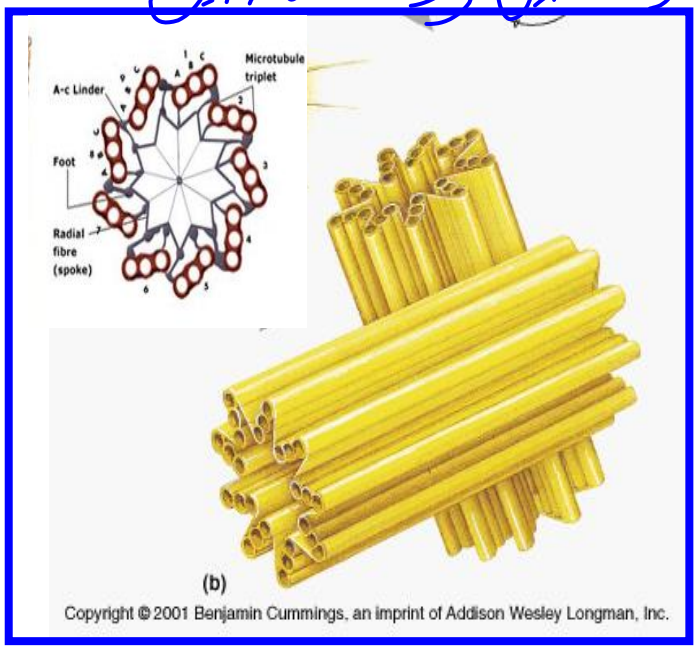
long-lived cells (cardiac muscle and nerve cells)

Centrosome

Non membranous organelle

Structure:

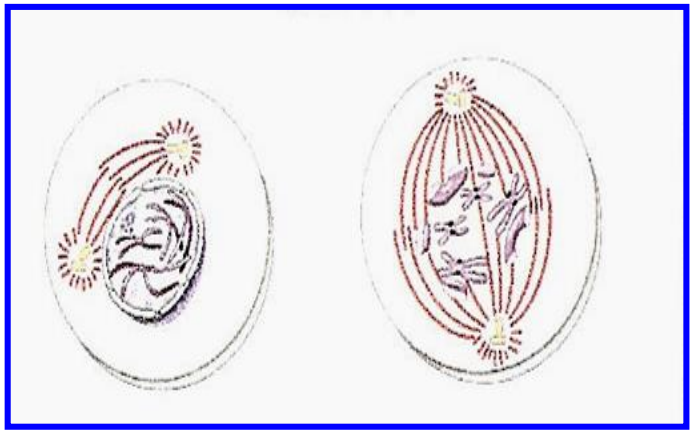
- An associated **pair** of centrioles, arranged **perpendicularly** to each other
- each composed of sets of **microtubules** arranges to form a cylinder.
- The walls of each centriole are usually composed of **nine triplets** of microtubules



Function:

It is called microtubules organizing center

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



Cilia & Flagella

الأساس بالسنتروسوم
Centrosome

Cilia (cilium) :

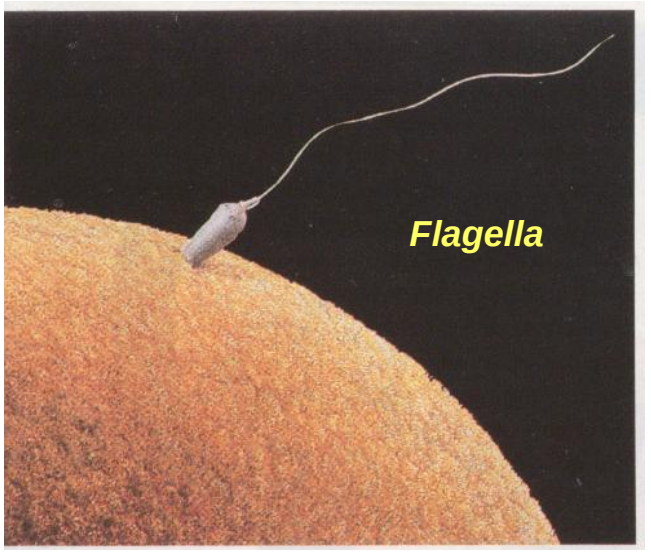
- project from cell surface, cylindrical in shape & enclosed by membrane.
- Contain microtubules.
- **Numerous** in certain cells e.g. cells that line **respiratory tract**

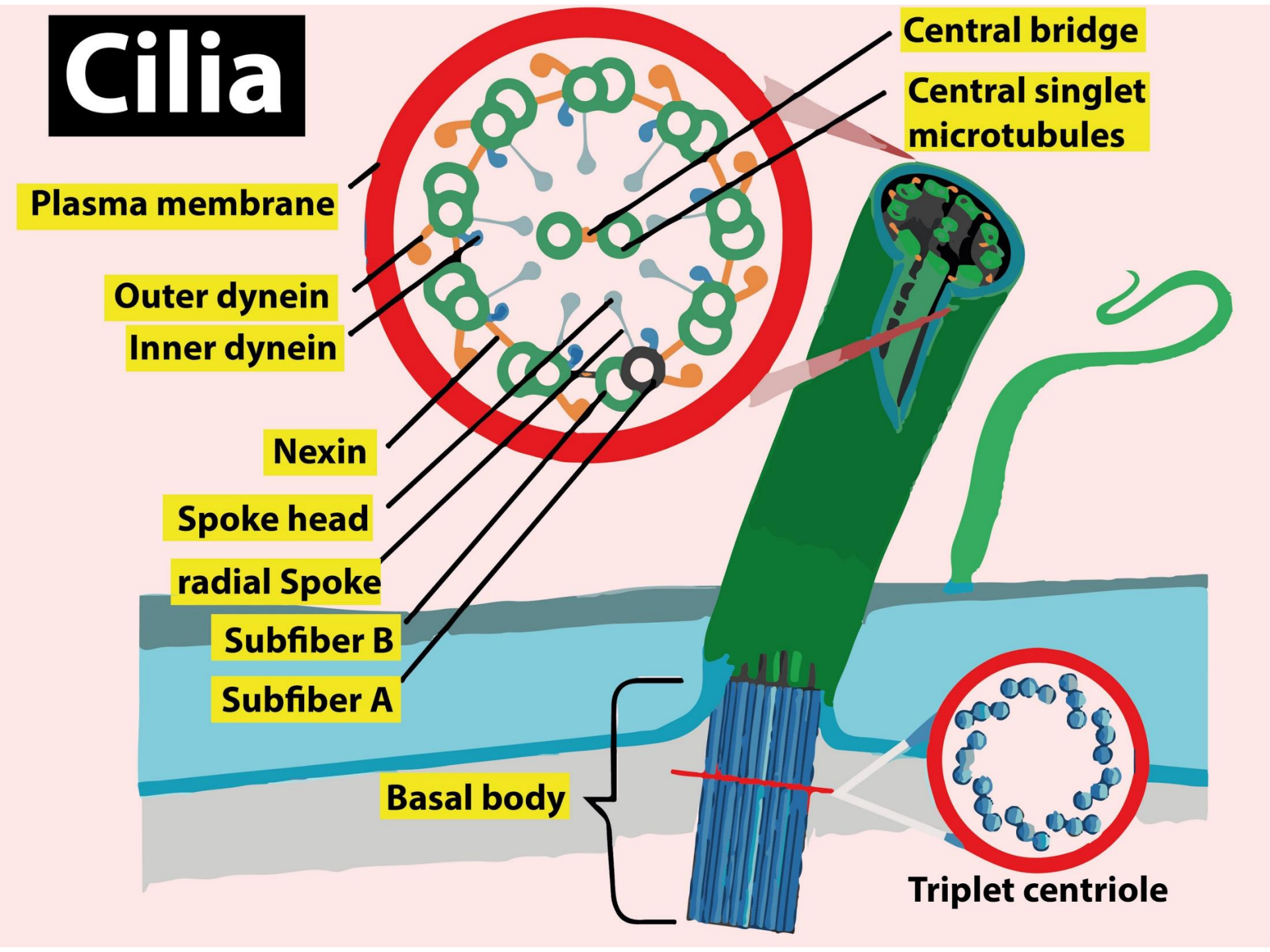
Flagella (flagellum) :

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
Central bridge
Central singlet microtubules
Plasma membrane
Outer dynein
Inner dynein
Nexin
Spoke head
radial Spoke
Subfiber B
Subfiber A
Basal body
Triplet centriole

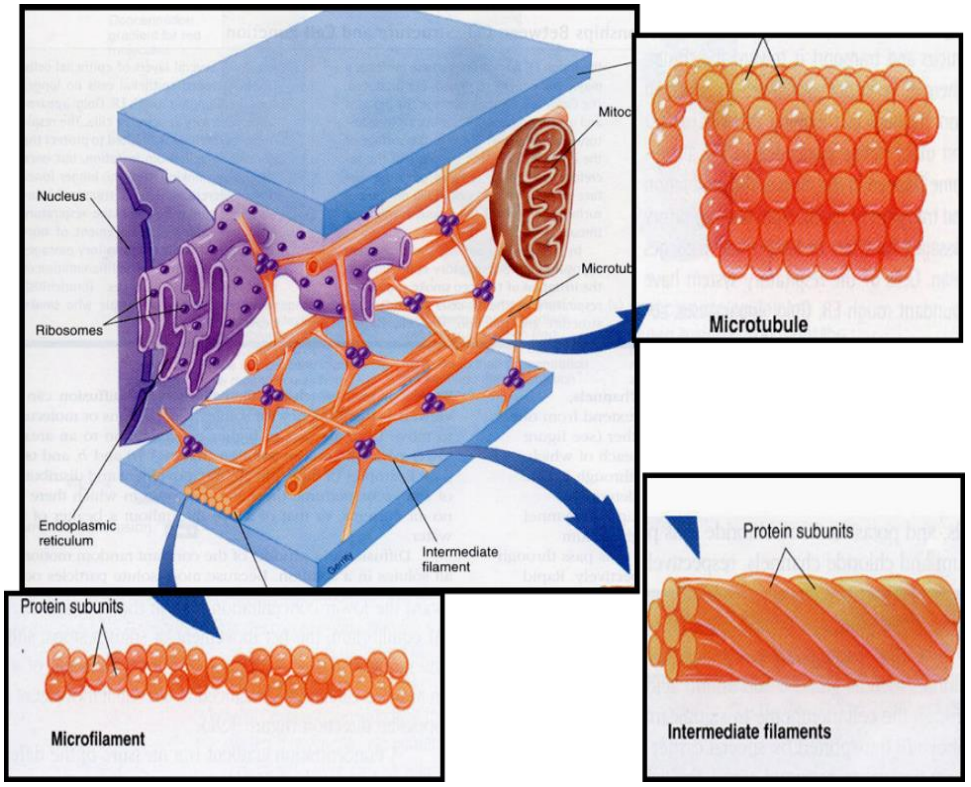
Cytoskeleton

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

Keratin



Function

- Support
- Motility
- Regulation of internal structure

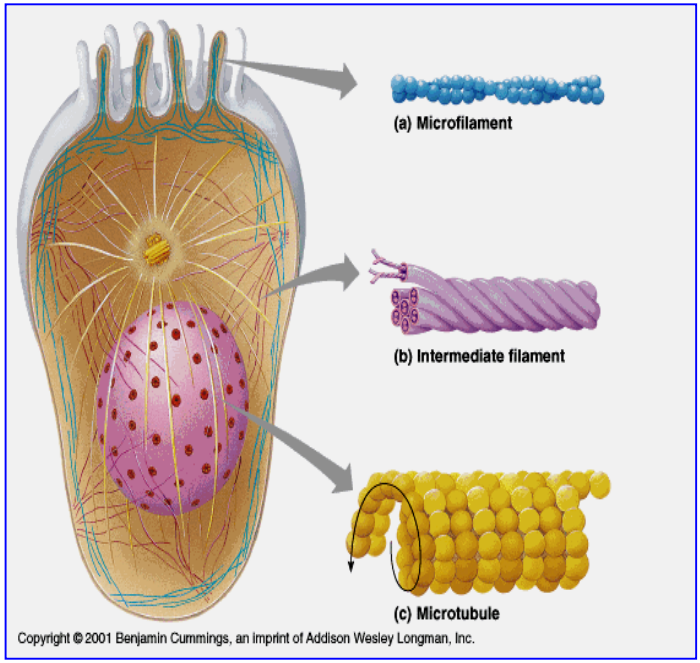
The cytoskeleton of eukaryotic cells is **not stable**, but is always being **assembled** & **disassembled**

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**.

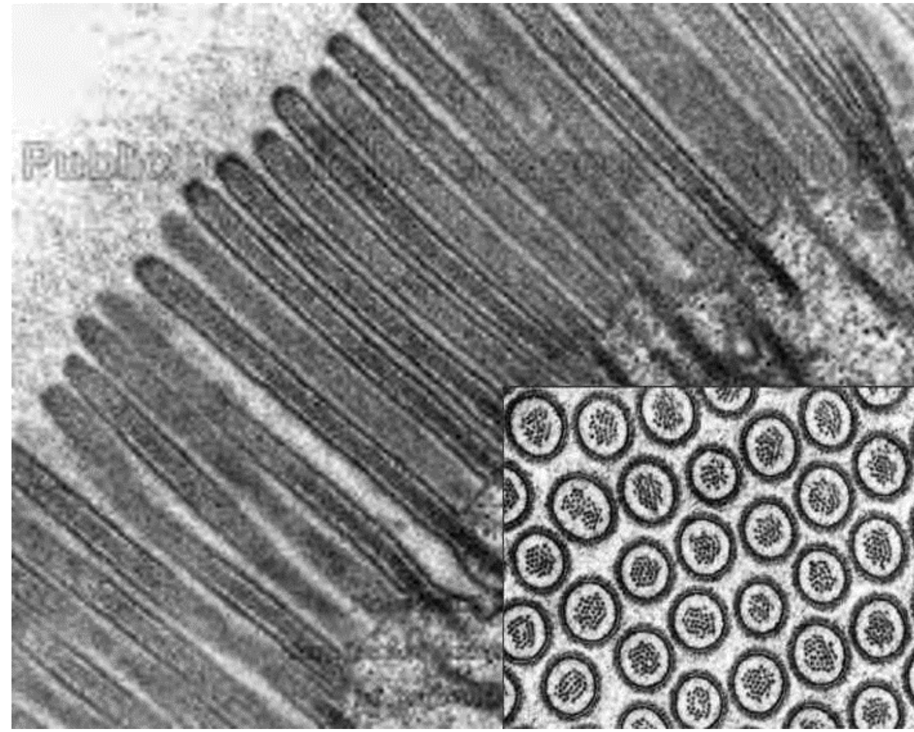
Intermediate Filaments: Bigger than microfilaments but smaller than microtubules, provides **tension bearing Permanent fixtures** of cells (**do not move**) Present only in **animal cells** of certain tissues

Microvilli : actin filaments

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

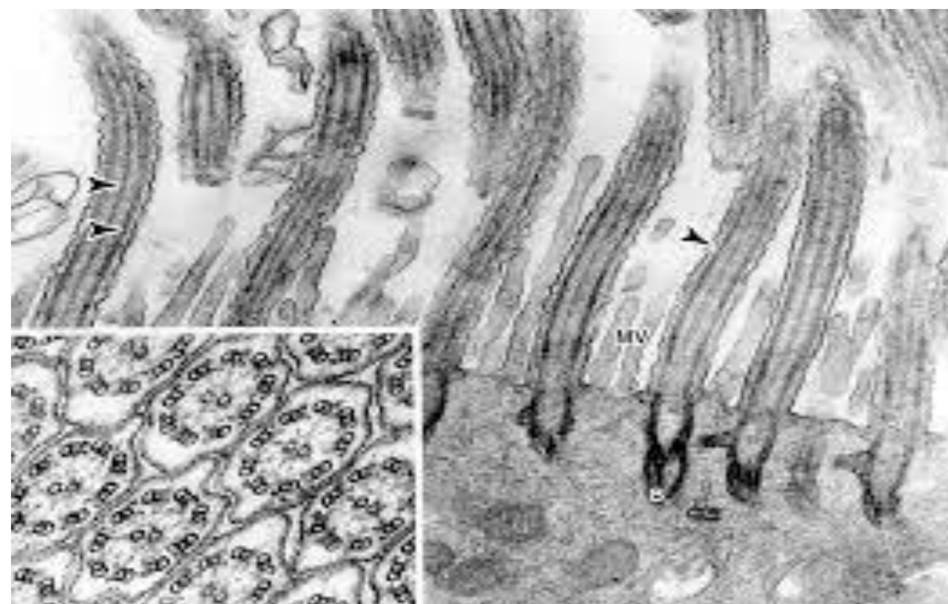
Function :

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

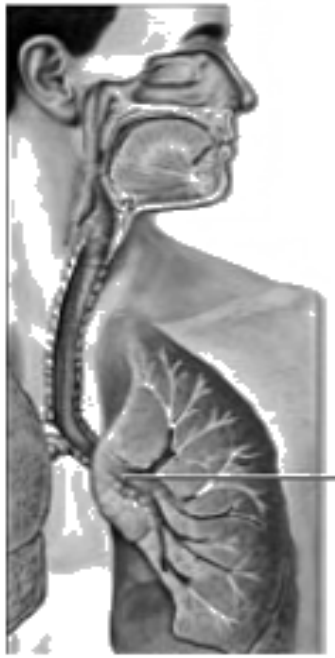
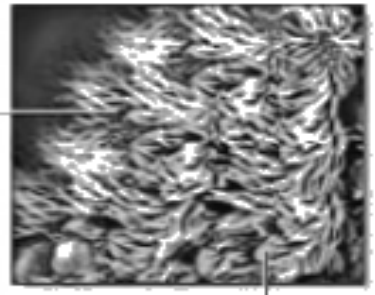
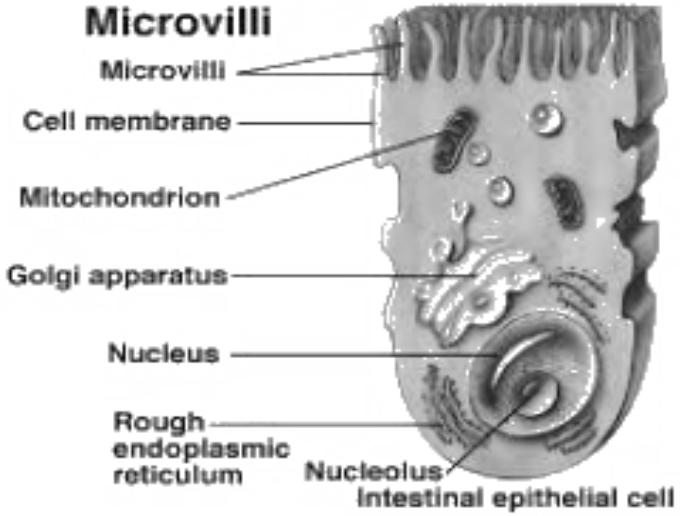


Sterocilia

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

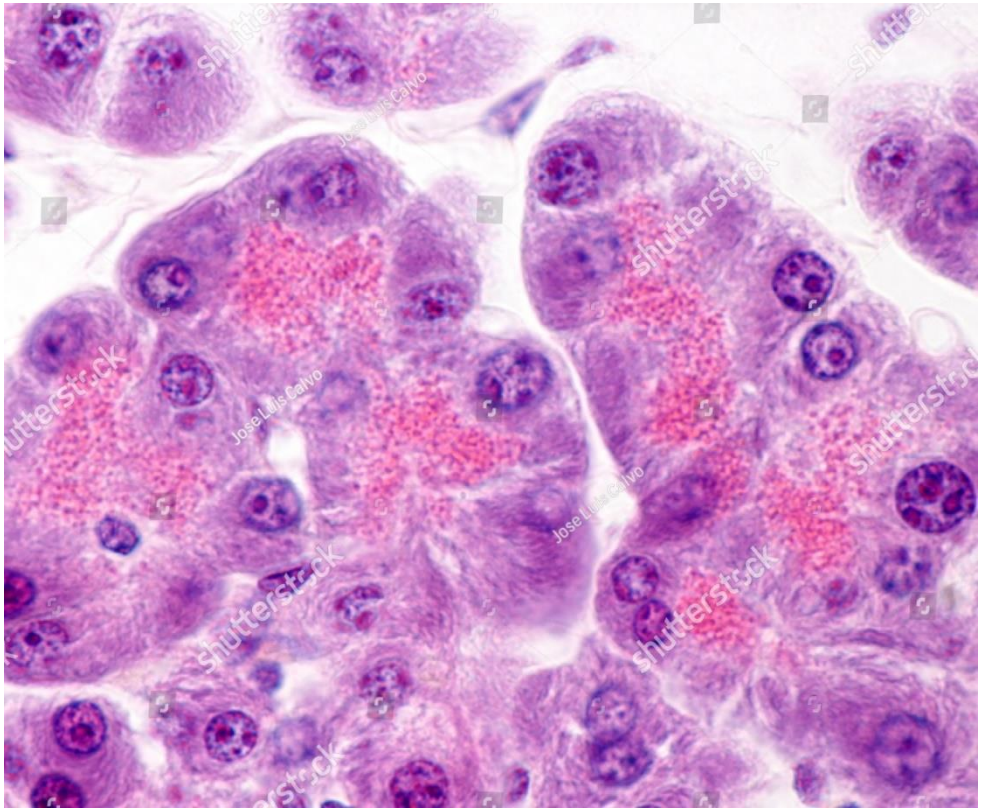


Cilia vs Microvilli

Cilia (tall)	Microvilli
 Hair-like projections called cilia line the primary bronchus to remove microbes and debris from the interior of the lungs 	
Occur in cells of respiratory and reproductive tracts.	Found in intenstine; where absorption an 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 structu

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:

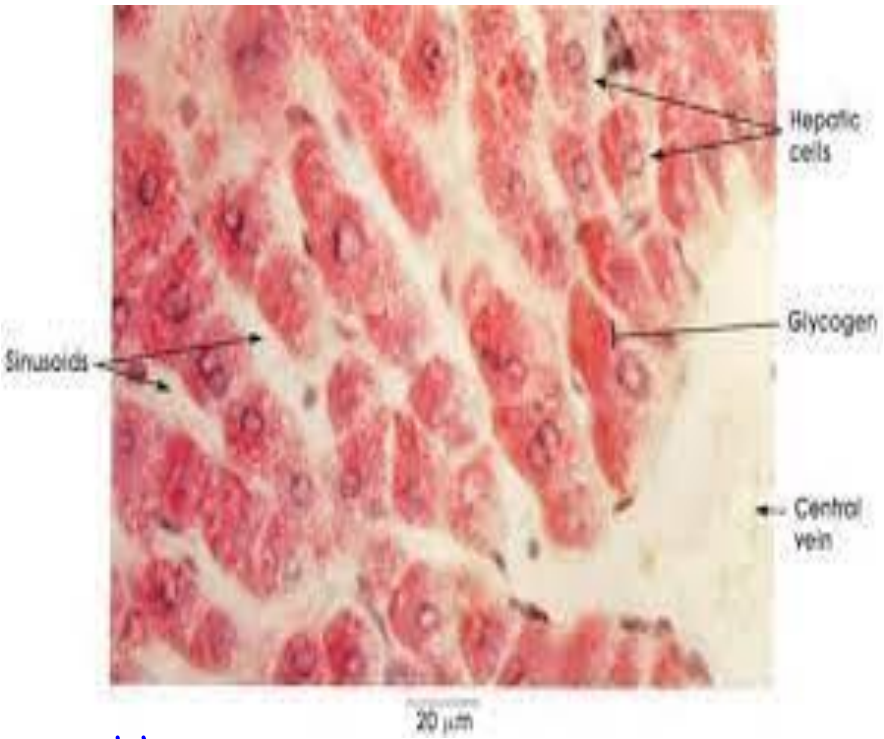
- ❑ **Endogenous:** in the skin
  - **e.g.** Melanin storage of pigment
  - Lipofuscin age pigment or waste product accumulation

Hemosiderin storing excess iron

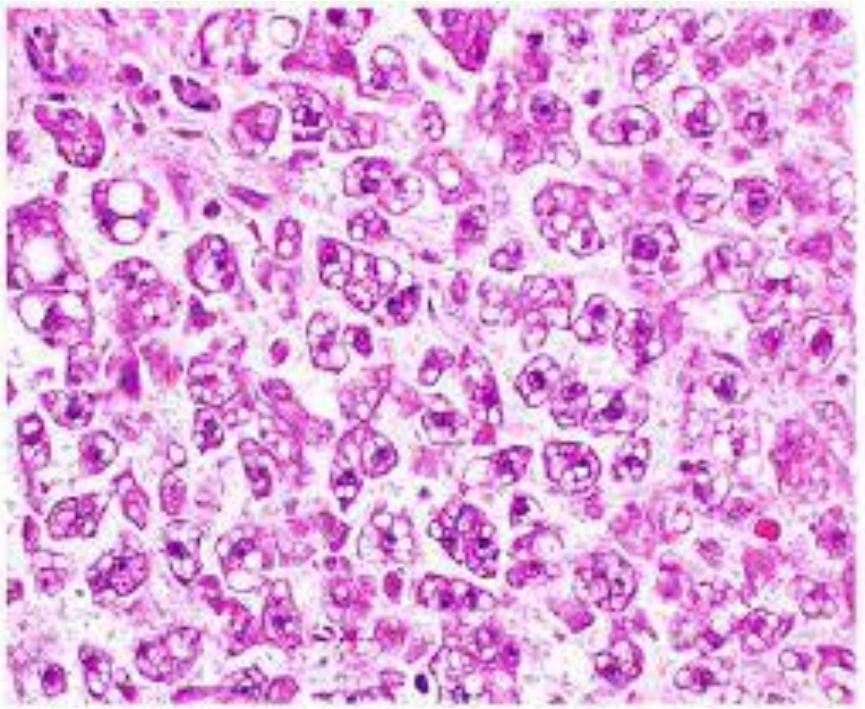
- ❑ **Exogenous :**

e.g. Carotene, carbon particles

Glycogen



Lipid



portical

* البروتينات التي تخزن تسمى regularity proteins