

# Functions of the cell membrane

## Control exchange of materials (semipermeable)

**Small molecules  
(micromolecules)**

- 1-Simple diffusion**
- 2-Active transport**

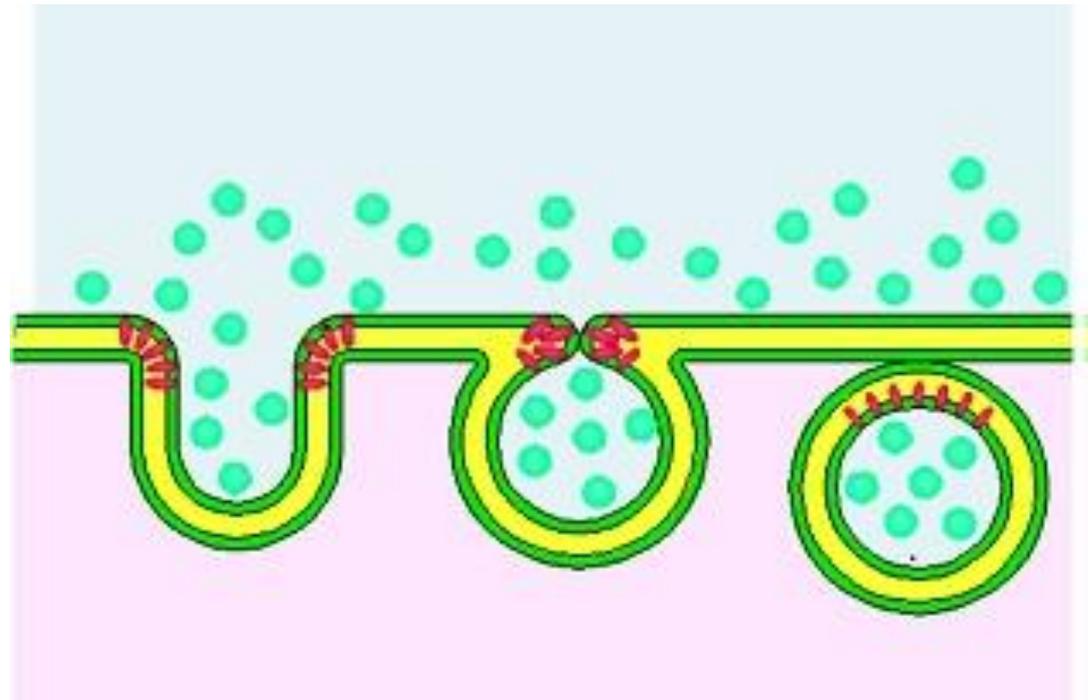
**Large molecules  
(macromolecules)**

- 1-Endocytosis**
- 2- Exocytosis**

# i-Endocytosis

**Inside = internal**

**Intake of molecules to the inside of cell.**



# Transport of macromolecule (vesicular transport)

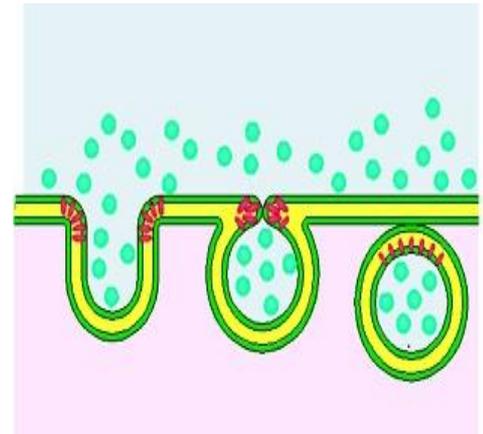
## 1-Endocytosis

Inside = internal

Intake of molecules inside the cell.

3 mechanisms:

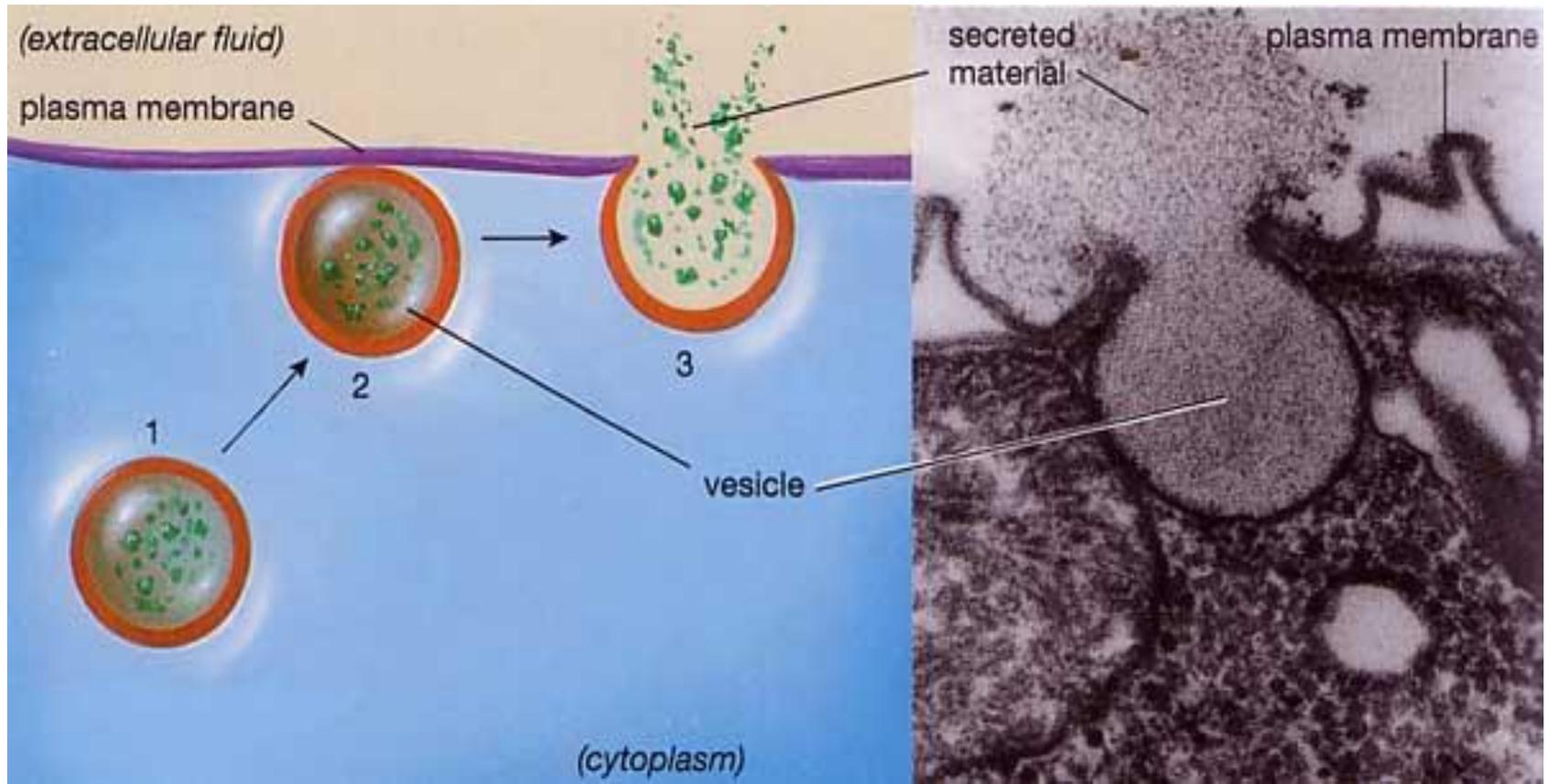
- Pinocytosis (cell drinking)
- Receptor-mediated endocytosis
- Phagocytosis (cell eating)



# 2-Exocytosis

**External = outside**

**Release of cell products into the extracellular environment.**



# Types of exocytosis

## 1- Regulated secretion:

- *stimulus-dependent*
- *secretory granules*

## 2- Constitutive secretion:

- **continuous**
- **without a stimulus**
- **transport vesicles**



# 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

# Organelles

## Little organs:

- Living structures
- Metabolically active
- Perform certain functions
- Permanent
- Present in all cell types

## Types:

- *Membranous organelles*
- *Non-membranous organelles*

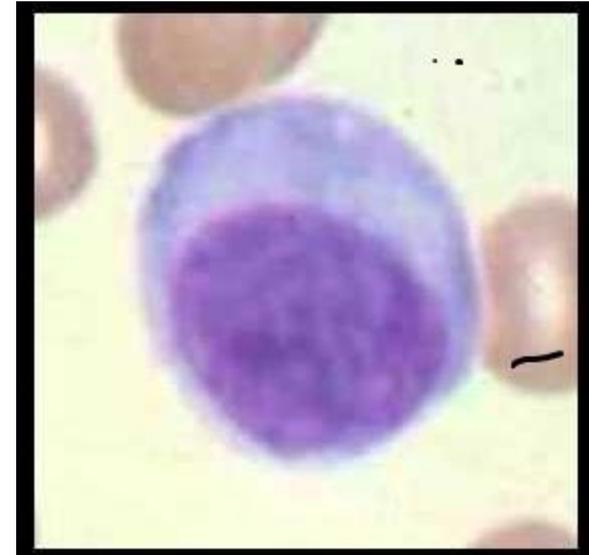
# Ribosomes

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

## -Structure:

### LM:

By H&E stain: can not be seen  
if large in number they impart  
**Cytoplasmic basophilia.**



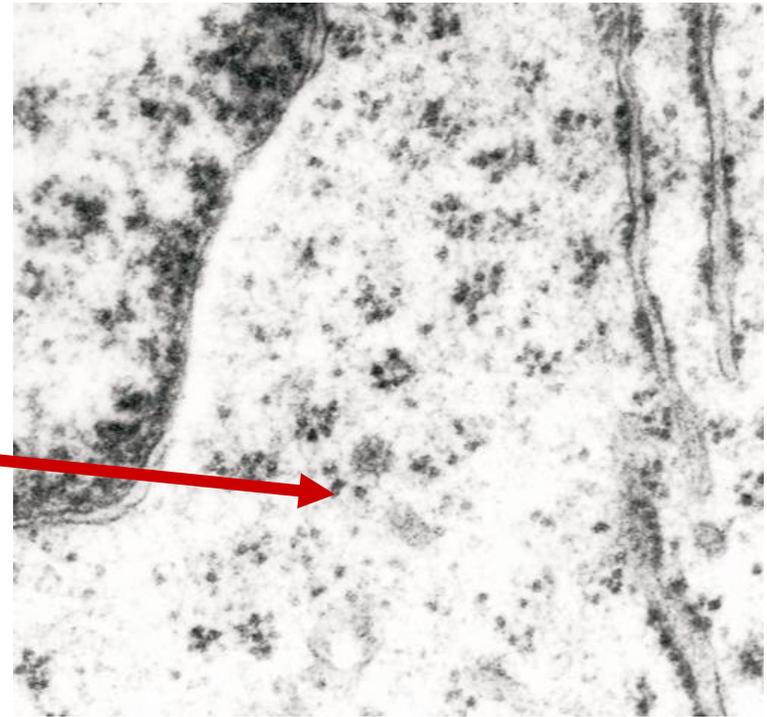
# EM :

Electron dense granules

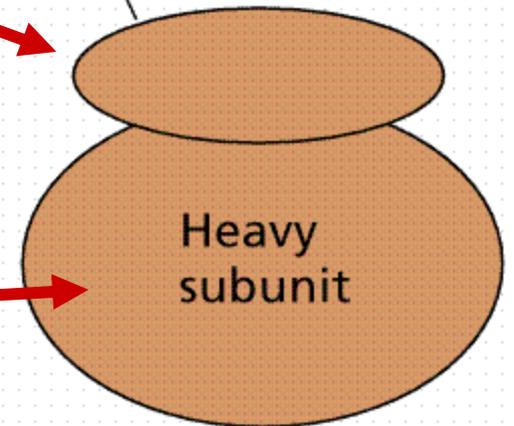
2 subunits:

Small subunit (RNA+30 P)

large subunit (2RNA+40 P)



Ribosome  
Light subunit



# ***Types of ribosomes***

```
graph TD; A[Types of ribosomes] --> B[Free]; A --> C[Attached]; B --> D[Solitary]; B --> E[Polysomes];
```

***Free***

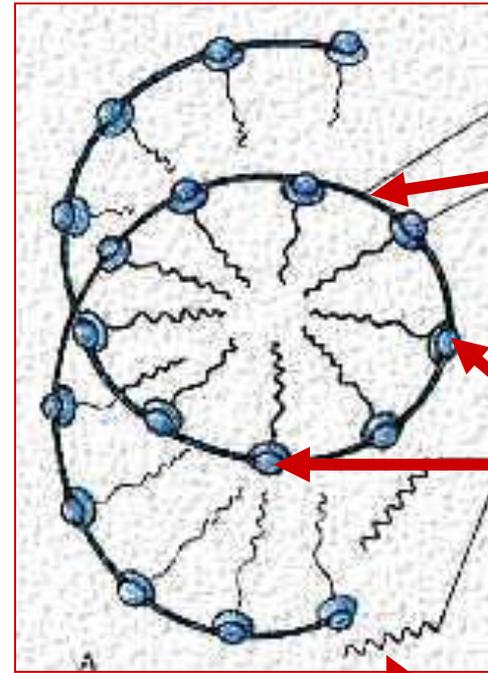
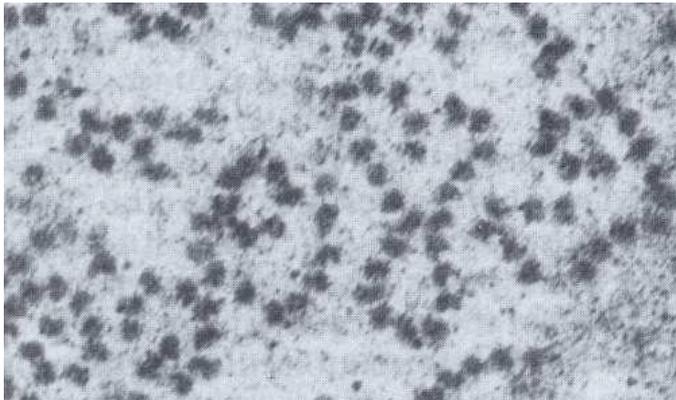
***Attached***

***Solitary***

***Polysomes***

# Polysomes

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

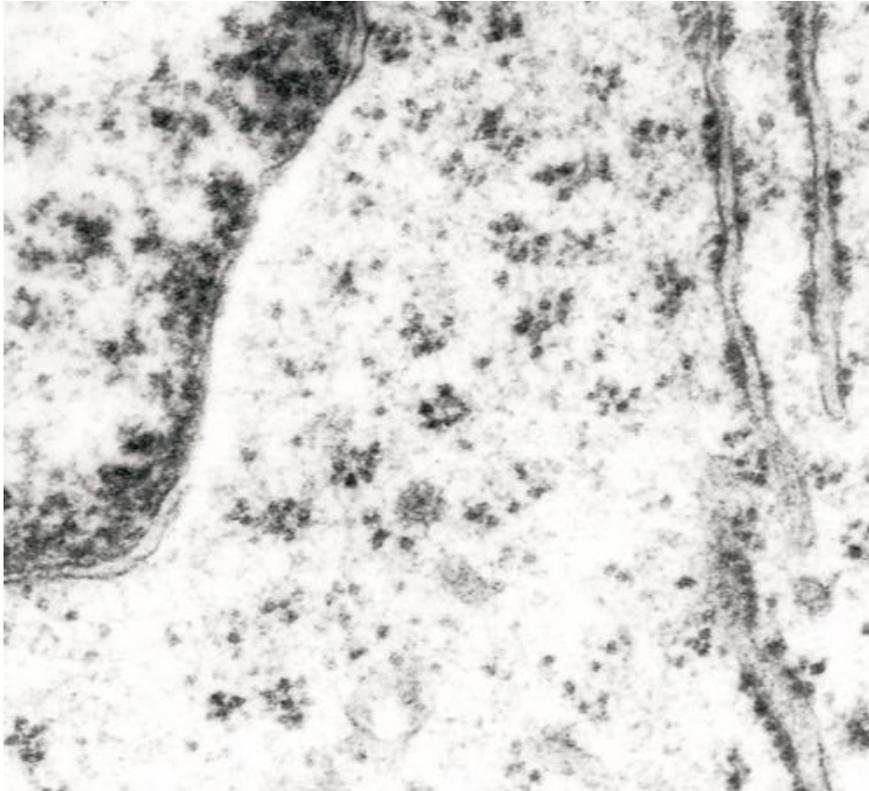


***mRNA***

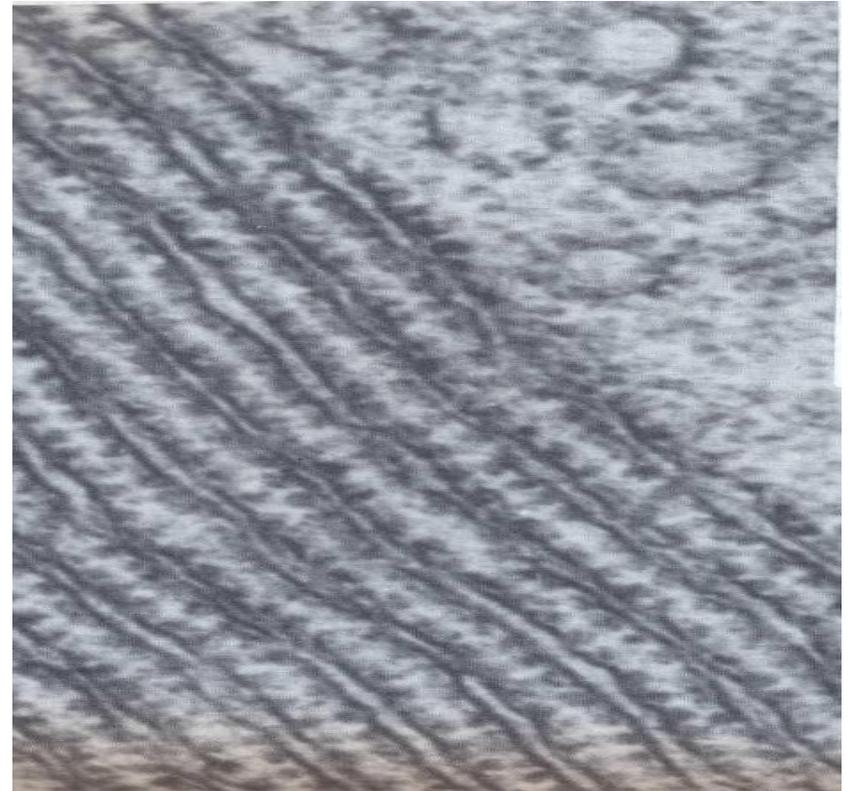
***ribosomes***

***Free protein in cytoplasm***

EM of free  
ribosome



EM of attached  
ribosome



# Function of ribosomes

**Ribosomes are the sites of protein synthesis:**

**Solitary: reserve**

**Polysomes: proteins used by the cell**

**Attached: proteins for secretion outside the cell**

# Endoplasmic reticulum

- *Membranous organelle*
- *Network of interconnecting tubules and cisternae*



# ***Endoplasmic reticulum***

```
graph TD; A[Endoplasmic reticulum] --> B[Rough (rER)]; A --> C[Smooth (sER)];
```

***Rough***  
***(rER)***

***Smooth***  
***(sER)***

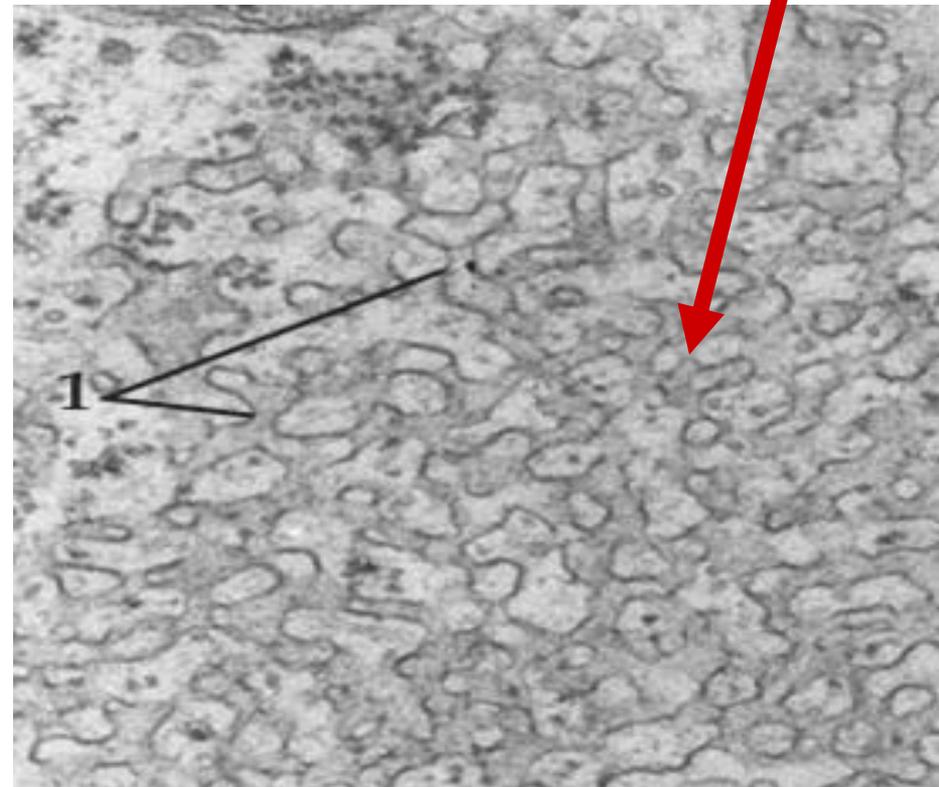
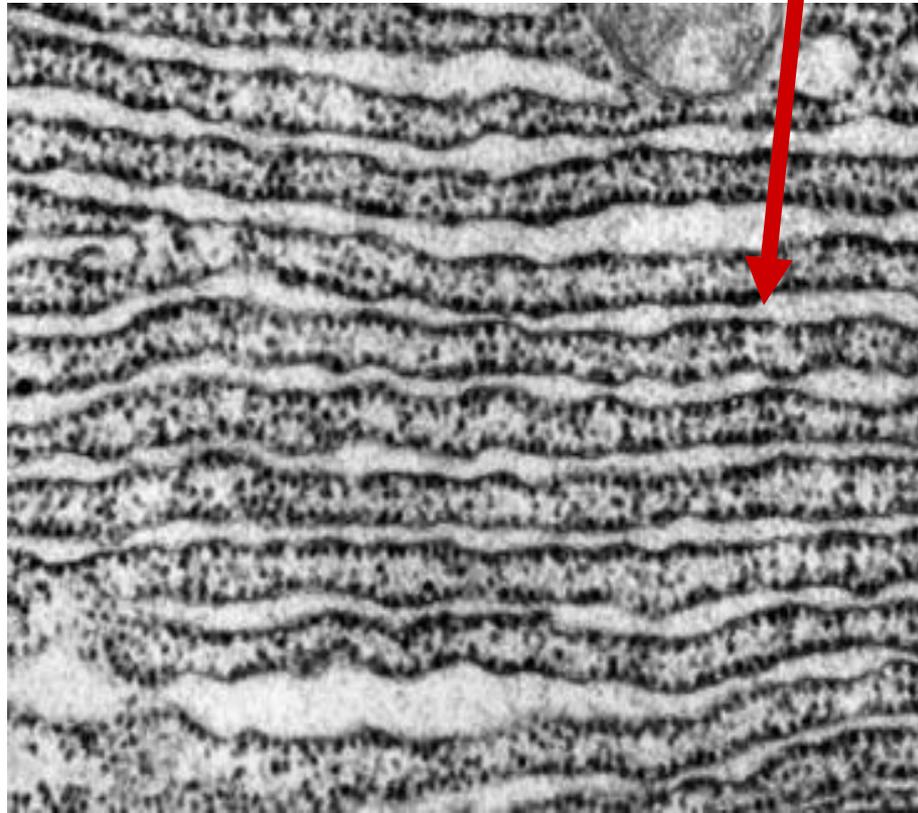
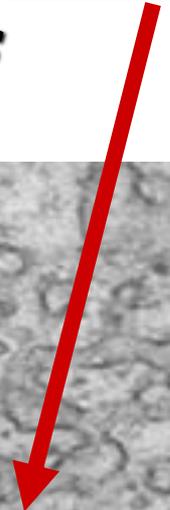
rER

sER

***EM***

**Interconnected cisternae**  
**Has attached ribosomes**

***Interconnected tubules***  
***Lacks ribosomes***



rER

*SER*

## Function

Participates in protein synthesis.

**1- Lipid synthesis** (*fatty acids ,cholesterol & steroid hormones*)

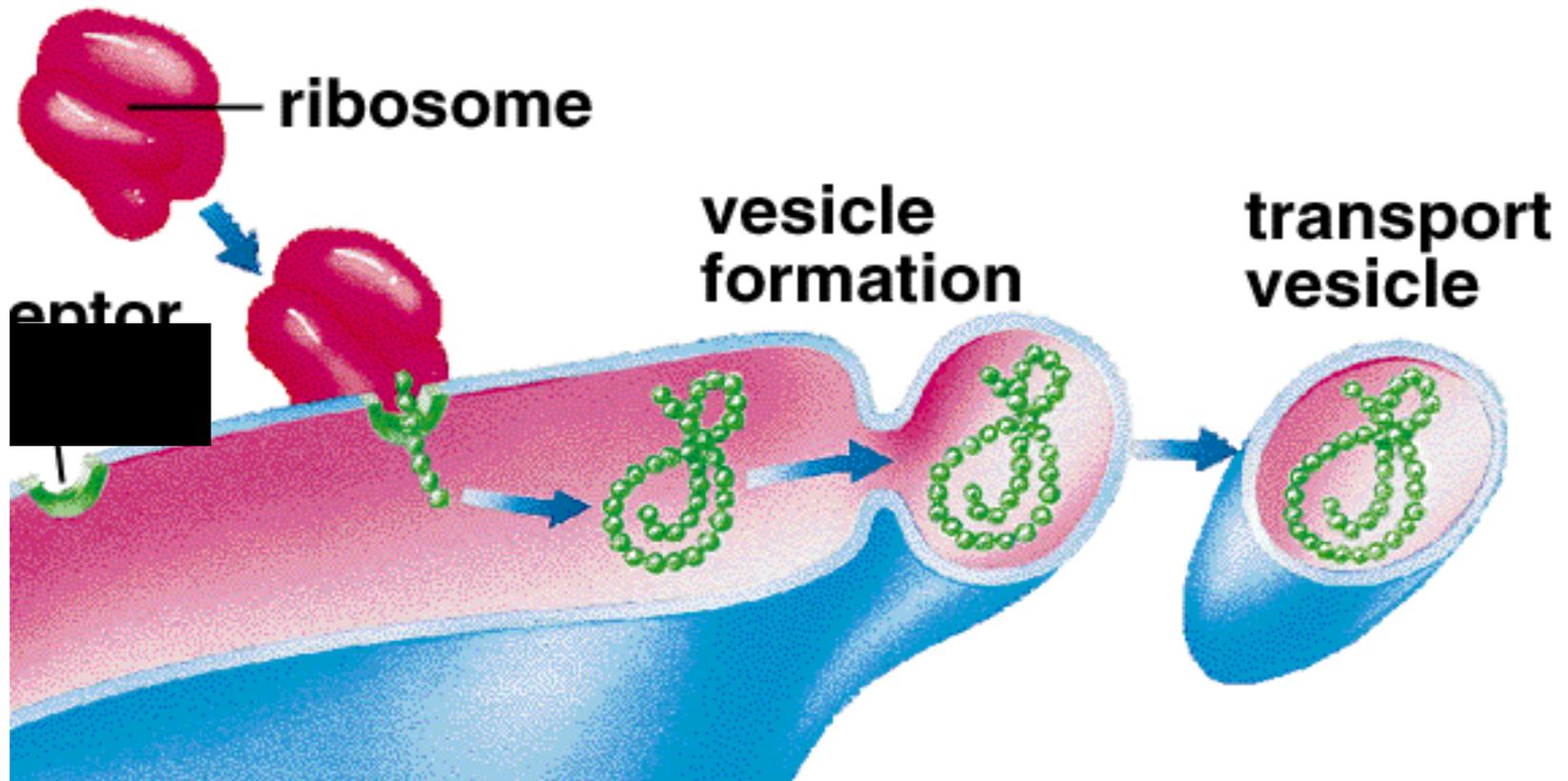
**2- Detoxification of toxic substance**

**3- Muscle contraction** (*control calcium ions - sarcoplasmic reticulum*)

**4- Glycogen synthesis**

# Role of rER in protein synthesis

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



# Golgi apparatus

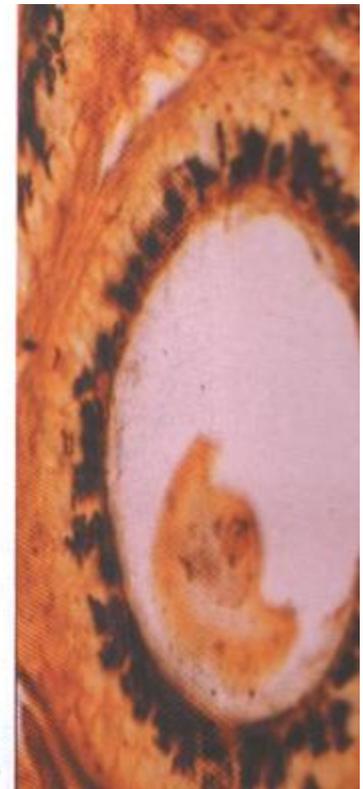
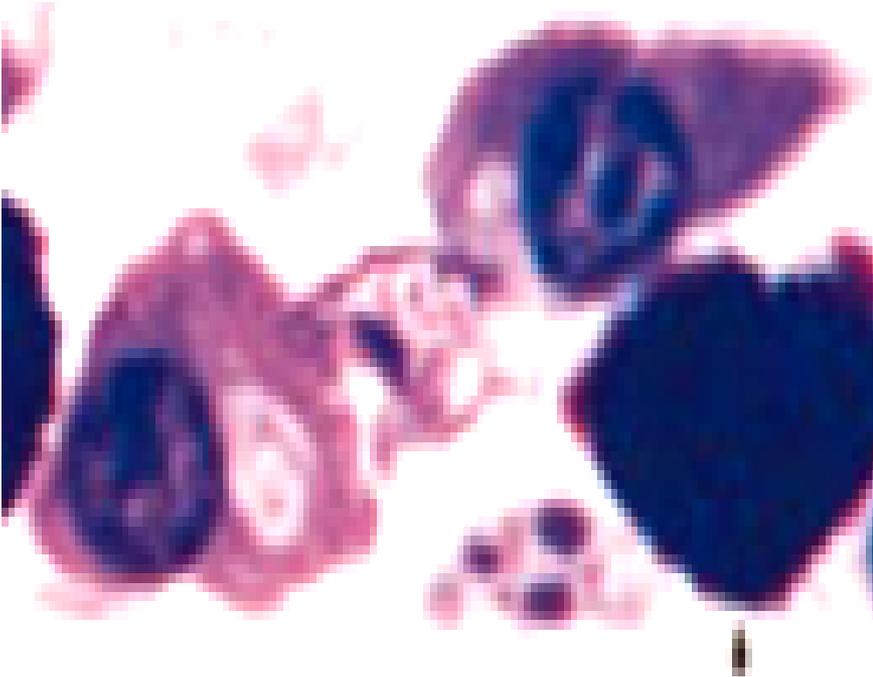
- Membranous organelle

*Structure:*

LM:

- *H&E stain: not apparent*

*Special stain: silver stain*



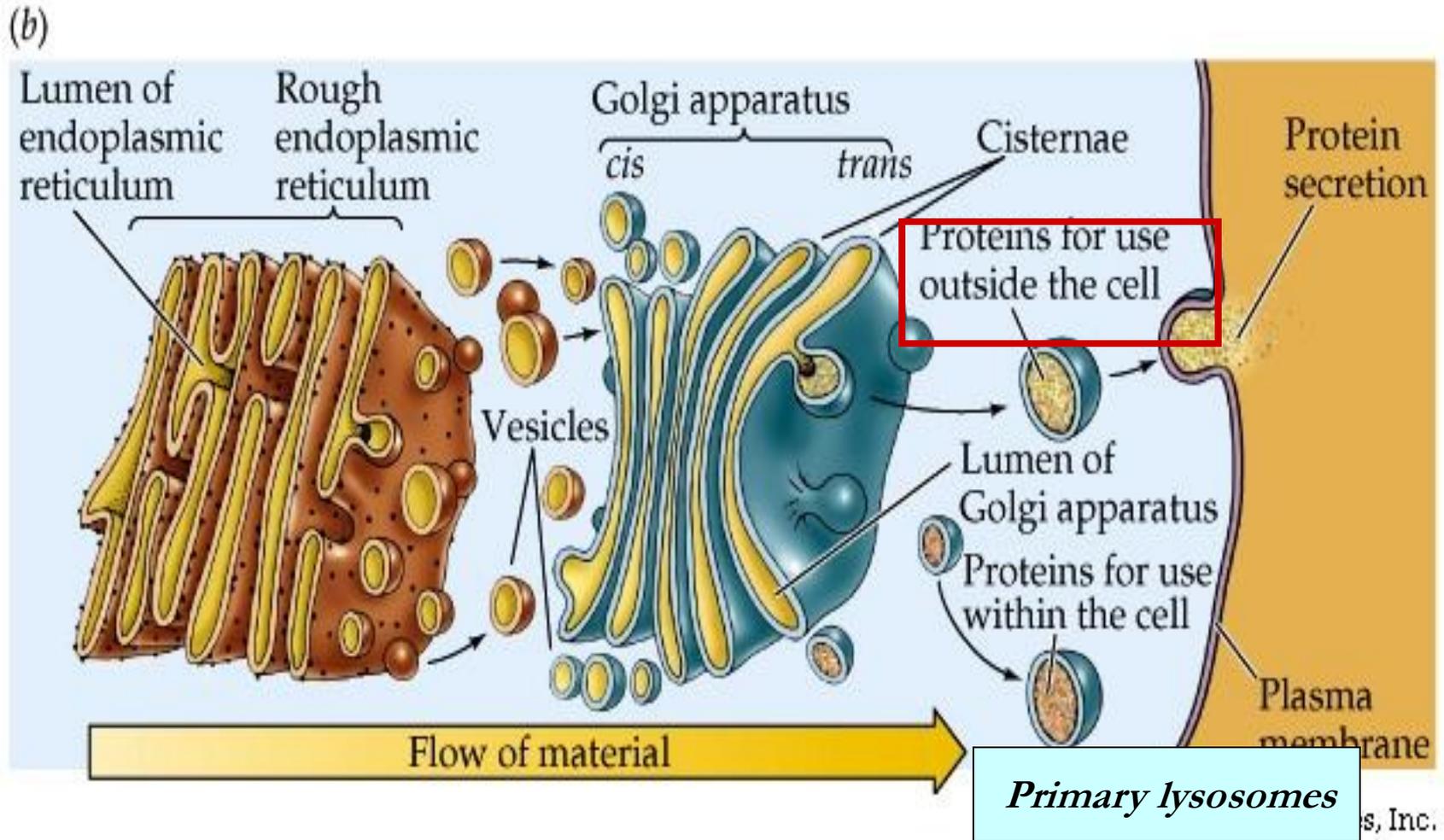
# Functions of Golgi apparatus

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

**Cytoplasmic Organelles that participate in the process of protein synthesis**

- 1- Ribosomes (factories)**
- 2- Rough endoplasmic reticulum (storage & transport)**
- 3- Golgi apparatus (chemical modification & secretion)**

# Fate of protein transported by rER



# Mitochondria

*Mitos = thread*

*chondros = granule*

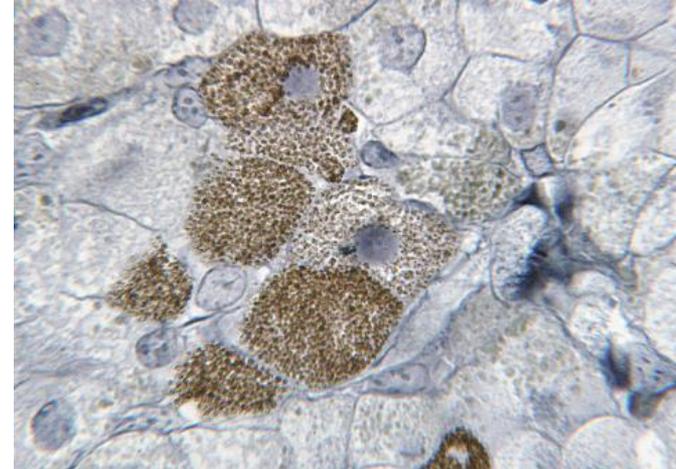
- Membranous organelles

Structure:

LM:

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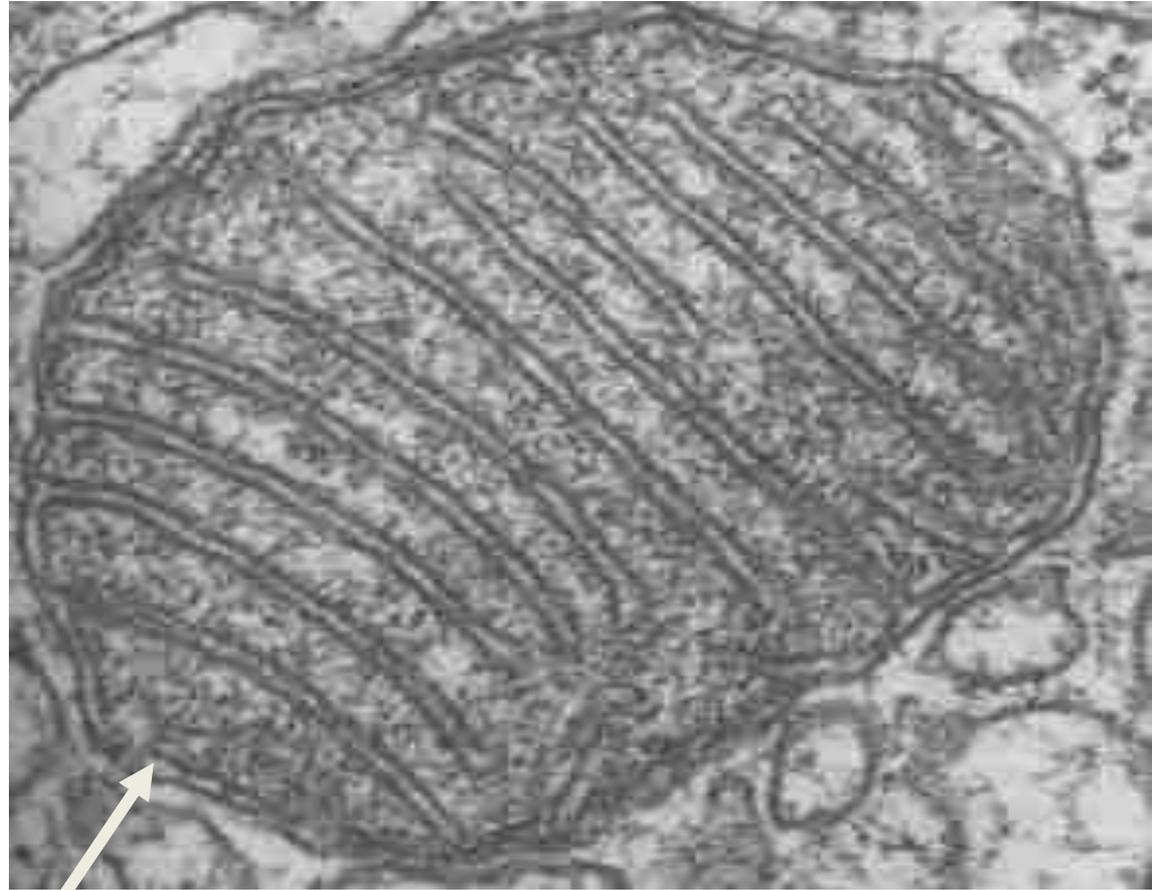
# EM of the Mitochondria

Double membranes:

- Outer smooth
- Inner folded forming cristae

Double spaces:

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

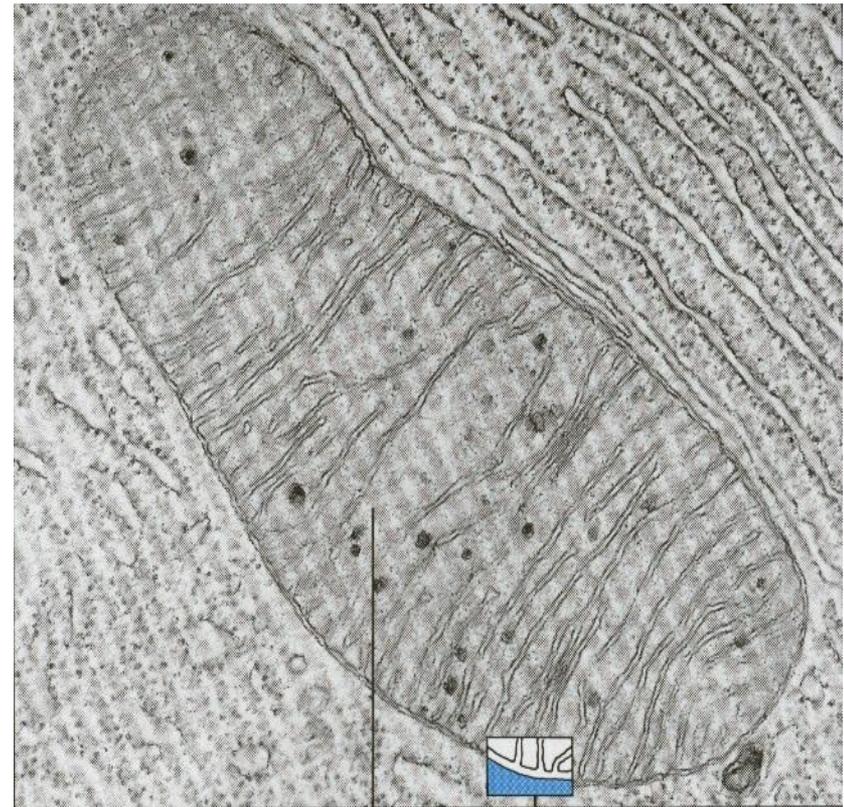


*intermembranous space*

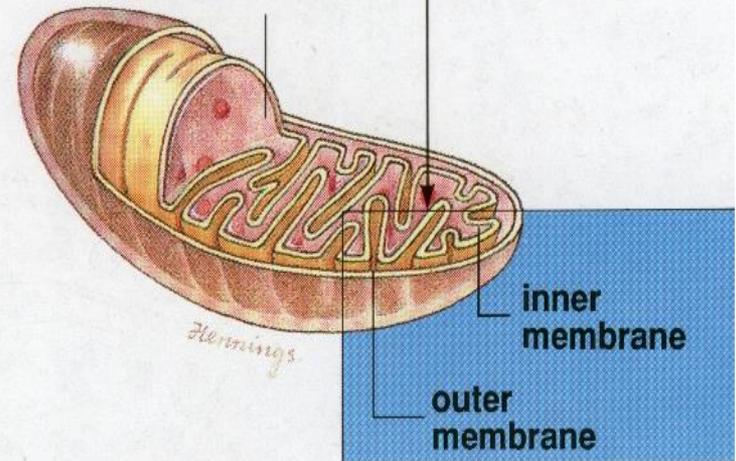
- cristae to increase surface area
- contains protein enzymes for respiratory chain
- contains ATP synthetase for ATP synthesis

Matrix:

- oxidative enzymes
- mitochondril DNA so mitochondria can replicate themselves



inner matrix



inner membrane

outer membrane

# 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.

