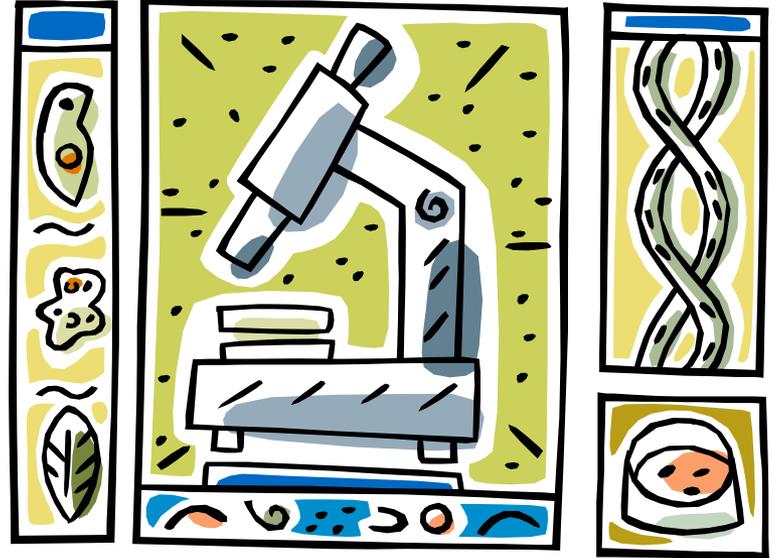


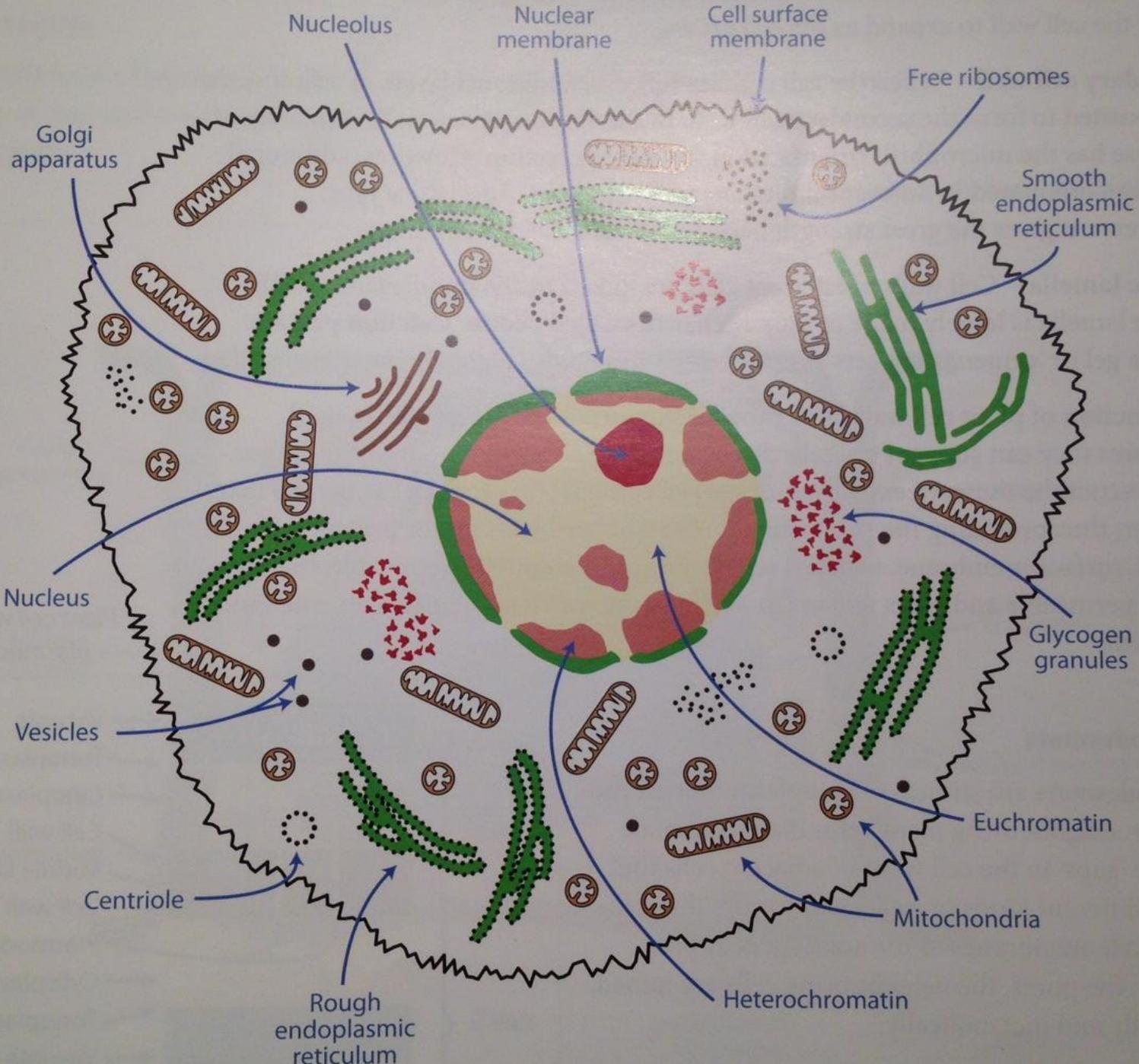
CELLS

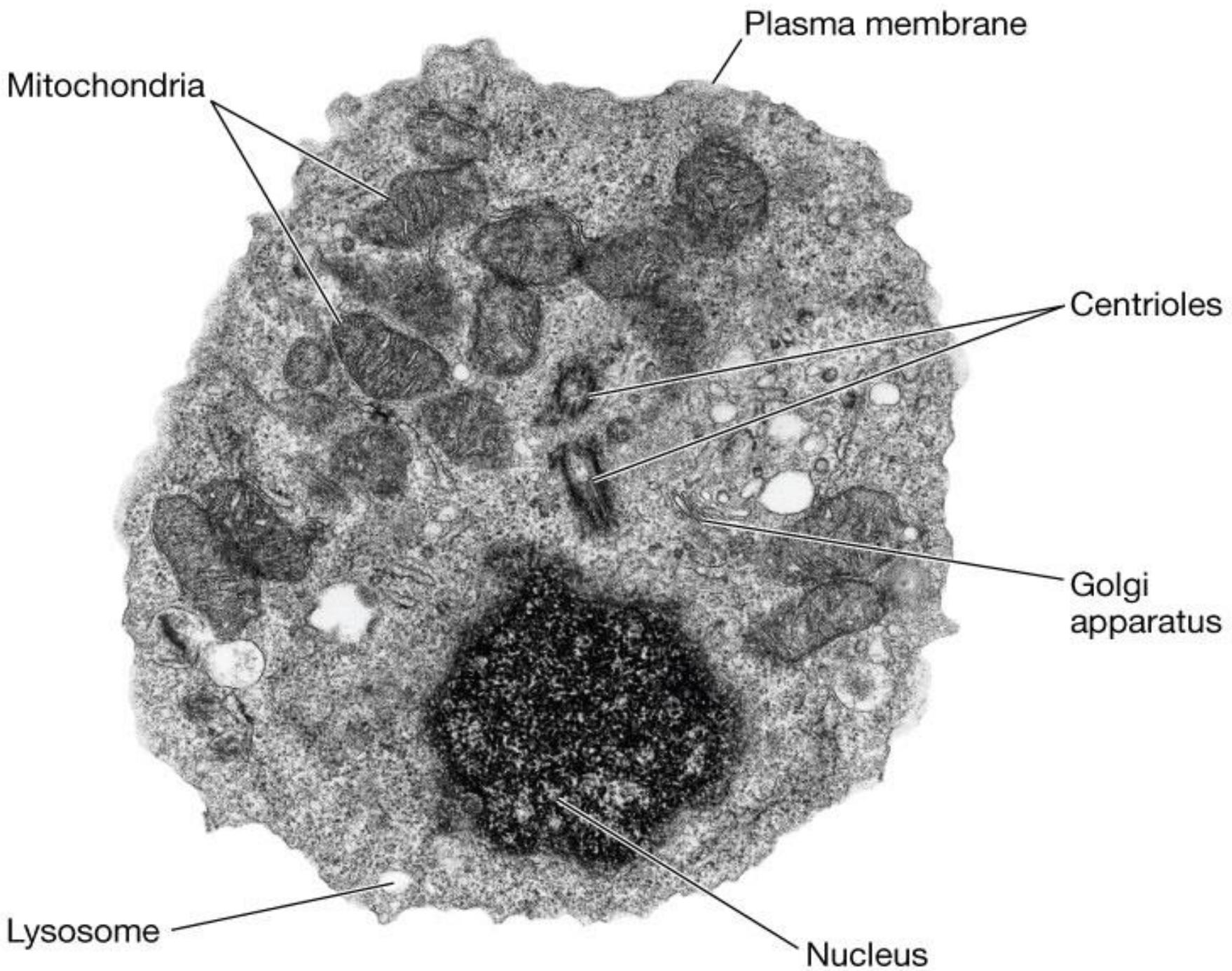


STRUCTURE OF ANIMAL CELLS

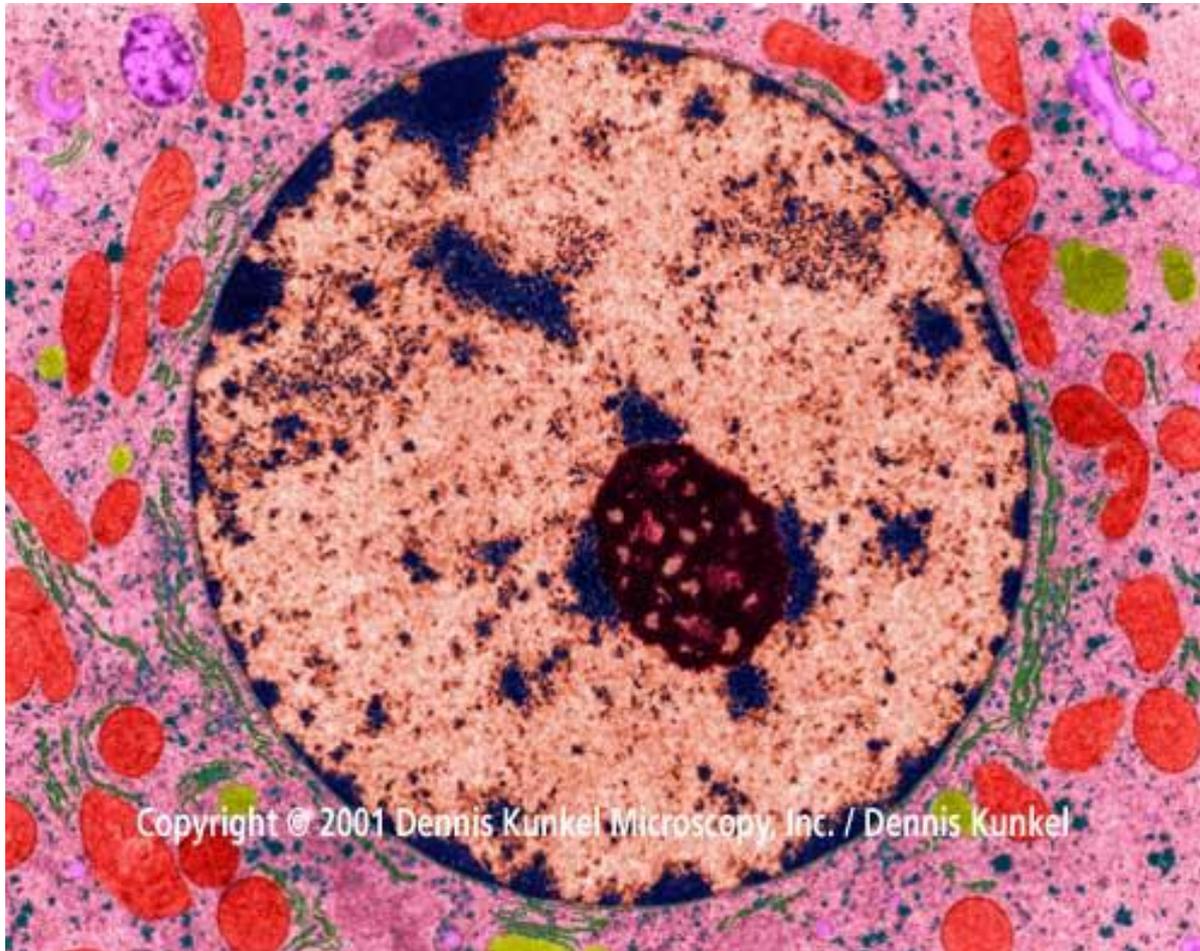


ANIMAL
CELL





Tim & Moby

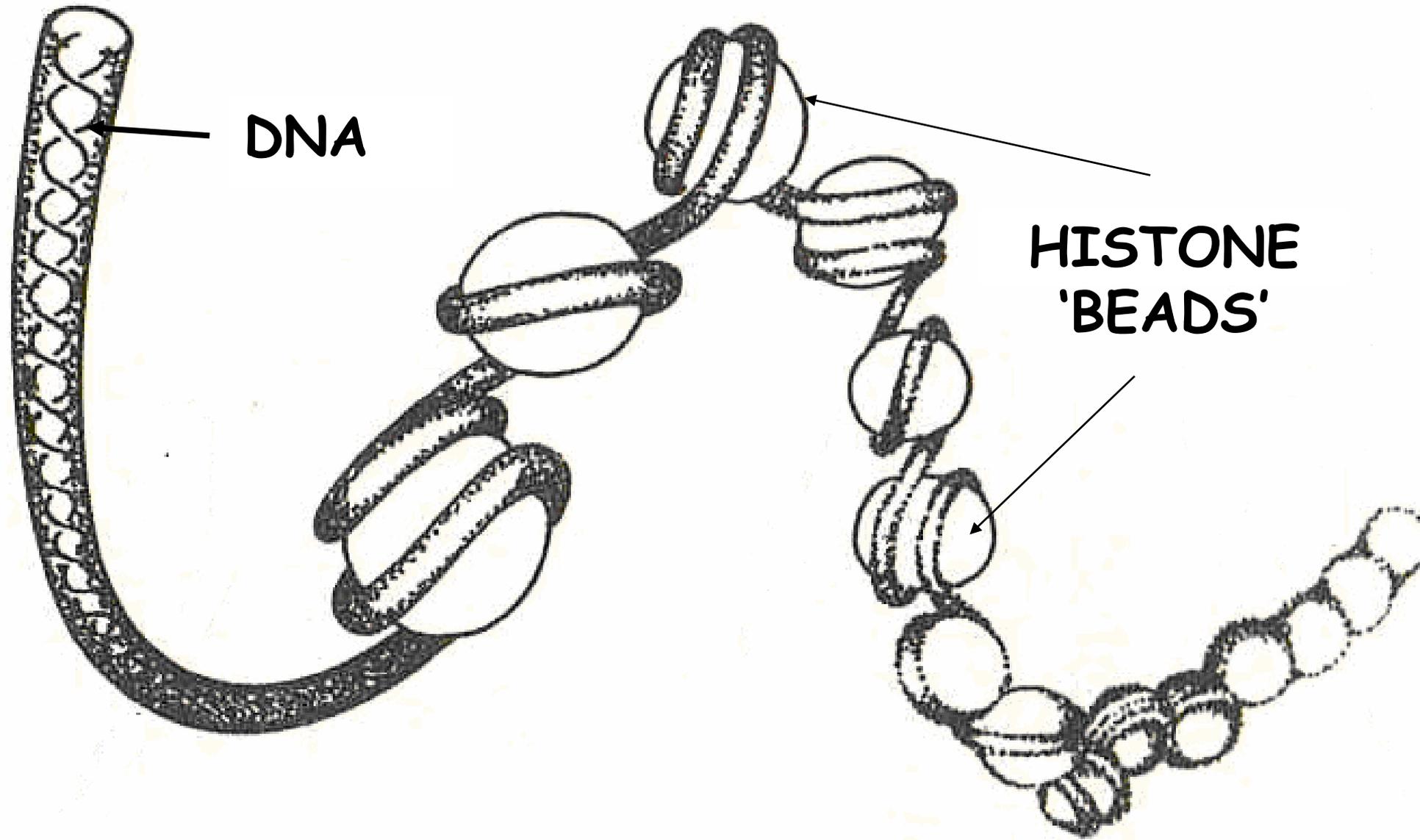


Electron micrograph of a liver (eukaryotic cell)
nucleus

NUCLEUS

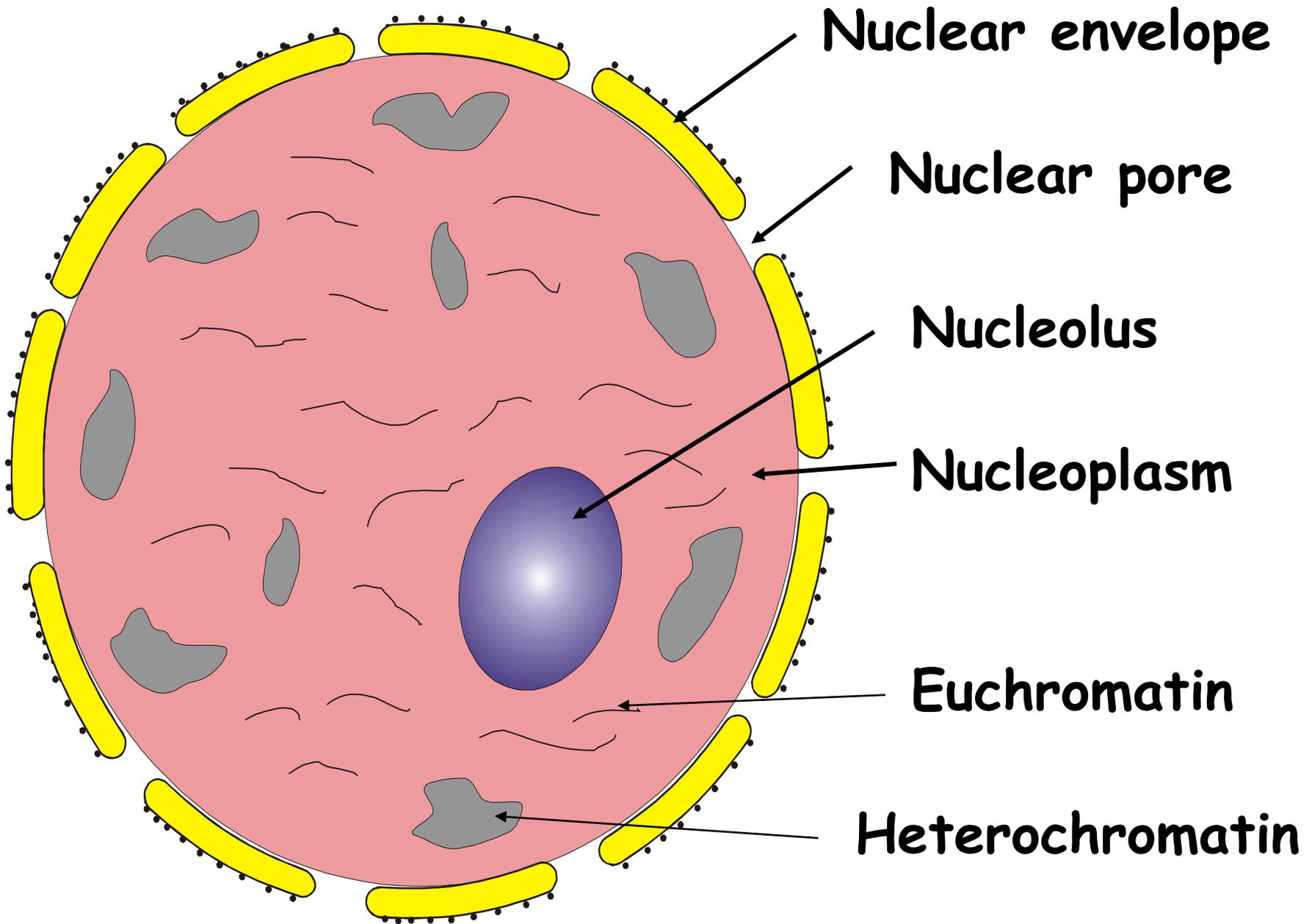
- 10-25 μ m diameter
- It is surrounded by the **nuclear envelope**, a double membrane containing **nuclear pores**.
- Contains **DNA** in the form of **chromosomes**
- The DNA is coiled around protein 'beads' called **histones**
- When not dividing the chromosomes are not visible and are in the form of **chromatin**
- Densely packed, darker **heterochromatin** is found close to the nuclear membrane.
- Less densely packed **euchromatin** is found throughout the nucleus.

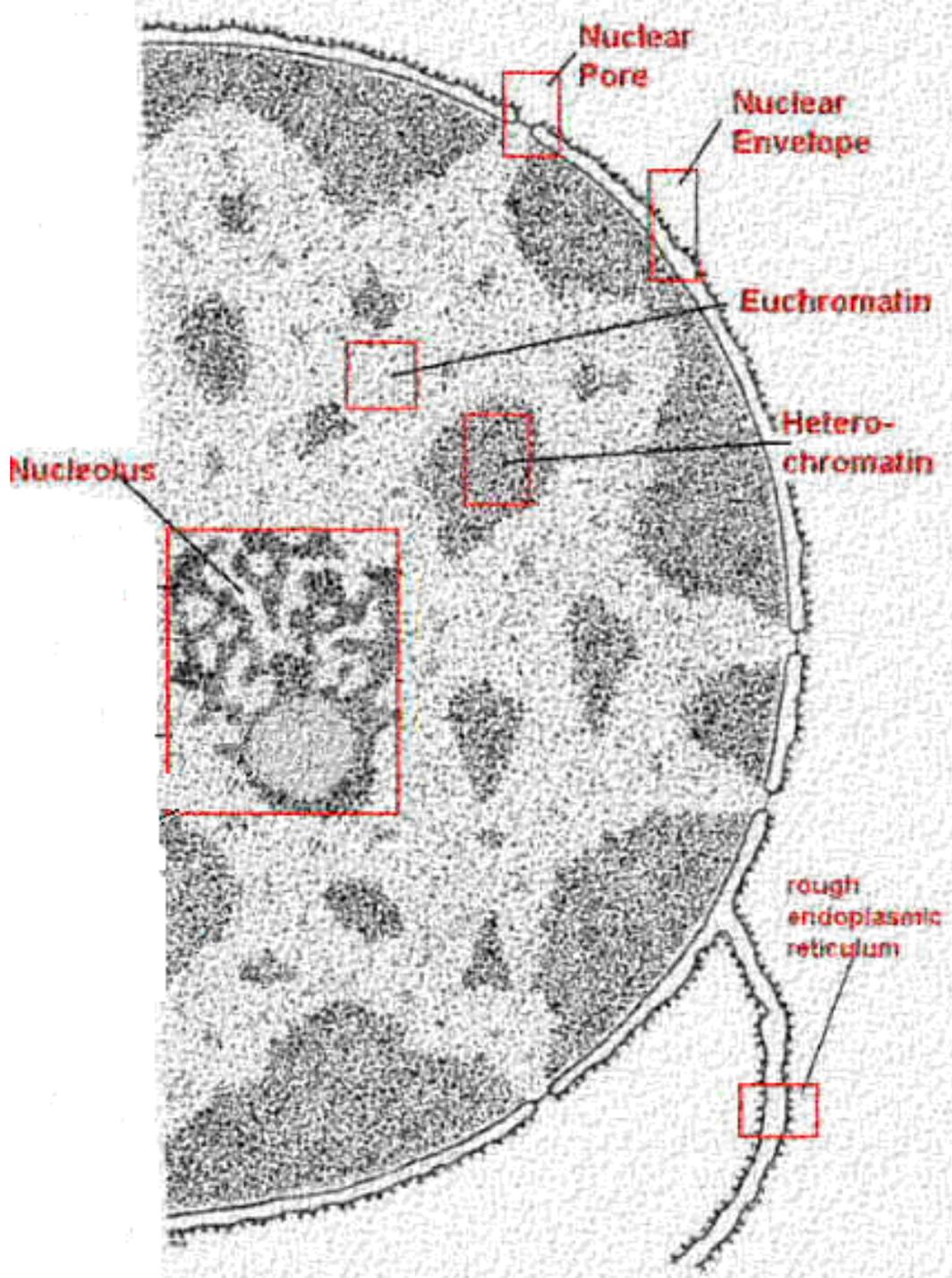
- The outer membrane is covered with **ribosomes**; this is where **RER** originates.
- Inside the nucleus is a large dense area called the **nucleolus**. This is where ribosomes are made.
- They are made in 2 parts, leaving the nucleus through the nuclear pores and assembling in the cytoplasm.



DNA

HISTONE
'BEADS'



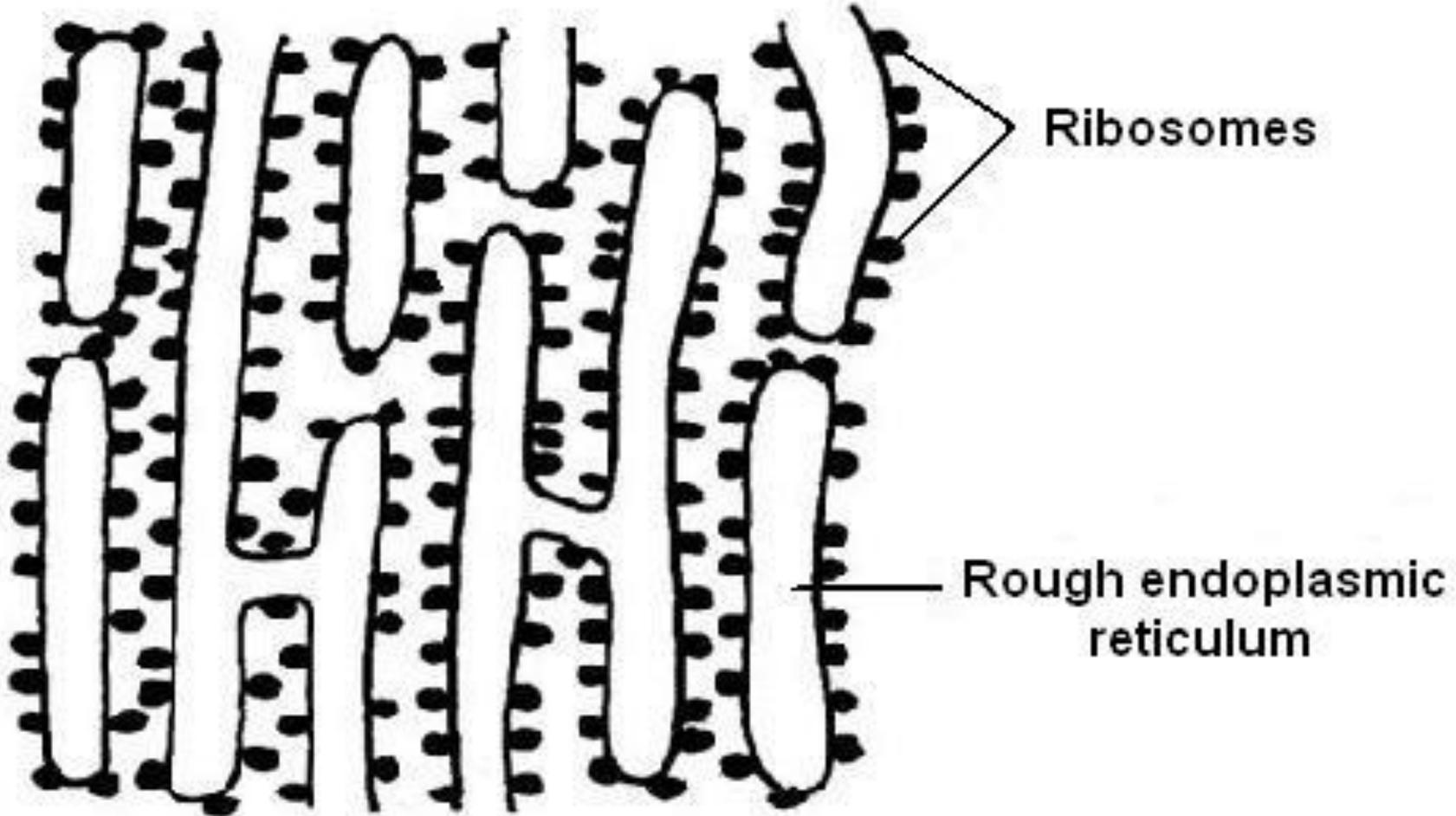


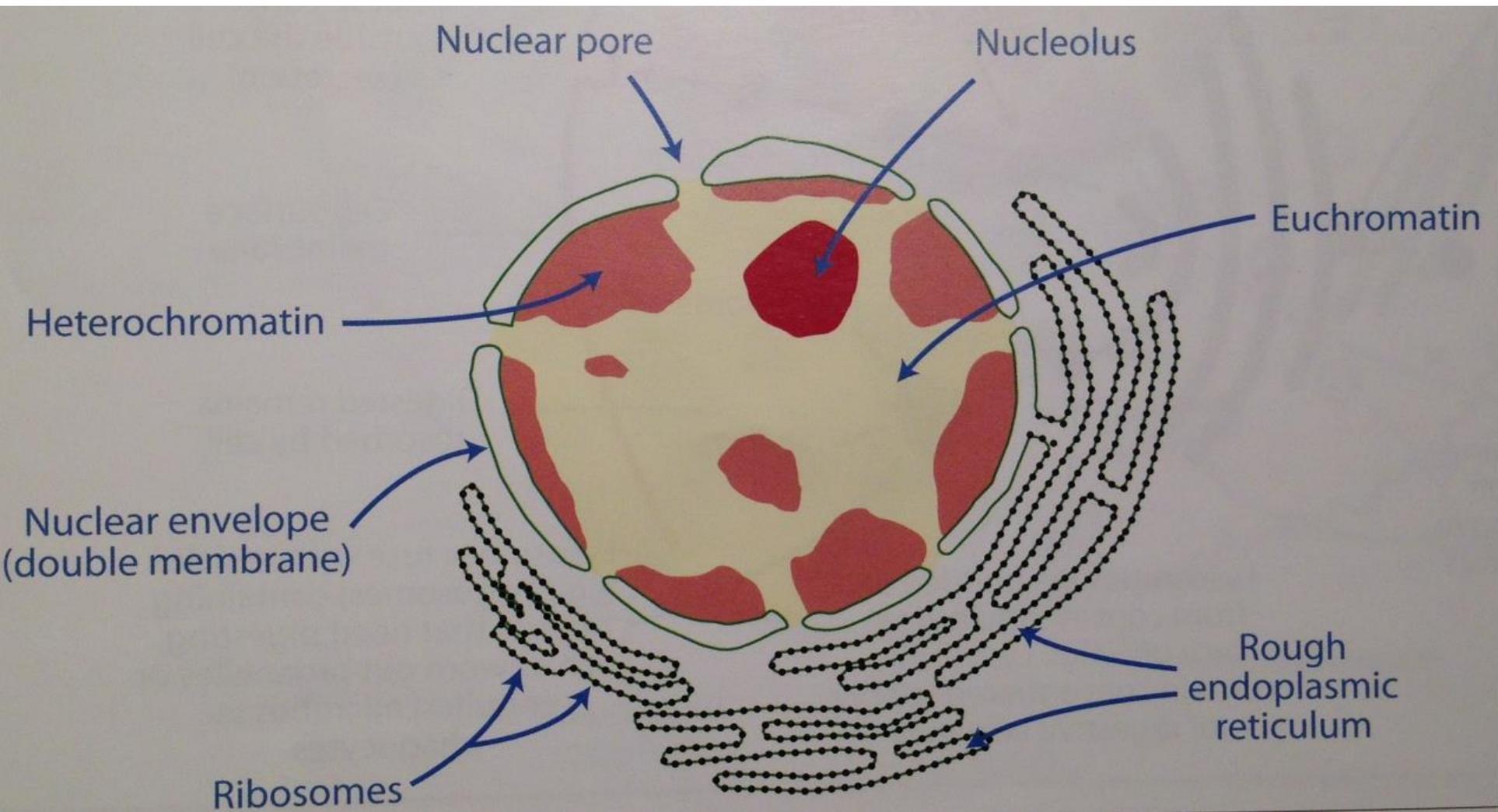
ENDOPLASMIC RETICULUM

- A membrane system extending throughout the cytoplasm
- The membranes form enclosed sacs called **cisternae.**

ROUGH ENDOPLASMIC RETICULUM (RER)

- Ribosomes are attached to the outer membrane
- The ribosomes make **proteins** that move into the cisternae
- And are then **transported**/distributed throughout the cell in the membrane network.
- The RER is continuous with the nuclear membrane
- This makes it easier to transport mRNA, which carries the genetic code, from the nucleus to the ribosomes.
- Found in cells that manufacture lots of protein e.g. pancreatic cells that make digestive enzymes

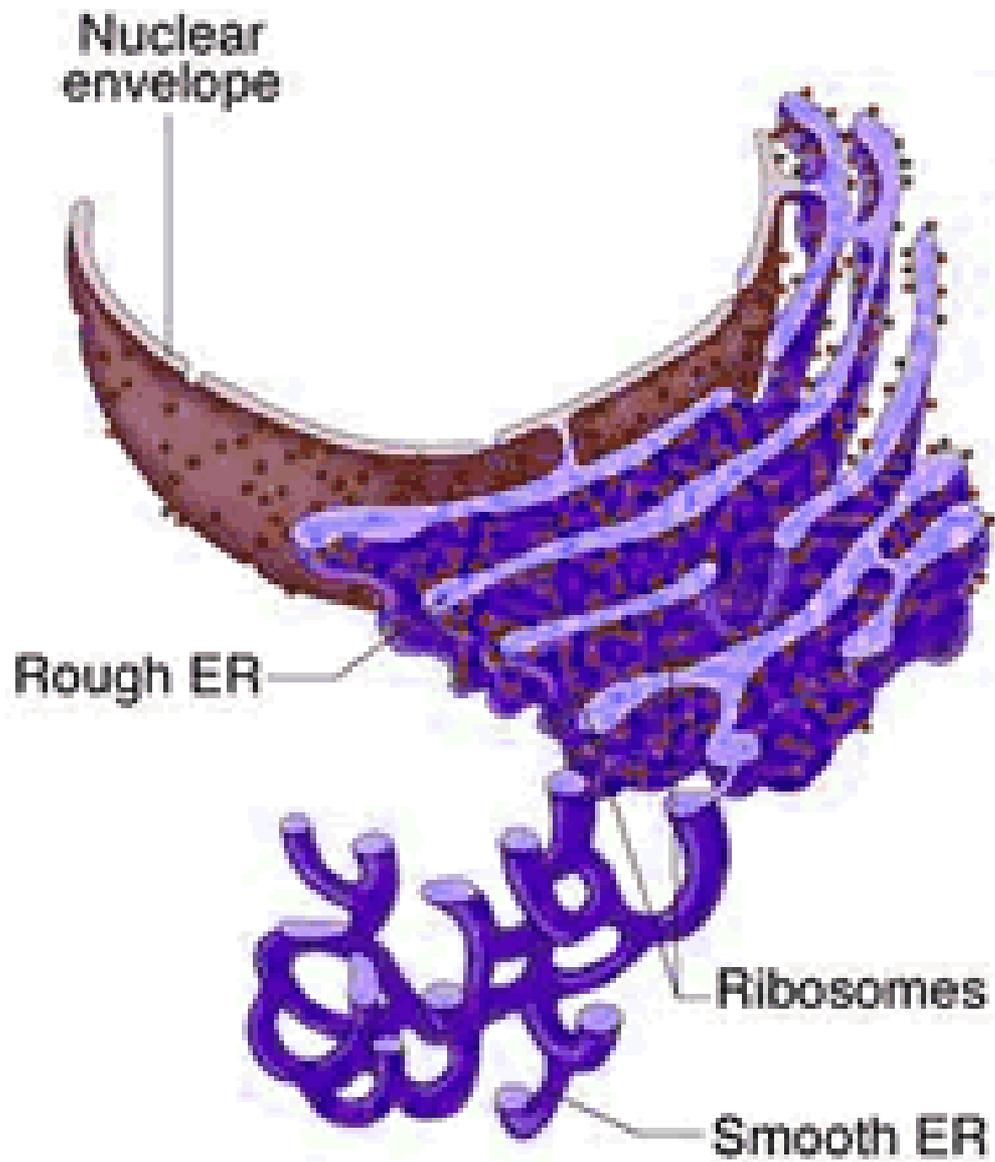


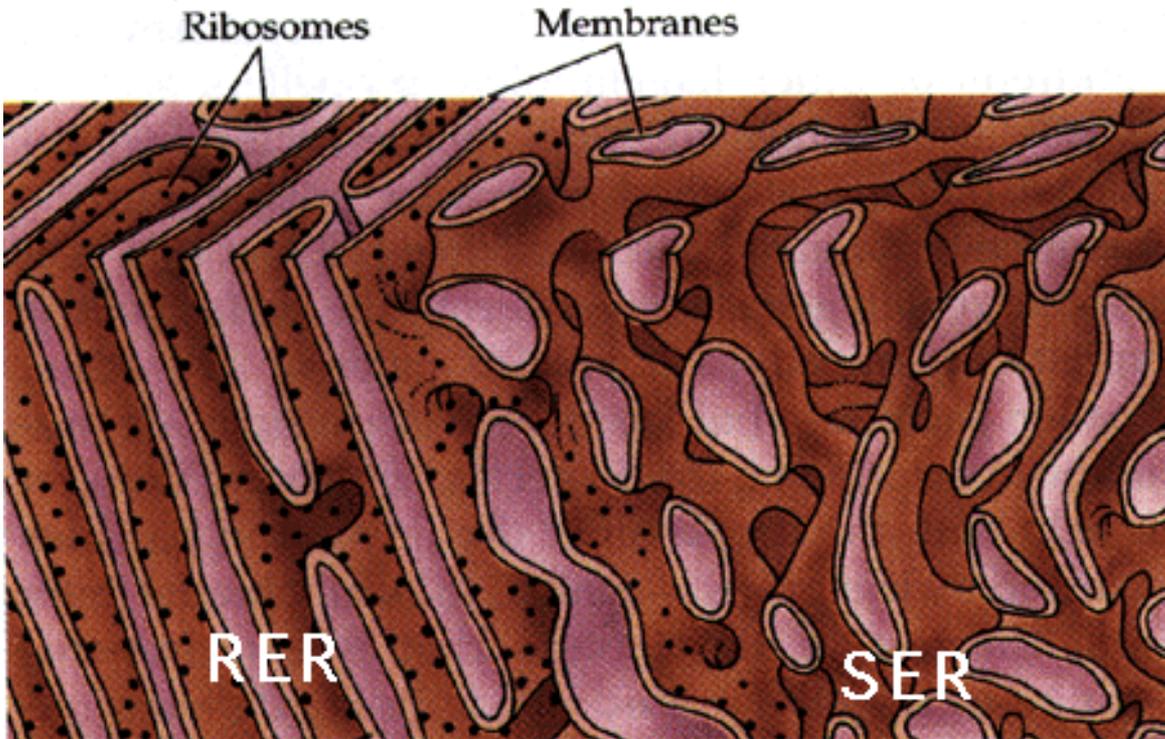
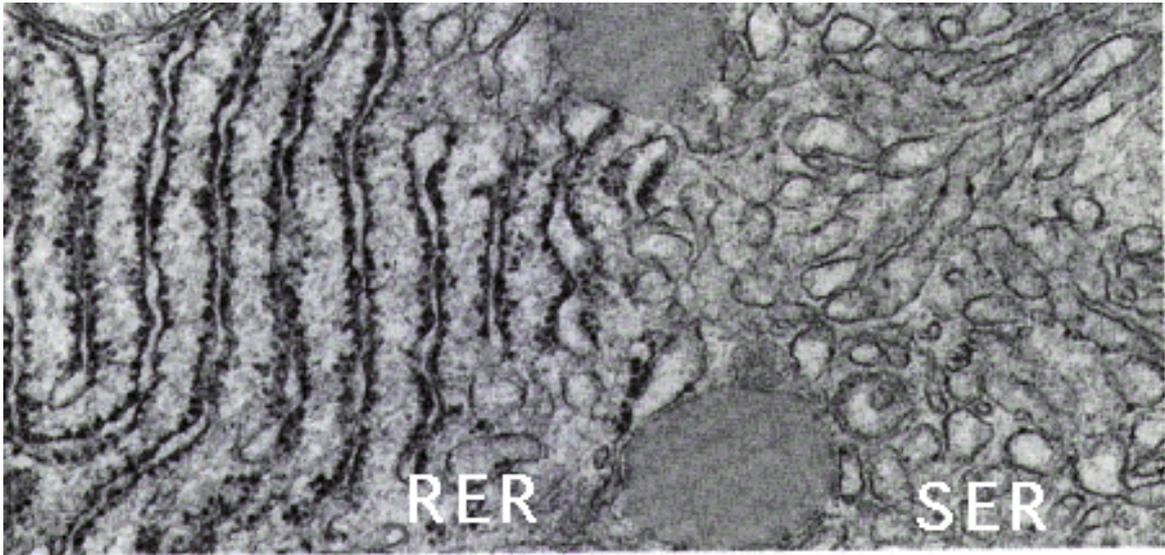


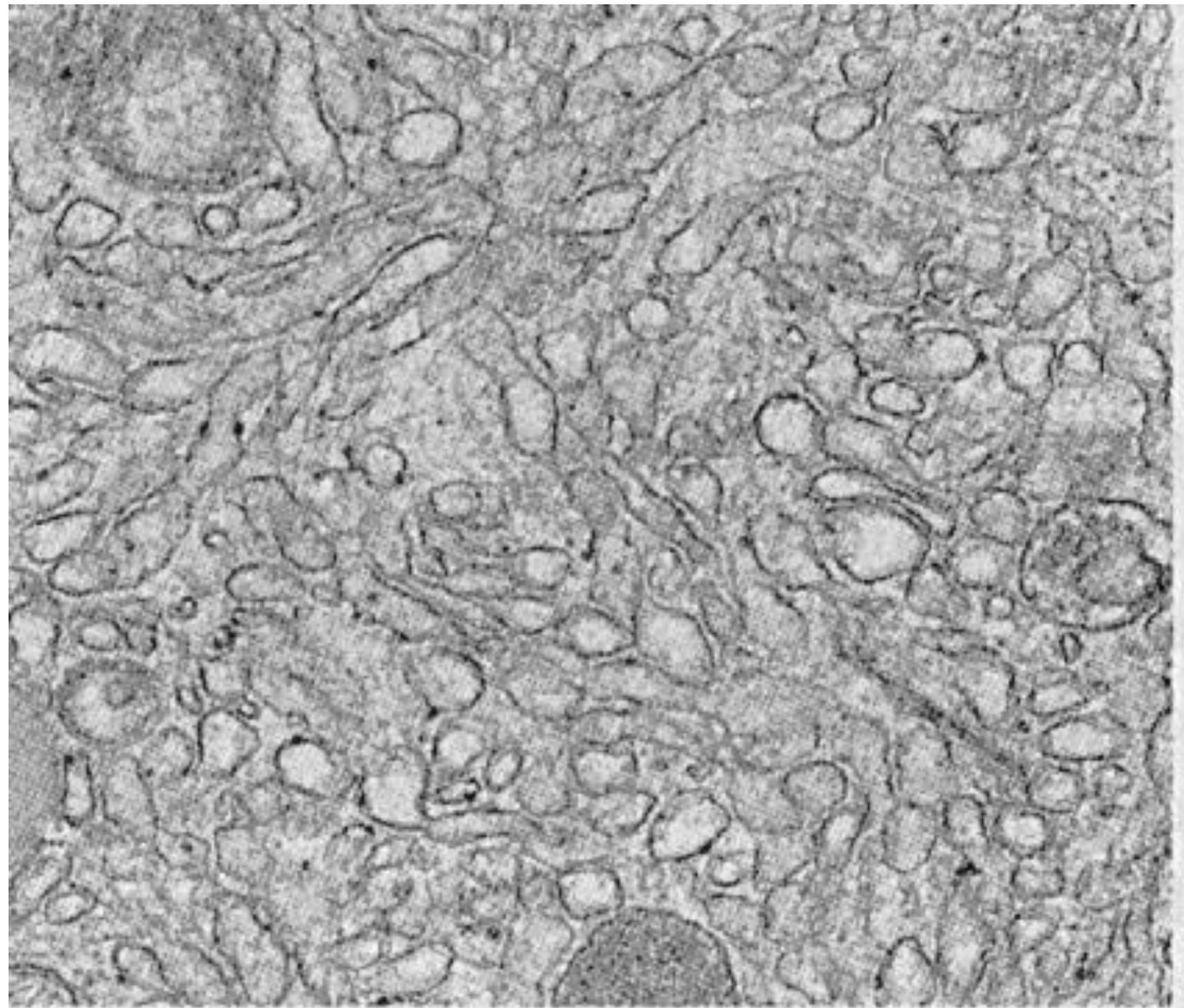


SMOOTH ENDOPLASMIC RETICULUM (SER)

- System of membranous tubes running through the cytoplasm.
- Site of **lipid** and **steroid metabolism** and **cholesterol synthesis**.



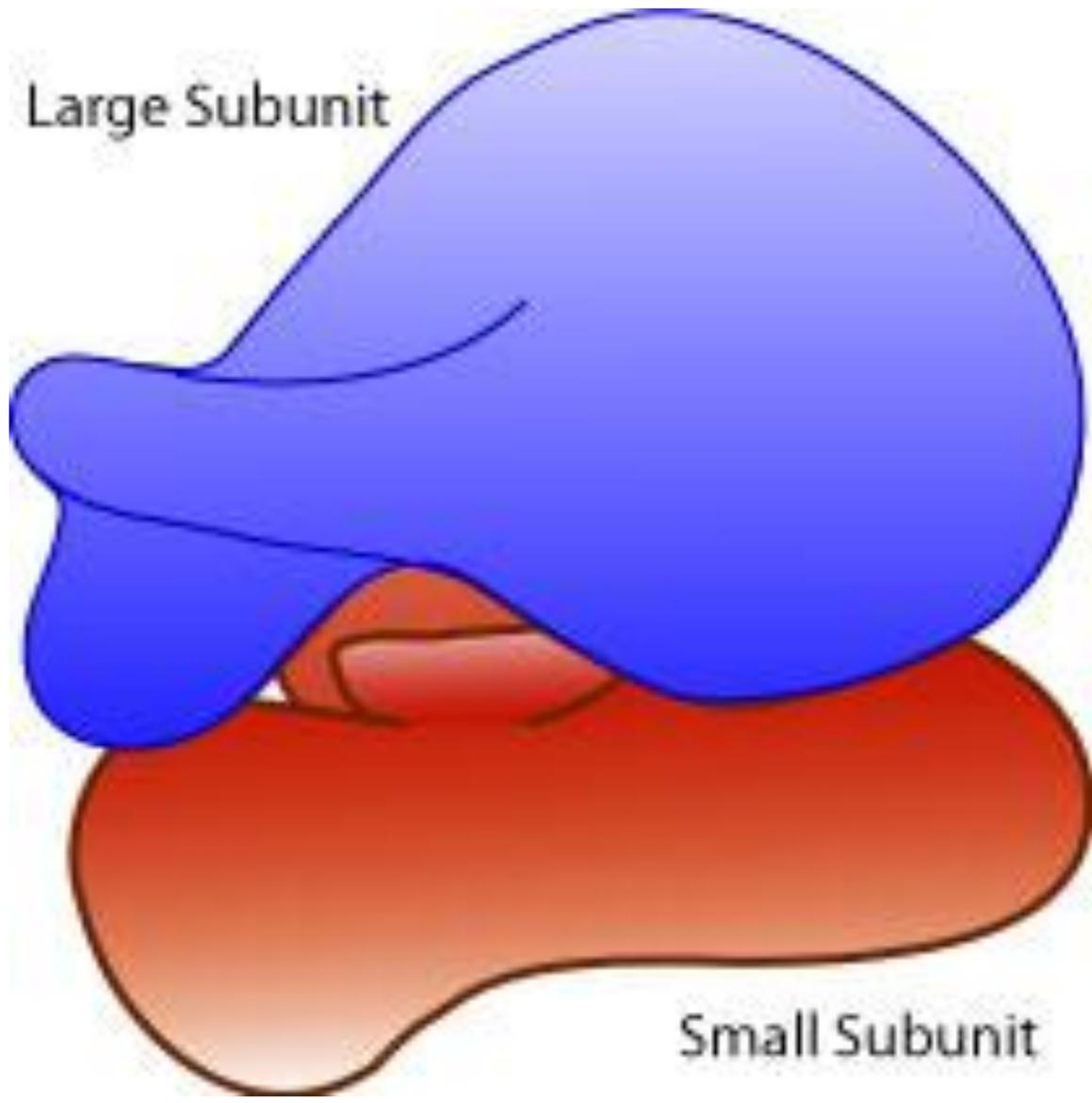




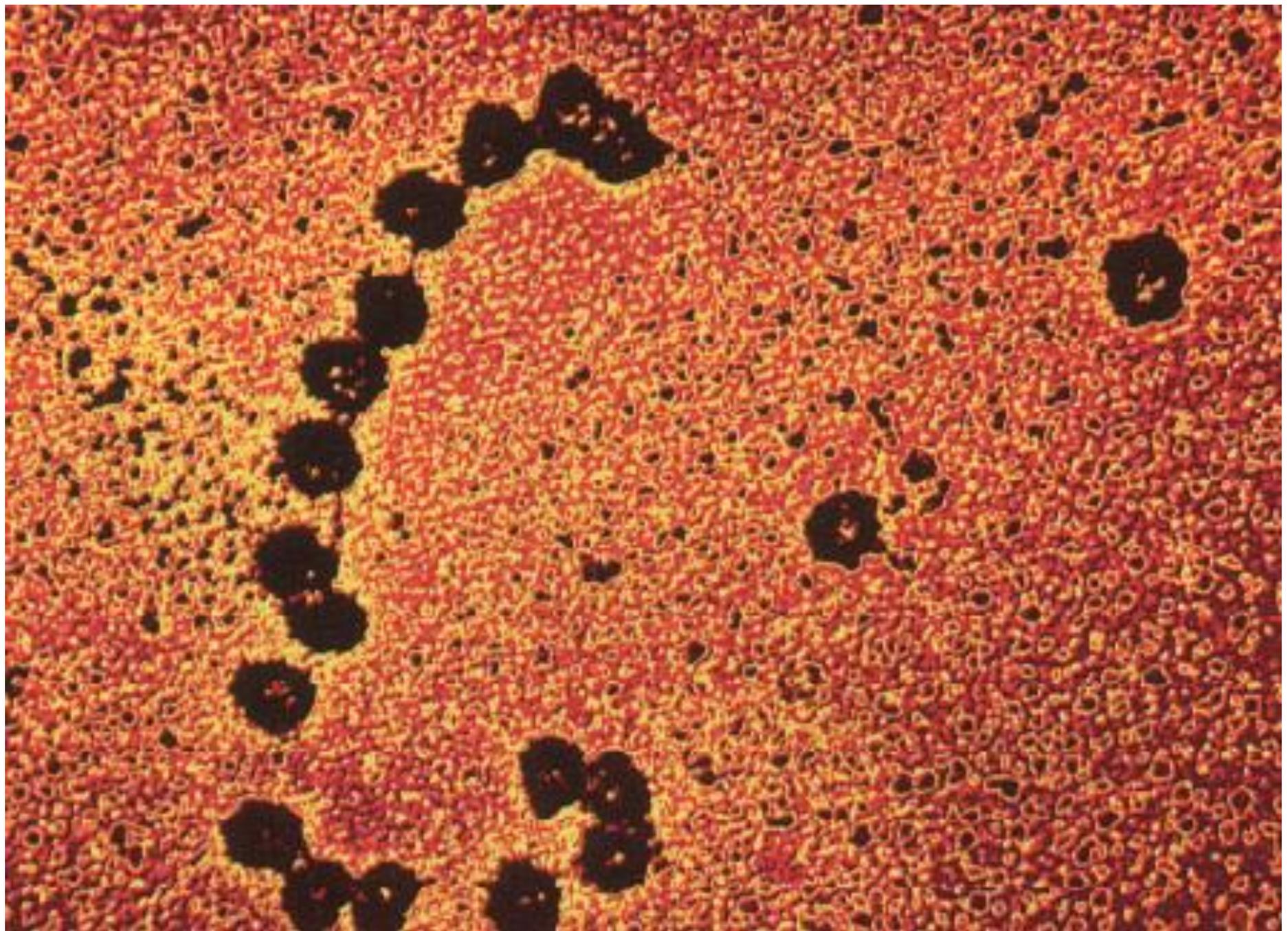
RIBOSOMES

- Up to **30nm** diameter.
- **Non-membrane** bound organelles
- Found attached to RER or free in the cytoplasm.
- Composed of a small and large sub-unit made in the nucleolus of the nucleus, form protein and rRNA.
- Found in huge numbers in all cells, often in groups called **polyribosomes**.
- Site of **protein synthesis**.

Large Subunit



Small Subunit

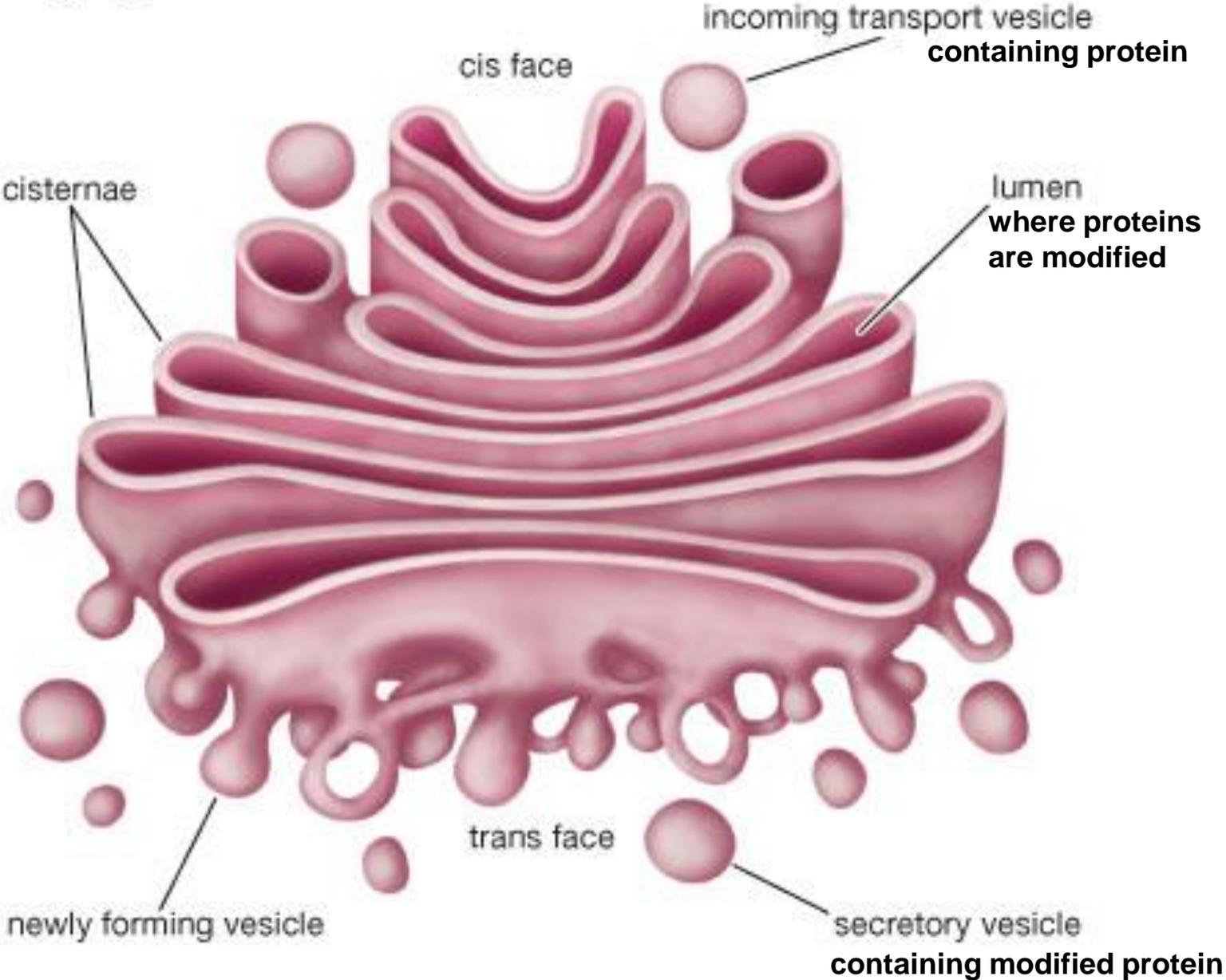


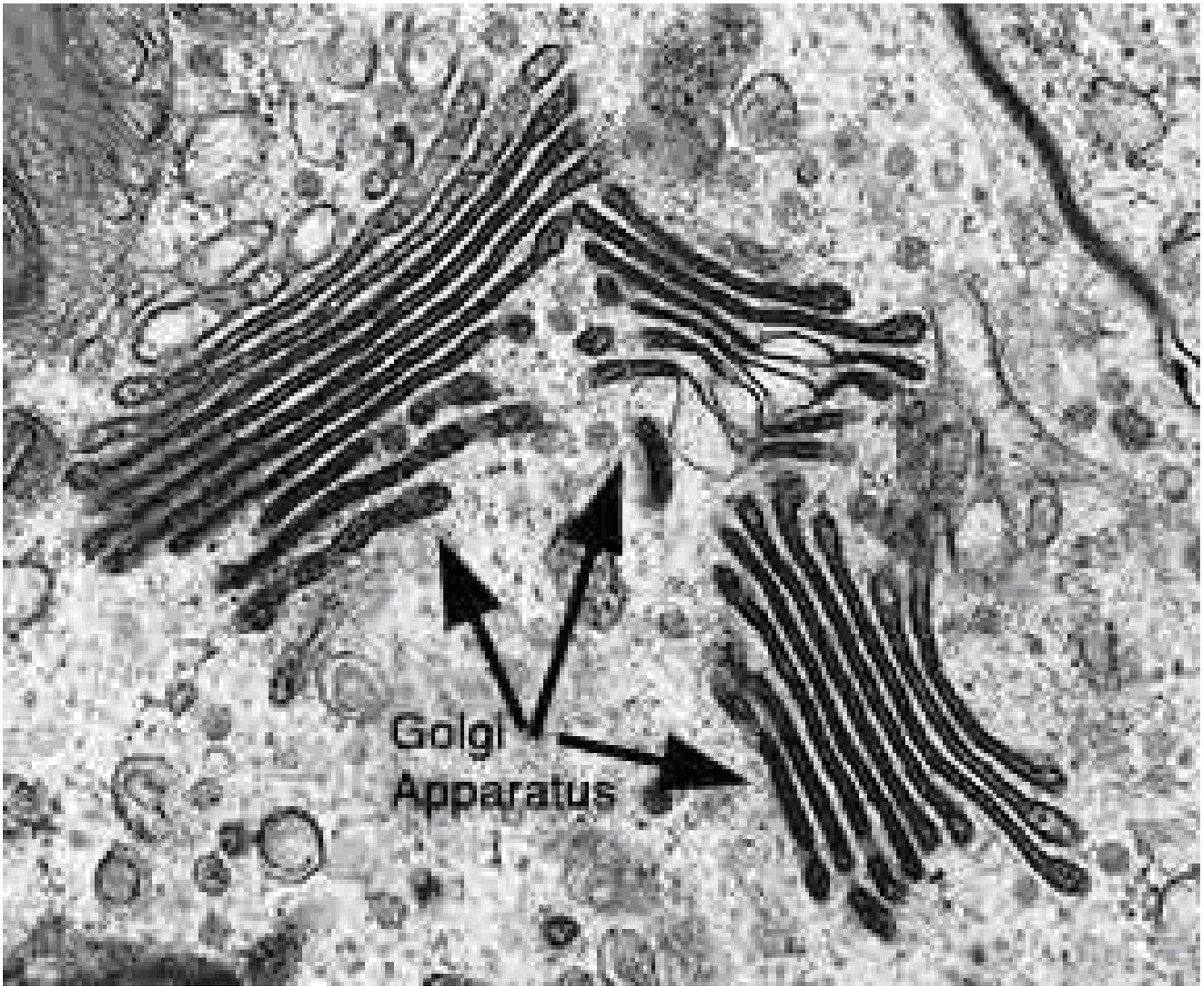
GOLGI APPARATUS

- Curved stack of flattened membrane bound sacs (cisternae).
- Small vesicles containing protein pinch off the RER and join the **cis** (convex) surface, closest to the nucleus.
- **Proteins** are **modified** within the cisternae e.g. carbohydrates added to form **glycoprotein**.
- Vesicles containing the modified protein bud off the **trans** (concave) surface, furthest from the nucleus.
- The vesicle transports the proteins are either within the cell or to the cell membrane where they fuse and release the contents by exocytosis.

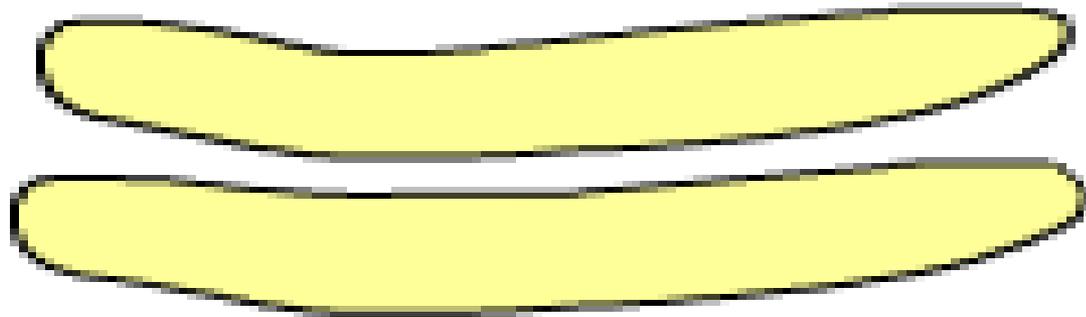
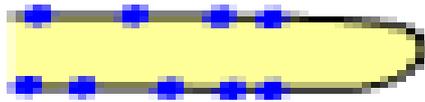
Nucleus side

Golgi apparatus





Golgi
Apparatus



Click on the Play button to start the animation.

Exocytosis through plasma membrane

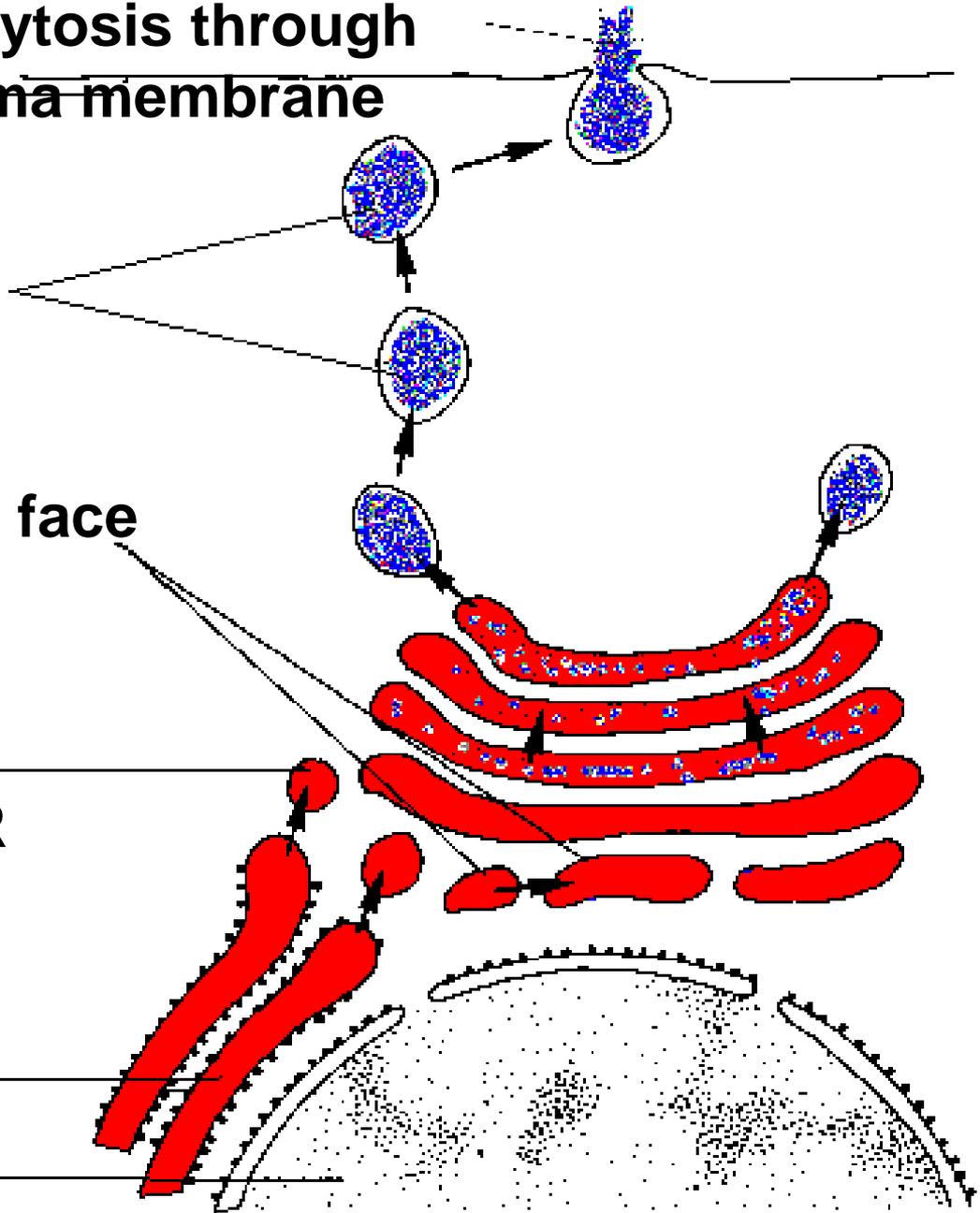
vesicles containing modified protein bud off trans face

vesicles join cis face of golgi body

Vesicle containing protein buds off RER

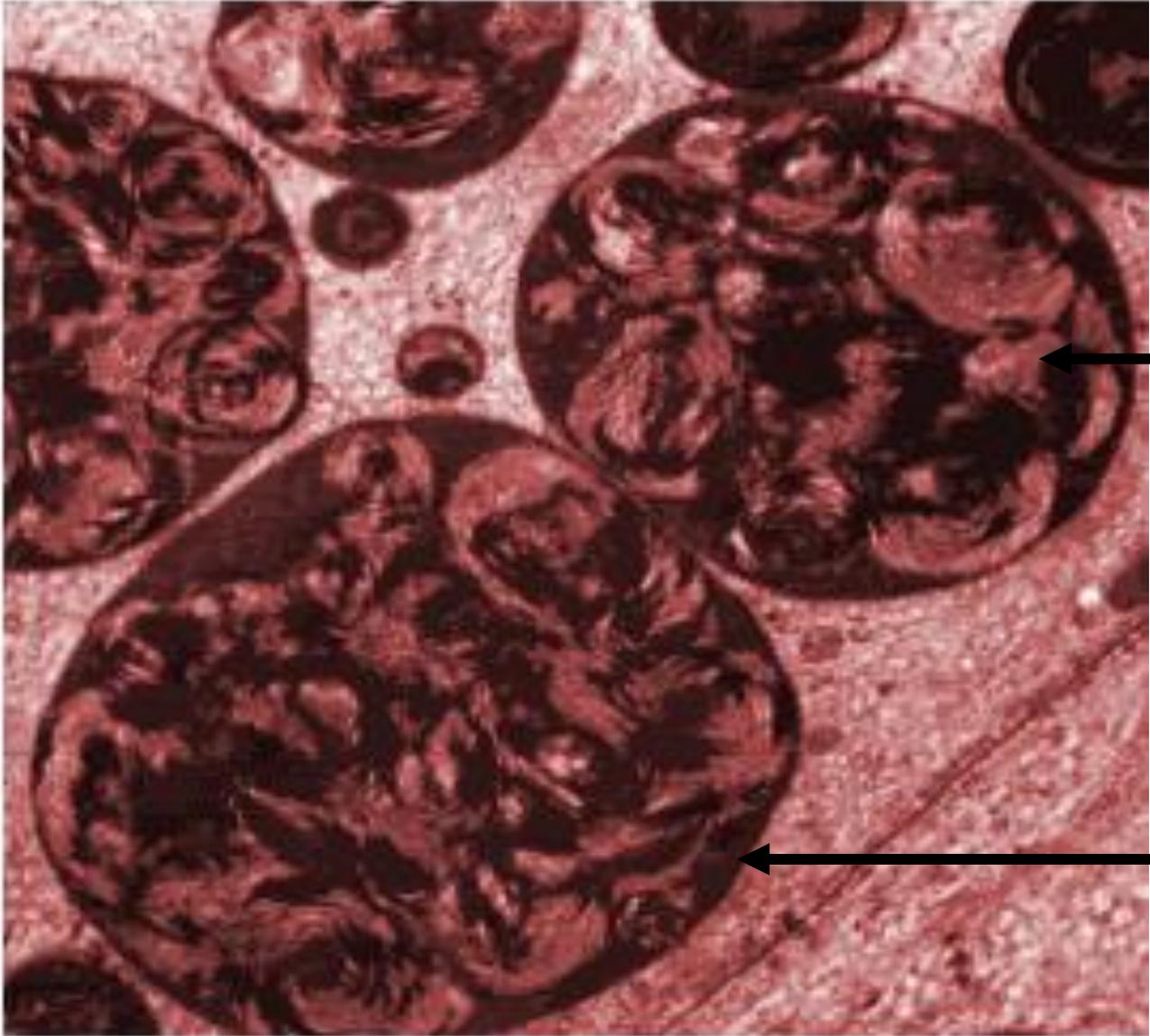
rough ER

nucleus



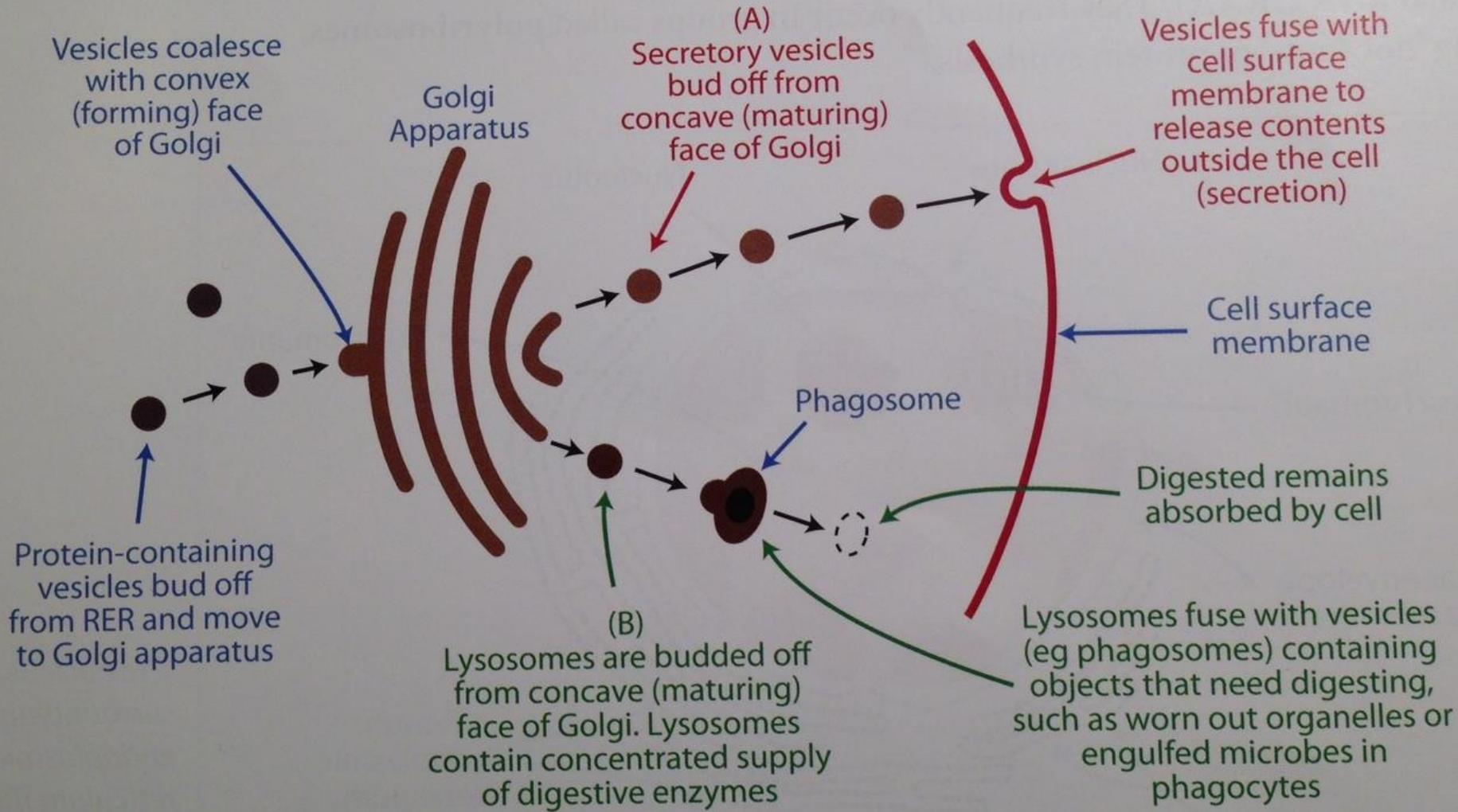
LYSOSOMES

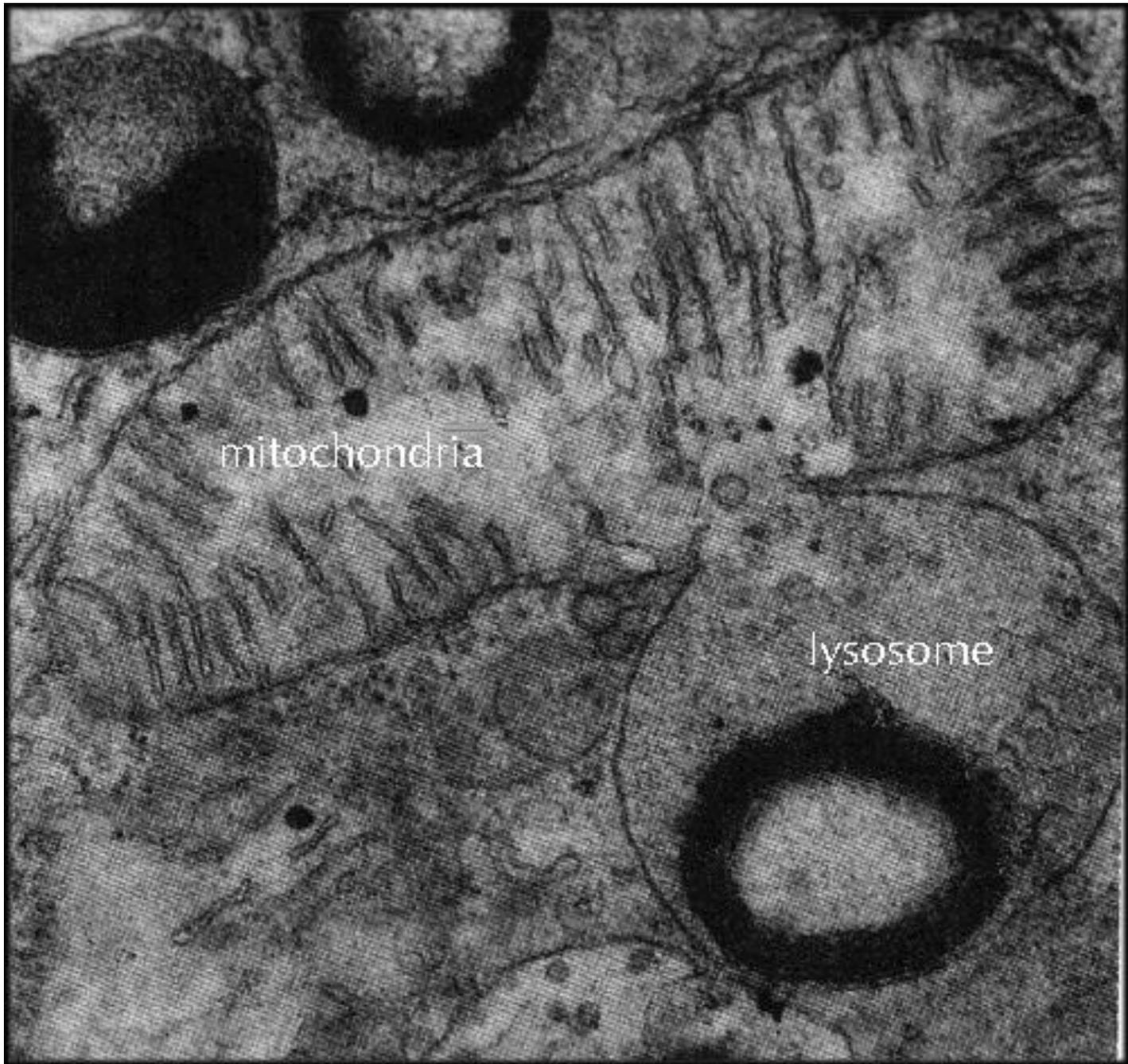
- About **0.5 μ m**
- Formed by the golgi apparatus
- contain **hydrolytic enzymes** for internal cell use.
- When lysosomes fuse with other vesicles in the cell that contain a substance that needs **digesting** e.g. **worn out organelles**, they are called **secondary lysosomes**.
- Important in phagocytes, where they digest engulfed bacteria in **phagosomes** (vesicle in a phagocyte).
- The thick lysosome membrane prevents the hydrolytic enzymes being accidentally released into the cell.
- **NOT FOUND IN PLANT CELLS**



hydrolytic
enzymes

membrane



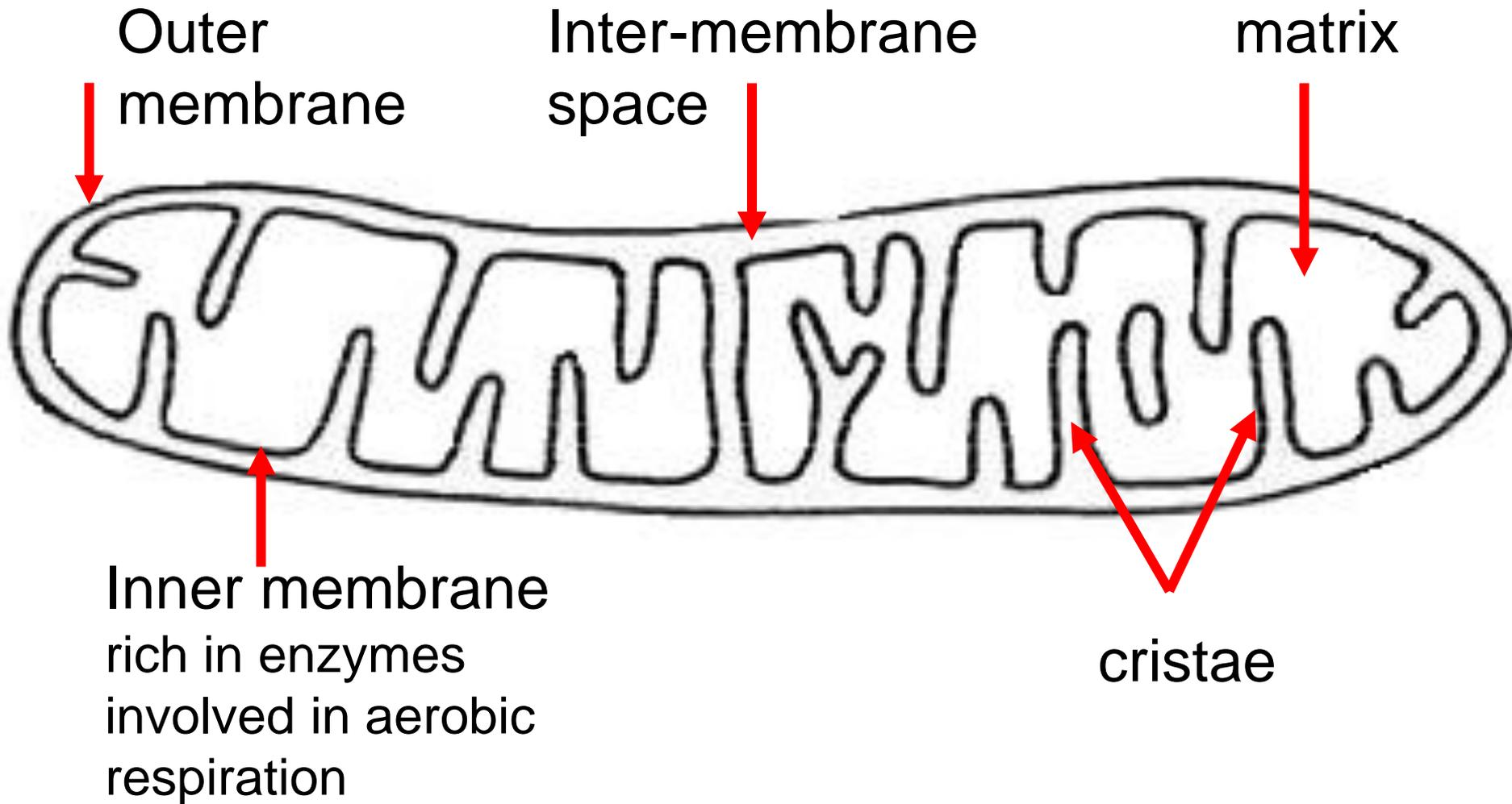


mitochondria

lysosome

MITOCHONDRIA

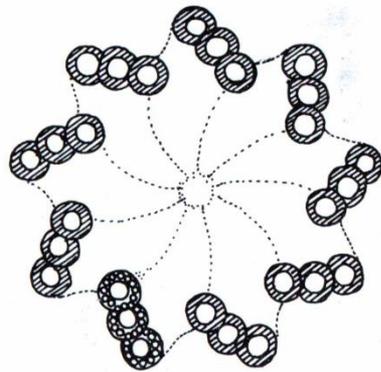
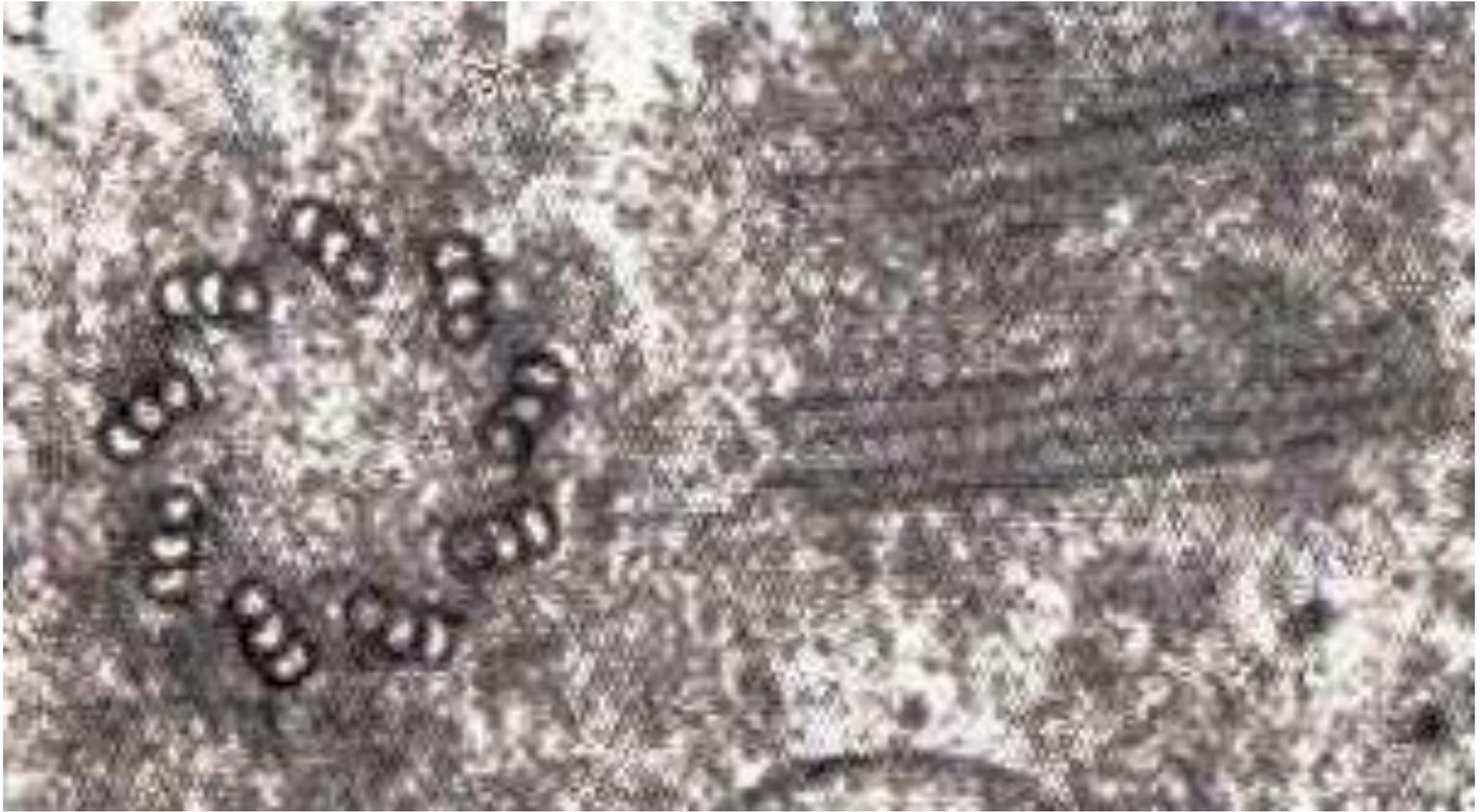
- 10 μ m length, sausage shaped
- **Double membrane**
- Outer membrane separated from a folded inner membrane by **inter-membrane space** and
- A fluid **matrix** is found in the inner cavity.
- Inner membrane folded into **cristae**, large SA.
- **Enzymes** on cristae release energy during **aerobic respiration** to form energy rich ATP.
- Cells that are metabolically active contain many mitochondria e.g. cells involved in active transport. Also their mitochondria have more cristae that have deeper folds.





MICROTUBULES

- Hollow cylinder made of the protein tubulin.
- 25nm diameter, up to 10 μ m length.
- They occur as a pair of **centrioles** in the **centrosome** just outside the nucleus.
- centrioles are a pair of short microtubules positioned at right angles to each other.
- Each centriole is composed of **9 triplets** of microtubules arranged in a circle.
- At cell division the centrioles move to opposite poles of the cell and produce **spindle fibres** that organise and separates the chromosomes.
- Also found in cilia and flagella, and as part of the **cytoskeleton** they help to direct the movement of cell organelles.
- **NOT FOUND IN PLANT CELLS**

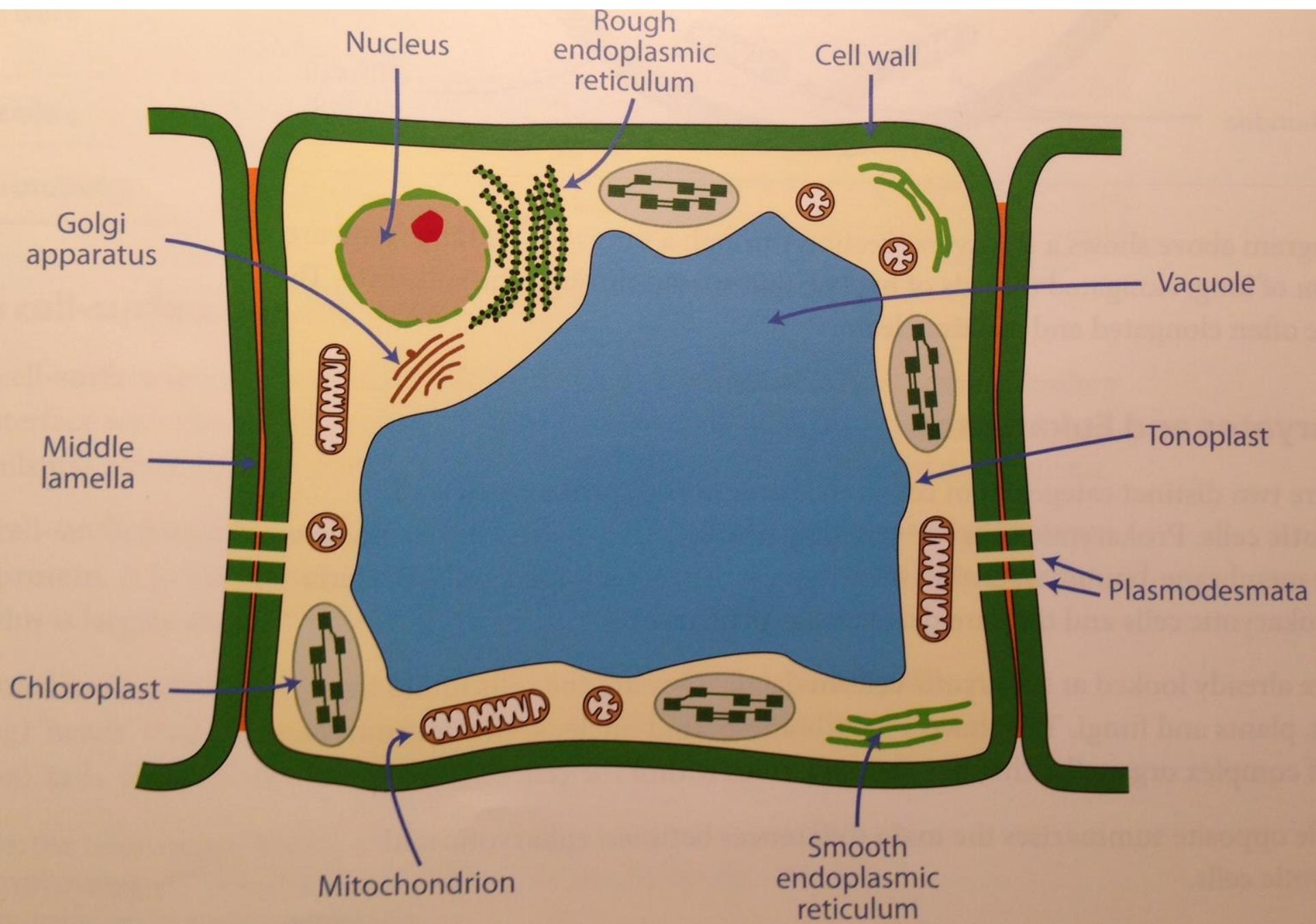


Spindle fibres



A Plant Eukaryotic cell

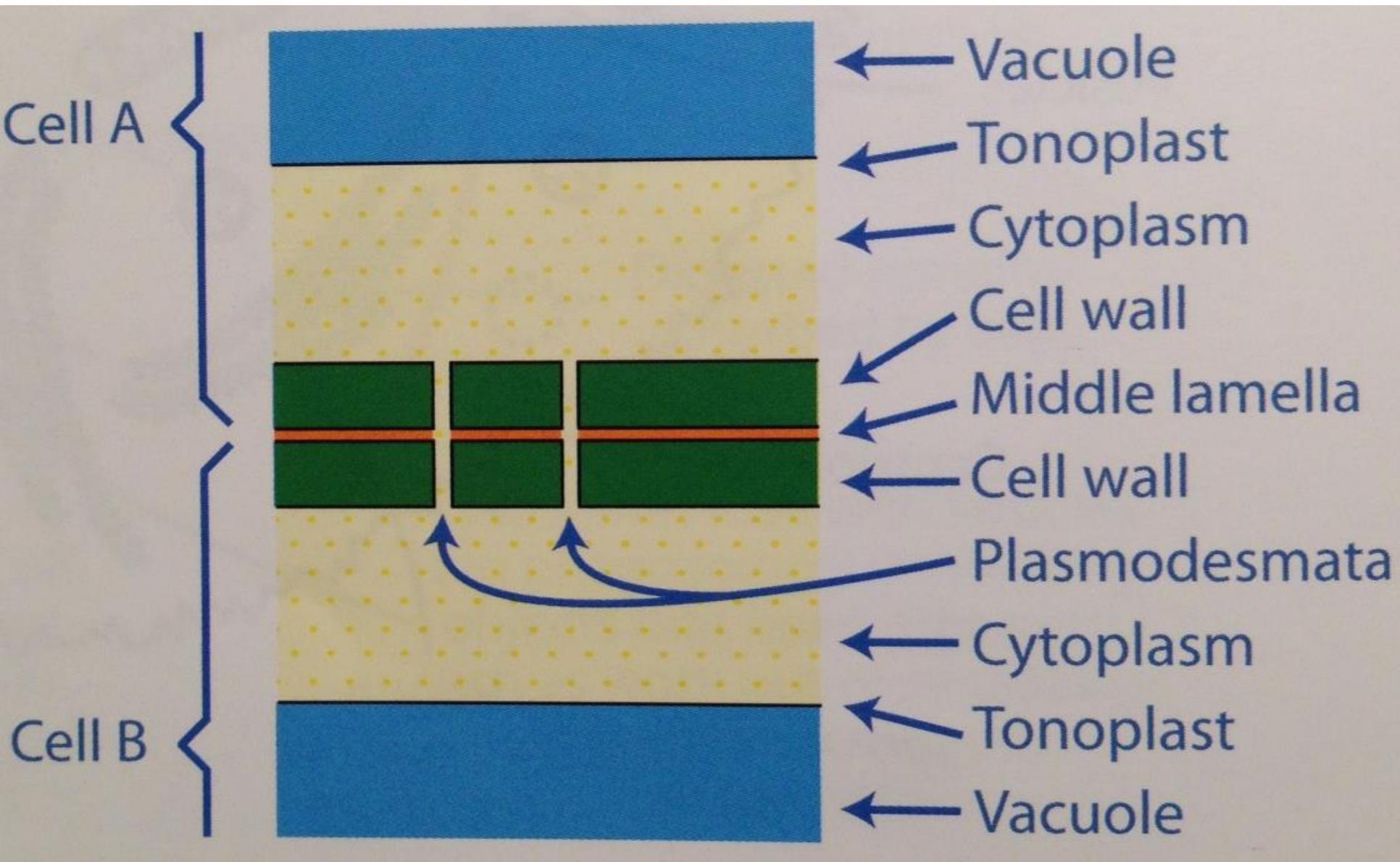
PLANT CELL

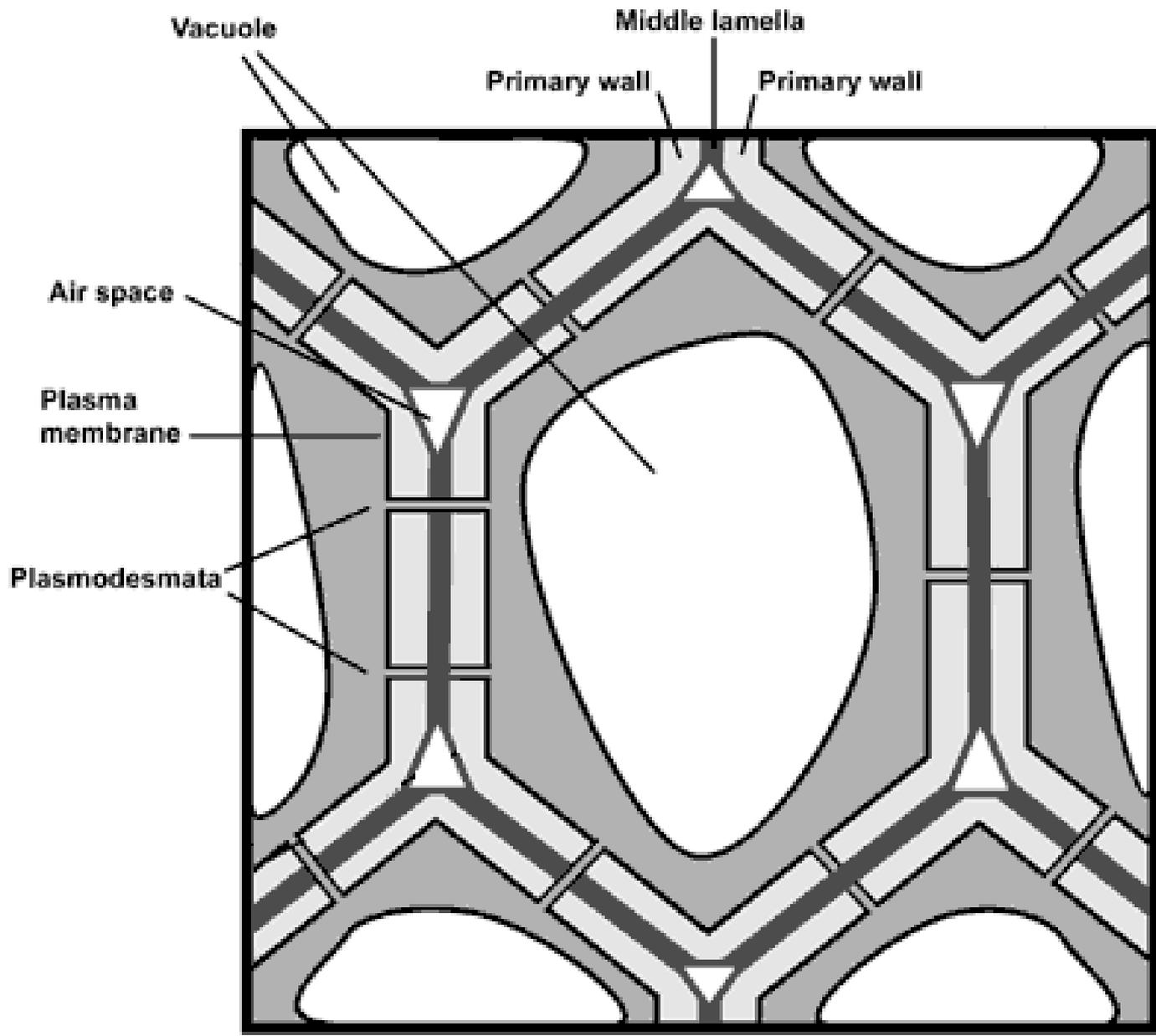


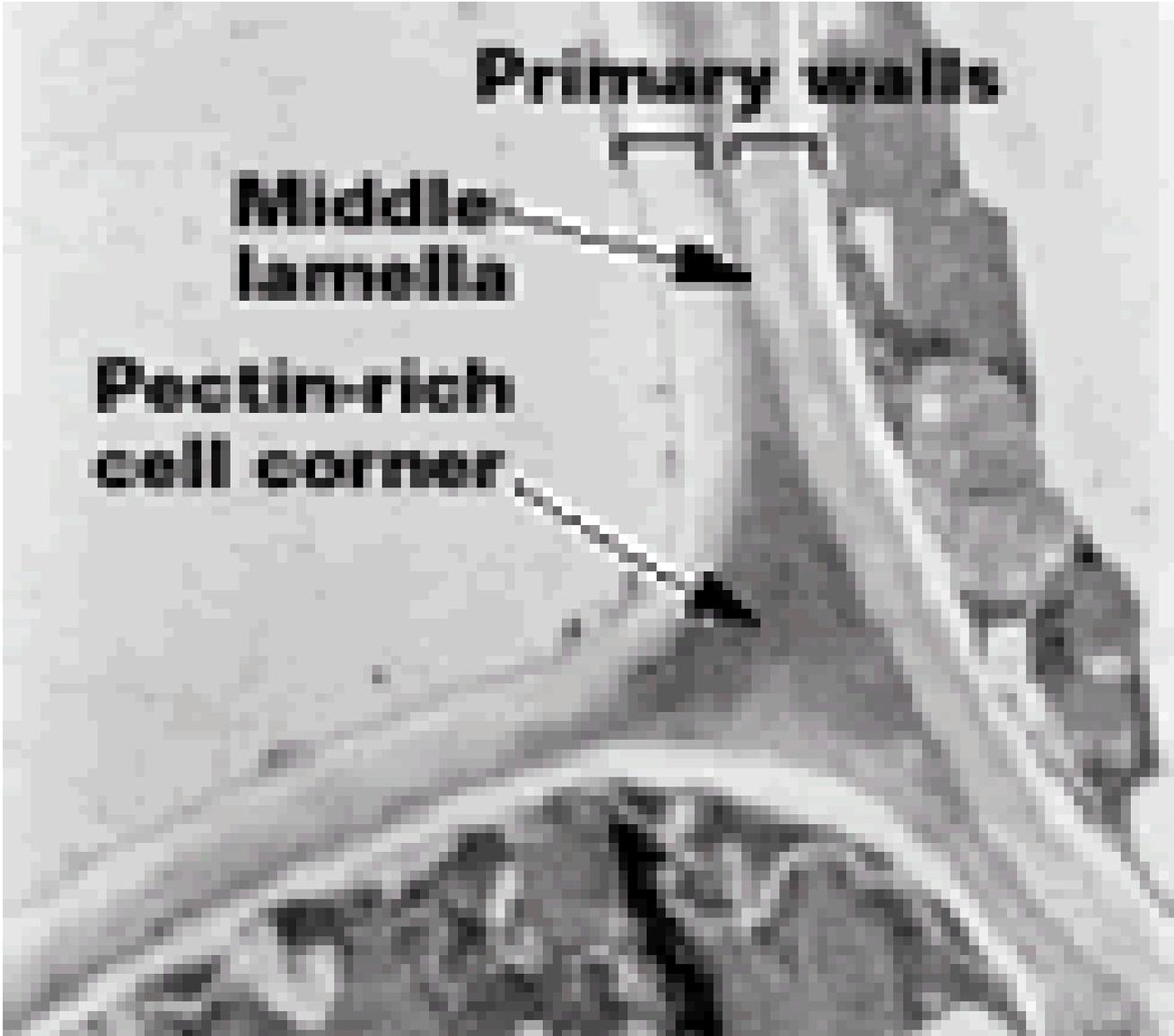
CELL WALL

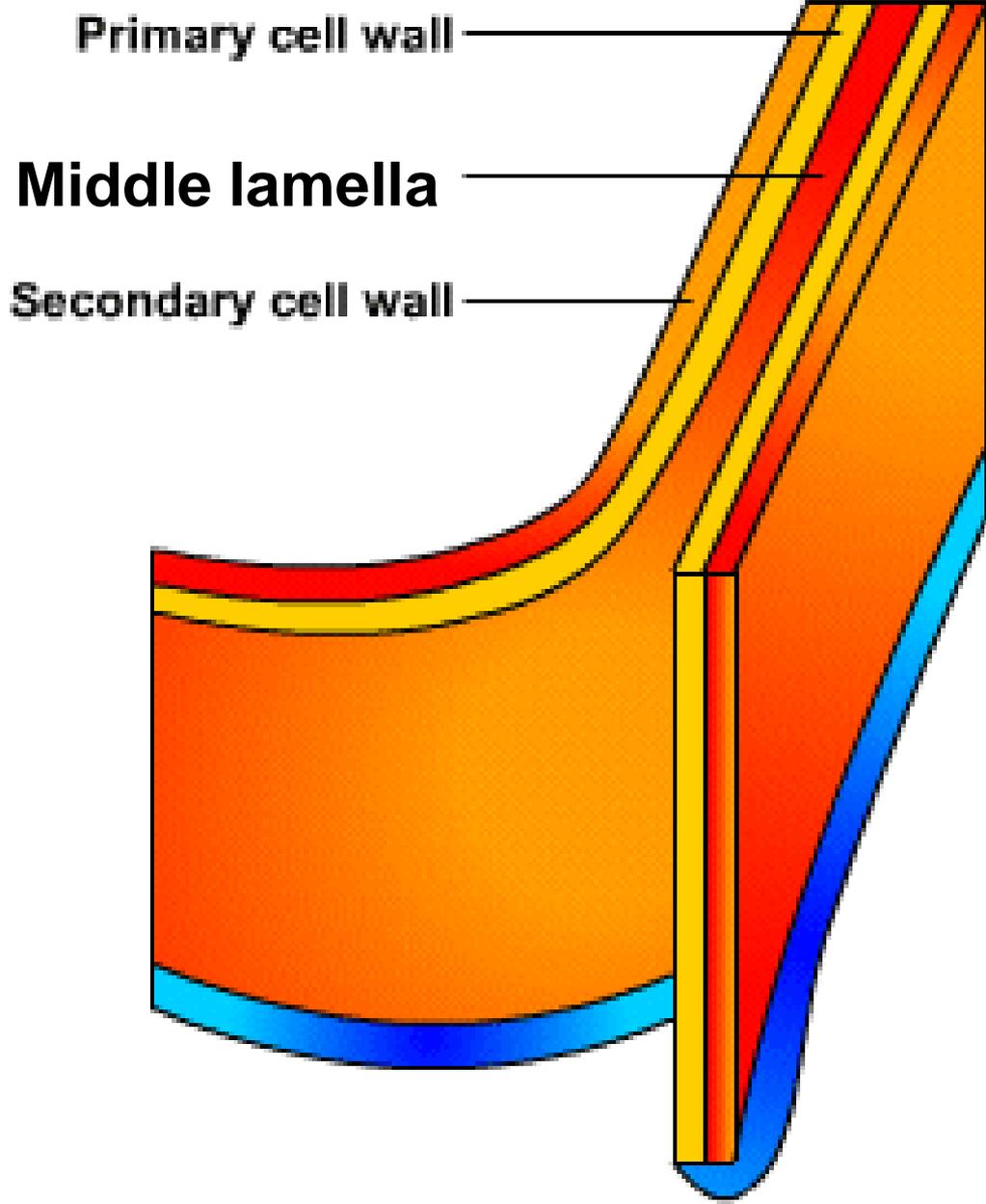
- Surrounds the cell membrane, mainly composed of **cellulose**.
- **1 μm** thick.
- The rigid structure supports the cell, but is also important in cell **turgor**, when they restrict the outward expansion of the **protoplast** as the cell takes in water.
- They are **fully permeable** and have no role in controlling the passage of substances in or out of the cell.

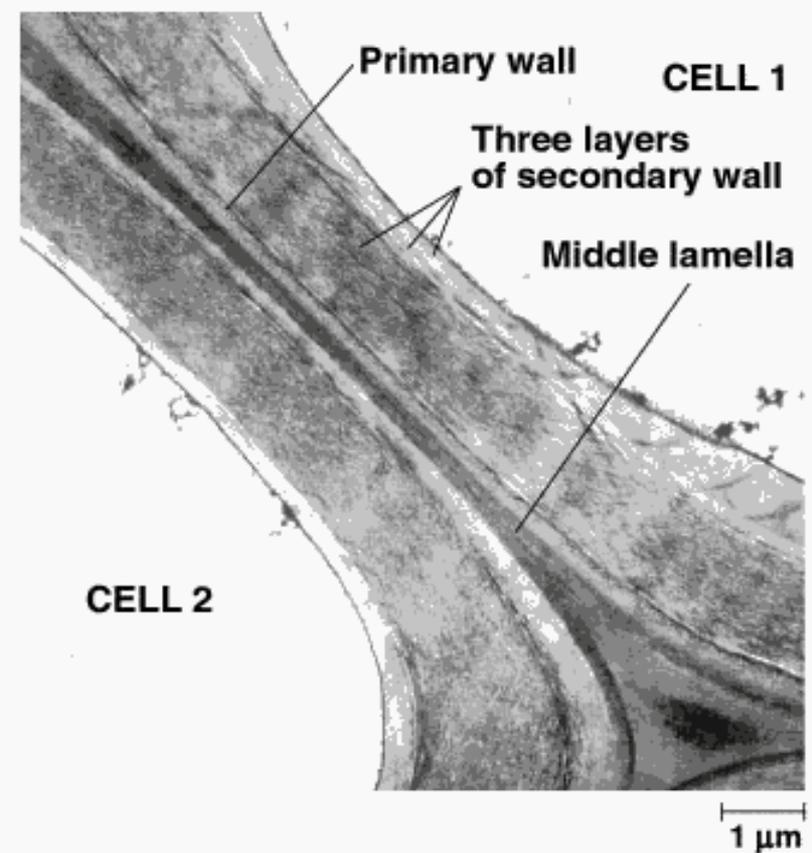
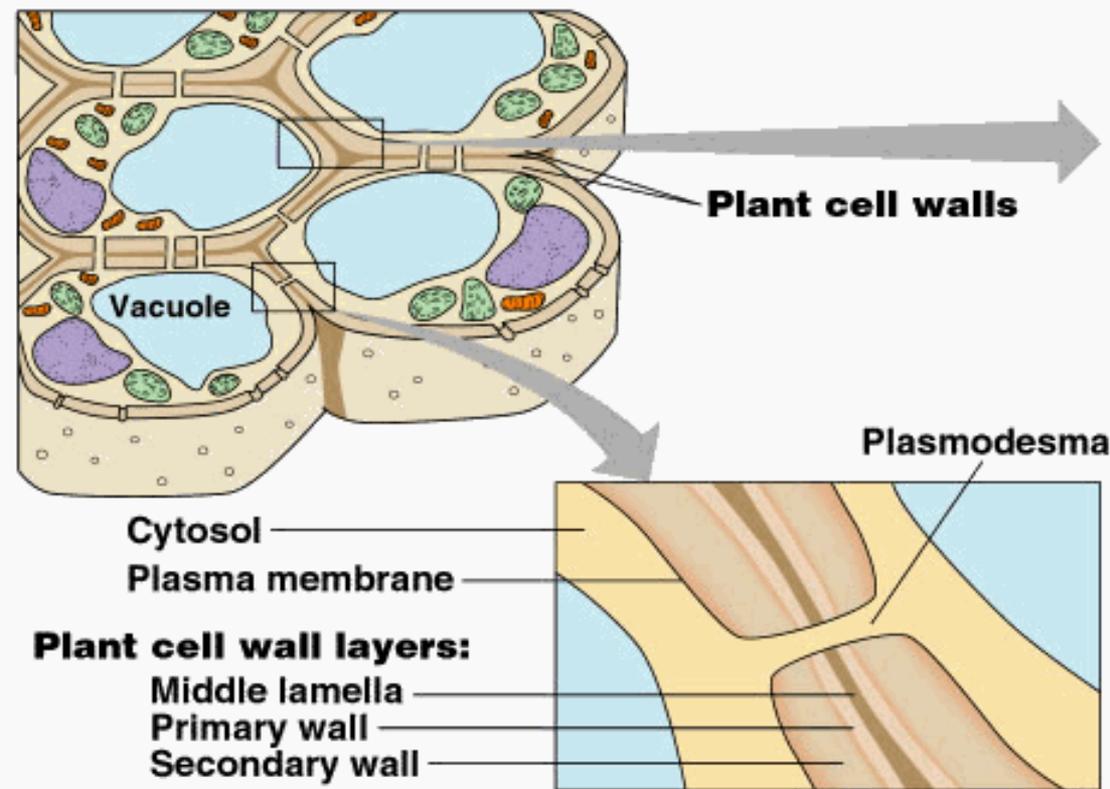
- The **primary cell wall** is composed of **cellulose microfibrils** laid down in **many different directions**. They are **cross-linked** to each other. The **loose** arrangement allows the cell wall to **expand and grow**.
- The **secondary cell wall** is laid down when the cell reaches **full size**. **Layers** of cellulose are **orientated in the same direction**, with additional layers laid on top in different directions. This gives **strength** to the wall.
- The **middle lamella** links adjacent cells. It is made of **polysaccharides** called **pectin**. Pectin contains **calcium pectate** which forms a gel that acts as an **adhesive** to join cells together.





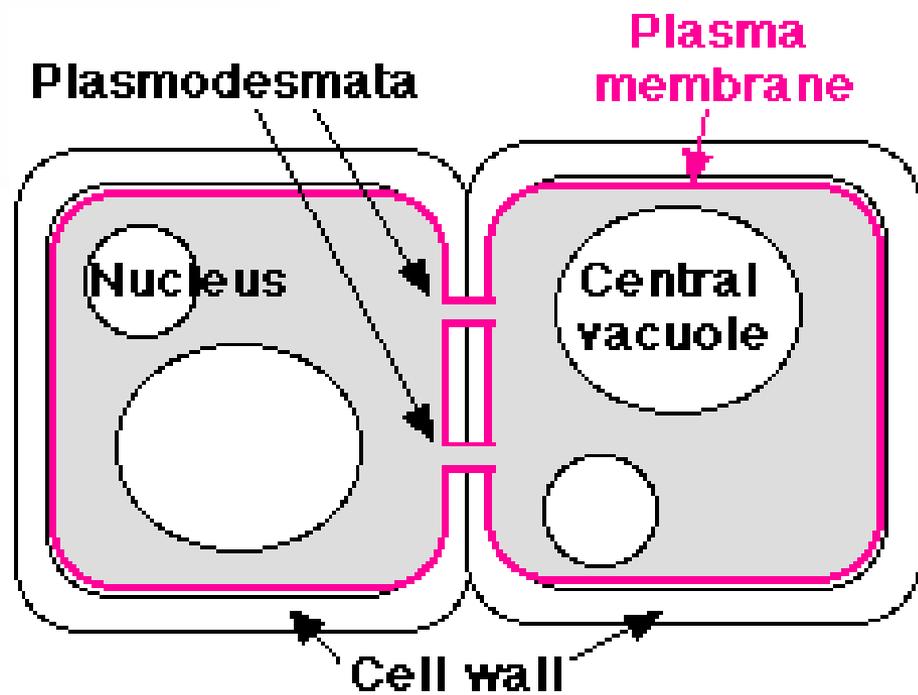
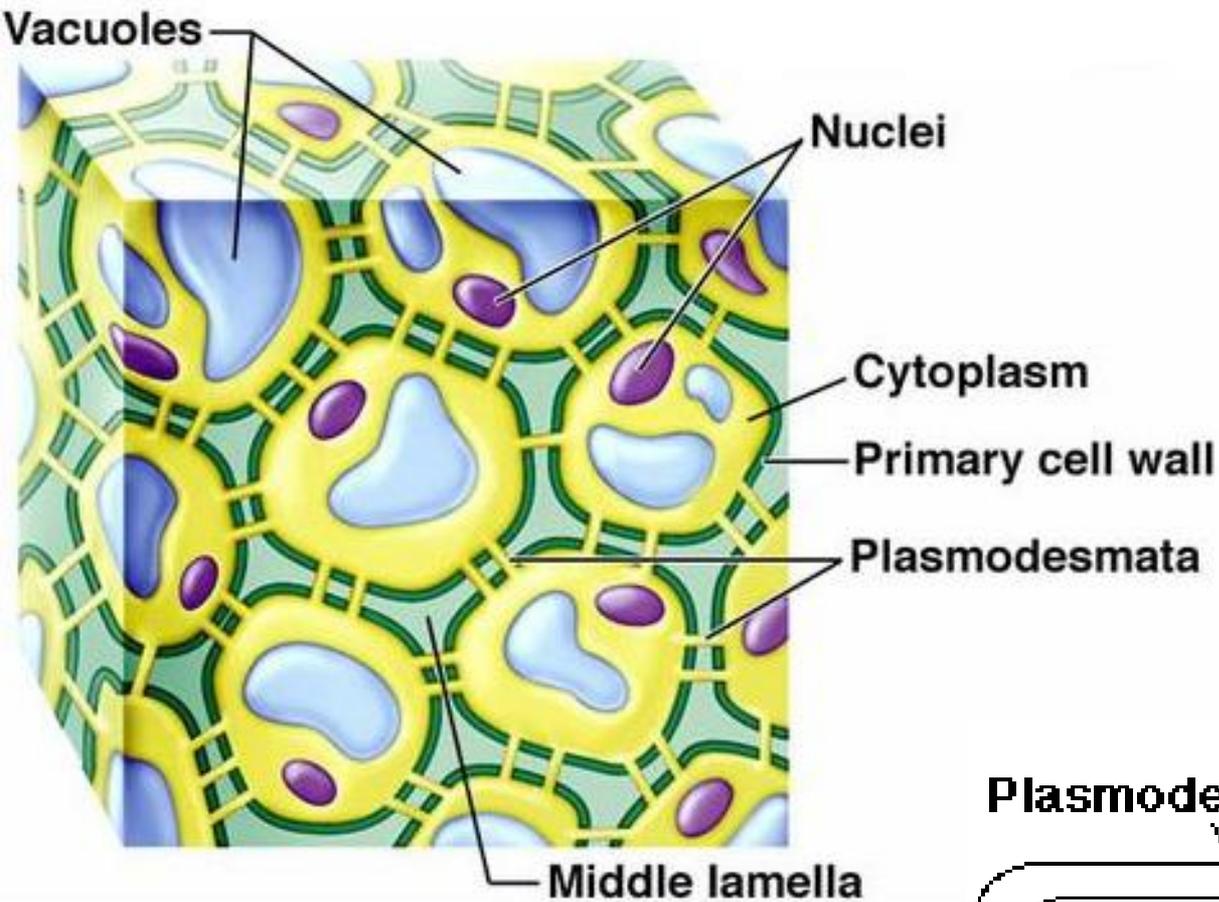


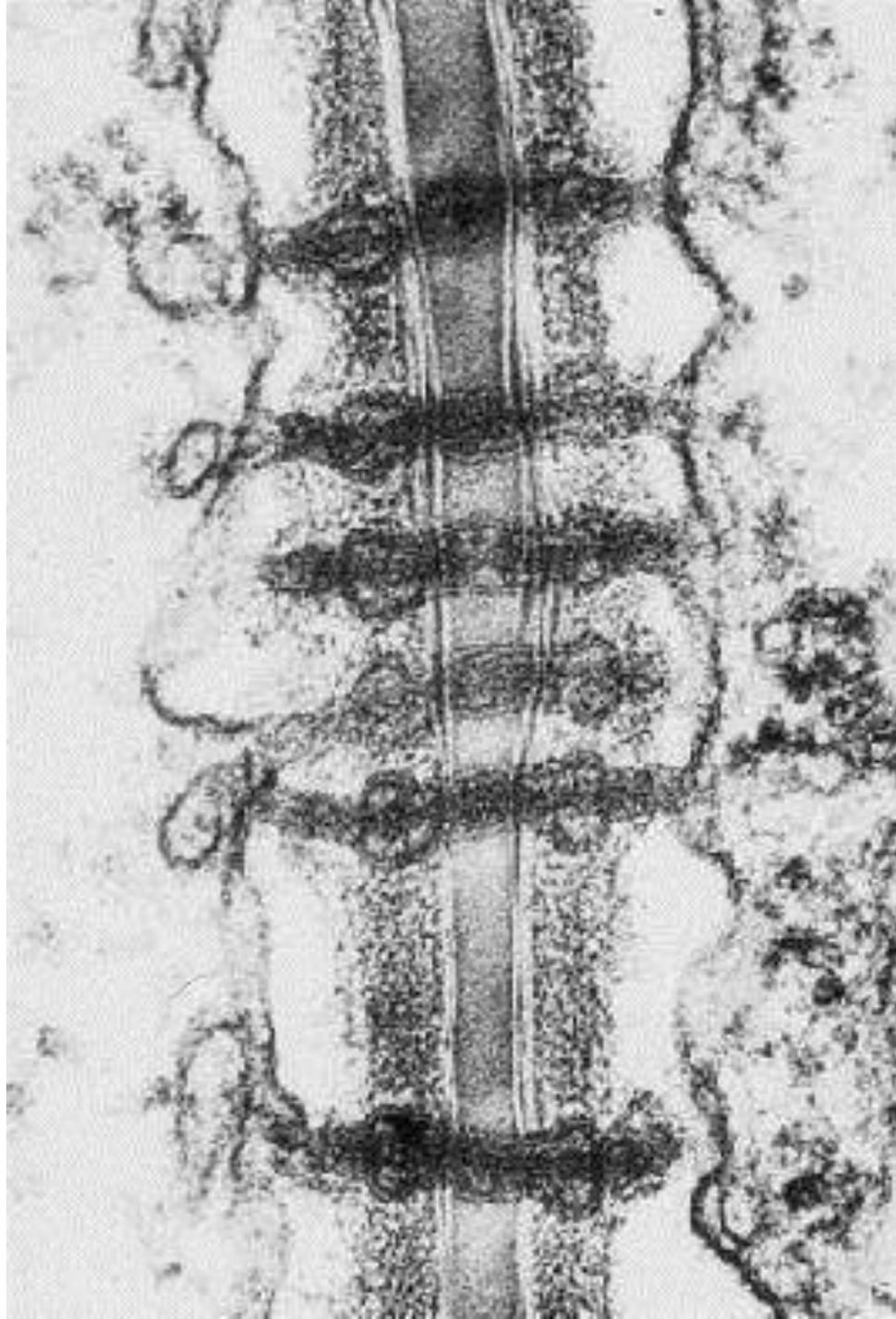




PLASMODESMATA

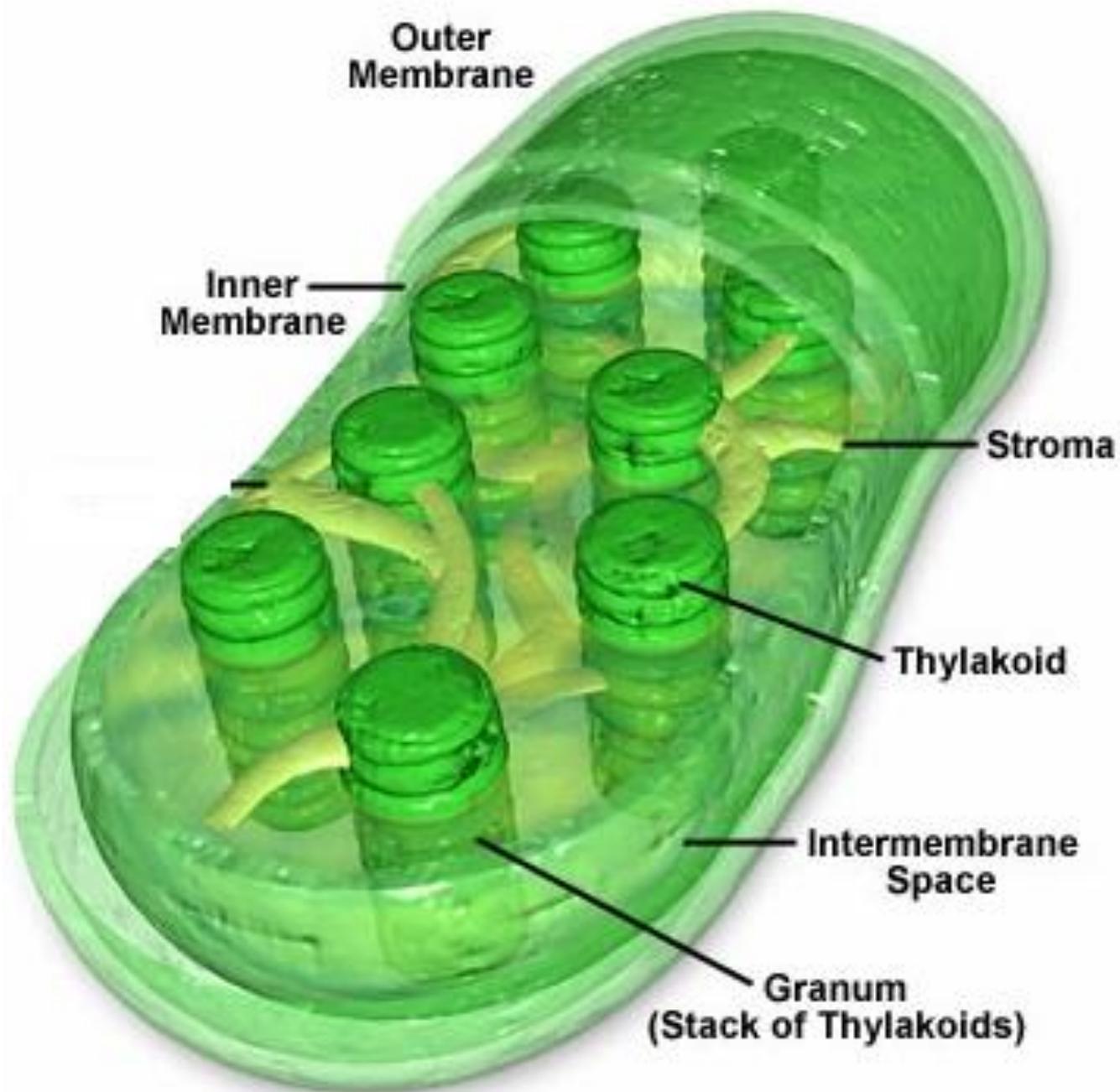
- Strands of cytoplasm that extend between neighbouring cells through the cell wall.
- The plasma membrane of one plant cell is continuous with the next.
- Allows substances to pass easily between cells, joining them physically and metabolically.

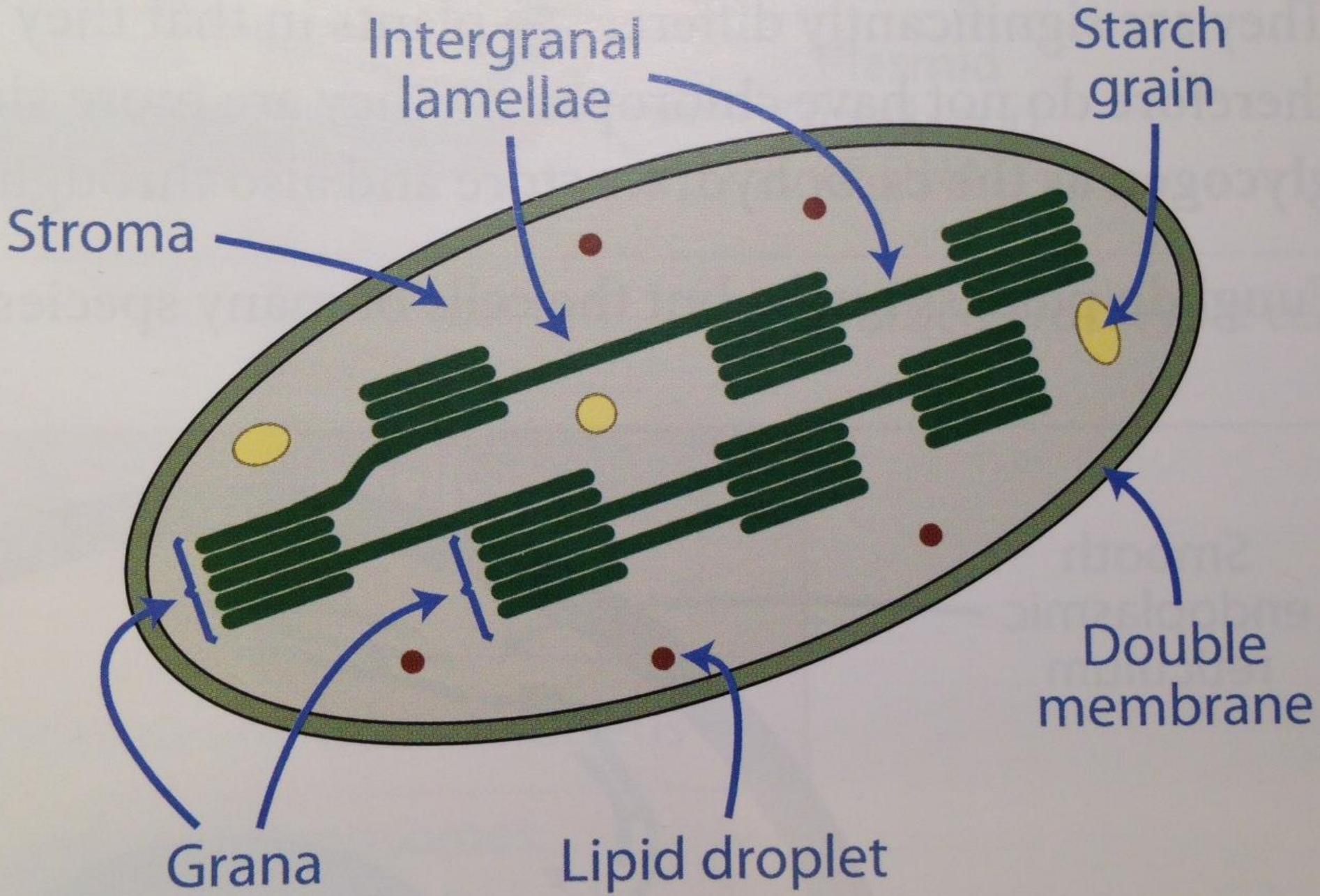


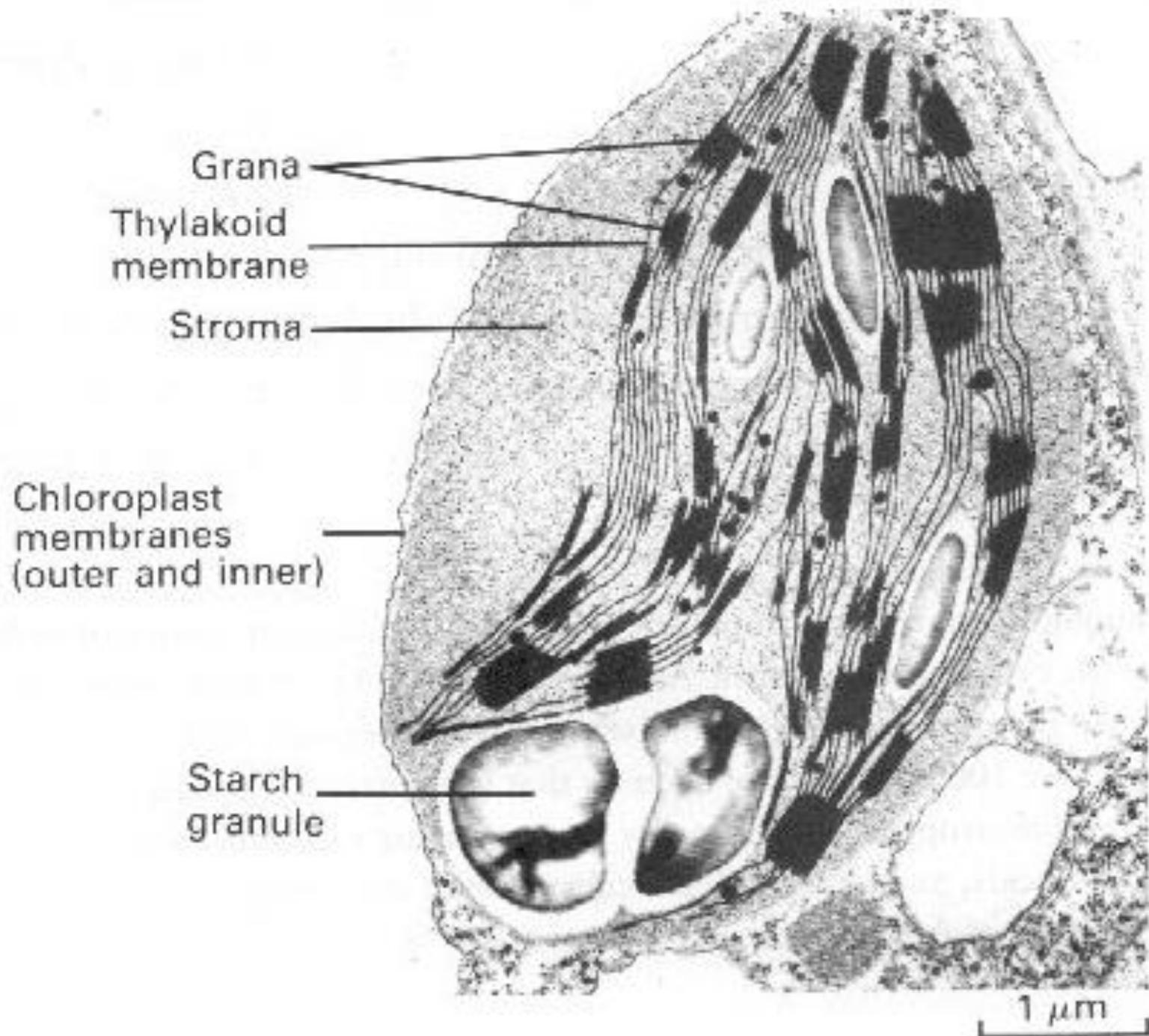


CHLOROPLAST

- Intermediate in size between the nucleus and mitochondria.
- Bound by a double membrane (envelope) containing the stroma.
- Inside the stroma is a network of flattened membranes called thylakoids.
- Thylakoids are stacked to form grana that have a large surface area for the space they take up.
- Between the grana the membranes are called inter-grana.
- Thylakoid membranes contain chlorophyll.
- Large starch grains and small lipid droplets are found in the stroma; products of **photosynthesis**.
- They are the site of photosynthesis and so are most abundant in palisade mesophyll cells of leaves.







Grana

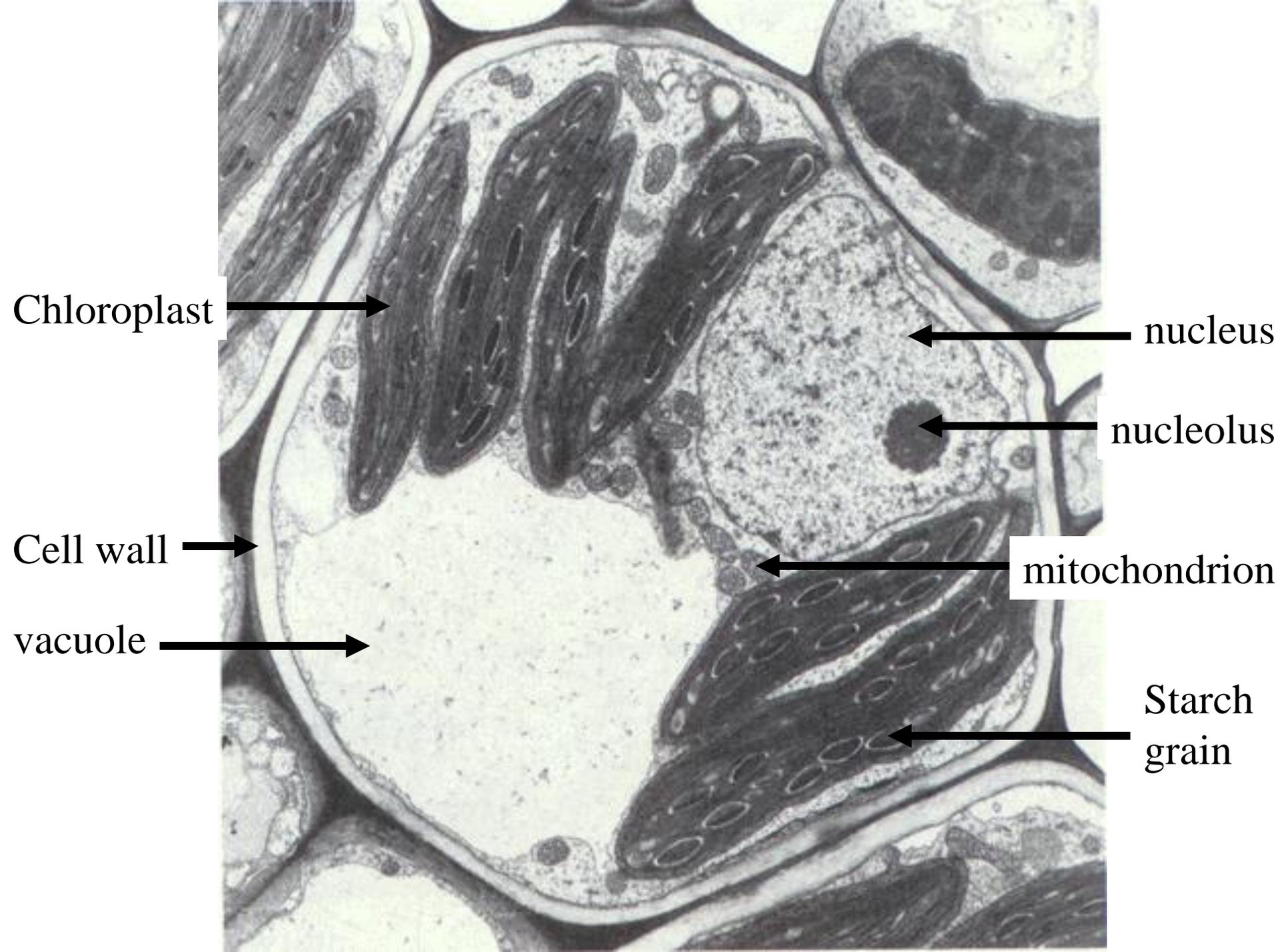
Thylakoid
membrane

Stroma

Chloroplast
membranes
(outer and inner)

Starch
granule

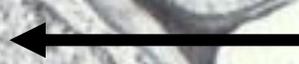
1 μ m



Chloroplast



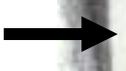
nucleus



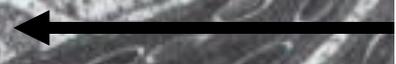
nucleolus



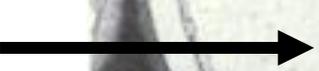
Cell wall



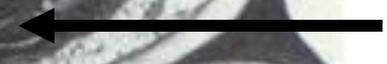
mitochondrion



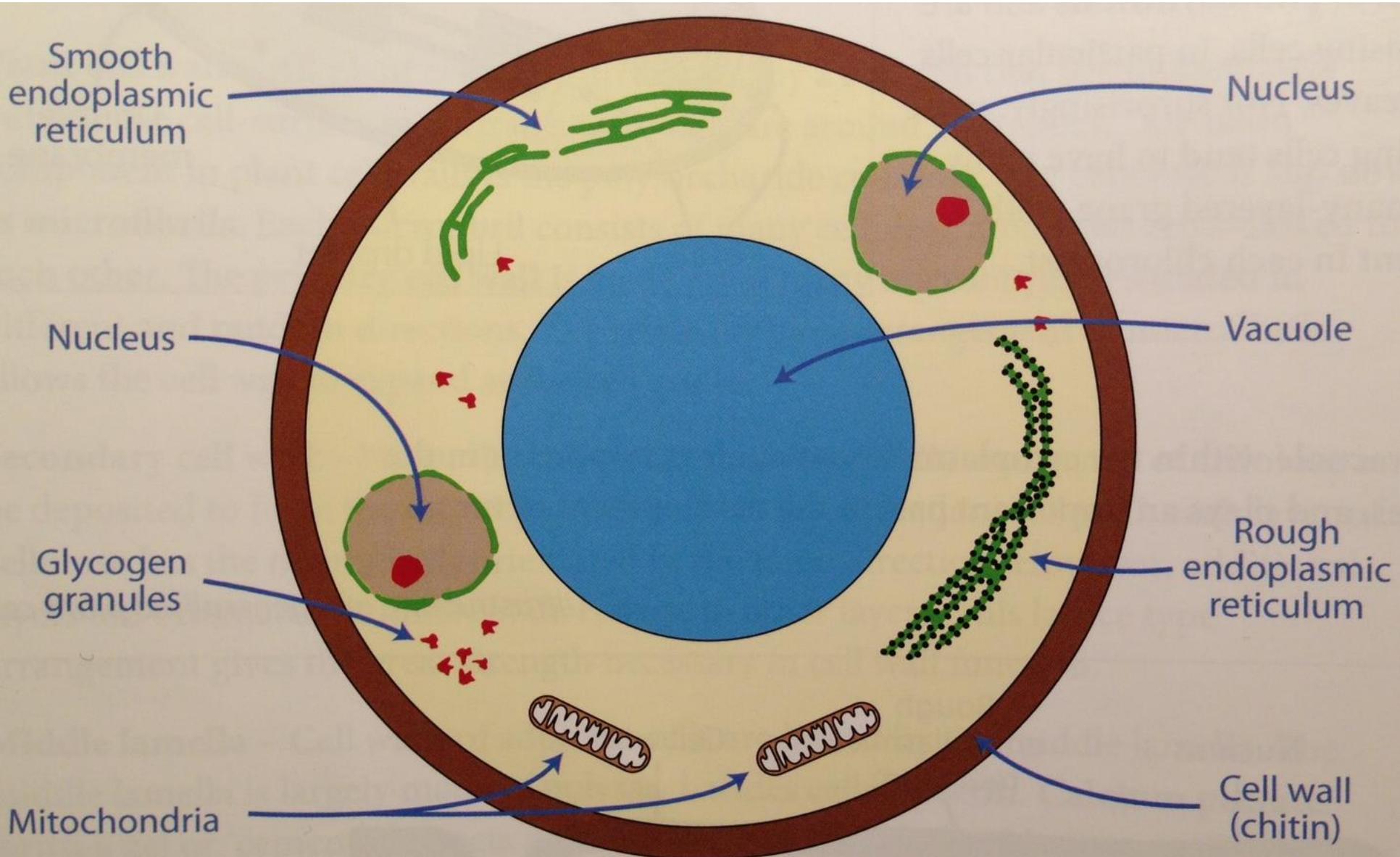
vacuole



Starch grain



FUNGAL EUKARYOTIC CELL



Plant like structures:

- **Cell walls** made of the polysaccharide **chitin**
- Possess **vacuoles**

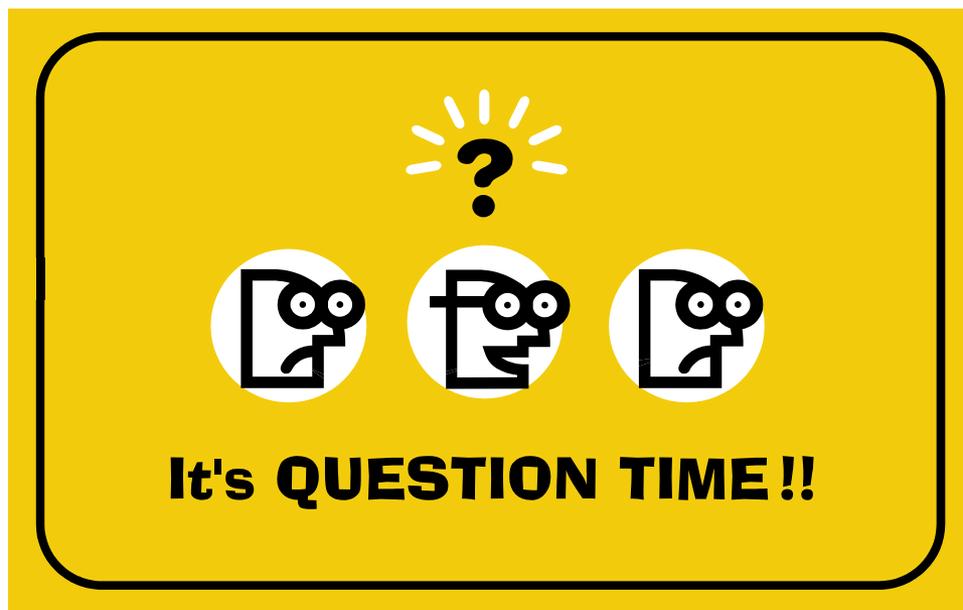
Animal like structures:

- Store **glycogen** granules
- Possess **lysosomes**

- Cells are elongated and form long threads called **hyphae**.
- The connecting walls are often broken, allowing organelles to move between cells, so that they are often **multinucleate**.

Eukaryotic cell structure

STRUCTURE	ANIMAL	PLANT	FUNGUS
Cell wall	x	cellulose	Chitin
Chloroplasts	x	✓	x
Centrioles	✓	x	x
Lysosomes	✓	x	✓
Carb storage	glycogen	starch	Glycogen
nucleus	✓	✓	multinucleate



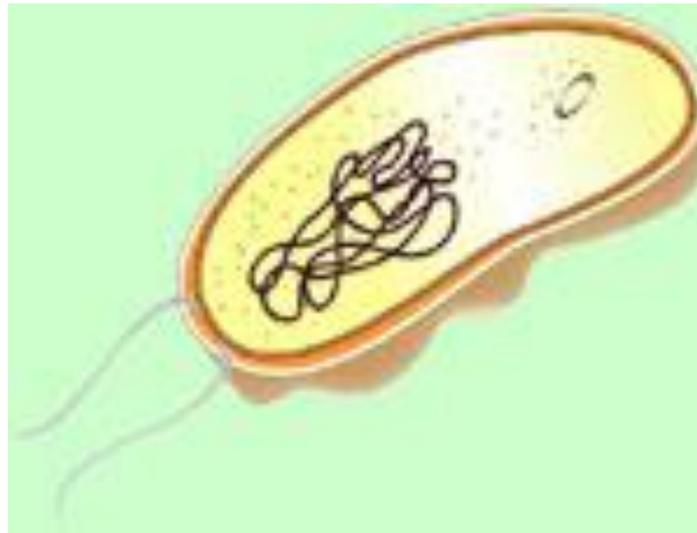
IDENTIFYING TEM PHOTOGRAPHS

EUKARYOTIC CELLS

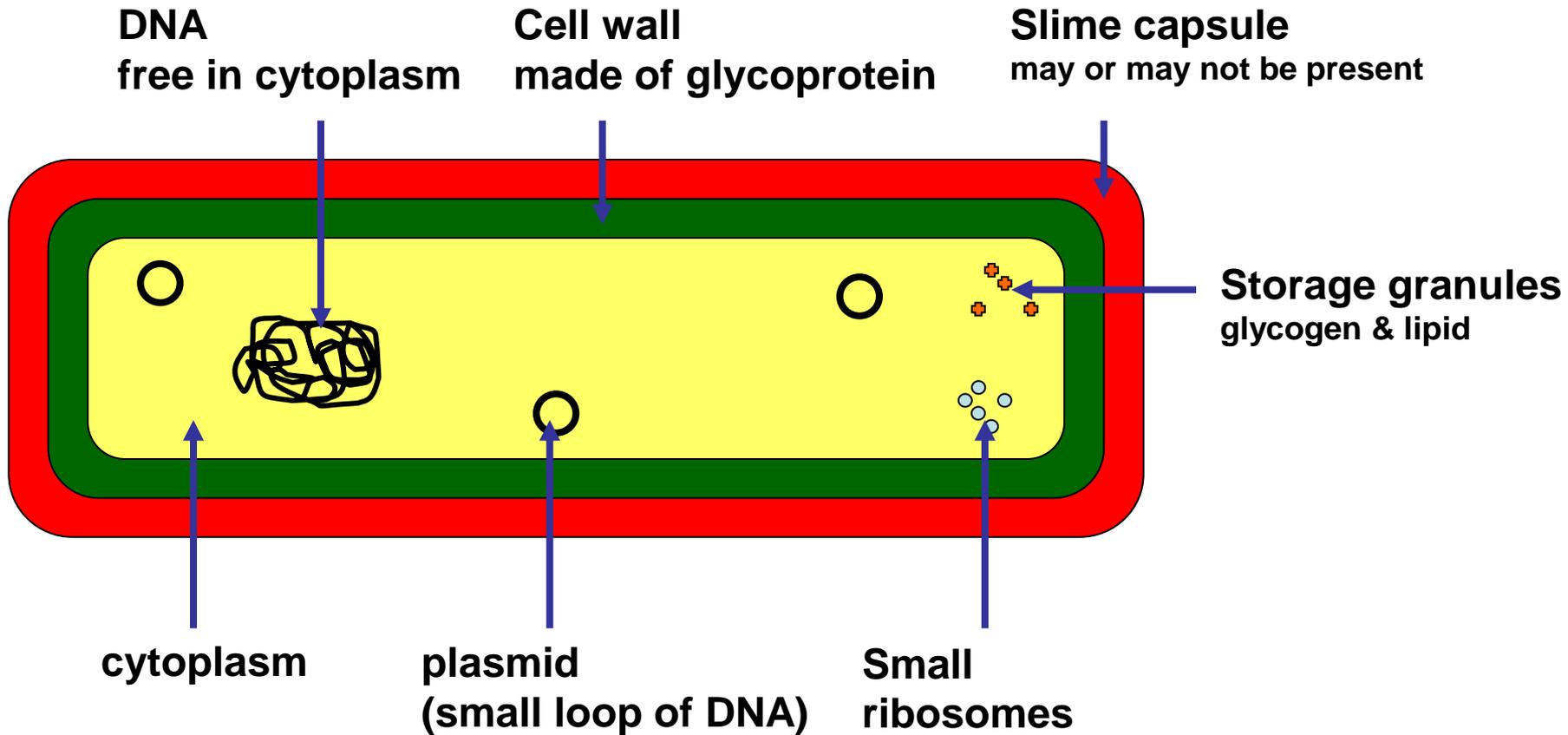
- *NUCLEUS*
- *MEMBRANE BOUND ORGANELLES*
- ANIMAL, PLANT, FUNGI, PROTOCTISTA.

PROKARYOTIC CELLS

- *NO NUCLEUS*
- *NO MEMBRANE BOUND ORGANELLES*
- BACTERIA



STRUCTURE OF PROKARYOTIC CELLS





Electron micrograph of a *E. coli* bacterium

STRUCTURE	prokaryotic cell	eukaryotic cell
Nucleus	× DNA loose in cytoplasm	✓
DNA organisation	✓ coiled, no histones	✓ chromosomes, histones
Ribosomes	✓ small: 20nm (70s)	✓ large: 25nm (80s)
Internal organelles:		
Mitochondria	×	✓
Chloroplasts	×	✓
Golgi apparatus	×	✓
RER & SER	×	✓
Cell walls	✓ made of glycoprotein	✓ Plants = cellulose ✓ Fungi = chitin
Plasmids	✓	×
Microtubules	×	✓ as centrioles in animals and some fungi