Structural Features of Eukaryotic Cells

- Prokaryotes versus Eukaryotes

1. Size
2. Membranes
3. Nucleus

Eukaryotic cells: Animal & plants cells

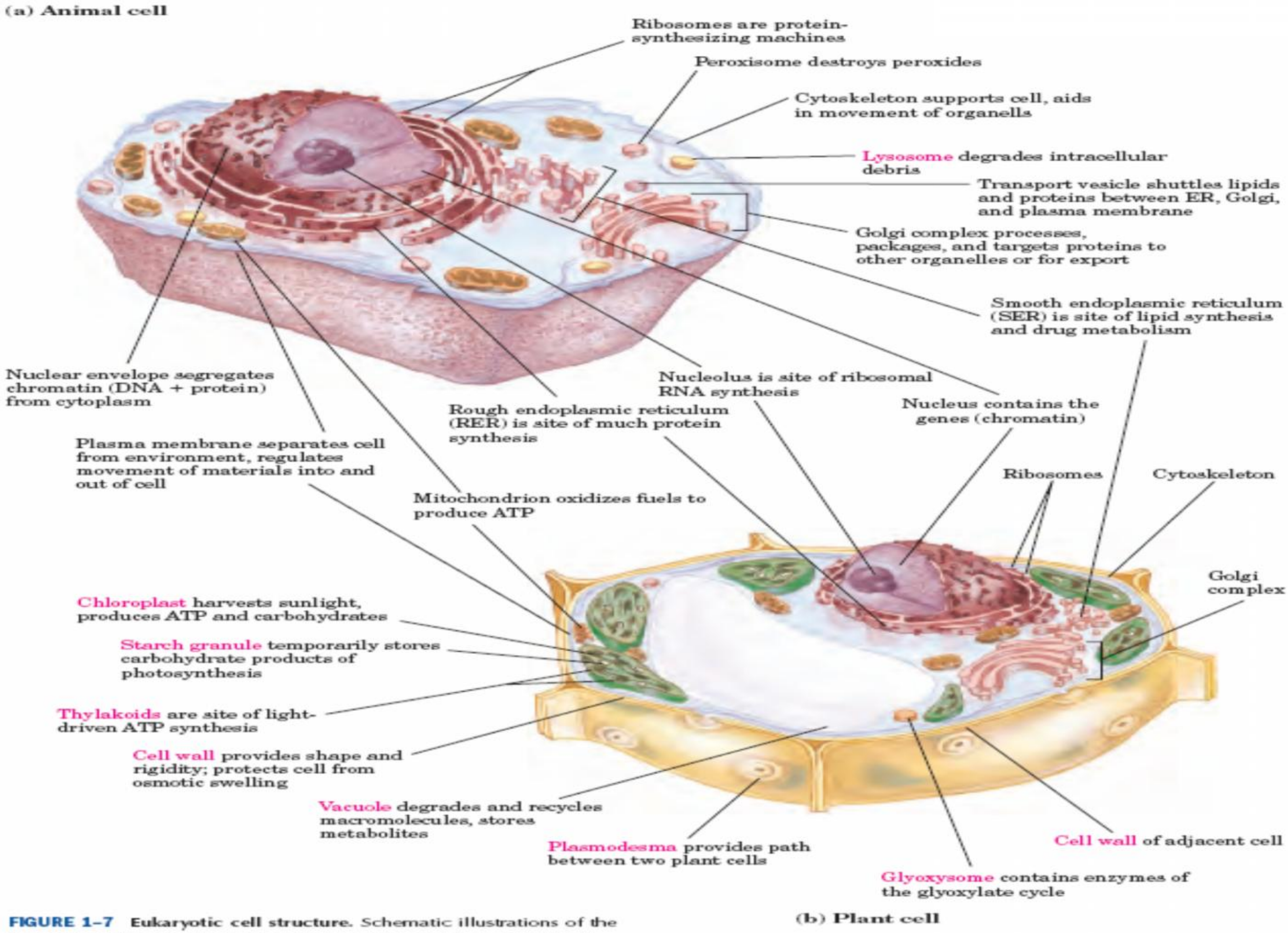
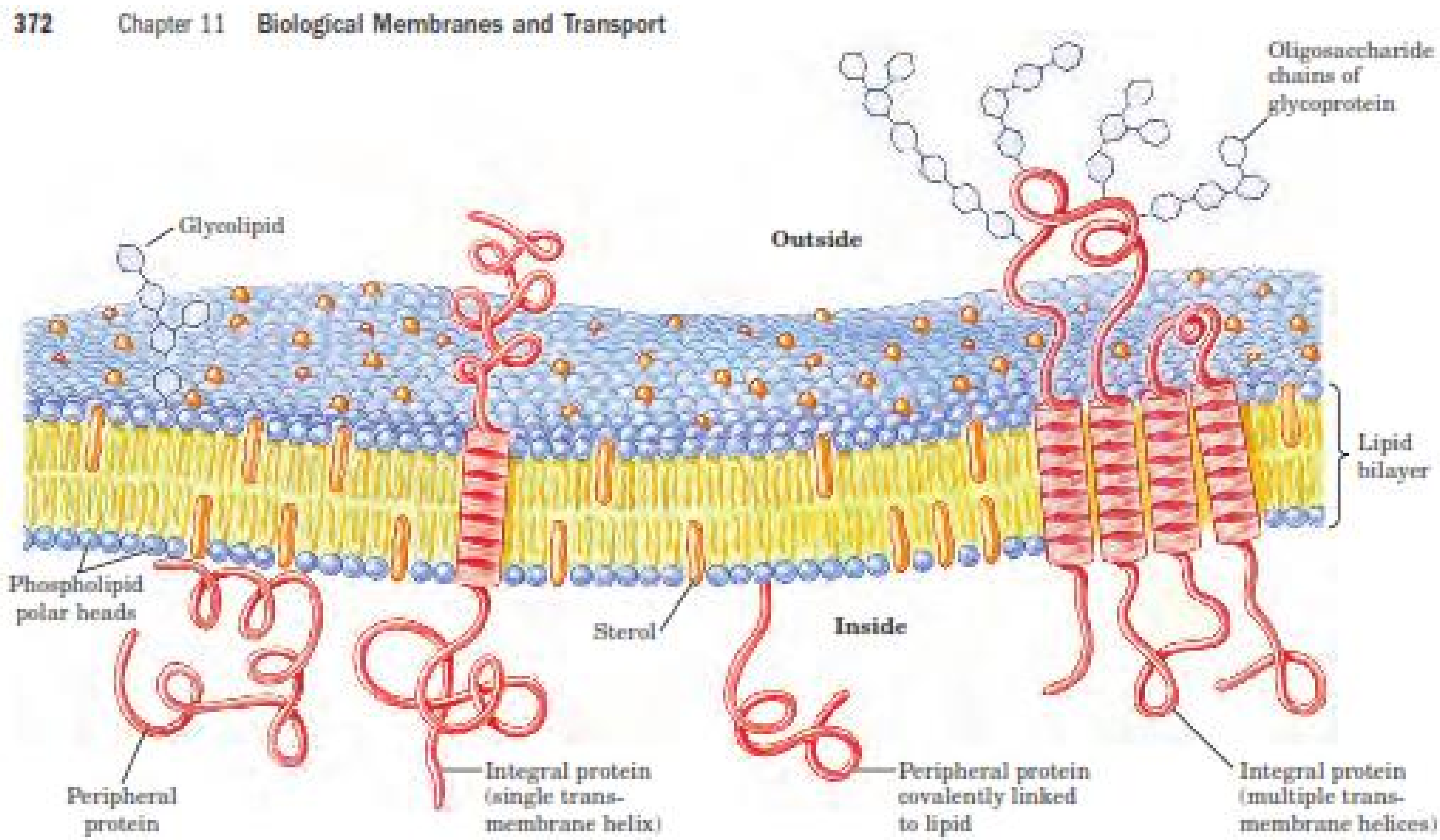


FIGURE 1–7 Eukaryotic cell structure. Schematic illustrations of the two major types of eukaryotic cell: (a) a representative animal cell and (b) a representative plant cell. Plant cells are usually 10 to 100 μm in diameter—larger than animal cells, which typically

Biological Membranes

- All membranes
- Boundary
- Communication
- Flexible, self-sealing, selectively permeable
- Transporters
- Adhesion molecules
- Molecular constituents (proteins, lipids)

Biological membranes



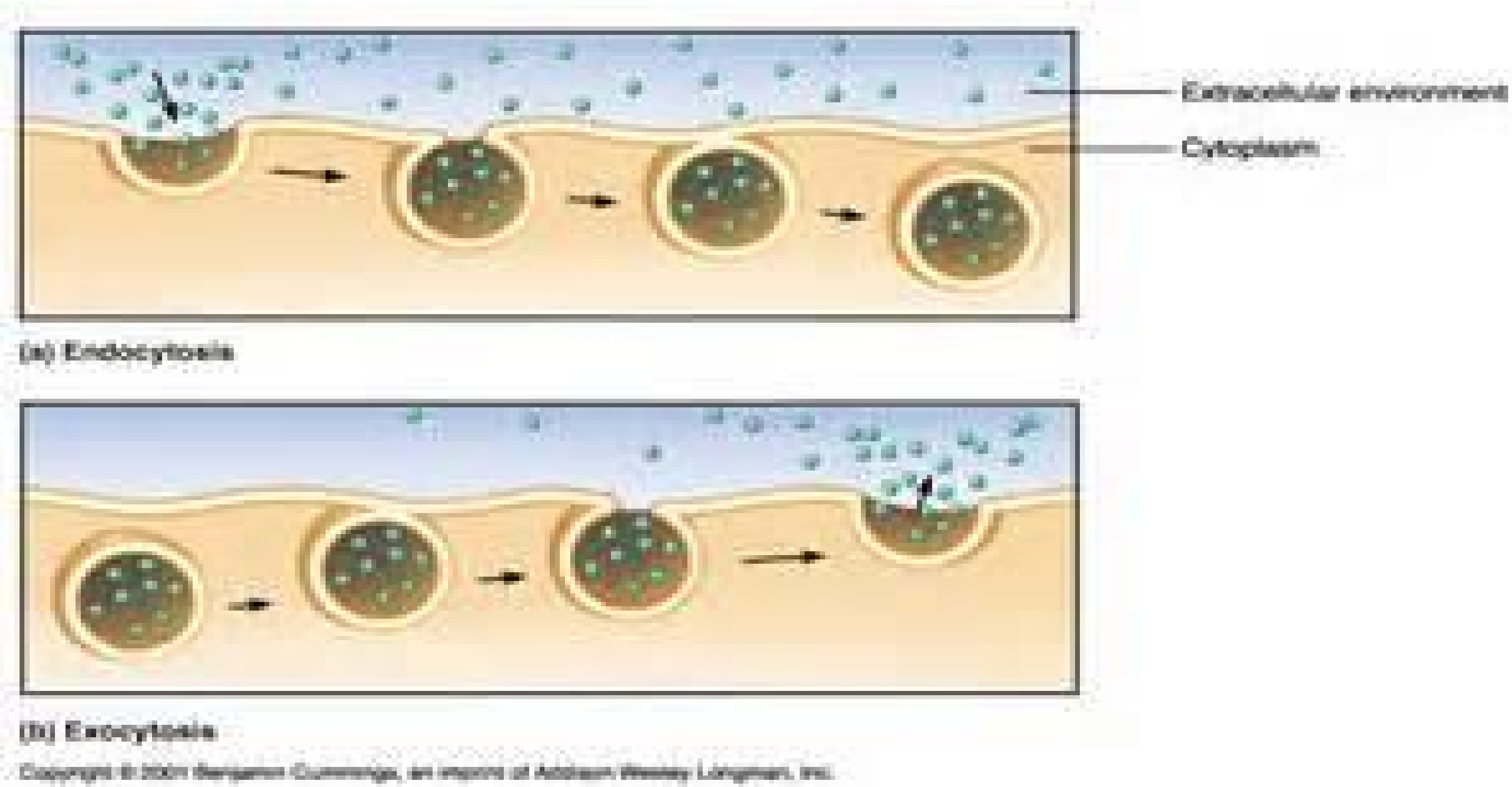
- Endocytosis

1.Phagocytosis

2. Pinocytosis

- Exocytosis

- Endocytosis
- Exocytosis

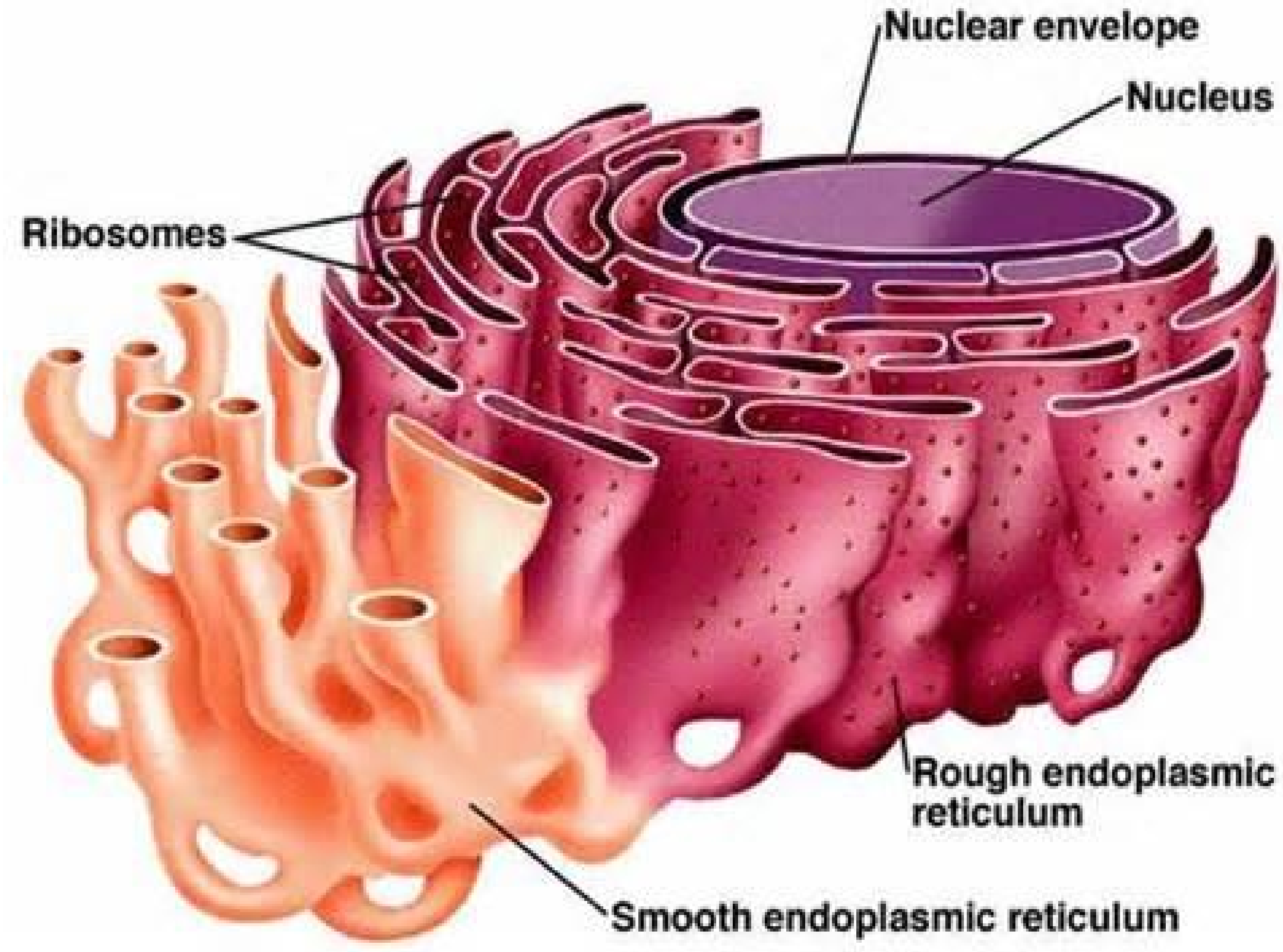


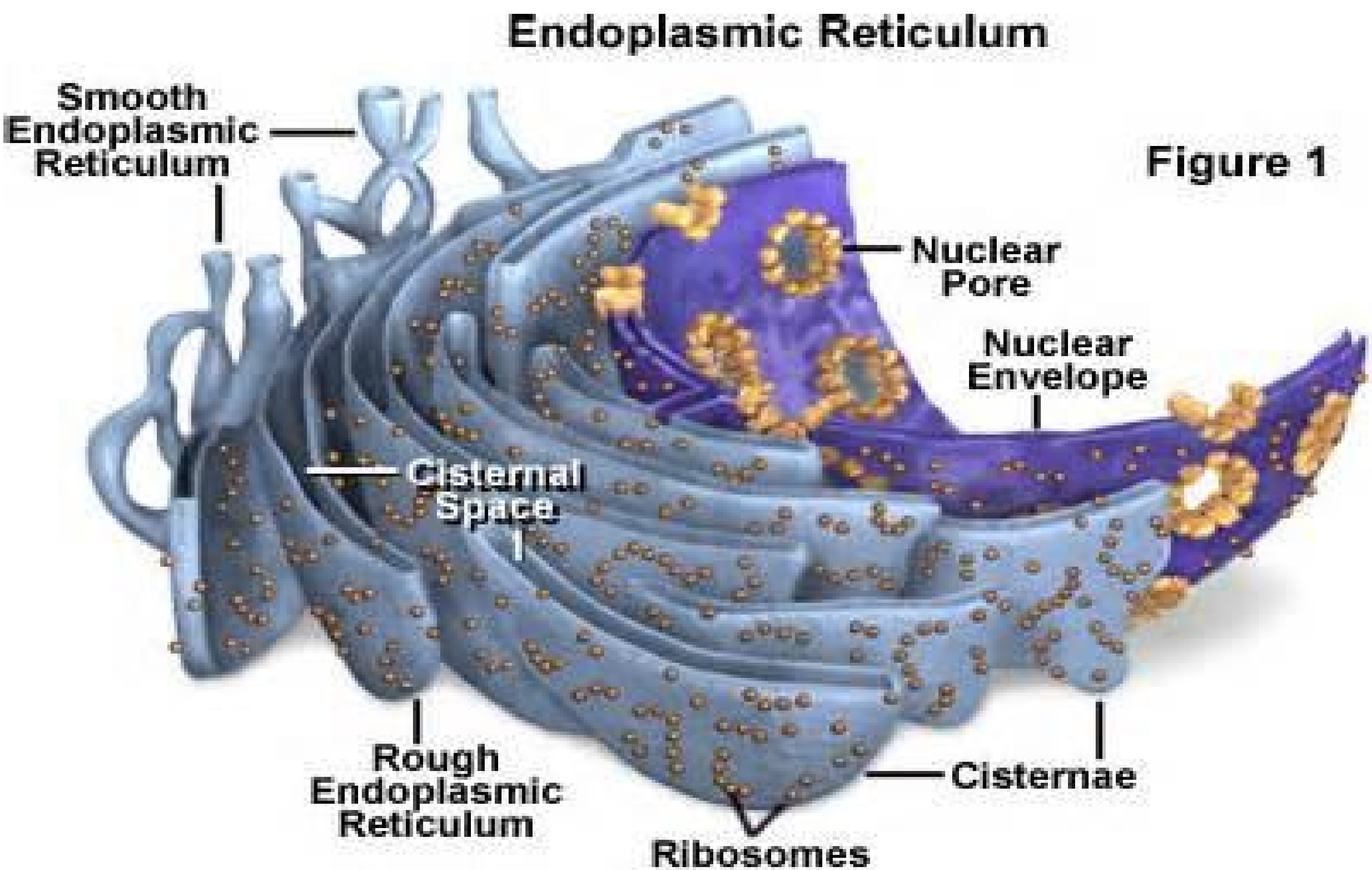
Endoplasmic Reticulum (ER)

- Smooth ER – Shape, location, function
- Rough ER – Shape, location, function

Endoplasmic Reticulum (ER)

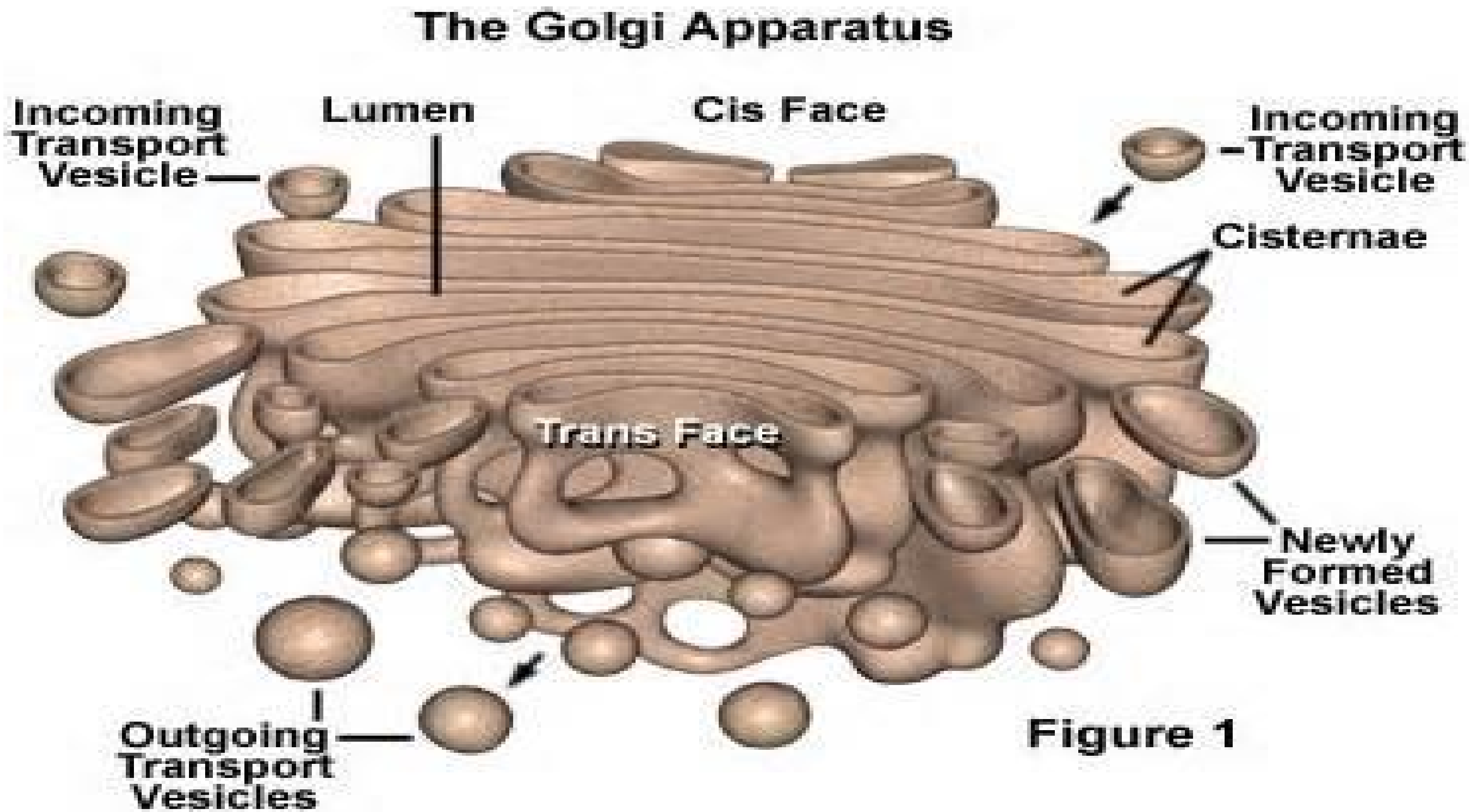
- Rough ER
- Smooth ER




Endoplasmic Reticulum
Smooth Endoplasmic Reticulum
Figure 1
Nuclear Pore
Nuclear Envelope
Cisternal Space
Rough Endoplasmic Reticulum
Ribosomes
Cisternae

Golgi Complex

- **Structure, location, functions**



Mitochondria

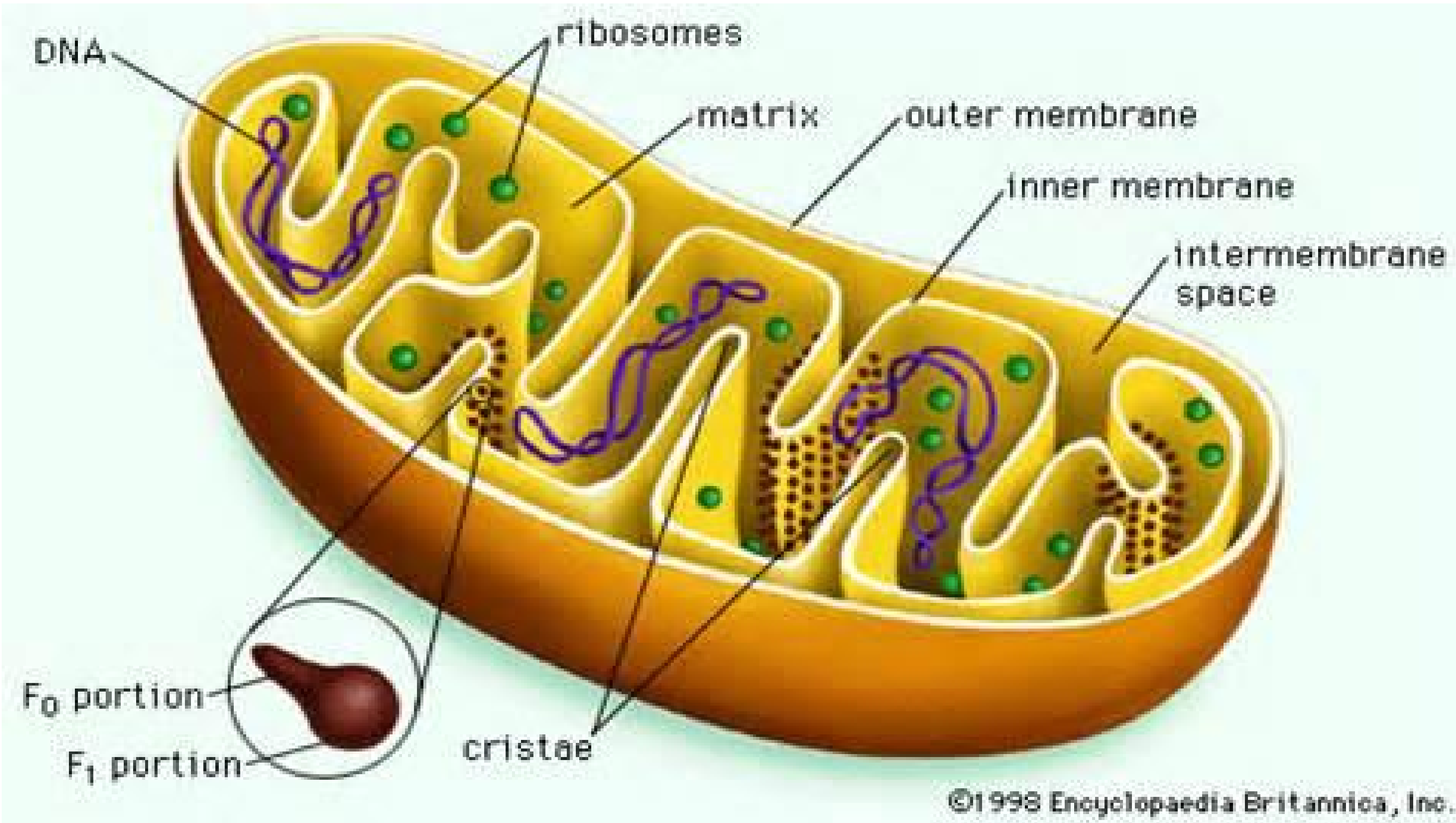
- Membrane-bound organelles
- Vary in size, but typically have a diameter of about 1um
- Vary widely in shape, number and location depending on the cell type or tissue function
- Most plant and animal cells contain several hundred to a thousand mitochondria
- Generally, cells in more metabolically active tissues devote a larger proportion of their volume to mitochondria.

- Each mitochondria has two membranes. The outer membrane is unwrinkled & completely surrounds the organelle
- Inner membrane has infoldings called cristae, which give it a large surface area
- Enclosed by the inner membrane is the matrix, a very concentrated aqueous solution of enzymes and chemical intermediates involved in energy-yielding metabolism.

- Mitochondrial enzymes catalyze the oxidation of organic nutrients by molecular oxygen (O_2)
- Some of these enzymes are in the matrix and some are embedded in the inner membrane
- Chemical energy released in the mitochondrial oxidation is used to generate ATP, the major energy-carrying molecule of the cell

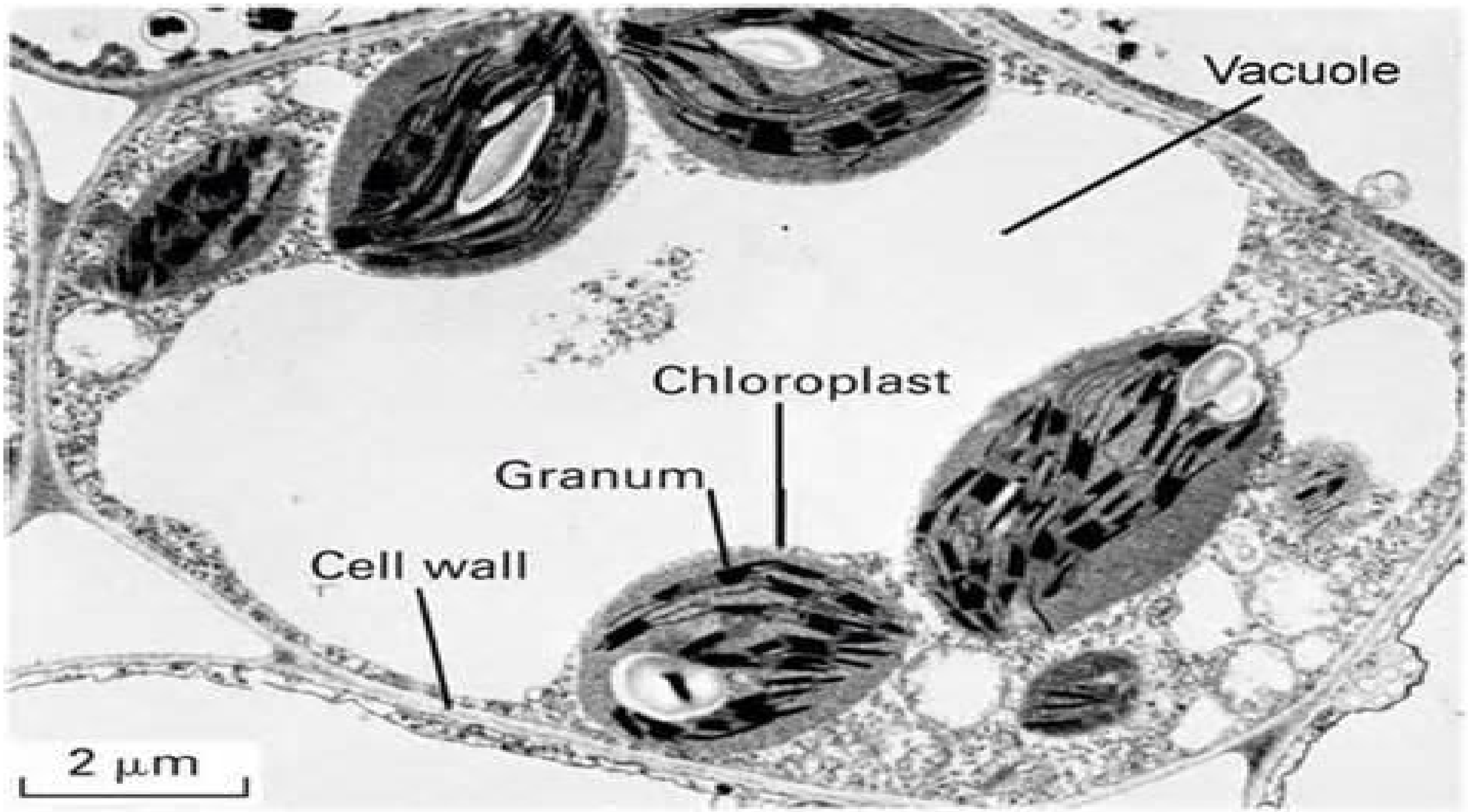
- In aerobic cells, mitochondria are the principal producers of ATP, which diffuses to all parts of cell and provides the energy for cellular work.

Mitochondria



Vacuole

- **Structure, location, functions**

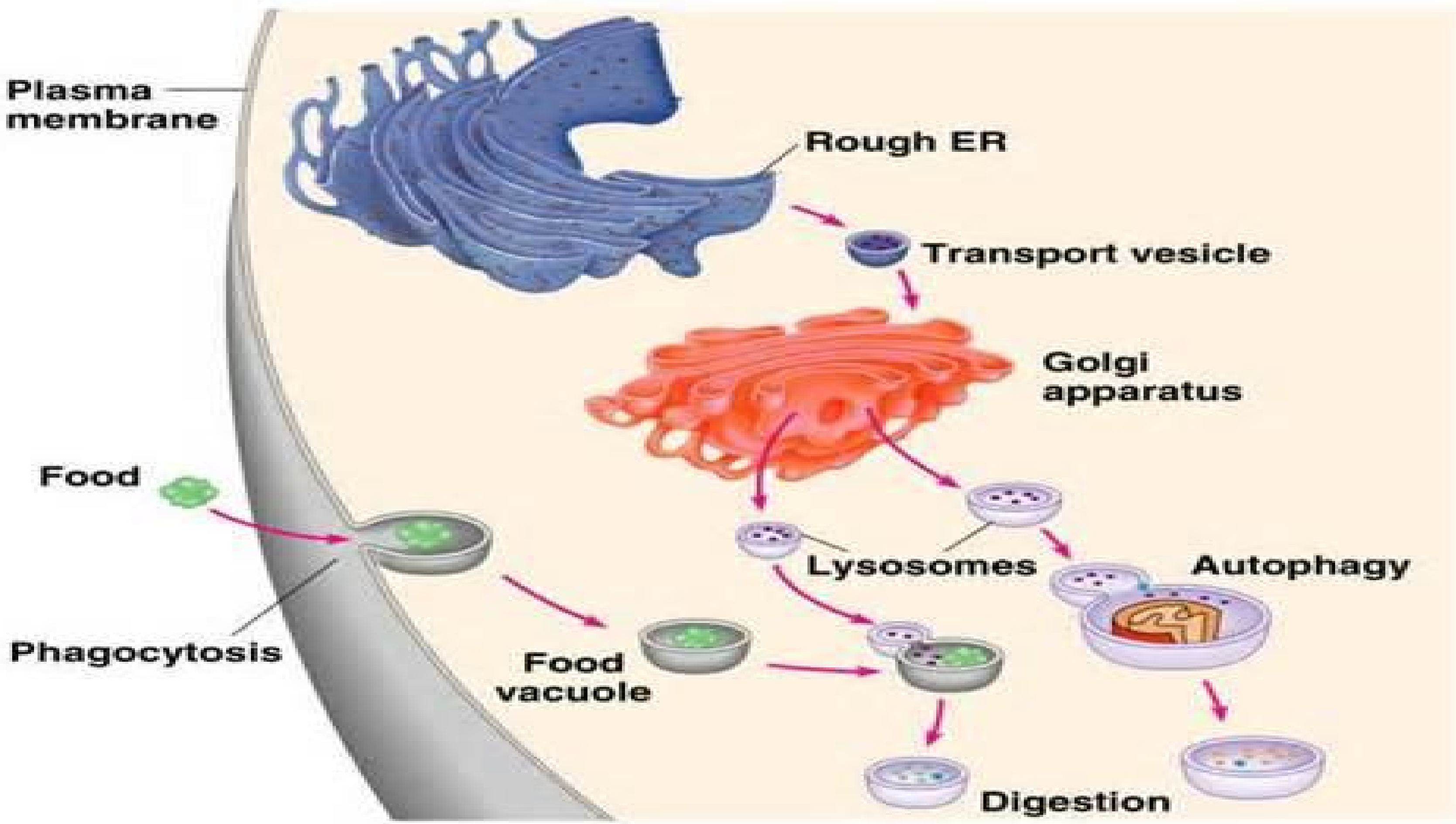


Lysosomes

- **F**ound only in animal cells
- Spherical vesicles bounded by a single membrane bilayer
- Usually about 1um in diameter
- Contain enzymes capable of digesting proteins, polysaccharides, nucleic acids, and lipids
- Function as cellular recycling centers

- Break down complex molecules brought into the cell by endocytosis, fragments of foreign cells brought in by phagocytosis or worn-out organelles from the cell’s own cytoplasm
- After degradation, these simple components (amino acids, polysaccharides and fatty acids) are released into the cytosol to be recycled into new cellular components or further catabolized.

Lysosomes



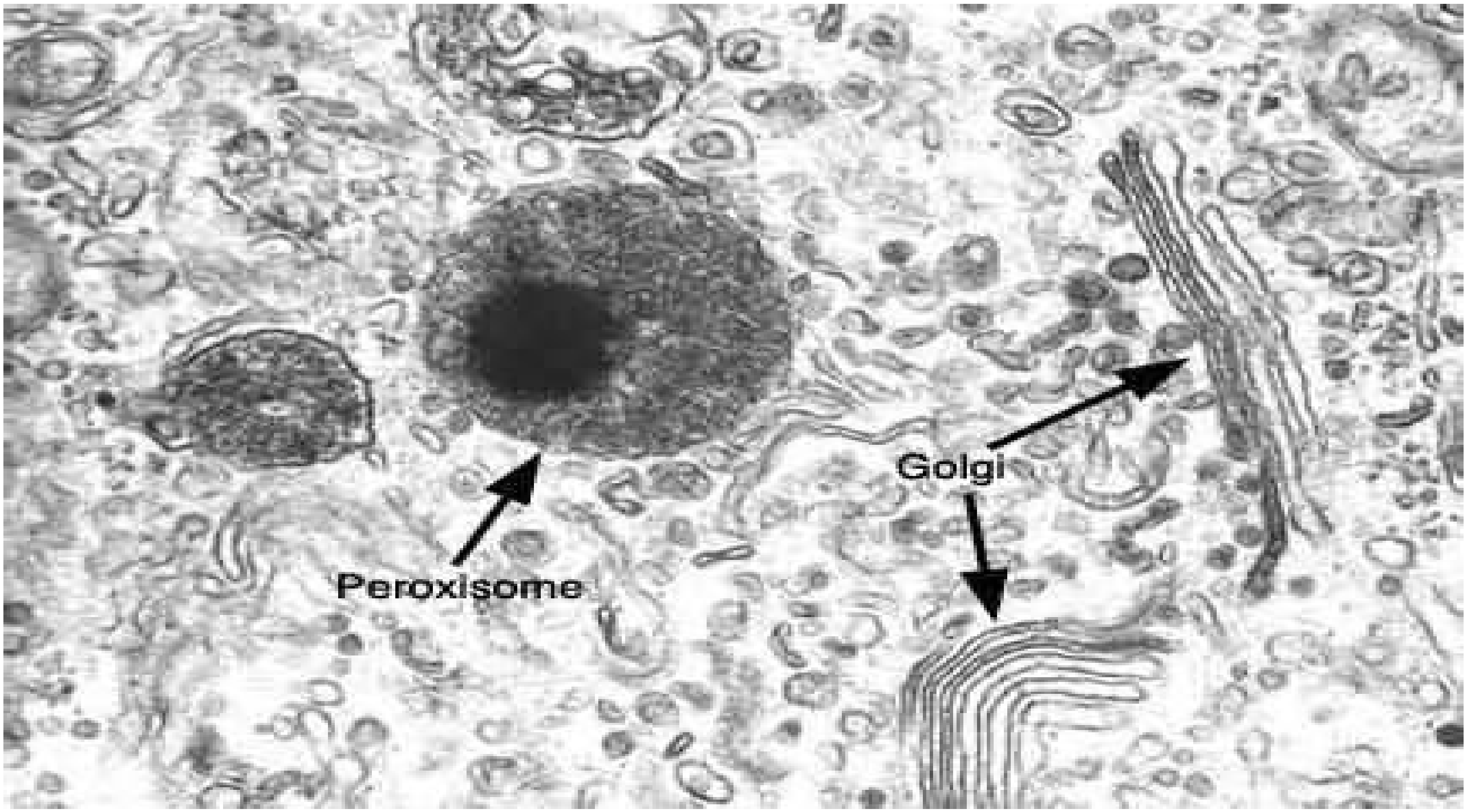
Plasma membrane
Rough ER
Transport vesicle
Golgi apparatus
Food
Lysosomes
Autophagy
Phagocytosis
Food vacuole
Digestion

Peroxisomes

- Single-membrane vesicles about 0.5 um in diameter
- Some of the oxidative reactions in the breakdown of amino acids and fats produce free radicals and hydrogen peroxide (H_2O_2)
- These are very reactive chemical specie that could damage cellular machinery

- To protect the cell from these destructive byproducts, such reactions are segregated within small membrane-bound vesicles called peroxisomes. The hydrogen peroxide is degraded by catalase, an enzyme present at high concentration in peroxisomes.

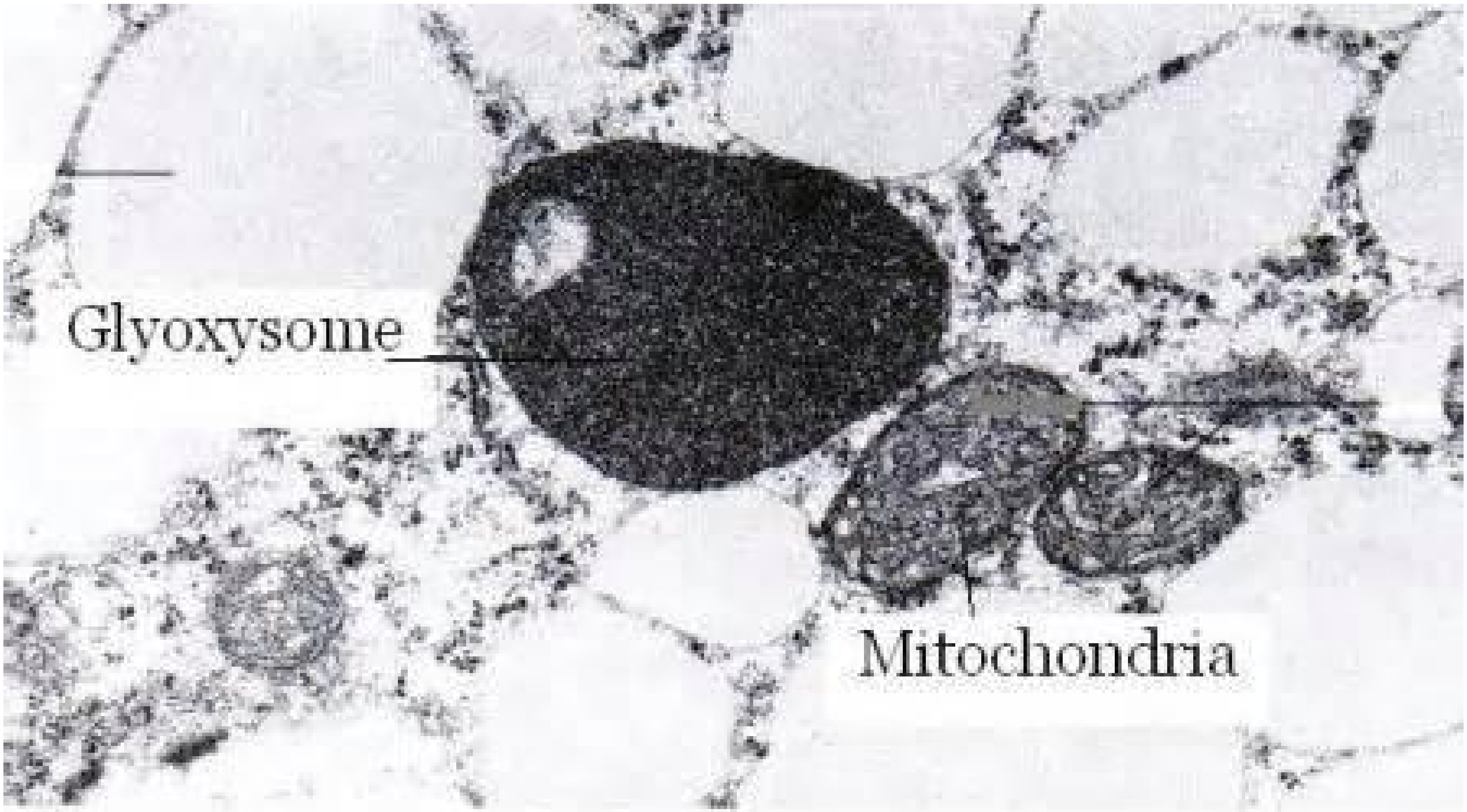
Peroxisomes



Glyoxysomes

- Specialized peroxisomes found in certain plant cells
- Contain high concentrations of the enzymes of glyoxalate cycle, a metabolic pathway unique to plants that converts stored fats to carbohydrates during seed germination.
- Lysosomes, peroxisomes and glyoxysomes are sometimes referred to collectively as **microbodies**.

Glyoxysomes



Microbodies

Lysosomes

Peroxisomes

Glyoxysomes

Chloroplasts

- Cytoplasm of plants contains plastids, specialized organelles surrounded by envelopes consisting of two membranes
- Most noticeable of the plastids & present in the photosynthetic cells of plants & algae are the **chloroplasts**
- Like mitochondria, chloroplasts may be considered power plants, with the important difference that the chloroplasts use solar energy, whereas mitochondria use the chemical energy of oxidizable compounds

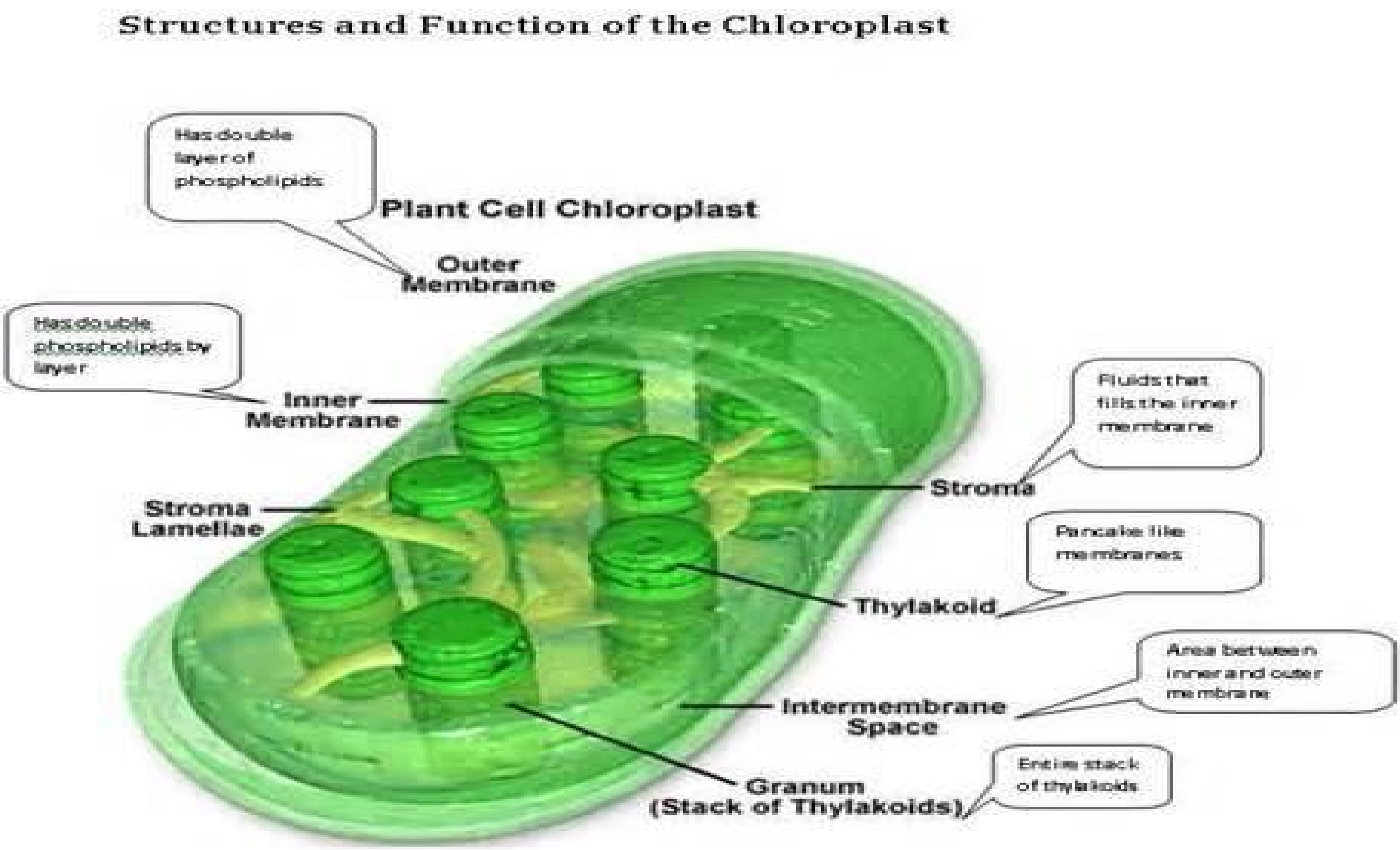
- Chloroplasts are generally larger (5um diameter) than mitochondria
- Have various shapes
- As chloroplasts contain a high concentration of the pigment chlorophyll, photosynthetic cells are usually green but their color depends on the relative amount of other pigments present.

- Chlorophyll and other pigment molecules which together can absorb light energy over much of the visible spectrum
- Are localized in the internal membranes of the chloroplast; these membranes form stacks of closed cisternae, known as thylakoids.

- Like mitochondria, chloroplasts contain DNA, RNA and ribosomes.
- Pigment molecules in the chloroplasts absorb the energy of light
- Make ATP, and ultimately to reduce carbon dioxide to form carbohydrates such as starch and sucrose.

- Photosynthetic plant cells contain both chloroplasts and mitochondria
- Chloroplasts produce ATP only in the light
- Mitochondria function independently of light, oxidizing carbohydrates generated by photosynthesis during daylight hours

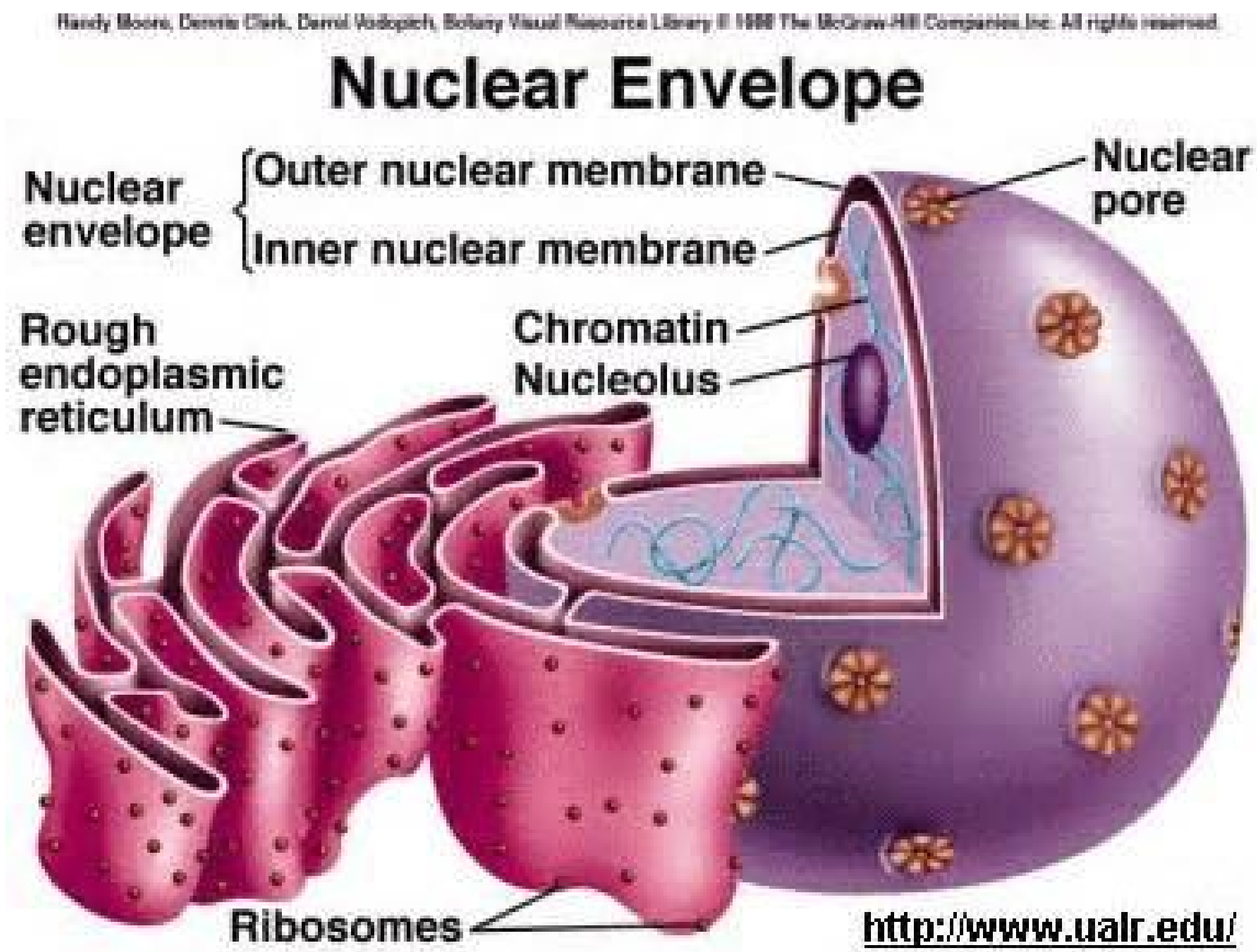
Chloroplast



Nucleus

- Complex structure & function
- Contains most of cell's DNA
- Nuclear membrane
- Nuclear pores, nuclear pore complexes
- Chromatin
- Nucleolus
- Chromosomes
- Diploid & haploid number

- DNA, Histone proteins
- DNA + Histone proteins= Nucleosomes
- Levels of organization of DNA in chromosomes
- DNA in chromosomes of a single diploid human cell – LENGTH-2m (if fully extended)
- BUT combined length of all 46 chromosomes is only about 200 μm


Nuclear Envelope
Nuclear envelope
Outer nuclear membrane
Inner nuclear membrane
Nuclear pore
Rough endoplasmic reticulum
Chromatin
Nucleolus
Ribosomes
http://www.ualr.edu/

DNA

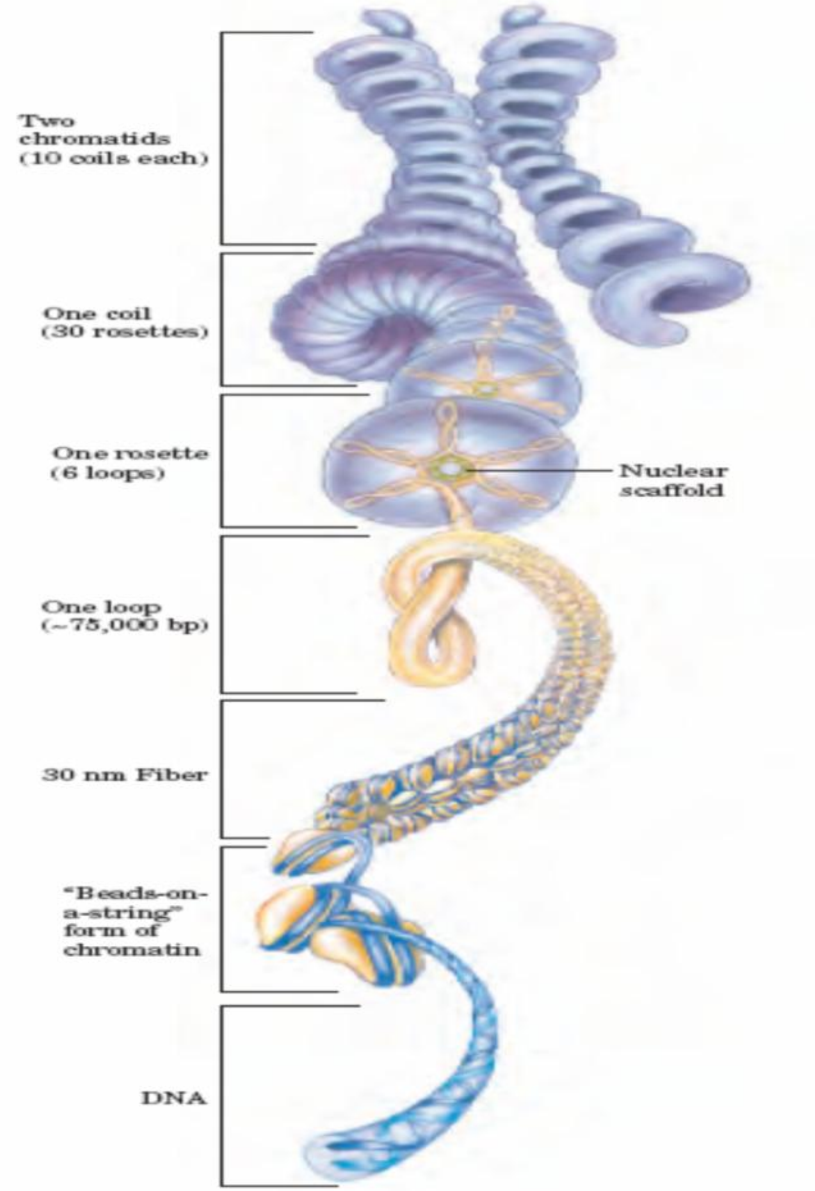


FIGURE 24–33 Compaction of DNA in a eukaryotic chromosome. Model for levels of organization that could provide DNA compaction in the chromosomes of eukaryotes. The levels take the form of coils upon coils. In cells, the higher-order structures (above the 30 nm fibers) are unlikely to be as uniform as depicted here.

Cytoskeleton

- Actin filaments
- Microtubules
- Intermediate filaments

Proteins polymers

General and specific roles

Actin filaments

- 6-7 nm diameter
- Filamin, fodrin
- Shape and rigidity to cell surface
- Myosins (nanomachines) + actin = cytoplasmic movements
- Muscular movement

- Actin-myosin complexes – squeeze cytoplasm during cytokinesis

Microtubules

- Alpha & beta tubulin proteins
- Dimer
- 22 nm diameter
- Polymerize & depolymerize continuously
- Concentrate in specific regions during specific cellular events

- Provide driving force for the separation of daughter chromosomes
- Kinesin & dynein combine with microtubules to drag cell organelles
- Beating of Celia & flagella – dynein + microtubules

Intermediate filaments

8-10 nm diameter

Vimentin (endothelial cells that line blood vessels, fat cells)

Cells have cytoskeletons