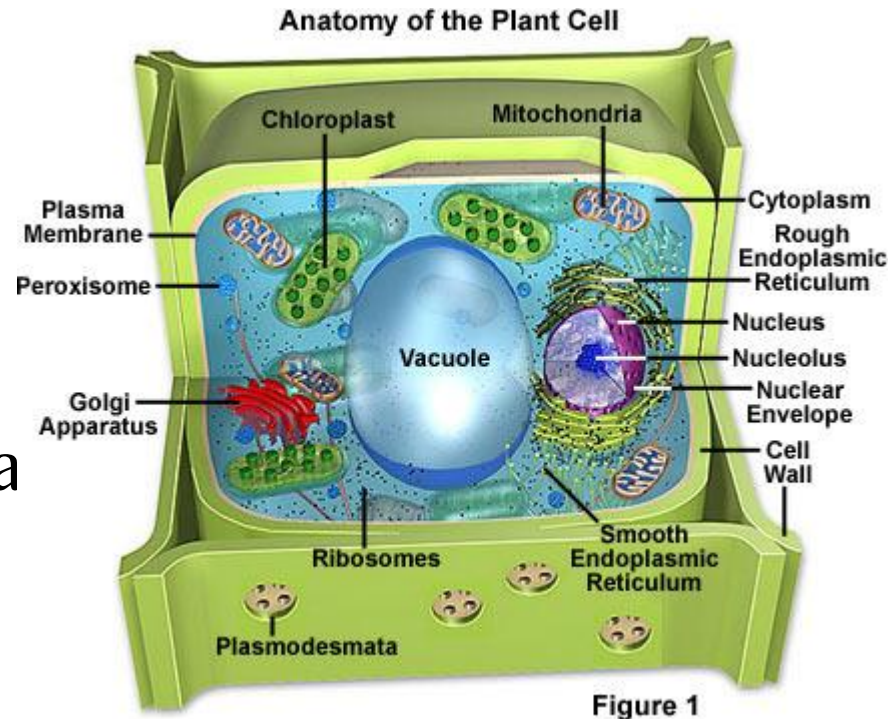
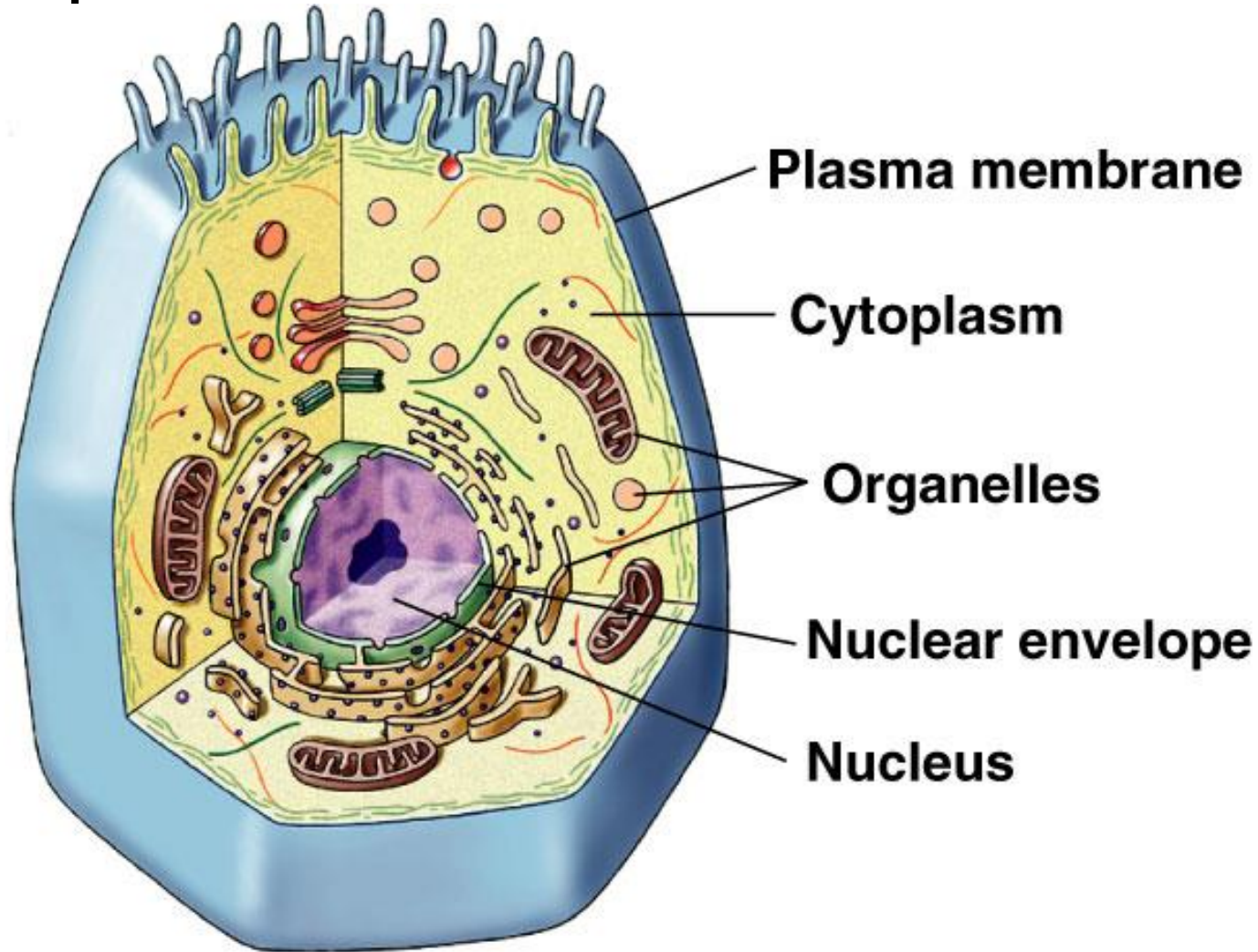


Plant Cell: Eukaryotic

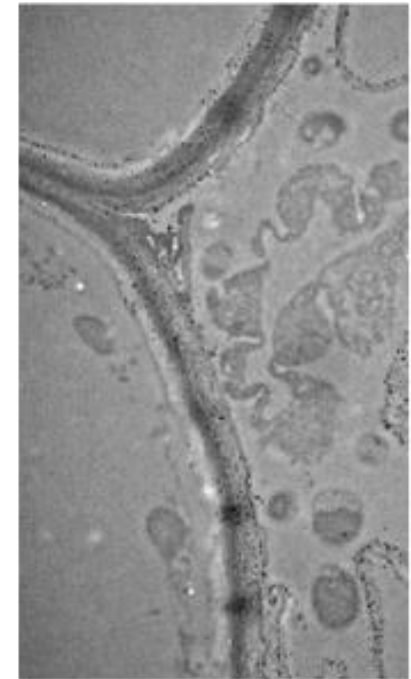
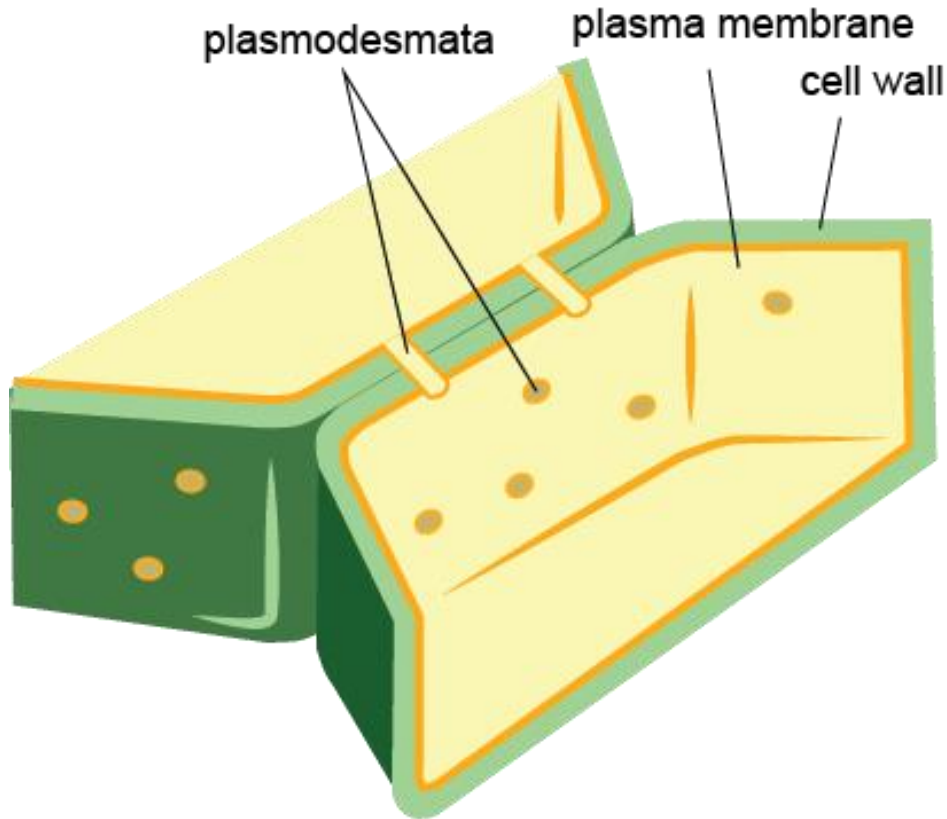
- Eukaryotes arose from prokaryotes and developed into larger more complex organisms.
- Eukaryotes are cells that contain a nucleus and organelles surrounded by a membrane, such as mitochondria and chloroplasts.



Generalized Eukaryotic Cell



The Cell Wall



TEM image of cell wall structure in plant roots

Cell Wall

- Provides support
- **Double layered**
- Made from cellulose

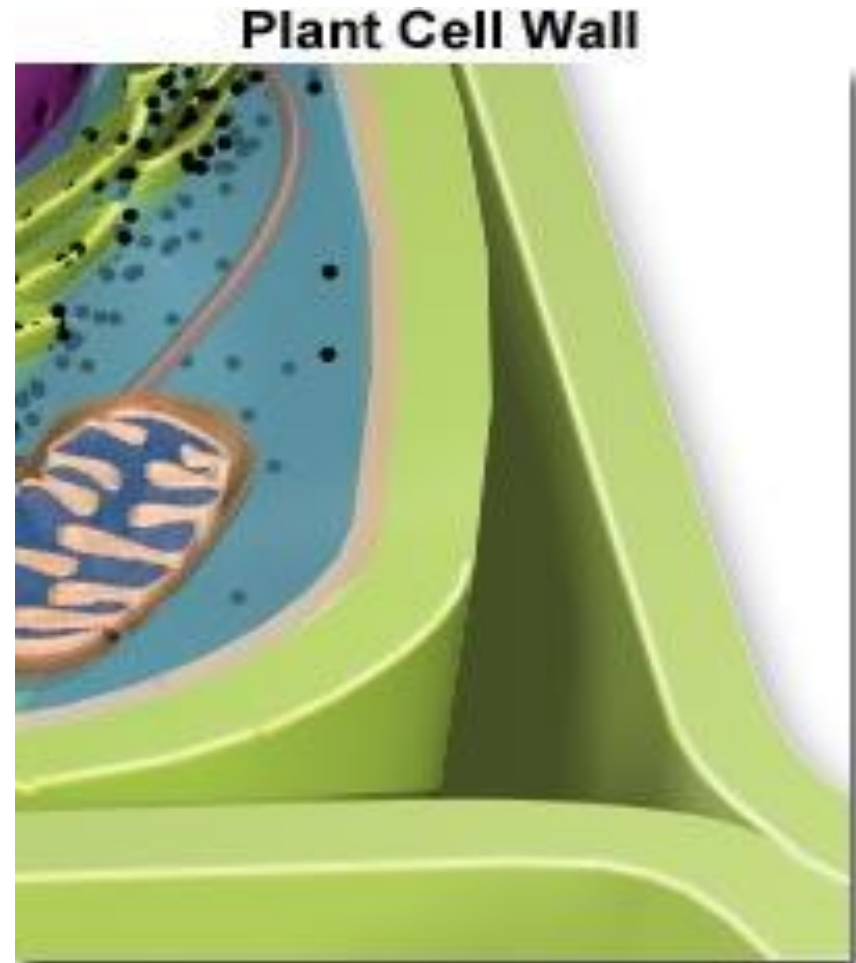


Figure 1

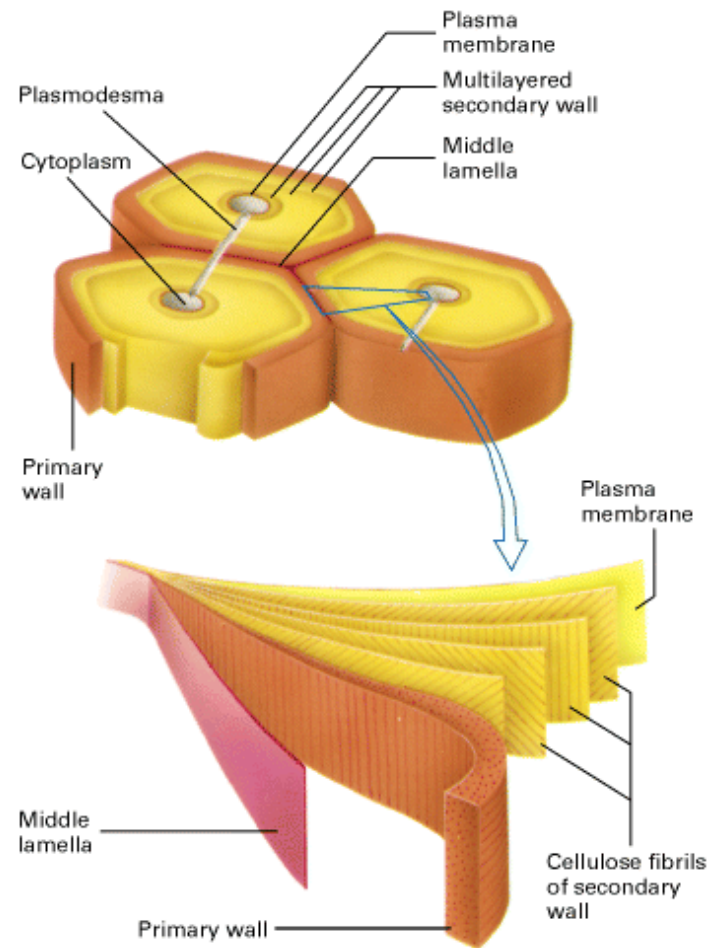


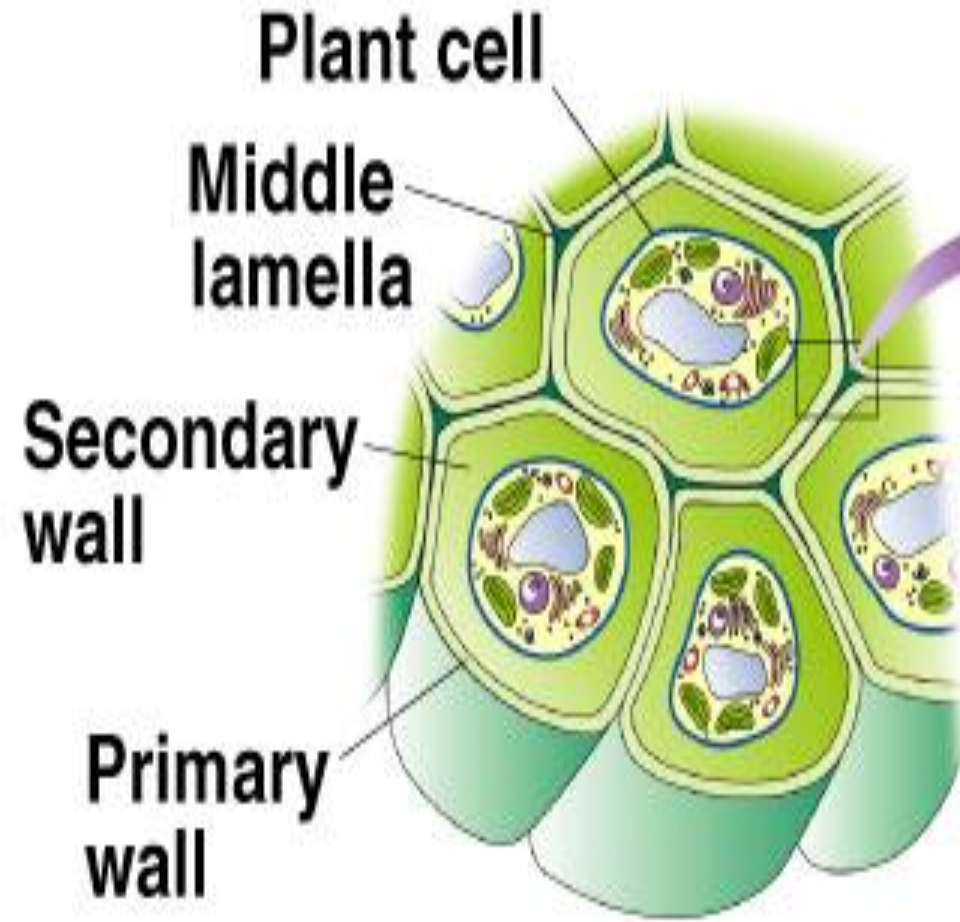
Cell Walls

- Cellulose cell walls help distinguish plants from other organisms
- The main component of a cell wall is cellulose arranged in microfibrils
- The cellulose framework is interpenetrated by a cross-linked matrix of non-cellulose molecules - primarily hemicelluloses and pectin
- Cell walls are layered - there is a primary cell wall, a middle lamella between two cells and sometimes a secondary cell wall

Cell Walls

- The primary cell wall is deposited before and during growth of the cell
- Actively dividing cells typically only have primary cell walls
- Secondary cell walls are usually formed after the cell has stopped growing and the primary cell wall is no longer increasing in surface area
- The secondary cell wall forms between the primary cell wall and the protoplast





Cell 2

Primary walls

Secondary wall

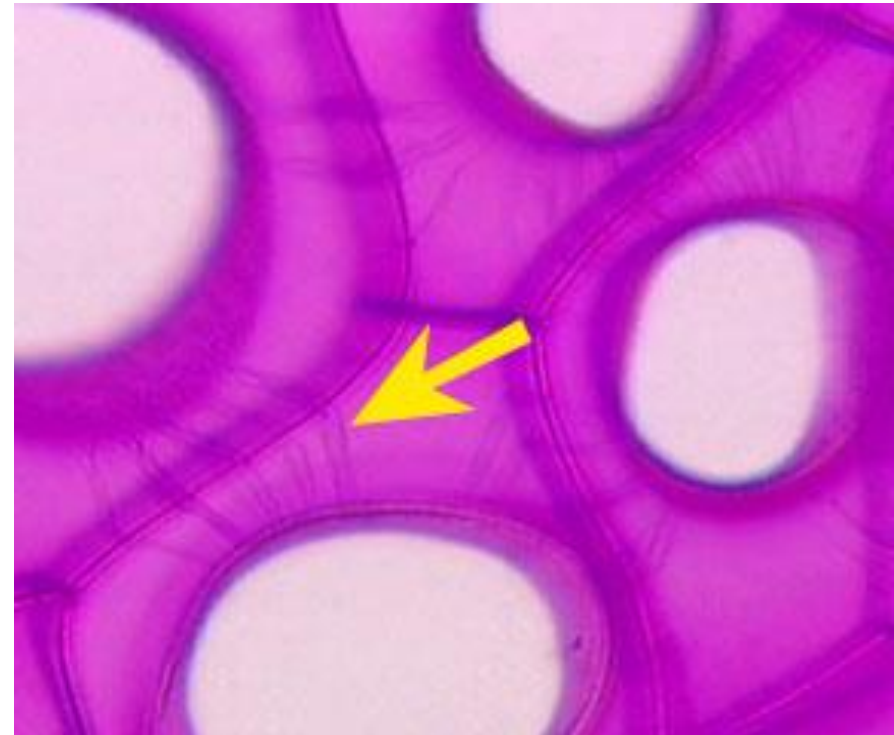
Middle lamella

Cell 1

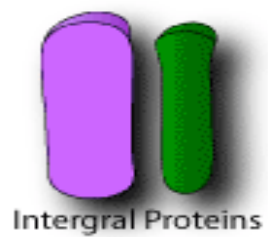
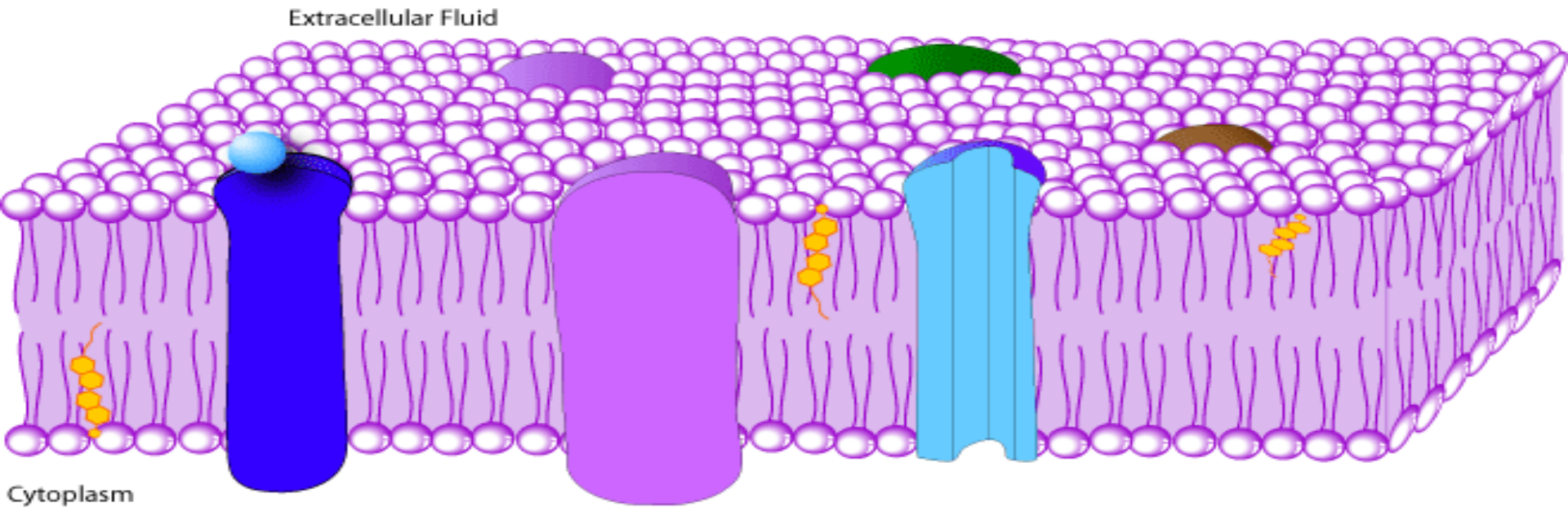
This micrograph shows a detailed view of the cell wall structure between two cells, Cell 1 and Cell 2. The primary walls are the thin, outermost layers. The secondary wall is the thick, multi-layered structure. The middle lamella is the thin layer between the primary walls of adjacent cells.

Plasmodesmata

- Plasmodesmata allow the transport of substances from one cell to the next
- They are cytoplasmic threads which connect the living protoplasts of adjoining cells

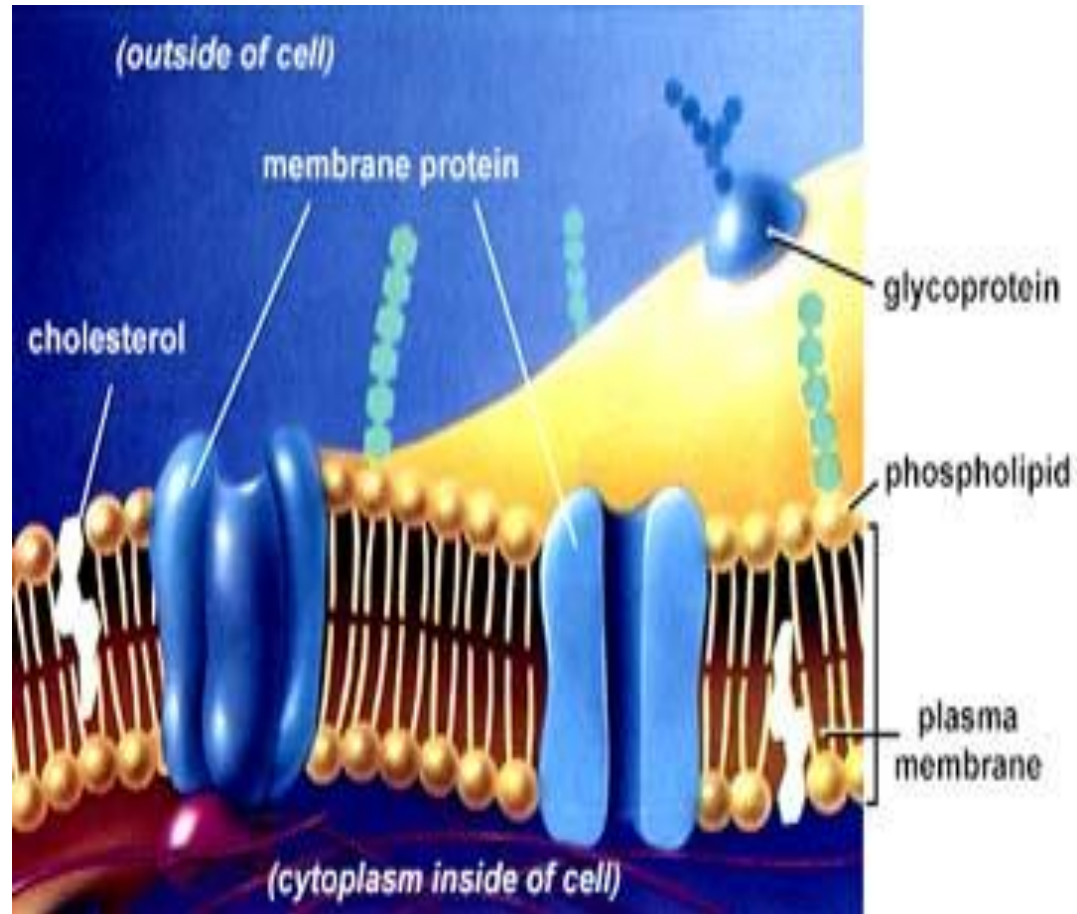


The Cell Membrane



Cell Membrane

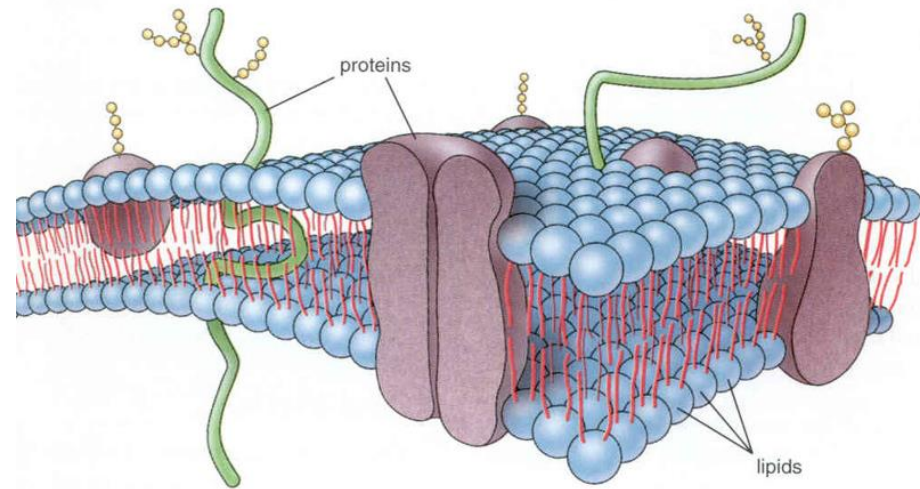
- Controls what enters and leaves the cell
- Found in **ALL** cells
- Phospholipid bilayer with transport proteins, and **cholesterol** (for flexibility)



Plasma Membrane

The plasma membrane has several functions

1. It mediates the transport of substances into and out of the protoplasm
2. It coordinates the synthesis and assembly of cellulose microfibrils
3. It relays hormonal and environmental signals involved in the control of cell growth and differentiation

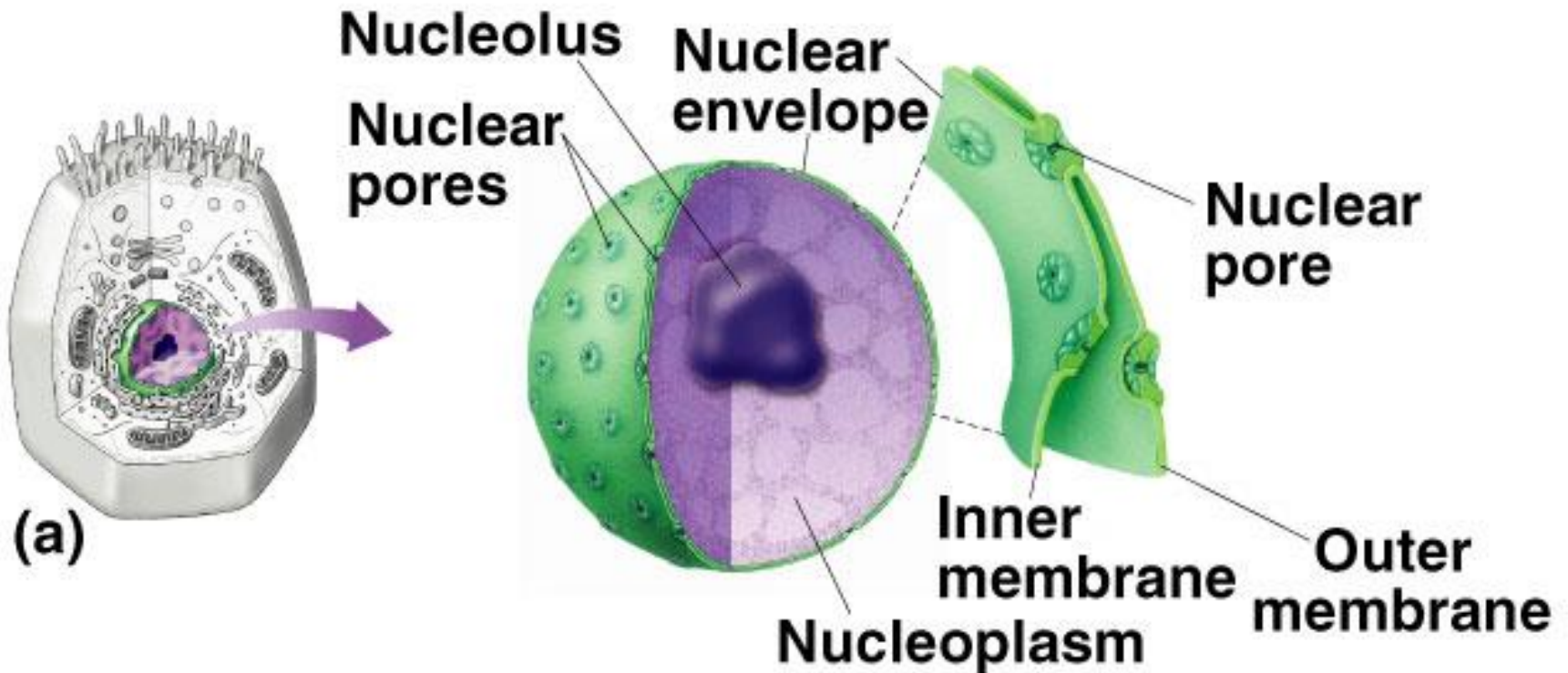




Cell Organelles

- Nucleus
- Ribosomes
- Endoplasmic reticulum
- Golgi apparatus
- Lysosomes
- Vacuole
- Organelles with DNA (mitochondria and chloroplasts)
- Cytoskeleton

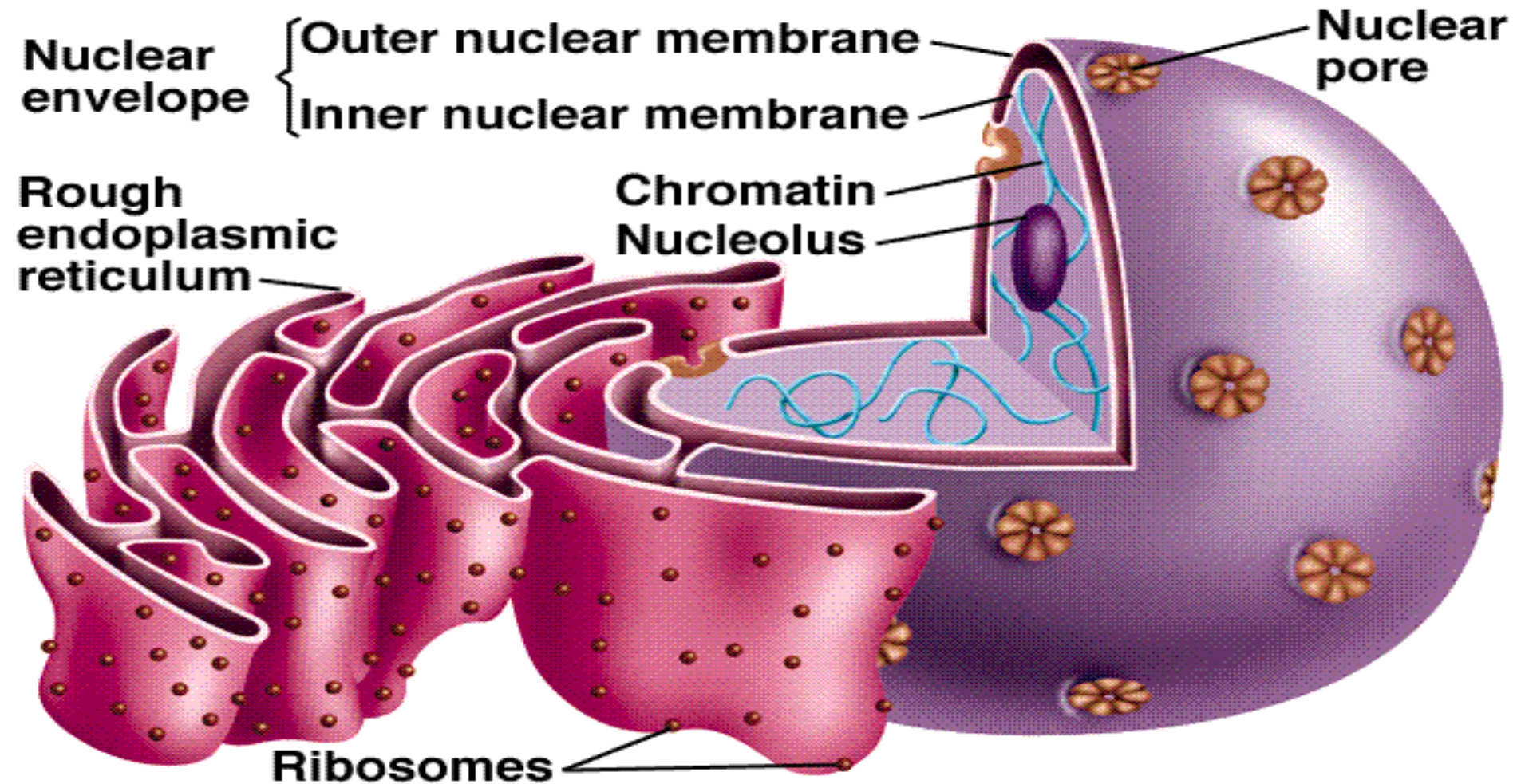
Nucleus



Nucleus

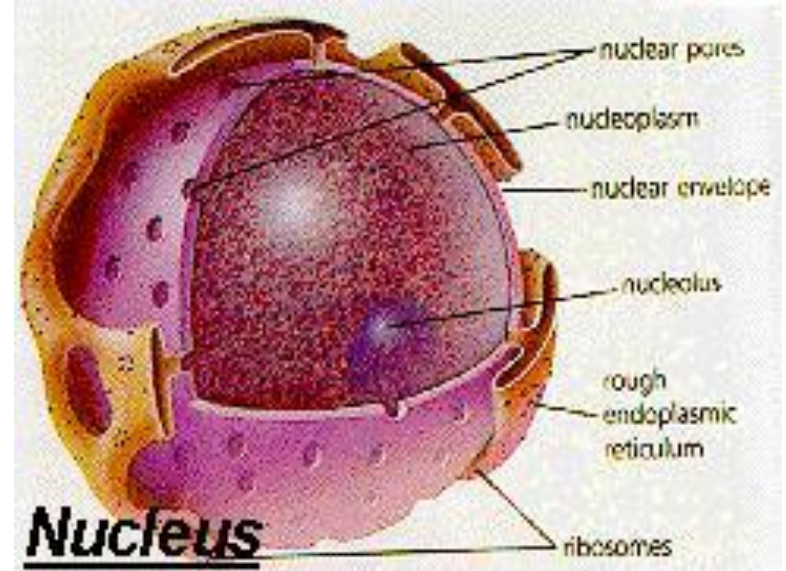
Randy Moore, Dennis Clark, Darrel Vodopich, Botany Visual Resource Library © 1998 The McGraw-Hill Companies, Inc. All rights reserved.

Nuclear Envelope

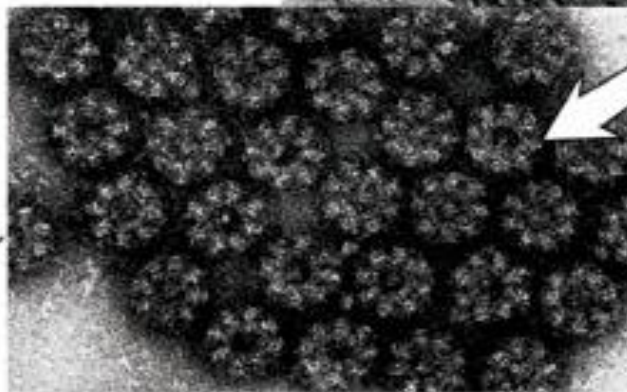
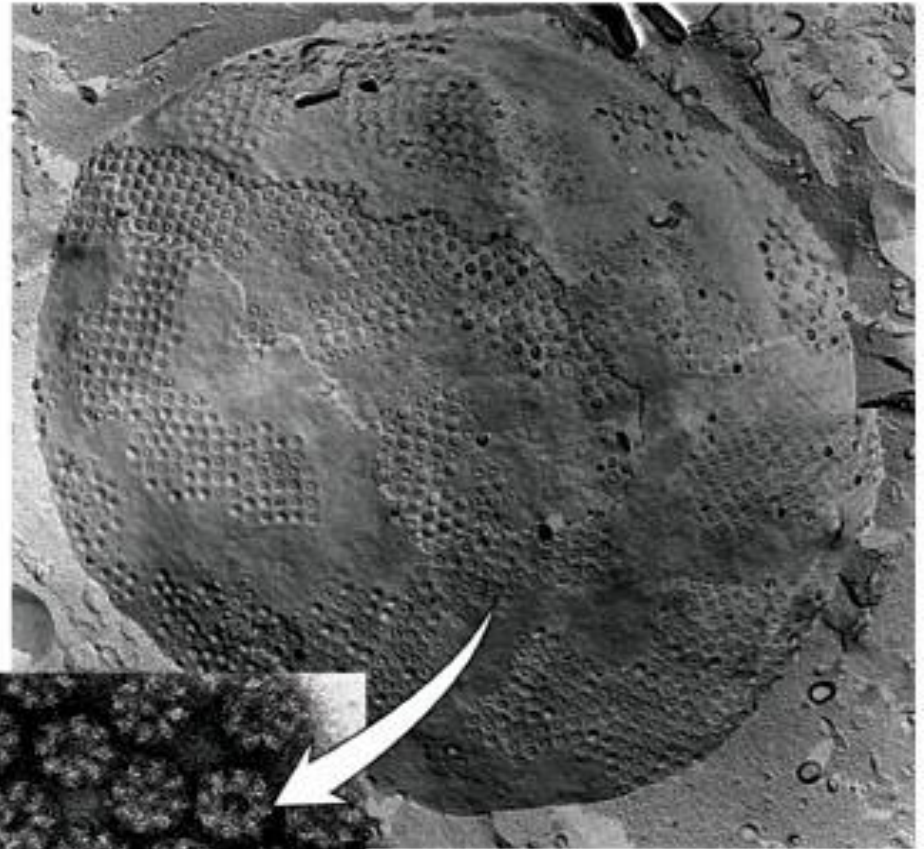
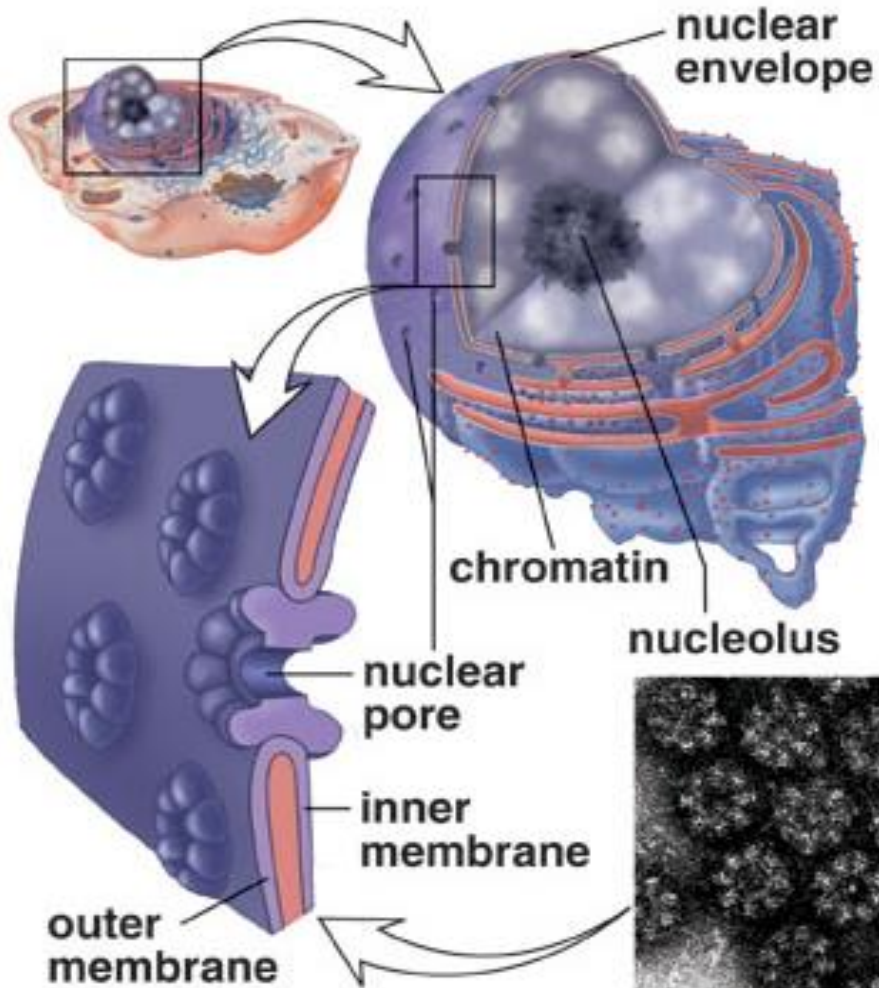


Nucleus

- Stores genetic material
- Contains DNA
- *Nucleolus*: site where RNA is made
- Chromatin and ribosomal subunits present
- *Nuclear envelope*:
 - Double membrane with pores
- Largest organelle
- BRAIN of the cell – controls protein synthesis



Nucleus



Electron micrographs of nuclear envelope showing pores.

Nucleus

The nucleus is usually the most prominent structure in the protoplast of eukaryote cells

1. It controls the ongoing activities of the cell by determining which protein molecules are produced by the cell and when they are produced
2. It stores genetic information, passing it onto daughter cells during cell division

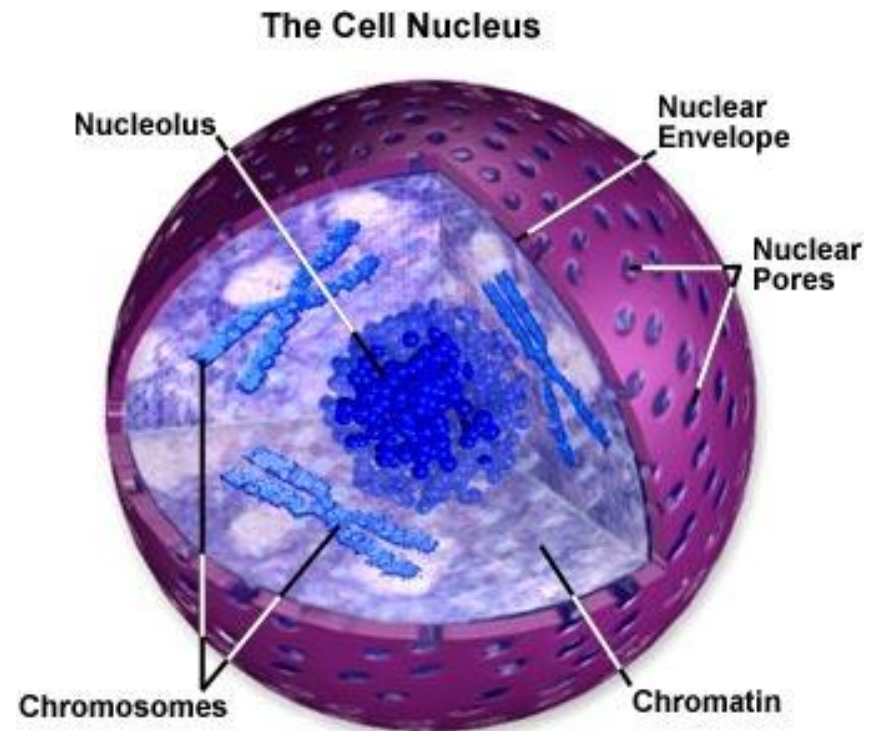


Figure 1

Ribosomes

- Ribosomes(80s) are RNA-protein complexes composed of two subunits(50s & 30s) that join and attach to messenger RNA.
 - site of protein synthesis
 - assembled in nucleolus

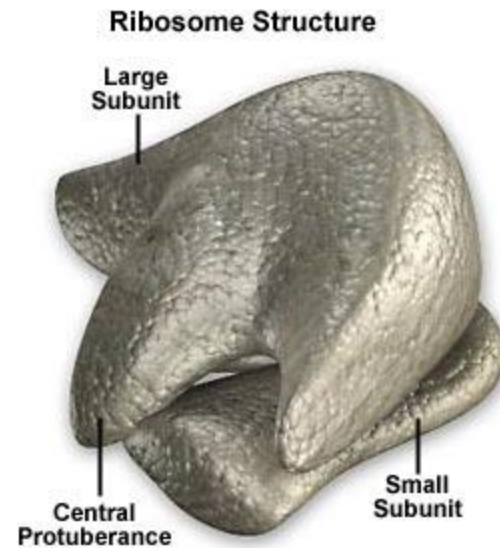
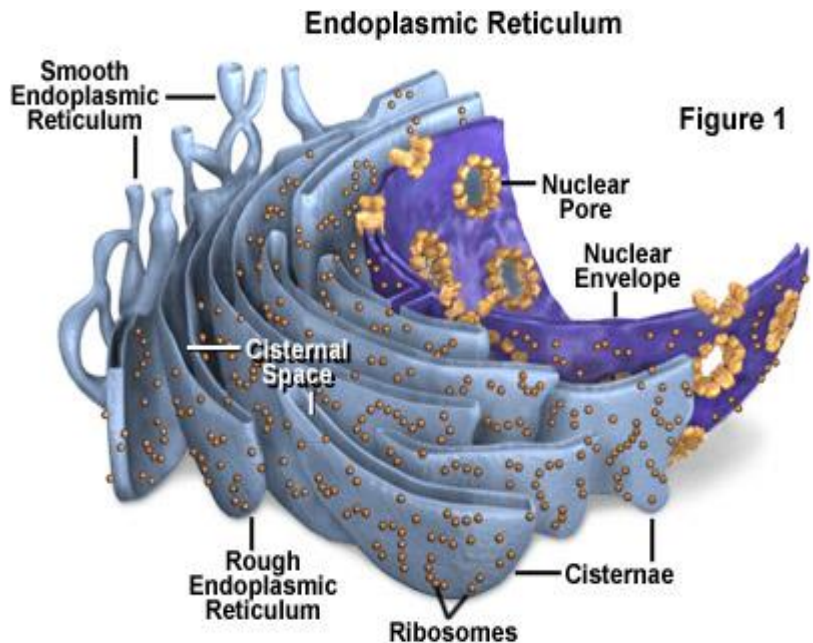


Figure 1

Ribosomes

They can be found alone in the cytoplasm or attached to the endoplasmic reticulum.

- Alone in cytoplasm- makes proteins for use within the cell
- Attached to RER(rough endoplasmic reticulum)- makes proteins for export out of the cell

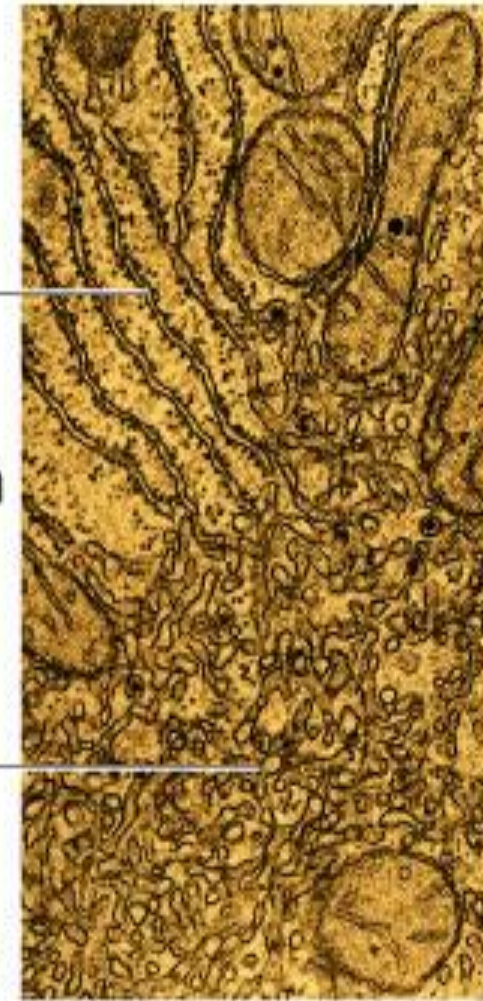
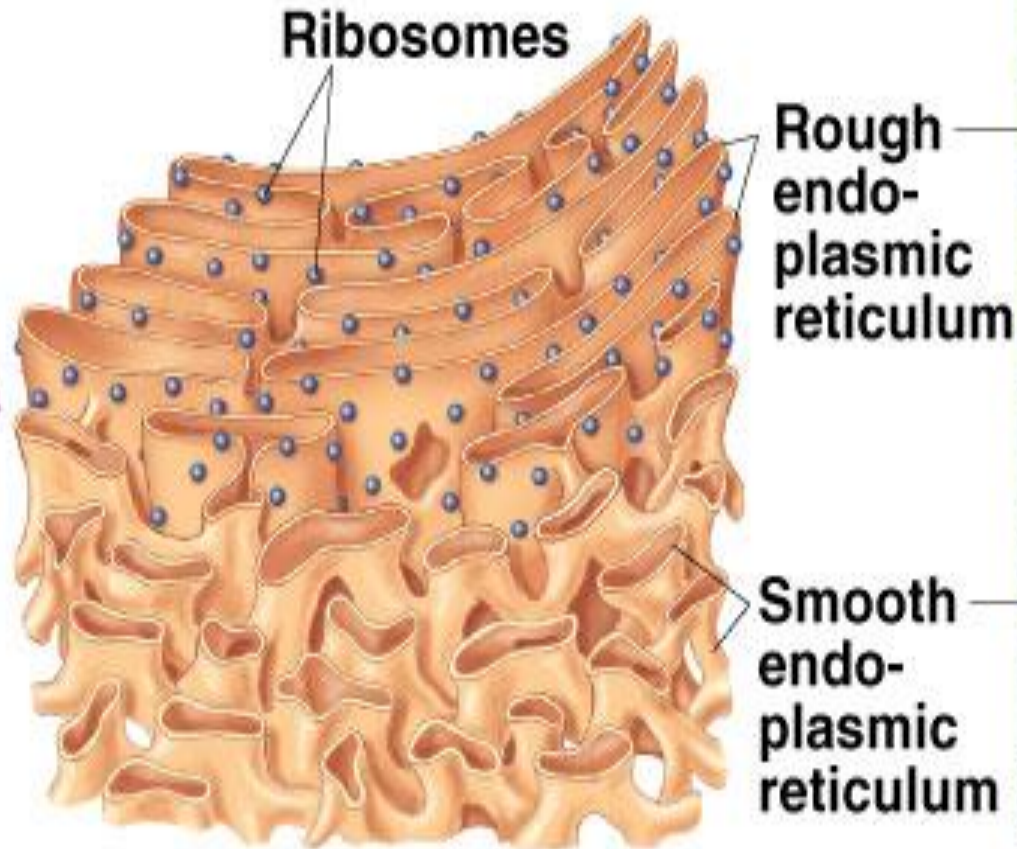




Endoplasmic reticulum

- Transports materials through the cell
- 2 types:- (i) Rough ER
(ii) Smooth ER
- **Rough ER** - studded with ribosomes
 - Attached to nuclear membrane
 - site of protein synthesis and processing
- **Smooth ER** - lacks ribosomes
 - site of synthesis of phospholipids and the packaging of proteins into vesicles

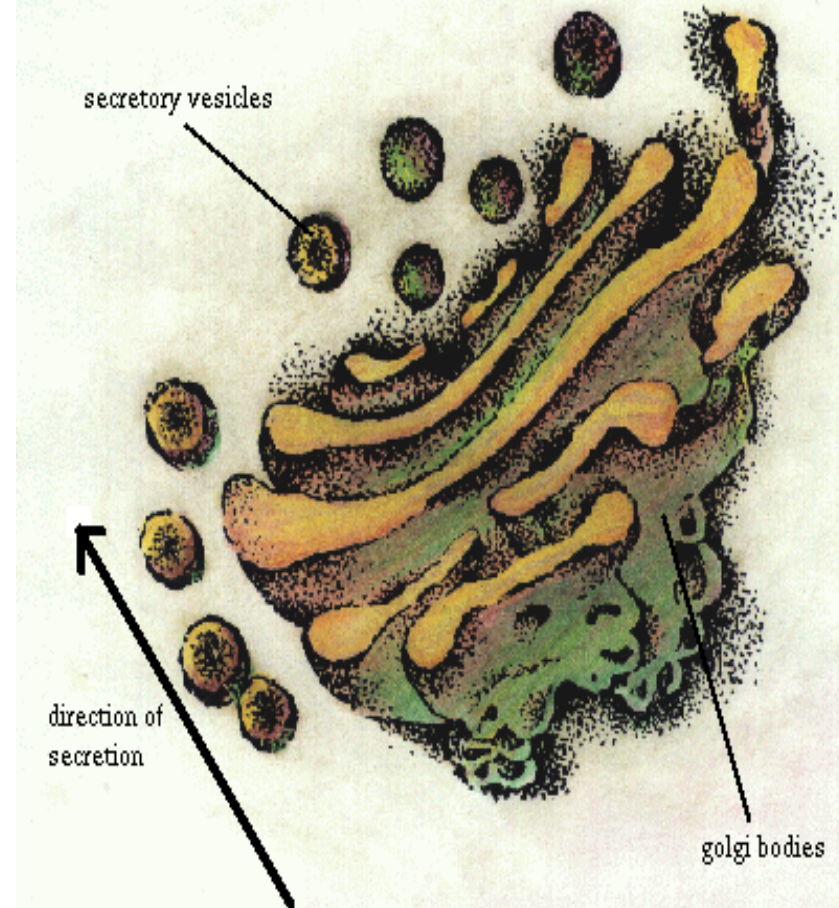
Endoplasmic reticulum



0.08 μm

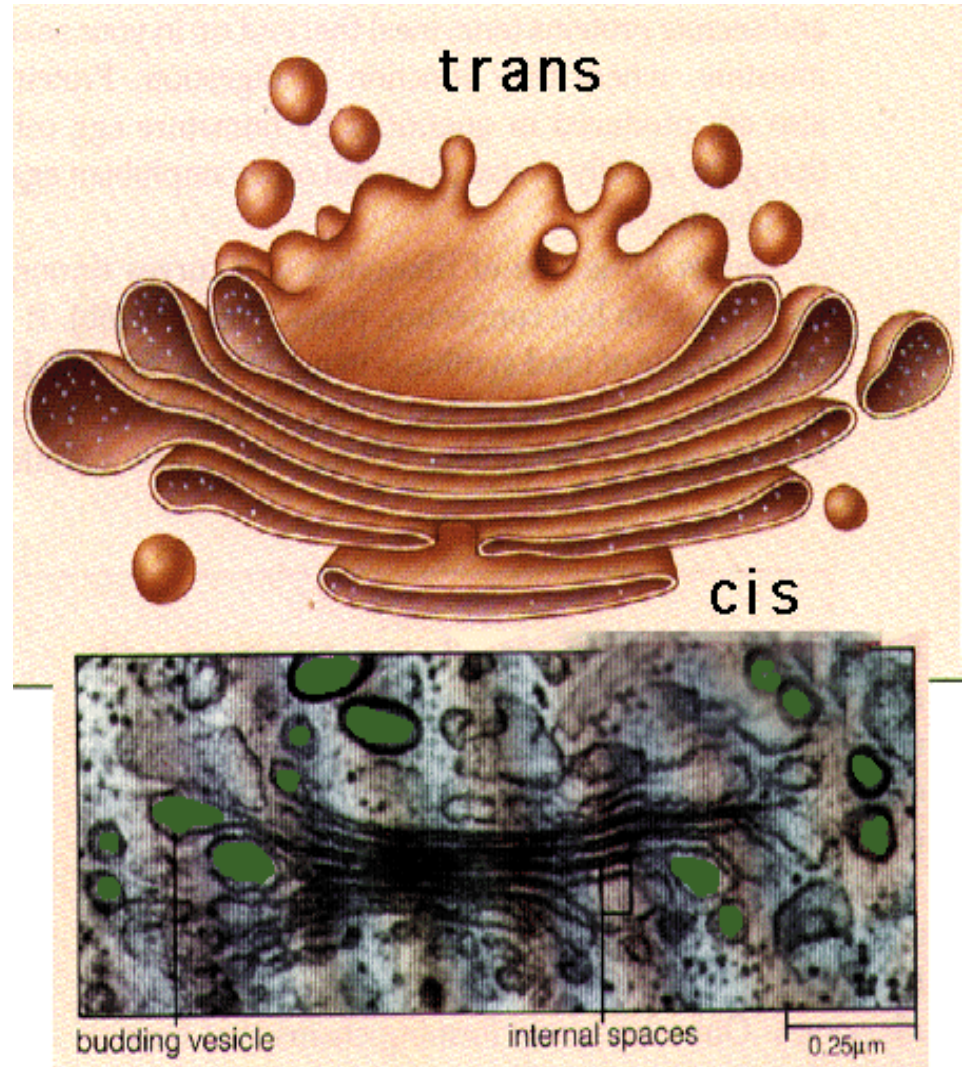
Golgi apparatus

- ● ● |
- Collection of Golgi bodies
 - Stacked flattened sacks
 - Site where cell products are packaged for export
 - Proteins are modified by being combined with fats or carbohydrates



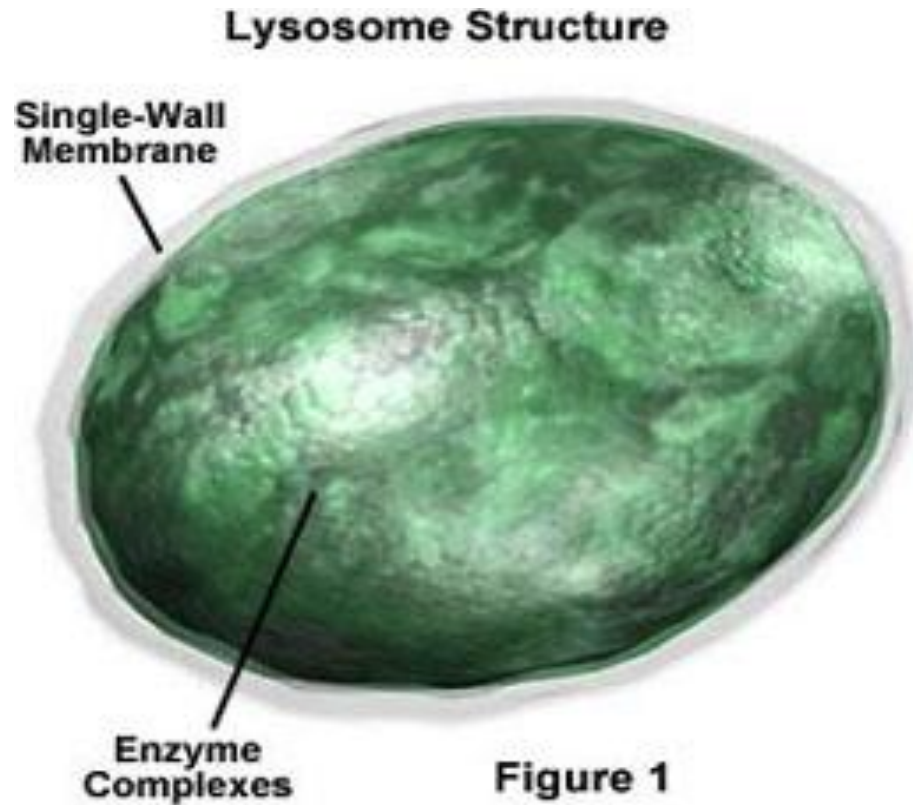
Golgi apparatus

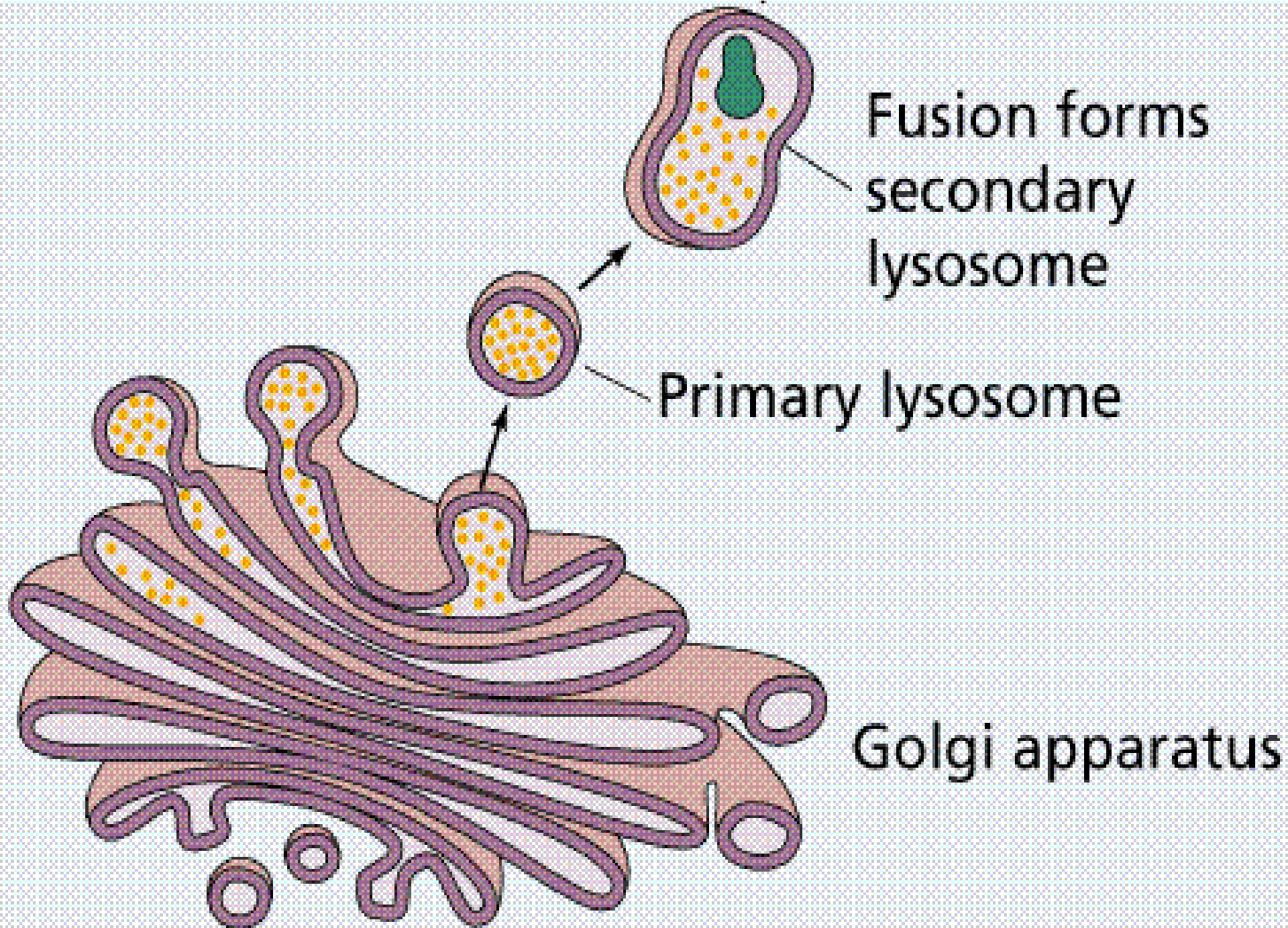
- Vesicles then pinch off from the Golgi body to be secreted (outside the cell)
- Involved in the production of lysosomes

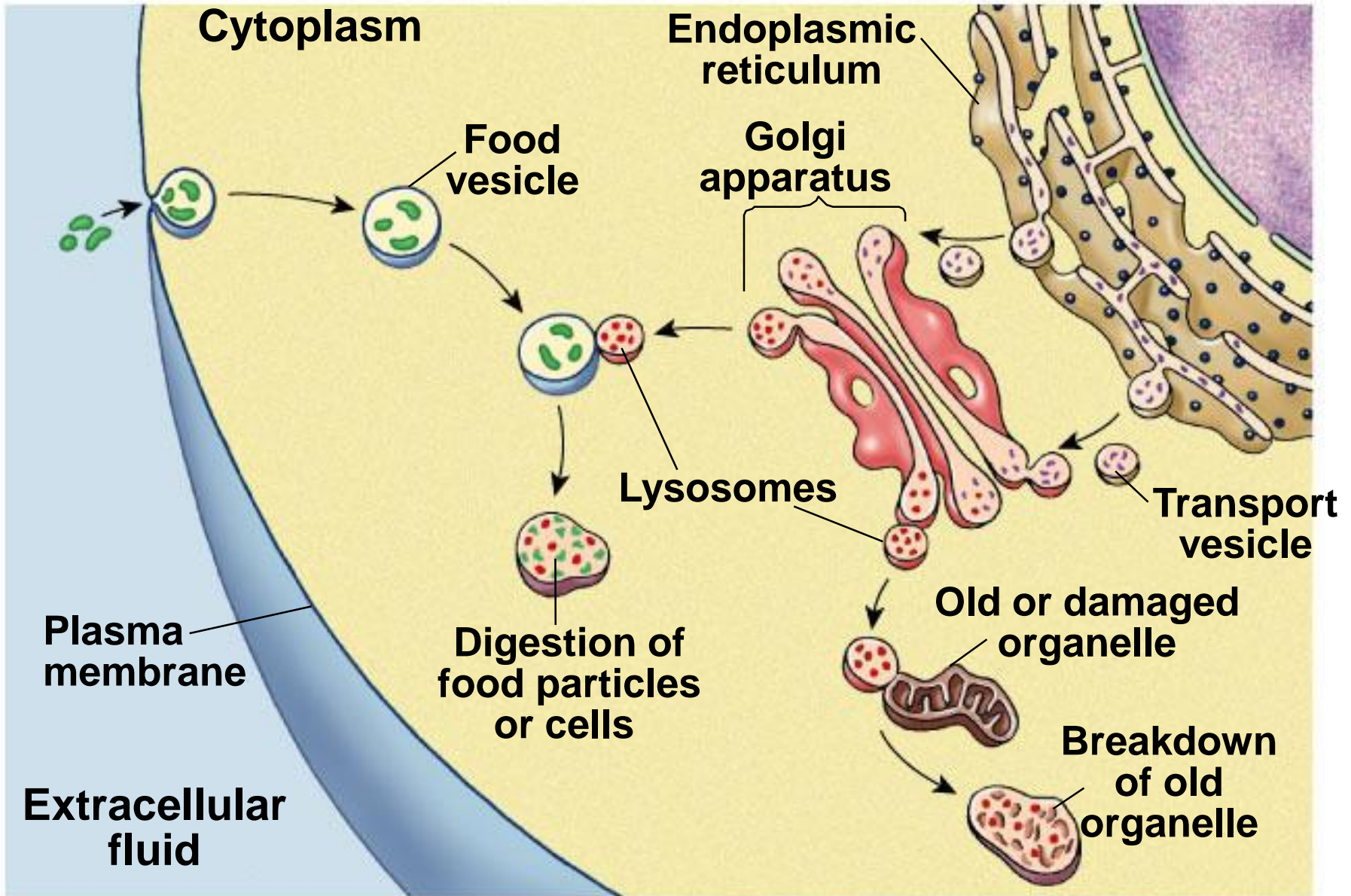


Lysosomes

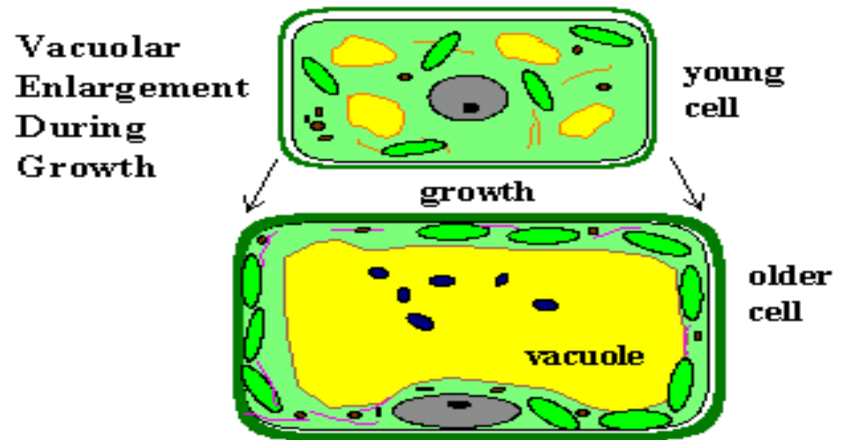
- Vesicles produced by the Golgi apparatus.
- Lysosomes contain digestive enzymes and are involved in intracellular digestion of food particles, disease causing bacteria and worn out cell parts
- They are known as the “suicidal bags of the cell”







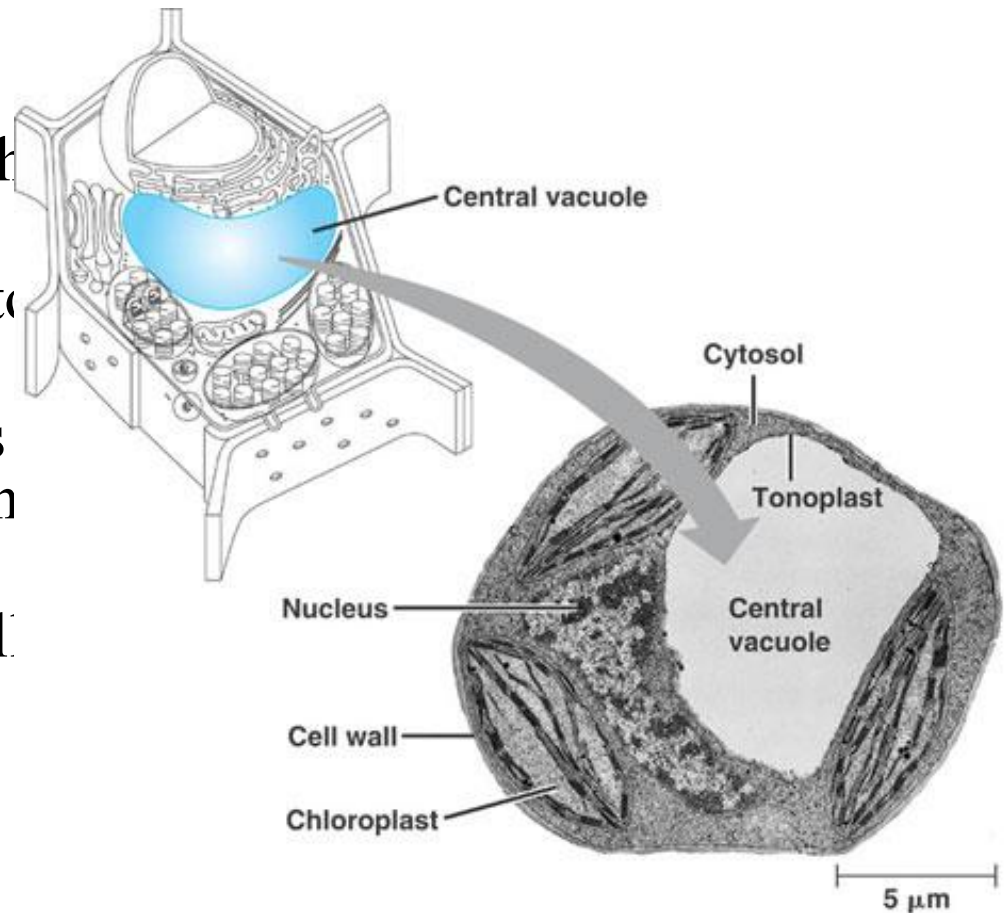
Vacuoles



- Found in PLANT and ANIMAL cells
- The vacuole acts as a container, storing water and dissolved particles
- Plants have a large central vacuole for water storage
- Unicellular animals can use contractile vacuoles for movement

Vacuoles

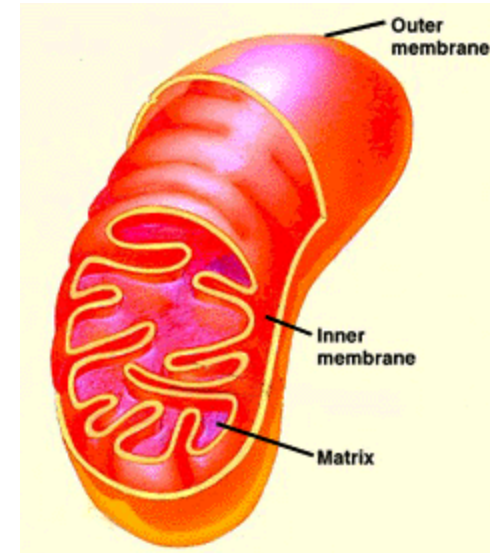
- Vacuoles are membrane bound organelles filled with cell sap
- The membrane is referred to as the tonoplast
- Different kinds of vacuoles may have different function within the same cell
- Along with water based cell sap, vacuoles typically contain salts, sugars and some dissolved proteins



Organelles With DNA

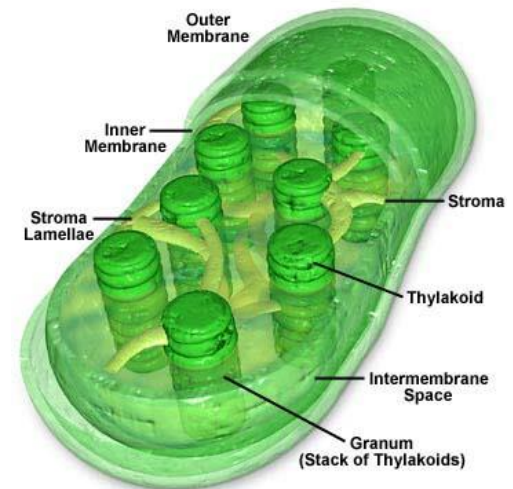
○ Mitochondria

- site of cell respiration



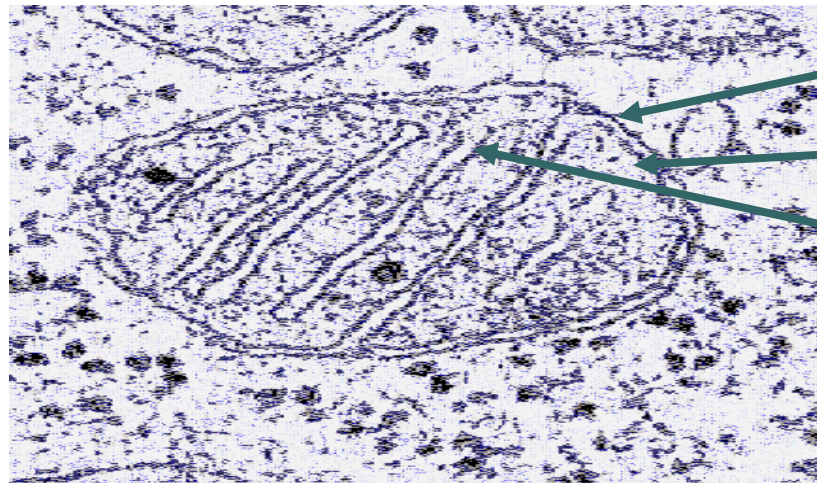
○ Chloroplasts

- site of photosynthesis



Mitochondria

- "Powerhouse of the cell" - cellular metabolism
- Structure- outer and inner membranes, cristae
- Found in both plant and animal cells
- Very active cells have more mitochondria



Outer membrane

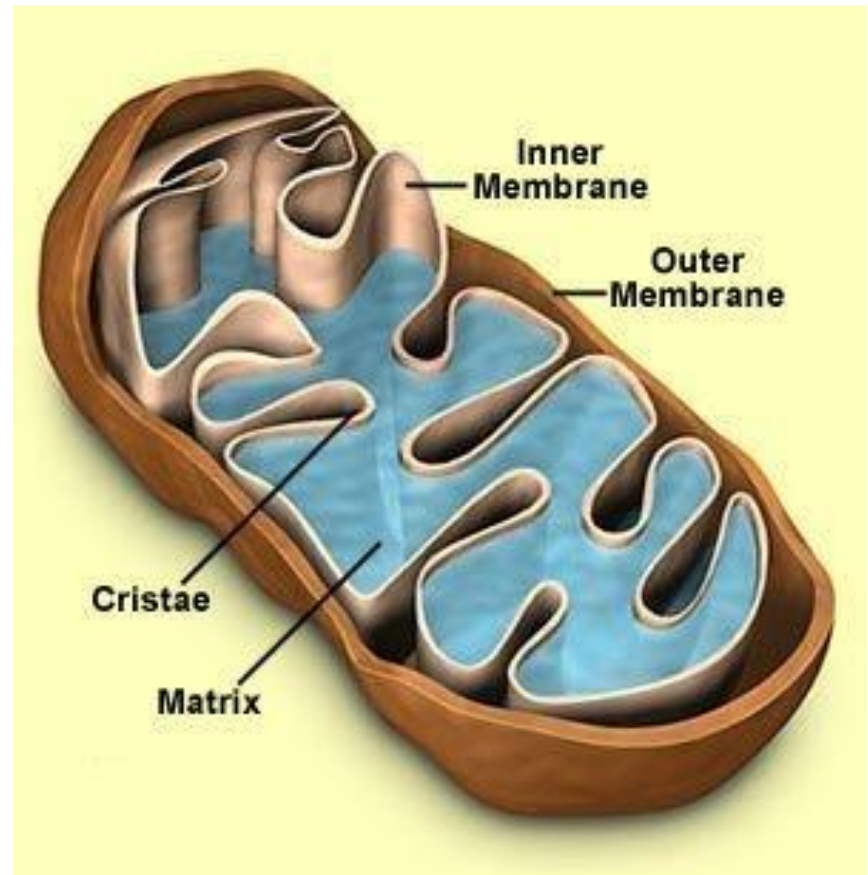
Inner membrane

Cristae

Matrix

Mitochondria

- Mitochondria are another organelle bounded by two membranes
- The inner membrane is folded into many pleats called cristae
- Mitochondria are the sites of cellular respiration - converting organic molecules to ATP the main immediate energy source for living eukaryote cells - plant cells may have hundreds to thousands of mitochondria





Plastids

- Plastids are a characteristic component of plant cells
- Plastids are classified and named based on the kinds of pigments they contain
- Each plastid is surrounded by two membranes and internally the plastid has a system of membranes which form flattened sacs called thylakoids and a ground (fluid) substance called stroma
- 3 types: chloroplasts, chromoplasts & leucoplasts

Chloroplasts

Plant Cell Chloroplast Structure

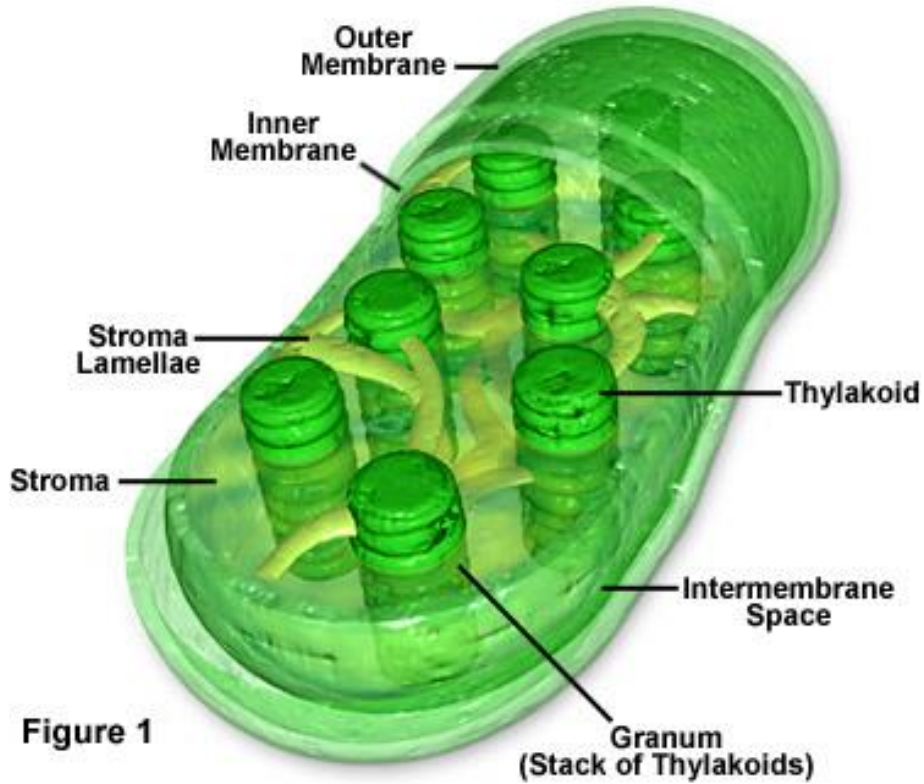
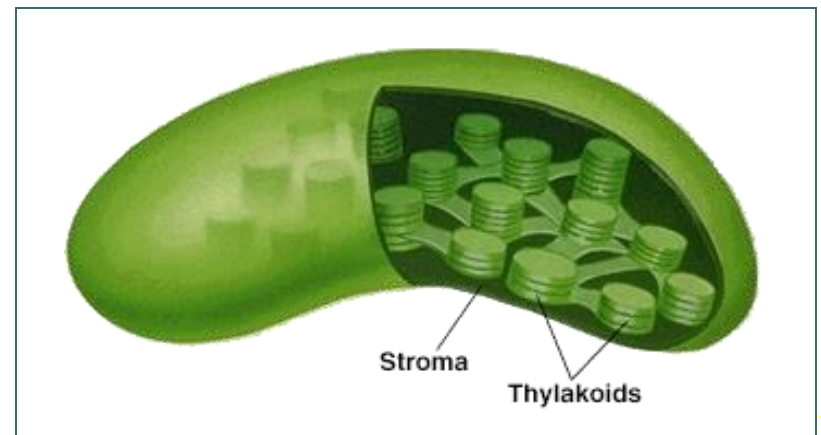


Figure 1

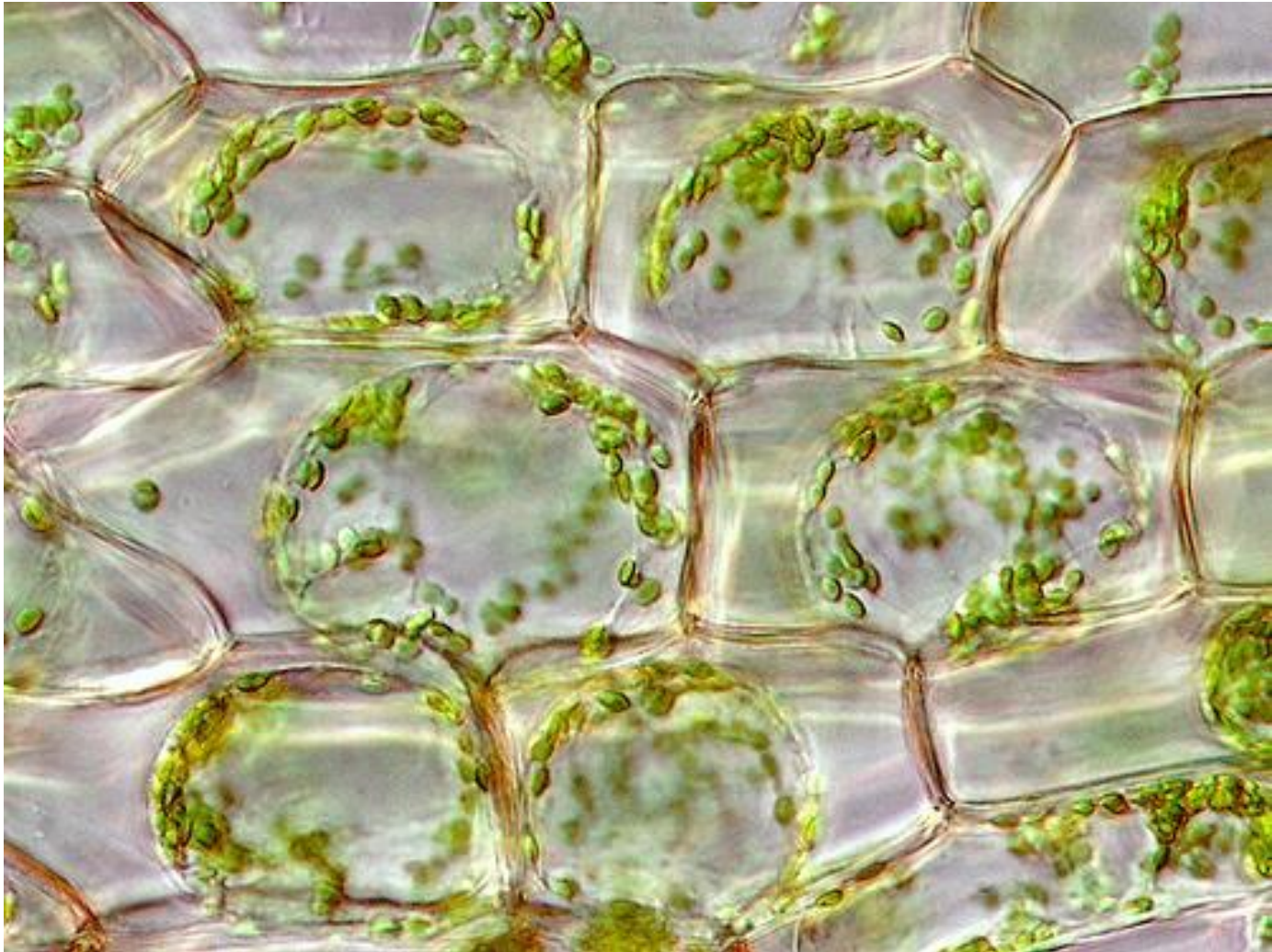


Chloroplasts

- Chloroplasts are larger and more complex than mitochondria
- Contain green pigment called chlorophyll that absorbs sunlight in the first step of photosynthesis
- Found **ONLY** in **PLANTS**

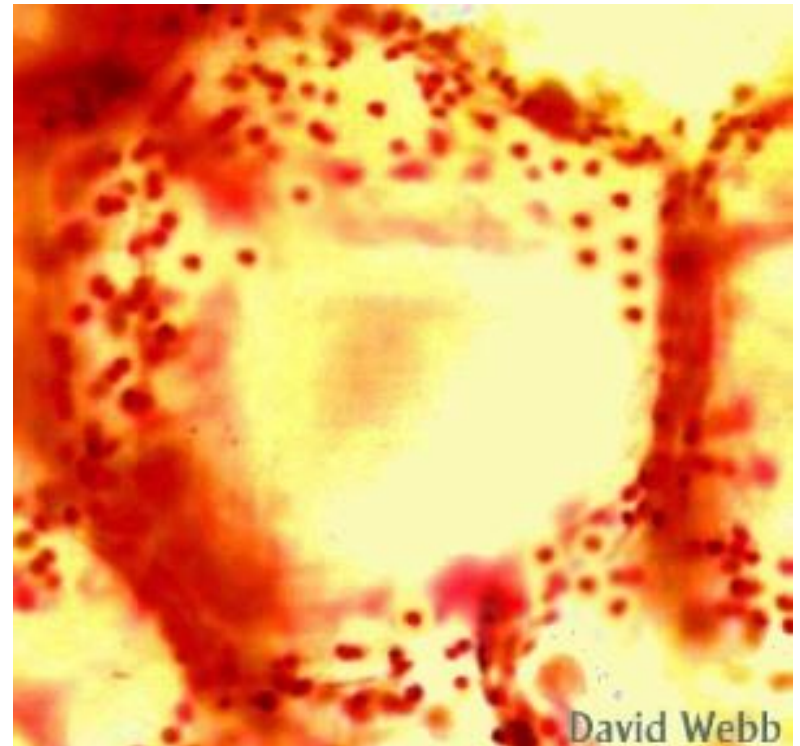


Plant Cells with Chloroplasts



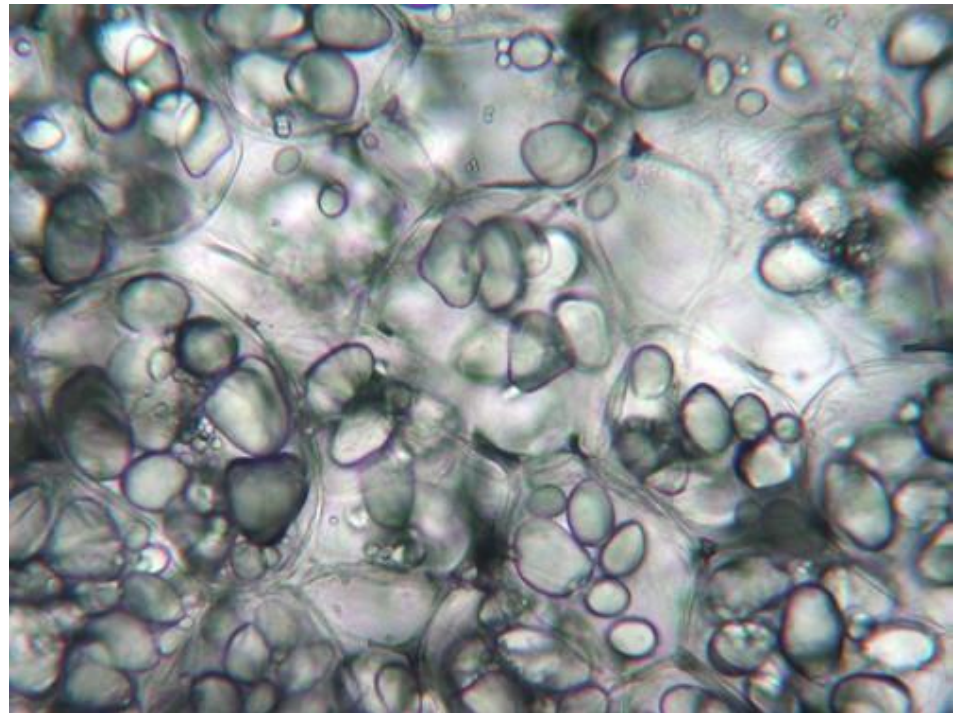
Chromoplasts

- Chromoplasts lack chlorophyll but synthesize and retain carotenoid pigments which are responsible for the yellow, orange or red colors of many flowers, old leaves, some fruits and some roots

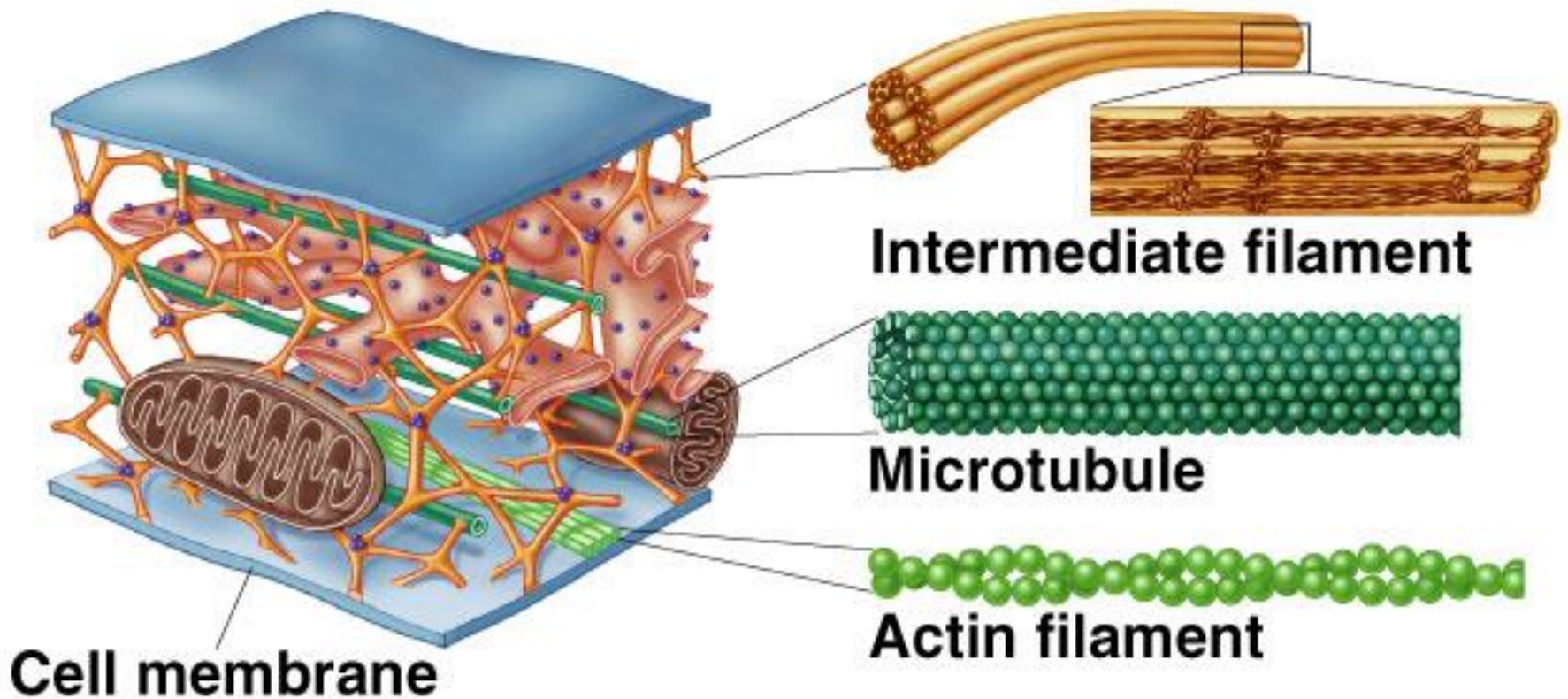


Leucoplasts

- Leucoplasts are non-pigmented plastids some of which synthesize starch while others produce oils or proteins
- Upon exposure to light they may develop into chloroplasts



Cytoskeleton





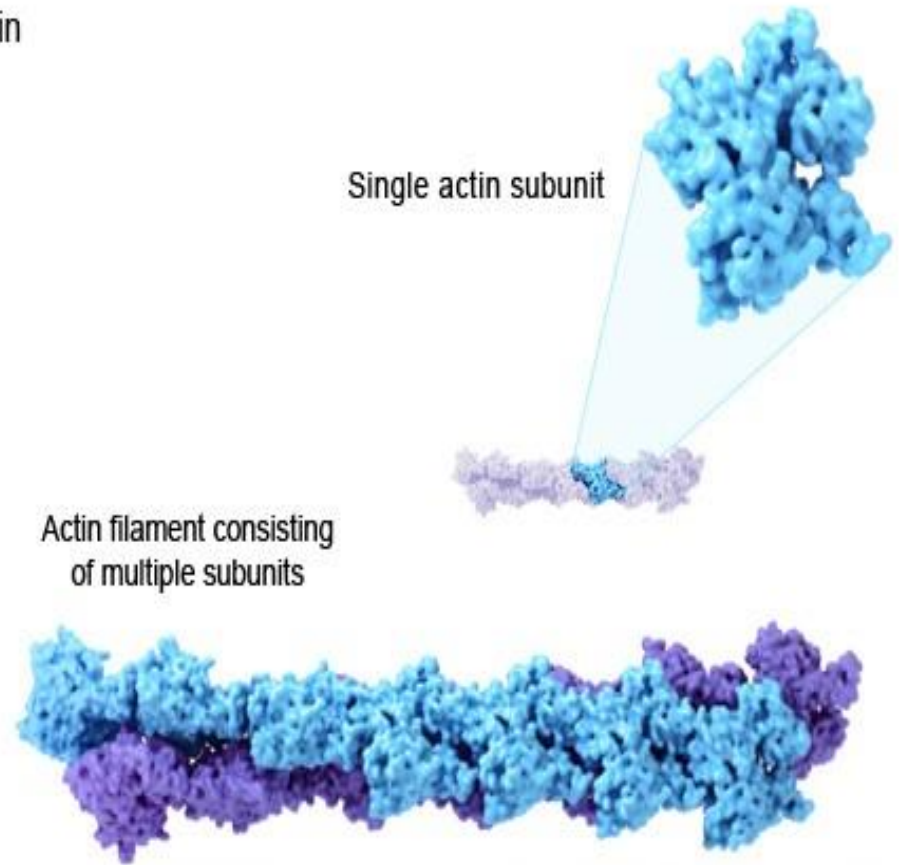
Cytoskeleton

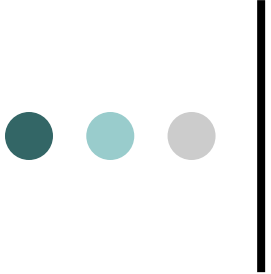
- Long slender protein tubes and fibers that extend from the nucleus to the plasma membrane.
- The cytoskeleton contains three types of elements responsible for cell shape, movement within the cell, and movement of the cell:
 - Microfilaments
 - Microtubules
 - Intermediate filaments

Cytoskeleton

- The cytoskeleton contains three types of elements :
 - Microfilaments

Actin

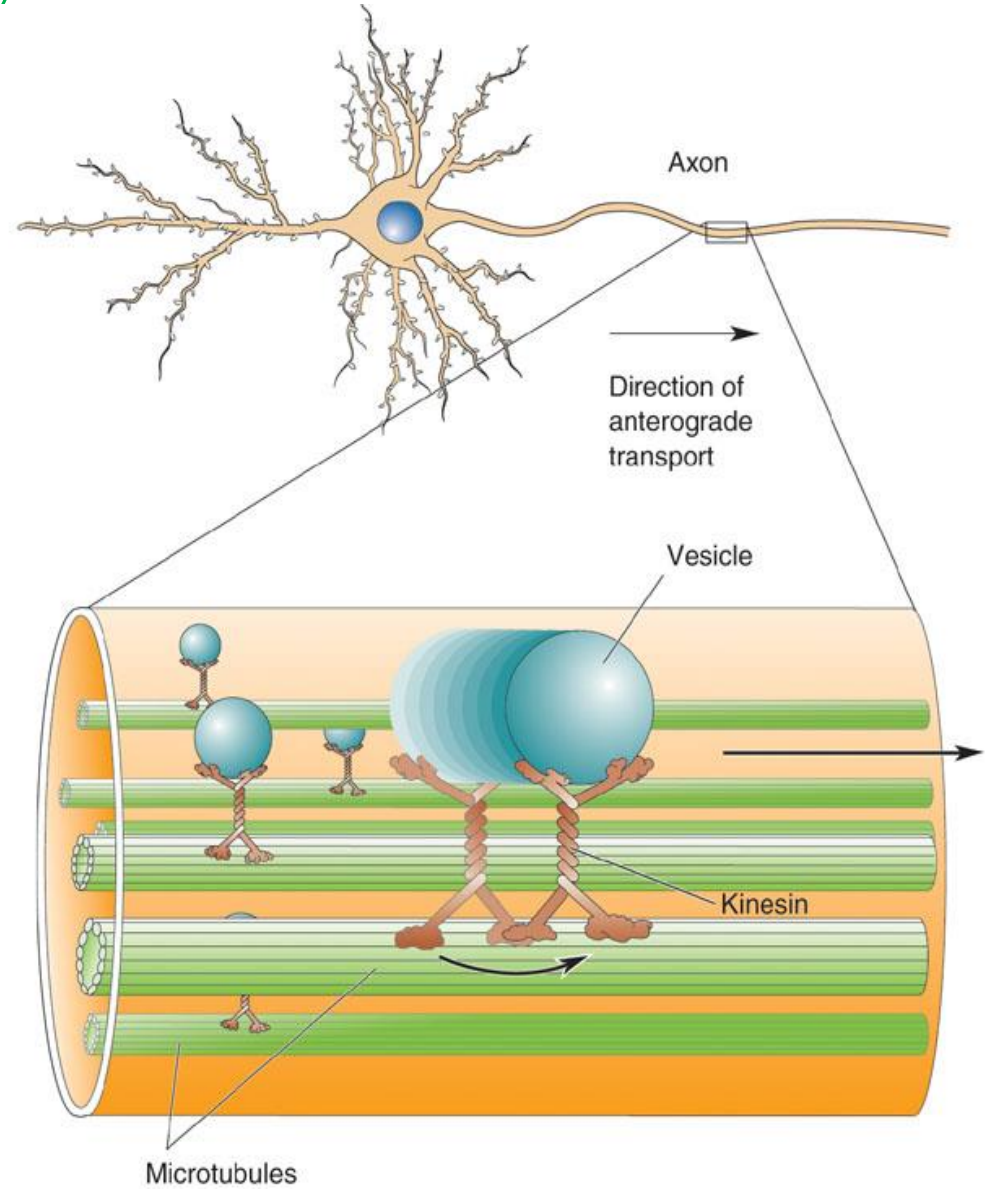




Cytoskeleton

The cytoskeleton contains three types of elements:

- Microtubules



Cytoskeleton

The cytoskeleton contains three types of elements:

- Intermediate filaments

