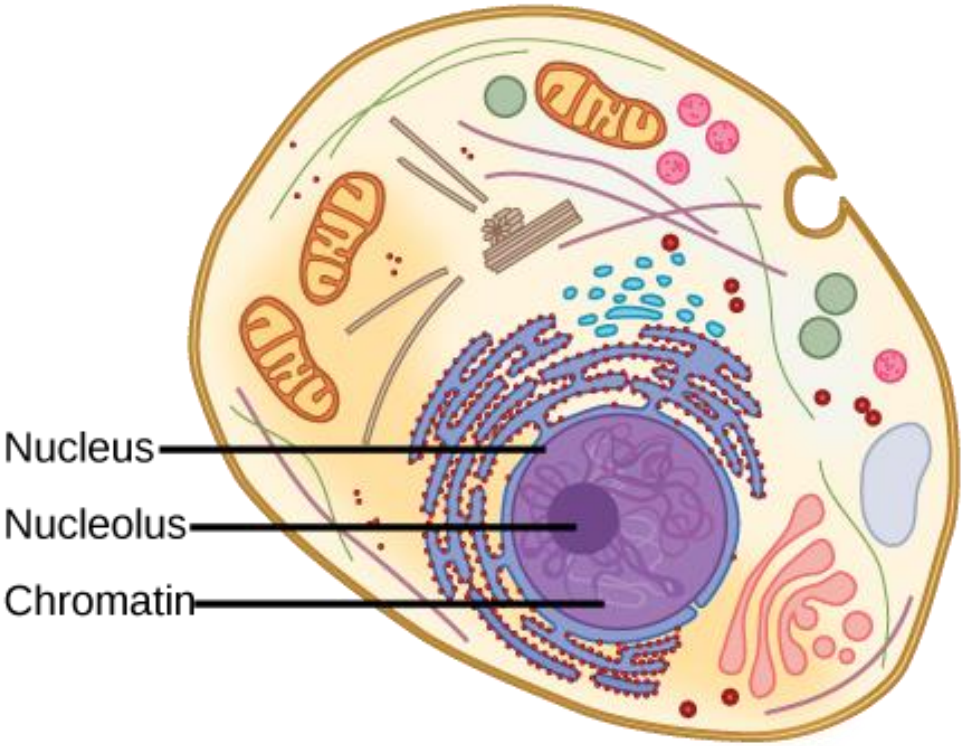
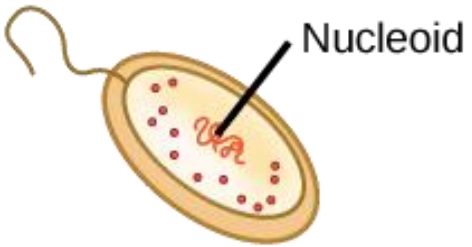
Basic Cell Types

All cells consist of a cytoplasm enclosed within a membrane.



Cells are typically categorized by how their genetic material is packaged:



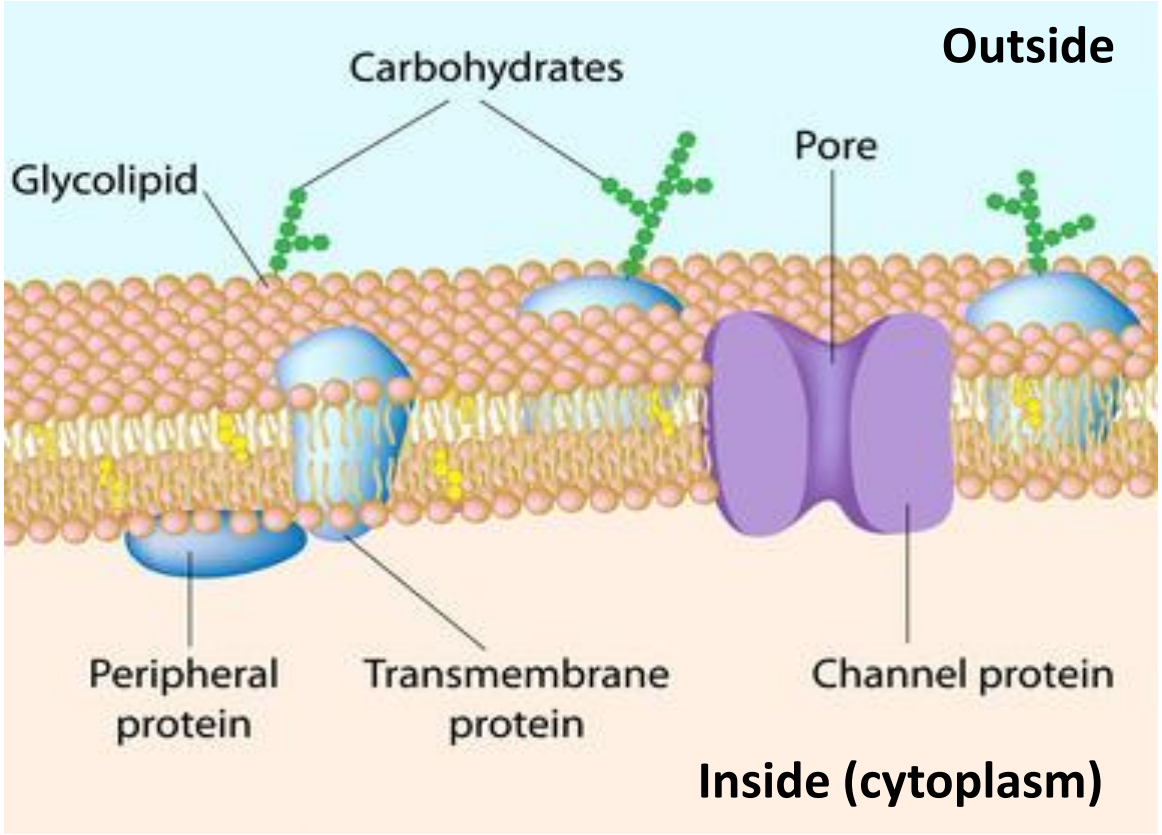
Eukaryote - the DNA is partitioned off in its own membrane-bound room called the nucleus.

Prokaryote - the DNA within a cell is not separated from the cytoplasm.

Cell Membrane

The <u>cell membrane</u> (aka the *plasma membrane*) separates the interior of all cells from the outside environment.

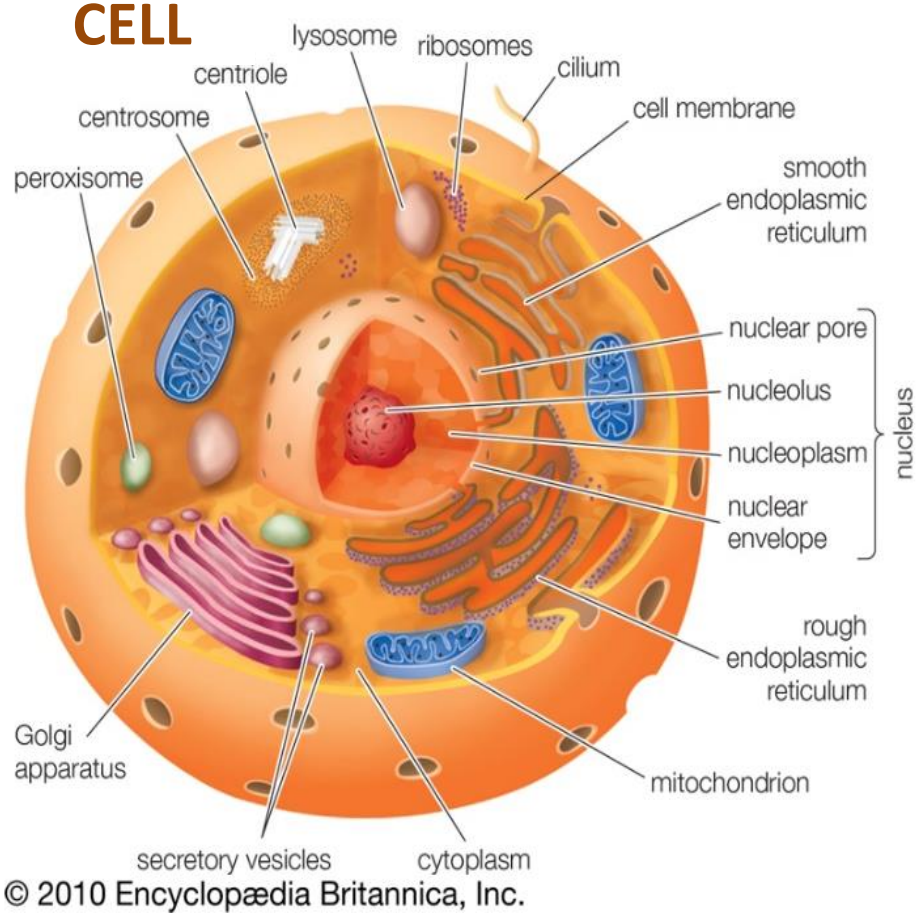
- **All membranes are lipid (fat) double layer.**
- **<u>Basic function</u> is to protect the cell from its surroundings.**
- **Selectively permeable to ions and organic molecules.**
- **Control the movement of substances in and out of cells.**



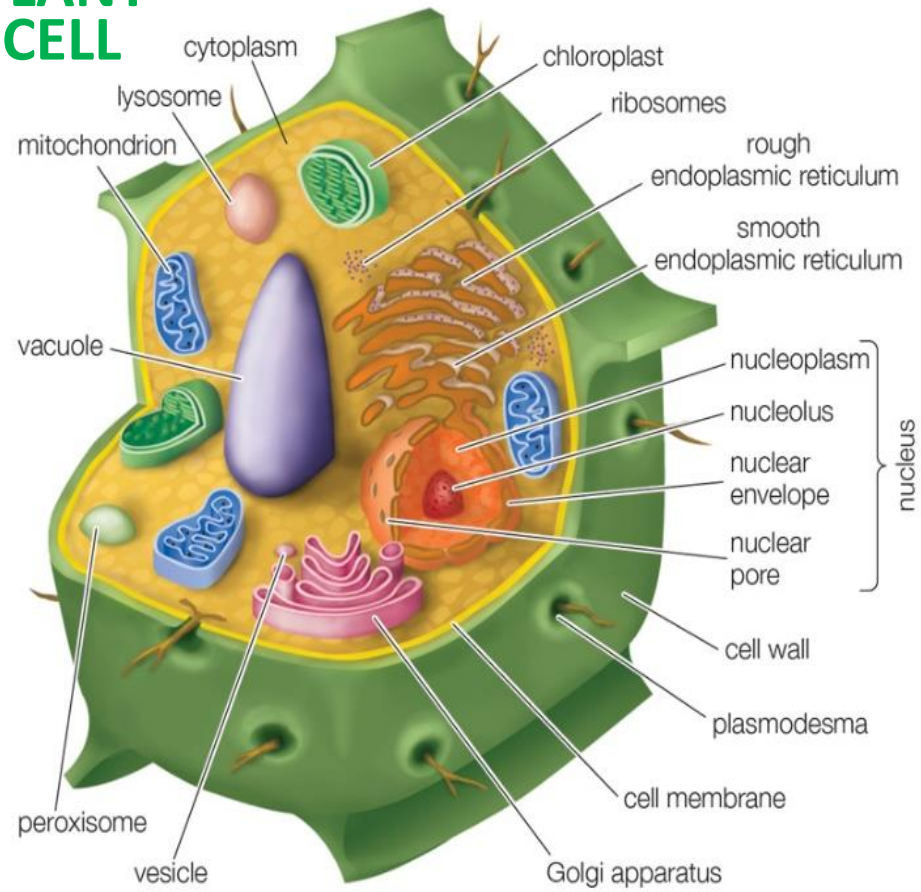
Organelles

Eukaryotic cells have specialized interior compartments, called organelles ("little organs"), that have specific functions and are enclosed by their own lipid membranes.

ANIMAL CELL



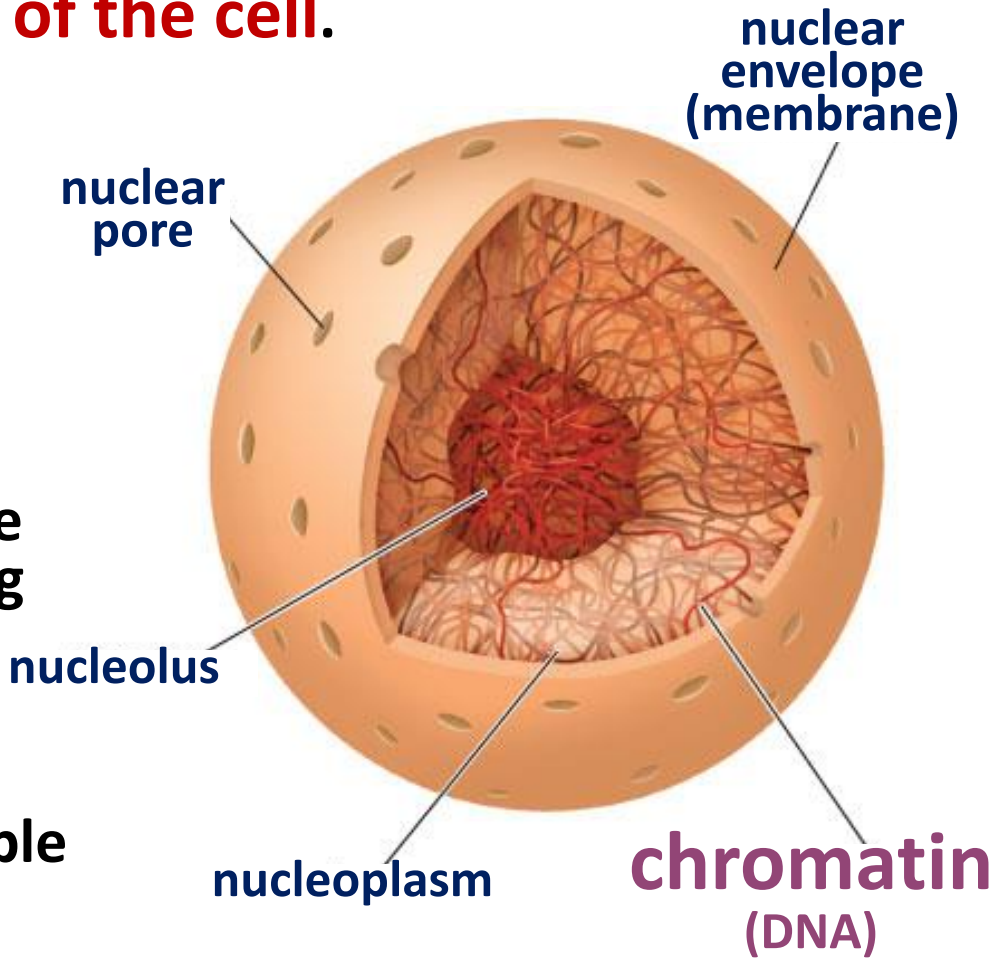
PLANT CELL



Nucleus

The nucleus is the control center of the cell.

- **The largest organelle in the cell.**
- **Contains (most of) the DNA of the cell.**
- **The nucleus was the first organelle to be discovered: Antonie van Leeuwenhoek observed a "Lumen", the nucleus, in the red blood cells of salmon.**
- **Main function - to control gene expression and mediate the replication of DNA during the cell cycle.**
- **Inside the nucleus is a *suborganelle* called the nucleolus, which is responsible for making ribosomes.**



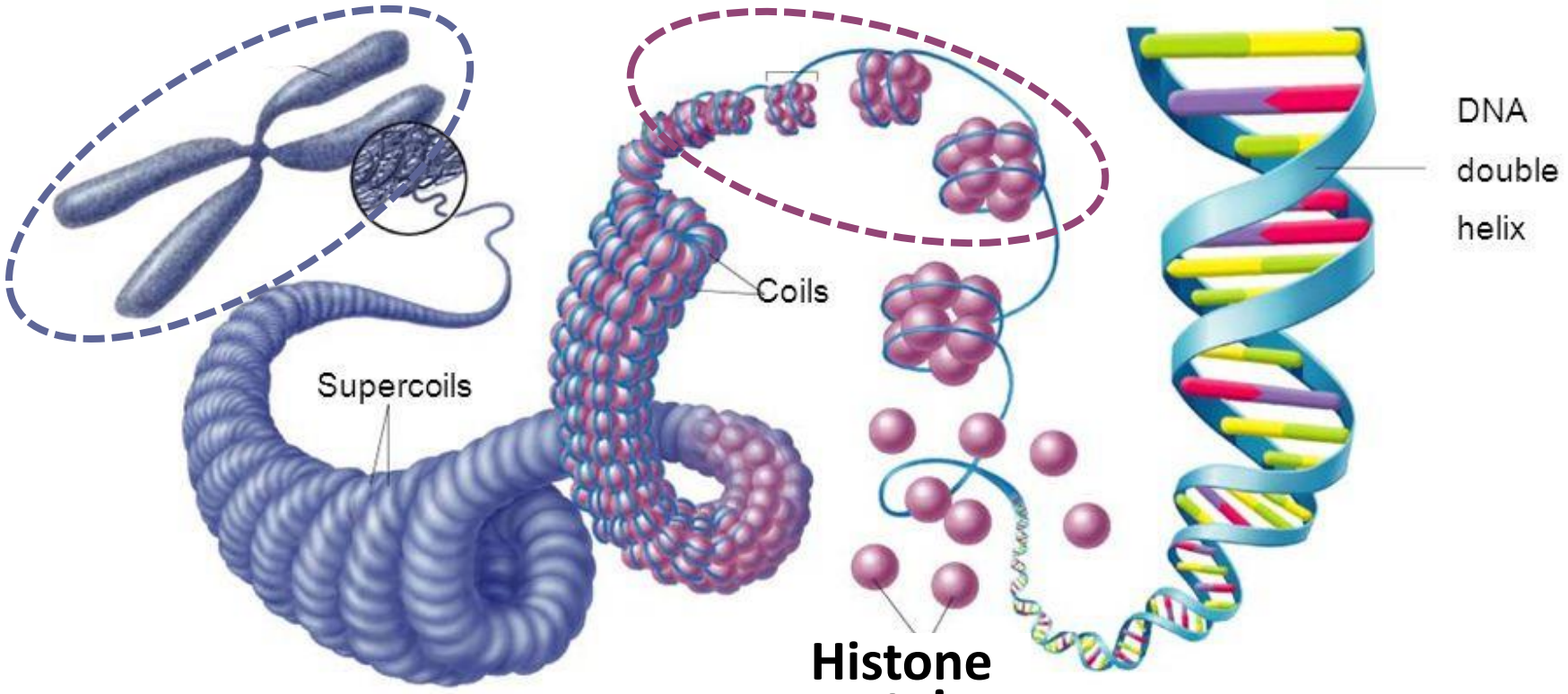
Chromosome

a *supercoiled condensed chromatin* (200 times tighter!) present during nuclear division to ensure proper separation of doubled DNA between daughter cells.

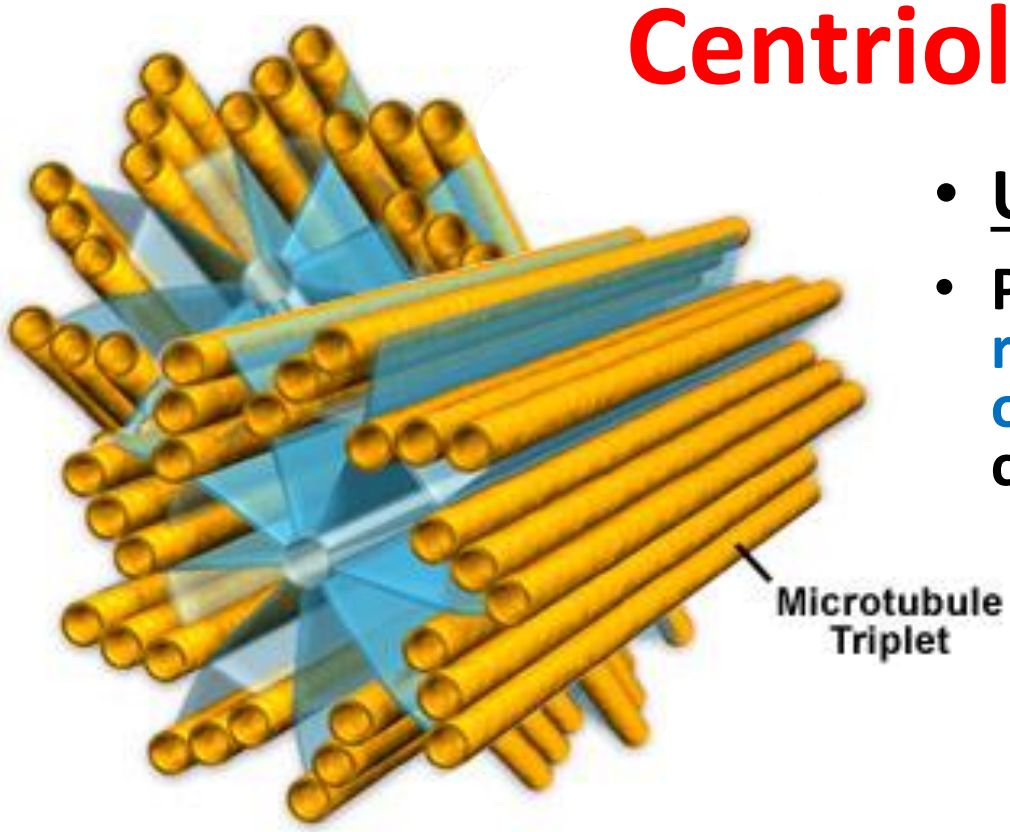
VS

Chromatin

a bead-on-a-string-like *DNA+proteins complex structure* present during the interphase of the cell cycle; the usual form of the packaged DNA in the cell.

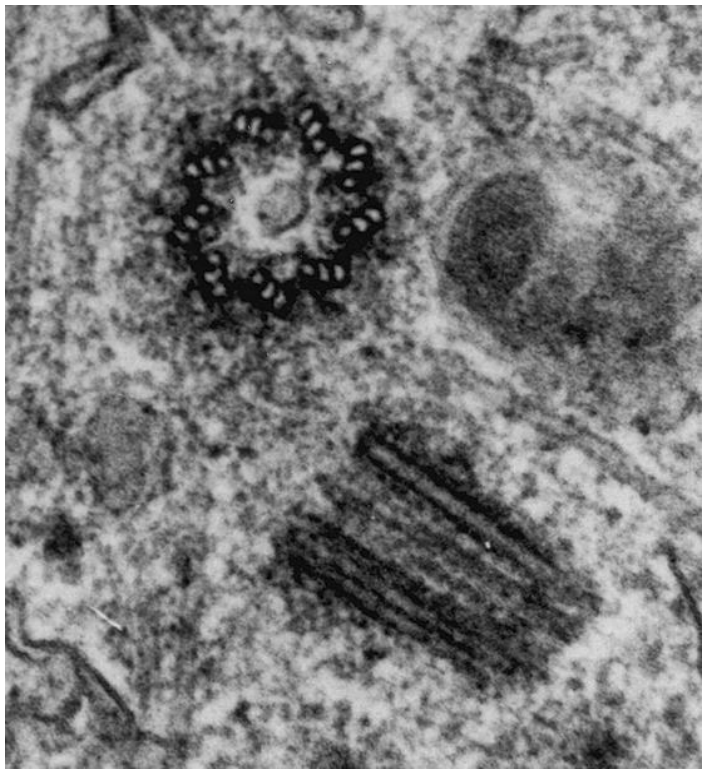


Centrioles



- **Unique to animal cells.**
- **Play an important role in regulating the separation of chromosomes during cell division.**

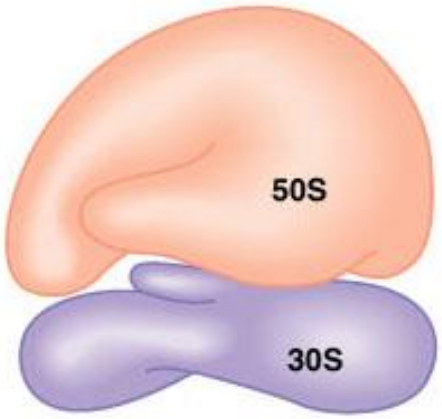
- **Small cylindrical arrangements of nine microtubule triplets each.**
- **Occur in pairs (two centrioles perpendicular to each other) forming a *centrosome*.**
- **Located near the nucleus.**



Ribosomes

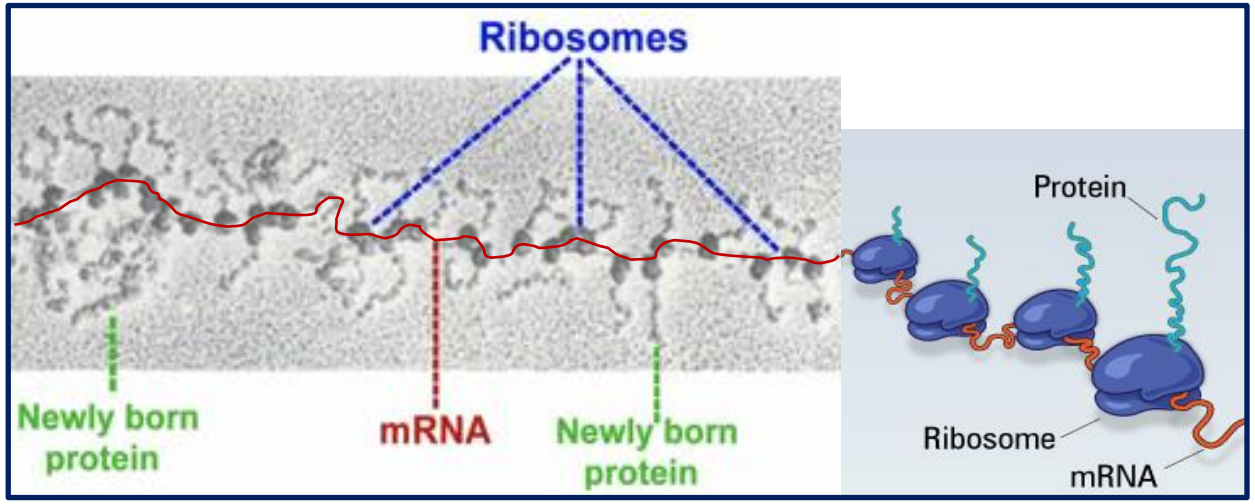
The ribosome is a complex molecular machine responsible for the synthesis of proteins in cells.

Two major components:



- **the small subunit which reads the RNA**
- **the large subunit which joins amino acids to form a polypeptide chain.**

The process of protein synthesis (*translation*) →



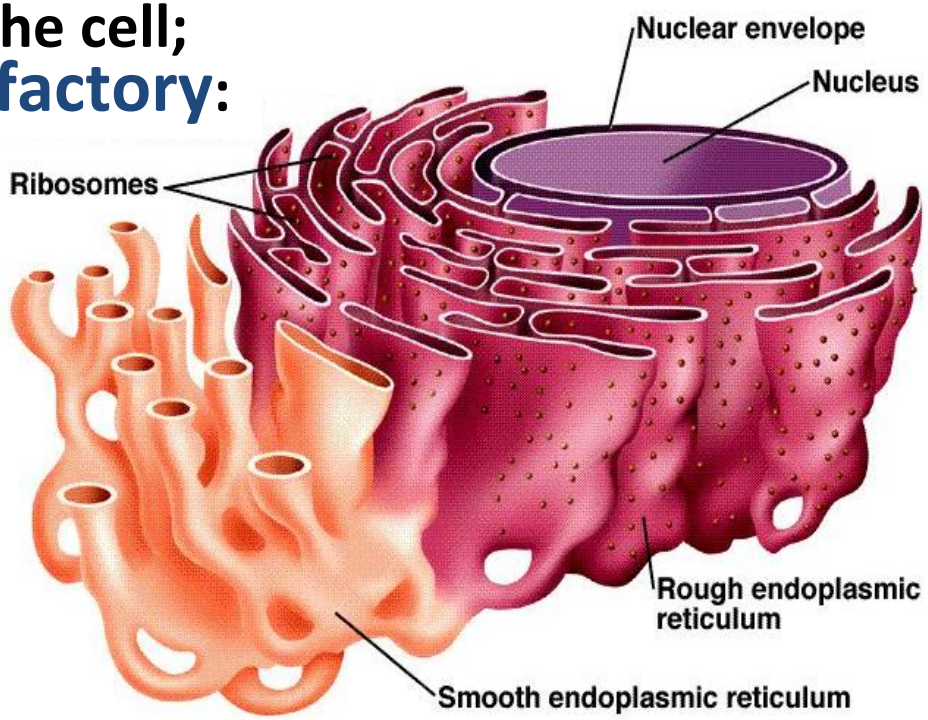
The ribosomes are found within all living cells: some are free floating in the cytoplasm, but most are attached to the endoplasmic reticulum.

Endoplasmic Reticulum

The endoplasmic reticulum serves many general functions: folding of protein molecules, synthesizing lipids and steroids, and transport of synthesized molecules within the cell.

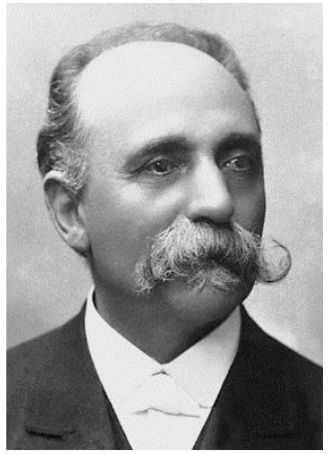
Consists of a network of "lacy" membranes throughout the cytoplasm of the cell; function is similar to that of a factory:

- **Rough ER - houses ribosomes on its surface; helps make and transports proteins.**
- **Smooth ER - makes and transports lipids and other materials within the cell (no ribosomes found on its surface).**



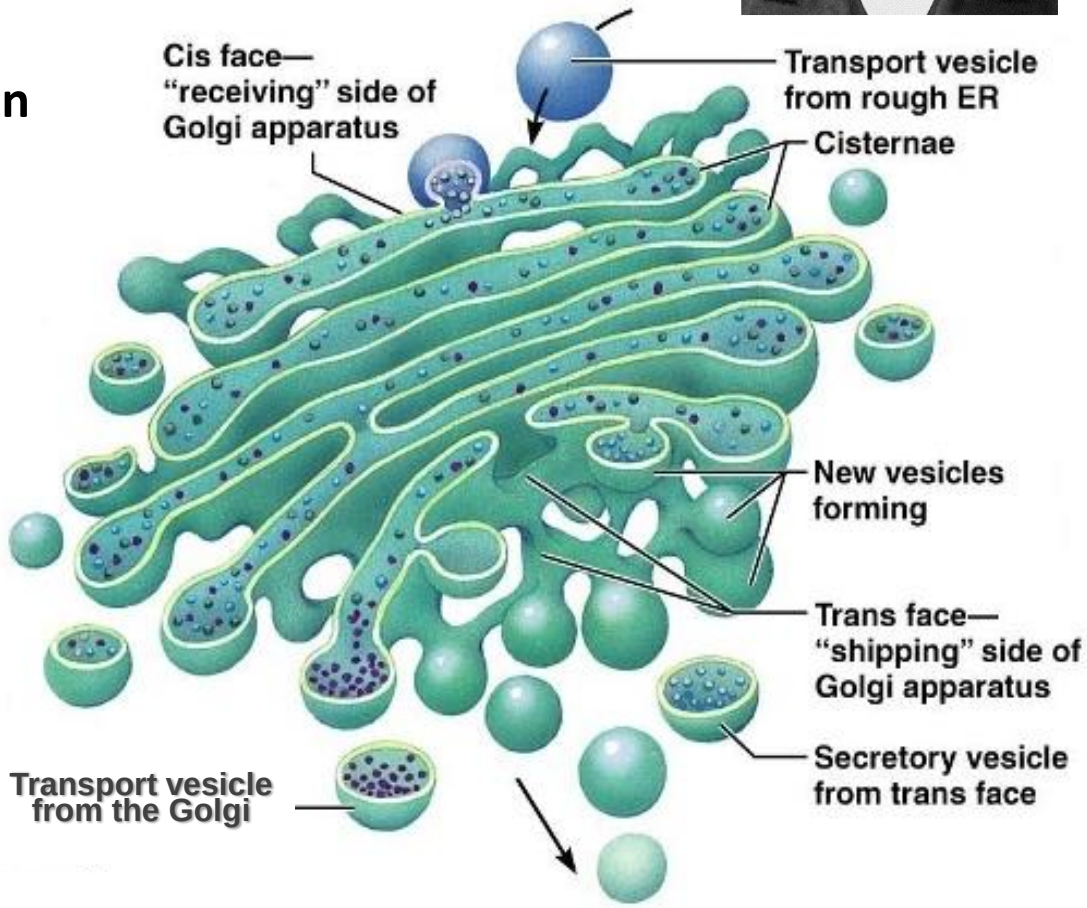
The rough endoplasmic reticulum works together with the Golgi Apparatus to target new proteins to their proper destinations.

Golgi Apparatus



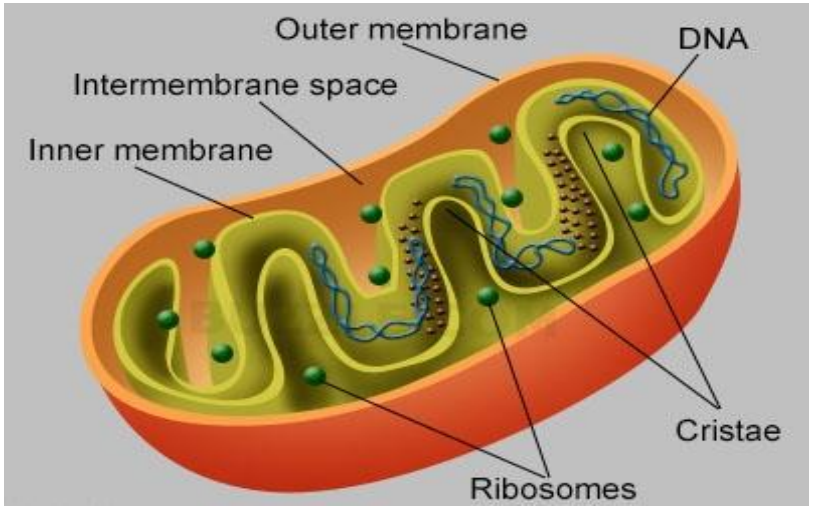
The Golgi apparatus (aka Golgi complex or Golgi body) processes proteins and other molecules produced in the endoplasmic reticulum.

- **One of the first large organelles discovered: identified in 1897 by the Italian physician Camillo Golgi.**
- **Present inside most eukaryotic cells.**
- **Golgi body function is similar to that of a post office: packages (into *vesicles*), sorts and labels items which it then sends to different parts of the cell or to the extracellular space.**



Mitochondria

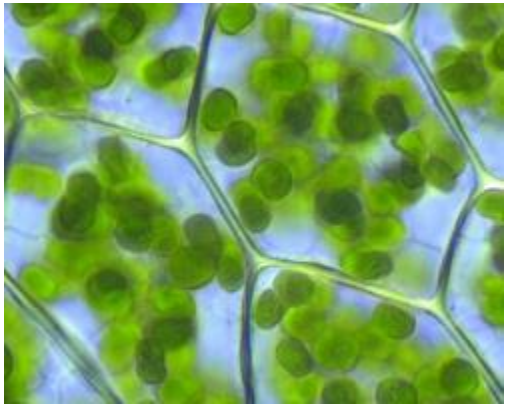
Mitochondrion is the powerhouse of the cell: generates *adenosine triphosphate* (ATP) which is used as a source of chemical energy within cells.



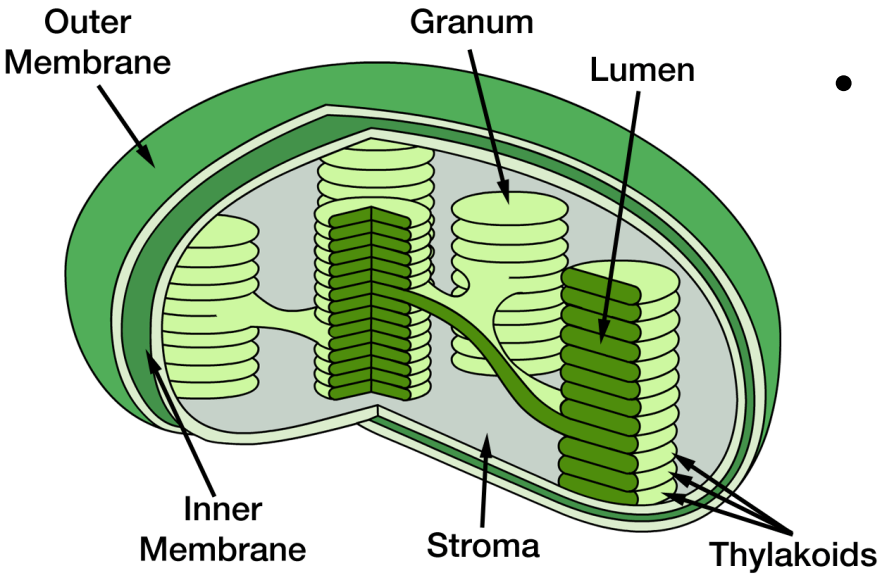
- **Mitochondria have their own small independent genome (DNA is circular and similar to bacterial) and ribosomes.**
- **They can replicate on their own (by fission) and make their own proteins.**

- **The number of mitochondria in a cell is based on energy demand and can vary widely by organism, tissue, and cell type (red blood cells have no mitochondria; liver cells can have more than 2000).**
- **Cells with high energy needs can meet their demands by increasing the number of mitochondria they contain (for example, muscle cells in people who exercise regularly possess more mitochondria than muscle cells in sedentary people).**

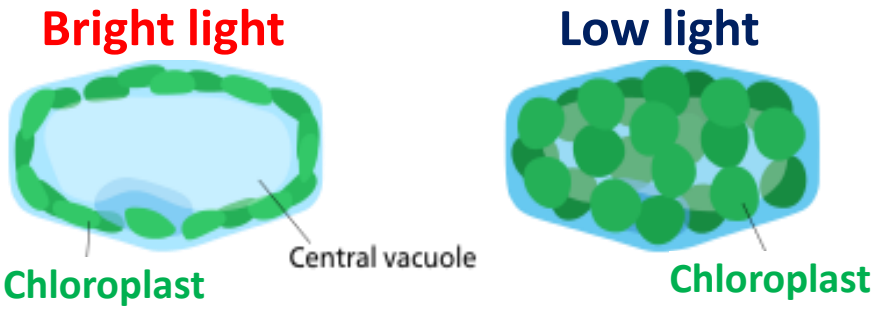
Chloroplast



<u>Chloroplasts</u> are organelles found in plant cells and eukaryotic algae that conduct photosynthesis.



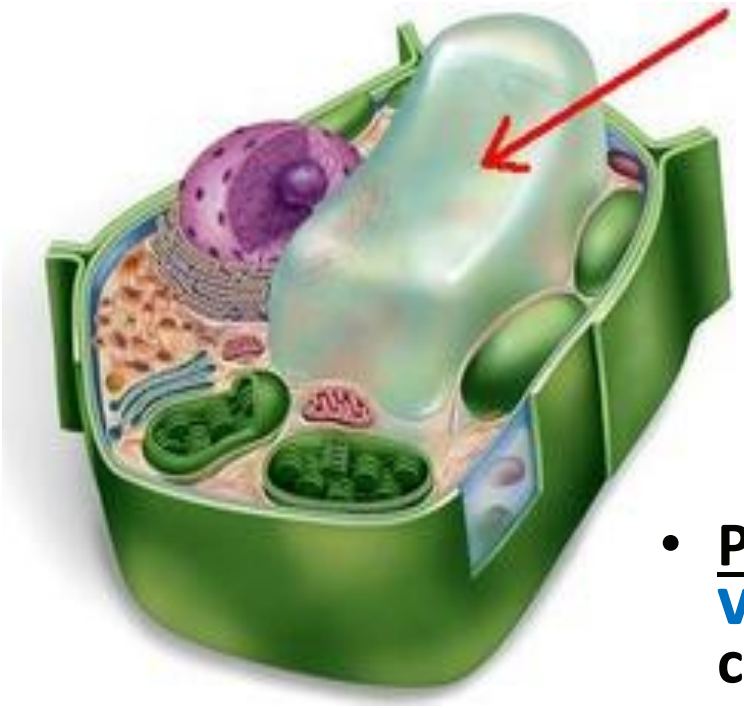
- **All green parts (but not all cells!) of a plant contain chloroplasts - the chlorophyll in them makes plants <u>appear green</u>; in most plants, chloroplasts are concentrated in the leaves.**



The chloroplasts can orient themselves to best suit the available light.

- **Participate in the plant immune response.**
- **Contain their own DNA and ribosomes (similar to mitochondria) .**

Vacuole

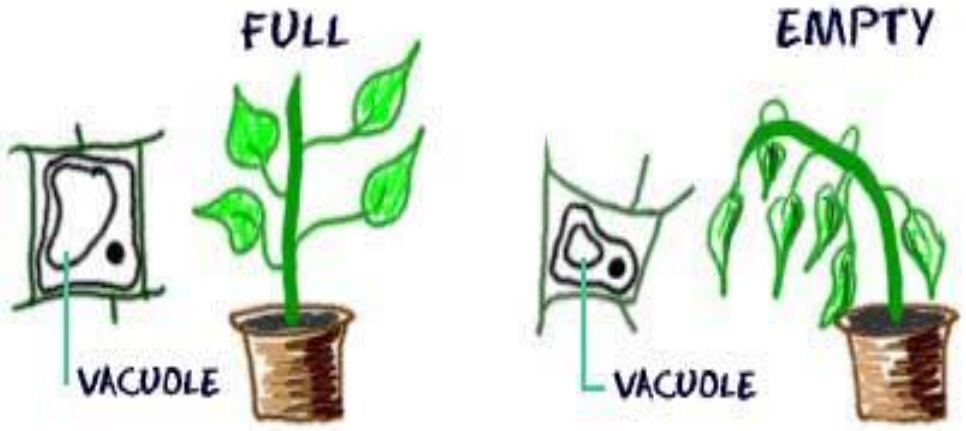


A sac-like <u>structure for storage</u> usually filled with water containing inorganic and organic molecules.

- **Has no basic shape or size; its structure varies according to the needs of the cell.**

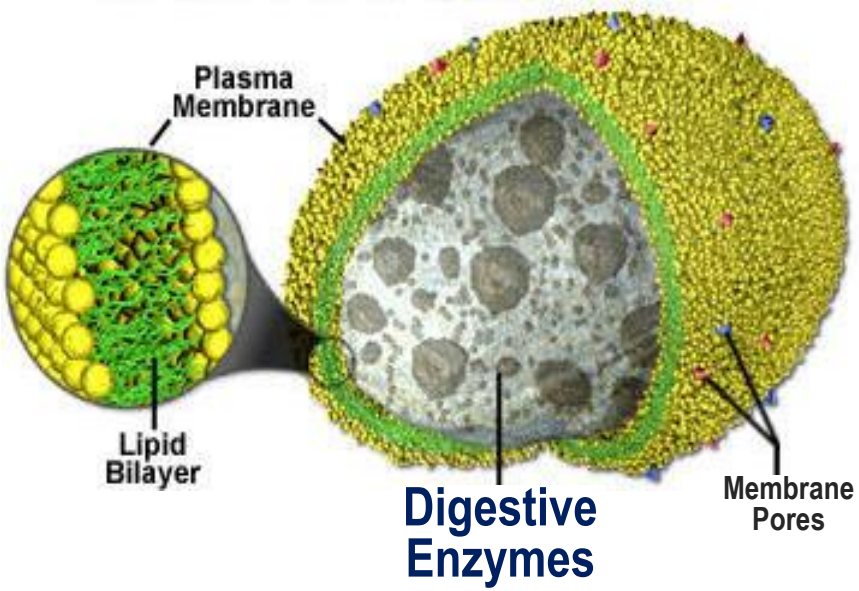
- **<u>Plant cells</u> usually contain one large vacuole that fills more than 30% of the cell volume - pressure from this large vacuole helps plants support themselves.**

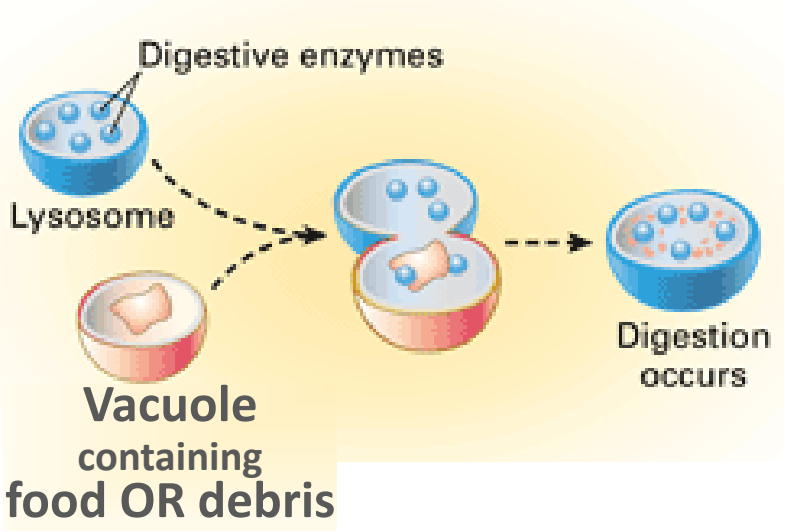
- **Vacuoles play a <u>less important role within animal cells</u>, mainly isolating materials that might be harmful and containing waste products.**



Lysosome

Lysosomes are membrane-enclosed organelles that **contain special enzymes** capable of breaking down all types of biological polymers - proteins, nucleic acids, carbohydrates, and lipids.





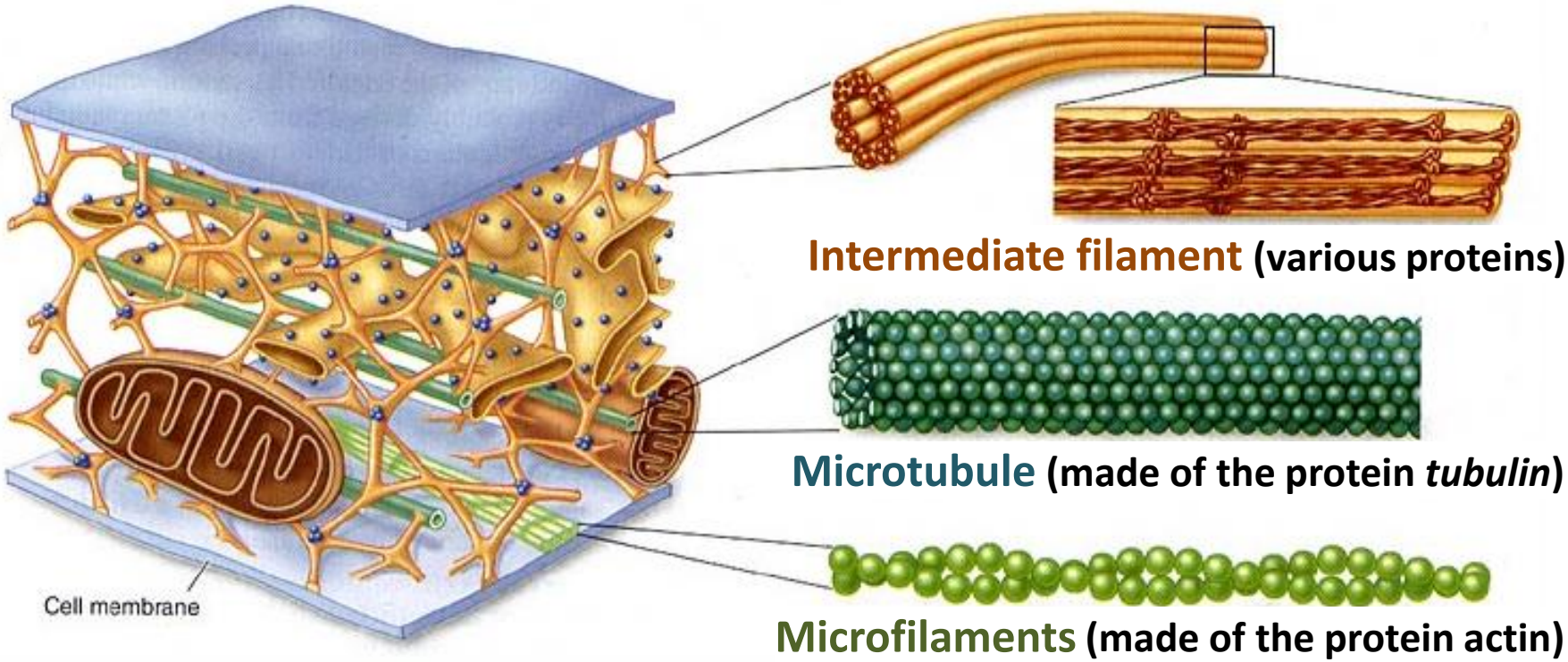
- Can be described as the **stomach of the cell**: digest food particles, waste materials, cellular debris, and engulfed viruses or bacteria.
- Lysosomes also play the role of **recycling units**: break down excess or worn-out organelles to their basic molecules.

Found in most animal cells (they are absent in red blood cells).

Cytoskeleton

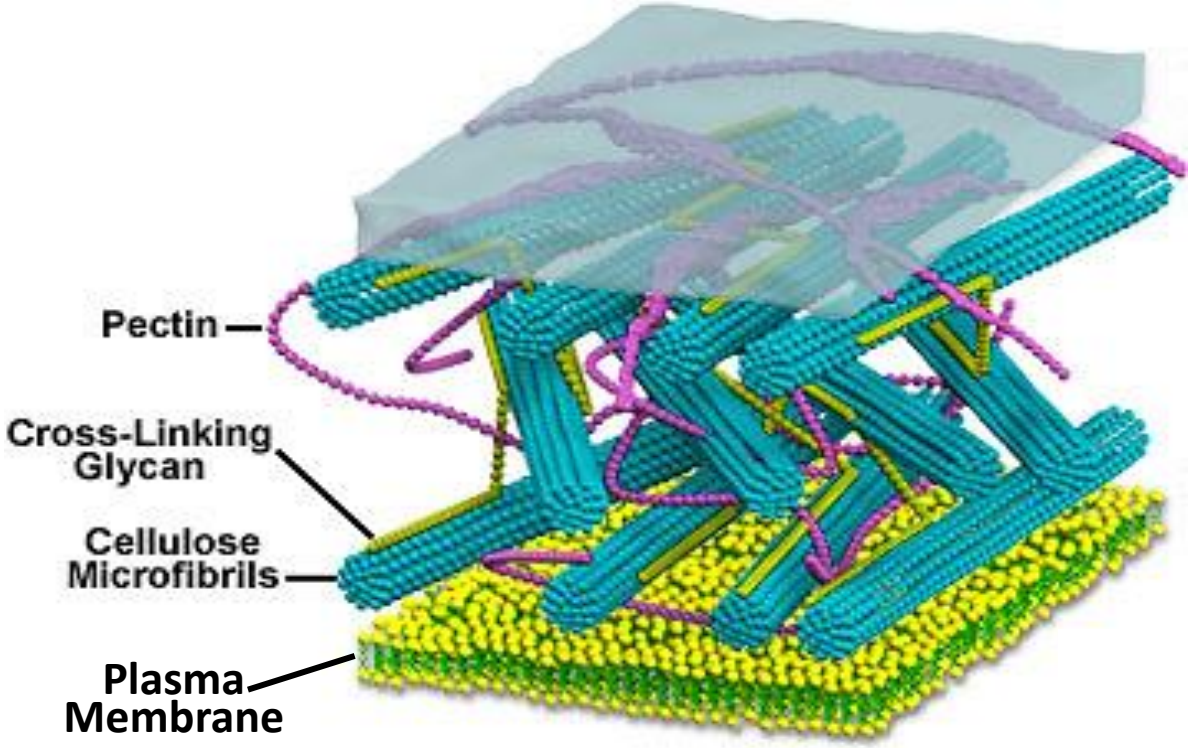
Cytoskeleton is a network of protein fibers that gives the cell shape and mechanical resistance to deformation.

- **Composed of three main filaments, which are capable of rapid assembly or disassembly dependent on the cell's requirements.**



Large-scale example of a cytoskeleton action: muscle contraction.

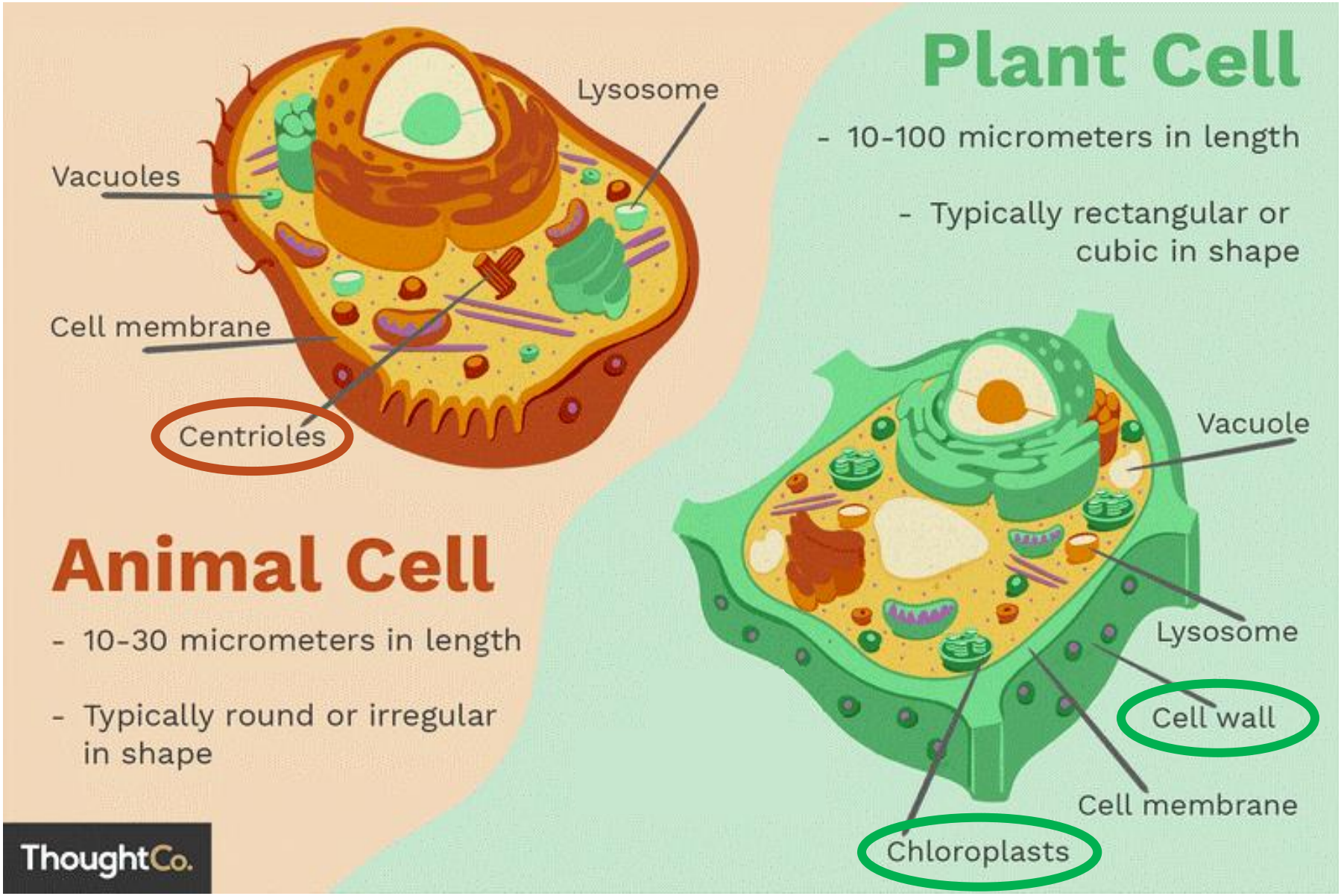
One of the most important distinguishing features of **plant** cells is the presence of a **cell wall**.



- An organized network of complex carbohydrates (cellulose) and branched polysaccharides (cross-linking glycan and pectin) is stretchy and has the ability to resist compression.

- The relative rigidity of a plant cell wall makes plants sedentary.
- Cell walls are significantly thicker than plasma membranes (*~0.1-5 µm vs ~10 nm*) and were visible even to early microscopists.

How much difference?



Biomolecular and structural components of (plant) cells