

Lecture 1

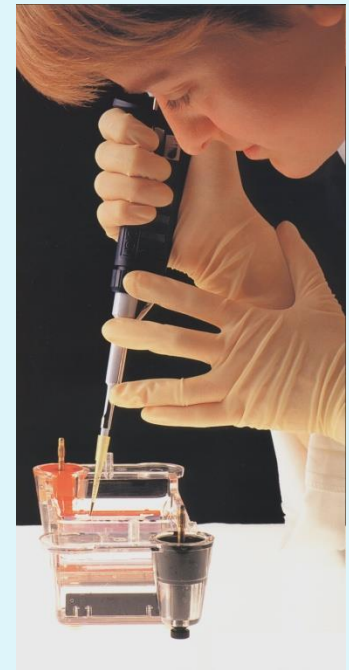
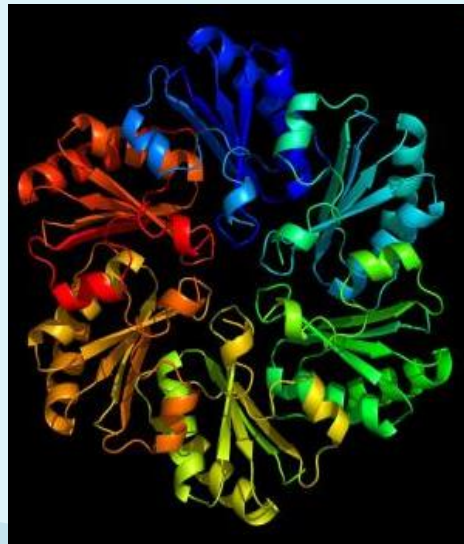
Introduction to Biochemistry

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What Is Biochemistry

- **Biochemistry** is the study of the chemistry of living things. This includes organic molecules and their chemical reactions.
- Chemistry of living organisms.



biochemistry

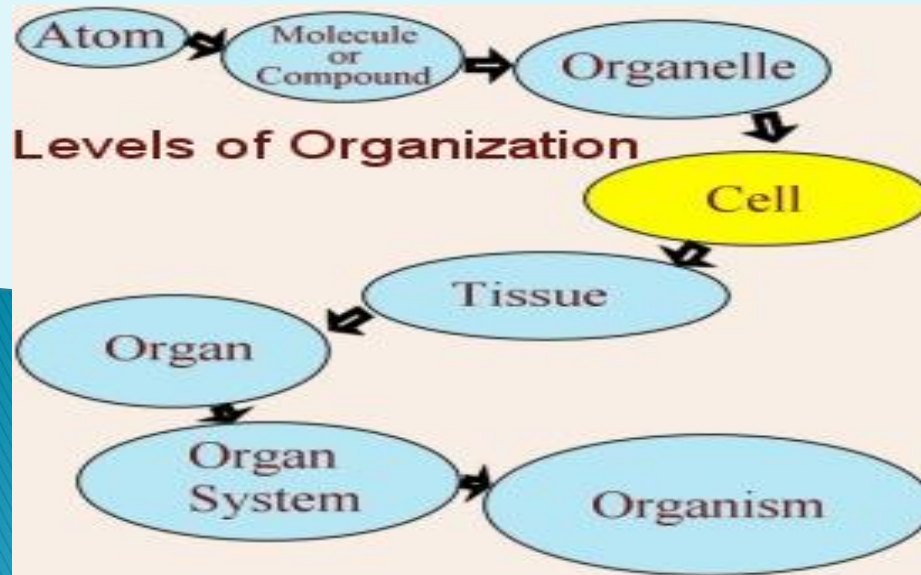
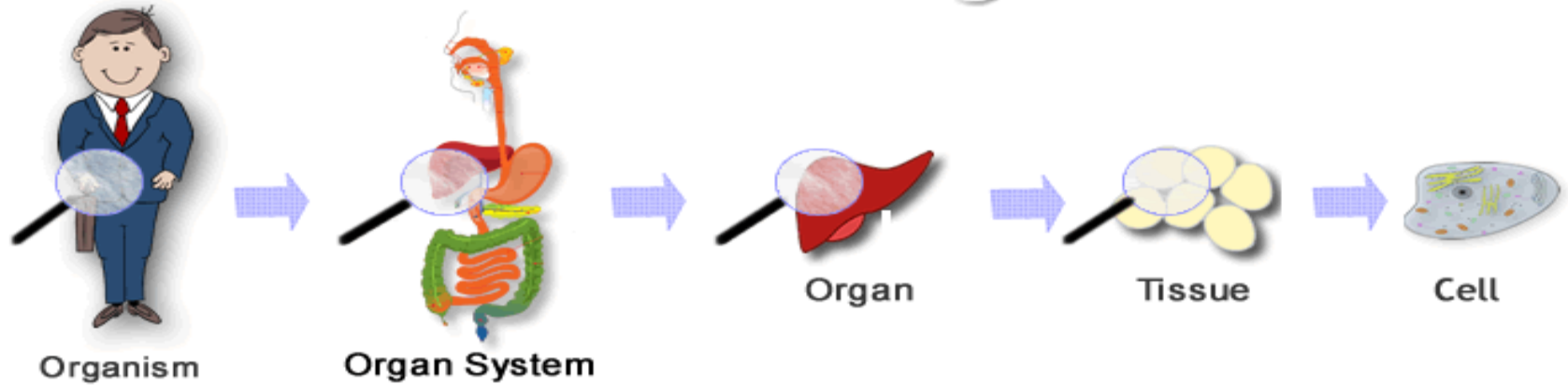
- A. Studying the structure and behavior of the complex molecules found in biological material and

- B. the ways these molecules interact to form cells, tissues and whole organism

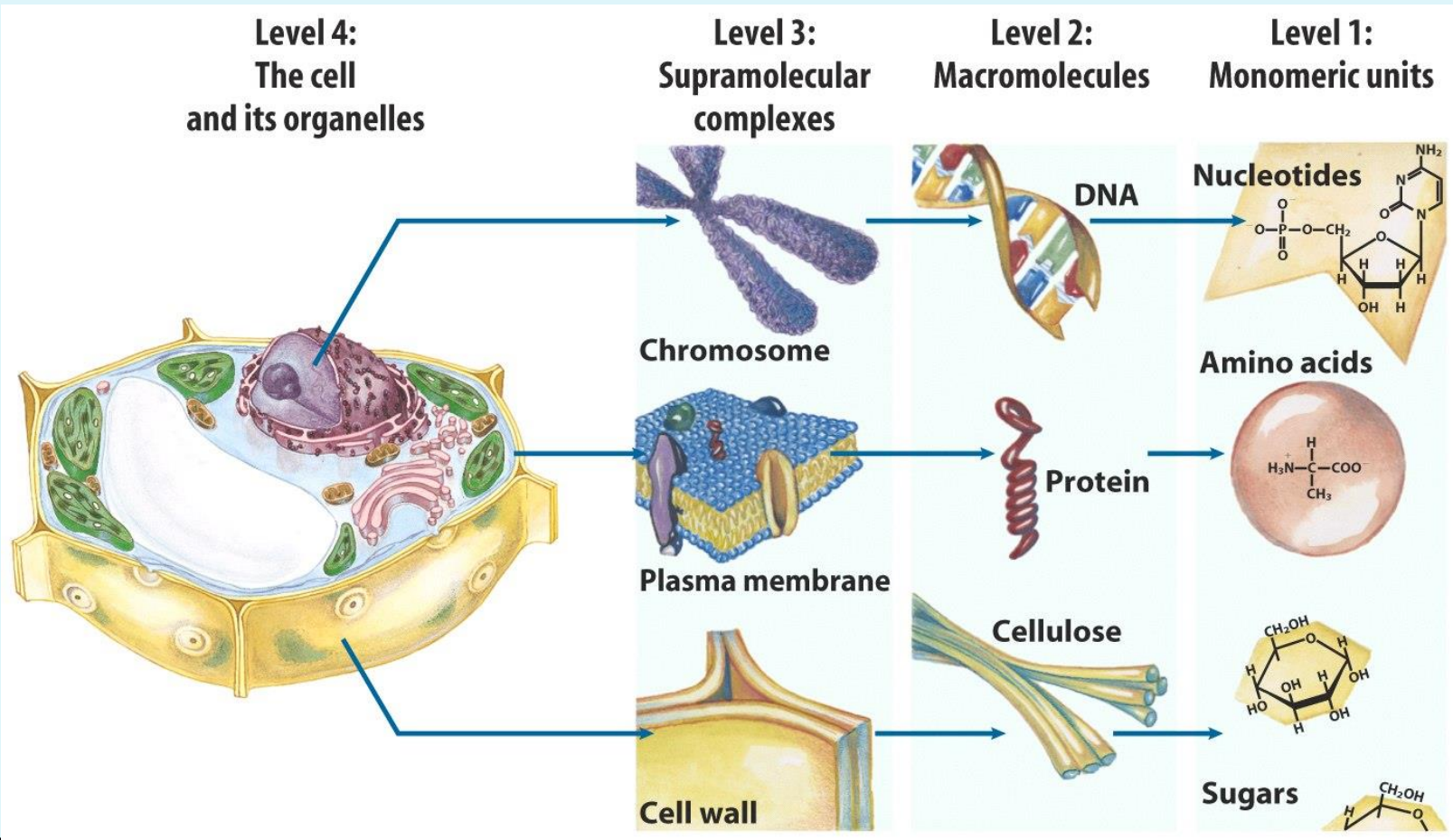
Biomolecules – Structure

- ▶ Animal and plant cells contain approximately 10, 000 kinds of molecules (bio-molecules)
- ▶ Water constitutes 50-95% of cells content by weight
- ▶ Ions like Na^+ , K^+ and Ca^+ may account for another 1%
- ▶ Almost all other kinds of bio-molecules are organic (C, H, N, O, P, S)
- ▶ The chemical properties of organic bio-molecules are determined by their functional groups. Most bio-molecules have more than one

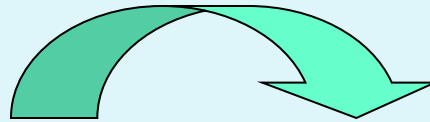
Levels of Cellular Organization



Molecular Organisation of a cell



Biomolecules – Structure



Anabolic

▶ Building block

▶ Simple sugar

▶ Amino acid

▶ Nucleotide

▶ Fatty acid

▶ Macromolecule

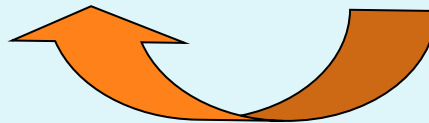
▶ Polysaccharide

▶ Protein (peptide)

▶ RNA or DNA

▶ Lipid

Catabolic



Introduction to the cells



What is the cell

- ▶ The cell is the smallest unit of matter that can carry on all the processes of life.
- ▶ All living organisms are made out of cells



Cell Theory

- ▶ Cell Theory consists of three principles:
 - A. All living things are composed of one or more cells.
 - B. Cells are the basic units of structure and function in an organism.
 - C. Cells come only from the replication of existing cells.

Properties of Cells

- ▶ they are highly complex and organized
- ▶ Cells Possess a Genetic Program and know how to use it
- ▶ all cells can reproduce- one becoming two. “Simple” (binary fission) in prokaryotes, much more complex-mitosis in eukaryotes.
- ▶ Cells acquire and use energy: (Chemo) Heterotrophs, (photo)autotrophs
- ▶ Chemical reactions are constantly taking place in the cell.
 - Catabolism
 - Anabolism
 - Metabolism – the total of both

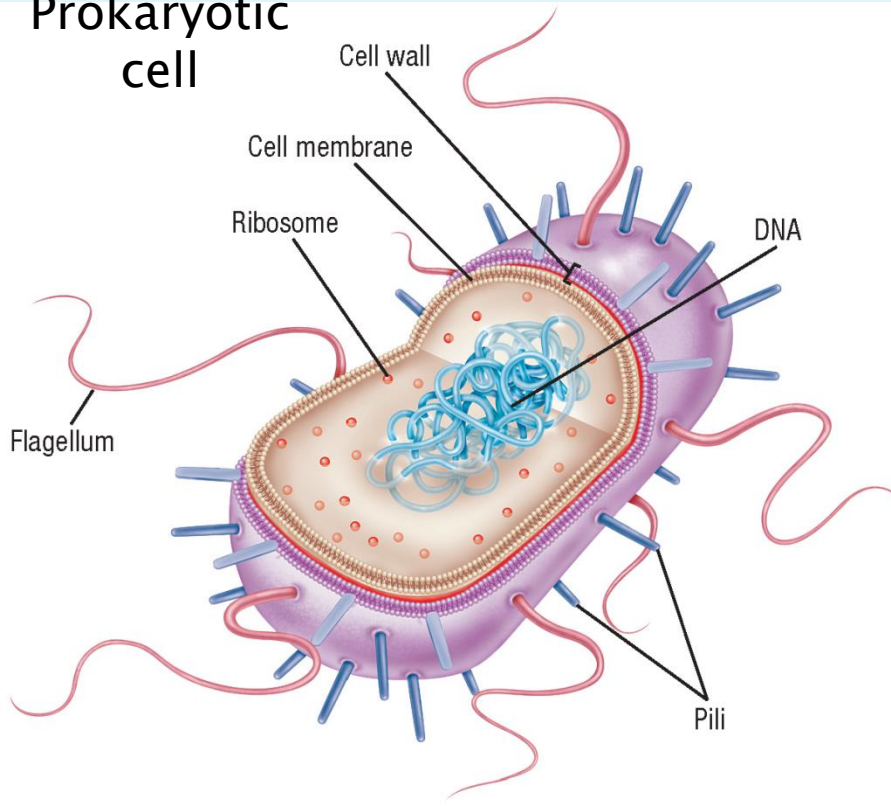
Properties of Cells

- ▶ Lots of mechanical activity in cells also- movement of cells, movement of things within cells.
- ▶ Cells respond to external stimuli- *illness, losing blood, eating, etc. can be described cellularly*
- ▶ *Cells Evolve (that is, current cells appear to be the ancestors of past cells.*

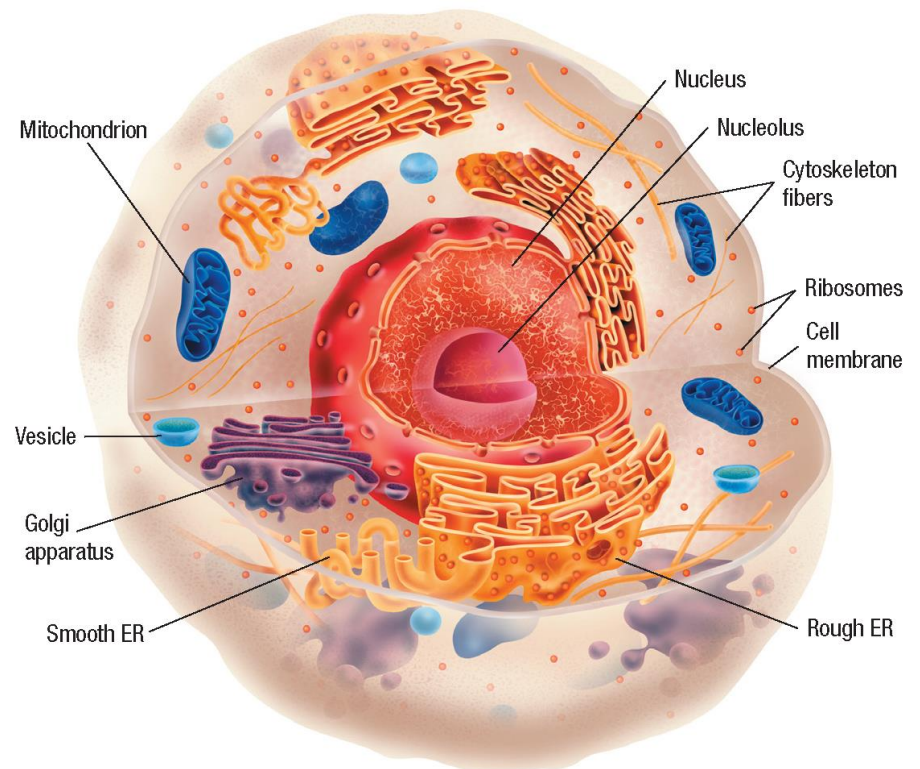
TYPES OF CELLS

- ▶ There are two cell types: eukaryotic cells and prokaryotic cells.

Prokaryotic cell



Animal cell



TYPES OF CELLS

- ▶ Organisms whose cells normally contain a nucleus are called Eukaryotes; those (generally smaller) organisms whose cells lack a nucleus and have no membrane-bound organelles are known as Prokaryotes.

*These are two distinct types of cells with
STRUCTURAL differences.*

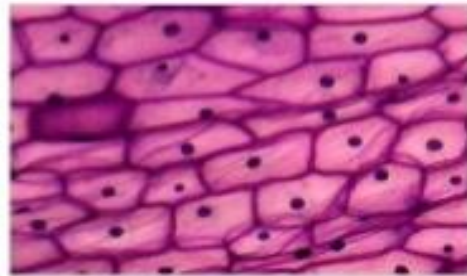
Prokaryotes

Bacteria

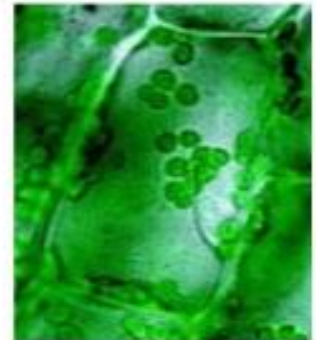


Eukaryotes

Animal

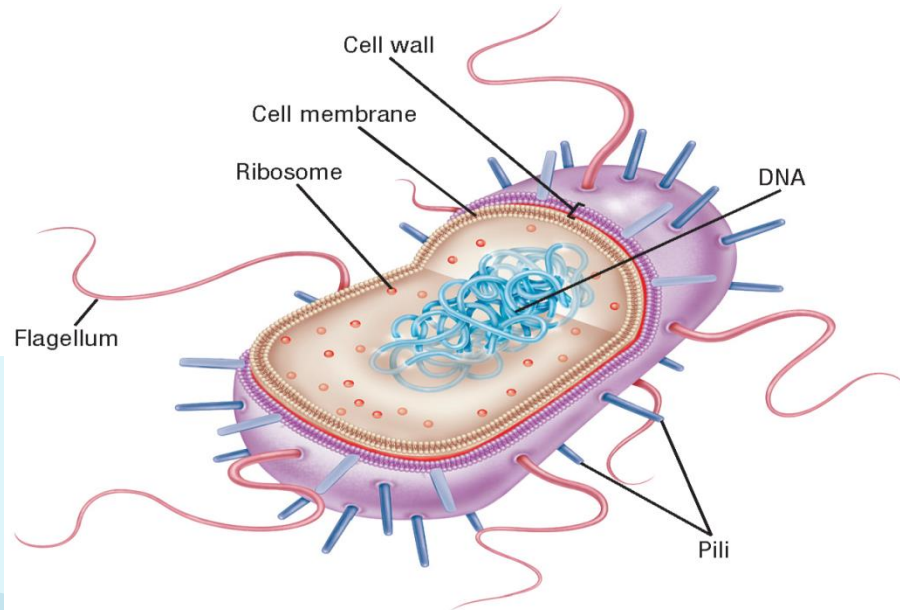


Plant

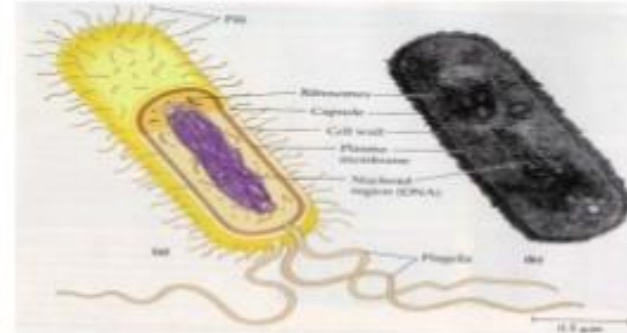


Prokaryote Cell

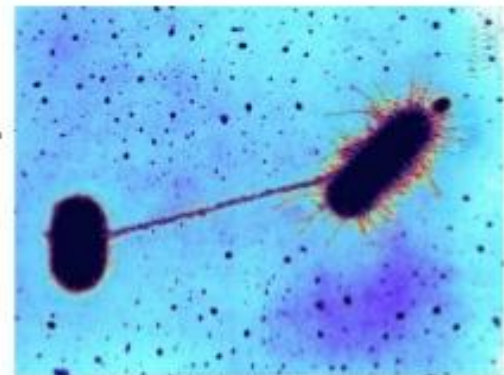
A single celled organism that does not have a nucleus.



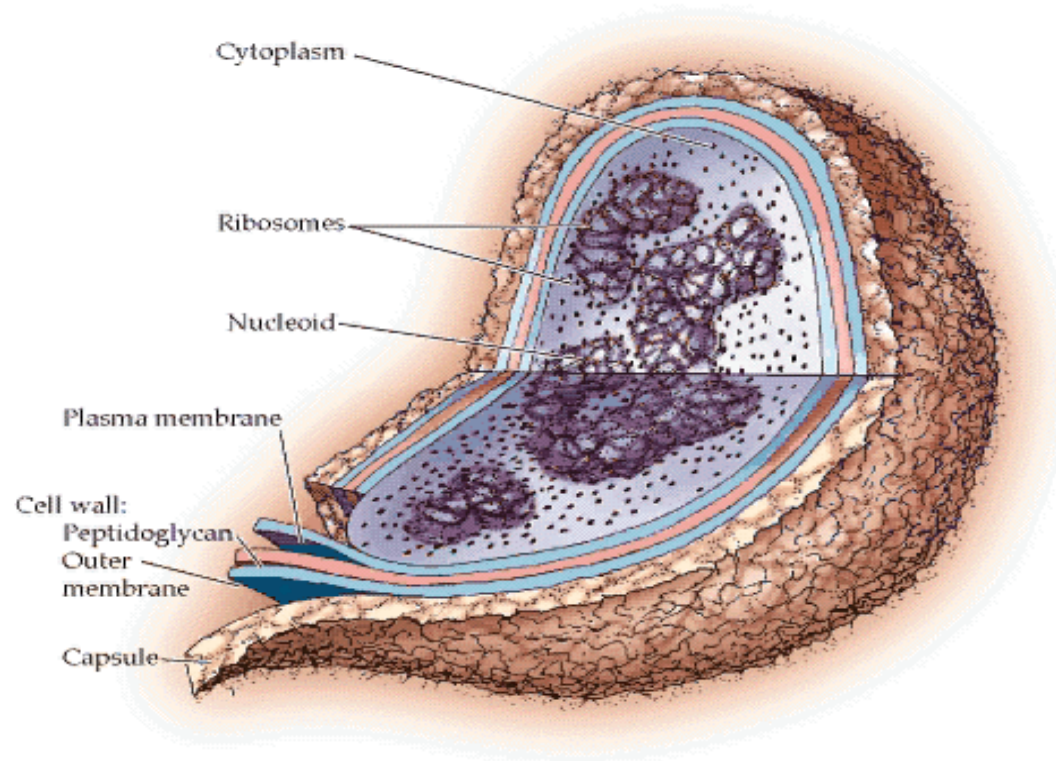
Prokaryotes:



- 1- They do not have a nucleus, and their genetic material is not stored in the nucleus.
- 2- They have some organelles, but not many.
- 3- They are less complicated than eukaryotes.
- 4- All bacteria are prokaryotes.



Prokaryotic cells



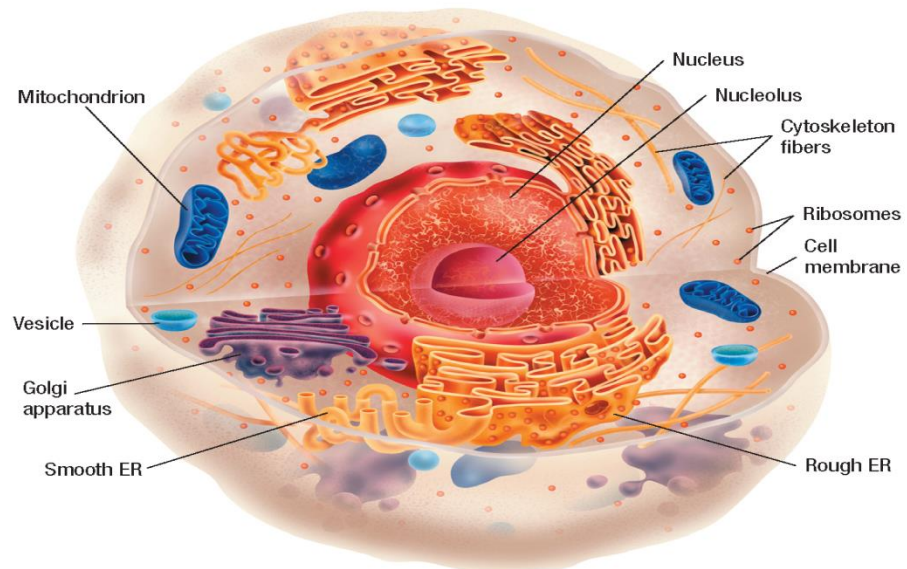
Components

- ▶ Cytoplasm
- ▶ Ribosomes
- ▶ Nuclear Zone
- ▶ DNA
- ▶ Plasmid
- ▶ Cell Membrane
- ▶ Cell Wall
- ▶ Capsule (or slime layer)
- ▶ Flagellum

Eukaryote Cell

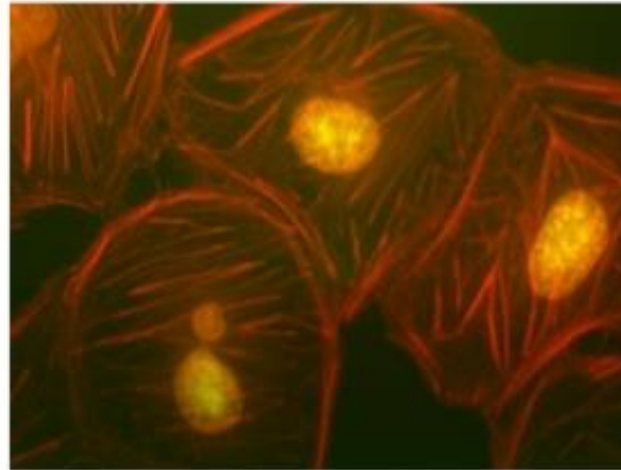
*A more complex cell
with a nucleus and
many organelles.*

Animal cell



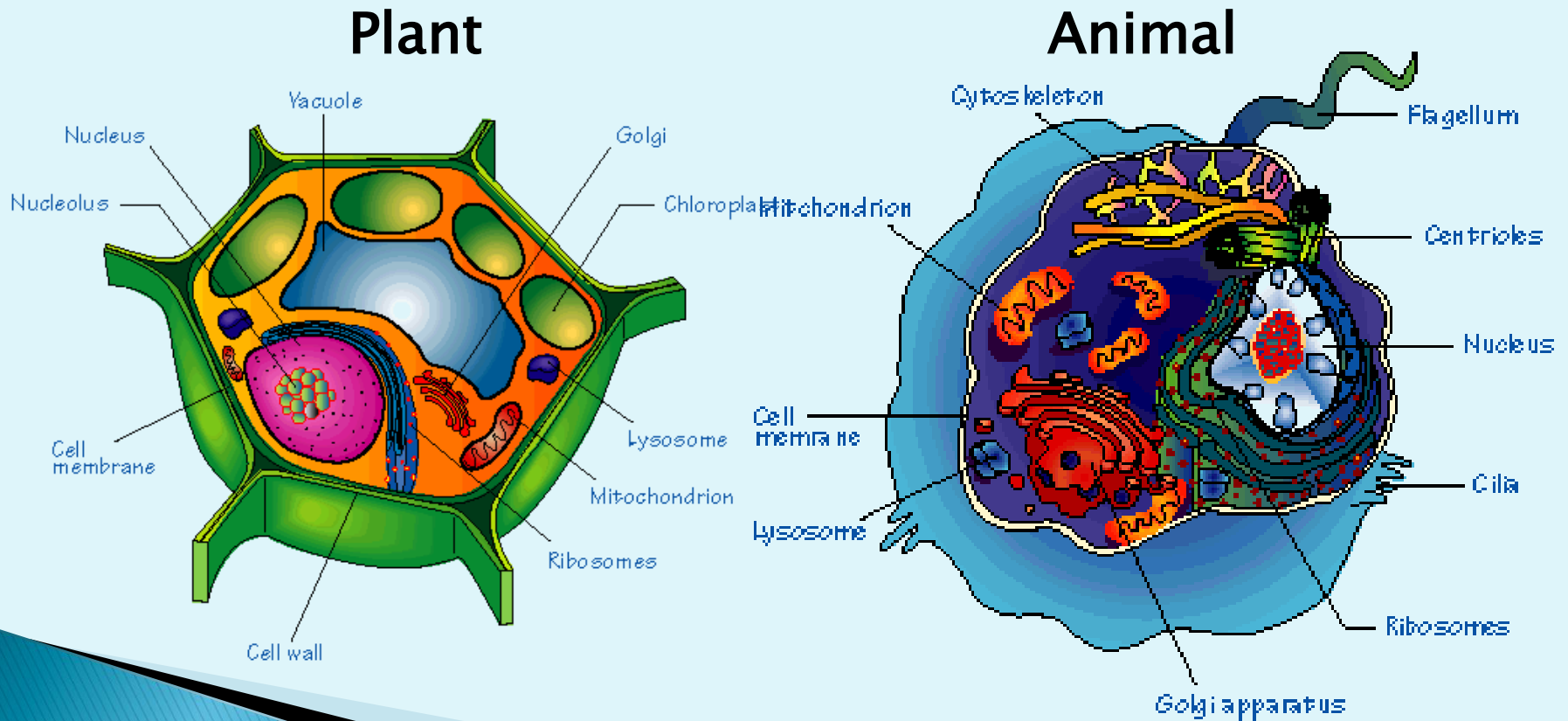
Eukaryotes:

1. They all have a nucleus where the genetic material of the cell is stored.
2. They have many organelles that work together to help the cell function.



Eukaryotic

- ▶ Contain organelles surrounded by membranes
- ▶ Most living organisms

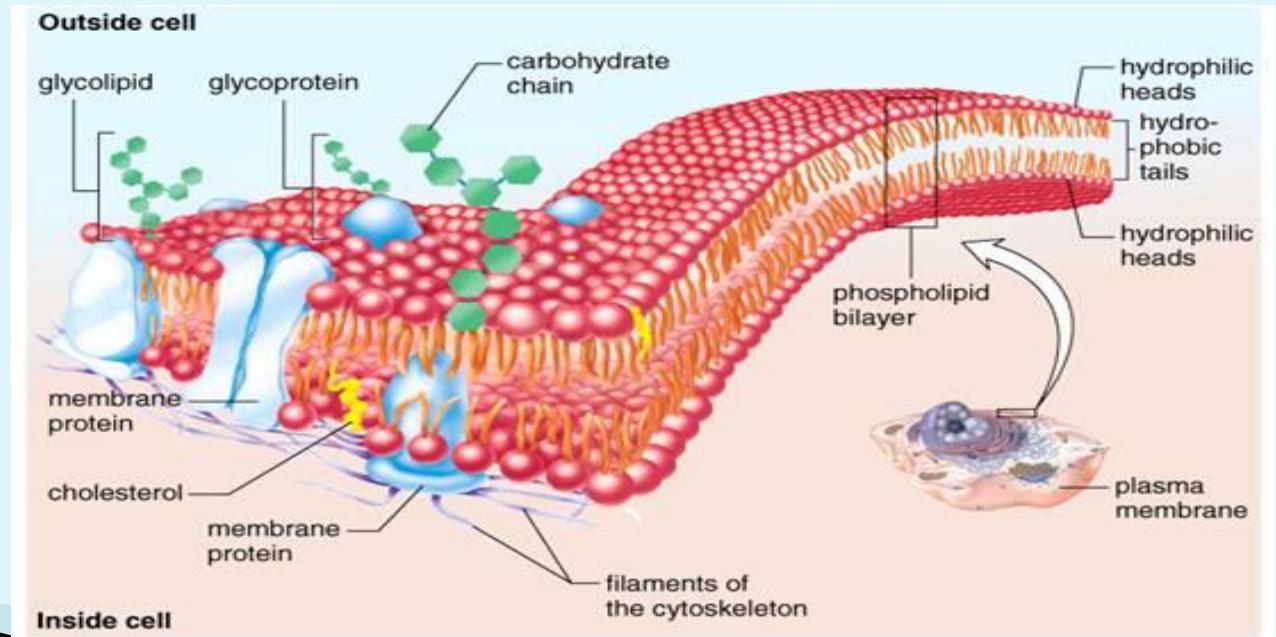


Cell Parts

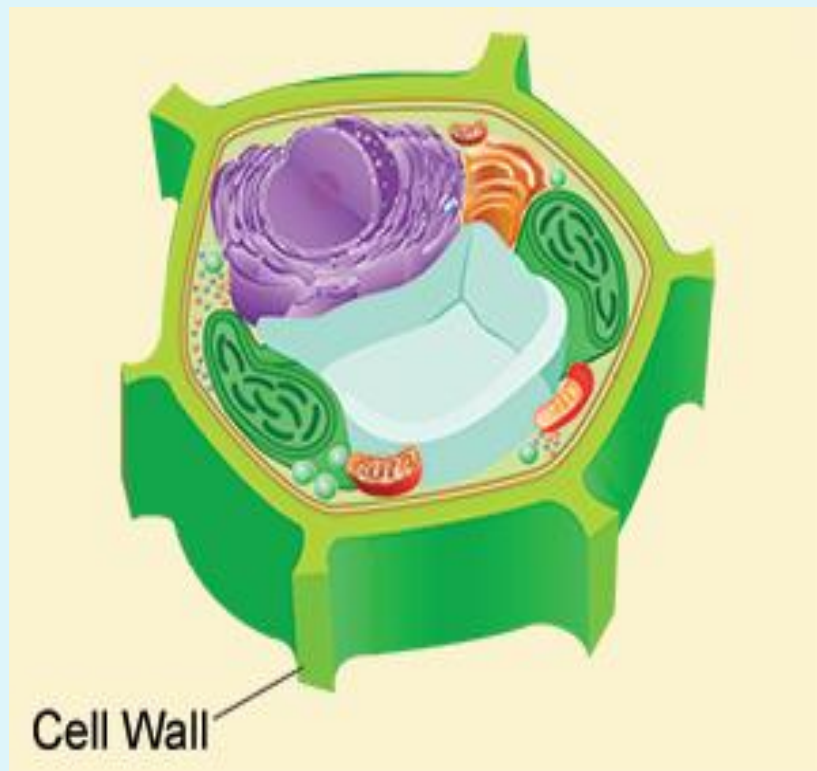
Organelles

Cell Membrane

- ▶ Outer membrane of cell that controls movement in and out of the cell
- ▶ lipid/protein/carbohydrate complex, providing a barrier and containing transport and signaling systems

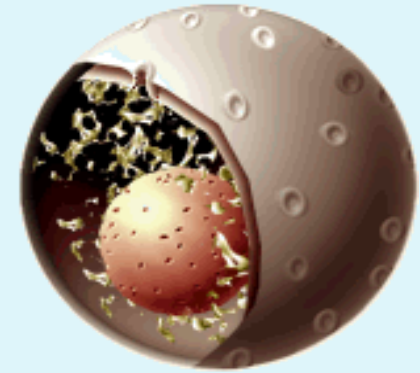


Cell Wall



- ▶ Most commonly found in plant cells & bacteria
- ▶ Supports & protects cells

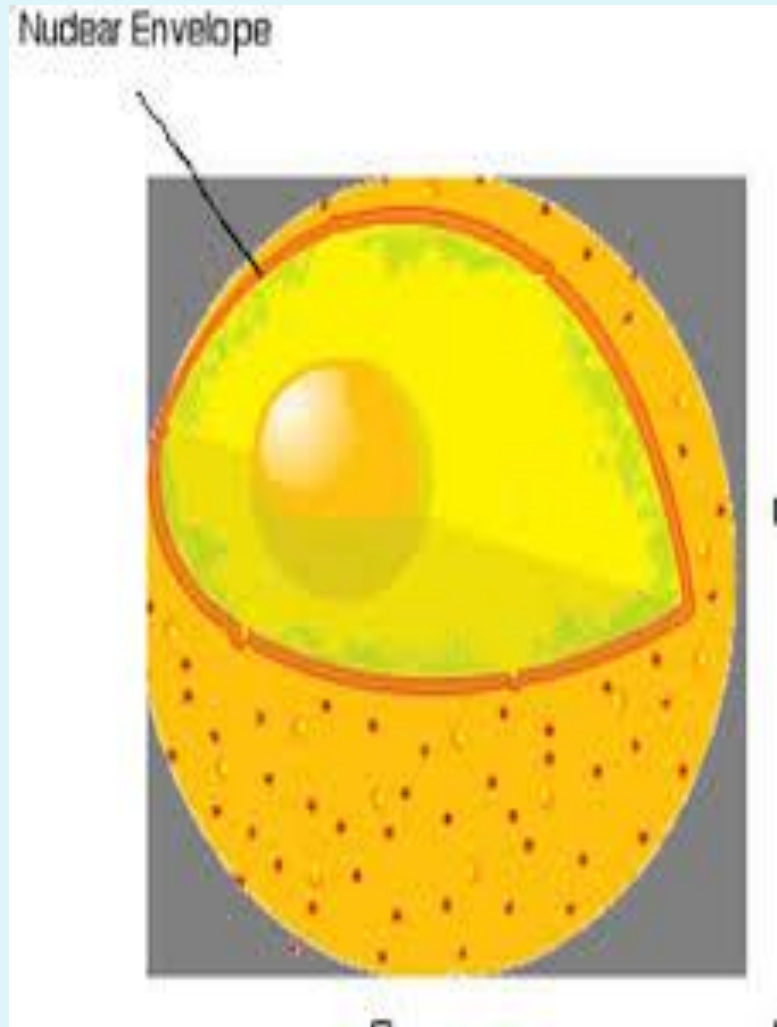
Nucleus



- ▶ Directs cell activities
- ▶ Separated from cytoplasm by nuclear membrane
- ▶ Contains genetic material – DNA

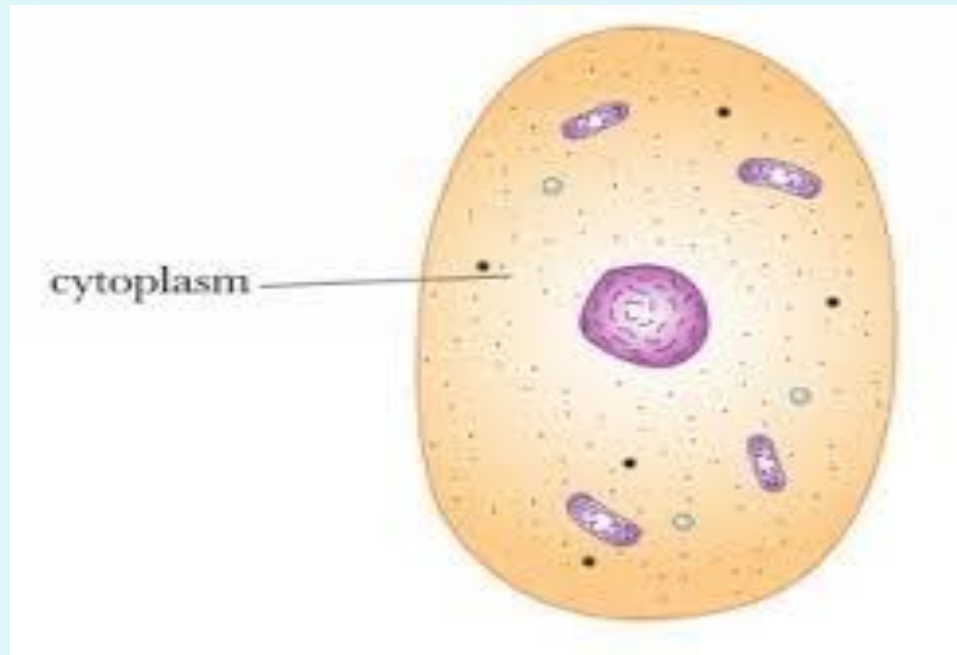
Nuclear Membrane

- ▶ Surrounds nucleus
- ▶ Made of two layers
- ▶ Openings allow material to enter and leave nucleus



Cytoplasm

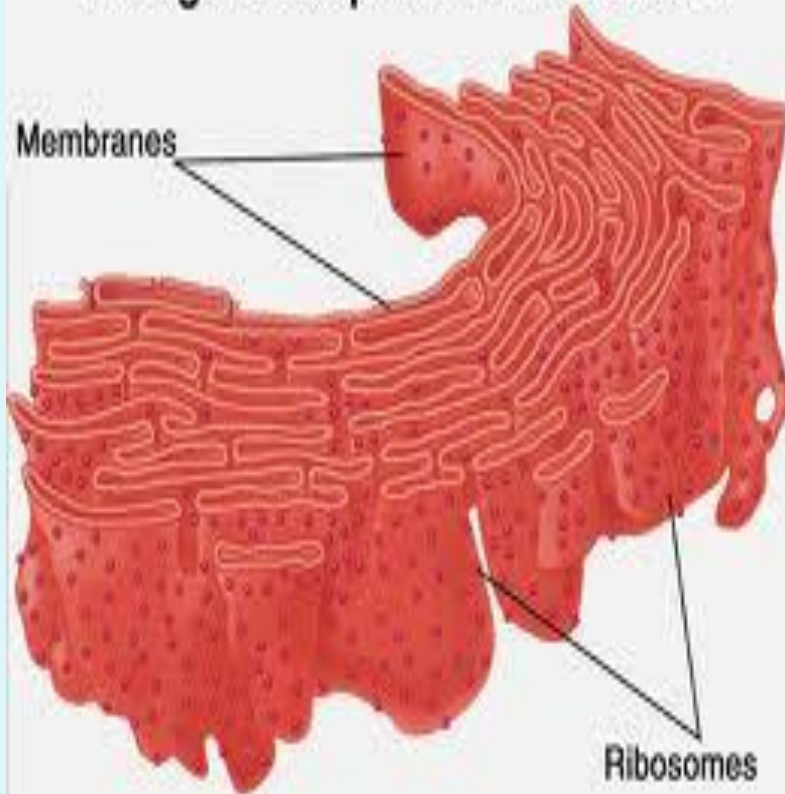
- ▶ Gel-like mixture
- ▶ Surrounded by cell membrane
- ▶ Contains hereditary material



Rough endoplasmic reticulum (RER)

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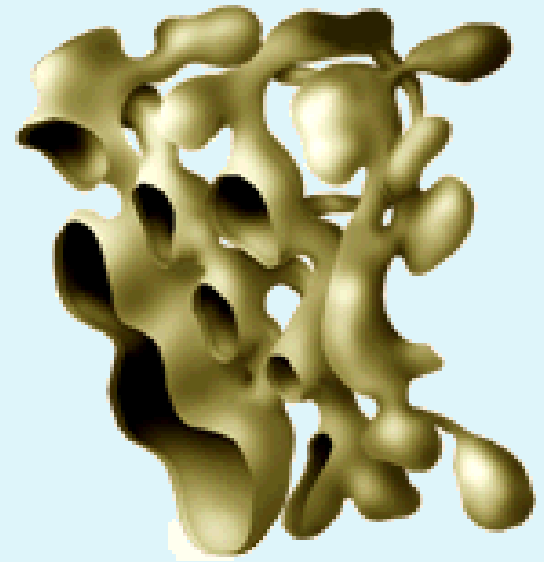
Rough Endoplasmic Reticulum

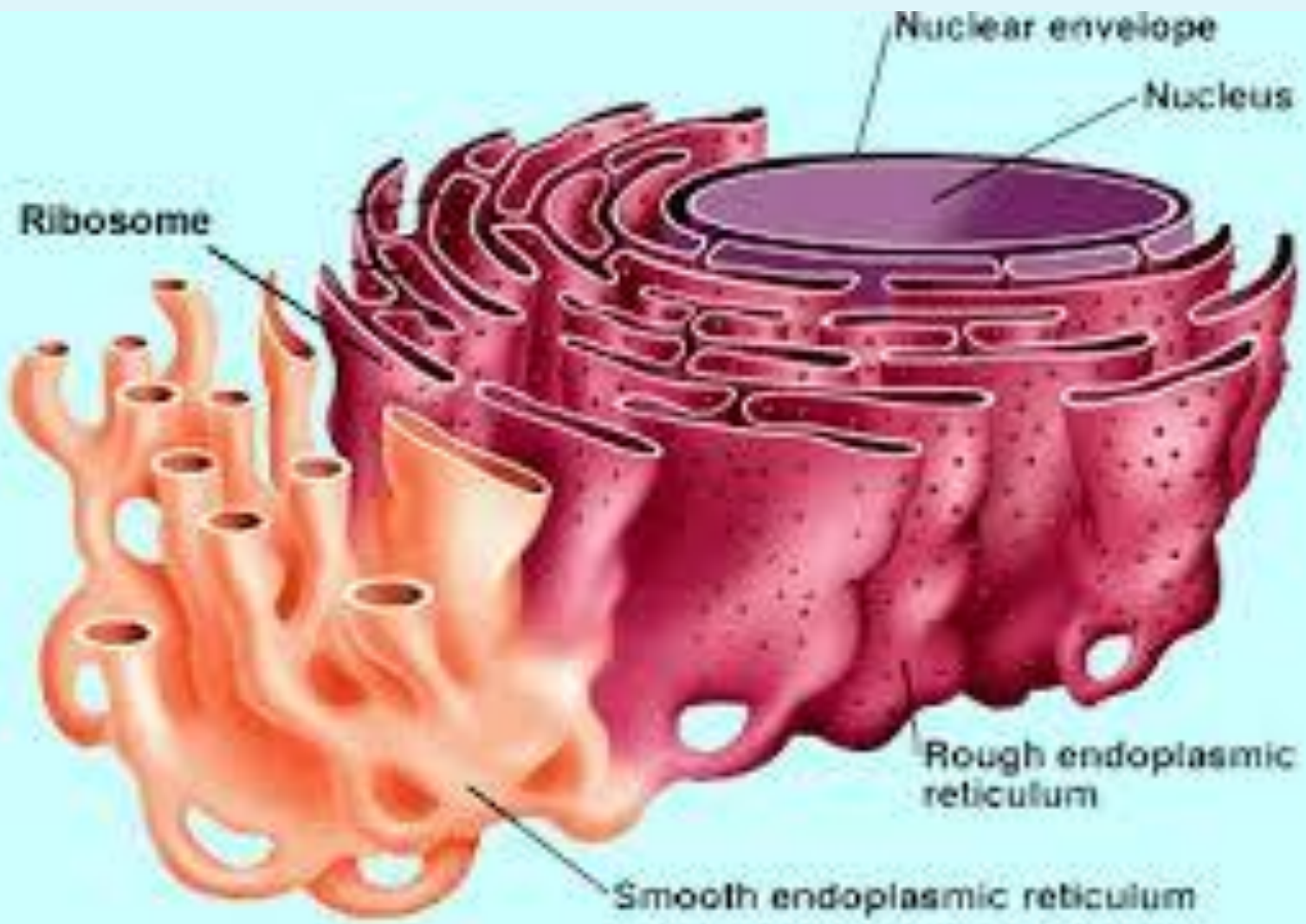


- ▶ A network of interconnected membranes forming channels within the cell. Covered with ribosomes (causing the "rough" appearance) which are in the process of synthesizing proteins for secretion or localization in membranes.

Smooth endoplasmic reticulum (SER)

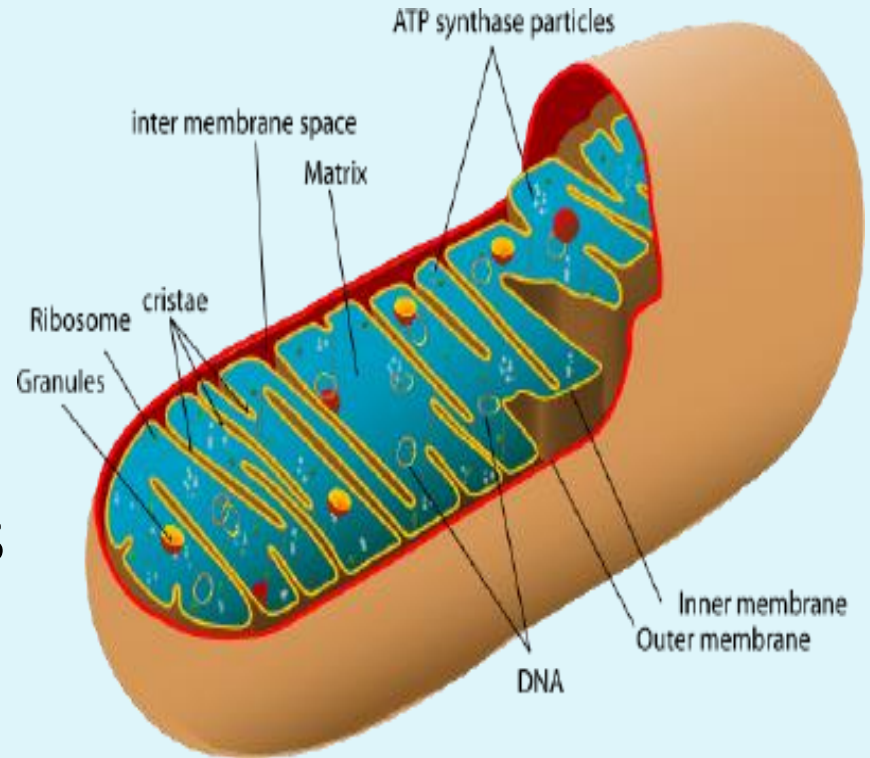
- ▶ A network of interconnected membranes forming channels within the cell. A site for synthesis and metabolism of lipids. Also contains enzymes for detoxifying chemicals including drugs.





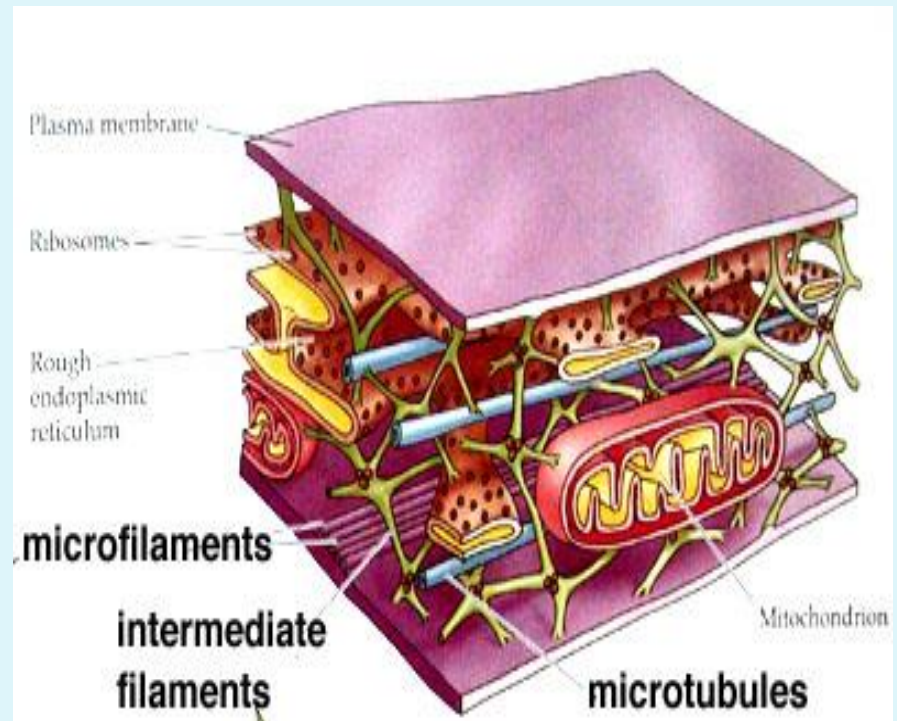
Mitochondria

- ▶ Surrounded by a double membrane with a series of folds called cristae. Functions in energy production through metabolism. Contains its own DNA



Cytoskeleton

- ▶ Arrays of protein filaments in the cytosol. Gives the cell its shape and provides basis for movement.
- ▶ E.g. microtubules and microfilaments.



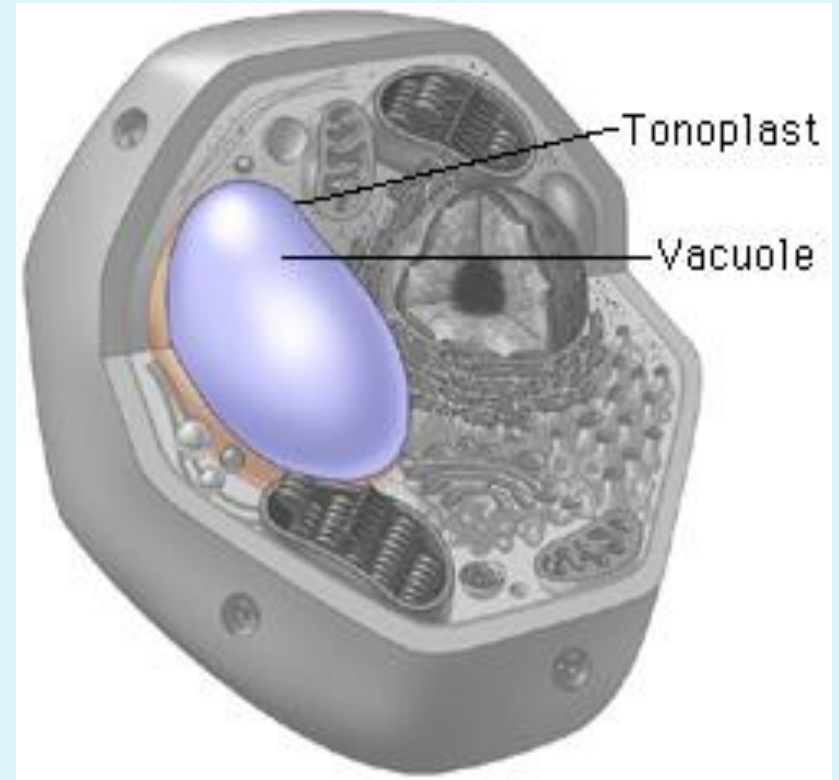
Golgi Bodies

- ▶ A series of stacked membranes. Vesicles (small membrane surrounded bags) carry materials from the RER to the Golgi apparatus. Vesicles move between the stacks while the proteins are "processed" to a mature form. Vesicles then carry newly formed membrane and secreted proteins to their final destinations including secretion or membrane localization



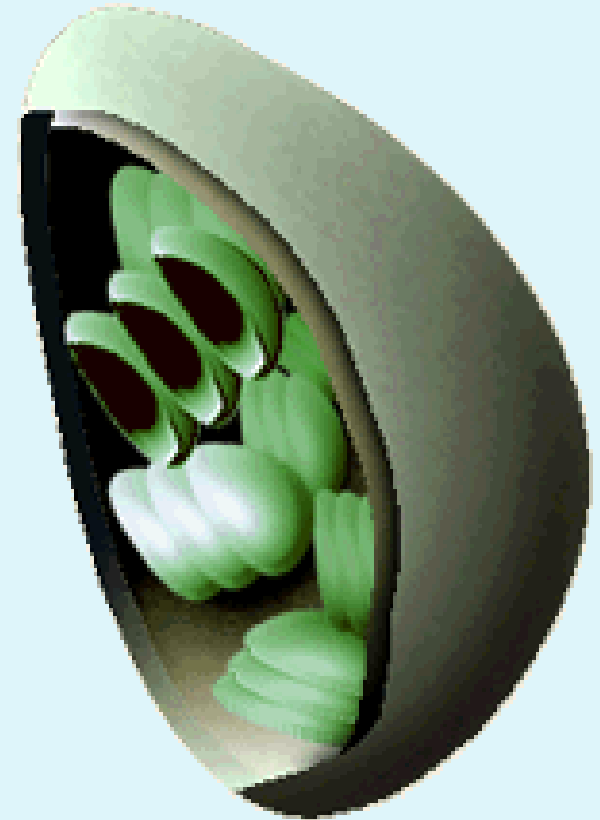
Vacuoles

- ▶ Membrane surrounded "bags" that contain water and storage materials in plants.



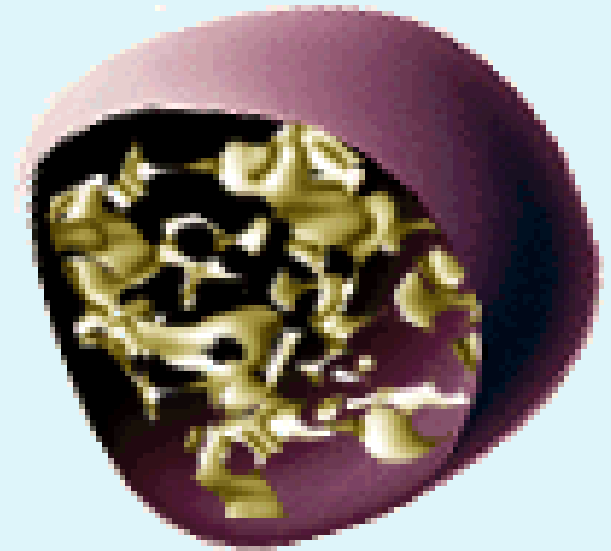
Chloroplast

- ▶ Surrounded by a double membrane, containing stacked thylakoid membranes. Responsible for photosynthesis, the trapping of light energy for the synthesis of sugars. Contains DNA, and like mitochondria is believed to have originated as a captured bacterium.



Lysosomes

- ▶ A membrane bound organelle that is responsible for degrading proteins and membranes in the cell, and also helps degrade materials ingested by the cell.



Summary of differences!

Prokaryotic Cells	Eukaryotic cells
small cells (< 5 mm)	larger cells (> 10 mm)
always unicellular	often multicellular
no nucleus or any membrane-bound organelles	always have nucleus and other membrane-bound organelles
DNA is circular, without proteins	DNA is linear and associated with proteins to form chromatin
ribosomes are small (70S)	ribosomes are large (80S)
no cytoskeleton	always has a cytoskeleton
cell division is by binary fission	cell division is by mitosis or meiosis
reproduction is always asexual	reproduction is asexual or sexual

Thank you