

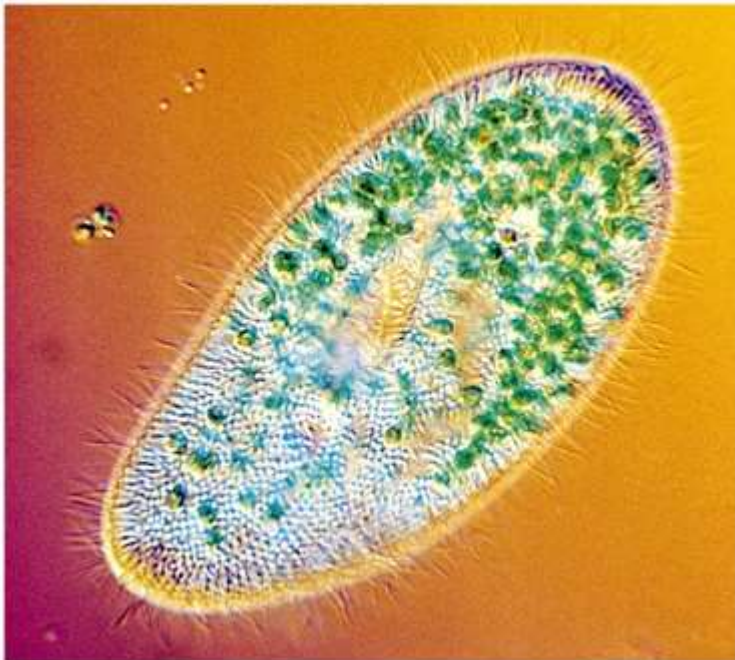


Cell Structure and Function

Botany Department,
B.N.D. College, Kanpur

Cells

- ▶ Smallest living unit
- ▶ Most are microscopic



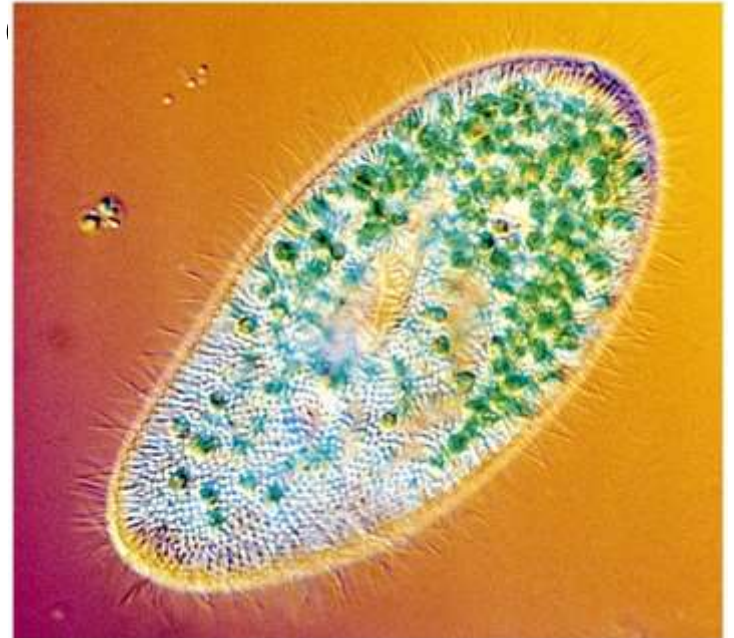
Discovery of Cells

- ▶ Robert Hooke (mid-1600s)
 - Observed sliver of cork
 - Saw “row of empty boxes”
 - Coined the term cell

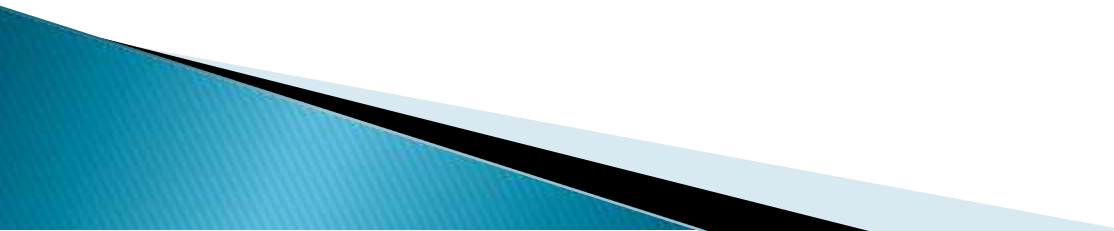


Cell theory

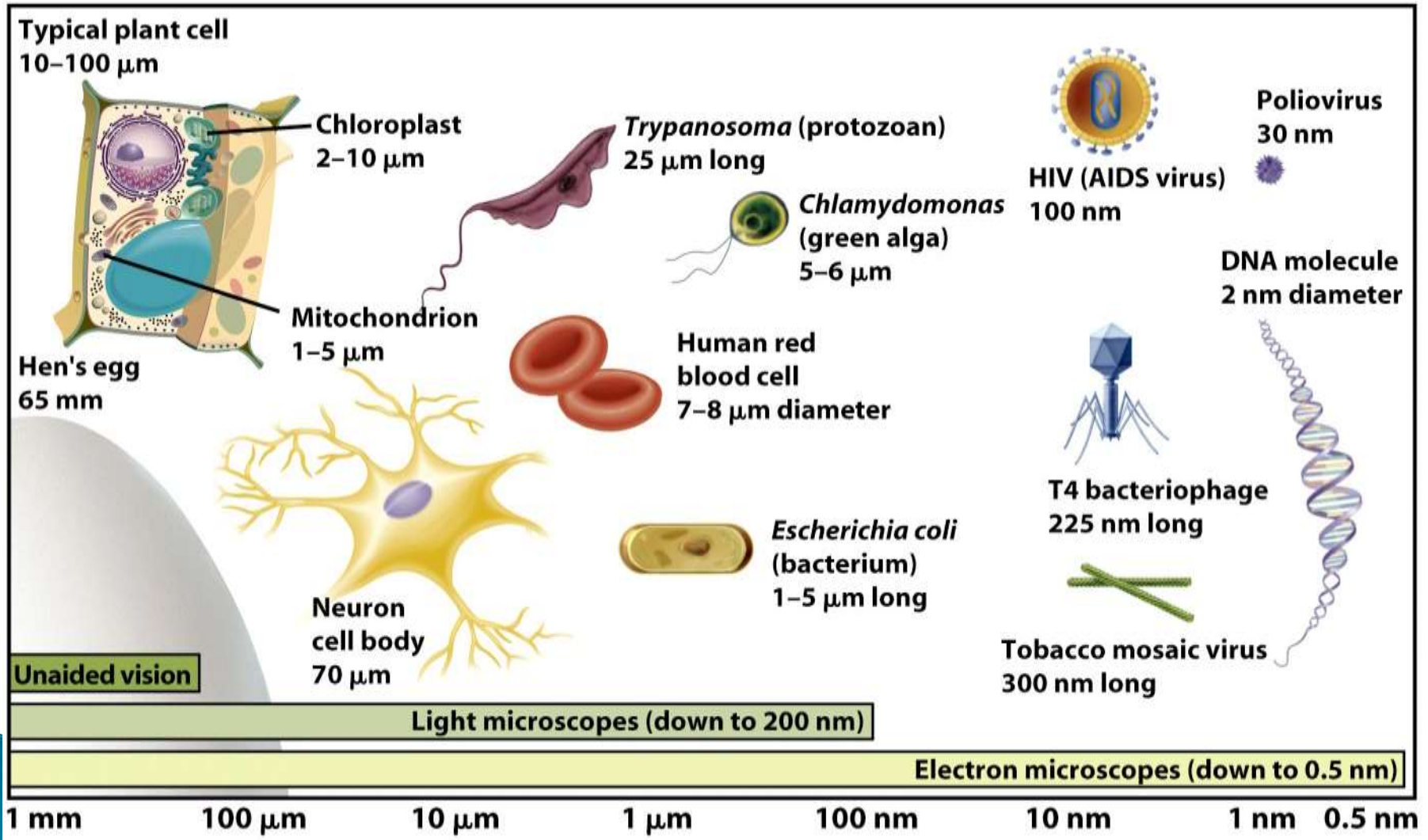
- ▶ (1839) Theodor Schwann & Matthias Schleiden
“all living things are made of cells”
- ▶ (50 yrs. later) Rudolf Virchow
“all cells come from cells”



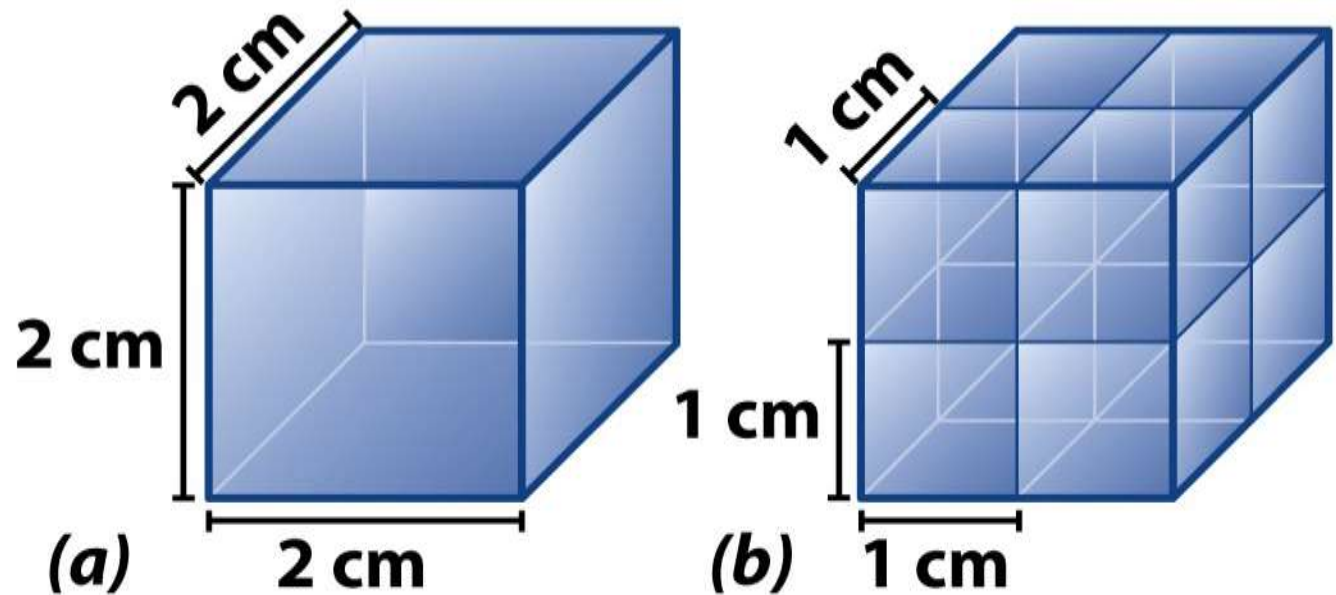
Principles of Cell Theory

- ▶ All living things are made of cells
 - ▶ Smallest living unit of structure and function of all organisms is the cell
 - ▶ All cells arise from preexisting cells (this principle discarded the idea of spontaneous generation)
- 

Cell Size



Cells Have Large Surface Area-to-Volume Ratio



Number of cells	1	8
Total surface area	24 cm ²	48 cm ²
Total volume	8 cm ³	8 cm ³
Surface area/volume	24/8 = 3:1	48/8 = 6:1

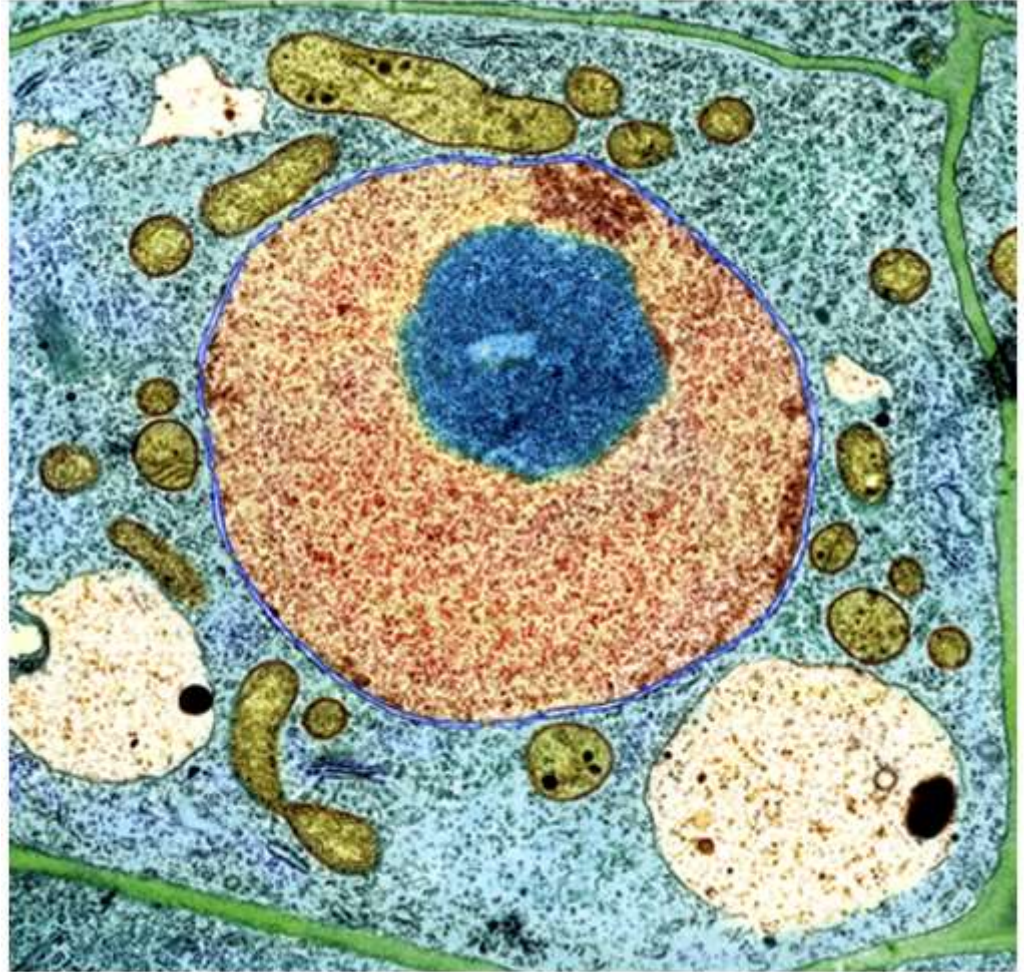
Characteristics of All Cells

- ▶ A surrounding membrane
- ▶ Protoplasm – cell contents in thick fluid
- ▶ Organelles – structures for cell function
- ▶ Control center with DNA



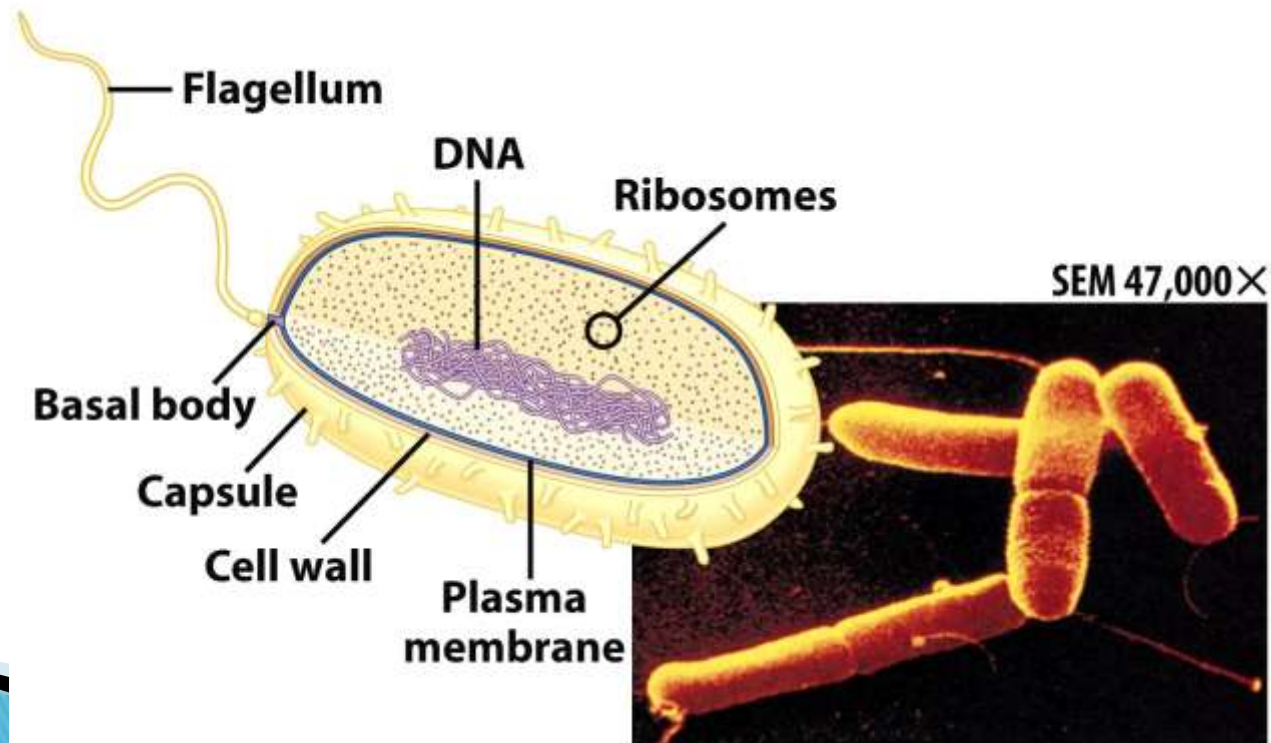
Cell Types

- ▶ Prokaryotic
- ▶ Eukaryotic



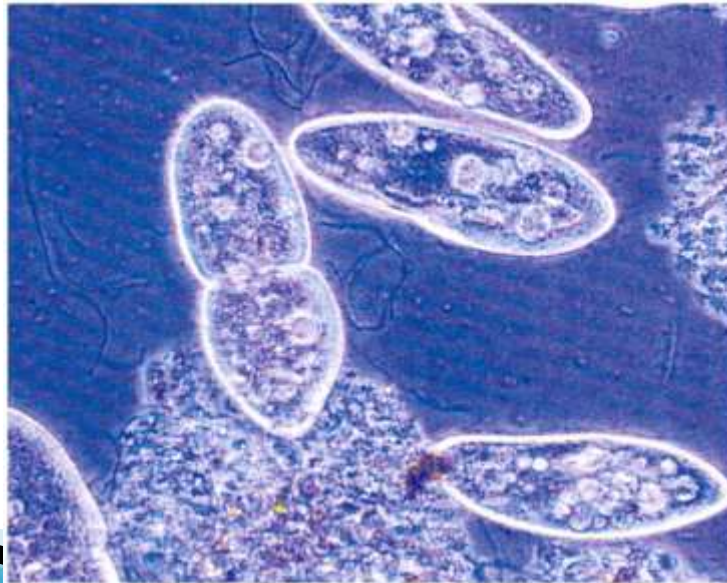
Prokaryotic Cells

- ▶ First cell type on earth
- ▶ Cell type of Bacteria and Archaea



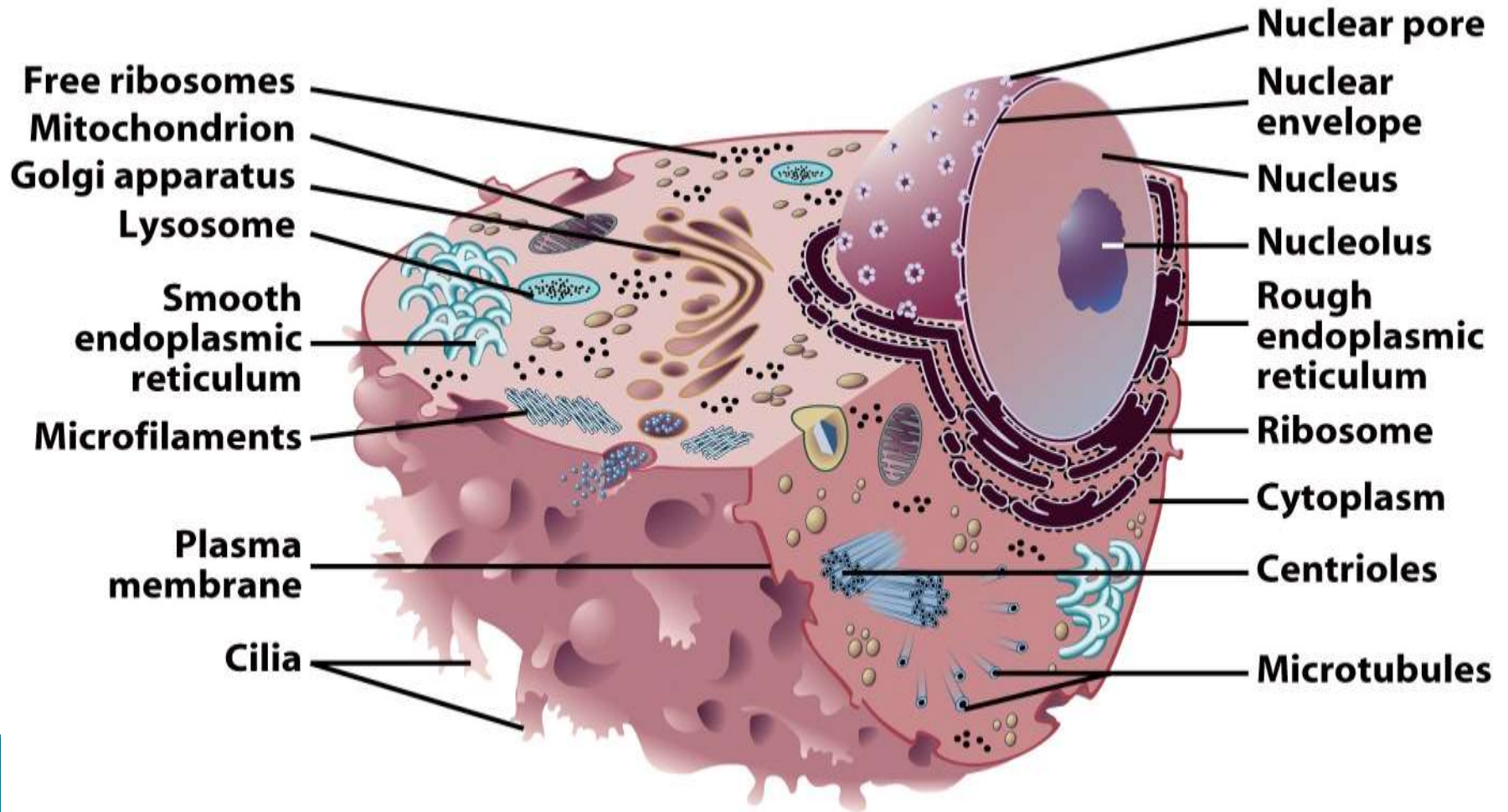
Eukaryotic Cells

- ▶ Nucleus bound by membrane
- ▶ Include fungi, protists, plant, and animal cells
- ▶ Possess many organelles

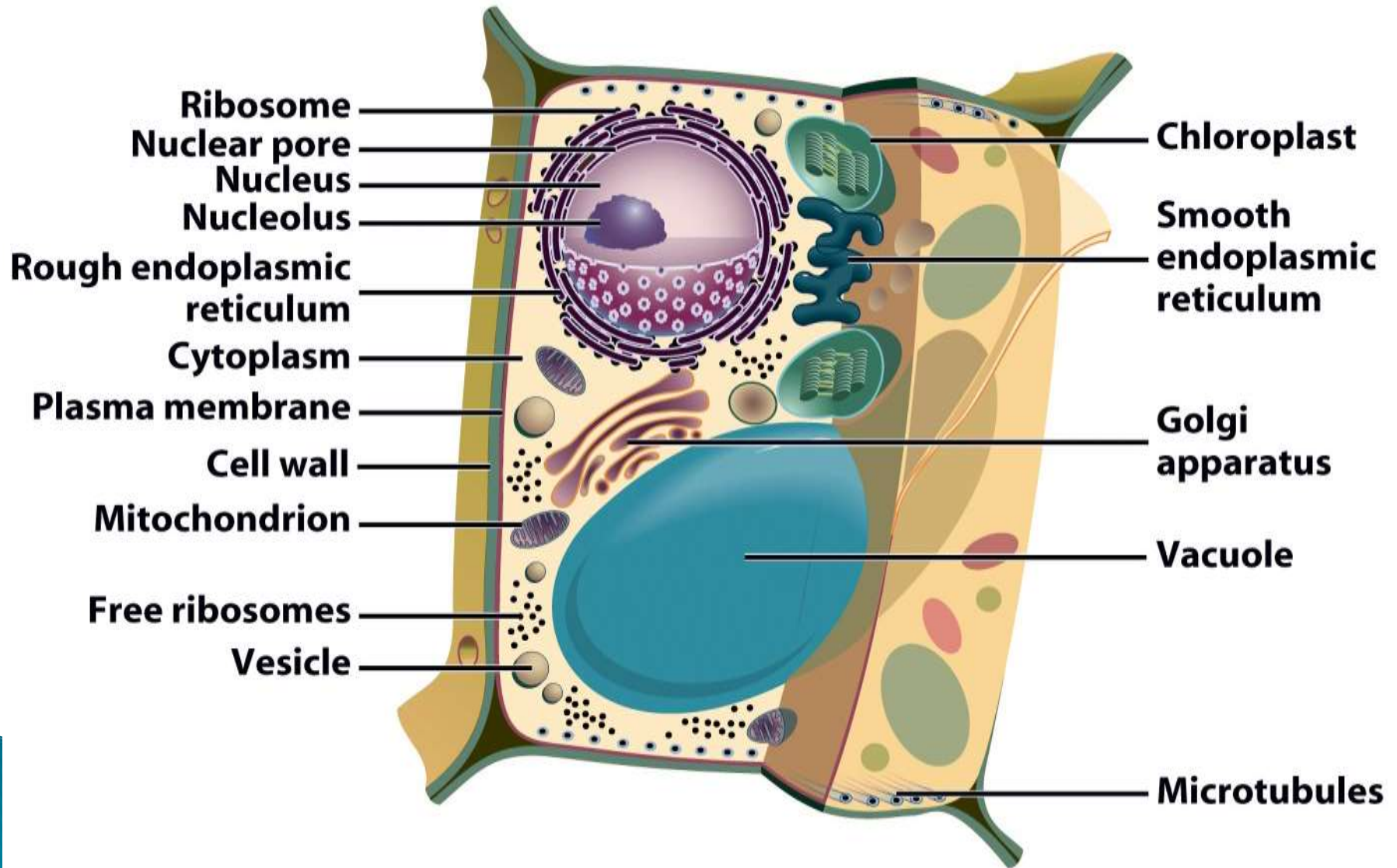


Protozoan

Representative Animal Cell

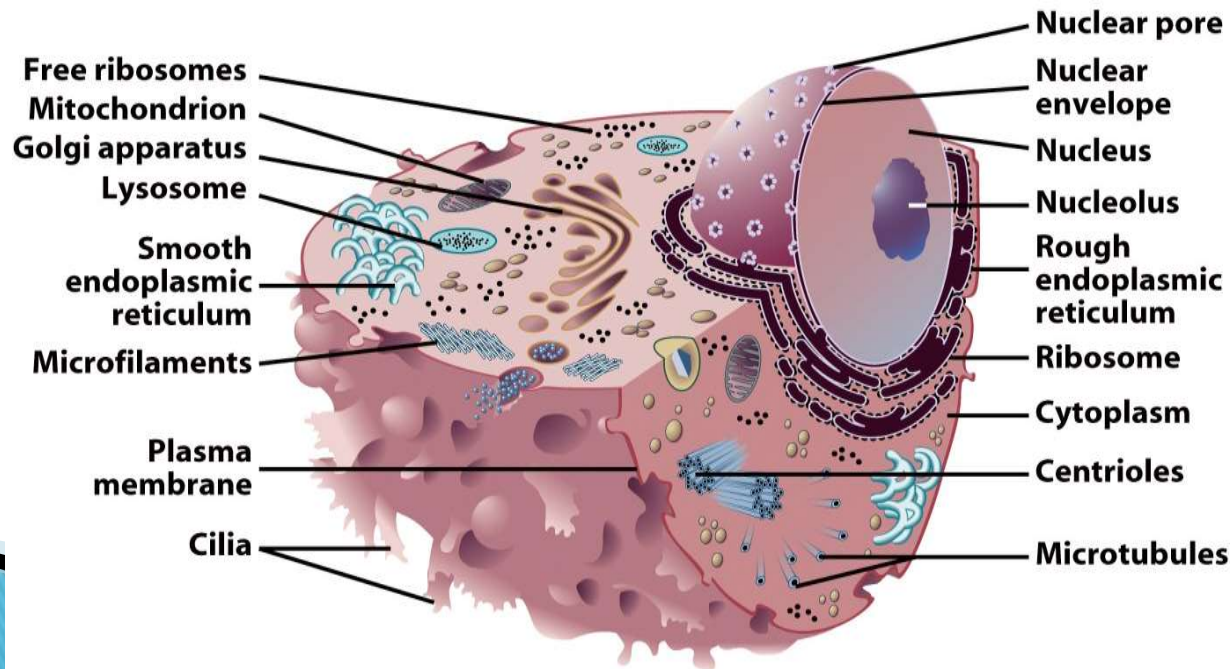


Representative Plant Cell



Organelles

- ▶ Cellular machinery
- ▶ Two general kinds
 - Derived from membranes
 - Bacteria-like organelles

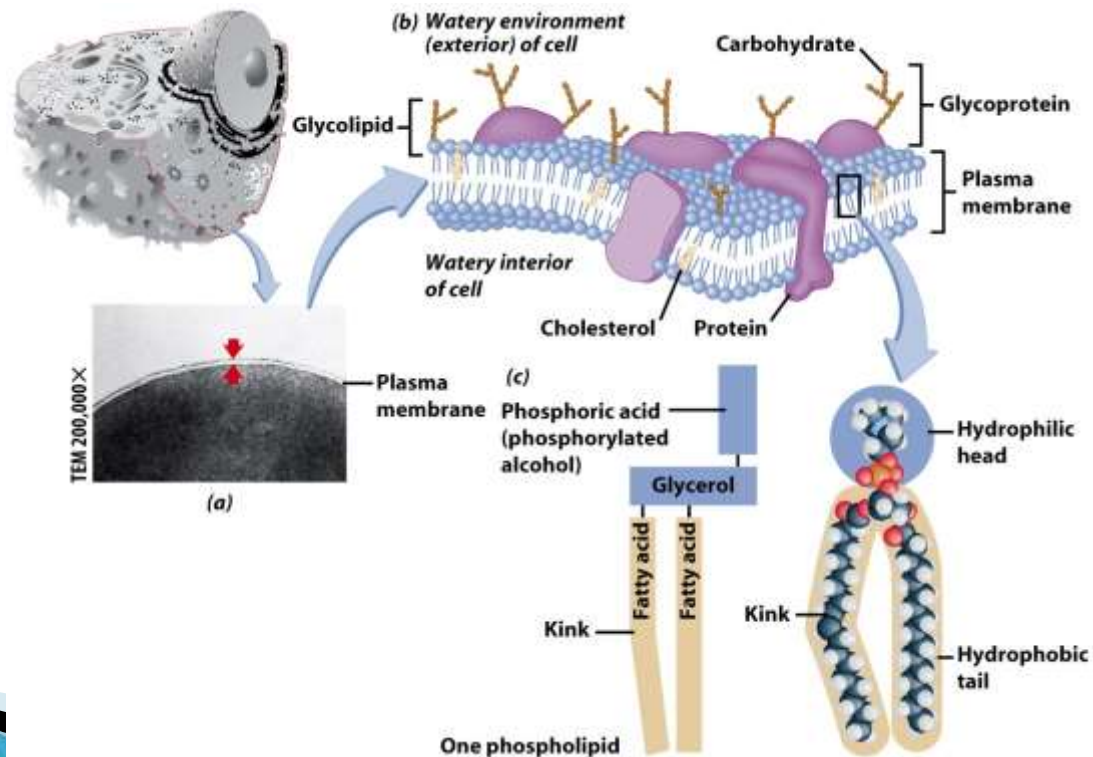


Bacteria-Like Organelles

- ▶ Derived from symbiotic bacteria
- ▶ Ancient association
- ▶ Endosymbiotic theory
 - Evolution of modern cells from cells & symbiotic bacteria

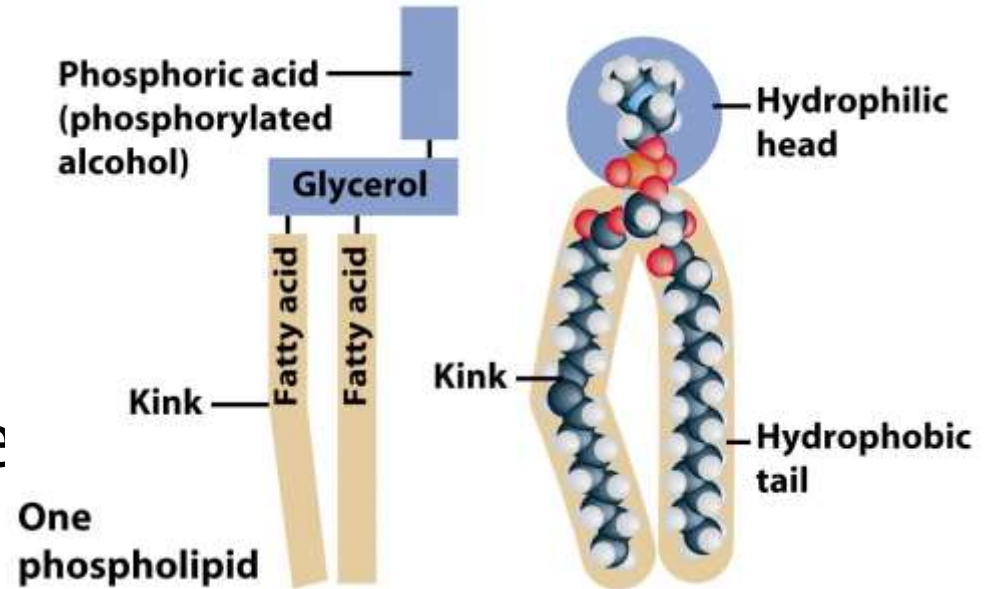
Plasma Membrane

- ▶ Contains cell contents
- ▶ Double layer of phospholipids & proteins

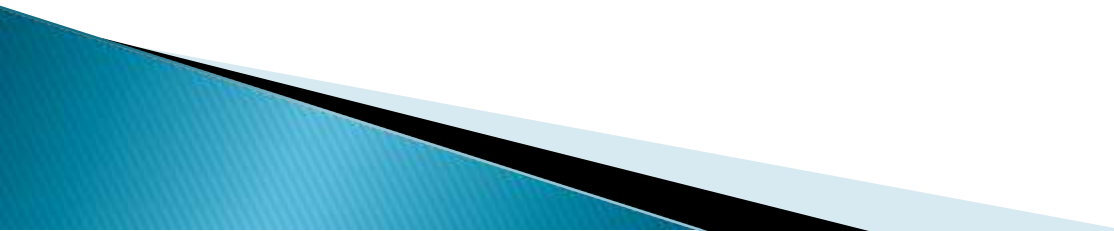


Phospholipids

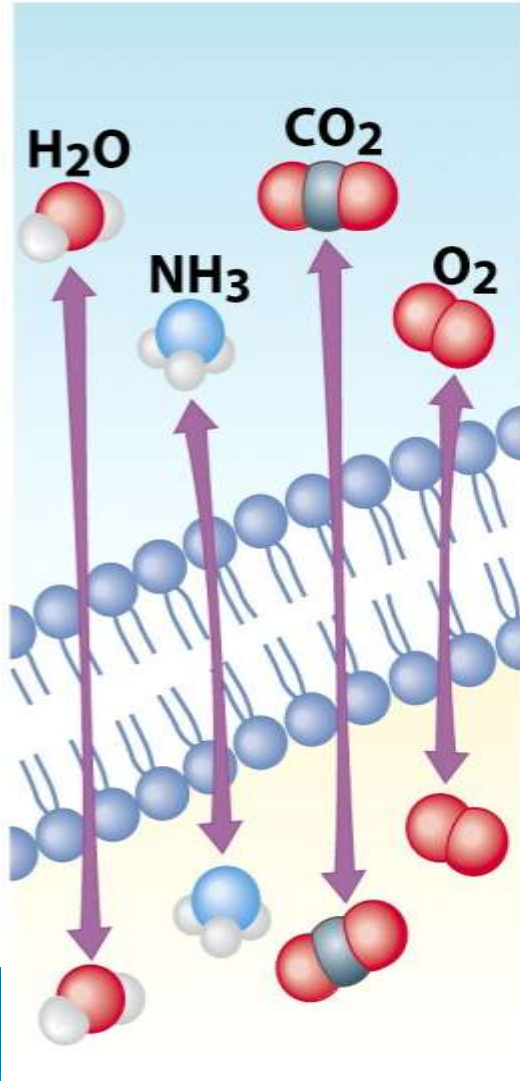
- ▶ **Polar**
 - Hydrophilic head
 - Hydrophobic tail
- ▶ **Interacts with water**



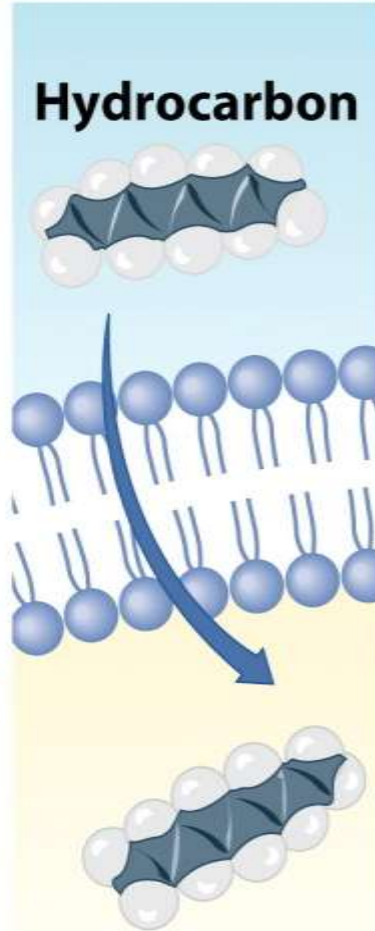
Movement Across the Plasma Membrane

- ▶ A few molecules move freely
 - Water, Carbon dioxide, Ammonia, Oxygen
 - ▶ Carrier proteins transport some molecules
 - Proteins embedded in lipid bilayer
 - Fluid mosaic model – describes fluid nature of a lipid bilayer with proteins
- 

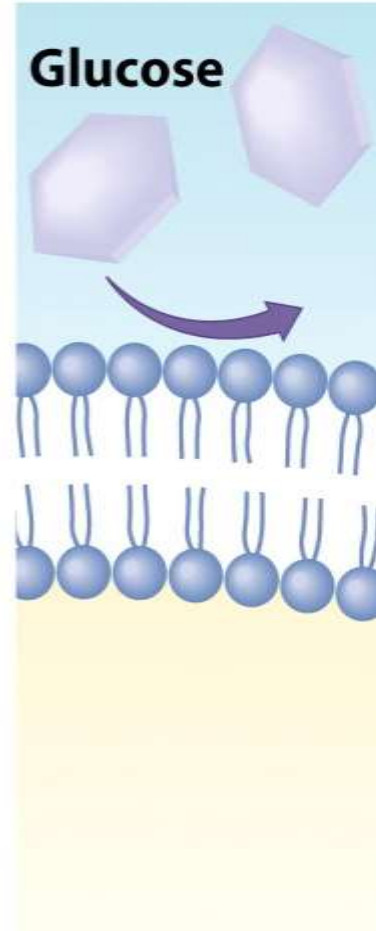
(a)
Small uncharged
molecules



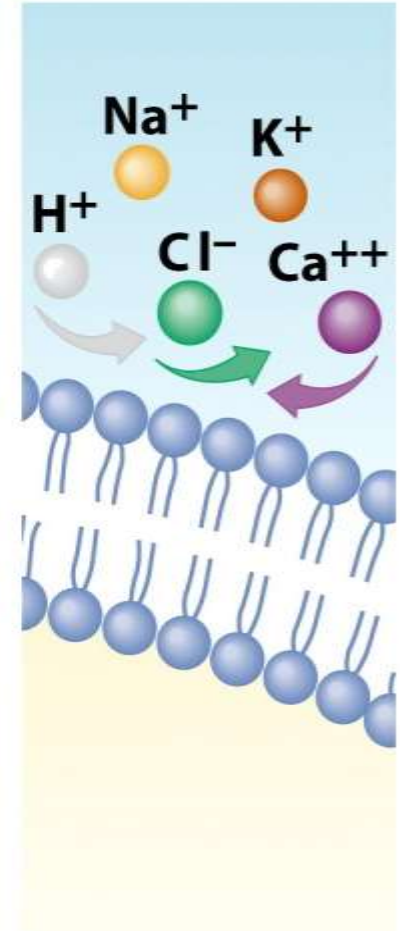
(b)
Lipid-soluble
substances



(c)
Water-soluble
substances

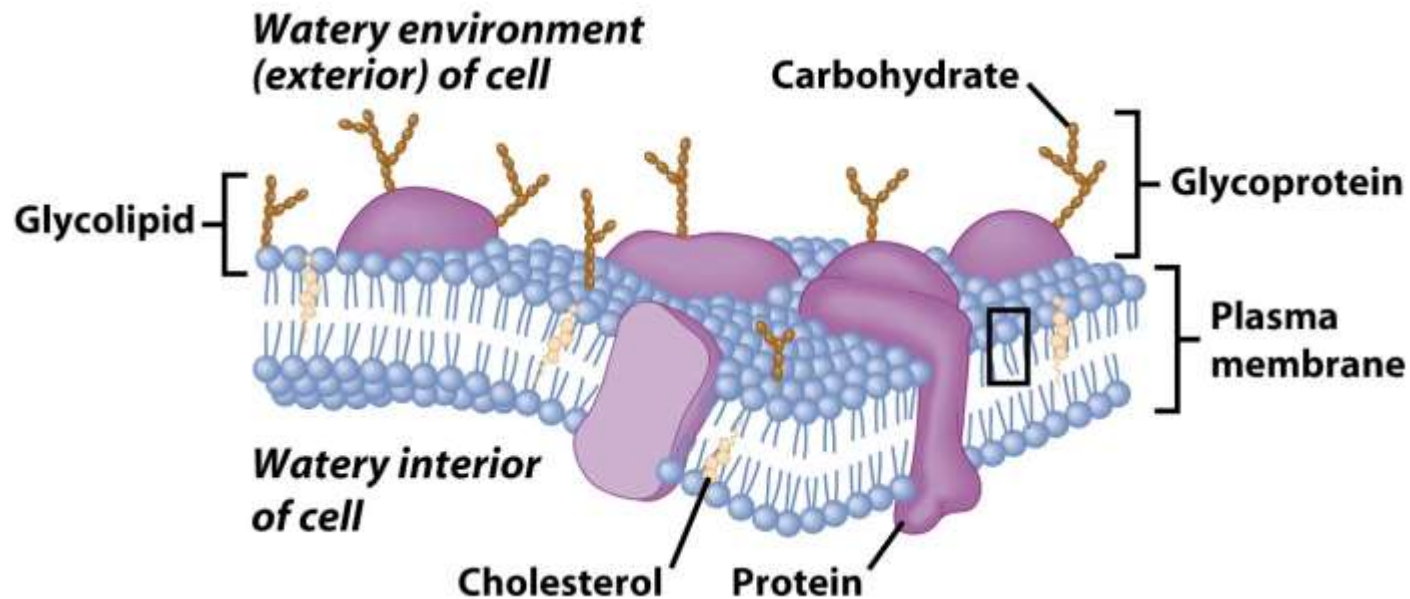


(d)
Ions



Membrane Proteins

1. Channels or transporters
 - Move molecules in one direction
2. Receptors
 - Recognize certain chemicals



Cell Walls

- ▶ Found in plants, fungi, & many protists
- ▶ Surrounds plasma membrane



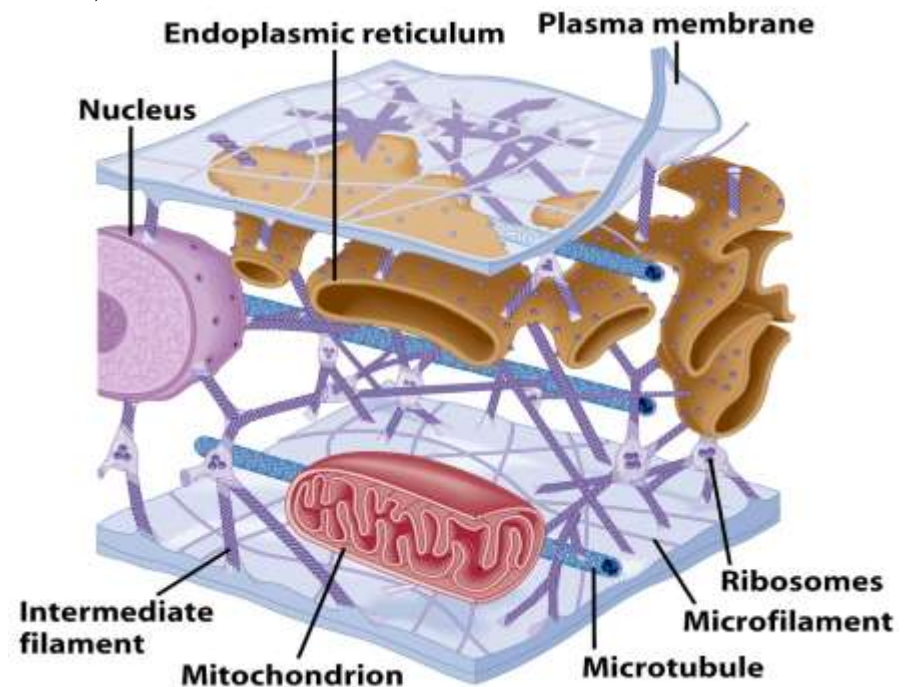
Cell Wall Differences

- ▶ Plants – mostly cellulose
- ▶ Fungi – contain chitin



Cytoplasm

- ▶ Viscous fluid containing organelles
- ▶ components of cytoplasm
 - Interconnected filaments & fibers
 - Fluid = cytosol
 - Organelles (not nucleus)
 - storage substances



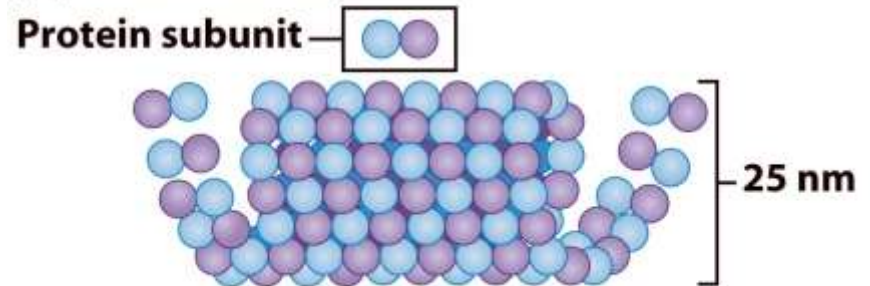
Cytoskeleton

- ▶ Filaments & fibers
- ▶ Made of 3 fiber types
 - Microfilaments
 - Microtubules
 - Intermediate filaments
- ▶ 3 functions:
 - mechanical support
 - anchor organelles
 - help move substances

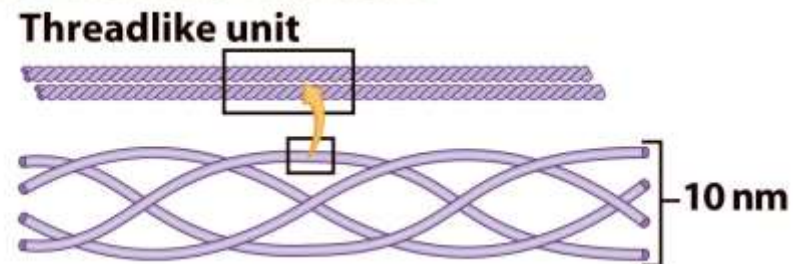
(a) Microfilament

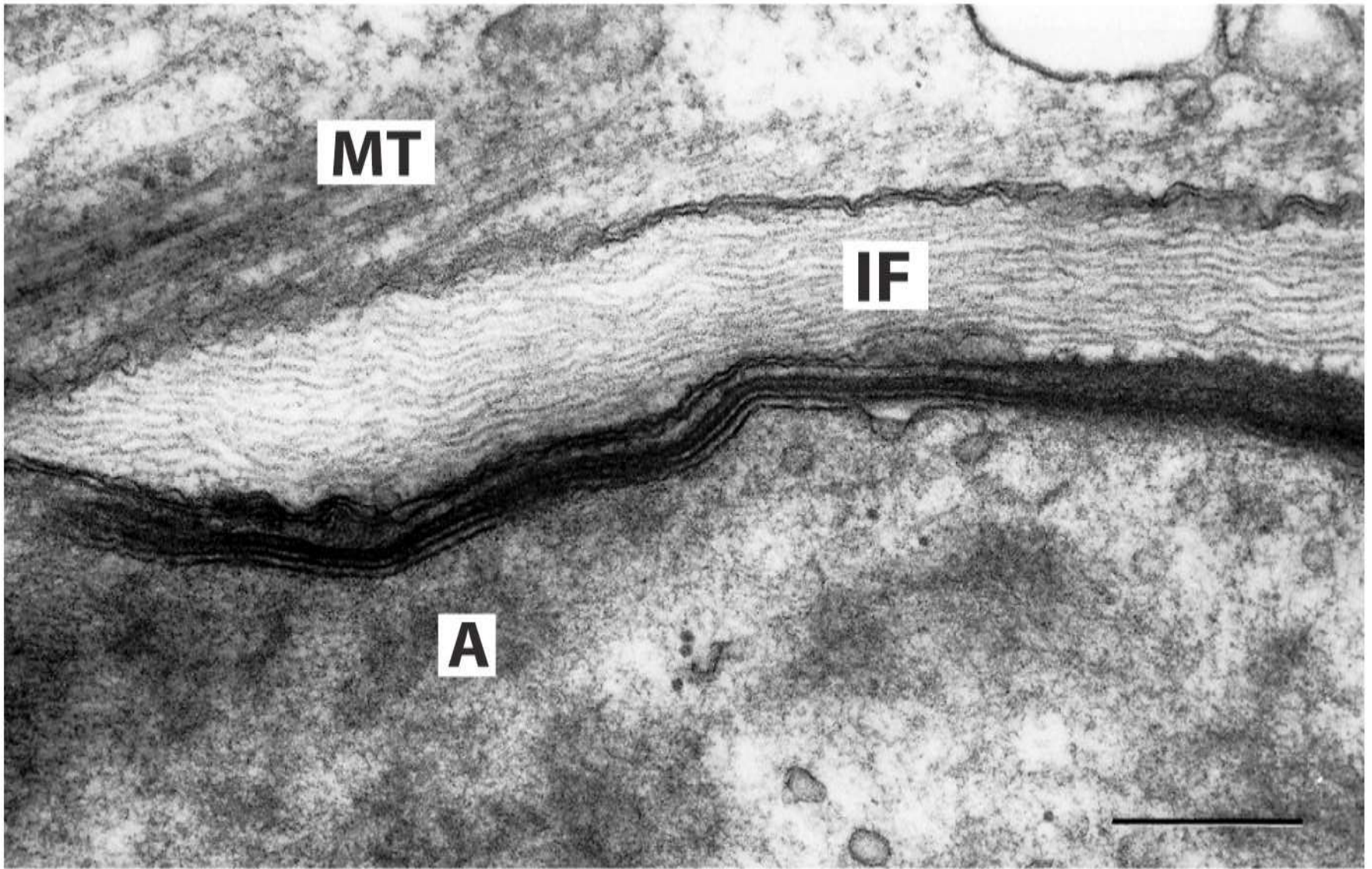


(b) Microtubule



(c) Intermediate filament





A = actin, IF = intermediate filament, MT = microtubule

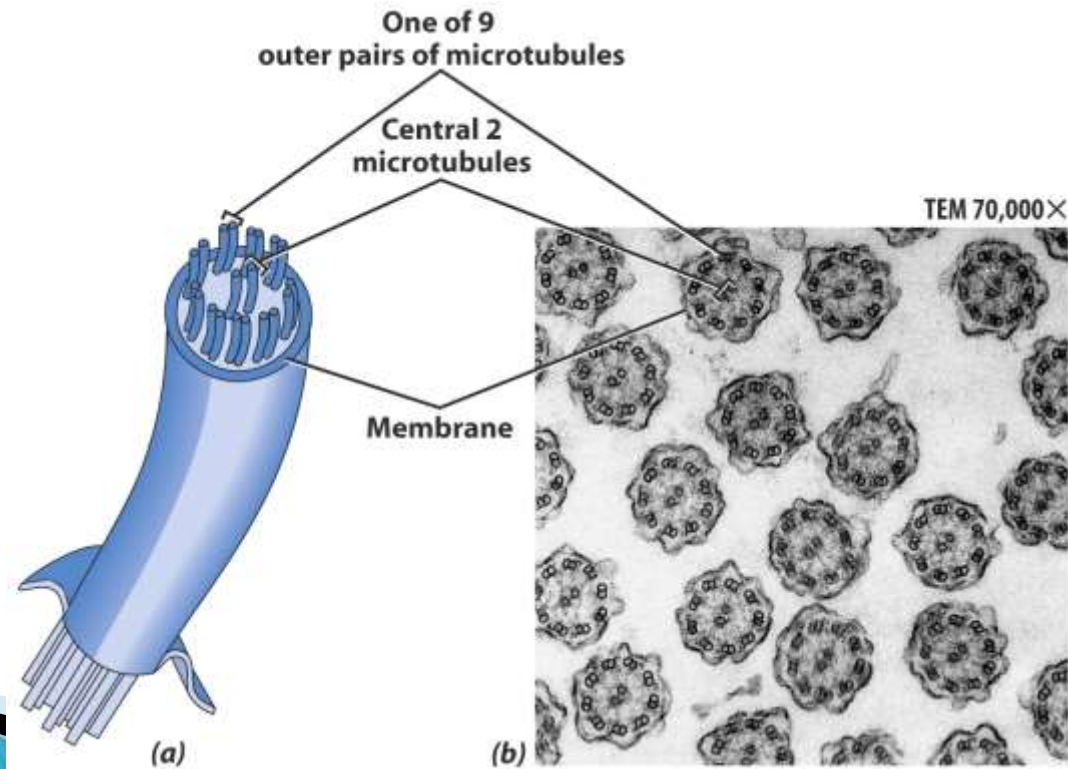
Cilia & Flagella

- ▶ Provide motility
- ▶ Cilia
 - Short
 - Used to move substances outside human cells
- ▶ Flagella
 - Whip-like extensions
 - Found on sperm cells
- ▶ Basal bodies like centrioles



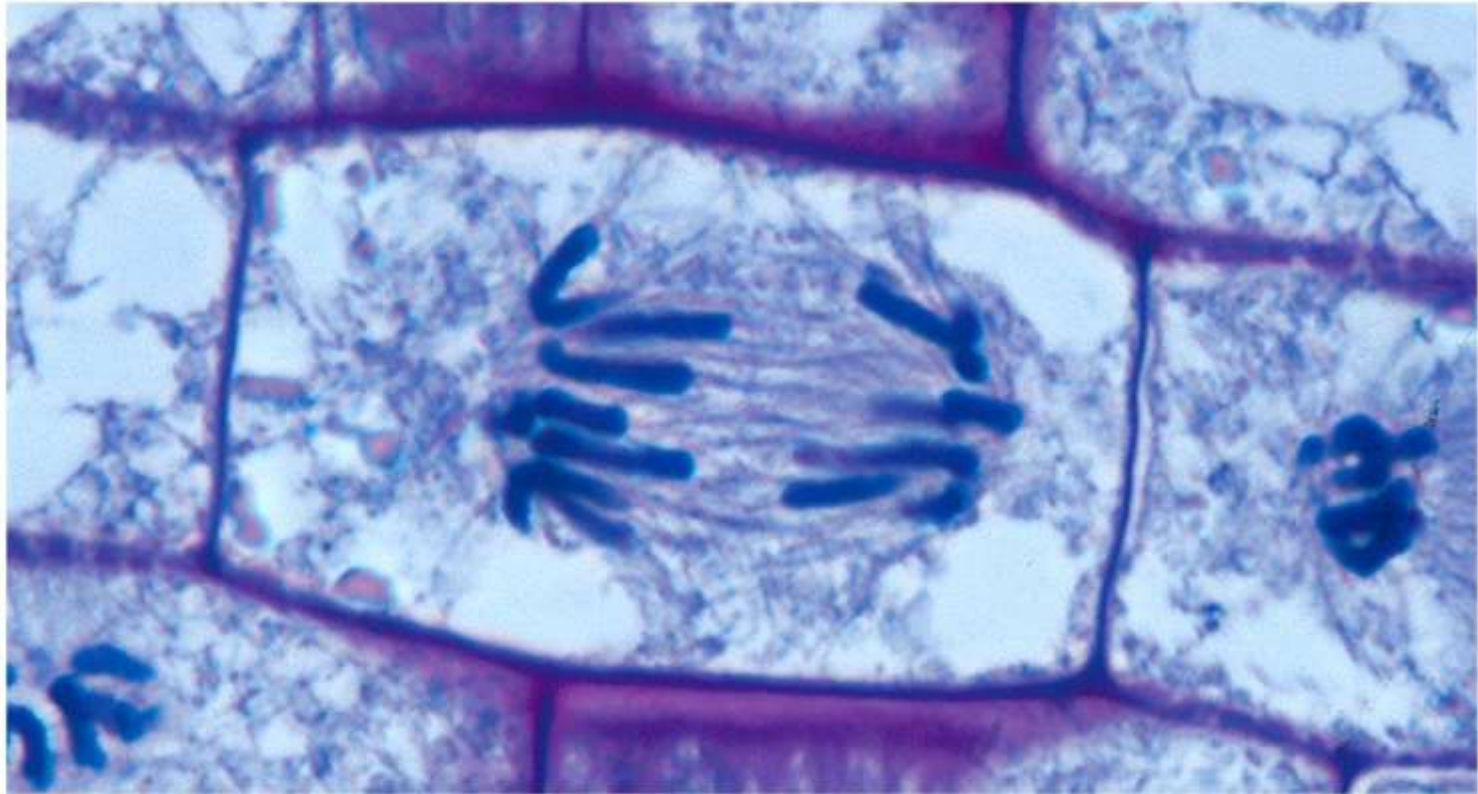
Cilia & Flagella Structure

- ▶ Bundles of microtubules
- ▶ With plasma membrane



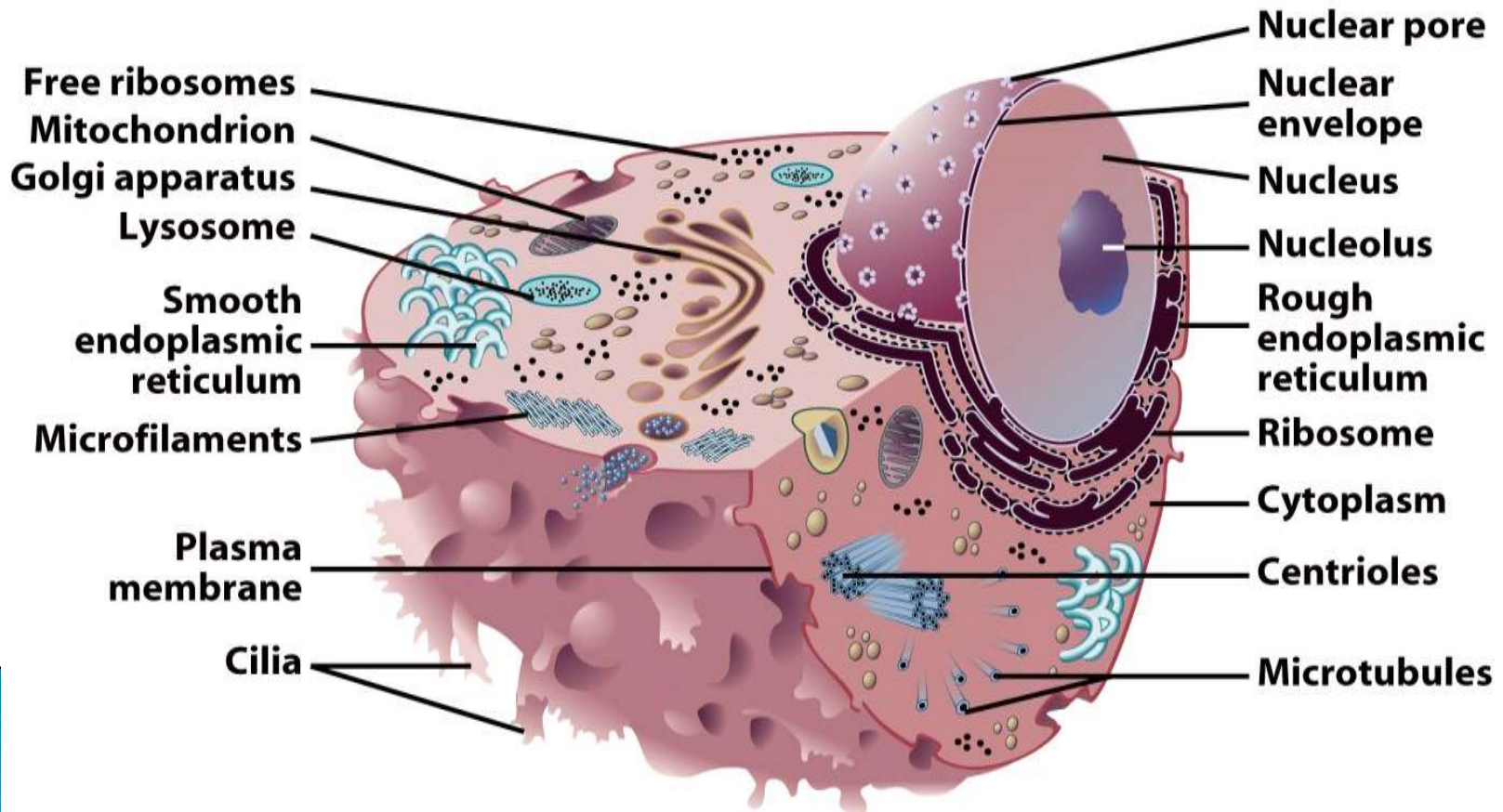
Centrioles

- ▶ Pairs of microtubular structures
- ▶ Play a role in cell division



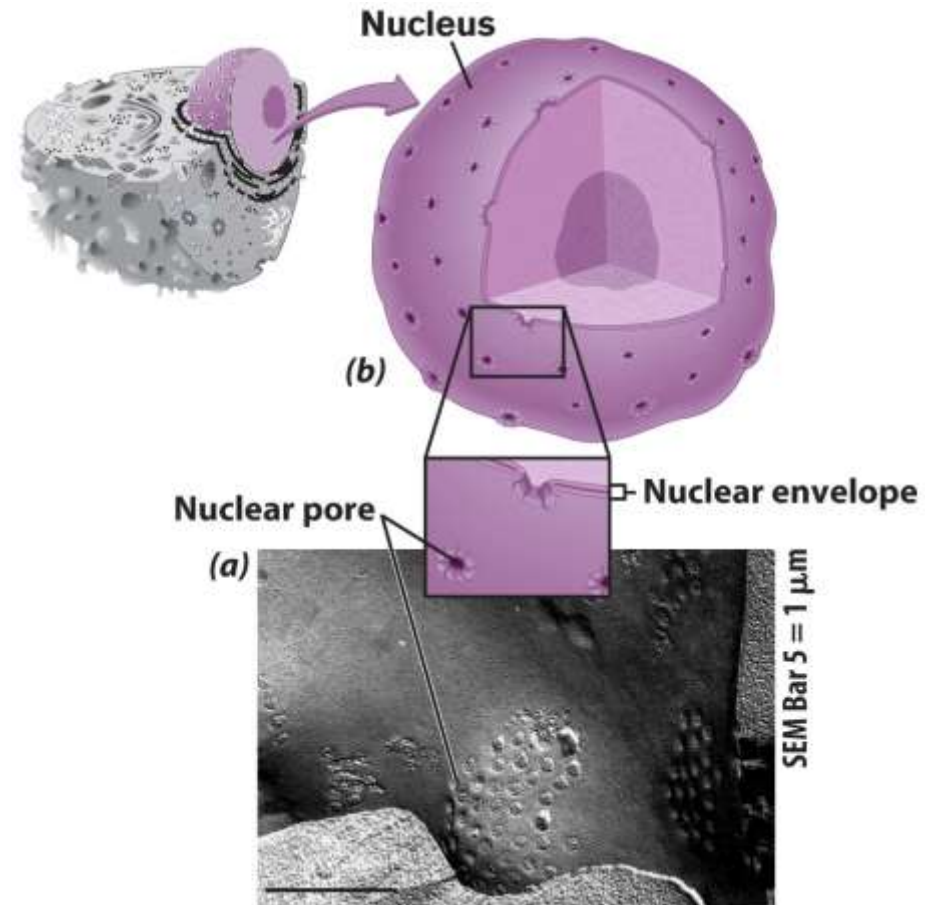
Membranous Organelles

- ▶ Functional components within cytoplasm
- ▶ Bound by membranes



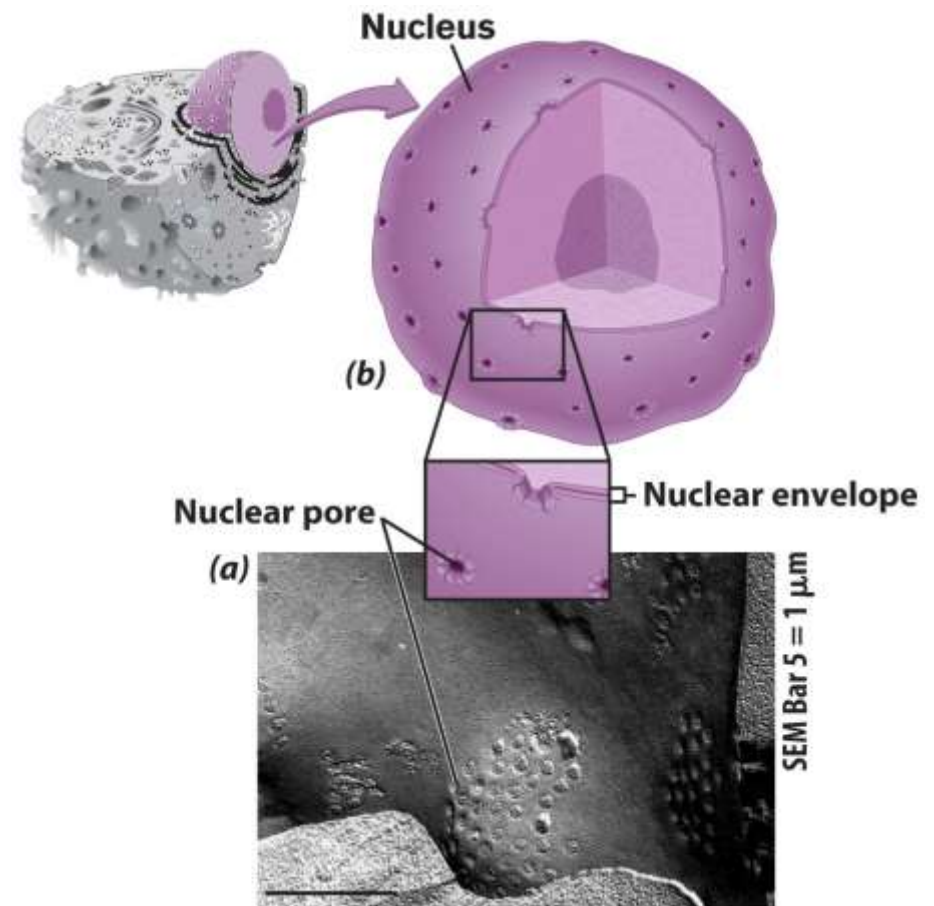
Nucleus

- ▶ Control center of cell
- ▶ Double membrane
- ▶ Contains
 - Chromosomes
 - Nucleolus



Nuclear Envelope

- ▶ Separates nucleus from rest of cell
- ▶ Double membrane
- ▶ Has pores



DNA

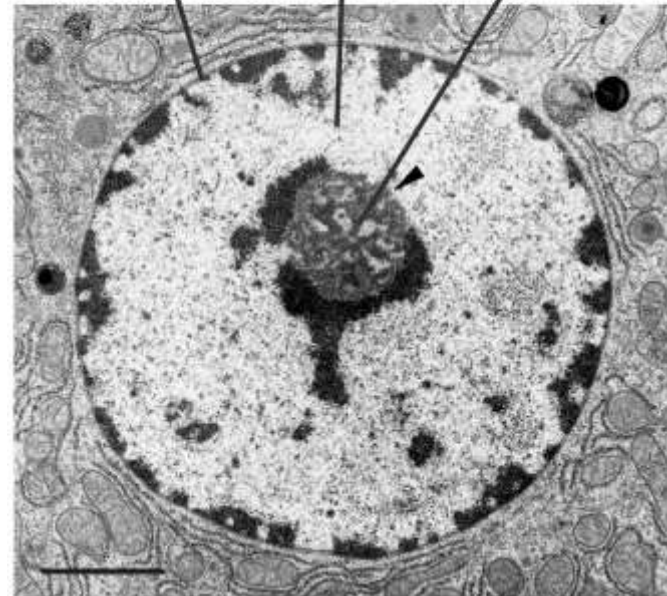
- ▶ Hereditary material
- ▶ Chromosomes
 - DNA
 - Proteins
 - Form for cell division
- ▶ Chromatin



Nucleolus

- ▶ Most cells have 2 or more
- ▶ Directs synthesis of RNA
- ▶ Forms ribosomes

Nuclear membrane Nucleus Nucleolus

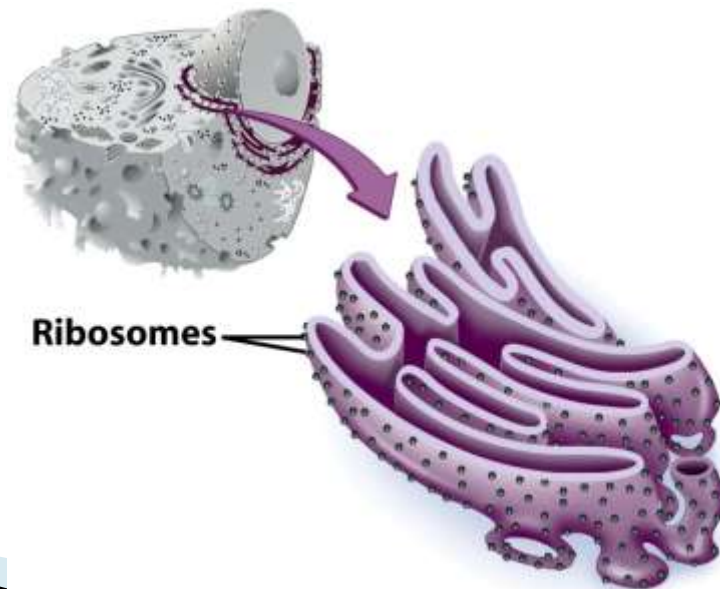


Endoplasmic Reticulum

- ▶ Helps move substances within cells
- ▶ Network of interconnected membranes
- ▶ Two types
 - Rough endoplasmic reticulum
 - Smooth endoplasmic reticulum

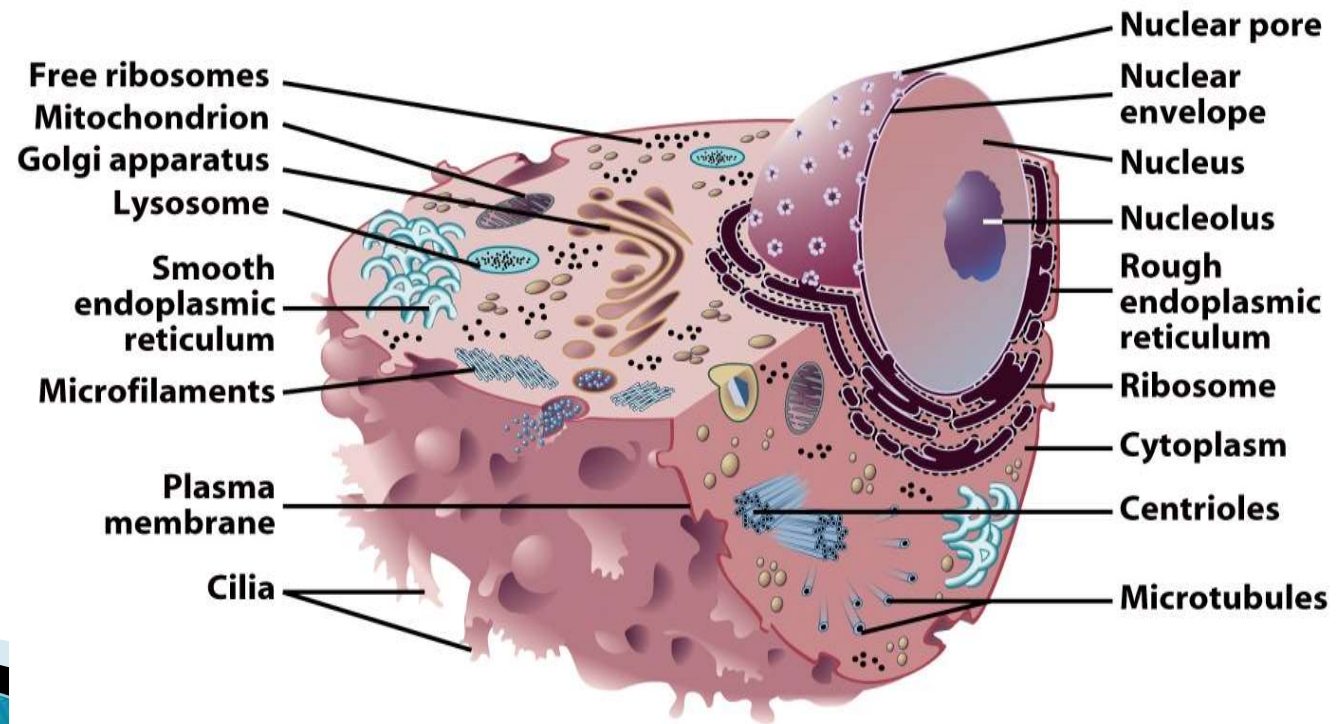
Rough Endoplasmic Reticulum

- ▶ Ribosomes attached to surface
 - Manufacture proteins
 - Not all ribosomes attached to rough ER
- ▶ May modify proteins from ribosomes



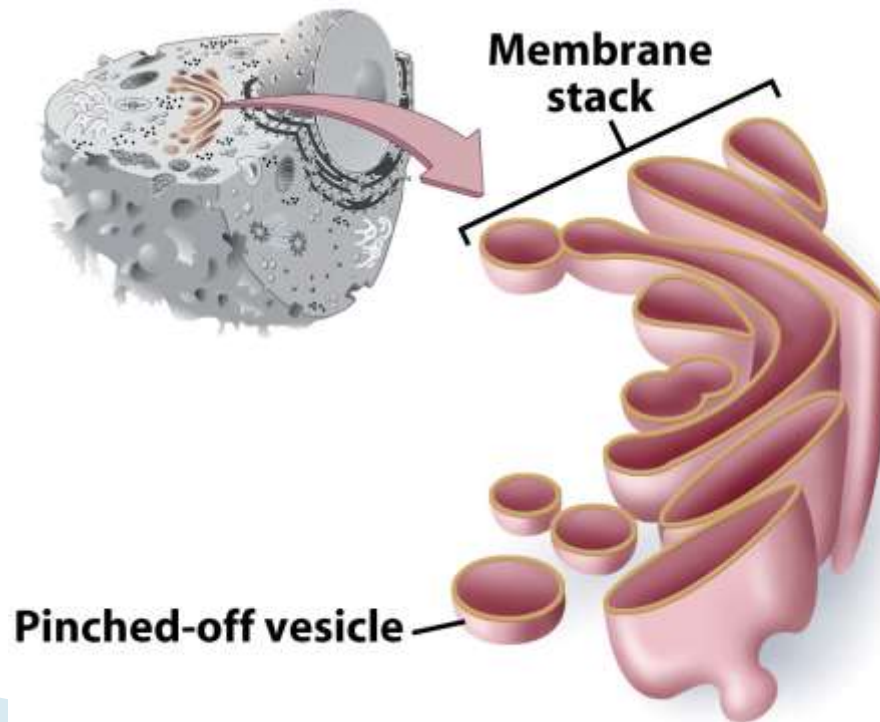
Smooth Endoplasmic Reticulum

- ▶ No attached ribosomes
- ▶ Has enzymes that help build molecules
 - Carbohydrates
 - Lipids

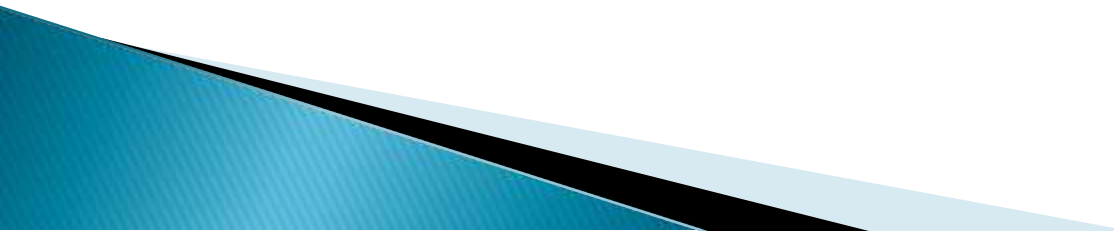


Golgi Apparatus

- ▶ Involved in synthesis of plant cell wall
- ▶ Packaging & shipping station of cell

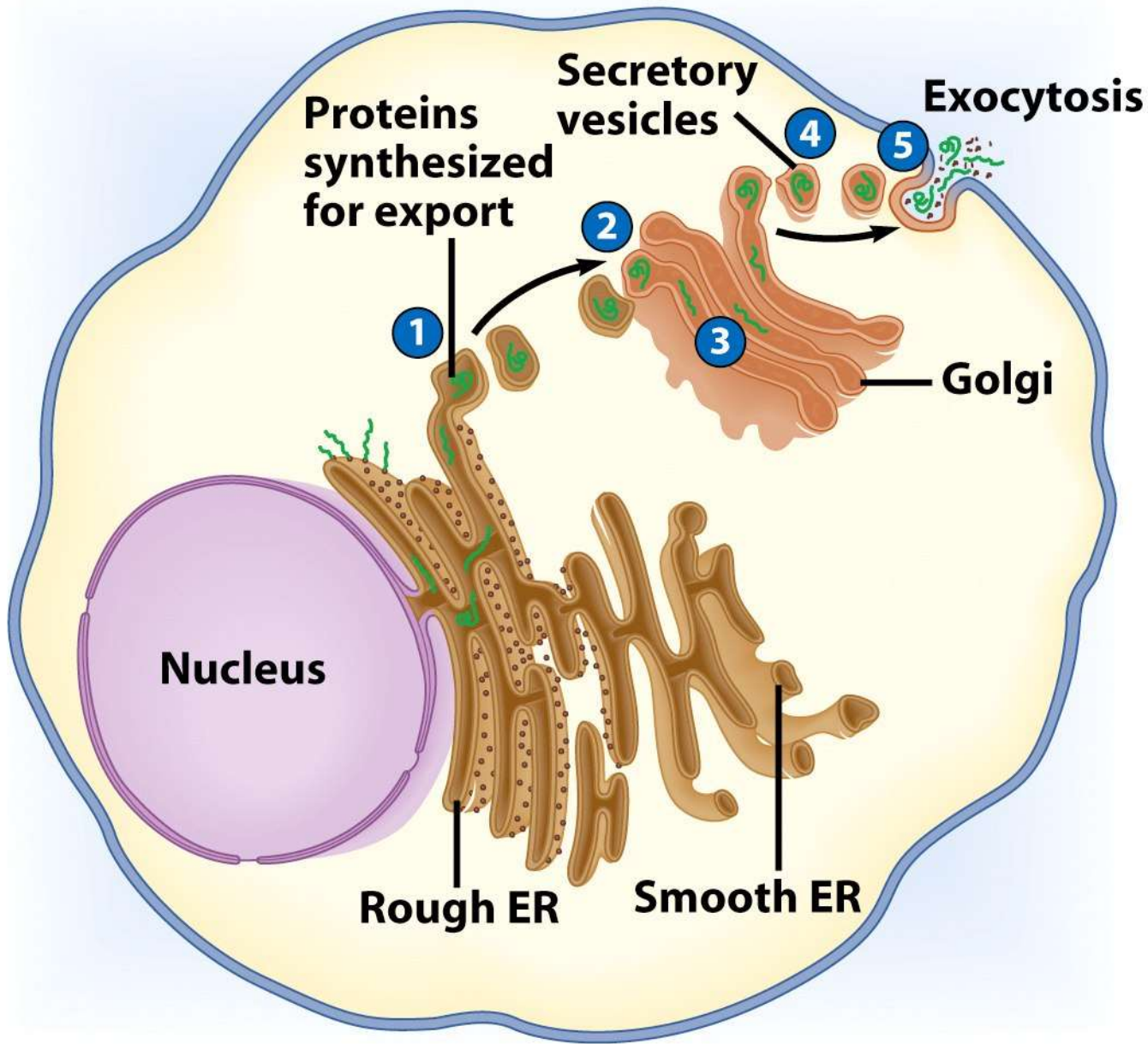


Golgi Apparatus Function

1. Molecules come in vesicles
 2. Vesicles fuse with Golgi membrane
 3. Molecules may be modified by Golgi
- 

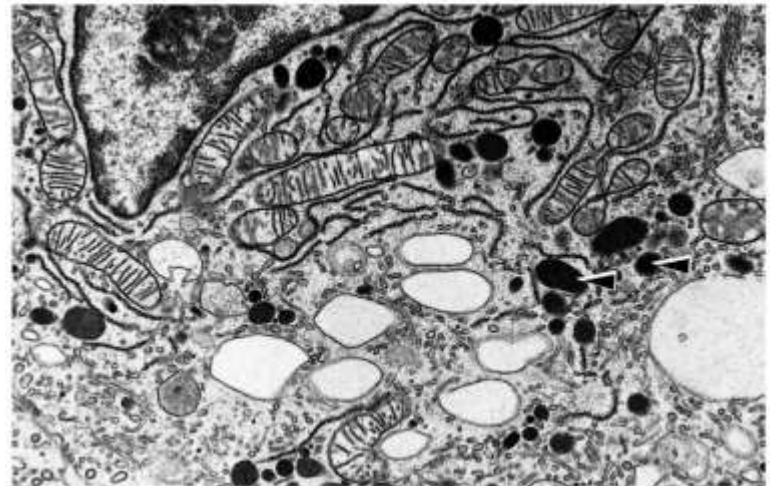
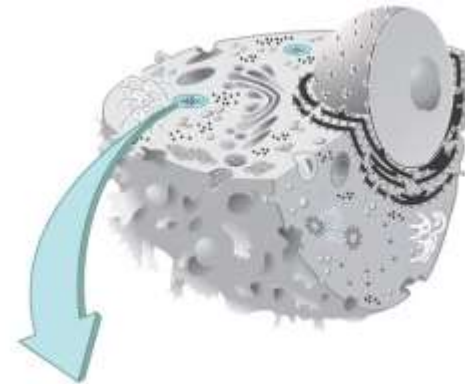
Golgi Apparatus Function (Continued)

4. Molecules pinched-off in separate vesicle
5. Vesicle leaves Golgi apparatus
6. Vesicles may combine with plasma membrane to secrete contents



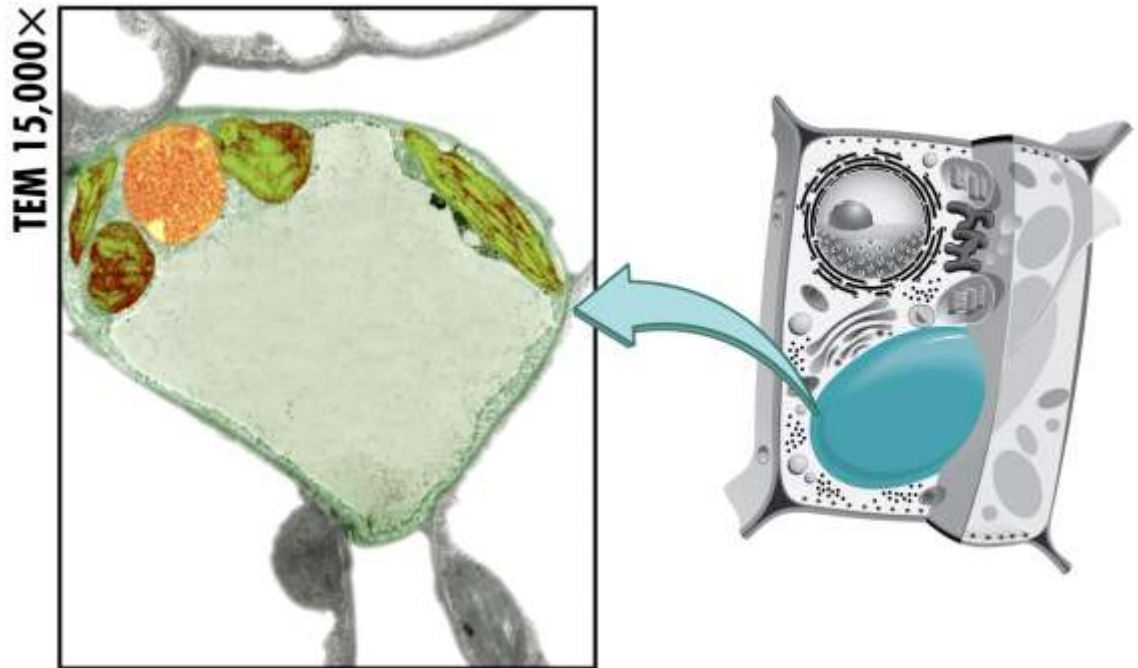
Lysosomes

- ▶ Contain digestive enzymes
- ▶ Functions
 - Aid in cell renewal
 - Break down old cell parts
 - Digests invaders



Vacuoles

- ▶ Membrane bound storage sacs
- ▶ More common in plants than animals
- ▶ Contents
 - Water
 - Food
 - wastes

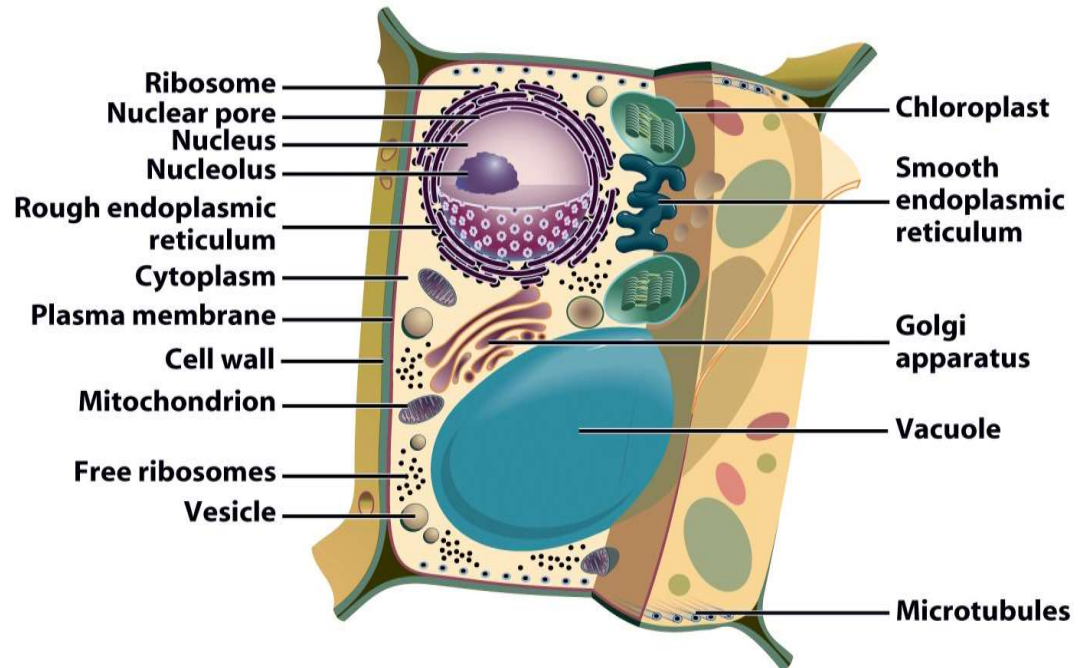


Bacteria-Like Organelles

▶ Release & store energy

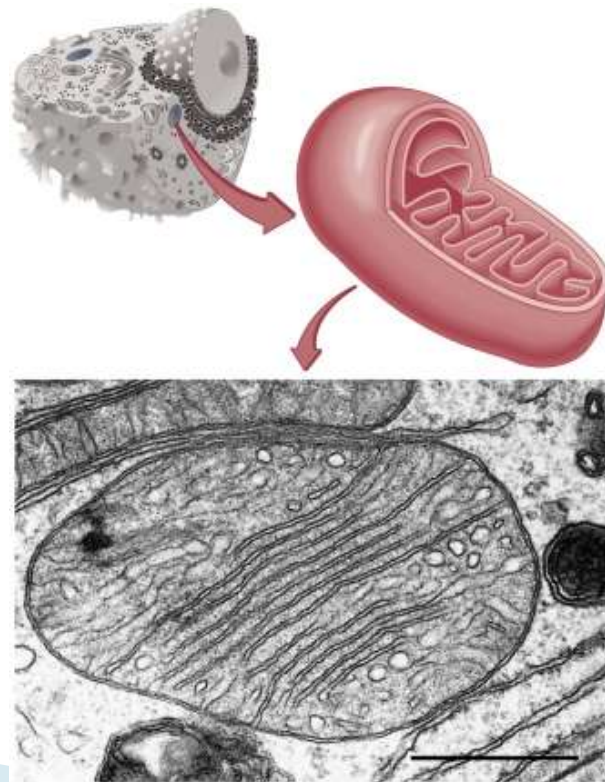
▶ Types

- Mitochondria (release energy)
- Chloroplasts (store energy)



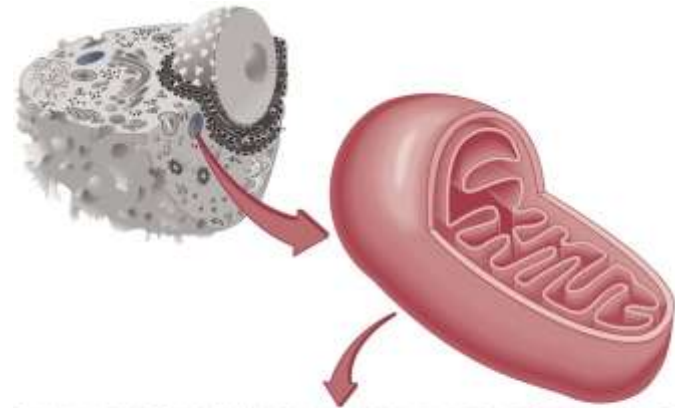
Mitochondria

- ▶ Have their own DNA
- ▶ Bound by double membrane



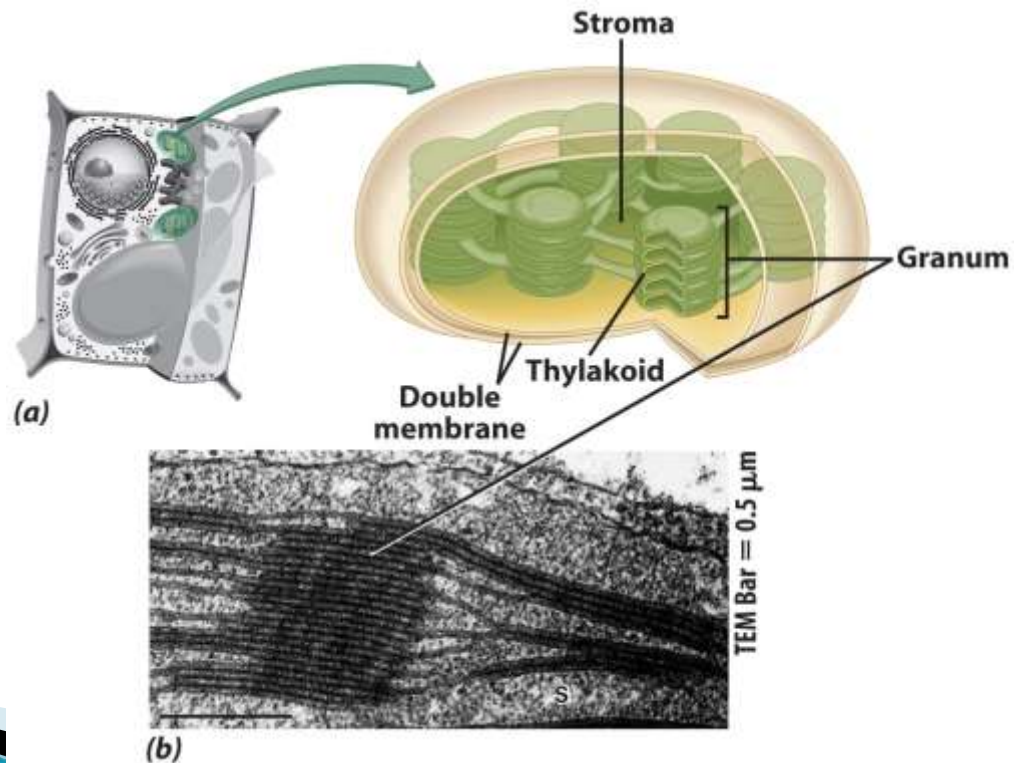
Mitochondria

- ▶ Break down fuel molecules (cellular respiration)
 - Glucose
 - Fatty acids
- ▶ Release energy
 - ATP



Chloroplasts

- ▶ Derived from photosynthetic bacteria
- ▶ Solar energy capturing organelle



Thank

You

