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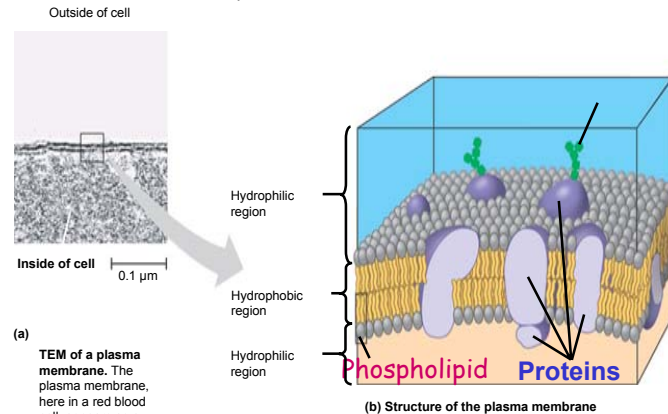
Plasma Membrane

- defines inside from outside

2

Plasma membrane

- Functions as a selective barrier
- Specific portals for selective transport of materials in and out of cell



3

Common features of all cells

Plasma Membrane

- defines inside from outside

Cytosol

- Semifluid "inside" of the cell

DNA "chromosomes"

- Genetic material - hereditary instructions

Ribosomes

- "factories" to synthesize proteins

4

Two Broad Classes of Cells

Prokaryotes

Pro = before

karyon = nucleus

DO NOT HAVE A NUCLEUS
NO internal membranes

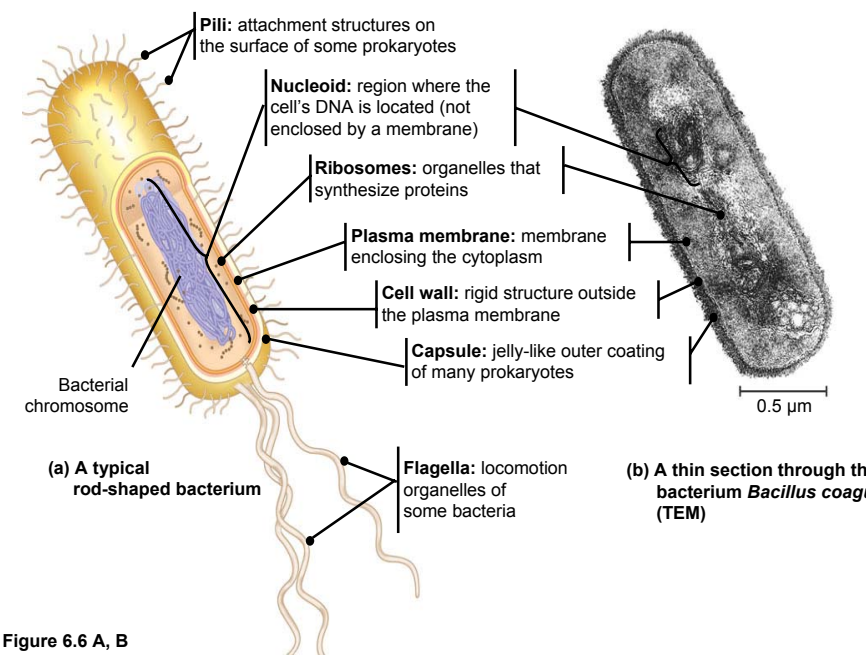
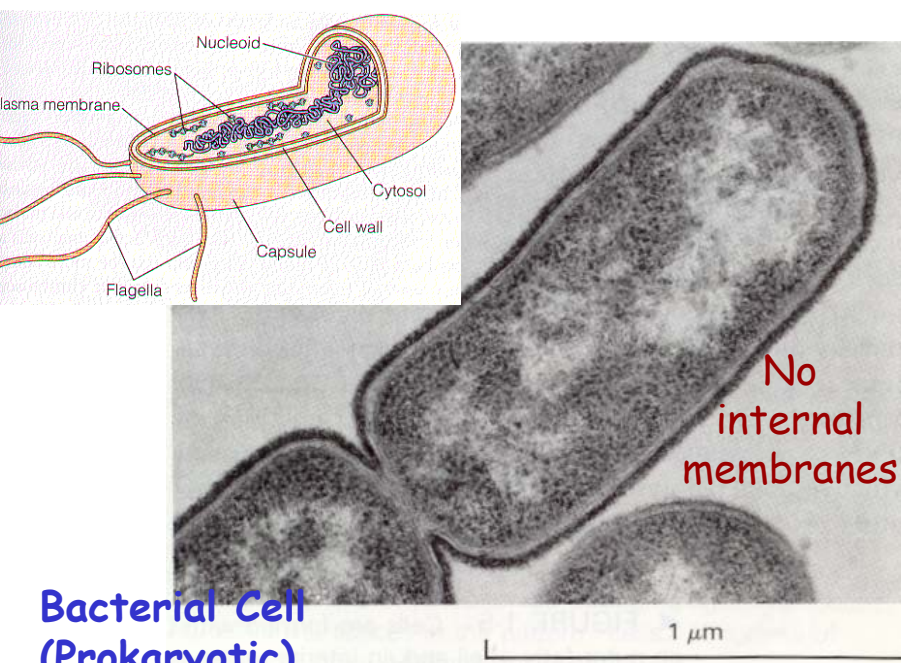
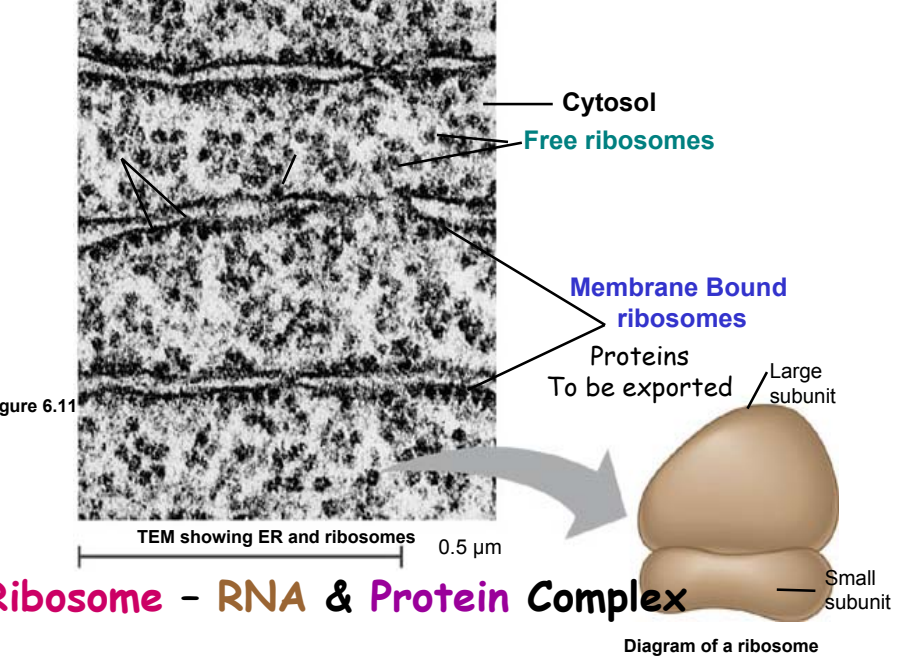
bacteria, cyanobacteria
archaebacteria

Eukaryotes

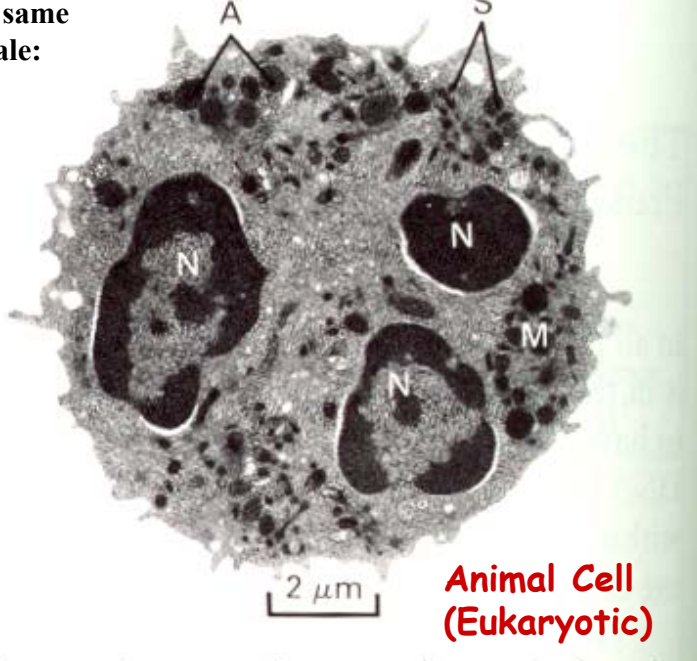
Eu = true

HAVE A NUCLEUS
membrane-bound organelles

Plants, Animals,
Fungi, protists



On the same size scale:



Bacterial cell (Prokaryotic)



Animal Cell (Eukaryotic)

Relative Sizes

"Typical" Bacterium

~ 1-2 μM

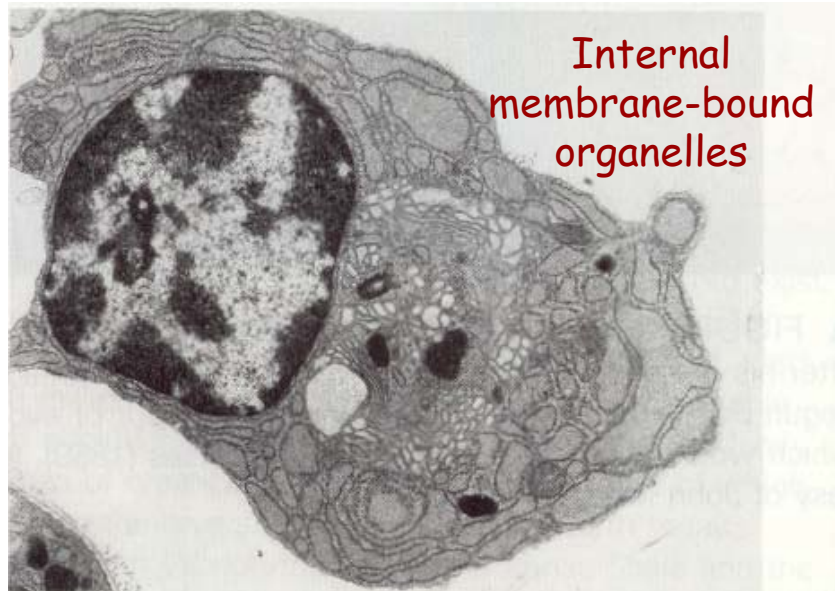
"Typical" Animal Cell

~ 5 to 20 μM diameter

"Typical" Plant Cell

~ 5 to 50 μM diameter

μM = micrometer or micron = 10^{-6} meter₁₀



Internal membrane-bound organelles

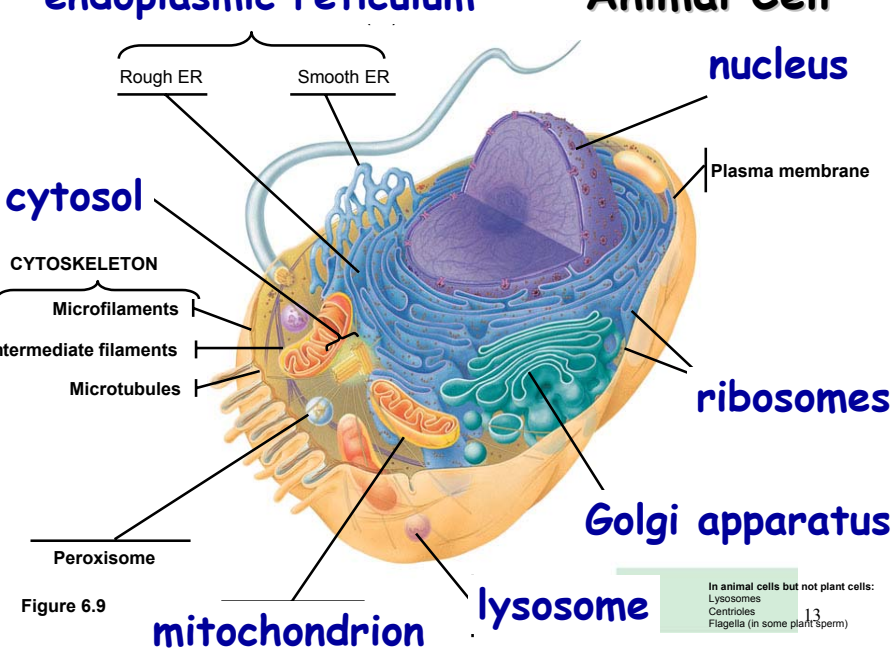
1 μm

Animal Cell (Eukaryotic)

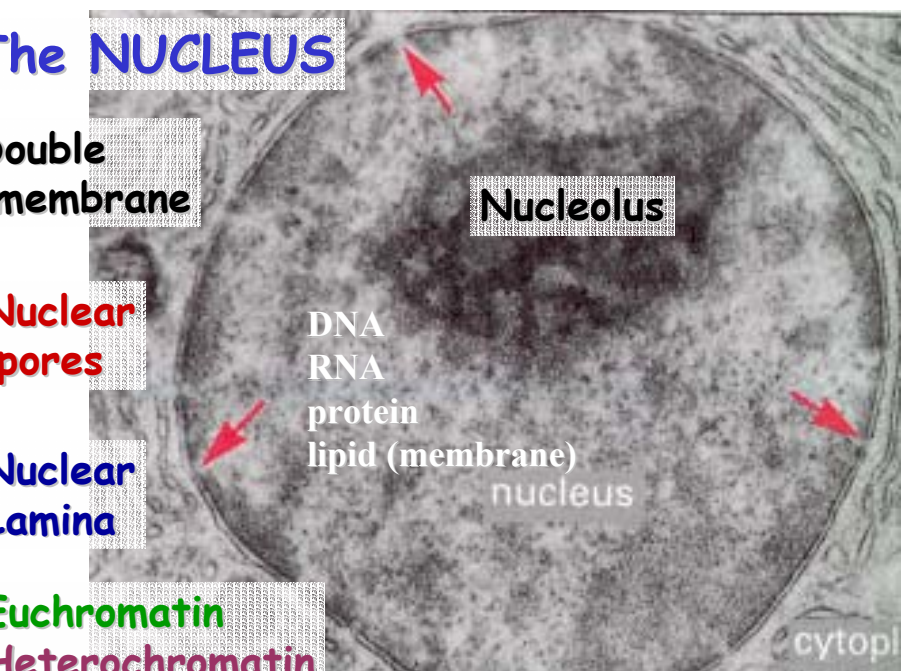
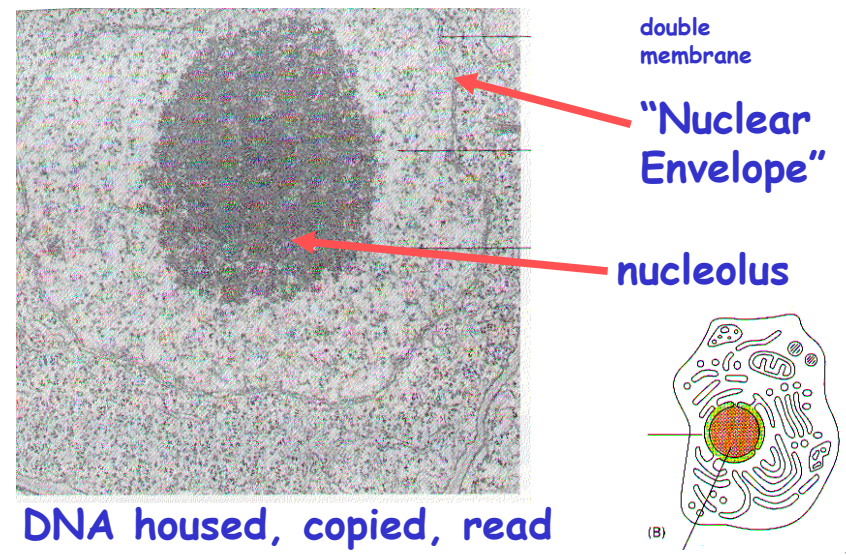
Why Internal Membranes?

Compartmentalization (Division of Labor)

I'm sleeping	I'm playing my sax	I'm watching TV	I'm cooking dinner
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Nucleus: Information storage



nuclear envelope

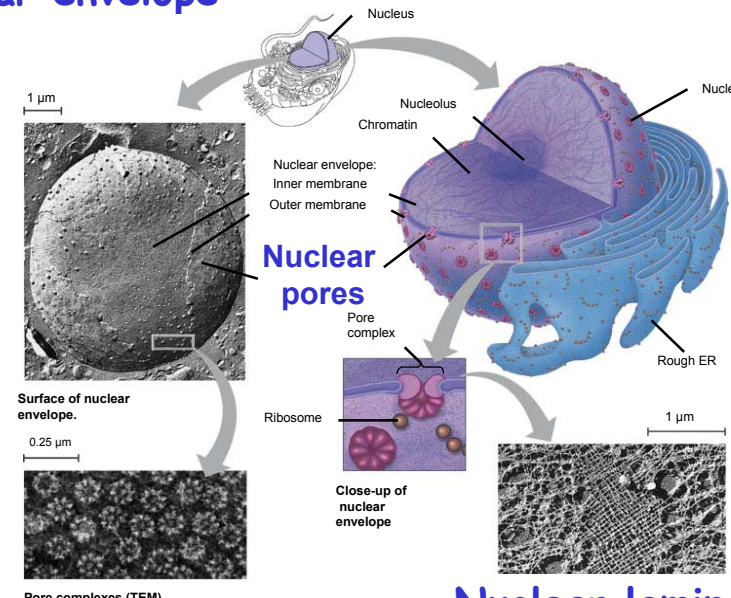
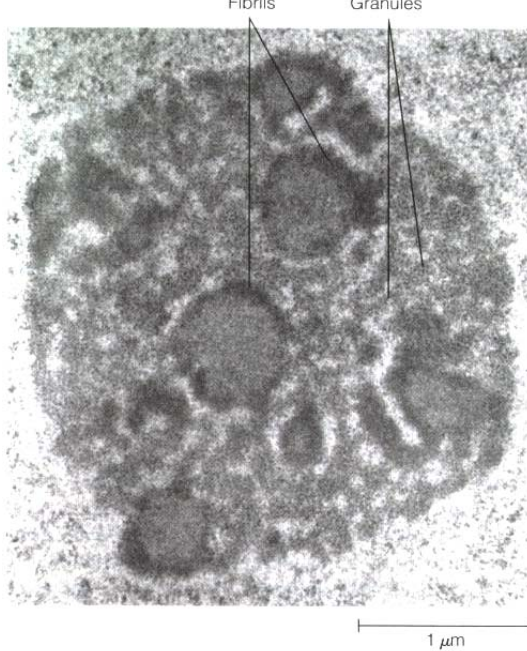


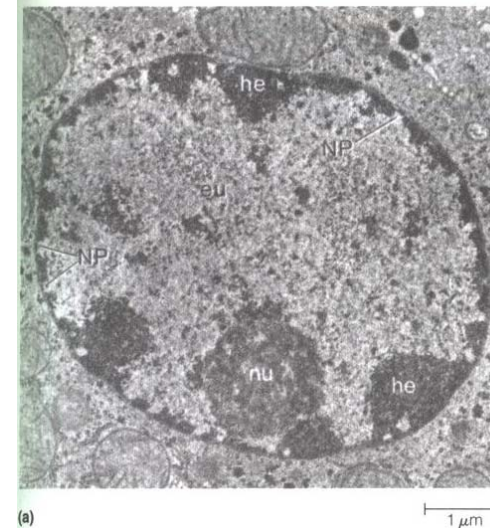
Figure 6.10

Nucleolus
Site of
Ribosome
Subunit
Assembly



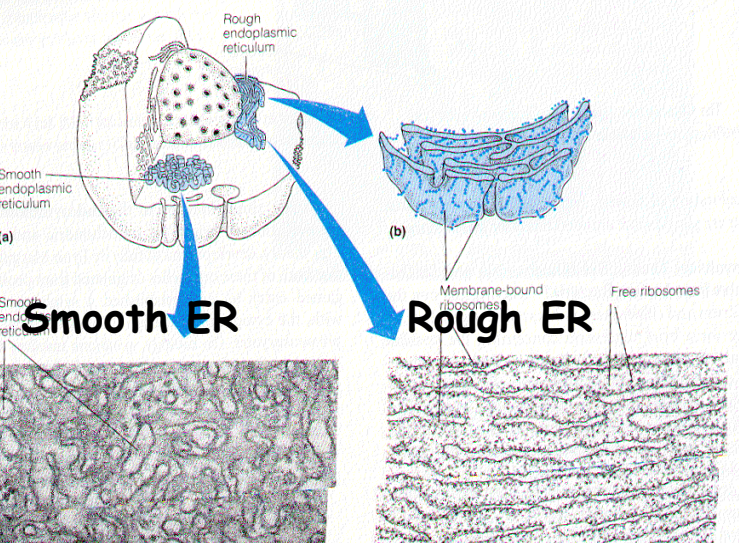
Note:
No membrane

Euchromatin region
Site of mRNA synthesis



Expression
Of
Informational
RNAs

Endoplasmic reticulum (ER)

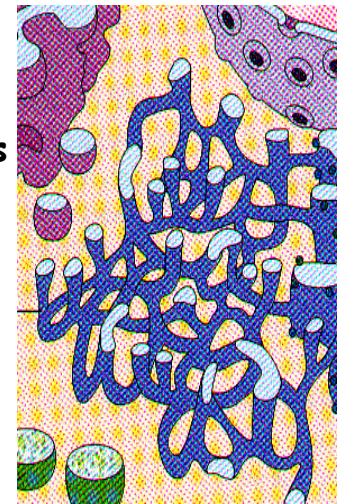


Endoplasmic reticulum (ER)

[*Reticulum - network*] Continuous network of flattened sacs, tubules, vesicles, throughout eukaryotic cytoplasm

Smooth ER

- Synthesizes membrane lipids
- Synthesizes steroids
- Stores calcium
- Detoxifies poison



Example: detoxification in smooth ER

Benzo(a)pyrene
charred meat,
cigarette smoke

Oxidations -
more soluble

Some metabolites
are more toxic

Chronic use of
barbiturates, alcohol-
SER proliferation,
resistance

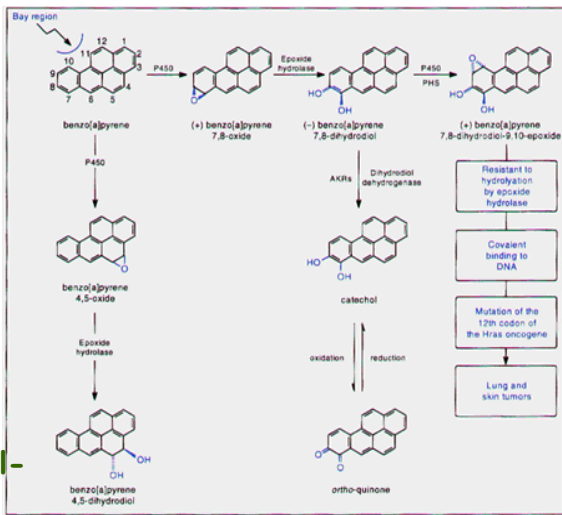
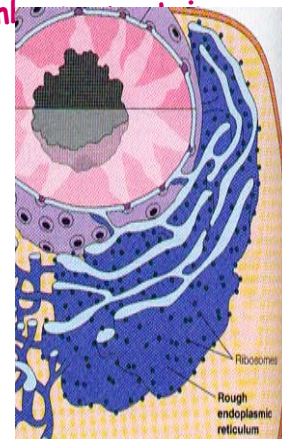


Figure 6-6. Role of epoxide hydrolase in the inactivation of benzo(a)pyrene 4,5-oxide and in the conversion of benzo(a)pyrene to its tumorigenic bay-region dilepoxide.

Also shown is the role of dihydrodiol dehydrogenase, a member of the aldoketo reductase (AKR) superfamily, in the formation of reactive catechol and ortho-quinone metabolites of benzo(a)pyrene.

Rough ER -
ribosomes attached to cytoplasmic face

- Large flattened sheets
- Synthesizes secreted proteins, membranes, exported
- Protein modification;
initial steps of
carbohydrate addition
- glycoproteins



Rough ER

Slips proteins
through ER
membrane

Glycosylation
Adds
oligosaccharides

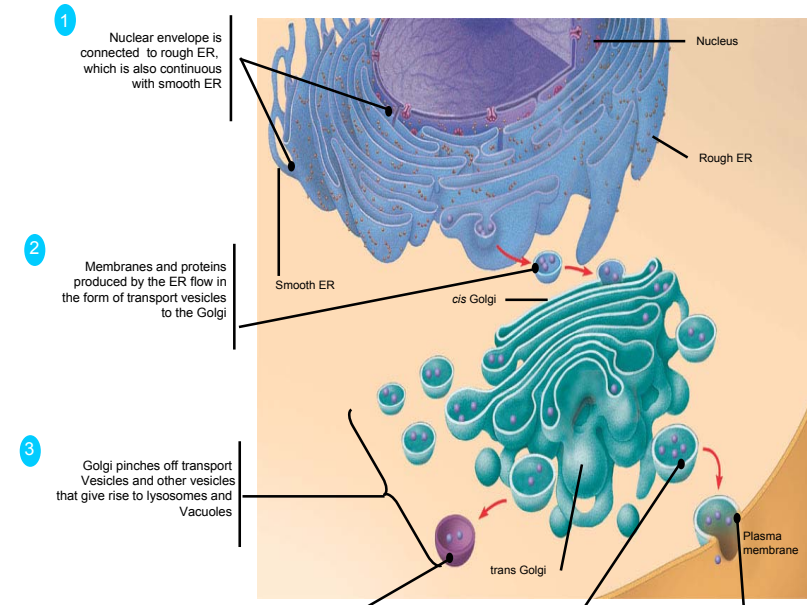
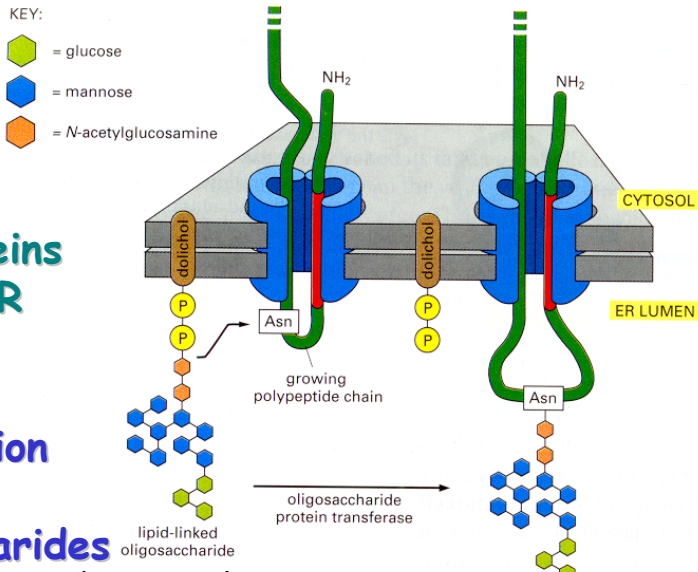
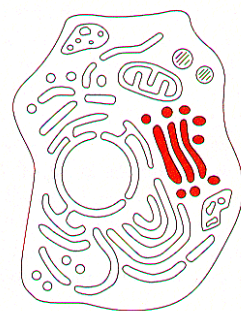


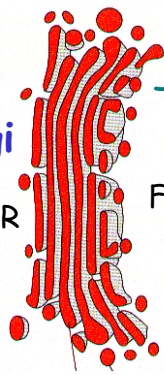
Figure 6.16

Golgi Apparatus: protein secretion

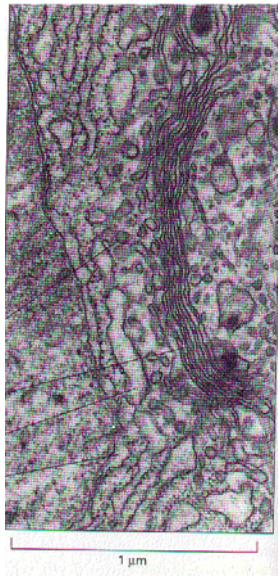
Processing, packaging and sorting center



Cis Golgi
Close To RER



Trans Golgi
Far side Away From RER



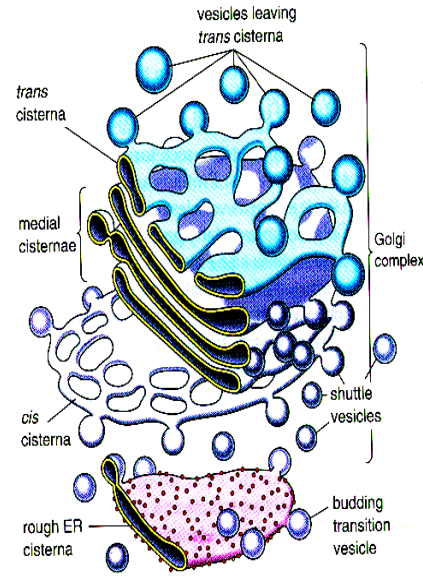
Functions of the Golgi Apparatus

cis Golgi
"near" processing center

Present wrapping Service - modifies proteins

trans Golgi
"far" sorting center

Fed Ex Central
Sorts for delivery To specific compartments



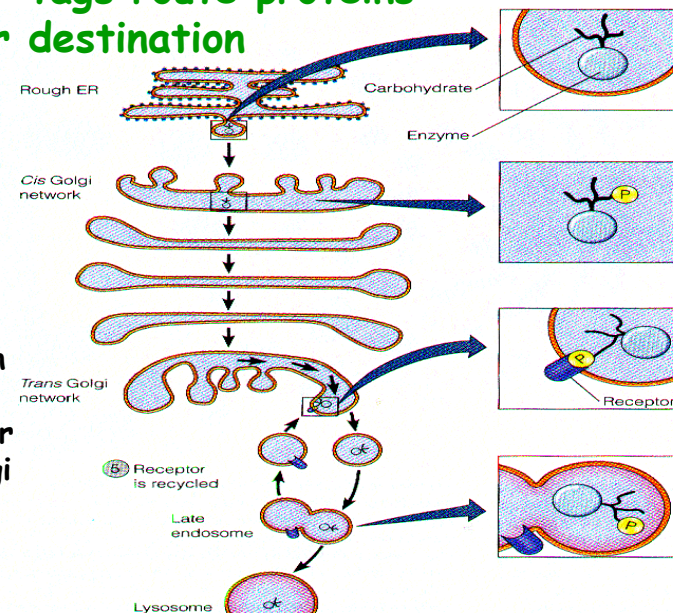
Functions of the Golgi Apparatus

- **Trimming of Oligosaccharide** side chains on glycosylated proteins
- **Addition of new Oligosaccharide** residues to existing side chains of glycosylated proteins
- **"Maturation" Cleavages** of specific proteins
e.g., insulin
- **Phosphorylation of specific sugar residues** on oligosaccharide side chains of glycosylated proteins

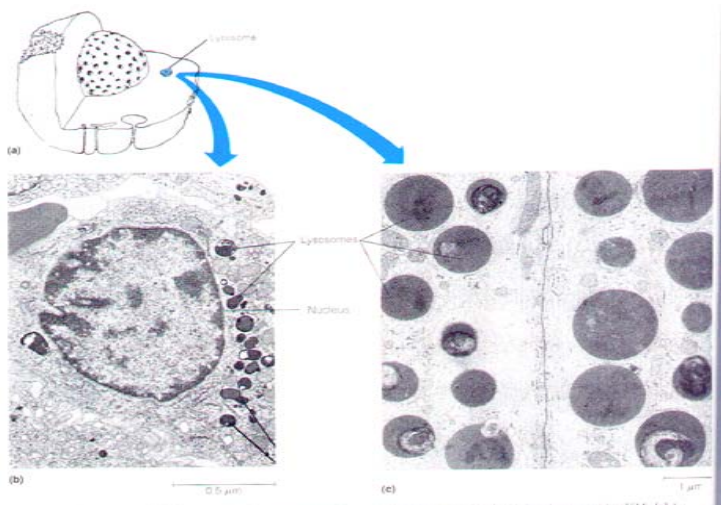
Molecular tags route proteins to proper destination

P added in *cis* Golgi

Proteins with M-6-P tag bind receptor in trans Golgi



sacs of digestive enzymes



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Endocytosis And Phagocytosis

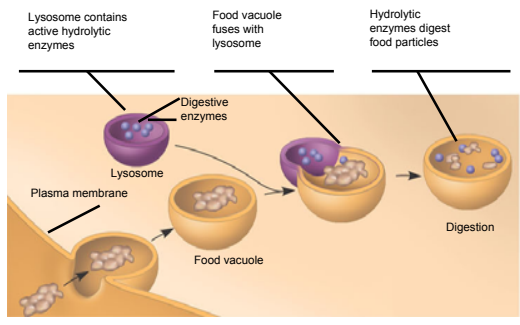
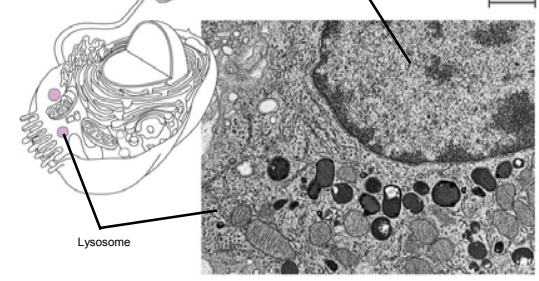
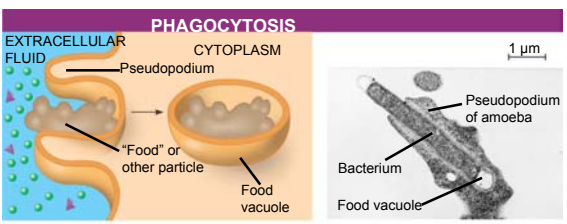


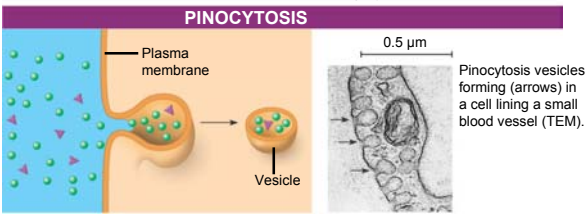
Figure 6.14 A

In **phagocytosis**, a cell engulfs a particle by Wrapping pseudopodia around it and packaging it within a membrane-enclosed sac large enough to be classified as a vacuole. The particle is digested after the vacuole fuses with a lysosome containing hydrolytic enzymes.

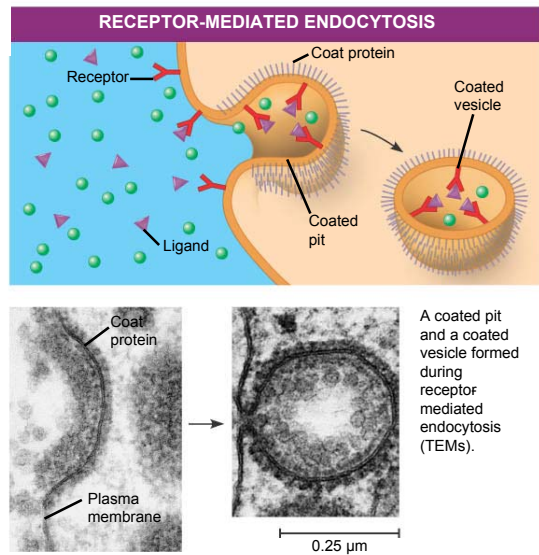


An amoeba engulfing a bacterium via phagocytosis (TEM).

In **pinocytosis**, the cell "gulps" droplets of extracellular fluid into tiny vesicles. It is not the fluid itself that is needed by the cell, but the molecules dissolved in the droplet. Because any and all included solutes are taken into the cell, pinocytosis is nonspecific in the substances it transports.



Receptor-mediated endocytosis enables the cell to acquire bulk quantities of specific substances, even though those substances may not be very concentrated in the extracellular fluid. Embedded in the membrane are proteins with specific receptor sites exposed to the extracellular fluid. The receptor proteins are usually already clustered in regions of the membrane called coated pits, which are lined on their cytoplasmic side by a fuzzy layer of coat proteins. Extracellular substances (ligands) bind to these receptors. When binding occurs, the coated pit forms a vesicle containing the ligand molecules. Notice that there are relatively more bound molecules (purple) inside the vesicle, other molecules (green) are also present. After this ingested material is liberated from the vesicle, the receptors are recycled to the plasma membrane by the same vesicle.



A coated pit and a coated vesicle formed during receptor mediated endocytosis (TEMs).

• Autophagy

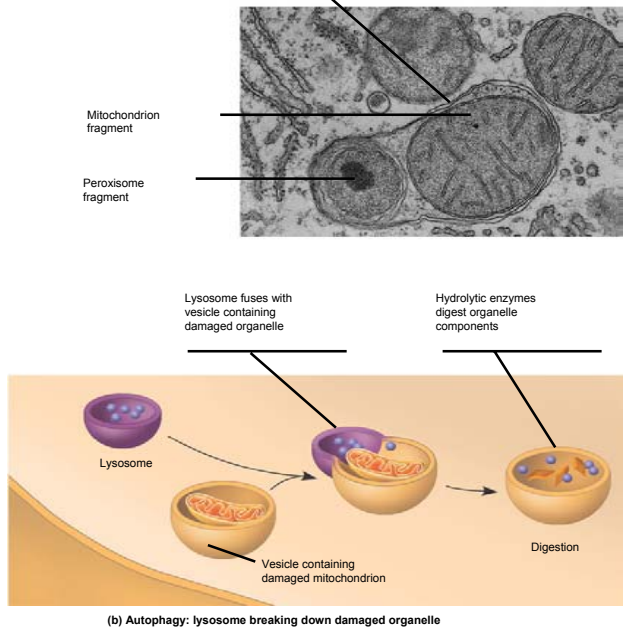
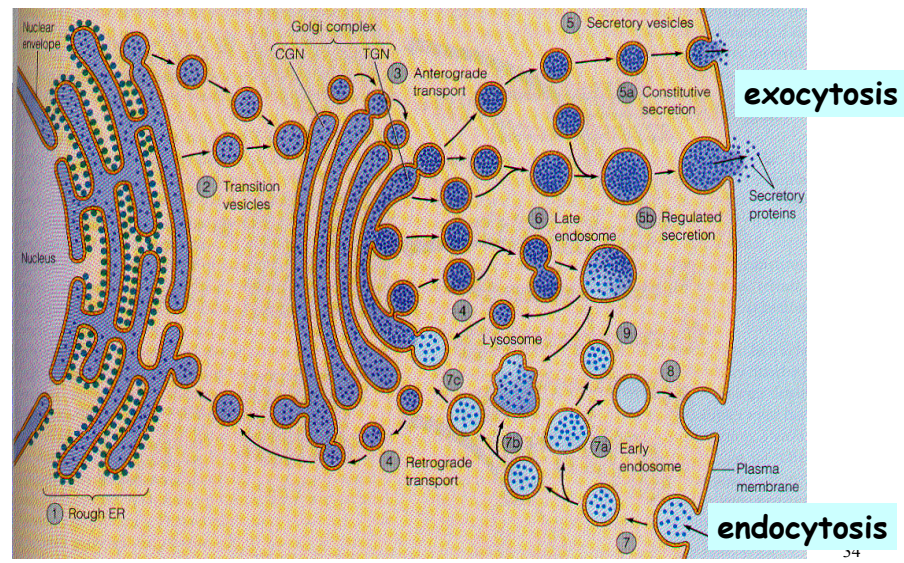


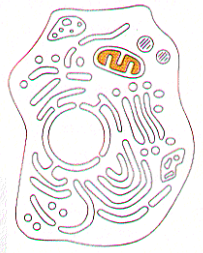
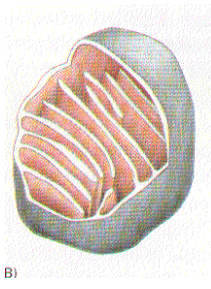
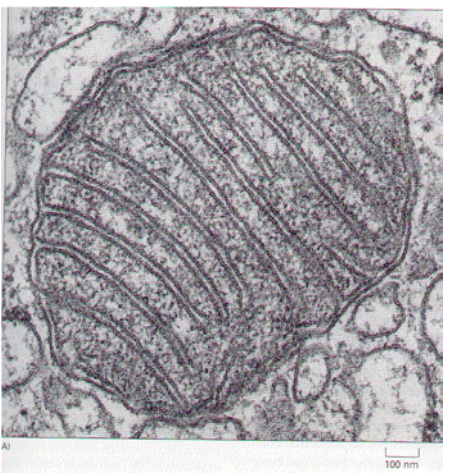
Figure 6.14 B

(b) Autophagy: lysosome breaking down damaged organelle

Vesicles move through the endomembrane system



Mitochondria:
Powerhouses of the cell



Mitochondria
singular = *mitochondrion*

- powerhouse of the animal cell
produces ~ 90% of ATP
- Carries out oxidative reactions
- Believed Derived from prokaryotic ancestor
 - DNA
 - ribosomes
 - double membrane - inner and outer

*define two functional spaces

- Mitochondria are enclosed by two membranes
- A smooth outer membrane
- An inner membrane folded into cristae

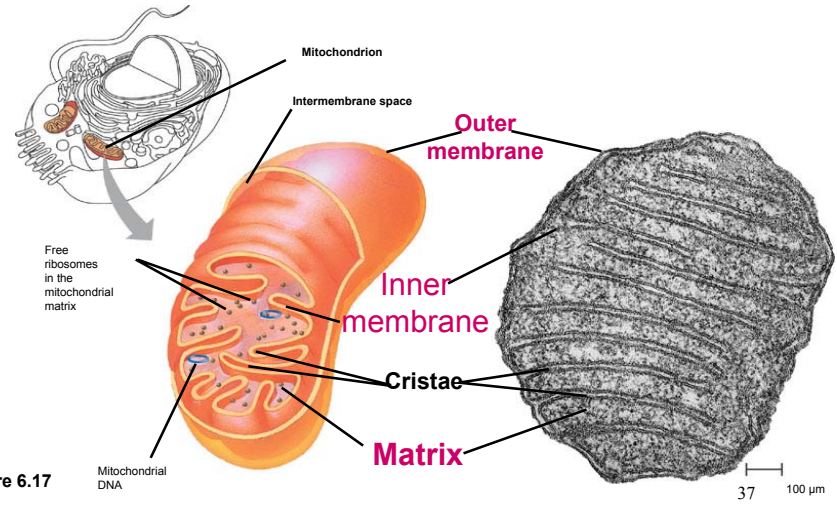
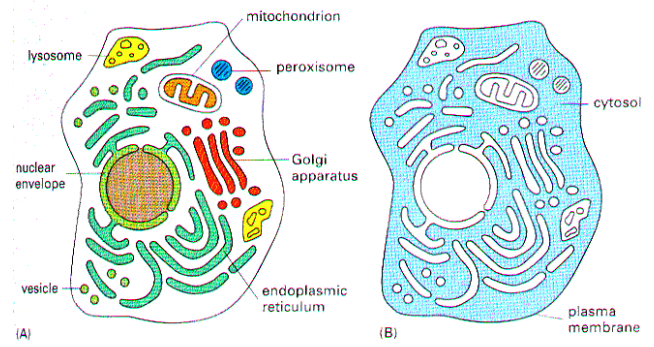


Figure 6.17

Cell - organelles = Cytosol

Gel

Important chemical reactions
cytoskeleton - eukaryotes



The cytoskeleton

- Is a network of fibers extending throughout the cytoplasm
- Structural Support
- Movement of Materials and Organelles

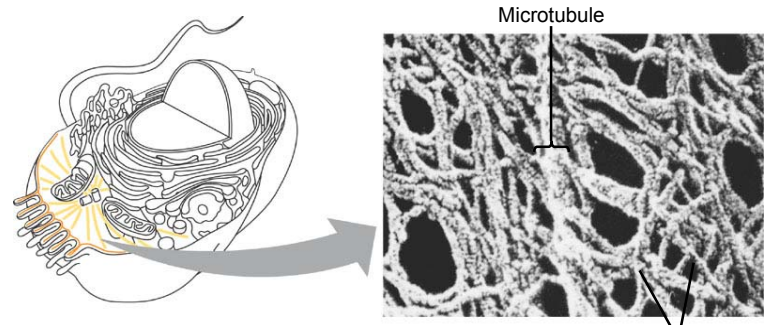


Figure 6.20

There are three types of fibers that make up the cytoskeleton

	Microtubules	Microfilaments	Intermediate Filaments
Structure	Tubulin	Actin	various
Diameter	25 μm dia	7 μm dia	8-15 μm dia
Protein subunits	Tubulin, consisting of α -tubulin and β -tubulin	Actin	One of several different proteins of the keratin family; desmosomes in cells
Main functions	Cell shape Organelle movt Chromosome separation Flagellar movt	Cell shape Cell cleavage Cytoplasmic streaming Muscle contract	Nuclear lamina Tension bearing elements Anchors
Motors:	Dynein Kinesin	Myosin	
Diagram labels:	Columns of tubulin dimers 25 μm	Actin subunit 7 μm	Protein subunits (keratin) Fibrous subunits 7-10 μm

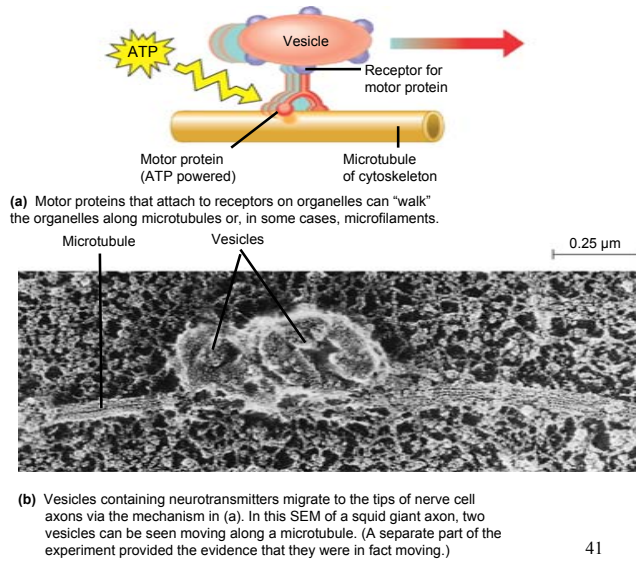
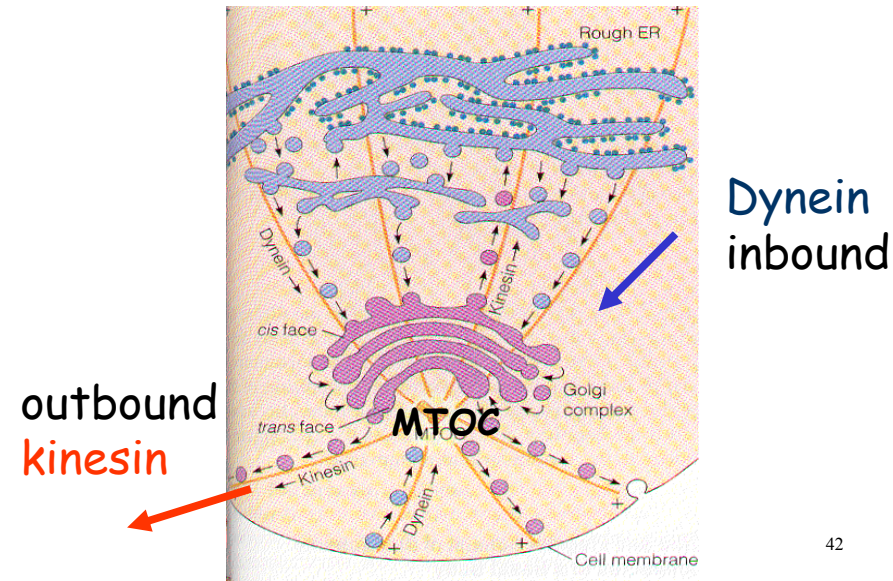
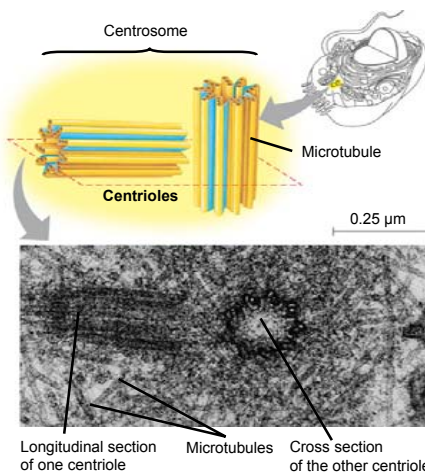


Figure 6.21 A, B

Motor MAPs transport vesicles



– Contains a pair of centrioles



“microtubule-organizing center”

- Animal cells
 - Lack cell walls
 - Are covered by an elaborate matrix, the ECM
- The ECM Is made up of glycoproteins

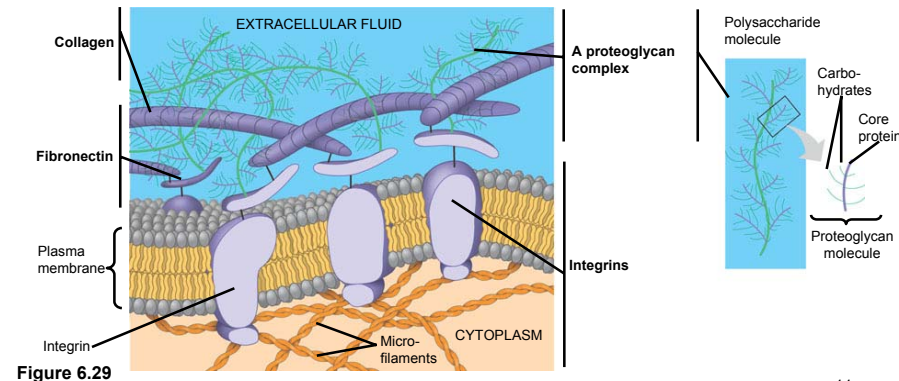


Figure 6.29

- Functions of the ECM include
 - Cell-Cell adhesion
 - Cell-Cell recognition
 - Regulation of cellular processes

plant cell

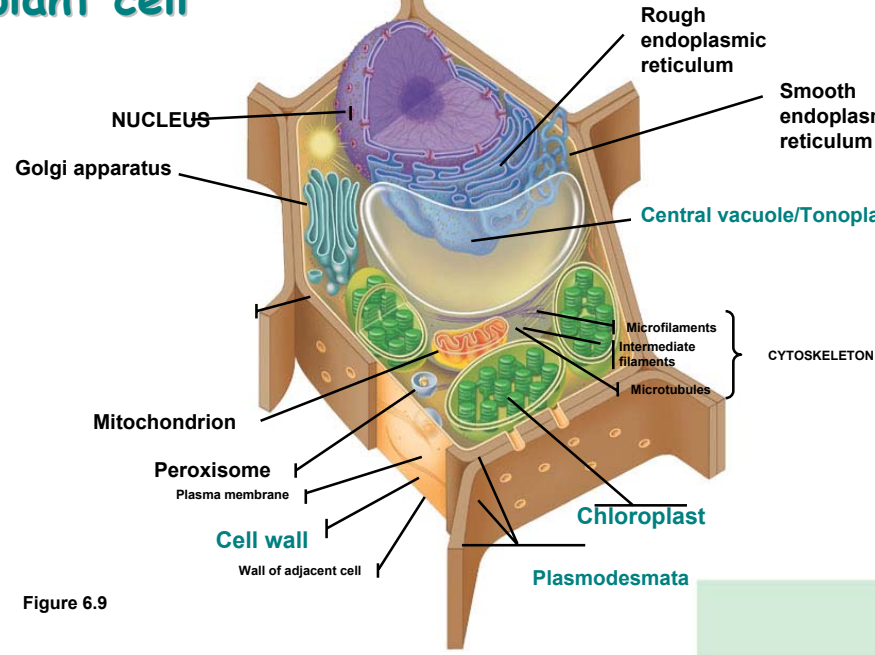


Figure 6.9

plant Central vacuoles - Tonoplasts

- Are found in plant cells
- Hold reserves of important organic compounds and water
- Regulates *Turgor*

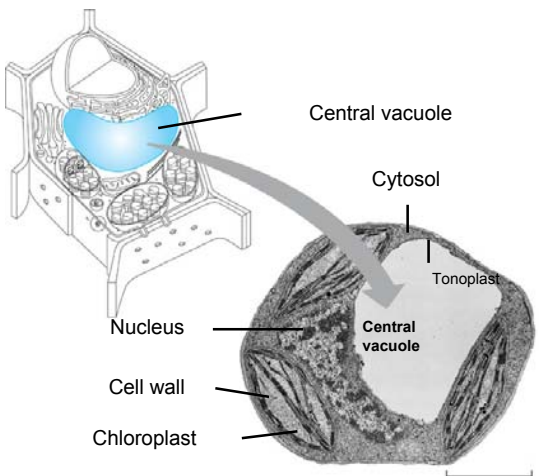


Figure 6.15

In plant cells, chloroplasts capture energy from the sun

Photosynthesis

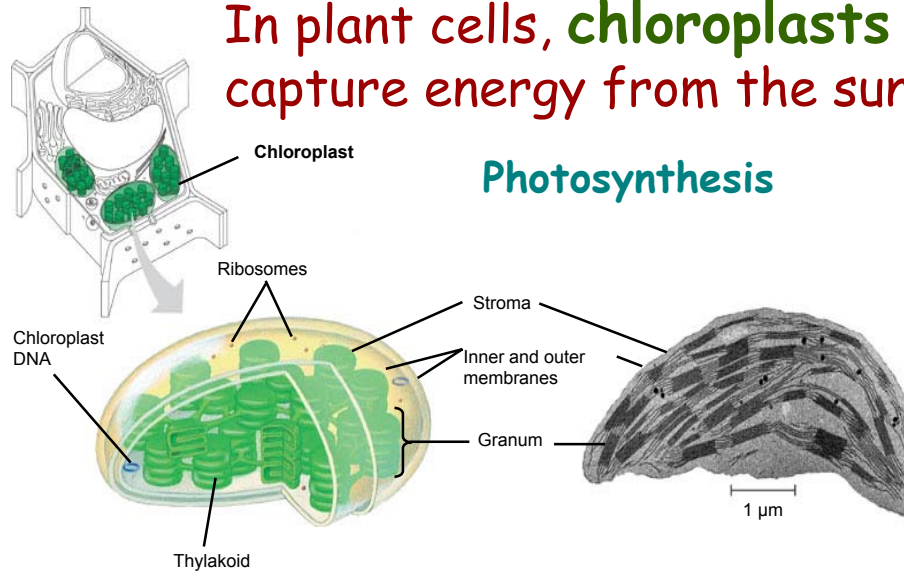
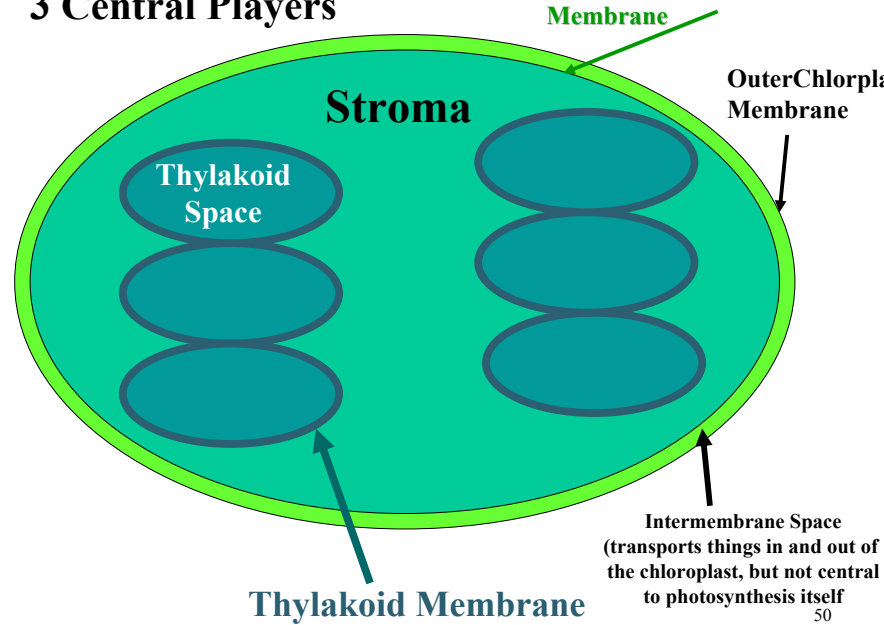


Figure 6.18

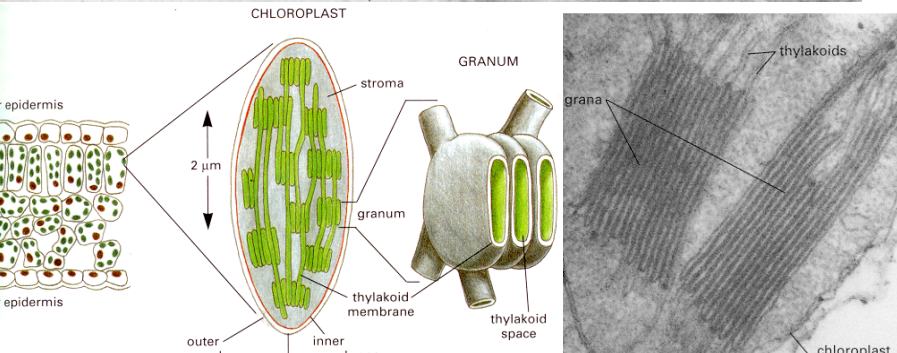
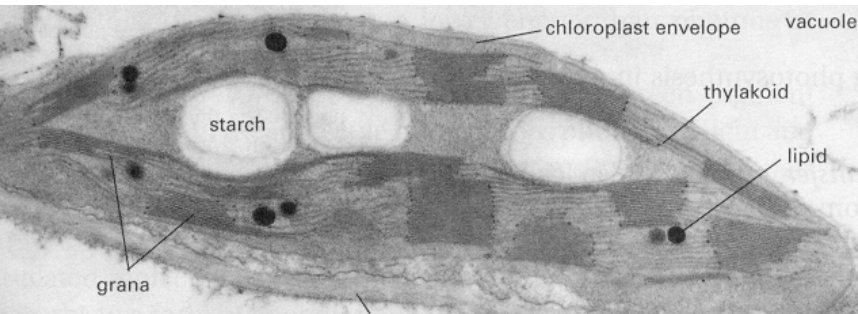
Chloroplasts

- Contain DNA
- Contain bacterial-like ribosomes
- Believed derived from prokaryotic ancestor
cyanobacterium = blue-green alga
- Double membrane organelle
defines *three* functional spaces

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50



Cell Walls of Plants

- The cell wall
 - Is an extracellular structure of plant cells that distinguishes them from animal cells

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Plant cell walls

- Are made of cellulose fibers embedded in other polysaccharides and protein
- May have multiple layers

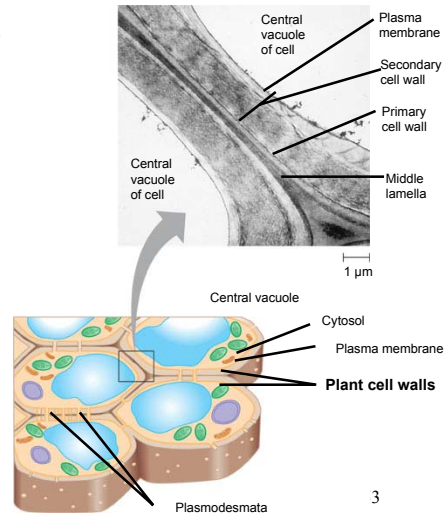


Figure 6.28

3

• Plasmodesmata

- Are channels that perforate plant cell walls

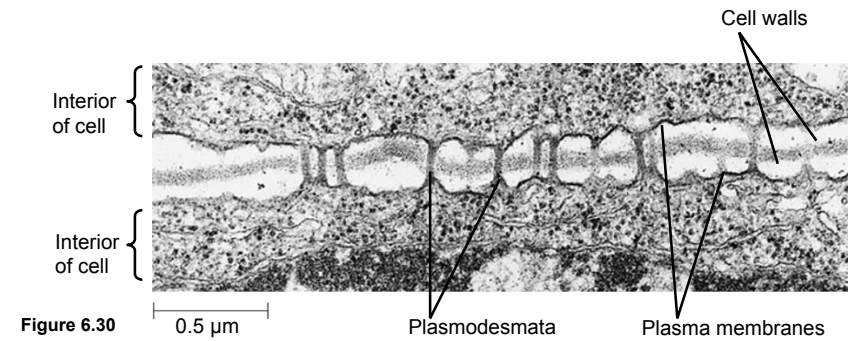


Figure 6.30

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Summary

Features of all cells

Features of Prokaryotes

Organelles of Animal Cells

Organelles of Plant Cells