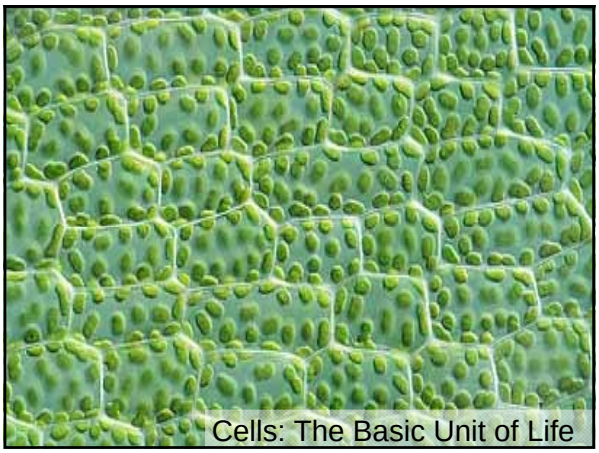


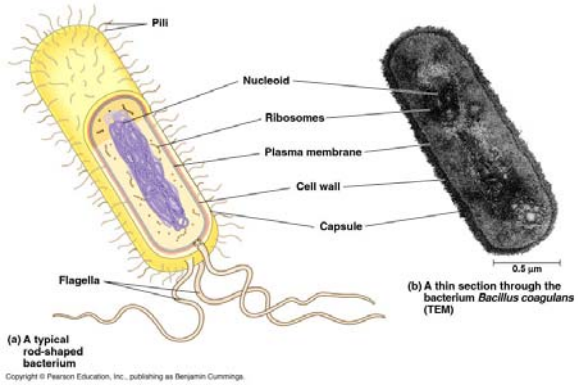
Cell Theory

- **All living things are composed of one or more cells**
- **Cells are the basic unit of structure and function of living things**
- **All cells are produced from other cells**

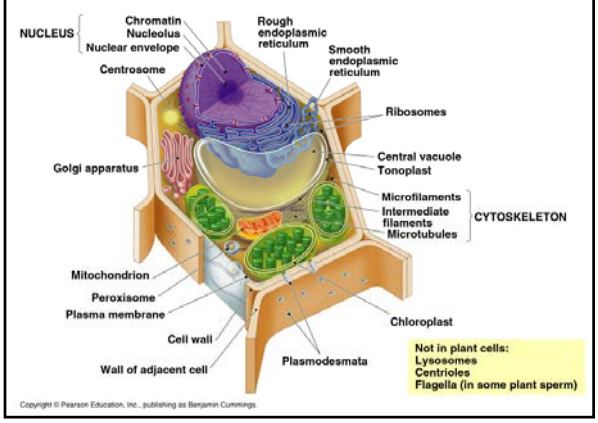
Two Types of Cells

- **Prokaryotic cells: Do not have a membrane around their nucleus**
  - **Example: Bacteria and Archae**
- **Eukaryotic cells: Have a membrane enclosed nucleus to protect their DNA**
  - **Example: Plants, Animals, Fungi, Protists**

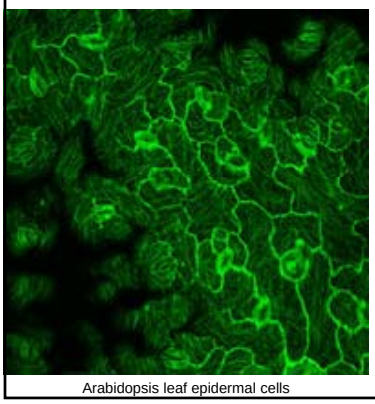
A prokaryotic cell



Overview of a Eukaryotic plant cell



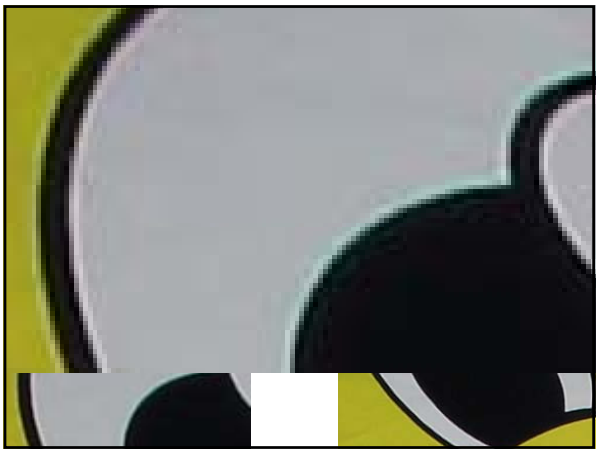
What we can see



Arabidopsis leaf epidermal cells

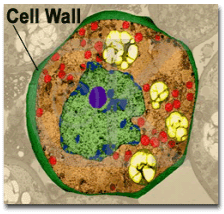
- Plant and animal cells can be easily seen using the compound light microscopes we have at school.

- However not all of the organelles are readily apparent using the light microscope.



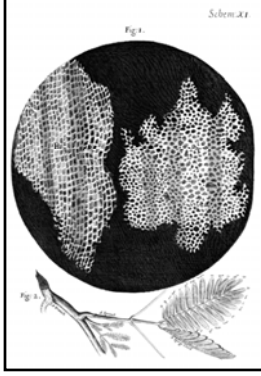
Cell wall

A cellulose-containing membrane that encloses the cell membrane and forms the external barrier of the cell.



The cell wall gives the cell its rigidity and strength, which makes the plant stiff.

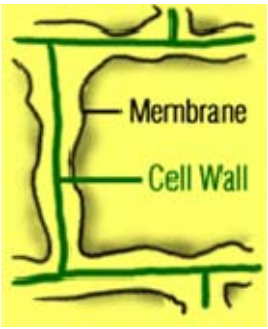
The Cell Wall



- Cell Wall
  - rigid layer of nonliving cellulose
  - Provide protection & support
  - Found in plant, some bacteria, some protists and some, fungi

Robert Hooke's 1664 Micrographia showing a drawing of the cell like structure of cork

Cell Membrane

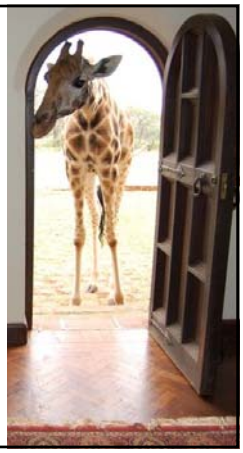


- The outer most layer of animal cells,
- Found just inside the cell wall in plants
- Regulates the materials that enter and leave the cell
- Functions to maintain homeostasis
- The force of the cell membrane pushing against the cell wall is called turgor pressure

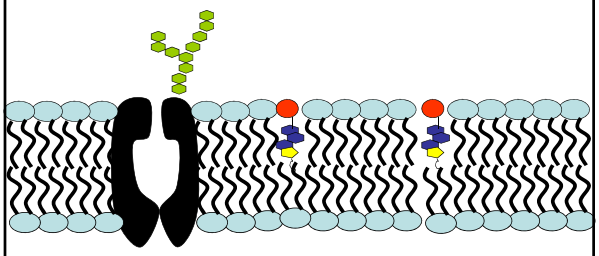
What is Homeostasis?

Homeostasis
Maintaining a Balance

- Cells must keep the proper concentration of nutrients and water and eliminate wastes.
- The plasma membrane is selectively permeable – it will allow some materials to pass through, while blocking others.



The Cell Membrane aka the Plasma Membrane is described using the fluid mosaic model



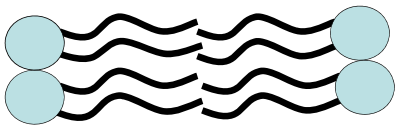
Structure of the Plasma Membrane

- Lipid bilayer – two sheets of lipids (phospholipids).
  - –Found around the cell, the nucleus, vacuoles, mitochondria, and chloroplasts.
  - –Embedded with proteins and strengthened with cholesterol molecules.

What is a Phospholipid?

What's a Phospholipid?

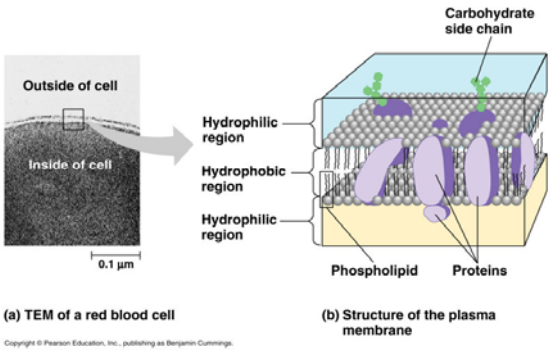
- It's a pair of fatty acid chains and a phosphate group attached to a glycerol backbone.
  - Polar (water-soluble) heads face out and the nonpolar fatty acids hang inside.

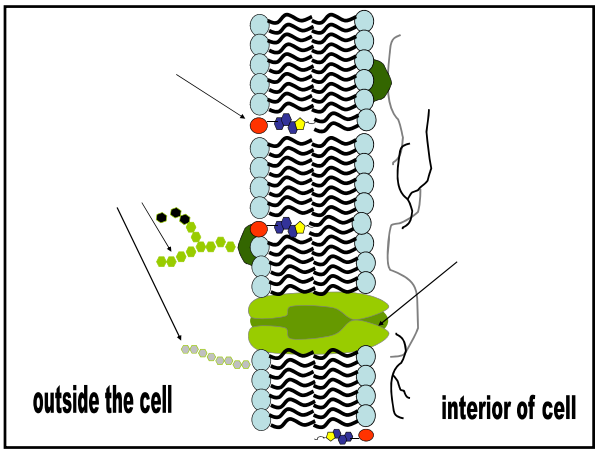


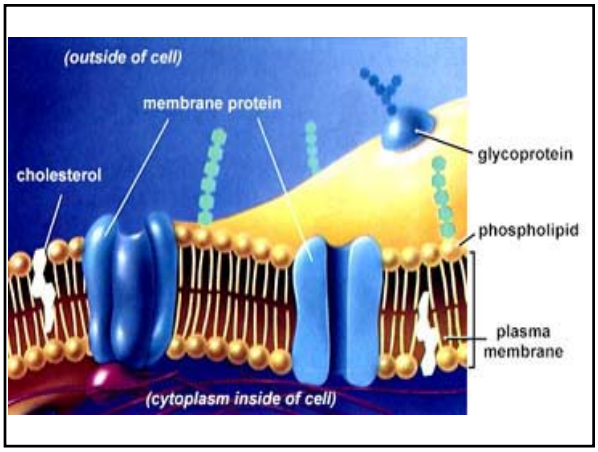
Membrane Proteins

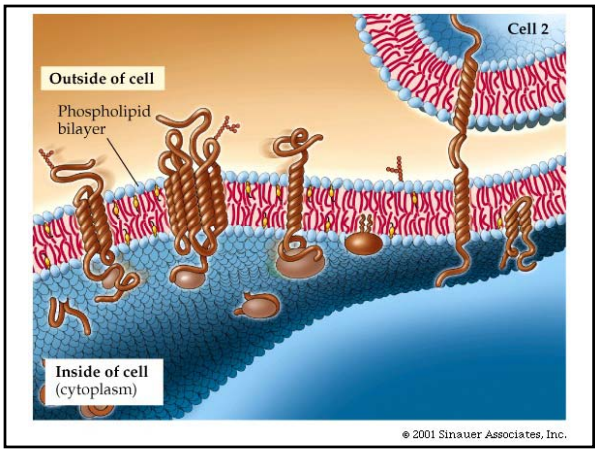
- 1. Determine what particles can pass through the membrane.
- 2. Serve as enzymes (may speed reactions).
- 3. Act as markers that are recognized by chemicals and molecules from the inside and the outside of the cell (the immune system).

The plasma membrane




outside the cell
interior of cell


(outside of cell)
membrane protein
cholesterol
glycoprotein
phospholipid
plasma membrane
(cytoplasm inside of cell)


Cell 2
Outside of cell
Phospholipid bilayer
Inside of cell (cytoplasm)
© 2001 Sinauer Associates, Inc.

Cellular Transport

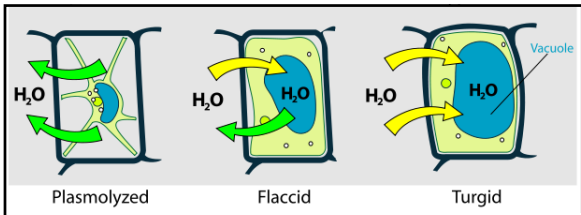
- Diffusion – movement of particles from an area of high concentration to an area of low concentration caused by kinetic energy.
  - Kinetic Energy (movement of particles because of the movement of their atoms).
  - Continues until an equilibrium is reached (no gradient).
  - Dynamic equilibrium – particles move freely and are evenly distributed.

Osmosis

- Diffusion of water across a selectively permeable membrane.
- Occurs until water is balanced on both sides of the membrane.

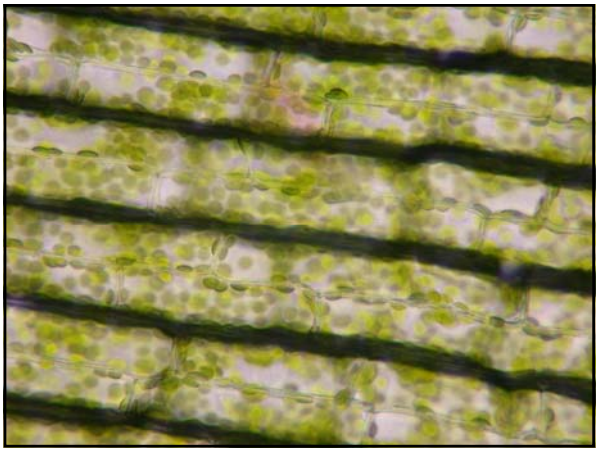
Cell Concentrations

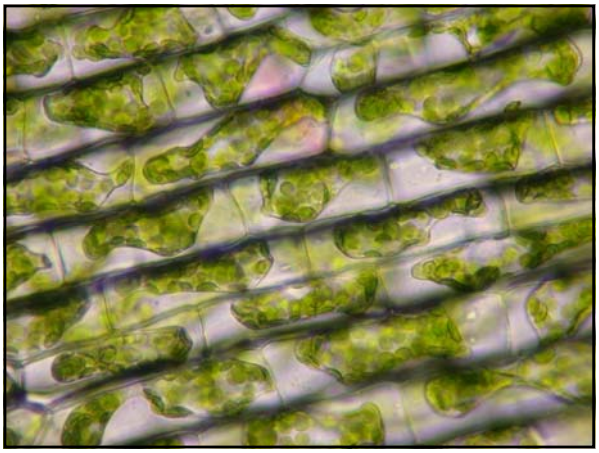
- Hypertonic solutions – when one solution has more dissolved solute.
- Hypotonic solutions – the solution with a lower concentration of dissolved solute.
- Isotonic solutions – the same concentration of dissolved solute.



When plant cells are placed in a Hypertonic solution – the cells will have more solvent than the environment (the cell's internal fluid is hypotonic to the environment). The water inside the cell will then move outwards to reach equilibrium. This will cause the cell to swell as it gains water.

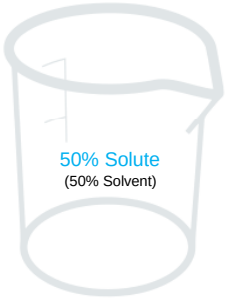
Luckily the cell wall will then prevent the membrane from growing so large that it bursts. Instead it will build up turgor pressure.





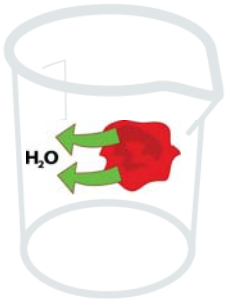
If a red blood cell is placed within a solution containing 50% solute what will the effect of diffusion on the cell if the cell membrane is impermeable to the solute?

5% Solute
(95% Solvent)



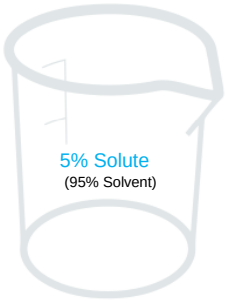
If a red blood cell is placed within a solution containing 50% solute what will the effect of diffusion on the cell if the cell membrane is impermeable to the solute?

Since the Solute cannot exit the cell (the membrane is impermeable to solute) the red blood cell will loose water to the beaker as the solvent flows out to reach equilibrium.



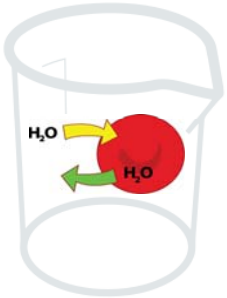
If a red blood cell is placed within a solution containing 5% solute what will the effect of diffusion on the cell if the cell membrane is impermeable to the solute?

5% Solute
(95% Solvent)



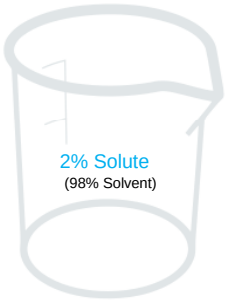
If a red blood cell is placed within a solution containing 5% solute what will the effect of diffusion on the cell if the cell membrane is impermeable to the solute?

Since the amount of solvent is equal both inside and outside the red blood cell the amount of solvent entering will be equal to the amount of solvent exiting



If a red blood cell is placed within a solution containing 2% solute what will the effect of diffusion on the cell if the cell membrane is impermeable to the solute?

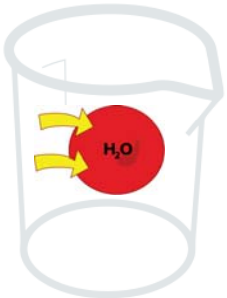
5% Solute
(95% Solvent)



2% Solute
(98% Solvent)

If a red blood cell is placed within a solution containing 2% solute what will the effect of diffusion on the cell if the cell membrane is impermeable to the solute?

Since the Solute cannot exit the cell (the membrane is impermeable to solute) the red blood cell will gain water to the beaker as the solvent flows into the cell as it tries to reach equilibrium.



Elodeagif.swf

Overcoming Osmosis

- Contractile vacuoles – expel excess water from bacterial cells that live in water.
- Turgor pressure – water pressure in a plant cell. Loss of turgor pressure causes wilting (plasmolysis).

Cytoplasm

- **Cytoplasm** is all of the liquidy stuff inside a cell except for the nucleus.
- Cytoplasm is separated from nucleus by the nuclear envelope and from the external environment by the plasma membrane.
- The cytoplasm contains the organelles and a colloidal like aqueous fluid called the cytosol. Dissolved in the cytosol are salts, minerals and organic molecules.

Cytoplasm

• contains the organelles
• allows for the transport of substances within the cell;
• provides an environment in which chemical reactions can occur;
• helps to support the cell.

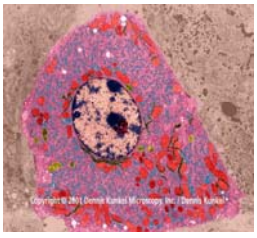
Colloids

A substance in between a solution and a suspension

Fog

Jell-O

Nucleus



- Nucleus→
  - Stores the recipes for making proteins
  - Contains DNA found on **chromatin** strands
  - Materials pass in and out through nuclear pores in the double layered nuclear membrane

Nucleus

The nucleus controls and regulates the cell's activities by transmitting genetic information during cell division; and by providing instructions for protein synthesis.

It is made up of the following components

•A double membrane-enclosed sac containing:
•Chromatin fibers (which comprise DNA and proteins)
•Nucleoplasm (a gel-like fluid)
•and the nucleolus.

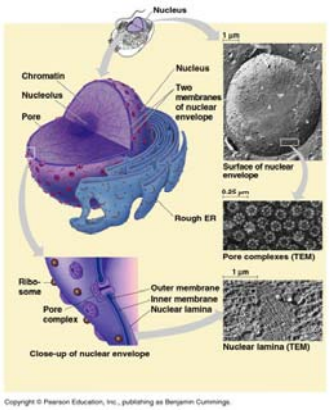
The nucleolus (a dense sphere made of RNA and proteins) makes ribosomal RNA.

Why is the Nucleus more like a library then a brain?

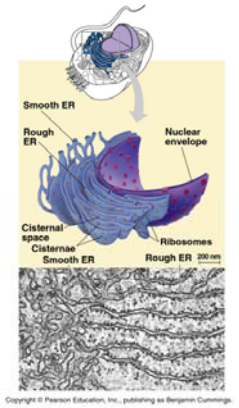
Libraries store information just like the nucleus stores DNA. DNA on it's own does not actually do anything. The information stored within the molecule is what is important.

Brains on the other hand are used to make decisions and actively participate in the running of the organisim.

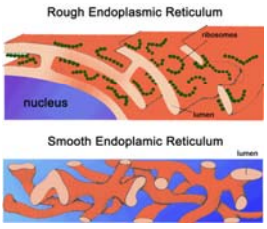
The nucleus and its envelope



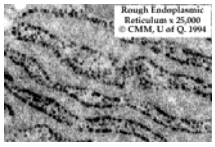
Endoplasmic reticulum (ER)



Endoplasmic Reticulum



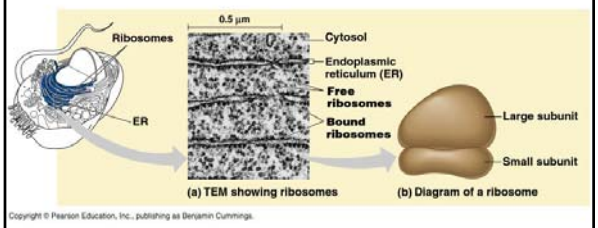
- Endoplasmic Reticulum→ (ER)
  - Carry proteins and other materials through the cell



Rough ER

A membranous system studded with ribosomes and enclosing a cavity. Rough ER makes the building blocks of the cell membrane, and helps to finish, store, and deliver proteins.

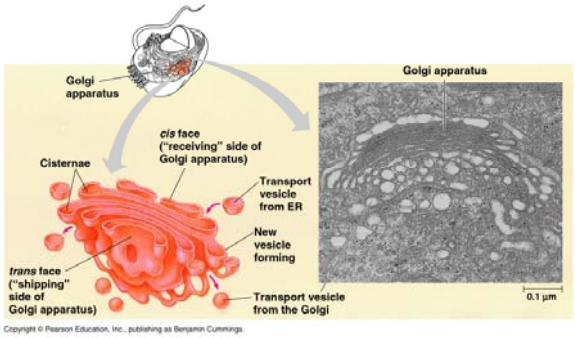
Ribosomes



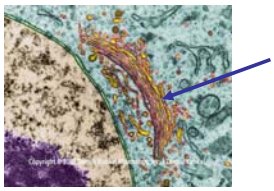
Ribosomes

- **Found on ER or in the cytoplasm**
- **Produce protein for the cell**
- **Dense particles composed of rRNA**
- **Ribosomes make proteins via translation**

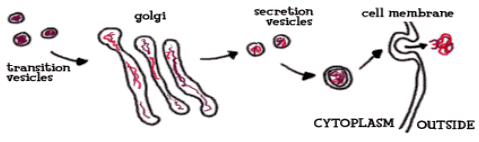
The Golgi apparatus



Golgi apparatus

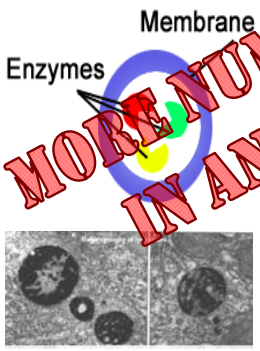


– A stack of membranous sacs that prepares and delivers proteins for secretion from the cell or for use within the cell.



The Golgi apparatus is the FedEx of the cell because it packages proteins and ships vesicles throughout the cell

Lysosomes



MORE NUMEROUS IN ANIMALS

- Contain enzymes that function in digestion of food and dead cell parts
- Surrounded by a membrane
- Created by the Golgi apparatus

Figure 7.14 The formation and functions of lysosomes (Layer 1)

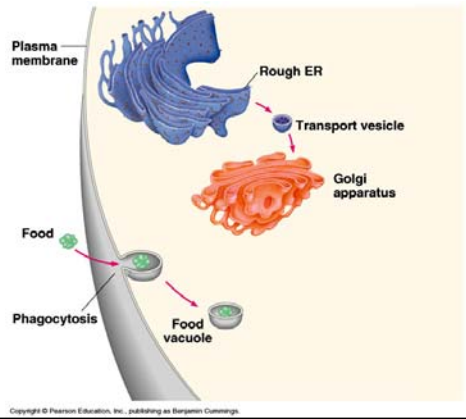


Figure 7.14 The formation and functions of lysosomes (Layer 2)

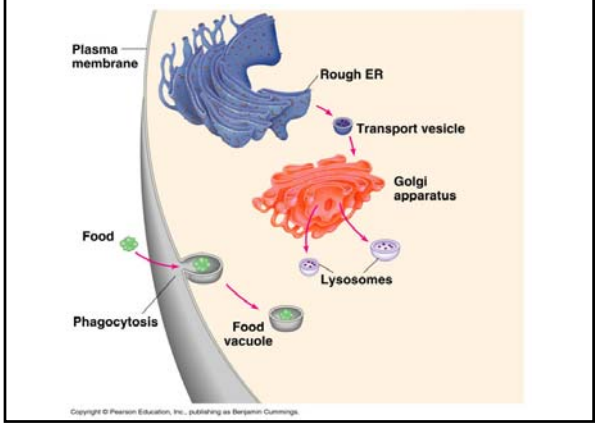


Figure 7.14 The formation and functions of lysosomes (Layer 3)

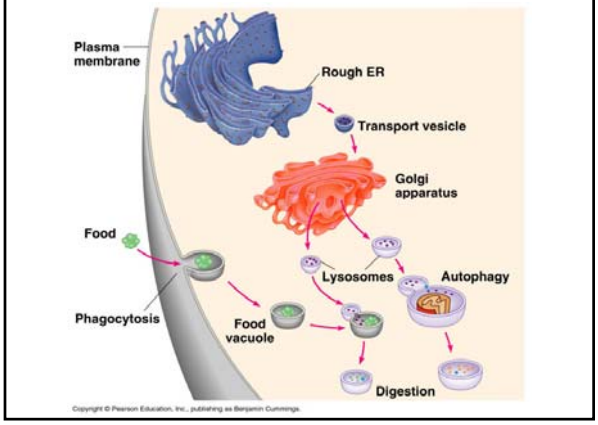
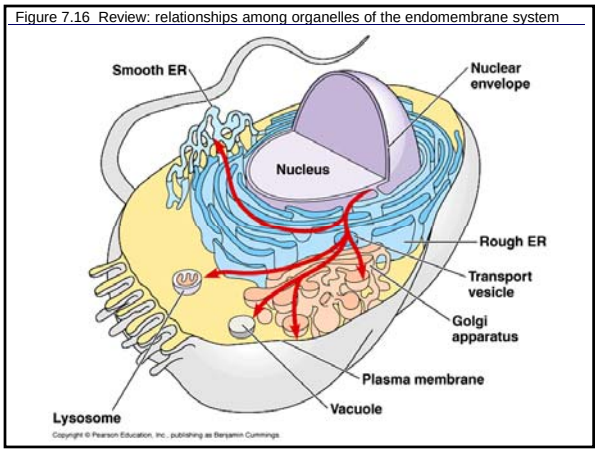
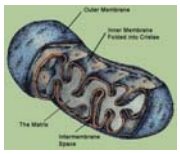
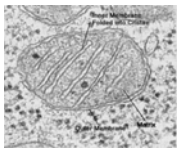


Figure 7.16 Review: relationships among organelles of the endomembrane system



Mitochondria





Often depicted as threadlike or kidney bean shaped organelles, mitochondria are continuously changing shape in living cells. They manufacture the cellular energy storage molecule, adenosine triphosphate (ATP) using the process of cellular respiration

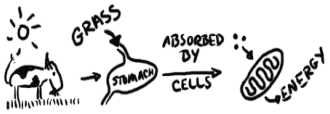
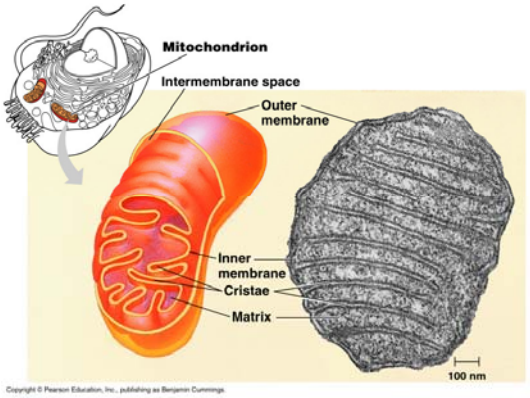


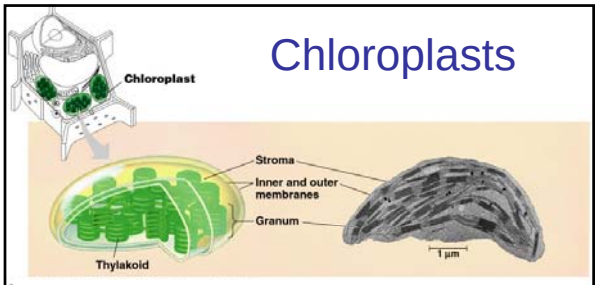
Figure 7.17 The mitochondrion, site of cellular respiration



Why is the inside of the Mitochondria highly folded?

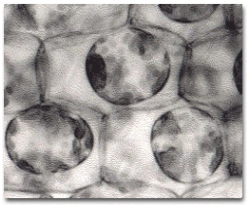
The cristae is the highly folded inner membrane of the mitochondria. It is folded to allow for greater surface area thus creating more room for making ATP

Chloroplasts



- **Turn the Sun's energy into food through photosynthesis**
- **Large organelles with a double-membrane envelope and elaborate interior membrane systems.**
  - **Thylakoids are sacks that hold the chlorophyll**
  - **The stacks of sacks (called grana) increase surface area for photosynthesis.**

Vacuoles

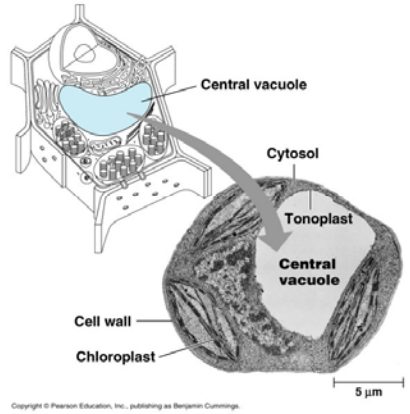


A large, membrane-enclosed, fluid-filled sac that can occupy up to 90% of the cell's volume.

The vacuole helps maintain cell shape and osmotic balance, stores sugars, salts, poisons and pushes the cytoplasm to edge of cell, which aids the intercellular transport of substances.

The vacuole membrane controls the movement of substances between the cytoplasm and the vacuole.

Figure 7.15 The plant cell vacuole



Cytoskeleton

Tiny tubes and fibers form the cell's "skeleton," which moves organelles within the cell; and helps control the shape of the cell.

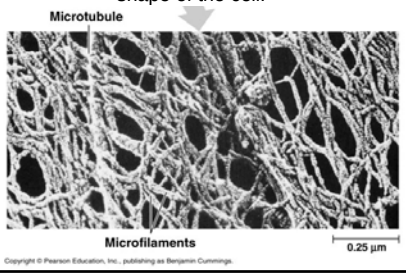
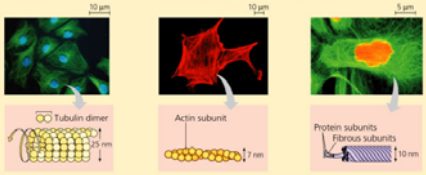


Table 7.2 The structure and function of the cytoskeleton

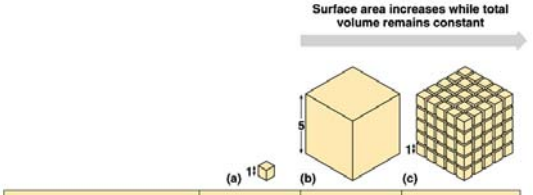
Table 7.2 The Structure and Function of the Cytoskeleton

Property	Microtubules	Microfilaments (Actin Filaments)	Intermediate Filaments
Structure	Hollow tubes; wall consists of 13 columns of tubulin molecules	Two intertwined strands of actin	Fibrous proteins supercoiled into thicker cables
Diameter	25 nm with 15-nm lumen	7 nm	8–12 nm
Protein subunits	Tubulin, consisting of α-tubulin and β-tubulin	Actin	One of several different proteins of the keratin family, depending on cell type
Main functions	Maintenance of cell shape (compression-resisting "girders") Cell motility (as in cilia or flagella) Chromosome movements in cell division Organelle movements	Maintenance of cell shape (tension-bearing elements) Changes in cell shape Muscle contraction Cytoplasmic streaming Cell motility (as in pseudopodia) Cell division (cleavage furrow formation)	Maintenance of cell shape (tension-bearing elements) Anchorage of nucleus and certain other organelles Formation of nuclear lamina



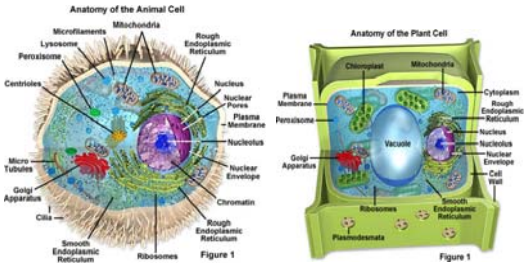
SOURCE: Adapted from W. M. Becker, L. J. Kleinsmith, and J. Hardin, *The World of the Cell*, 4th ed. (San Francisco, CA: Benjamin Cummings, 2000), p. 753.

Figure 7.5 Geometric relationships explain why most cells are microscopic



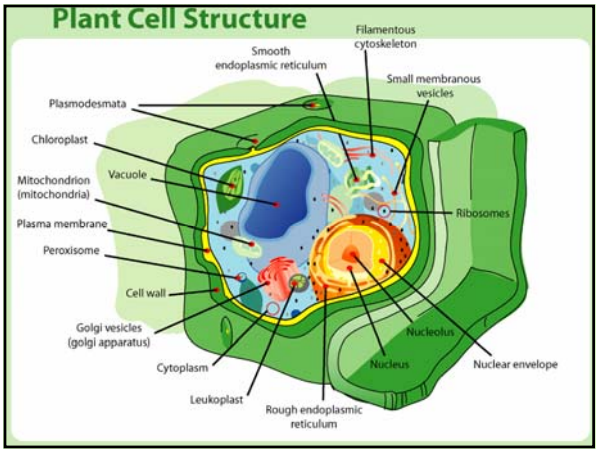
	(a)	(b)	(c)
Total surface area (height × width × number of sides × number of boxes)	6	150	750
Total volume (height × width × length × number of boxes)	1	125	125
Surface-to-volume ratio (area ÷ volume)	6	1.2	6

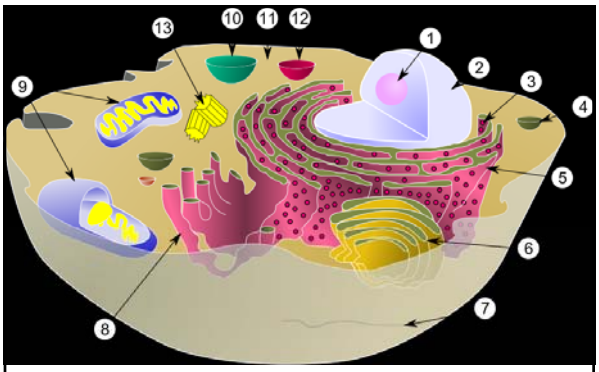
Animal vs. Plant



Animal vs. Plant

1. Plant cells have chloroplasts
2. Plant cells have a cell wall
3. Plant cells have a large central vacuole
4. Animal cells have more lysosomes





1. Nucleolus
2. Nucleus
3. Ribosome
4. Vesicle
5. Rough endoplasmic reticulum
6. Golgi apparatus (or "Golgi body")
7. Cytoskeleton
8. Smooth endoplasmic reticulum
9. Mitochondrion
10. Vacuole
11. Cytoplasm
12. Lysosome 13. Centriole