

Chapter 3

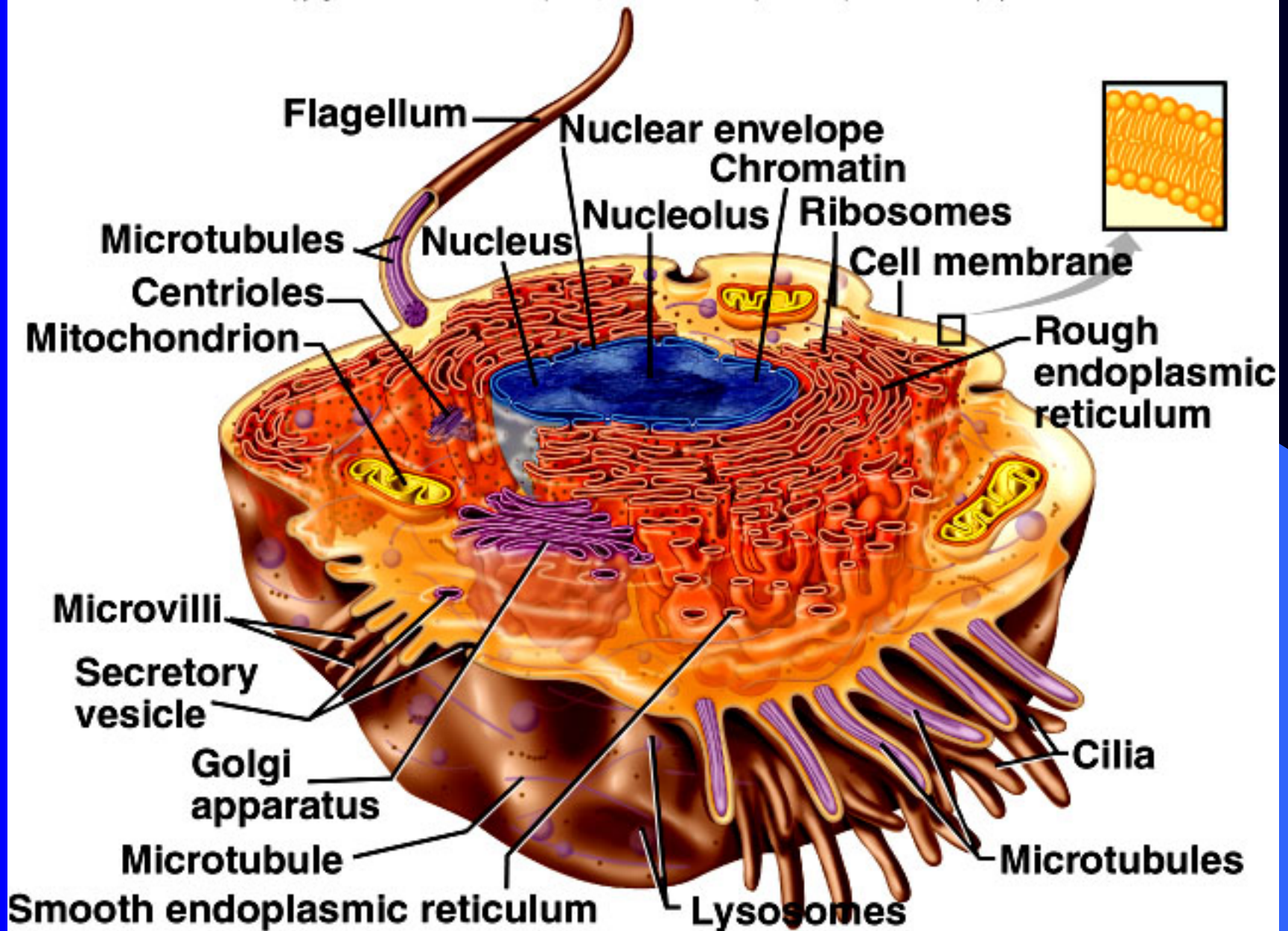
Cells

Introduction:

- A. The human body consists of 75 trillion cells that vary considerably in shape and size yet have much in common.
- B. Differences in cell shape make different functions possible.

A Composite Cell:

- A. A composite cell includes many different cell structures.
- B. A cell consists of three main parts---the nucleus, the cytoplasm, and the cell membrane.
- C. Within the cytoplasm are specialized organelles that perform specific functions for the cell.



D. Cell Membrane:

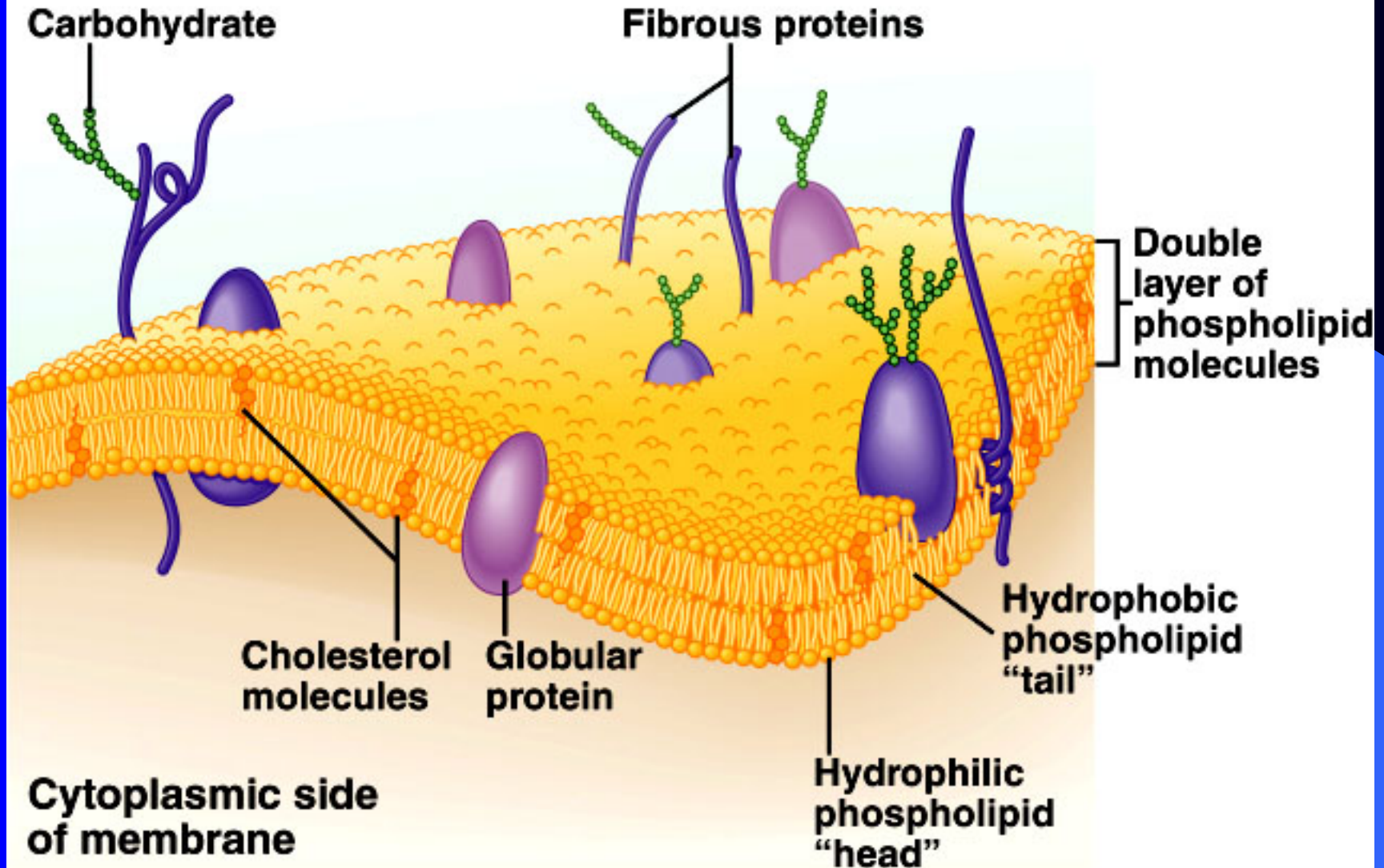
1. The cell membrane regulates the movement of substances in and out of the cell, participates in signal transduction, and helps cells adhere to other cells.

D. Cell Membrane:

2. General Characteristics

- a. The cell membrane is extremely thin and selectively permeable.
- b. It has a complex surface with adaptations to increase surface area.

Extracellular side of membrane



D. Cell Membrane:

3. Cell Membrane Structure:

- a. The basic framework of the cell membrane consists of a double layer of phospholipids, with fatty acid tails turned inward.
- b. Molecules that are soluble in lipids (gases, steroid hormones) can pass through the lipid bilayer.

D. Cell Membrane:

- c. Embedded cholesterol molecules strengthen the membrane and help make the membrane less permeable to water-soluble substances.
- d. Many types of proteins are found in the cell membrane, including transmembrane proteins and peripheral membrane proteins.

D. Cell Membrane:

- e. Membrane proteins perform a variety of functions and vary in shape.
- f. Some proteins function as receptors on the cell surface, starting signal transduction.
- g. Other proteins aid the passage of molecules and ions.

D. Cell Membrane:

- h. Proteins protruding into the cell anchor supportive rods and tubules.
- i. Still other proteins have carbohydrates attached; these complexes are used in cell identification. Membrane proteins called cellular adhesion molecules (CAMs) help determine one cell's interactions with others.

E. Cytoplasm:

1. The cytoplasm consists of a clear liquid (cytosol), a supportive cytoskeleton, and networks of membranes and organelles.
 - a. Endoplasmic reticulum is made up of membranes, flattened sacs, and vesicles, and provides a tubular transport system inside the cell.

E. Cytoplasm: (cont.)

1a1. With ribosomes, endoplasmic reticulum (ER) is rough ER, and functions in protein synthesis.

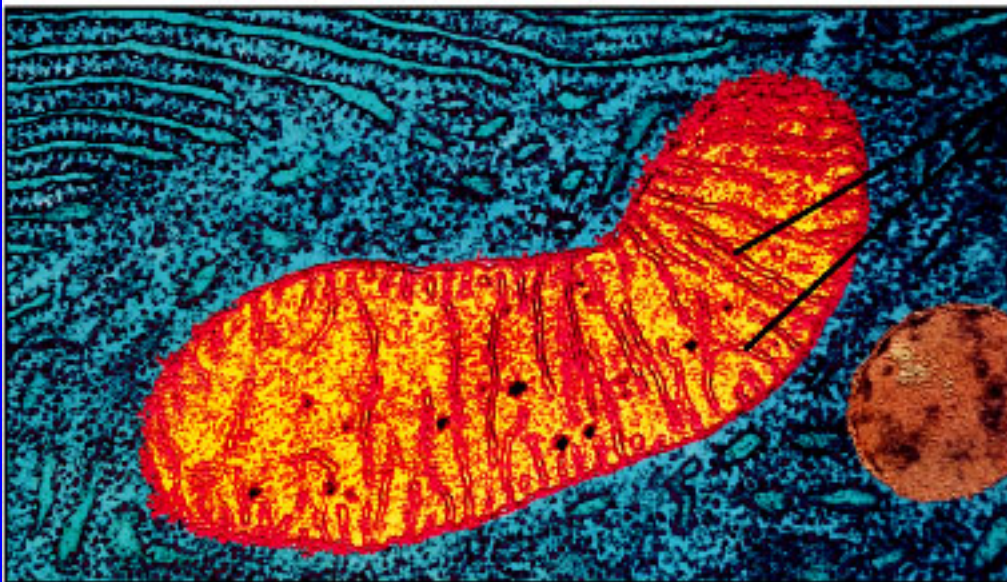
1a2. Without ribosomes, it is smooth ER,
and functions in lipid synthesis.

E. Cytoplasm: (cont.)

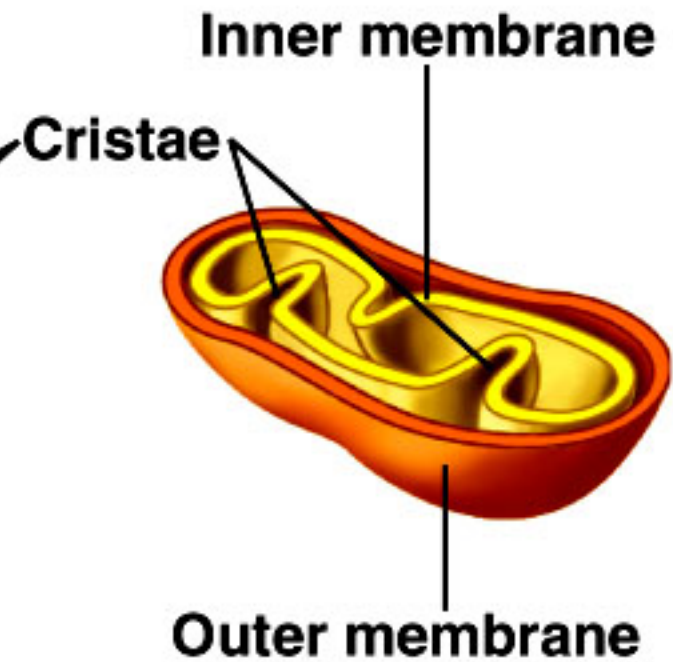
- b. Ribosomes are found with ER and are scattered throughout the cytoplasm. They are composed of protein and RNA and provide a structural support for the RNA molecules that come together in protein synthesis.

E. Cytoplasm: (cont.)

- d. Mitochondria are the powerhouses of the cell and contain enzymes needed for aerobic respiration.
 - i. The inner membrane of the mitochondrion is folded into cristae which hold the enzymes needed in energy transformations to make ATP.
 - ii. Very active cells contain thousands of mitochondria.



A



B

E. Cytoplasm: (cont.)

- e. Lysosomes are the "garbage disposals" of the cell and contain digestive enzymes to break up old cell components and bacteria.
- f. Peroxisomes contain enzymes that function in the synthesis of bile acids, breakdown of lipids, degradation of rare biochemicals, and detoxification of alcohol.

E. Cytoplasm: (cont.)

F. Cell Nucleus:

1. The fairly large nucleus is bounded by a double-layered nuclear membrane containing relatively large nuclear pores that allow the passage of certain substances.

Movements Through Cell Membranes

- A. The cell membrane controls what passes through it.**
- B. Mechanisms of movement across the membrane may be passive, requiring no energy from the cell (diffusion, facilitated diffusion, osmosis, and filtration) or active mechanisms, requiring cellular energy (active transport, endocytosis, and exocytosis).**

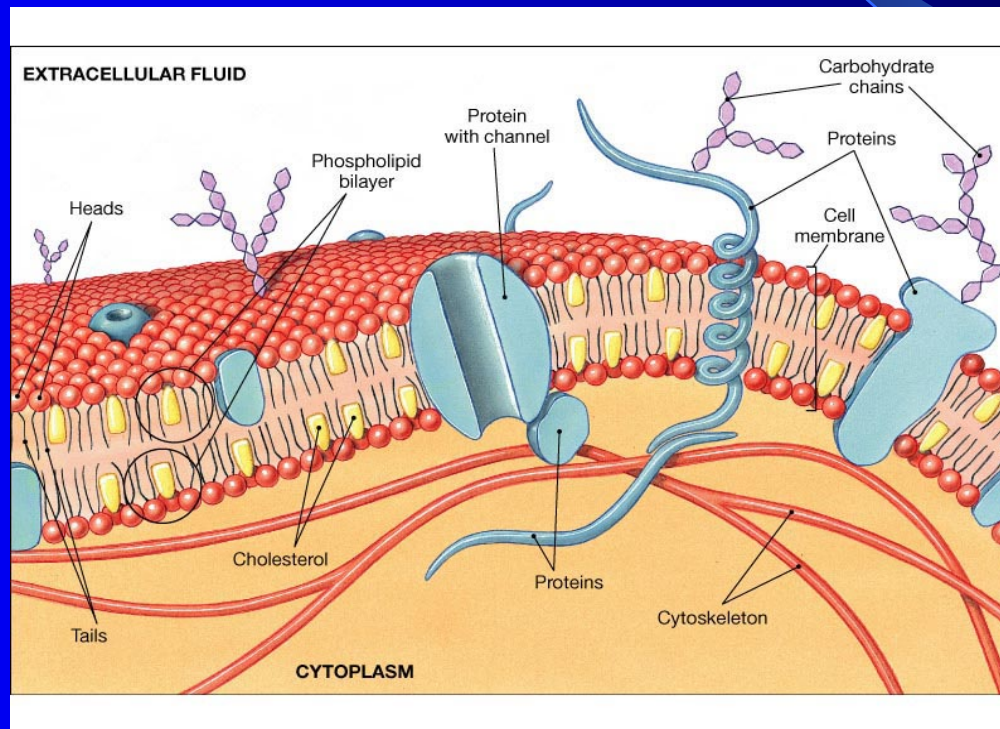
Movements Through Cell Membranes (cont.)

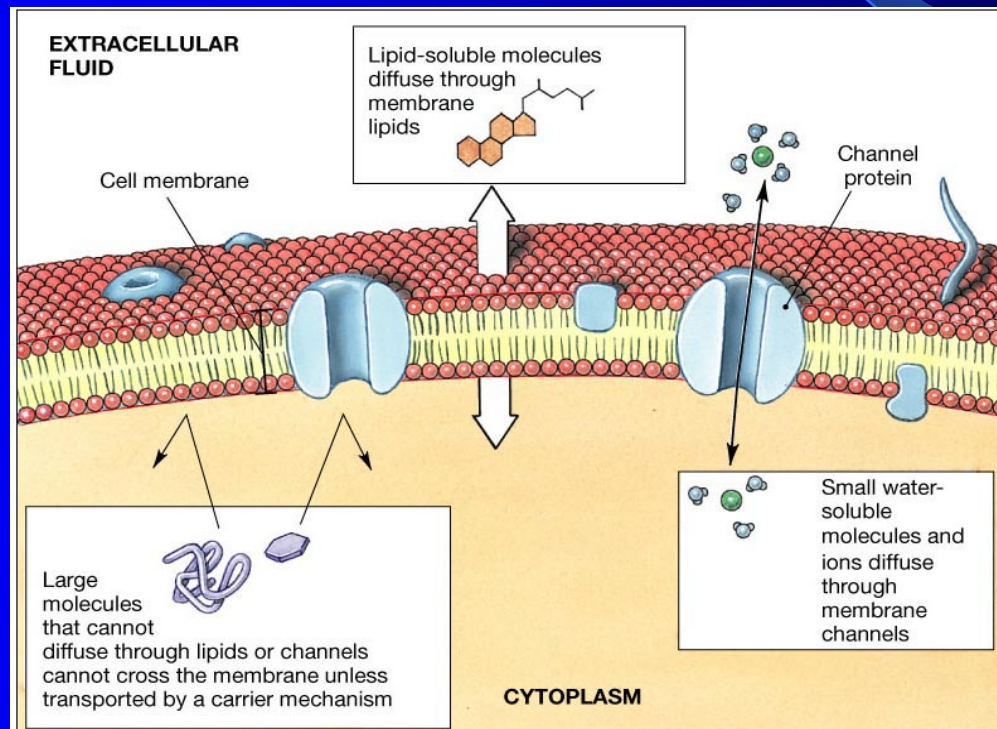
C. Passive Mechanisms

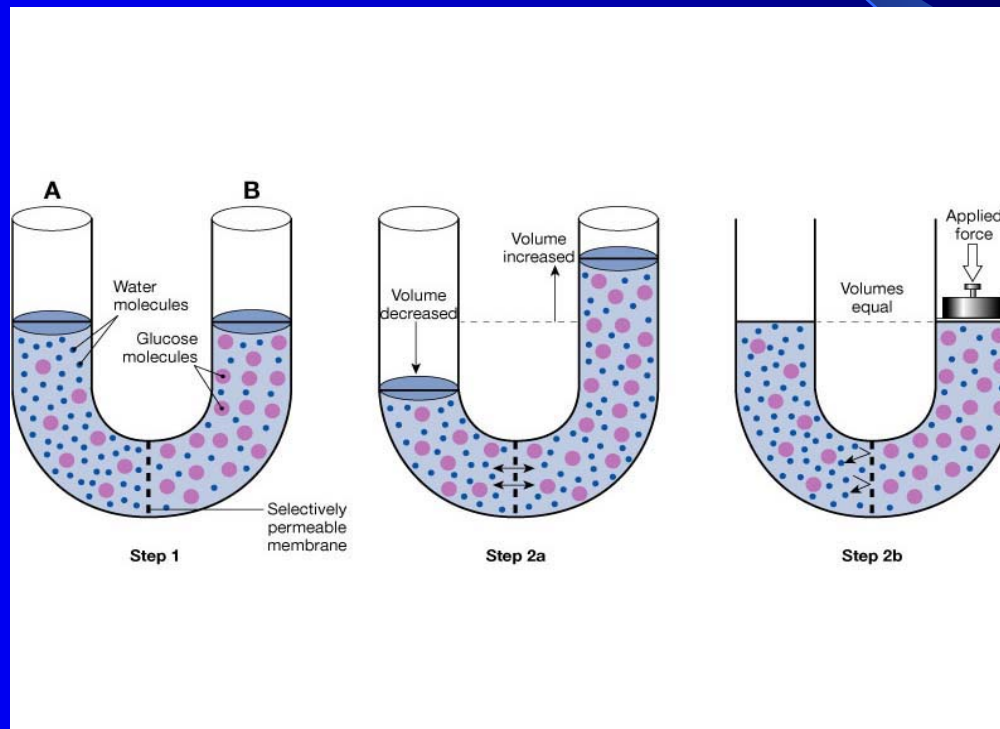
1. Diffusion

- a. Diffusion is caused by the random motion of molecules and involves the movement of molecules from an area of greater concentration to one of lesser concentration until equilibrium is reached.**









Movements Through Cell Membranes (cont.)

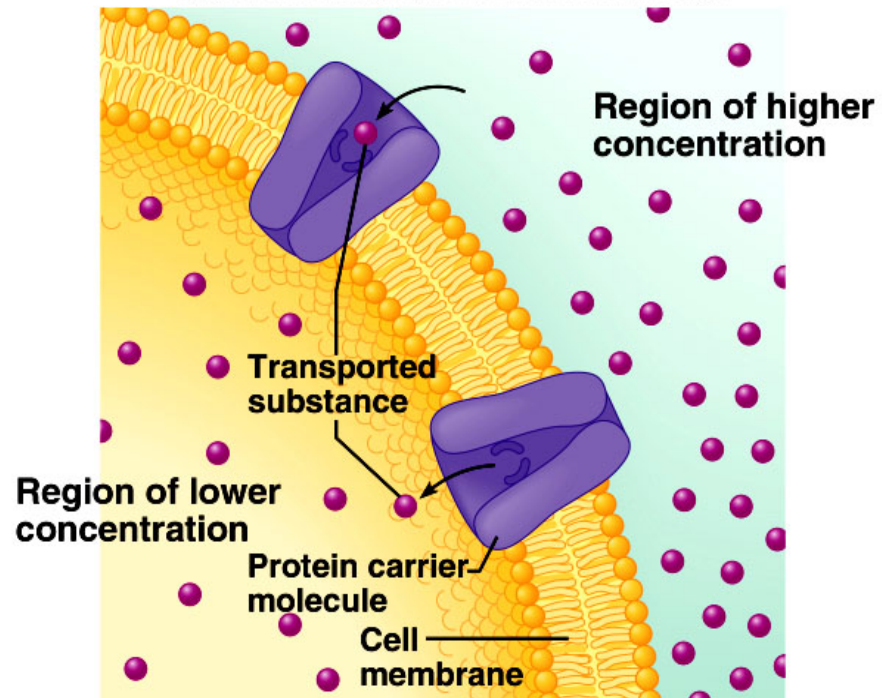
C1b. Diffusion enables oxygen and carbon dioxide molecules to be exchanged between the air and the blood in the lungs, and between blood and tissue cells.

Movements Through Cell Membranes

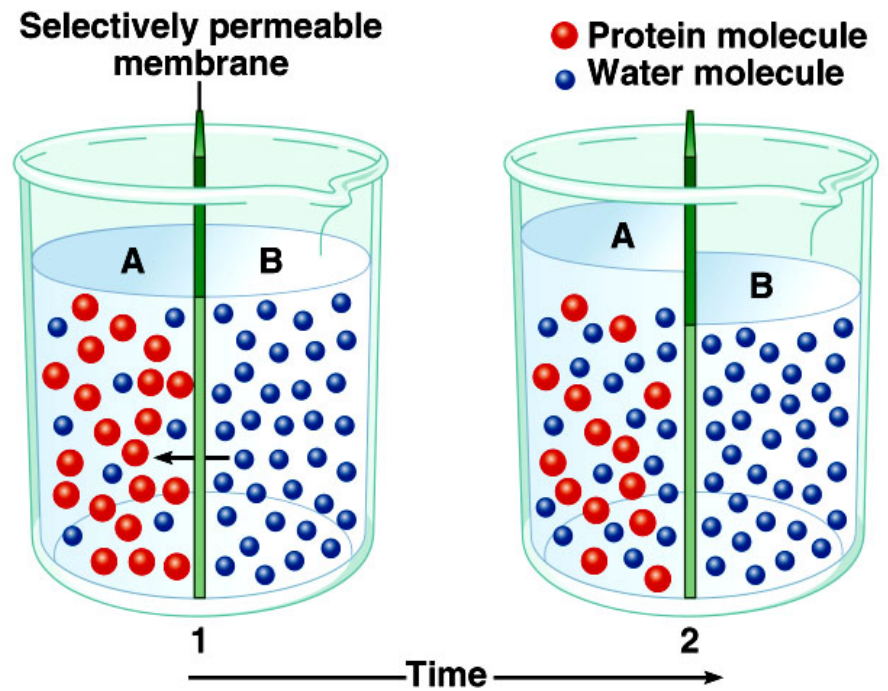
C2.Facilitated Diffusion

- a. Facilitated diffusion uses membrane proteins that function as carriers to move molecules (such as glucose) across the cell membrane.**
- b. The number of carrier molecules in the cell membrane limits the rate of this process.**

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Movements Through Cell Membranes

C3.Osmosis

a. Osmosis is a special case of diffusion in which water moves from an area of greater water concentration (where there is less osmotic pressure) across a selectively permeable membrane to an area of lower water concentration (where there is greater osmotic pressure).

Movements Through Cell Membranes

A solution with the same osmotic pressure as body fluids is called isotonic; one with higher osmotic pressure than body fluids is hypertonic; one with lower osmotic pressure is hypotonic.

Movements Through Cell Membranes

C4. Filtration

- a. Because of hydrostatic pressure, molecules can be forced through membranes by the process of filtration. Blood pressure is a type of hydrostatic pressure.**

Movements Through Cell Membranes

D. Active Mechanisms

1. Active Transport

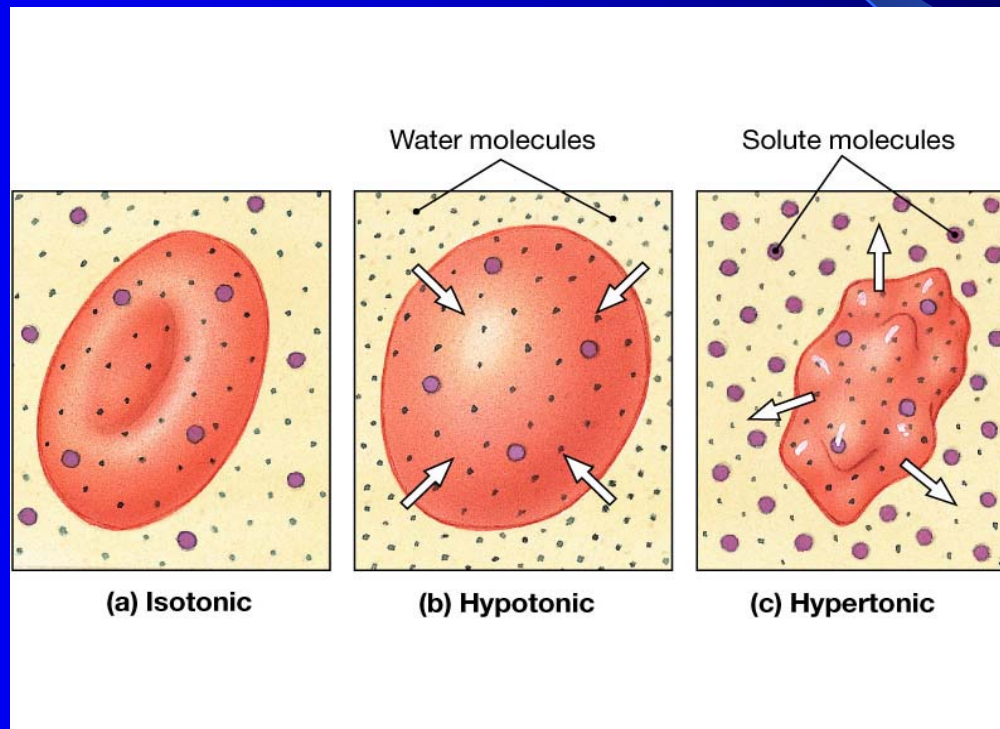
- a. Active transport uses ATP to move molecules from areas of low concentration to areas of high concentration through carrier molecules in cell membranes.
- b. As much as 40% of a cell's energy supply may be used to fuel this process.

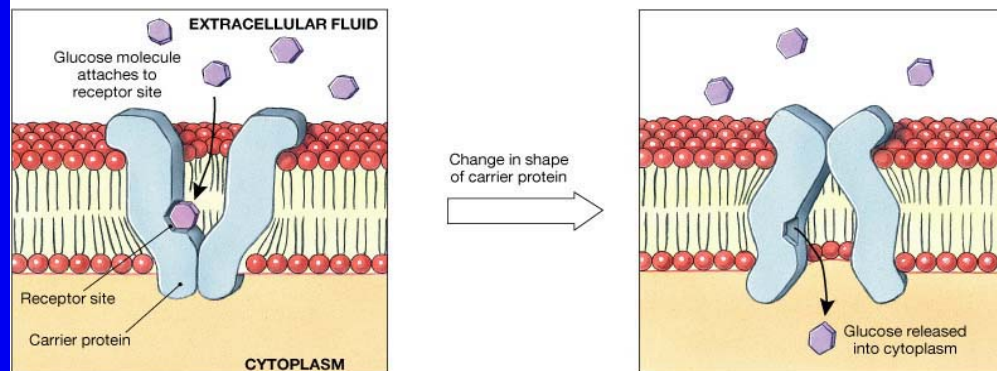
Movements Through Cell Membranes (cont.)

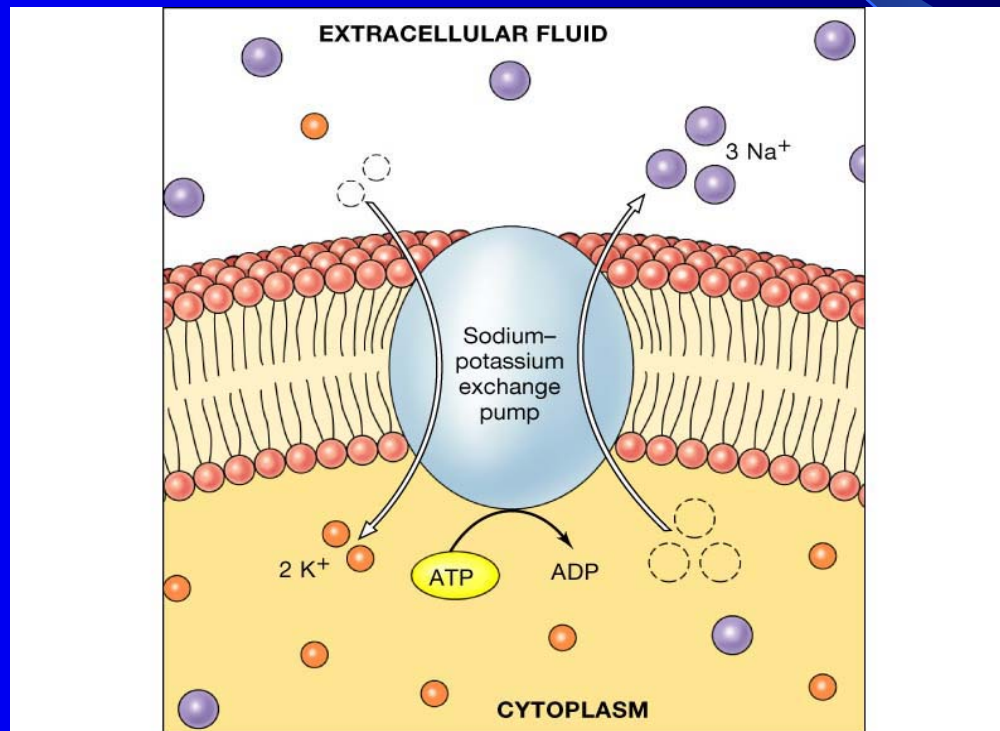
- D1c. The union of the specific particle to be transported with its carrier protein triggers the release of cellular energy (ATP), which in turn alters the shape of the carrier protein, releasing the particle to the other side of the membrane.

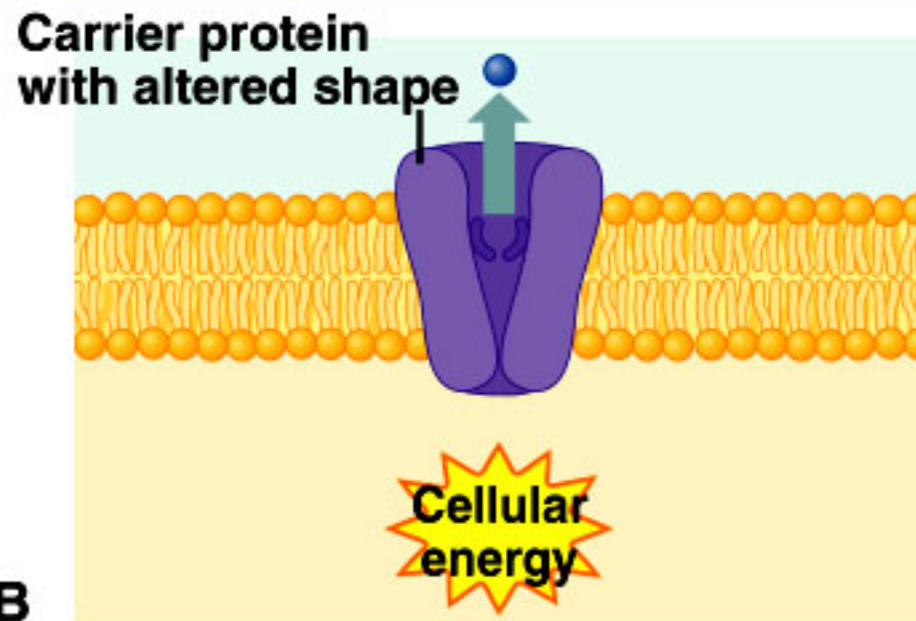
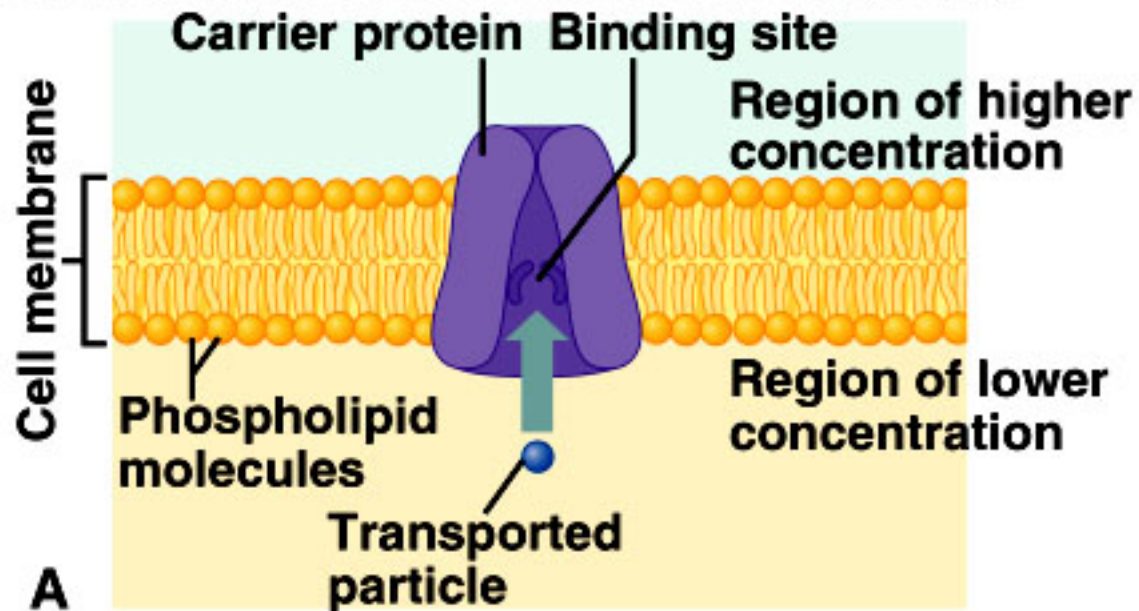
Movements Through Cell Membranes (cont.)

D1d. Particles that are actively transported include sugars, amino acids, and sodium, potassium, calcium, and hydrogen ions, as well as nutrient molecules in the intestines.









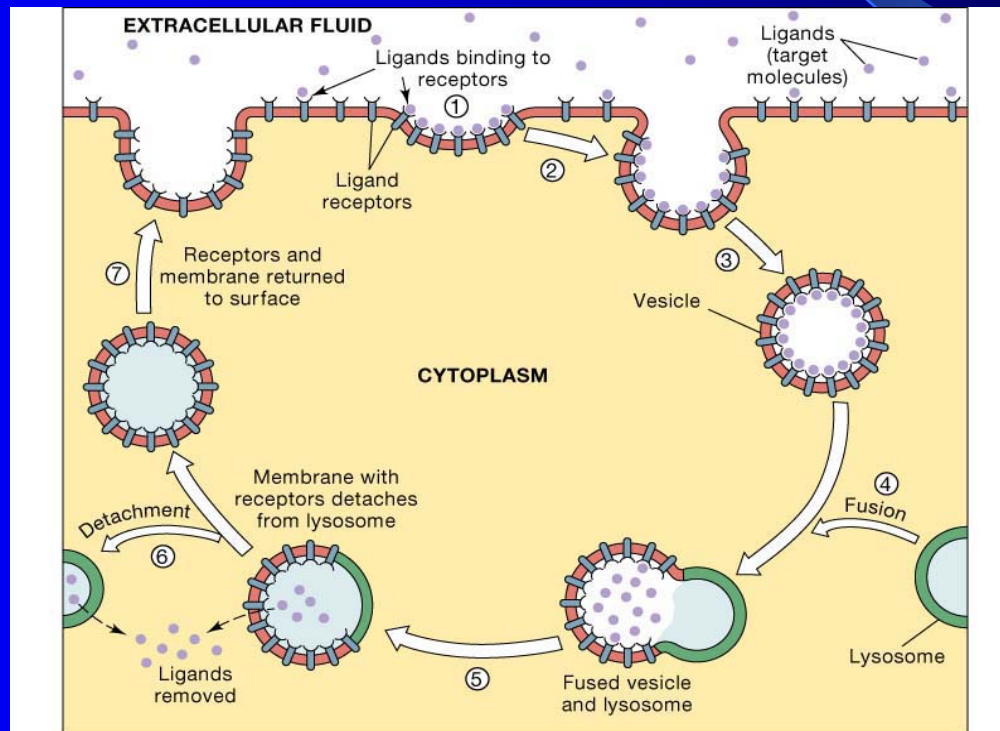
Movements Through Cell Membranes (cont.)

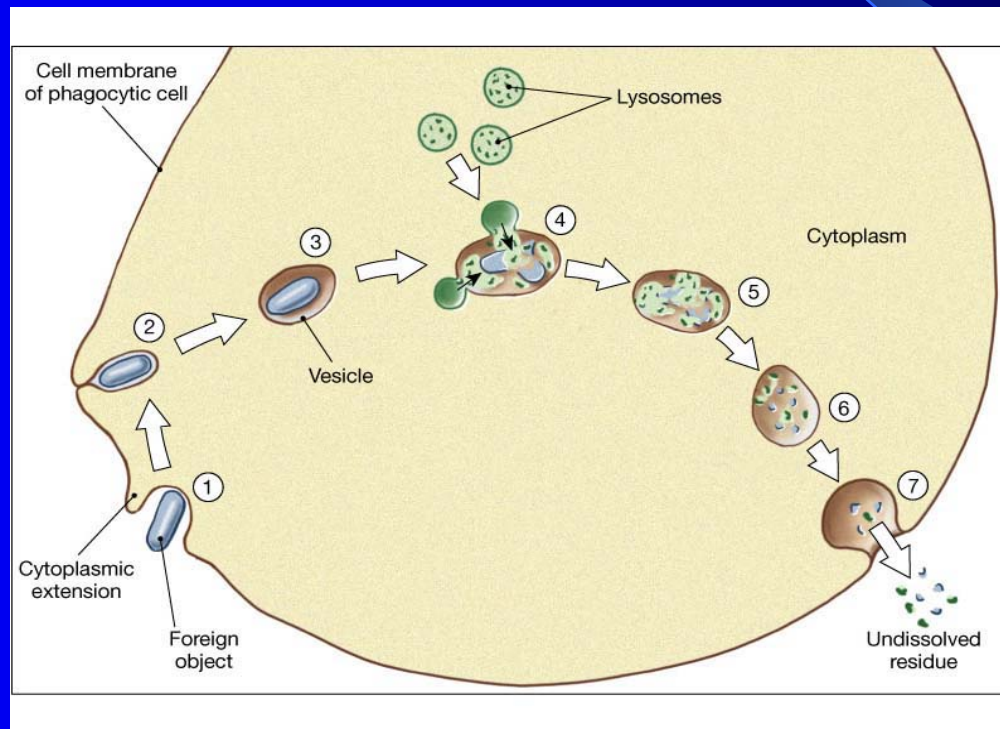
D2. Endocytosis and Exocytosis

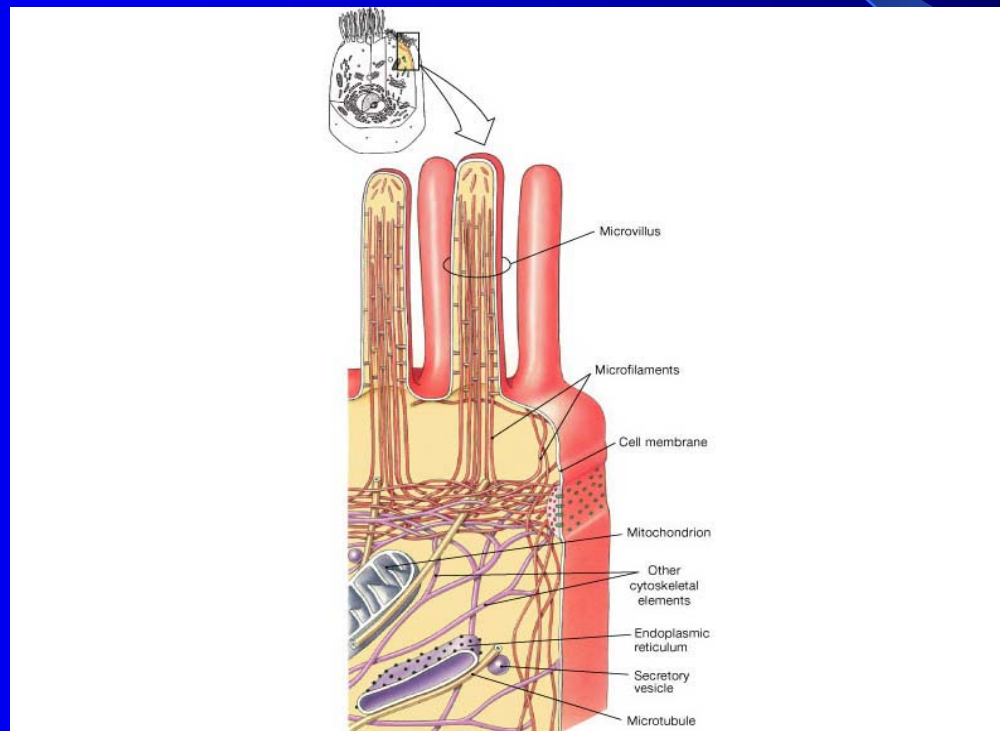
- a. In endocytosis, molecules that are too large to be transported by other means are engulfed by an invagination of the cell membrane and carried into the cell surrounded by a vesicle.
- b. Exocytosis is the reverse of endocytosis.

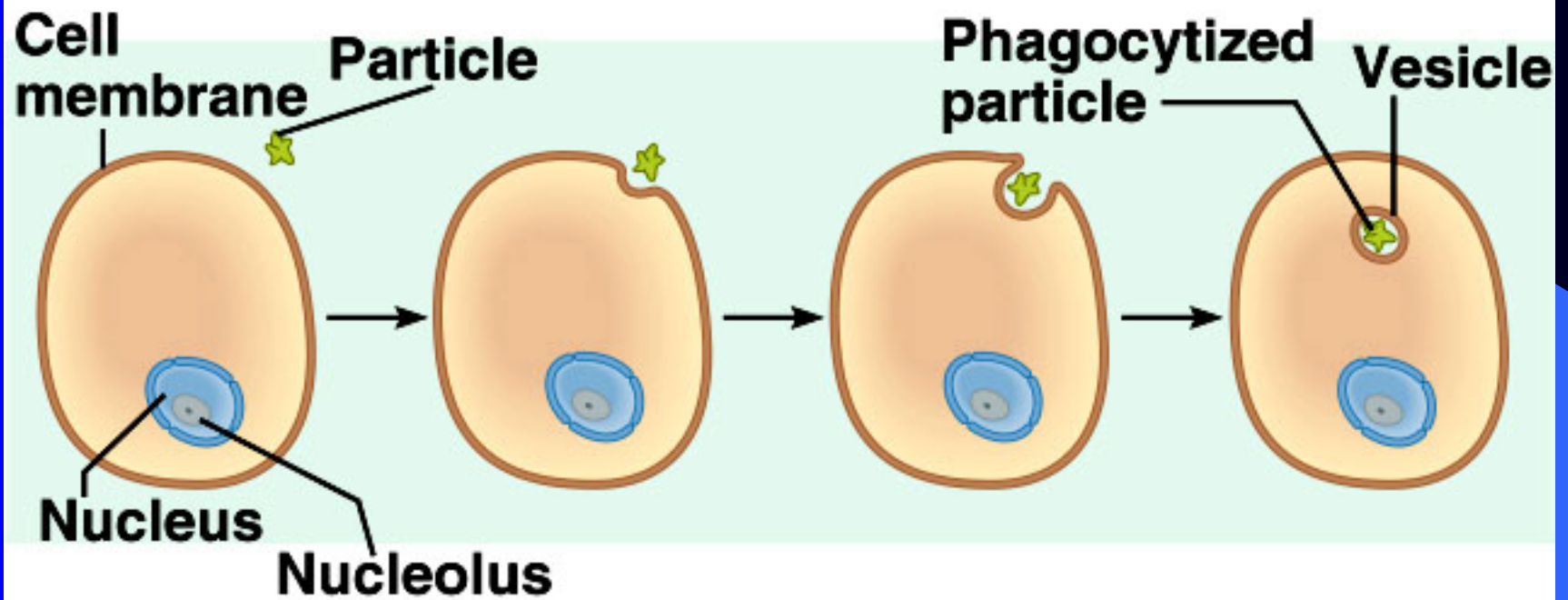
Movements Through Cell Membranes (cont.)

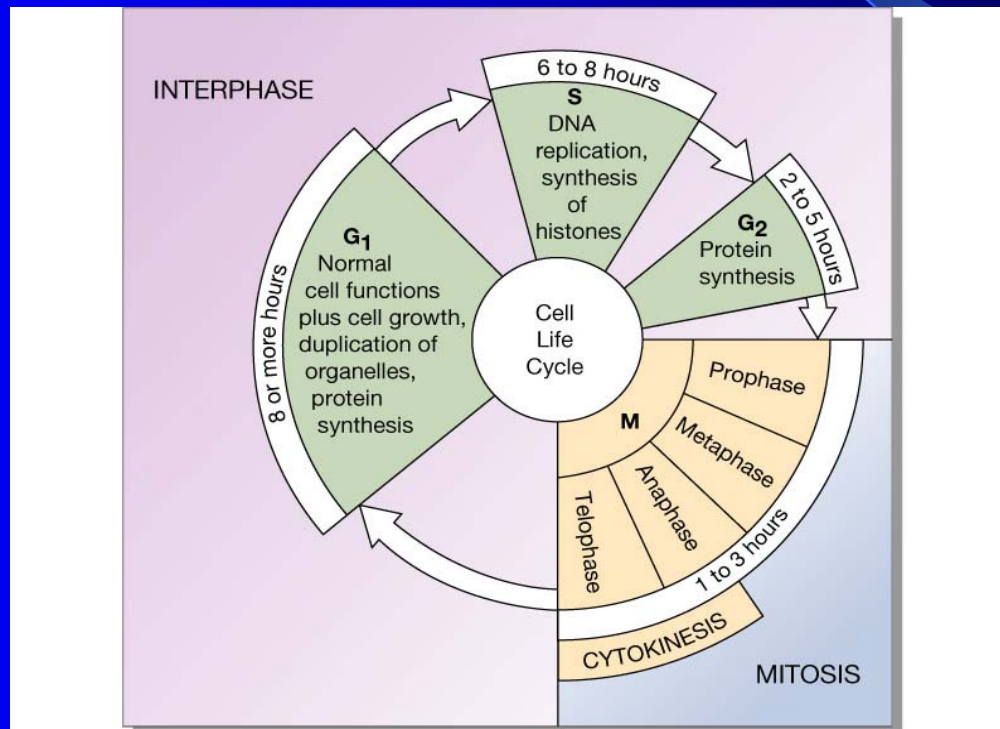
- D2c. Three forms of endocytosis are pinocytosis, phagocytosis, and receptor-mediated endocytosis.
- i. Pinocytosis is a form of endocytosis in which cells engulf liquids.
 - ii. Phagocytosis is a form of endocytosis in which the cell takes in larger particles, such as a white blood cell engulfing a bacterium.
 - iii. Receptor-mediated endocytosis allows the cell to take in very specific molecules (ligands) that pair up with specific receptors on the cell surface.

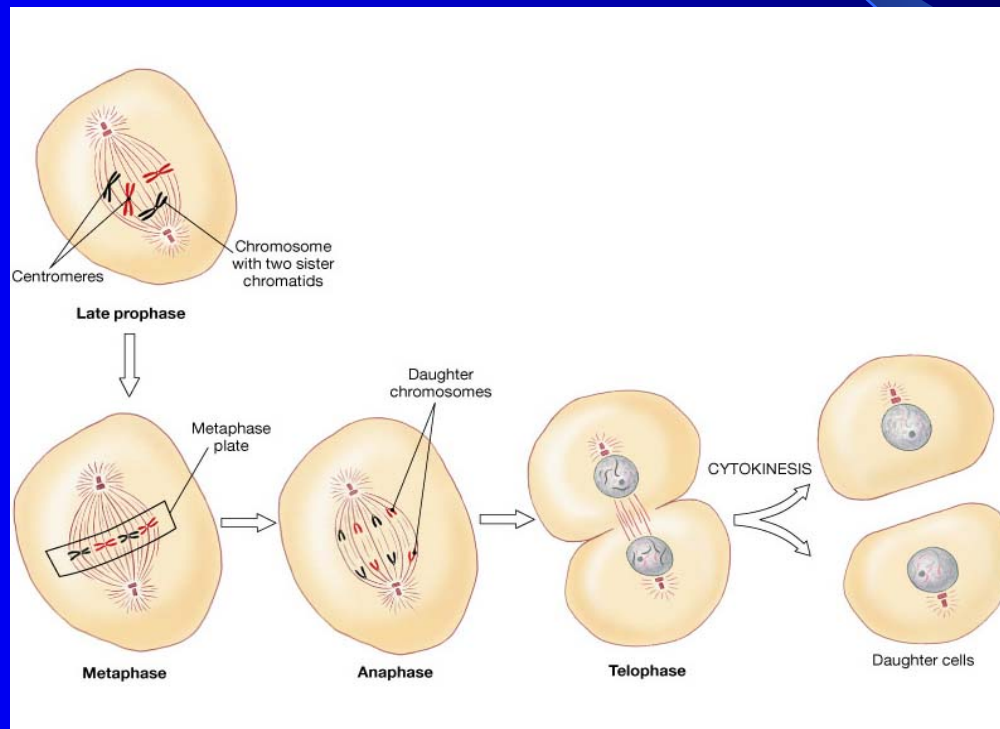


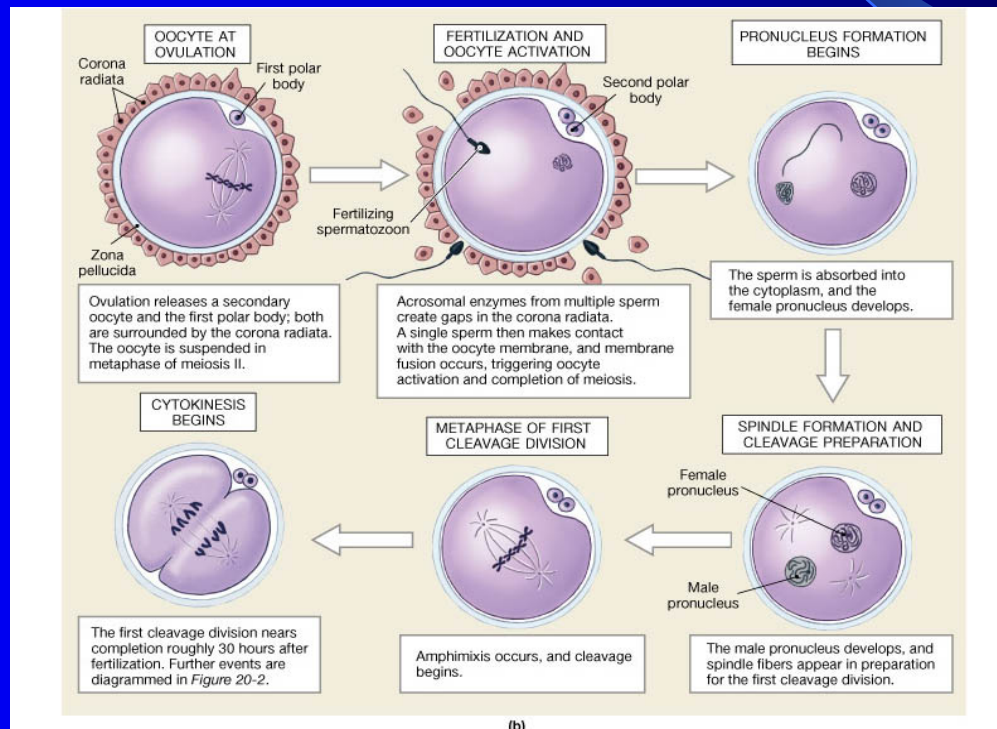




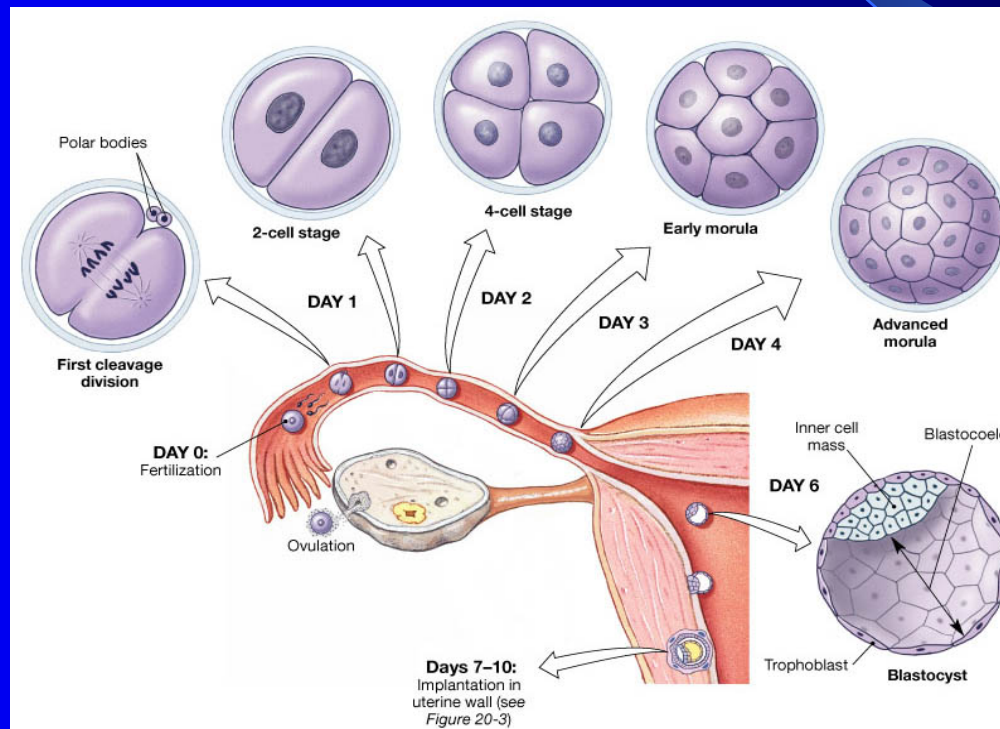


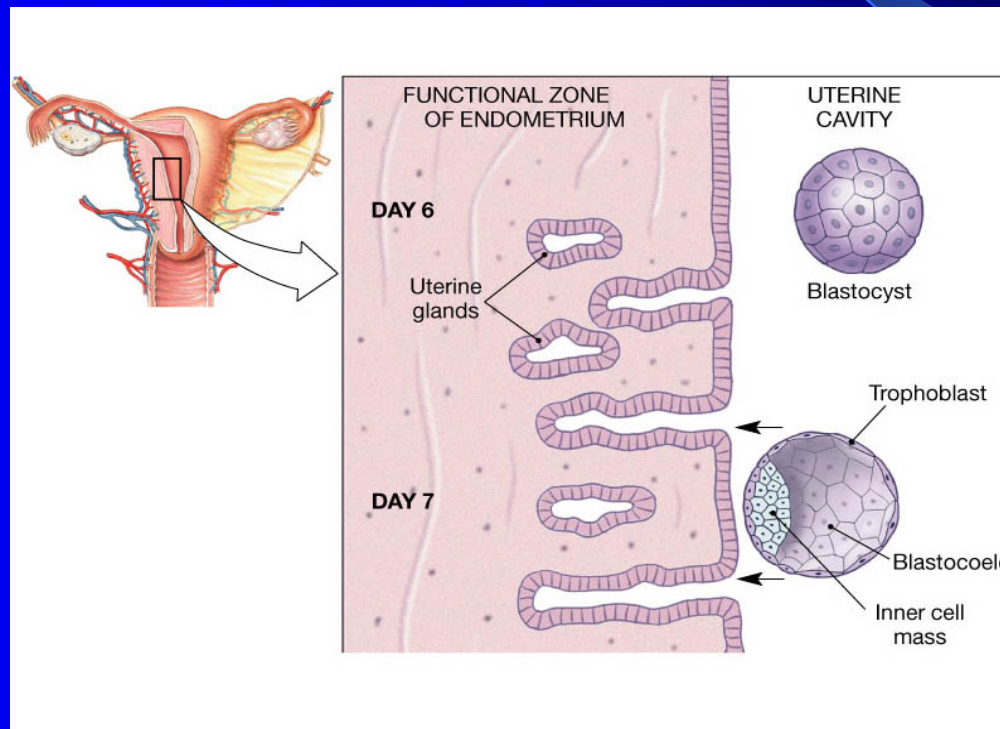


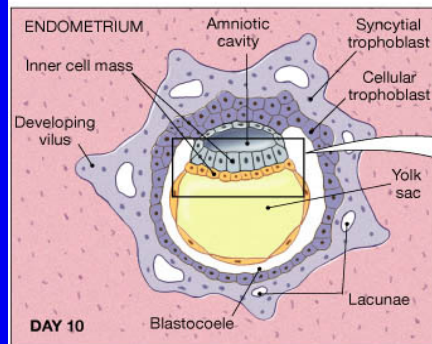




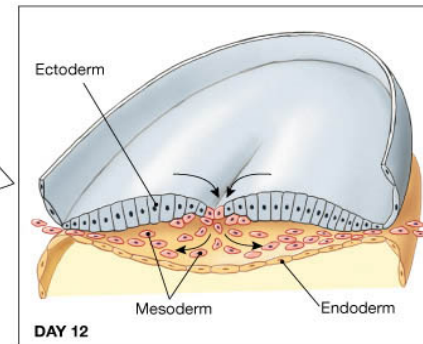
(b)



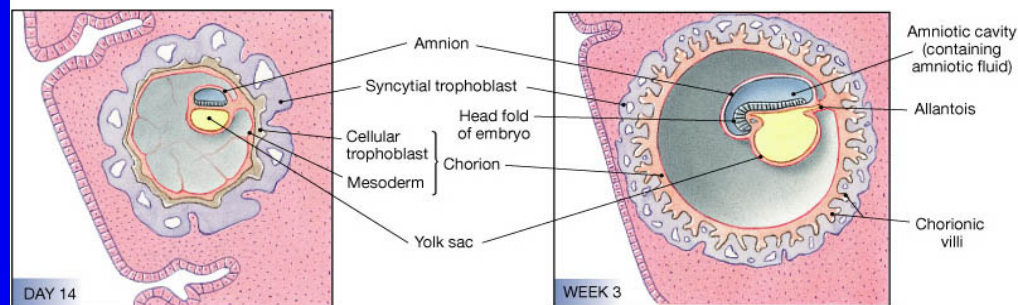




The inner cell mass at day 10 consists of two layers: a superficial layer, facing the amniotic cavity, and a deep layer, exposed to the blastocoele. Migration of cells around the amniotic cavity is the first step in the formation of the amnion. Migration of cells around the edges of the blastocoele is the first step in yolk sac formation.

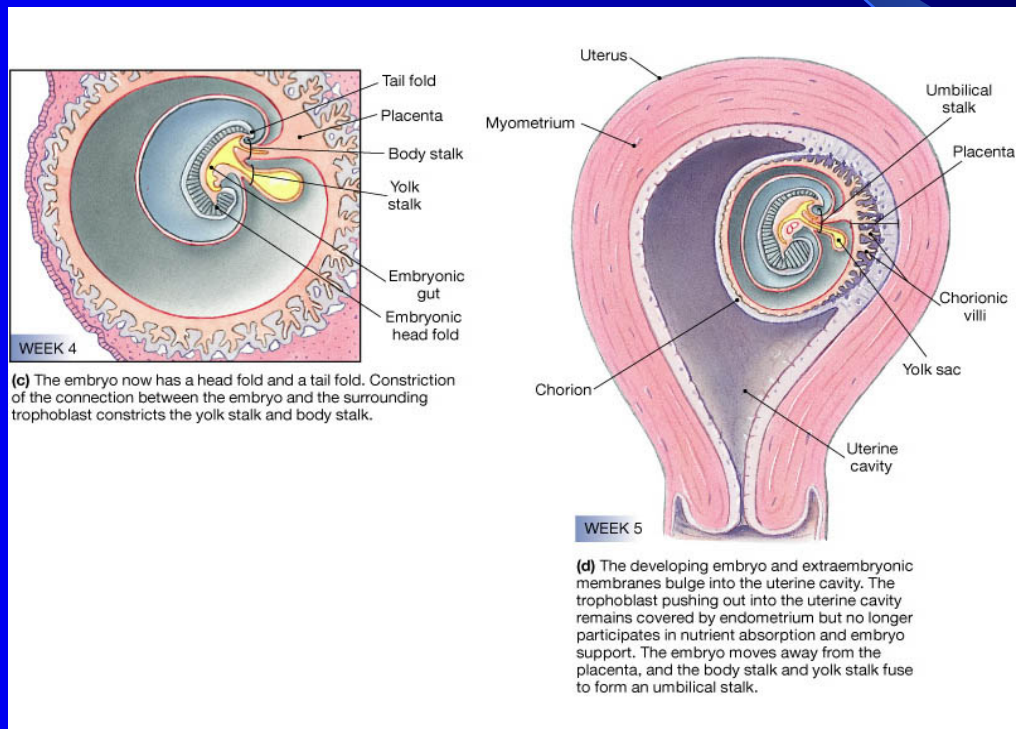


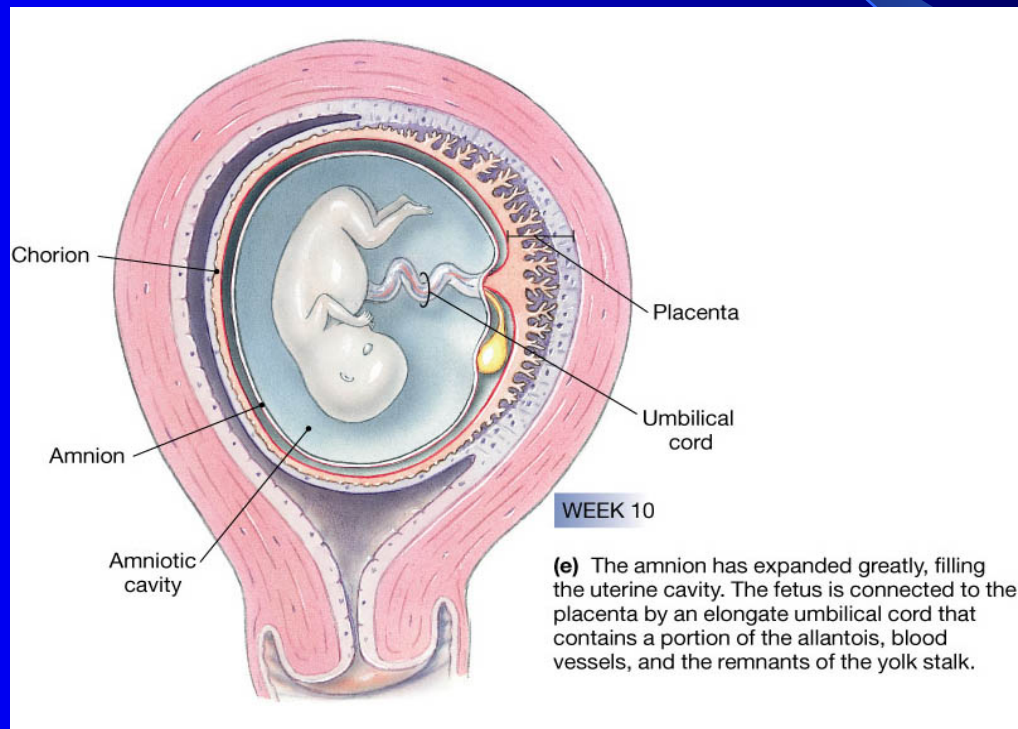
Migration of superficial cells creates a third layer. From the time this process (gastrulation) begins, the surface facing the amniotic cavity is called *ectoderm*, the layer facing the yolk sac is called *endoderm*, and the migrating cells form the *mesoderm*.



(a) The migration of the mesoderm around the inner surface of the trophoblast creates the chorion. Mesodermal migration around the outside of the amniotic cavity, between the ectodermal cells and the trophoblast, creates the amnion. Mesodermal migration around the endodermal pouch creates the yolk sac.

(b) The developing embryo bulges into the amniotic cavity at the head fold. The allantois, an endodermal extension surrounded by mesoderm, extends toward the trophoblast.





G. Cell Differentiation

1. The process by which cells develop into different types of cells with specialized functions is called differentiation.
2. Cell differentiation reflects genetic control of the nucleus as certain genes are turned on while others are turned off.

Cell Differentiation

