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Chapter 5 – Membrane Structure and Function
Exercise 1 – Membrane Structure (5.1)

Review the animal cell plasma membrane by labeling this diagram. Label the items in **boldface** type: Start with the **cytoplasm, extracellular fluid,** and a **fiber of the extracellular matrix.** In the membrane, label **phospholipids**, **glycoprotein, glycolipid, carbohydrate chain, hydrophobic tails, hydrophilic heads, phospholipid bilayer, peripheral protein, cholesterol, integral protein, and filaments of the cytoskeleton.**

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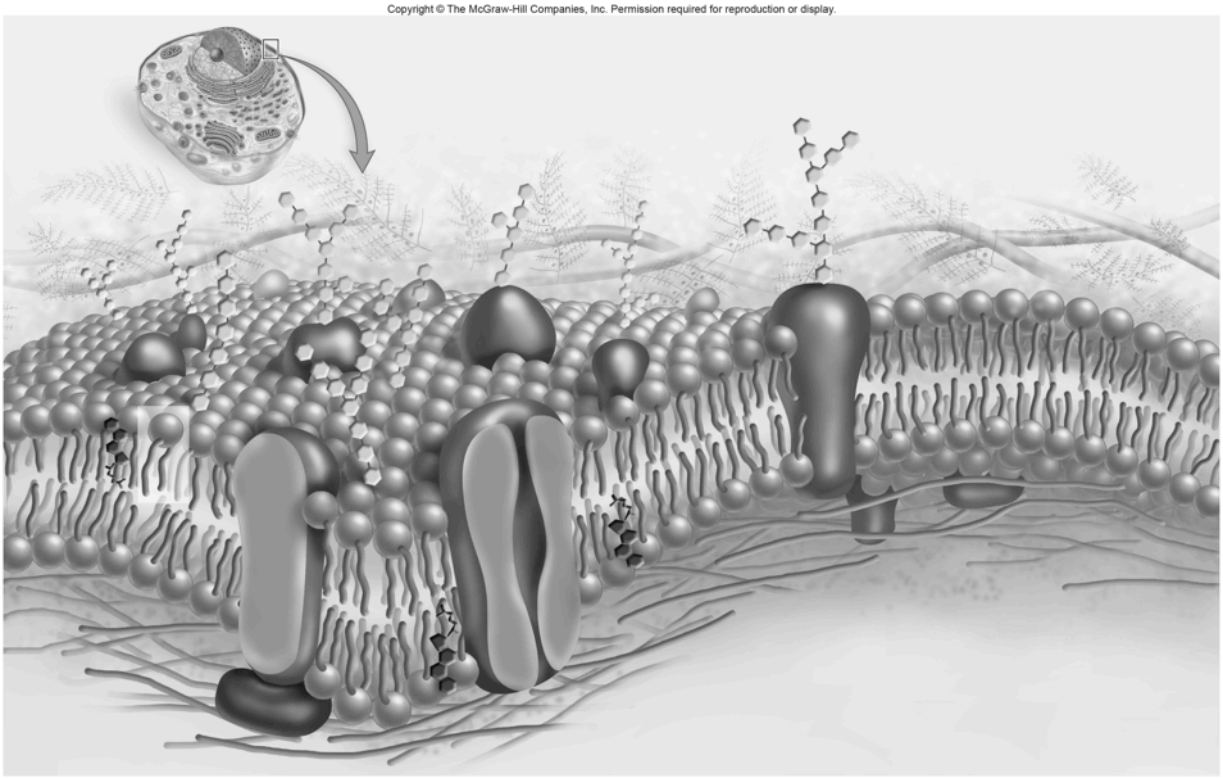

Exercise 2 – Membrane Proteins (5.1)

Label each membrane protein shown below. (See Figure 5.3)

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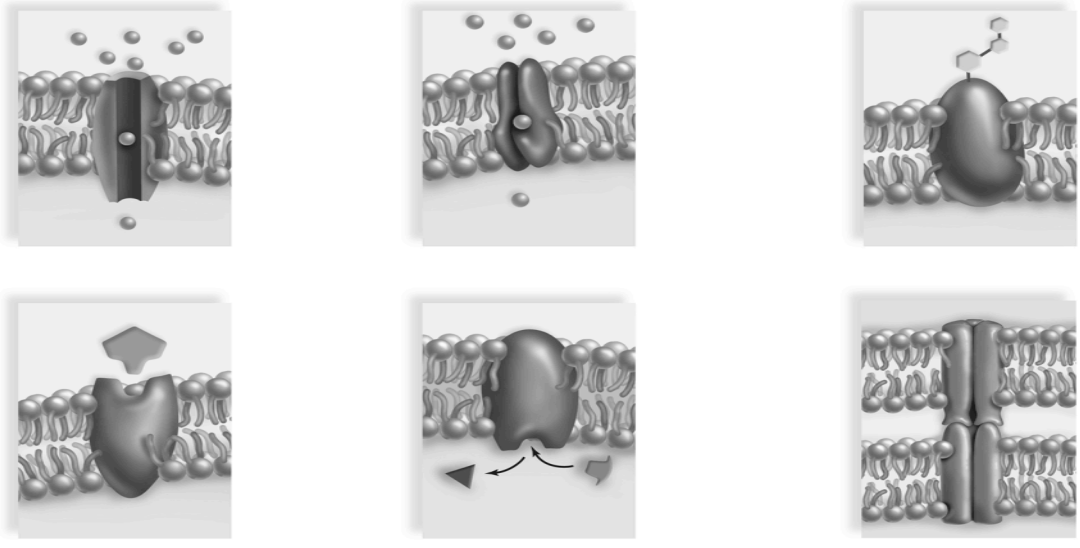

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Exercise 3 – Diffusion, Osmosis, and Active Transport (5.2-5.3)

Review diffusion and the function of cell membranes by matching each of the phrases on the right with the appropriate mechanisms from the list on the left. Two questions require more than one answer.

A. Diffusion
B. Active transport
C. Osmosis
D. Phagocytosis
E. Passive transport
F. Facilitated diffusion
G. Pinocytosis
H. Receptor-mediated endocytosis
I. Exocytosis

_____ 1. Type of diffusion across a biological membrane
_____ 2. Moves solutes against concentration gradient
_____ 3. Any spread of molecules from area of higher to lower concentration
_____ 4. Diffusion with the help of a transport protein
_____ 5. Three types of endocytosis
_____ 6. Engulfing of fluid in membrane vesicles
_____ 7. Diffusion of water across selectively permeable membrane
_____ 8. Transport molecules need ATP to function
_____ 9. Enables cell to engulf bulk quantities of specific large molecules
_____ 10. How oxygen and carbon dioxide enter and leave cells
_____ 11. Two types of passive transport
_____ 12. Engulfing of particle in membrane vesicle
_____ 13. Fusion of membrane-bound vesicle with membrane, and dumping of contents outside cell
_____ 14. How a cell might capture a bacterium
_____ 15. Helped by aquaporins

Exercise 3 – Facilitated Diffusion (5.2)

Osmosis is an important process that has many effects on living things. Test your understanding of osmosis by predicting in each of the following cases whether water will enter the cell (In) or leave the cell (Out), or whether there will be no net movement of water (None). Assume that the plasma membrane is permeable to water but not solutes.

___ 1. Cell is exposed to hypertonic solution.
___ 2. Cell is placed in salt solution whose concentration it greater than cell contents.
___ 3. Due to disease, solute concentration of body fluid outside cell is less than solute concentration of cells.
___ 4. Cell is in isotonic solution.
___ 5. Single-celled organism is placed in drop of pure water for examination under microscope.
___ 6. Cell is immersed in solution of sucrose and glucose whose individual concentrations are less than concentration of solutes in cytoplasm, but whose combined concentration is greater than concentration of solutes in cytoplasm.
___ 7. Solute concentration of cell is greater than solute concentration of surrounding fluid.
___ 8. Cell is exposed to hypotonic solution.
___ 9. Concentration of solutes in cytoplasm is equal to solute concentration of extracellular fluid.
___ 10. Cytoplasm is more dilute than surrounding solution.

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Exercise 4 – Membrane Structure and Functions

Try to picture membranes and their functions close up by completing the following story.

Your first mission as a Bionaut requires you to enter a blood vessel and observe the structure and functions of cell membranes. You step into the water-filled chamber of the Microtron, which quickly shrinks you to a size much smaller then a red blood cell.

You tumble through the tunnel-like needle and into a blood vessel in the arm of a volunteer. Huge, rubbery red blood cells slowly glide past. Floating in the clear, yellowish blood plasma, you switch on your headlamp and examine the epithelial cells of the vessel wall. Their plasma membranes seem made of millions of small balloons. These are the polar "heads" of the 1_____ molecules that make up most of the membrane surface. Through the transparent surface, you can see their flexible, 2_____ tails projecting inward toward the interior of the membrane, and beyond them an inner layer of 3_____ molecules with their tails pointing toward you. Here and there are globular 4_____ molecules embedded in the membrane; some rest lightly on the surface, but most project all the way into the interior of the cell. The membrane is indeed a 5_____ mosaic; the proteins are embedded like the pieces of a picture, but you can see that they are free to move around. You push on one of the proteins, and it bobs like an iceberg. Some of the phospholipids and proteins have chains of sugar molecules attached to them, forming 6_____ and 7_____. These are the molecules that act as cell 8_____ tags. You notice that one of the proteins has a dimple in its surface. Just then a small, round molecule floating in the plasma nestles in the dimple. The molecule is a hormone, a chemical signal, and the dimpled protein is the 9_____ that enables the cell to respond to it.

In you light beam, you can see the sparkle and shimmer of many molecules, large and small, in the blood and passing through the cell membrane. Oxygen is moving from the plasma, where it is more concentrated, to the cell interior, where it is less concentrated. This movement is 10_____; where it occurs through a biological membrane, it is called 11_____ transport. Similarly, carbon dioxide is flowing out of the cell, down its 12_____ gradient, from the cell interior, where it is 13_____ concentrated, to the blood, where it is 14_____ concentrated.

You note that water molecules are passing through the membrane equally in both directions. The total concentration of solutes in the cell and in the blood must be equal; the solutions must be 15_____. You signal the control team to inject a small amount of concentrated salt solution into the blood, making the blood slightly 16_____ relative to the cell contents. This causes water to flow 17_____ the cell, until the two solutions are again in equilibrium. This diffusion of water through a 18_____ permeable membrane is called 19_____.

Some sugar molecules floating in the blood are simple too large and polar to pass easily through the plasma membrane. The sugar molecules simply bounce off, unless they happen to pass through pores in special 20_____ proteins. This is a type of passive transport, because the molecules move down a concentration gradient without the expenditure of 21_____. Because transport proteins help out, it is called 22_____ diffusion.

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Your chemscanner detects a high concentration of potassium ions inside the cell. Transport proteins here and there in the membrane are able to move potassium into the cell against the concentration gradient. This must be 23_____ transport; the cell expends 24_____ to provide energy to "pump" the potassium into the cell.

Suddenly there is a tug at your foot. You look down to see your flipper engulfed by a rippling membrane. A white blood cell the size of a building quickly pins you against the vessel wall. The phospholipids of its membrane are pressed against your face mask. The cell is engulfing you, protecting the body from a foreign invader! Taking in a substance in this way is called 25_____, more specifically 26_____, if the substance is a solid particle. Suddenly the pressure diminishes, and you are inside the white blood cell, floating free in a membrane-enclosed bag, or 27_____. Another sac is approaching; it is a 28_____, full of digestive enzymes. You manage to get your legs outside of the vacuole and move it back toward the inner surface of the cell membrane. As the vacuole fuses with the membrane, you tear your feet free and swim away from the voracious cell, realizing that 29_____ expelled you almost as fast as endocytosis trapped you!

You swim to the exit point, and the control team removes you by syringe. You are soon back in the lab, restored to normal size, and telling your colleagues about your close call.

Exercise 5 - Cell Communication (5.1)

Read page 90 in the textbook and label the following diagram. Answer the questions.

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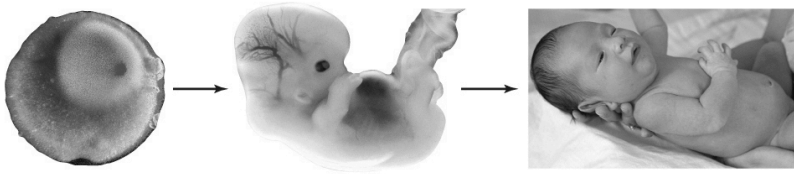

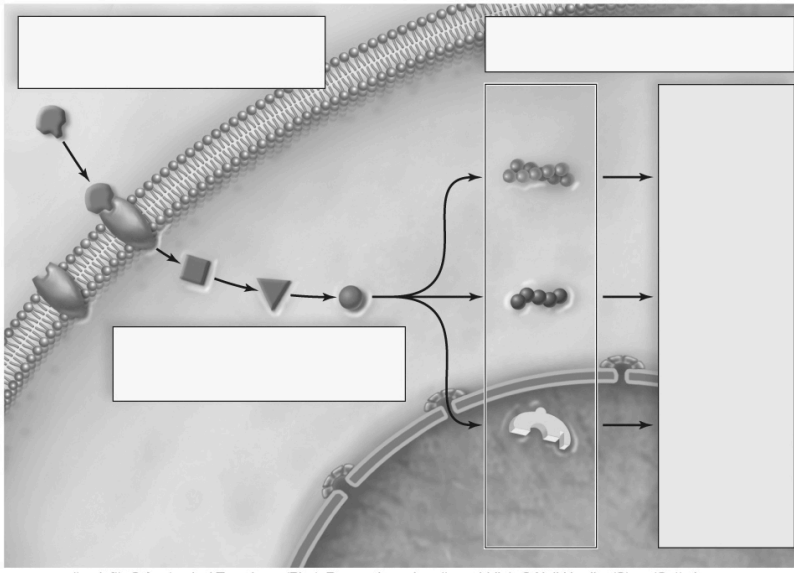

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1. If your cells needed to rapidly respond to a changing environment, would you want the effect to be short- or long-lived?

2. Given the essential role of signaling in cellular and organismal health, how might diseases arise from signaling errors?