

Chapter 5 A Closer Look at Cell Membranes

Lecture Outline

Impacts, Issues: One Bad Transporter and Cystic Fibrosis

- A. Cell membranes must be very selective to keep conditions inside the cell favorable for survival.
- B. Sometimes there is a defect in the CFTR transporter protein.
 1. Not enough chloride and water cross the epithelial cells' lining; mucus becomes thick.
 2. Cystic fibrosis is the most common fatal genetic disorder in the United States that results from this deficiency.
 3. The CFTR is one of many different membrane proteins that allow passage of substances across the cell membrane.
 - a. CFTR is a channel protein allowing hydrophilic substances across the cell membrane.
 - b. Mutant CFTR may even contribute to sinus problems of an estimated 30 million people in United States.

5.1 Organization of Cell Membranes

A. Revisiting the Lipid Bilayer

1. The _____ portion of the cell membrane is made of phospholipids.
 - a. A phospholipid molecule is composed of a _____ head and two hydrophobic tails.
 - b. If phospholipid molecules are surrounded by _____, their hydrophobic fatty acid tails cluster and a bilayer results; hydrophilic heads are at the outer faces of a two-layer sheet.

B. The Fluid Mosaic Model

1. Cell membranes are of mixed composition including the following:
 - a. _____ differ in their hydrophilic heads and the length and saturation of their fatty acid tails.
 - b. _____ have sugar monomers attached at the head end.
 - c. _____ is abundant in animal membranes
2. Within a bilayer, phospholipids show quite a bit of _____; they _____ diffuse _____, _____, and _____ their tails to prevent close packing and promote fluidity.

C. Do Membrane Proteins Stay Put?

1. Some proteins can move about the bilayer laterally, while others are stationary.
2. Many anchored proteins are tethered by cytoskeleton elements, still others are

united in unmoving complexes

5.2 Overview of the Membrane Proteins

A. How Are the Proteins Oriented?

1. The arrangement of molecules on one side of the membrane differs from that on the other side (asymmetrical).
 - a. _____ proteins span the lipid bilayer
 - b. _____ proteins are positioned at the surface of the membrane.

B. What Are Their Functions?

1. _____ passively allow water-soluble substances to move through their interior, which opens on both sides of the bilayer.
2. _____ have binding sites for hormones (and like substances) that can trigger changes in cell action, as in growth processes.
3. _____ identify the cell as a certain type, help guide cells into becoming tissues, and function in cell-to-cell recognition and coordination.
4. _____ are glycoproteins that help cells stay connected to one another in a tissue.
5. _____ form channels that match up across the plasma membranes of two cells, letting signals flow between their cytoplasms.

5.3 Diffusion, Membranes, and Metabolism

A. What Is a Concentration Gradient?

1. _____ refers to the difference in the number of molecules (or ions) of a substance in a given volume of fluid between two adjoining regions.
2. The thermal energy of the molecules drives the movement of molecules.
 - a. Molecules constantly collide and tend to move _____ a concentration gradient (move from areas of higher concentration to areas of lower concentration).
 - b. The net movement of like molecules down a concentration gradient is called _____; each substance diffuses independently of other substances present, as illustrated by dye molecules in water.

B. What Determines Diffusion Rates?

1. Several factors influence the rate and direction of diffusion:

- a. _____ Rates are high with steep gradients.
 - b. _____ More heat energy makes molecules move faster. (higher = faster)
 - c. _____ Smaller molecules diffuse faster than larger ones. (smaller = faster)
 - d. _____ A difference in electric charge between adjoining regions.
2. When gradients no longer exist, there is no net movement ().

C. Membrane Crossing Mechanisms

1. All cell membranes show _____ permeability, that is, some substances can cross, others cannot.
2. Glucose and other large _____ molecules cannot pass through the bilayer directly but must rely on passage through the interior of transport proteins.

5.4 Working With and Against Gradients

A. When _____ molecules bind to transport proteins, they trigger changes in shape that “ease” the solute through the protein and hence through the membrane.

B. Passive Transport

1. A concentration gradient drives diffusion of a substance across a cell membrane through a _____ protein—a passive process expending no energy.
2. Passive transport will continue until solute concentrations are _____ on both sides of the membrane or other factors intervene.

C. Active Transport

1. To move ions and large molecules across a membrane against a concentration gradient, special proteins are induced to change shape, but only with an _____ boost from ATP.

5.5 Which Way Will Water Move?

A. Movement of Water

1. _____ is the passive movement (diffusion) of water across a differentially permeable membrane in response to solute concentration gradients, pressure gradients, or both.
2. For example, if a bag containing a sugar solution is placed in pure water, the water will

diffuse _____ (higher to lower).

B. Effects of Tonicity

1. _____ denotes the relative concentration of solutes in two fluids—extracellular fluid and cytoplasmic fluid, for example.
2. Three conditions are possible:
 - a. A _____ fluid has a lower concentration of solutes than the fluid in the cell; cells immersed in it may swell.
 - b. A _____ fluid has a greater concentration of solutes than the fluid in the cell; cells in it may shrivel.
 - c. An _____ fluid has the same concentration of solutes as the fluid in the cell; immersion in it causes no net movement of water.
3. Cells either are dependent on relatively constant (isotonic) environments or are adapted to hypotonic and hypertonic ones.
 - a. _____ is a force directed against a membrane by a fluid; the greater the solute concentration, the greater will be the hydrostatic pressure it exerts.
 - b. This force is countered by _____, which prevents any further increase in the volume of the solution.
 - c. When plants lose water there is a shrinkage of the cytoplasm, called _____.

5.6 Membrane Traffic To and From the Cell Surface

A. Endocytosis and Exocytosis

1. In _____, a cytoplasmic vesicle moves substances from cytoplasm to plasma membrane where the membranes of the vesicle and cell fuse.
2. _____ encloses particles in small portions of plasma membrane to form vesicles that then move into the cytoplasm.