

Section 2.2: Membrane Structure and Function

Section 2.2 Questions, page 86

1. The “mosaic” in “fluid mosaic model” refers to the mixture of lipids and proteins in the plasma membrane.
2. The term “glyco” refers to polar carbohydrate groups that are attached to the molecules.
3. **(a)** The membranes are asymmetrical because the proteins and other components of one half of the lipid bilayer differ from those that make up the other half.
(b) Membrane asymmetry reflects the differences in functions performed by each half of the membrane.
4. The phospholipids on the bilayer are oriented so that their hydrophilic heads point outwards towards the aqueous external environment and inward towards the aqueous cytosol of the cell. The hydrophobic tails point towards the interior of the membrane. This prevents most polar or ionic substances from diffusing through.
5. **(a)** “Membrane fluidity” is the dynamic nature of the membrane, which allows for it to be flexible. That is, membrane lipids undergo free movement on their side of the bilayer.
(b) Membranes are composed of a bilayer of phospholipids, which interact with each other by nonpolar fatty acid chains and possess the ability to laterally flow around each other. This interchangeable nature gives the membrane its fluidity. Increased phospholipid movement increases membrane fluidity, while restrained phospholipid movement reduces fluidity.
(c) Temperature and lipid composition affect membrane fluidity. For example, fatty acids composed of saturated hydrocarbons—in which each carbon is bound to a maximum number of hydrogen atoms—tend to have a straight shape, which allows the lipids to pack more tightly together. Alternatively, the double bonds in unsaturated fatty acids cause bent structure, so the lipid molecules are less straight and pack more loosely. Lipid molecules become more closely packed and rigid at low temperatures and more fluid at high temperatures. Cholesterol helps maintain the fluidity of the membrane by restraining lipid movement at high temperatures and preventing close packing at low temperatures.
6. **(a)** Sterols act as membrane stabilizers. At high temperatures they help to restrain the movement of lipid molecules in a membrane, reducing the fluidity of the membrane. At low temperatures, sterols occupy the spaces between the lipid molecules preventing fatty acids from associating and forming a non-fluid gel, thus increasing fluidity of the membrane.
(b) Answers may vary. Sample answer: Cholesterol is a sterol that is found in membranes of animal cells but not in plant cells or in prokaryotes.
7. Cholesterol’s hydrocarbon tail is made up of hydrogen and carbon that is non-polar but it also has a polar hydroxyl group so it is amphipathic (it has both a water-soluble and a fat-soluble region).
8. Phospholipids have a structural function. They form the lipid bilayer that makes up the plasma membrane itself. Proteins have several functions: they act as channels for substances to pass through the cell membrane, they act as cell identifiers, and they participate in adhesion complexes between cells or between the plasma membrane and cytoskeleton. Carbohydrates function in cell-cell interaction and as labels for the recognition of other cells.

9. Transport proteins help substances move through the plasma membrane. Enzymatic proteins help with respiration and photosynthesis. Triggering signal proteins bind specific chemicals used in cellular communication. Attachment and recognition proteins act as attachment points for structural elements such as the cytoskeleton or as recognition sites for foreign substances such as microbes.

10. They both detect molecules and perform an action in response. They both recognize and bind only to specific molecules at a specific time, changing shape after binding.

11. When a receptor binds to a chemical signal, it changes shape. This shape change is critical because it affects how receptors interact with other molecules. If proteins were rigid, receptors would not be able to change shape and would lose functionality.

12. Integral proteins are embedded in the lipid bilayer of the membrane and peripheral proteins are positioned on the surface of the membrane. Integral proteins interact with the hydrophobic core of the membrane and contain non-polar amino acids as well as polar amino acids. Peripheral proteins interact with hydrophilic regions of the membrane or exposed portions of integral proteins and are composed of polar amino acids.

13. No, not all organelles have identical membranes. Examples may vary. All membranes are composed of phospholipids. They contain different protein and non-lipid components. The nucleus contains specialized pores in its membrane. Mitochondria have multiple membranes and contain proteins involved in cellular respiration.

14. SSRIs work by slowing or blocking the sending neuron from taking back the released serotonin. In that way, more of this chemical is available in the synapse. The more of this neurotransmitter that is available, the more likely the message is received, and depression is reduced.