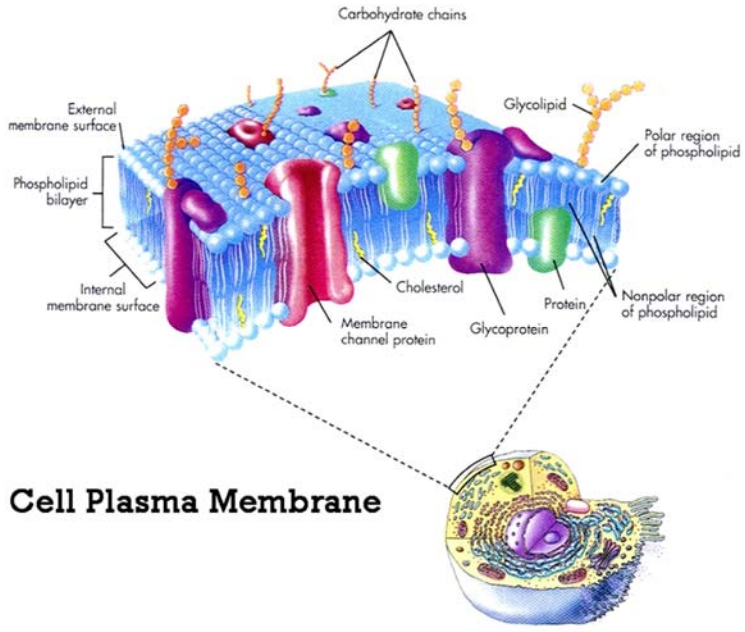
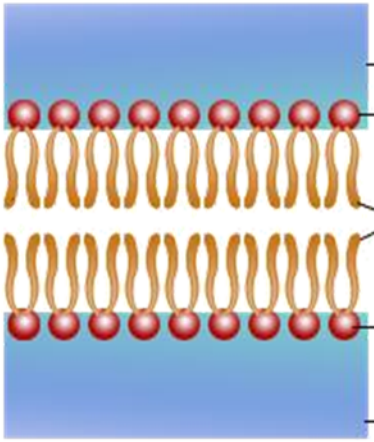
Cell Membrane

Remember that all cells, no matter what type, have a **Cell Membrane (also known as Plasma Membrane)**. You should also recall that the cell membrane surrounds the cell, and serves to protect the cell and control the movement of substances and messages in and out of the cell. We mentioned the idea of homeostasis as the ability of an organism to maintain a constant internal environment regardless of changes in the organism's external environment. Keep in mind that cells, at the cellular level of organization, must also maintain homeostasis in order to survive. The cell membrane, controlling what substances enter and leave a cell, is one way cells maintain homeostasis. We will discuss in this unit the structural components of the cell membrane.



Phospholipid Bilayer

The cell membrane is made up of two layers of phospholipid molecules. A phospholipid molecule is a specialized lipid molecule made up of a phosphate and two fatty acid chains. The phosphate is considered the head and is polar. The two fatty acid chains are considered the tails and are nonpolar. The polar phospholipid head is described as being hydrophilic, which means it is attracted to water. The nonpolar tails are described as being hydrophobic, which means they are repelled by water. As you can see, in the figure, the hydrophobic tails make up the interior of the bilayer (2 layer) membrane. Since these tails repel water, they make a good barrier for separating the water of the cytosol in the cytoplasm found inside the cell from the water in the extracellular fluid outside the cell. Because of the nature of this cell membrane, only certain materials can pass directly through the lipid bilayer. **Only small, nonpolar substances can pass directly through the phospholipid bilayer.** Other substances that need to pass through the phospholipid bilayer for maintaining homeostasis will make use of membrane proteins.



Cholesterol is another lipid found mostly in animal cell membranes and in small amounts in plant cell membranes. The cholesterol is found dispersed among the phospholipids. The role of cholesterol is to keep the cell membrane flexible so it doesn't become too rigid. The figure at the beginning of this unit shows cholesterol among the phospholipids in the membrane.

QuickTime Phospholipid Bilayer

Membrane Proteins

There are many different types of proteins found in the cell membrane. Some of these proteins face inside the cell, some face outside, and others stretch across the phospholipid bilayer and face inside and outside. These proteins are held in the membrane because of their chemical nature. Remember that the building block of a protein is an amino acid. Some amino acids are polar while others are nonpolar. Nonpolar amino acids of a protein are attracted to the nonpolar inside of the phospholipid bilayer while being repelled by water. The polar amino acids of a protein are attracted to water. This opposing chemical attraction with water help hold the protein within the cell membrane.

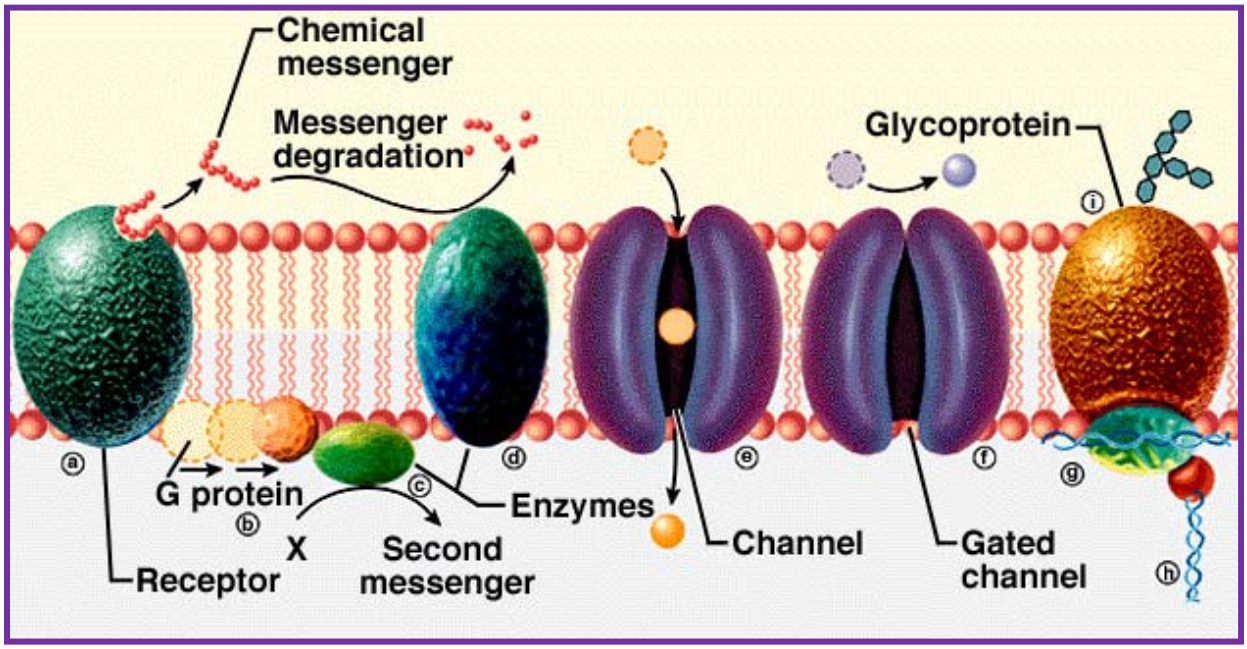
There are four main types of membrane proteins based on function: cell-surface markers, receptor proteins, transport proteins, and enzymes.

- **Cell-Surface Markers** help identify a cell type thus allowing one cell to distinguish itself from another. These markers consist of a chain of sugars attached to a protein found in the membrane. Recall that sugars are carbohydrates and sometimes use the prefix glyco- in reference to glucose, therefore, since these sugars on a cell-surface marker are attached to a protein they are then called glycoproteins.

- **Receptor Proteins** enable a cell to sense its surroundings by binding to certain substances outside the cell. "Receiving", or binding to, substances outside the cell will cause changes inside the cell as the receptor protein will relay the signals or messages.

- **Transport Proteins** aid in the movement of certain substances across or through the cell membrane. As mentioned earlier, only small nonpolar substances can pass directly through the phospholipid bilayer of the cell membrane. Transport proteins will help ions, most polar molecules, and other substances that cannot directly pass through to be carried or "transported" across the cell membrane. There are two groups of transport proteins: channels and carriers. *Channel proteins* may be permanently open (known as pores) or open and close (known as gated channels). *Carrier proteins* bind to a substance on one side of the membrane and then carry that substance to the other side.

- **Enzymes** are proteins in the cell membrane that help with biochemical reactions inside the cell. Recall that enzymes are proteins used to increase the speed of biochemical reactions within the cell by lowering the activation energy of the reaction.



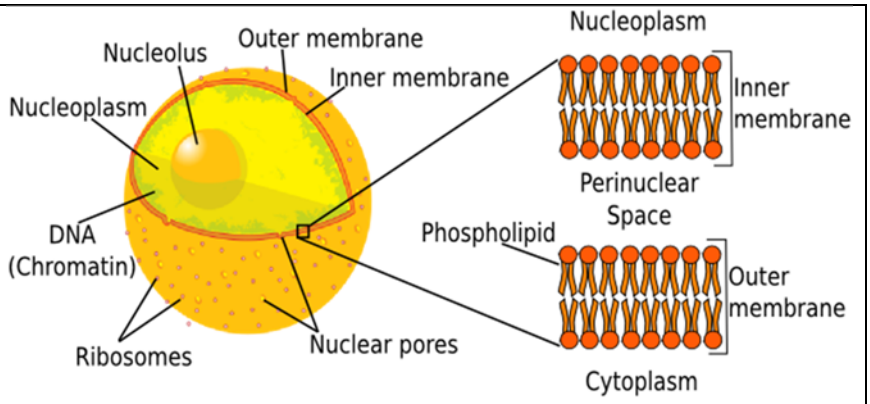
Fluid Mosaic Model

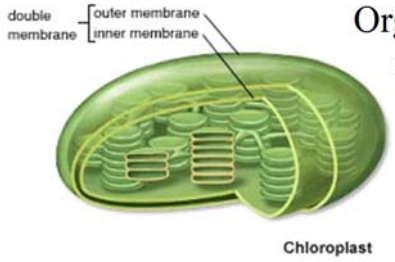
The fluid mosaic model is used to describe the nature of a cell membrane. The fluid mosaic model was developed by S.J. Singer and Garth Nicolson in 1972 to describe the structure of a biological membrane. The phospholipid component of the plasma membrane is described as "fluid" because the phospholipids have the ability to move laterally, or sideways, throughout the entire membrane within their layer. "Mosaic" refers to all of the possible proteins, previously identified, which can be found scattered and also moving with the phospholipids throughout the phospholipid bilayer.

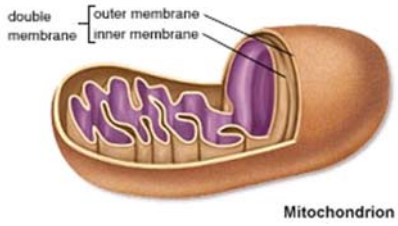
QuickTime Transport across Membranes-Fluid Mosaic Model

Plasma Membrane Differences

Keep in mind that in eukaryotes not only is the cell membrane made up of a phospholipid bilayer, but also all the organelle membranes. However, realize that some of the organelles are unique in terms of the plasma membrane.







Organelles such as the mitochondria, chloroplasts, and nucleus are made of 2 phospholipid bilayers, whereas, the other organelle membranes are made of 1 phospholipid bilayer. In addition, the mitochondria, chloroplasts, and nucleus have pores, however, there is a difference among the three of them. The nucleus has pores, as mentioned in a previous unit, which connect and go through the 2 phospholipid bilayers or all four phospholipid layers. Whereas the mitochondria and chloroplasts have pores only in the outermost phospholipid bilayer. Also, recall that prokaryotes do not have membrane-bound organelles, therefore, the cell membrane is the only place where you will find a phospholipid bilayer in a prokaryote.

Cell Membrane Worksheet

UNIT VOCABULARY REVIEW

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Now answer questions 1 through 20.