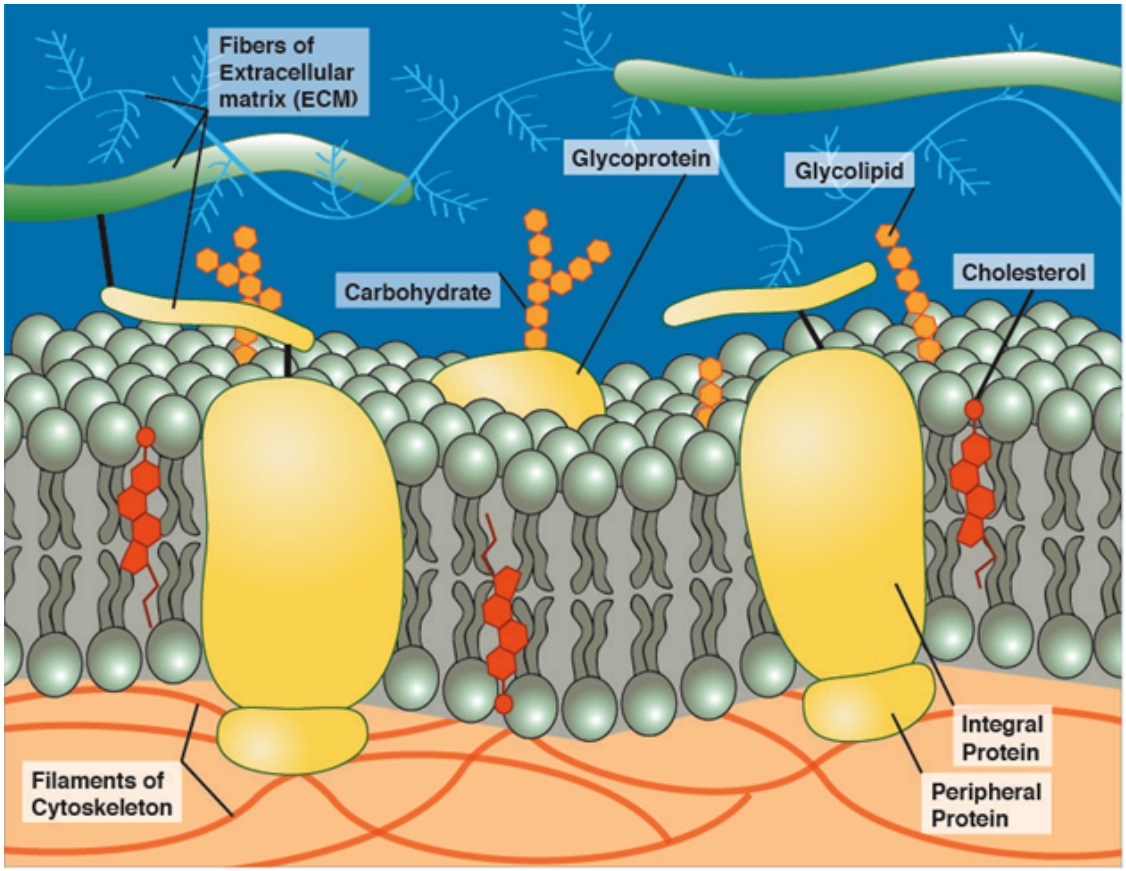
5.1.4

Membrane Proteins

Making up about another 50% of the membrane are the membrane proteins. The figure below demonstrates the relationship of the membrane proteins with the phospholipid bilayer. Note that some of the proteins are found only on the inner or outer surface of the membrane. These are called **peripheral or extrinsic proteins** because they do not extend through the membrane. One function of the peripheral proteins is to attach the membrane to the cytoskeletal proteins inside the cell or to proteins of the extracellular matrix. Peripheral proteins can bind to other proteins or lipids within the bilayer. When a protein binds directly to lipids it is called **amphitropic**. The integration of proteins within the bilayer causes the protein to have unique folding patterns which can alter (enhance) function.

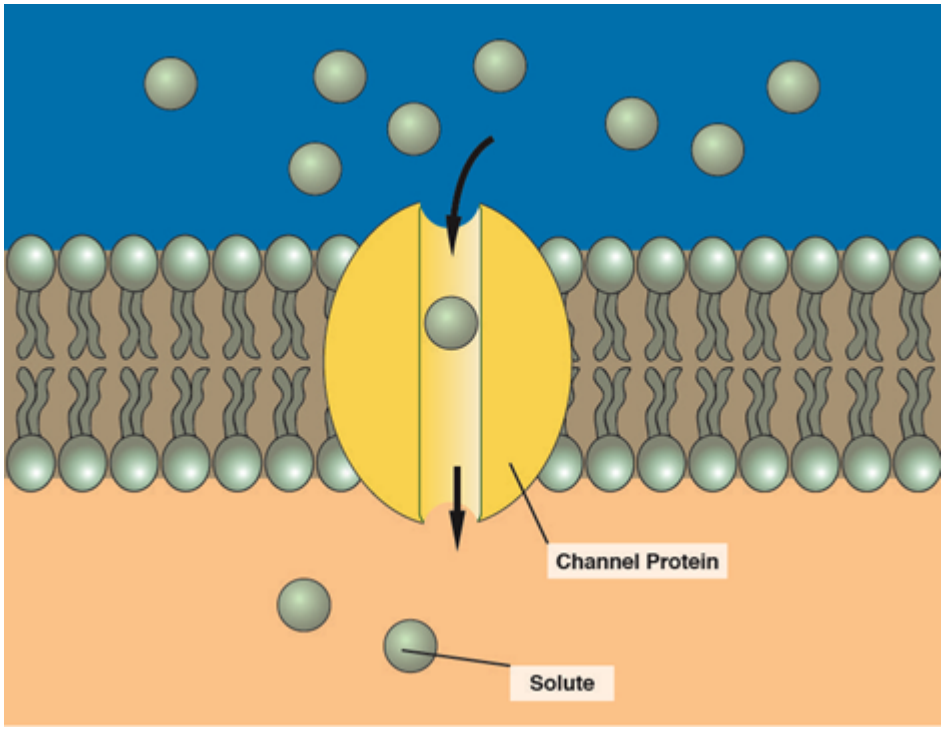


Cell Membrane Model: Relationship of Lipids, Proteins & Carbohydrates.
Image created by BYU student, Hannah Crowder 2013

Other proteins pass all the way through the membrane. These proteins are called **integral or transmembrane proteins** and have segments that associate with the hydrophobic region of the membrane that most often contain alpha helical structures. These integral proteins perform several important functions in the cell. Based on their functions, these integral proteins can be grouped into the following categories:

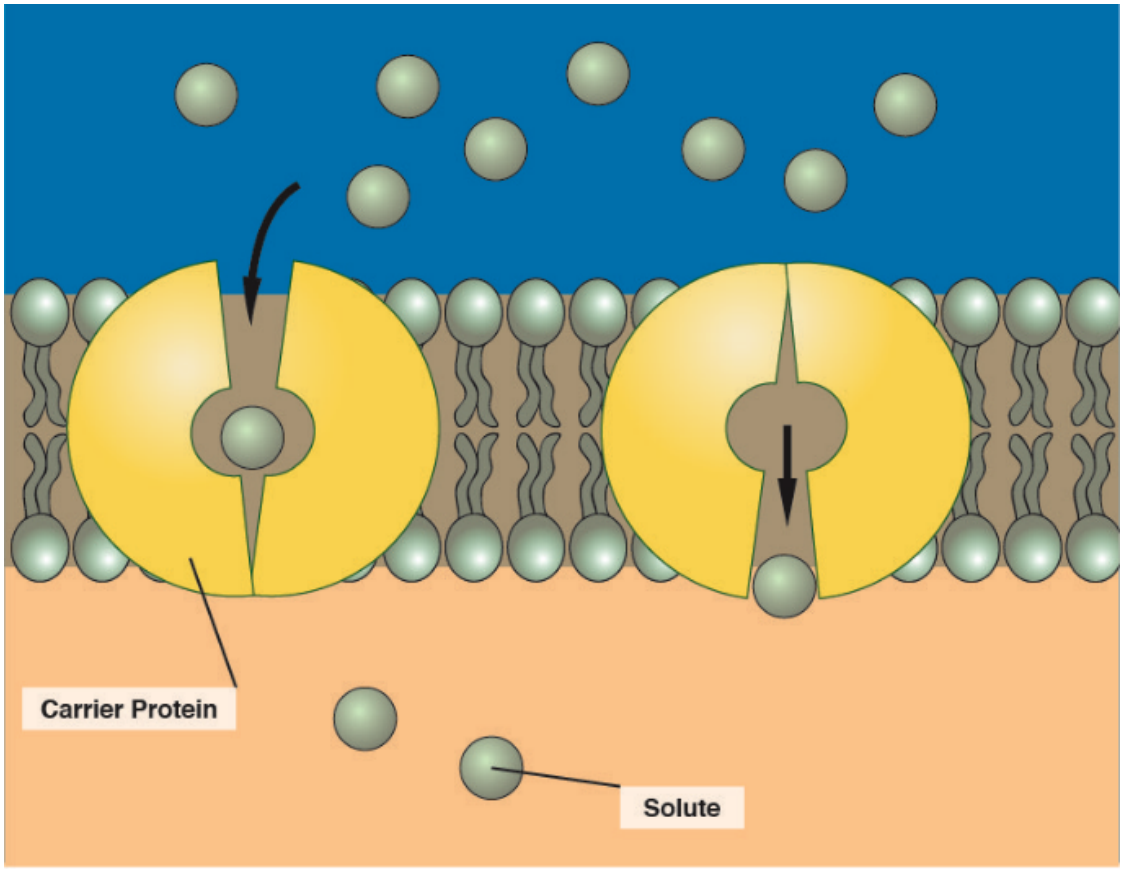
Transport Proteins

Integral proteins can act as transporters that facilitate the movement of compounds across the membrane. One type of transport protein, called **channels,** form a 'tunnel' for hydrophilic materials, such as ions and even water to cross the membrane. These channel proteins are usually gated; like a door, they allow substances to cross only when they are open.



Channel proteins allow solutes, such as ions, to move across the membrane.
Image created by BYU student, Hannah Crowder 2013

Carrier proteins are another type of transport protein. Carriers have sites that bind to specific solutes. For example, one type of carrier binds with glucose, while another carrier binds to urea. Once the solute binds, the carrier protein changes shape, allowing the solute to move across the membrane. Imagine a revolving door. As these doors turn (change shape), they are open to either the inside of the building or to the outside but never to both at the same time. You can enter a revolving door from the outside of a room and move the door until it is open to the inside of the room. At no time in this process was the door open to both sides at the same time. This is how carrier proteins work. Carrier proteins bind to solutes and then move them across the membrane by changing shape.



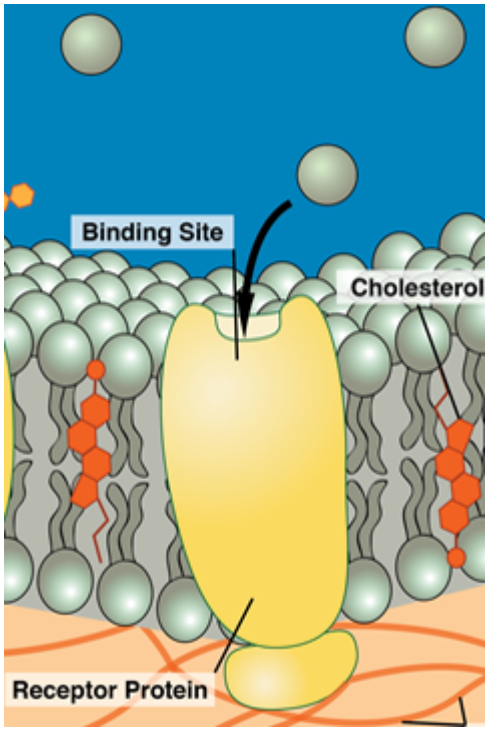
Carrier Proteins. *Image created by BYU student, Hannah Crowder 2013*

Enzymes

Integral membrane proteins can function as enzymes, catalyzing important chemical reactions. The enzyme, lactase, which digests the disaccharide lactose in the small intestine is an integral membrane protein in the cells that line the lumen of the duodenum. The discomfort associated with lactose intolerance is caused by having insufficient amounts of this enzyme in the body.

Receptor Proteins

Integral proteins may act as receptor proteins and allow the cell to respond to extracellular chemical messengers which regulate the activity of the cell. When a chemical signal (also known as a ligand) binds to its specific receptor protein, it transmits a signal to the inside of the cell through a shape change in its transmembrane protein structure. This shape change will then activate or inhibit intracellular events that result in altered cell function.



Receptor Protein. *Image created by BYU student, Hannah Crowder 2013*

Attachment Proteins

Integral proteins are involved in attaching cells to each other, as well as to the extracellular matrix and to intracellular structural proteins. Often, a peripheral protein functions as a link between the integral proteins and the structural proteins or the extracellular matrix. These attachments can confer tissue strength and shape.

Marker Proteins

These proteins allow cells to identify one another. Functions of these marker proteins include the ability of sperm cells to recognize the oocyte during fertilization, as well as the ability of immune cells to distinguish between “self” cells and foreign cells.