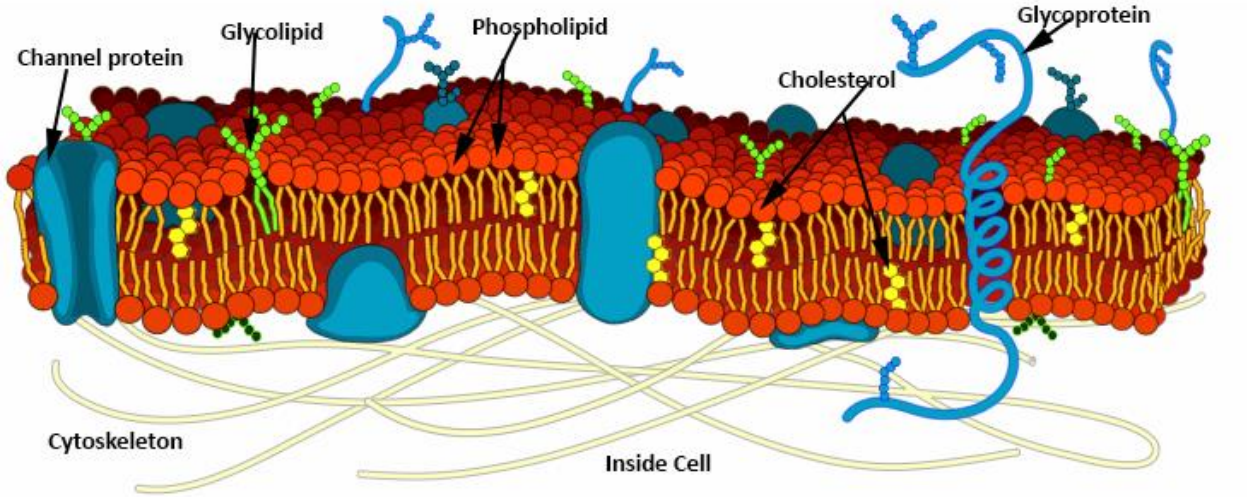
Cell Structure: Plasma Membrane

The cell's plasma membrane serves a vital role in maintaining homeostasis and keeping the cell alive. The plasma membrane separates the metabolic machinery and hereditary information of the cell from the external environment. The plasma membrane controls what enters and exits the cell, allowing nutrients and needed materials to enter and be retained by the cell while exporting or permitting the exit of waste products. Because of the ability of the membrane to discriminate between molecules it is often described as selectively or semi- permeable.

How does the membrane accomplish these vitally important functions? The structure of the membrane and its component parts determine its function.

Fluid Mosaic Model of the Plasma Membrane



Plasma membranes are lipid bilayers with some associated proteins. The model used to describe their function is the Fluid Mosaic Model. The model describes a structure that freely moves (fluid) and is made of many pieces (like mosaic tiles). The lipids found in the membrane are primarily phospholipids although cholesterol and glycolipids are also significant components. If you recall from the biochemistry module, the common characteristic of lipids is their hydrophobicity. Phospholipids however, have a dual nature. The head of a phospholipid, the glycerol component of the lipid with the attached phosphate is actually hydrophilic and will orient the molecule toward watery environments. The fatty acid tails are long chain hydrocarbons and are hydrophobic. When phospholipids are mixed with water, the molecules naturally orient themselves with the glycerol head immersed in water and the tails all pointing away from water. In a watery environment lipids will automatically form a micelle or bilayer. A bilayer simply means there are 2 separate layers of lipids. The heads of lipids point in opposite directions and the tails meet in the middle.

When considering the role of membrane in maintaining homeostasis the lipid composition is critical. One way to think about this is to consider the cell wrapped in a layer of fat. That is effectively what the fatty acid tails represent on a molecular level, a layer of fat. When water is dropped onto fat, it beads up. It does penetrate though the fat. The lipids in plasma membrane form a very effective barrier to water soluble or polar compounds with a very few exceptions. Fat soluble compounds freely move

across the membrane as do some small molecules like carbon dioxide and oxygen, but hydrophilic molecules do not pass through lipid layers. In order to get things into and out of a cell another mechanism is needed. Proteins are the mechanism for moving large or polar molecules across the membrane. Proteins come in many shapes and have many functions. Some proteins are only loosely associated with the membrane, some are slightly embedded and some pass through the entire membrane. One type of protein, the channel protein extends across the entire membrane and allows selected molecules to pass though. One important channel protein is called an aquaporin. Aquaporins allow water to move freely across the membrane. Protein transport is an important topic, but one that will not be addressed further in this module.