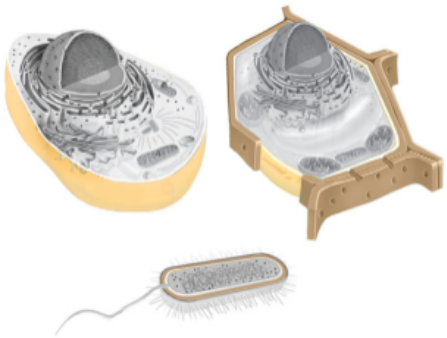
Cellular Boundaries



A working factory needs walls and a roof to protect it from the environment outside and also to serve as a barrier that keeps its products safe and secure until they are ready to be shipped out. Cells have similar needs, and they meet them in a similar way. As you have learned, all cells are surrounded by a barrier known as the cell membrane. Many cells, including most prokaryotes, also produce a strong supporting layer around the membrane known as a cell wall.

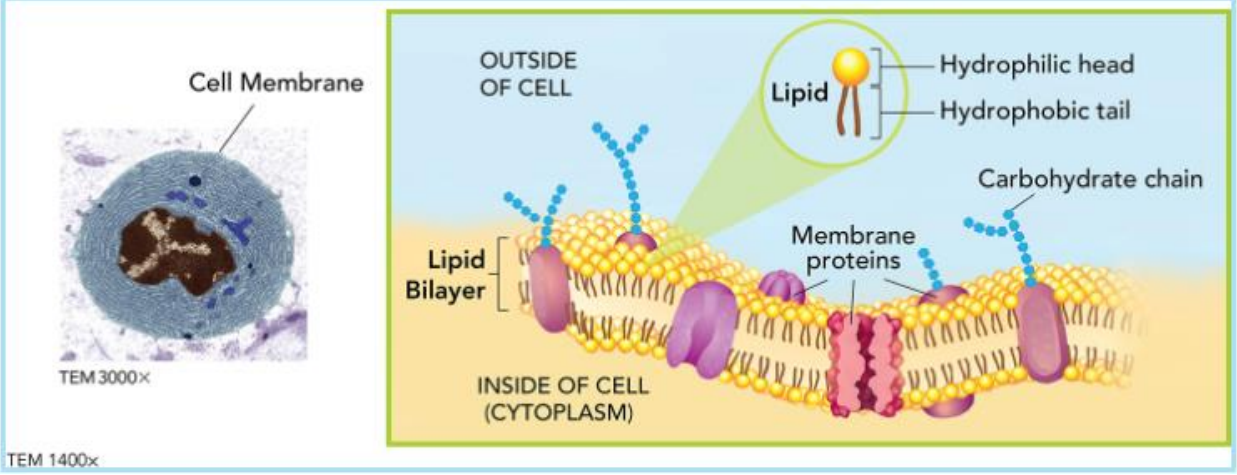
Cell Walls Many organisms have cell walls that lie just outside their cell membranes. The main function of the cell wall is to support, shape, and protect the cell. Most prokaryotes and many eukaryotes, including plants and fungi, have cell walls, although animal cells do not. Most cell walls are porous enough to allow water, oxygen, carbon dioxide, and certain other substances to pass through easily.

Cell walls provide much of the strength needed for plants to stand against the force of gravity. In trees and other large plants, nearly all of the tissue we call wood is made up of cell walls. The cellulose fiber used for paper as well as the lumber used for building comes from these walls. So if you are reading these words from a sheet of paper in a book resting on a wooden desk, you've got cell walls all around you.

Cell Membranes All cells contain cell membranes, generally made up of a double-layered sheet called a lipid bilayer, as shown in **Figure 8-14**. The lipid bilayer gives cell membranes a flexible structure that forms a strong barrier between the cell and its surroundings. ***The cell membrane regulates what enters and leaves the cell and also protects and supports the cell.***

Figure 8-14 Cell Membrane

Every cell has a membrane that regulates the movement of materials. Nearly all cell membranes are made up of a lipid bilayer in which proteins and carbohydrates are embedded.



The Properties of Lipids The layered structure of cell membranes reflects the chemical properties of the lipids that make them up. You may recall that many lipids have oily fatty acid chains attached to chemical groups that interact strongly with water. In the language of a chemist, the fatty acid portions of this kind of lipid are hydrophobic (hy druh FOH bik), or "water-hating," while the opposite end of the molecule is hydrophilic (hy druh FIL ik), or "water-loving." When these lipids, which are common in cell membranes, are mixed with water, their hydrophobic fatty acid "tails" cluster together, while their hydrophilic "heads" are attracted to water. A lipid bilayer is the result. As you can see in **Figure 8-14**, the head groups of lipids are exposed on both sides of the membrane, while the fatty acid tails form an oily layer inside the membrane that keeps water from passing across it.

Although many substances can cross cell membranes, some are too large or too strongly charged to cross the lipid bilayer. If a substance is able to cross a membrane, the membrane is said to be permeable to it. A membrane is impermeable to substances that cannot pass across it. Most cell membranes are selectively permeable, meaning that some substances can pass across them and others cannot. Selectively permeable membranes are also called semipermeable membranes.

The Fluid Mosaic Model Protein molecules are embedded in the lipid bilayer of most cell membranes. Carbohydrate molecules are attached to many of these proteins. Because the proteins embedded in the lipid bilayer can move around and "float" among the lipids, and because so many different kinds of molecules make up the cell membrane, scientists describe the cell membrane as a "fluid mosaic." (A mosaic is a kind of art, such as the example shown in **Figure 8-15**, that involves putting bits and pieces of different colors or materials together.) Some of these proteins form channels and pumps that help to move material across the cell membrane. Many of the carbohydrate molecules act like chemical identification cards, allowing individual cells to identify one another. Some proteins attach directly to the cytoskeleton, enabling cells to respond to their environment by using their membranes to help move or change shape.

Figure 8-15 Mosaic

Mosaics are made by assembling small pieces of different colors and types of materials. Similarly, cell membranes are made up of different kinds of molecules.