Every cell is enclosed by a membrane which gives structure to the cell and allows for the passage of nutrients and wastes into and out of the cell. The purpose of the bilayer membrane is to separate the cell contents from the outside environment. The outside of the cell is mostly water and the inside of the cell is mostly water. The cell membrane may be coated with other molecules such as carbohydrates and proteins, which serve as receptor sites for other messenger molecules. Interaction with the cell membrane allows for molecular communication signals to pass from outside to inside of the cell.

Introduction

Cell membranes are composed of two classes of molecules: lipids and proteins. The proteins serve as enzymes, carry molecules, and provide the membrane with distinctive functional properties. Details of proteins and enzyme structures are given elsewhere. The lipids provide the structural integrity for the cell. The lipids found in the membrane consist of two parts: hydrophilic (water soluble) and hydrophobic (water insoluble). The hydrophobic portion of the lipids is the non-polar long hydrocarbon chains of two fatty acids. The fatty acids are present as esters bonded to glycerol. The third-OH group on glycerol is ester bonded to phosphate hence the term phospholipid. The phosphate ester portion of the molecule is polar or even ionic and hence is water soluble. A simple interaction of several phospholipids is shown in the graphic on the left.

There are two common phospholipids found in the bilayer:

1. **Lecithin** contains the amino alcohol, choline.
2. **Cephalins** contain the amino alcohols serine or ethanolamine.

The arrangement of phospholipids in cell membranes has been deduced by X-Ray diffraction data. The phospholipids are arranged as a bilayer (two molecules thick). The phospholipids are stacked with the non-polar hydrocarbon chains pointed inward while the polar ends act as the external surface as shown in graphic on the left. The structure of the bilayer is another application of the solubility principle of "likes dissolve likes".

Most of the fatty acids in the membrane are unsaturated because this allows the membrane to be more flexible (cis bonds are bent) to allow certain molecules through the membrane. However, the interaction of the hydrophobic inside of the layer acts as a barrier for ionic and polar molecules from entering the inside of the cell. In animal cells **cholesterol** is inserted between the non-polar chains, and makes up about 20% of the molecules of the membrane. This helps to make the membrane more rigid and adds strength.
Lipid Bilayer Graphic: Red/white spheres represent water molecules on the outside surfaces of the bilayer which are hydrophilic (water loving). The gray spheres represent the non-polar hydrocarbon chains, which are hydrophobic or water hating. The purple spheres represent individual phospholipid molecules.

References

• Chime from: Dr. William McClure, Department of Biological Sciences, Carnegie Mellon University, Pittsburgh, PA 15213

Contributors

• Charles Ophardt, Professor Emeritus, Elmhurst College; Virtual Chembook