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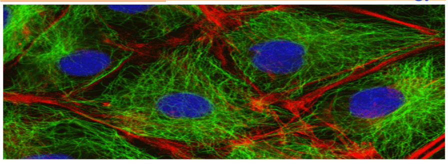

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An overview on lipids, carbohydrates and proteins in plasma membrane

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ABOUT THE STUDY

The cell membrane (also known as the progenitor membrane or cytoplasmic membrane, historically called the plasma membrane) is a biological membrane that separates the interior of all cells from the external environment (extracellular space) and protects the cells from that environment. The cell membrane is composed of a lipid bilayer consisting of two layers of phospholipids interspersed with cholesterol (lipid component), so that proper membrane fluidity is maintained at various temperatures. Membrane proteins such as integrated proteins that function as membrane transporters across the membrane and peripheral proteins that loosely adhere to the outer (peripheral) side of the cell membrane and function as enzymes that promote interaction with the cellular environment. Glycolipids embedded in the outer lipid layer serve a similar purpose. The cell membrane controls the movement of substances in and out of cells and organelles and selectively permeates ions and organic molecules. In addition, the cell membrane is involved in various cellular processes such as cell adhesion, ionic conductivity and cell signaling and functions as an attachment surface for multiple extracellular structures such as the cell wall and carbohydrate layer called sugar coating. An intracellular network of protein fiber's called the cytoskeleton. In the field of synthetic biology, cell membranes can be artificially reconstructed (Espiritu., 2022).

Cell membranes contain a variety of biomolecules, especially lipids and proteins. The composition is not fixed, but it is constantly changing due to changes in fluidity and environment and can even fluctuate at various stages of cell development. In particular, the amount of cholesterol in the cell membrane of human primary neurons changes and this change in composition affects the fluidity of the entire developmental stage (Horn et al., 2019).

Material is incorporated into or removed from the membrane by a variety of mechanisms. Intracellular vesicle-membrane fusion (exocytosis) not only excretes the contents of the vesicle, but also incorporates the components of the vesicle membrane into the cell membrane. The membrane forms a sac around the extracellular material, which pinches off into the sac (endocytosis) (Kalappurakkal et al., 2020).

If the membrane is continuous with the tubular structure of the membrane material, the material from the tube can be continuously drawn into the membrane.

Although the concentration of membrane components in the aqueous phase is low (stable membrane components are less water soluble), molecular exchange occurs between the lipid phase and the aqueous phase.

Lipids: Cell membranes are composed of three classes of amphipathic lipids phospholipids, glycolipids and sterols. The amount depends on the cell type, but in most cases it is the most abundant in phospholipids and often accounts for more than 50% of all lipids in the plasma membrane. Glycolipids make up a small part of about 2% and the rest are made up of sterols. In the study of red blood cells, 30% of the plasma membrane is composed of lipids. However, in most eukaryotic cells, the composition of the plasma membrane is about half that of lipids and half that of proteins.

Lipid vesicles or liposomes are almost spherical pockets surrounded by a lipid bilayer. These structures are used in the laboratory to study the effects of intracellular chemicals by delivering them directly to the cell and to gain more insight into the permeability of cell membranes. Lipid vesicles and liposomes are formed by first suspending the lipid in an aqueous solution and then stirring the mixture by sonication, resulting in vesicles. By measuring the rate of outflow from the inside of the vesicle to the surrounding solution, researchers can better understand the permeability of the membrane. The vesicle can be formed by the molecules and ions in the vesicle by forming the vesicle with the desired molecules or ions present in the solution. Proteins can also be implanted in membranes by solubilizing desired proteins in the presence of detergents and binding them to the phospholipids on which liposomes are formed. They provide researchers with tools for studying the various functions of membrane proteins.

Carbohydrates: The plasma membrane also contains carbohydrates, mostly glycoproteins, but also some glycolipids (cerebroside and ganglioside). Carbohydrates play an important role in eukaryotic cell recognition. They are on the surface of cells, where they recognize host cells and exchange information. Viruses that bind to cells through these receptors cause infection. In most cases, glycosylation does not occur in the intracellular membrane. Rather, glycosylation occurs on the extracellular surface of the plasma membrane. Sugar coating is an important feature of all cells, especially the epithelium with microvilli. Recent data suggest that sugar coating is involved in cell adhesion, lymphocyte homing and many others. The penultimate sugar is galactose and the terminal sugar is sialic acid because the Golgi apparatus modifies the sugar skeleton. Sialic acid is negatively charged and forms an external barrier for charged particles (Kulma et al., 2021).

Proteins: Cell membranes are high in protein, usually about 50% of the volume of the membrane. These proteins are important for cells because they are involved in a variety of biological activities. About one-third of yeast genes specifically encode them and their numbers are even higher in multicellular organisms.

There are three main types of membrane proteins: endogenous proteins, peripheral proteins and lipid-fixing proteins.

Ion channels allow inorganic ions such as sodium, potassium, calcium and chlorine to diffuse through the membrane through hydrophilic pores along the electrochemical gradient through the lipid bilayer. The electrical behavior of cells (such as nerve cells) is controlled by ion channels (Shaw et al., 2021). A proton pump is a protein pump embedded in a lipid bilayer that allows protons to move across membranes by moving from one amino acid side chain to another. Proton pumps are used in processes such as electron transfer and ATP production. G protein-coupled receptors are single polypeptide chains that cross the lipid bilayer seven times and respond to signaling molecules (hormones and neurotransmitters). G protein-coupled receptors are used in processes such as cell-cell signaling, regulation of cAMP production and regulation of ion channels.

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