OPEN ACCESS Freely available online

Biological Systems: Open Access

ISSN: 2329-6577

Perspective

Description and Formation of Biological Membranes

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PERSPECTIVE

Biological membranes allow life to exist as we know it. They create cells and provide separation between the inside and exterior of an organism, determining which chemicals enter and leave through their selective permeability. Membranes allow living creatures to generate energy by permitting ion gradients to form across them.

In addition, they send, receive, and process information in the form of chemical and electrical signals to govern the flow of messages between cells. This essay discusses the structure and function of membranes and the proteins that make them up, as well as their role in trafficking and transportation, as well as their impact on health and disease. Membrane research techniques are also addressed.

Biological membranes are made up of a bilayer of lipid molecules that form a double sheet. The phospholipid bilayer is the name given to this structure. Membrane proteins and sugars, in addition to the numerous types of lipids found in biological membranes, are also important components of the structure. Membrane proteins are important in biological membranes because they aid to maintain structural integrity, organisation, and material flow. Sugars are exclusively found on one side of the bilayer and are connected to some lipids and proteins via covalent interactions.

Phospholipids, glycolipids, and sterols are the three forms of lipids present in biological membranes. Two fatty acid chains are connected to glycerol and a phosphate group makes up phospholipids. Glycerophospholipids are phospholipids that contain glycerol as a component. Phosphatidylcholine (PC), which comprises a choline molecule linked to the phosphate group, is an example of a glycerophospholipid that is often found in biological membranes

Phosphatidylserine (PS) and Phosphatidylethanolamine (PE) are lipids that can take the place of choline in this location. Sphingophospholipids, such as sphingomyelin, are phospholipids that are based on sphingosine. Glycolipids can contain either glycerol or sphingosine, but they invariably have a sugar in place of the phosphate head seen in phospholipids. Most bacterial membranes are devoid of sterols, but they are an essential component of animal (usually cholesterol) and plant (mostly stigmasterol) membranes. Cholesterol differs significantly from phospholipids and glycolipids in terms of structure. A hydroxyl group (the hydrophilic 'head' area), a four-ring steroid structure, and a short hydrocarbon side chain make up the structure.

Because of the structural diversity of sugar chains, sugars coupled to lipids and proteins can behave as markers. Antigens made comprised of sugar chains on the surface of red blood cells, for example, identify a person's blood group. Antibodies recognise these antigens and elicit an immunological reaction, which is why blood transfusions must use matching blood types. Other carbohydrate indicators can be found in disease (for example, particular carbohydrates on the surface of cancer cells), and doctors and researchers can utilise them to diagnose and treat a variety of conditions.

Membrane lipids are all amphipathic, which means they have a hydrophilic (water-loving) and a hydrophobic (water-hating) area. As a result, the hydrophilic head thrives in an aqueous environment, whereas the hydrophobic tail thrives in a lipid environment. Membrane lipids are amphipathic, which means they naturally form bilayers with hydrophilic heads pointing outward to the aqueous environment and hydrophobic tails pointing inward to each other. Membrane lipids will spontaneously create liposomes, which are spheres comprised of a bilayer with water inside and outside that resemble a microscopic cell when immersed in water. This is the best arrangement for these lipids because it puts all of the hydrophilic heads in contact with water and all of the hydrophobic tails in contact with lipids E.Gorter and F.Grendel's experiments in 1925 were the first to show that biological membranes are bilayers. These researchers isolated lipids from red blood cells and discovered that they took up twice as much space as the cell's surface area. They reasoned that because red blood cells lack internal membranes, the plasma membrane must be made up of two layers of lipids.

Jonathan Singer and Garth Nicolson proposed the fluid mosaic concept in 1972 to represent the dynamic and fluid nature of biological membranes. Lipids and proteins can move from one side of the membrane to the other. Phospholipids move fast through the leaflet of the bilayer in which they are found. A phospholipid can cross the length of a bacterial cell in 1 second or around the perimeter of a red blood cell in 12 seconds. Phospholipids may spin around on their head-to-tail axis and have extraordinarily flexible lipid tails. These many movements combine to form a dynamic, fluid barrier that surrounds cells and organelles.

Membrane proteins can also migrate laterally in the bilayer, but their rates of mobility differ from lipids' and are often slower. Membrane proteins are sometimes retained in specific parts of the membrane to polarise the cell and allow various ends of the cell to perform different activities. The use of a Glycosyl-phosphatidylinositol (GPI) anchor to bind proteins to the apical membrane of epithelial cells while excluding them from the basolateral membrane is an example of this.

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Received: September 09, 2021; **Accepted:** September 27, 2021; **Published:** September 30, 2021

Citation: Thirunahari A (2021) Description and Formation of Biological Membranes. J Biol Syst Open Access. 10:208.