Architecture of biological membranes

The basic architecture of the approximately 6–10 nm thick cytoplasmic membrane is a phospholipid bilayer permeated by proteins and cholesterol . Carbohydrates can be attached to both proteins and phospholipids , which form glycolipids and glycoproteins . This basic structure, altered to varying degrees in the membranes of individual organelles, affects the physico-chemical properties of the membranes (especially their permeability) closely related to the function and course of biochemical processes in the relevant organelle.

An example can be the myelin sheath of neurons, in which the ratio of proteins to lipids is 19%: 81% (which causes their excellent insulating properties) or the inner membrane of mitochondria, in which the ratio turns in favor of proteins 76%: 24% (and is related to its considerable impermeability even for substances that normally pass through membranes).

Phospholipid molecules form two physically distinct parts:

1. **Polar (hydrophilic) part**

   The polar part is made up of a phosphate group , or groups attached to it - this part faces the aqueous environment (or another polar solvent).

2. **Non-polar (hydrophobic) part**

   The non-polar part is formed by MK chains facing each other, thus forming the hydrophobic core of the membrane . It is precisely on the basis of hydrophobic interactions that phospholipids tend to aggregate and form membranes.

The phospholipid molecule therefore contains both polar and non-polar parts, it is a so-called amphipathic molecule.

Historical correlation

A currently used model describing the structure of biological membranes was created in 1972 by SJ Singer and GL Nicolson . According to this fluid mosaic model , membranes can be considered as a form of 2-dimensional liquid in which phospholipid and protein molecules diffuse to varying degrees.

The mobility of phospholipids is much higher than the mobility of other membrane components. Therefore, the places in which proteins or cholesterol are embedded in the membrane show lower lateral mobility and thus stabilize the membrane (this applies especially to cholesterol). Parts of the membrane made up mainly of lipids can sometimes flip to the opposite side by a so-called *flip-flop mechanism.*

The fluidity of the membrane depends mainly on:

1. **Temperature** - at higher temperatures, the membrane is more mobile, the so-called *gel phase* , at lower temperatures it is stiffer, the so-called *sol phase*
2. **The proportion of unsaturated MK – the higher their content, the more mobile the membrane (gel phase).**

Proteins form the basic component of cell membranes. According to their storage in the membrane, we divide them into peripheral and integral.

- **Peripheral proteins** do not penetrate into the hydrophobic core of the membrane, they only bind to its surface (from the extra- or intracellular side), and therefore can be separated from the membrane without damaging it . The interactions involved in bonds are primarily electrostatic forces and hydrogen bonds.

- **Integral proteins** penetrate the membrane, either through its entire thickness – so-called transmembrane proteins – or to varying depths. Separation of these proteins from the membrane is associated with disruption of its integrity

Proteins fulfill the function of biological membranes:

- receptor.
- transportation.
- enzymatic.

Cholesterol makes up about one quarter of all the lipids in the membrane. The cholesterol molecule, like the phospholipid molecule, has an amphipathic character due to the OH– group attached to the third carbon. The basic function of cholesterol in the membranes of animal cells is their **stabilization** and **reduction of fluidity** .