Importance of membranes in living organisms

All kinds of living organisms consist of cells, which are the smallest known living units, the smallest parts of any existence of life. The cell is the morphological and functional unit that all organisms are composed of. Robert Hooke was the first that observed a plant cell using a compound microscope (1655) and used the word ‘ cell’ for the first time. After a long time Theodor Schwann came to frame the ‘ cell theory’, which says that cells are the basic unit of structure in every living thing and every cell is formed from another existing cell. The biological science is based on this specific theory. By that time, many scientists have shown great interest in the cell and its structure, its multiplication and its properties. Consequently, today we are able to know that the cell is the basis of structural and functional organization of an organism. Specifically, similar cells are connected together to form tissue, different tissues combine to form one organ, different organs together to form a system that performs a specific function of the body, and finally all the systems together create an organism. Despite their great diversity, the cells have a common way of organization. Thus, all cells are surrounded by a membrane, which is called ‘ plasma membrane’. The interior of the cell consists of the cytoplasm in which the cellular organelles are found. And this is where the importance of the membranes in living organisms can be discussed.

The plasma or cell membrane is the outer limit of the cell, which separates it from the outer environment surrounding the interior space of the cell. The plasma membrane, the nucleus and the cytoplasm constitute the protoplasm. As far as the structure of the cell membranes is concerned, it is based on a lipid bilayer. The lipid bilayer is an oily boundary, which controls

the passage of water soluble substances in the interior space of the cell. Each plasma membrane consists of two layers of phospholipids. They are structured of a phosphate-containing head and two fatty acid tails attached to one glycerol backbone. The head dissolves easily and fast in water and that is why it is called hydrophilic. On the other hand, the tails are hydrophobic. Furthermore, the bonds between molecules of phospholipid bilayers are weak so that each individual phospholipid molecule moves freely within the bilayer and in some cases to jump from layer to layer.

Every cell membrane has also a protein component, which is about half of its mass. Membrane proteins vary depending on the type of cell. Membrane proteins can be incorporated into the cell membrane (integral membrane proteins) or to penetrate the entire thickness of the membrane (transmembrane proteins). The membrane proteins can diffuse laterally on the cell surface, leading to the formulation of the theory of the fluid mosaic structure of the cell membrane. The main role of proteins in the cell membrane is to be other structural components, or to have a functional role (for example, control of entry and exit of substances from the cell, or transfer of information and messages from the extracellular to the intracellular space.

In addition, the fluid mosaic model maintains that the membrane consists of several types of molecules (phospholipids, cholesterol, protein and carbohydrates) that are in constant motion and float on a fluid. Additionally, the membranes of animal cells may be attached to carbohydrate molecules, which are mainly located in the intracanalicular part of the cellular membrane system and the external surface of the plasma membrane, which

is called the glycocalyx. Carbohydrates membranes are visible using immunohistochemical technique against lectins, which are plant proteins that can be attached to specific groups of carbohydrates.

The basic properties of a cell membrane are the fluidity and flexibility. This is due to the membrane phospholipids because of the presence of unsaturated fatty acids, which prevent the hydrophobic tails from coming close to one another. The observation of cell membranes has revealed the presence of cholesterol molecules in a 1: 1 ratio with the phospholipid molecules. Cholesterol restricts the movement of adjacent phospholipids thereby reducing liquidity and increasing the stability of the membranes.

One of the functions of the plasma membranes is the selective permeability, which controls the movement of substances and the ability of the cell to allow some substances to pass in the interior of the cell while others do not. If the membrane was impermeable to all substances, then it could neither take the necessary substances for the survival of the cell, nor to remove the useless substances that could maybe be useful for other cells, especially when it comes to multicellular organisms. If the membrane was permeable to all substances it would also result to the entrance of substances harmful to the cell and would be difficult to maintain the correct concentrations of substances necessary for the cell because eventually the cell because of the phenomenon of diffusion would become one with the environment. The plasma membrane also regulates the recognition and reception of messages from the outer and interior environment. The communication between cells seems to be served by a special class of lipids identified in cell membranes, the glycolipids. Thus, one more important function of the cell is the uptake

and excretion of substances from the cell by creating outgrowths (pseudopodion) and indentation.

Another important chapter of the plasma membranes is the transportation of substances in and out of the cell. The transportation can be either passive, which means that the movement of substances through the cell membrane does not require any energy consumption from the cell. Or the transportation can be active, which means that the movement of substances does require some energy consumption from the cell. Diffusion is a result of the passive transportation, which is actually the movement of substances from regions where their concentration is high to areas where concentration is small and according to the slope of concentration. Another result of the passive transportation of substances is the Simple diffusion, which is the movement of molecules from one side to the other membrane phospholipids across the membrane or through protein channels, depending on the slope of the concentration. Assisted diffusion is the movement of substances according to their concentration gradient through specialized transmembrane proteins called protein carriers. The passive transportation of substances can also provoke the osmosis, which is one of the most important processes in life and functionality of cells through which the plasma membrane, while allowing passage of molecules of water, reduces or prevents passage of substances to their size is larger than a given threshold or lipofova . This results in the intracellular substance does not leach into the extracellular environment. Particularly one characteristic is that when the extracellular environment has a bigger concentration than the intracellular substance

water can enter the cell, but otherwise water comes out of the cell to the extracellular environment, so that each time everything is balanced.

Gases, small and non-polar molecules and water can pass through the membrane phospholipids. The large size molecules, polar molecules and ions can not pass through the membrane phospholipids. Thus, talking about active transportation, the protein channels are hydrophilic channels formed by certain transmembrane proteins of the cell membrane and are specialized to allow a simple diffusion type polar molecule or ion, which can happen during an active transportation of substances in and out of the cell. Although, there are two more types of intracellular and extracellular transportation and are called endocytosis and exocytosis. For the transfer of large molecules to the inside of the cell, the cell uses a process called endocytosis or exocytosis. In endocytosis there is an engulfment, which is formed around a molecule that is about to enter the cell (around the projections of the cytoplasm called pseudopodia). Then, after the engulfment the vesicle enters the interior of the cell. Exocytosis is the reverse process, by which the molecule (or molecules) leaves the cell. When a mainly large, solid substance is about to enter the interior of a cell by endocytosis is a different process called phagosytosis (nutrition in white blood cells).

When the plasma membrane of a cell makes a mistake several disorders to the organism can be caused, such as cystic fibrosis, which is a genetic disorder. Patients with cystic fibrosis, a specific pair of genes (on chromosome 7) is not functioning properly. This pair of genes helps to control how cell membranes manage the entrance and the exit of the sodium and chloride ions (salts). There are many different abnormalities (mutations)

of the gene for cystic fibrosis, but basically, it is mostly caused by the wrong management of the sodium and chlorine by the cell membrane. As a result, cells in the affected organs are defective in the way they absorb and excrete sodium and chlorine. Basically, the cells absorb too much sodium, followed by water absorption, resulting in very little water left outside the cells. This makes the mucus or watery secretions outside the cells very pasty (for example, in the airways of the lungs).

To sum up, all organisms consist of cells and cellular derivatives. All cells are constructed from the same chemical compounds and exhibit similar metabolic processes. The function of organisms is the result of collective action and interaction of each and every cell in an organism. Each cell is derived by dividing an existing cell. On the other hand the plasma membrane is the thin boundary between the inanimate matter and life and also defines the cell to the external environment. According to the upper information, the cell membranes are really important for every living organism. The miracle of life is a combination and collaboration of everything in an organism, but everything is certainly because of the existence of the cells, which operate autonomously just like small independent organisms. Of course, the cell membranes are also very important for the function of a cell and their operation is priceless to every living organism.