

Free essay on membrane transport

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Membrane transport refers to the mechanisms by which ions and other small molecules move across the lipid bilayer of the plasma membrane. The lipid bilayer of the plasma membrane allows the passage of certain molecules down their concentration gradient. This passage depends on the charge, size and polarity of the molecule. Non-polar molecules and small polar molecules diffuse easily across the cell membrane by the process of simple diffusion. However, it becomes difficult for charged polar molecules to enter the cell even though the concentration of the ion is more outside the cell when compared to the cytosol. At some occasions, ions need to be transported into the cell against their concentration gradient also. For all these purposes, it becomes essential for the cell to possess mechanisms to move ions across the membrane. There are two types of proteins involved in transporting molecules across the cell membrane: channel proteins and carrier proteins. Channel proteins are pores that traverse the lipid bilayer allowing the passage of ions depending on their size and charge. Carrier proteins specifically bind to the molecule and undergo conformational changes to enable the transport of the bound molecule. Membrane transport enables the cell to maintain its membrane potential. The interior of the cell has numerous macromolecules and sugars which could cause water to move inside the cell by osmosis. Membrane transport ensures that the osmolarity of the cell is maintained by balancing the presence of macromolecules by the movement of ions into and out of the cell. In nerve cells, the electrical signal is initiated and propagated by the movement of ions. Thus, membrane transport is essential for the survival of the cell. There are two kinds of membrane transport: active transport and passive transport (Cooper, 2000).

Passive Transport

Passive transport refers to the movement of molecules across the cell membrane down their concentration gradient and charge. Since the ions move by the principle of diffusion facilitated by a channel protein this type of transport is also called facilitated diffusion. Uncharged molecules are transported based on only their concentration gradient but charged molecules are transported based on the collective electrochemical gradient which includes both its concentration and charge. The transport of glucose ions, which is essential for the metabolic activities of the cell, is an example of passive transport. Glucose is transported by a carrier protein called the glucose transporter which exists in two conformations. When glucose is not bound, the binding site stays exposed to the outside of the cell. Binding of glucose induces a conformational change on the protein causing the binding site to be exposed to the cell interior. The glucose molecule is released into the cell and the protein reverts back to its unbound conformation (Cooper, 2000).

Fig1: Passive transport of glucose (Cooper, 2000).

Active Transport

Facilitated diffusion of a molecule always takes place down its concentration and charge gradient. However, the cell needs to transport certain molecules against their electrochemical gradient. This type of transport is known as active transport and it utilizes the energy released by the hydrolysis of ATP for the uphill movement of molecules. An example of active transport is the pumping of Na^+ and K^+ ions across the membrane by the Na^+-K^+ ATPase pump. The concentration of sodium ions is higher outside the cell than the

cell interior but the concentration gradient of potassium ions is the opposite. The Na⁺-K⁺ pump has binding sites for Na⁺ and K⁺ ions. The binding of Na⁺ ions induces a conformational change driven by the hydrolysis of ATP and consequent phosphorylation of the pump. The change in the conformation causes the Na⁺ binding site to face the interior of the cell and the affinity for Na⁺ to weaken. This reduction in the affinity causes the Na⁺ ions to get released into the cell and the K⁺ ions to bind to the pump. Binding of K⁺ induces the dephosphorylation of the pump. The resulting conformational change reduces the affinity of the pump for sodium which gets released to the cell exterior (Cooper, 2000).

The proteins on the surface of the cell thus enable the entry and exit of ions and molecules across the cell in reactions that are as concise and important as enzyme-substrate interaction. This transport of molecules across the membrane is essential for the survival of the cell. Specific molecules called ionophores can be used to improve the permeability of the membrane to certain ions.

References

Cooper, G. M. 2000. *The Cell: A Molecular Approach*. Sunderland (MA): Sinauer Associates.