Active membrane transport

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LITTLE BIOPHYSICS - TOO SHORT

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What is Active Transport?

Active transport involves the movement of molecules, in the direction against their concentration gradient, across the membrane of a cell with the use of energy. There are specific carrier proteins which are used to do this which have receptors that bind to specific substrates. There are two different types of active transport:

1.Primary

Primary active transport is when chemical energy is used in the process, for example adenosine triphosphate (ATP). The proteins involved in this process are normally described as pumps and almost all of the enzymes involved in this process are transmembrane ATPases. There are 4 different types of these ATP using processes; ATP binding cassette (ABC) transporter e.g. CFTR involved with cystic fibrosis; F-ATPase e.g. chloroplast ATP synthase; V-ATPase e.g. vacuolar ATPase; P-type ATPase e.g. the Na+/K+ pump used to help maintain the potential of a cell. Although ATP is used in most forms of active transport there are other sources of energy too; the electron transport chain involves redox energy using the energy from reducing NADH for the movement of protons against their concentration gradient into the inner mitochondrial membrane; in photosynthesis the proteins involved use photon (light) energy to create power from reduction in the form on NADPH and also a proton gradient is formed across the thylakoid membrane.

Example of mechanism of active transport

The transport of hydrogen ions against their electrochemical gradient is done with the use of ATP hydrolysis. A conformational change is induced in the carrier protein when it is phosphorylated and the hydrogen ion has bound to it. This in turn drives the process and the bound phosphate is hydrolysed causing the release of the hydrogen and also restoring the carrier protein back to its original shape.

2.Secondary

Secondary active transport is different from primary transport in that it is reliant upon ions being pumped in/out of the cell which creates and electrochemical gradient i.e. the movement of an ion in a place of lower concentration to a place of higher concentration can be used as a source of energy due to the increased entropy. Another name for secondary active transport is cotransport and the are two different classifications of cotransporters:

Antiporters

An antiporter allows two different types of ion (or other solute) to be pumped across a membrane in opposite directions. One goes from high concentration to low concentration which serves as a source of energy (entropic) to allow the other to go from a place of low concentration to high concentration. An example of this would be the Na+/Ca2+ exchanger allowing the cell to transport 3 Na+ into the cell and 1 Ca2+ out.

Symporters

A symporter works very much in the same way as an antiporter except for the major difference in that the two different ions (or other solutes) are transported in the same direction as each other. An example of this would be the SGLT1 protein which is a glucose symporter allowing the movement of 1 of either glucose or galactose for every 2 sodium ions into the cell.

Reference(s)

Wikipedia- Active Transport. Last visited: 7th December 2014.