Active transport

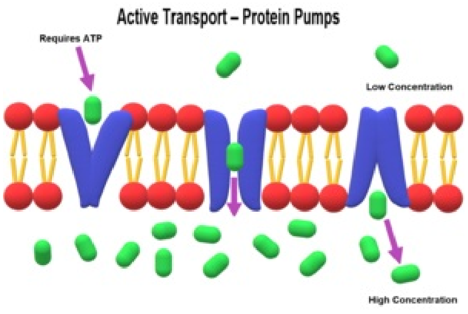
Active transport is the transfer of substances across the cell membrane, which, unlike passive transport , is associated with energy consumption. Thanks to the supplied energy, which is most often produced by the splitting ATP, it is possible to carry out this transport even against the direction of the concentration gradient (concentration drop).

Active transport is enabled by specialized integral membrane proteins embedded in the cell membrane:

- Ion pumps – ion channels equipped with the enzyme ATPase.
- Carrier proteins equipped with an ATPase enzyme.

We distinguish two types of active transport:

Primary active transport



Active Transport - Protein Pumps

> The presence of free energy is required. Only one particle is transferred (eg to the Na + /K + ATPase, which simultaneously pumps sodium out of the cell and potassium into the cell). [1]

Primary active transporters can be classified based on the method of obtaining the necessary energy:

- Carriers (transporters) powered by ATP hydrolysis - occur in all domains of organisms
- Decarboxylation powered transporters – found in prokaryotic organisms.
- Methyl group transfer driven transporters – found in archaebacteria.
- Oxidoreductase-driven transporters: the source of energy is the oxidation of a reduced substrate mediated by the flow of electrons – they occur in all domains of organisms.
- Carriers powered by light energy - found in archaebacteria.

Secondary active transport

> Coupling with the transfer of another substance in the direction of the concentration gradient is used as an energy source. The energy stored in the gradient that follows the passively transported particle is used to transport the second particle against the direction of concentration gradient.

The gradient for the passive transfer of the second substance is created primarily by an active transport mechanism elsewhere in the membrane (e.g. resorption of glucose against the gradient and sodium in the direction of the gradient in the small intestine). The term cotransport is also used for secondary active transport.[1]

According to the number of transmitted particles, we distinguish:

- **uniport** – only one molecule or ion is transported,
- **cotransport** - two or more molecules or ions are transported.

We further divide cotransport according to the mutual direction of the transported particles:

- **symport** – particles are transported in the same direction,
- **antiport** – particles are transported in the opposite direction.

A typical example of active transport is the **sodium-potassium pump** (alternatively **Na^+/K^+ ATPase**), which maintains the sodium - potassium concentration difference between the intracellular and extracellular environments by depleting sodium from the cell and reabsorbing potassium. These differences are quite significant: sodium concentration is 140 mmol/l extracellularly and 10 mmol/l intracellularly, potassium concentration is 5 mmol/l extracellularly and 165 mmol/l intracellularly. Actually, it is an antiport of sodium and potassium, more precisely three molecules of sodium and two molecules of potassium. Because both sodium and potassium move against a concentration gradient, an energy source is needed; in the case of the sodium-potassium pump, it is the source of energy ATP.

Links

Related articles

- Active transport
    - Symport
    - Antiport
- Passive transport
    - Diffusion
        - Simple diffusion
        - Faciliated diffusion
    - Filtration
    - Osmosis
- Drug penetration through membranes
- Donnan Equilibrium/Example

References

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1. ŠVÍGLEROVÁ, Jitka. *Active transport* [online]. Last revision 2/18/2009, [cit. 13/11/2010]. < https://web.archive.org/web/20160416224212/http://wiki.lfp-studium.cz/index.php/Aktivn%C3%AD_transport >.