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Physiology sheet

Doctor 2021 -mercy- I medicine I MU

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Diffusion : is a random process from top to bottom where the outside of the cell membrane contains many solutes.

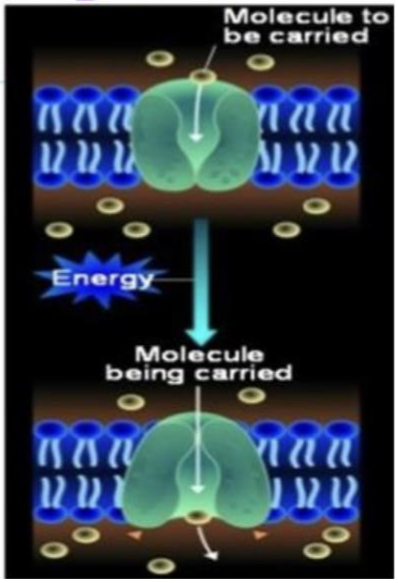
Active Transport

What is active transport?

Active transport is the transport of substances from a region of lower concentration to higher concentration using energy, usually in the form of ATP.

Examples: Na, K and Ca active transport.

1. sodium-potassium pump
2. Calcium pump
3. Potassium hydrogen pump



Active transport involves the use of carrier proteins, like those of facilitated diffusion, but these carrier proteins act as pumps, using the energy from splitting ATP to pump specific molecules against the concentration gradient

We imagine active transport, many cars regulated by traffic lights or traffic police.The energy a cell needs to transport depends on the cell's need for it.The sodium-potassium pump is the most important pump as it is found in many cells.

- We compare pumps to traffic lights or a traffic policeman.
- Active transport is need to be organized because of the transport process from lower to higher concentrations.

The difference between pumps and carriers:

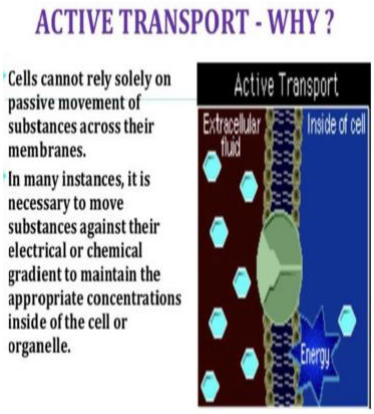
-Carries connect and change the shape of the cell membrane to allow the passage of substances through facilitated diffusion, while pumps transfer substances to and from the cell in against concentration gradient.

- the pumps always use energy but the carrier may or may not be active Transport (passive&active).

-Active transport does not depend on concentration gradient.

Active Transport – why?

- **Cells cannot rely solely on passive movement of substances across their membrane.**
- **In many instances, it is necessary to move substances against their electrical or chemical gradient to maintain the appropriate concentrations inside of cell or organelle.**

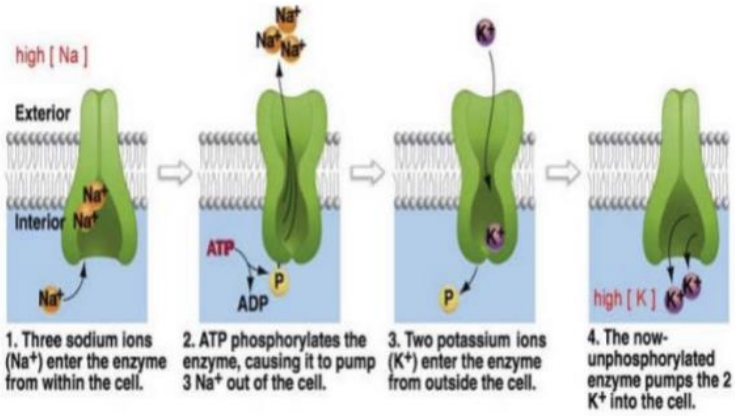


Pumps involved in ACTIVE TRANSPORT

1- **Sodium-Potassium pump**
Found in many cells

2- **Calcium pump**
Found in membrane of Sarcoplasmic reticulum

3- **Potassium hydrogen pump**
Found in Gastrointestine cell membrane



The sodium potassium pump:

- **is the most energy consuming pump.**
- **works to maintain the resting position of the cell.**
- **maintains a negative charge inside the cell compared to a positive charge outside because the cell is in equilibrium.**
- **works to enter 2 potassium and excrete 3 sodium, which makes the inside of the cell negative, and it is attracted to the positive charge outside.**

Primary Active Transport

- **It is the transport of substances uphill using energy (ATP hydrolysis)**
- **It causes a conformational change that results in the transport of the molecules through the protein.**

E.g. Na+ - K+ pump

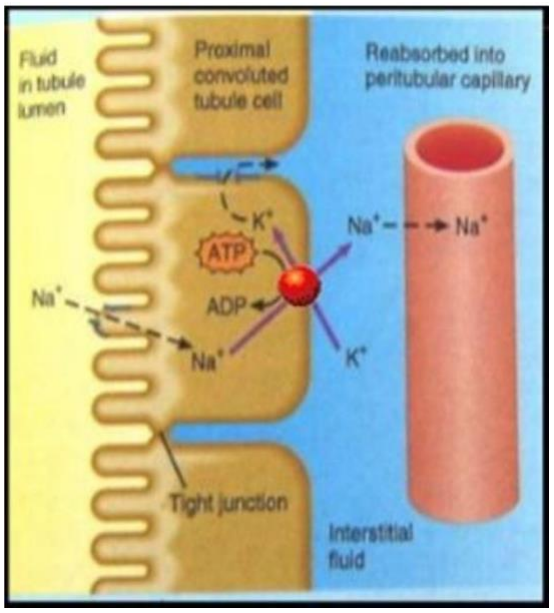
Functions of Na+ k+ pump

-It is responsible for maintaining the high k+ and low Na+ concentration inside the cell.

-It maintains intracellular negativity.

-Maintains cell volume.

-Activate the carrier



Secondary Active Transport:

The transport of substances against a concentration gradient involving energy to establish a gradient across the cell membrane, utilizes the gradient to transport a molecule of interest up its concentration gradient.

The transport may be :

- **In the same direction (SYMPORT)**
- **In the opposite direction (ANTIPORT)**

The secondary active transport benefits from energy resulting from primary active transport instead of depending on ATP. It consumes energy indirectly.

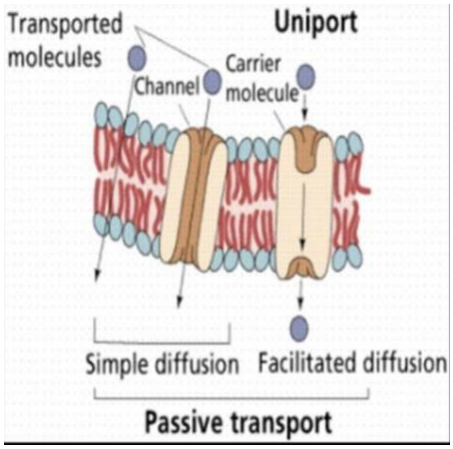
Uniport

The movement of a single substance.
It requires no energy from the cell.

Examples:

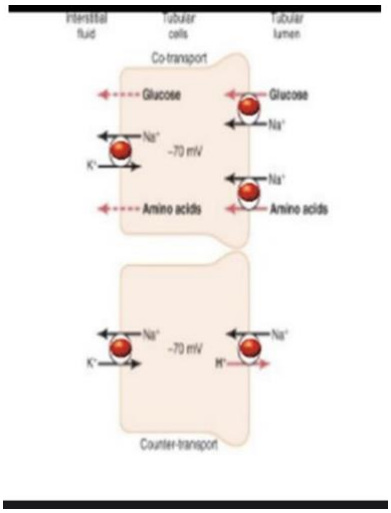
- **Simple diffusion**
- **Facilitated diffusion**

Uniport is not active transport its passive one.



SYMPORT (Co- transport)

Transport of two substances using the energy produced by concentration difference developed by primary active transport



-Substances are moving in the same direction

Examples: transport of amino acids, Glucose.

Symport is called because of the entry of glucose and sodium in the same direction.

Anti port (Counter -Transport)

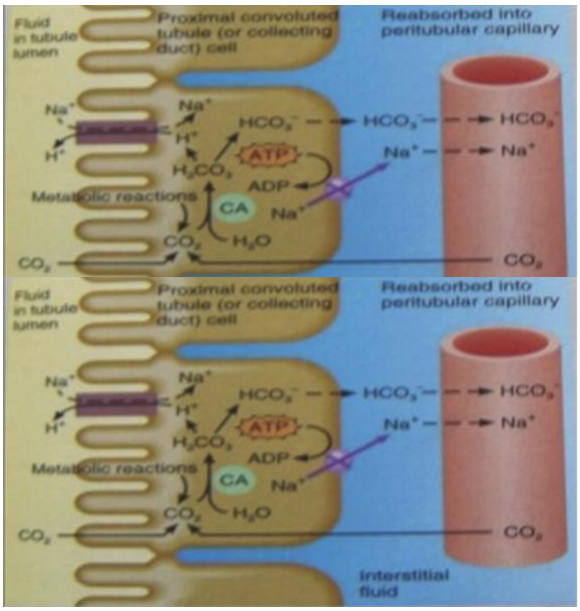
In this process, the two substances move Across the membrane in opposite directions.

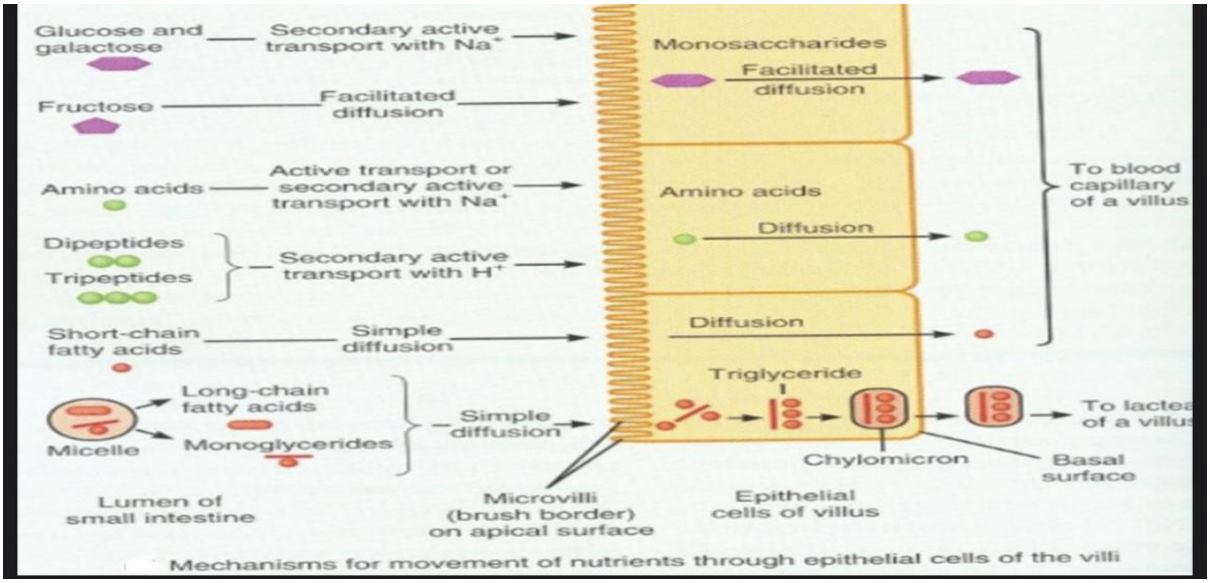
Examples: Exchange of H+ and Na+ in renal tubule.

H2CO3 -----> HCO3 + H+*by carbonic anhydrase enzyme

***Na+ is pumped actively through Na+\k+ pump, which maintains The required energy for H+\Na+ Pump (secondary active). In Which Na+ reenters the cell, balancing the overall charge inside it, while H+ exits the cell (antiport).**

***HCO3 goes toward blood**





Mechanisms for movement of nutrients through epithelial cells of the villi

Intestines have two sides: firstly, nutrients are transported from the lumen to inside the epithelial cells of villi, then to the other side of the intestinal cells (blood). This substances migration from the intestinal lumen to blood vessels is called absorption. It is also defined as the final required process in digestion.

***Fructose does not require energy to transport it.**
(Fructose the fastest sugar to be absorbed)

***Facilitated diffusion requires special vectors.**

Long Fatty acids are broken down by an enzyme located on the surface of the epithelium, which facilitates their entry.
Fatty acids are not absorbed directly into the blood but first associate to triglycerides in a chylomicron and pass into the lymphocytes.

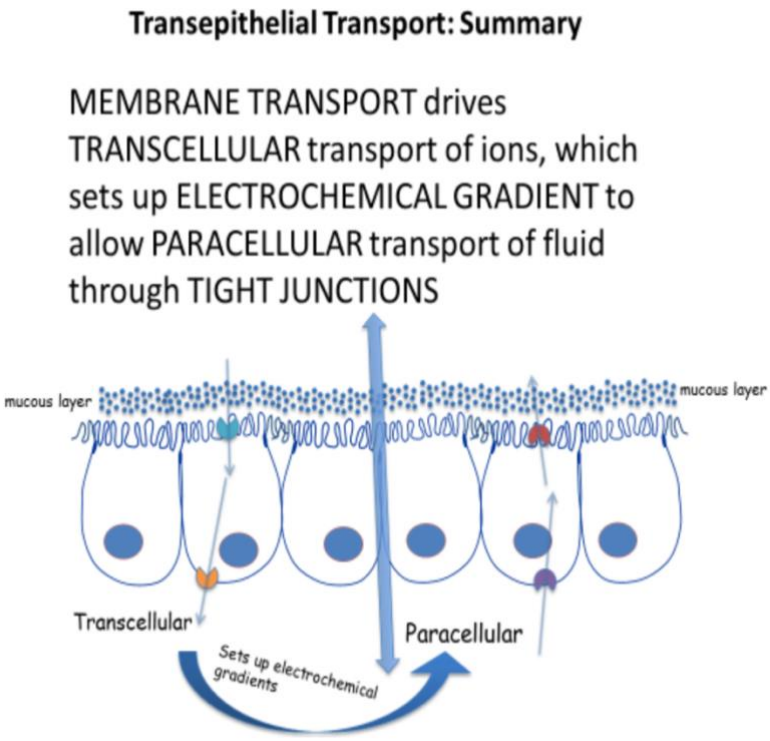
It produces a difference in the charge called electrochemical, which prevents the passage of materials in the opposite direction, except for water, so the cell remains in a state of equilibrium.

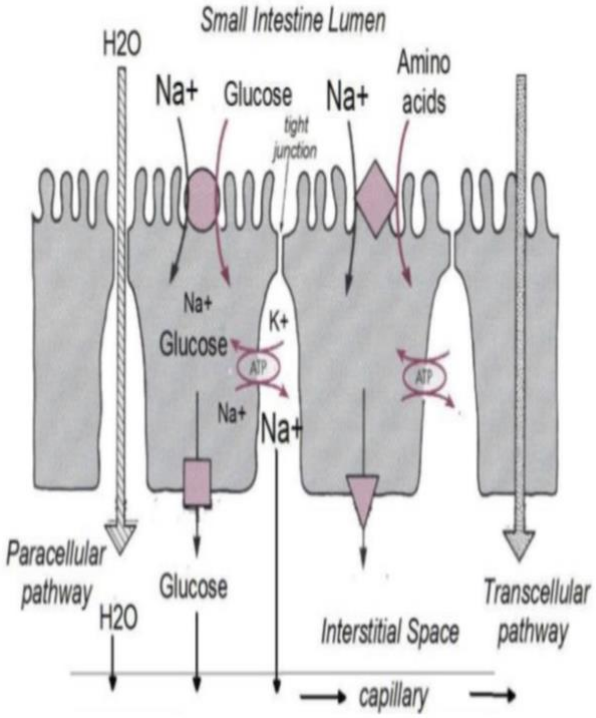
<u>is active transport dependent on concentration?</u>

It has nothing to do with the concentrations of substances (important).

If there are two solutions, one of them It contains glucose and the other contains glucose and sodium, which one is absorbed faster by body cells when given to the patient orally ??

The solution that contains glucose and sodium is faster through the entry of glucose and sodium, the higher the number of sodium, the faster the entry of glucose during the second active transport process, so it enters glucose with sodium, benefiting from energy in the first active transport.





When the solutes, such as Na+, are transported trans cellularly into blood stream, the osmotic pressure increases (hypertonic) , As a result, water is allowed to be transported paracellularly through tight junction, in order to balance the osmotic pressure (reverse blood stream as isotonic)