Comparison of transport

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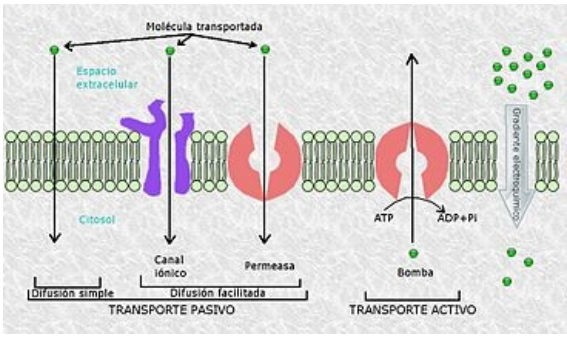
Introduction

Passive Processes

Movement of substances down the concentration gradient (from high to low until equilibrium is reached). No energy is required for any of this processes.

Active Processes

Cellular energy (ATP) is used to pump substances against (up) the concentration gradient – from low concentration of solute to high concentration of solute.



Comparison Chart

	Active	Passive
Types of transport	Vesicular transport (endocytosis/exocytosis), Pumps	Diffusion, Osmosis
Types of particles transported	proteins, ions, large cells, complex sugars	Small lipophilic molecules, water, small monosaccharides, Oxygen, Carbon dioxide,...
Examples	Endocytosis (Phagocytosis, Pinocytosis, receptor-mediated Endocytosis), Exocytosis, Sodium/Potassium-Pump	Simple diffusion, Facilitated diffusion (channel-mediated, carrier-mediated), Osmosis
Importance	In eukaryotic cells, amino acids, sugars and lipids need to enter the cell by protein pumps, which require active transport.These items either cannot diffuse or diffuse too slowly for survival.	It maintains equilibrium in the cell. Wastes (carbon dioxide, water, etc.) diffuse out and are excreted; nutrients and oxygen diffuse in to be used by the cell.
Functions	Transports molecules through the cell membrane against the concentration gradient so more of the substance is inside the cell (i.e. a nutrient) or outside the cell (i.e. a waste) than normal. Disrupts equilibrium established by diffusion.	Maintains dynamic equilibrium of water, gases, nutrients, wastes, etc. between cells and extracellular fluid; allows small nutrients and gases to enter/exit.

Major mechanisms by wich molecules cross membranes

Channel Proteins

Channel Proteins are responsible for the transport of water-soluble substances such as glucose and electrolytes. Since they are ion selective, they contain a pore through which the solutes pass at a very high flux rate (compared to the flux rate of carrier proteins). Channel proteins only do passive transport down the concentration gradient. Some channels are also gated and/or selective. Gated means it opens only when appropriately stimulated.

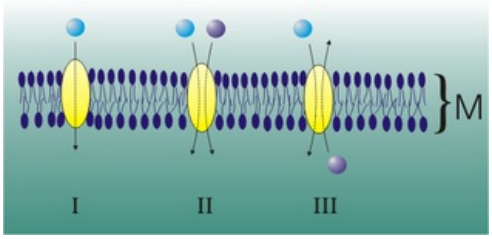
Selective means it only lets certain substances through. It can be seen as a tunnel. Only some examples for channels are: Ca2+ channel protein, slow Na+ channel protein, fast Na+ channel proteins, Nicotinic Acetylcholine (nACh) receptor, N-methyl-D-aspartate.

Carrier Proteins

Carrier Proteins transport both water soluble and insoluble substances. When transporting the solutes, they bind them on one side of a membrane, undergo conformational changes, and release them on to the other side of the membrane. Both active and passive transport - active means transport ion of the solute up the concentration gradient, whereas passive is the transport down the concentration gradient where no energy (ATP) is needed. Carrier only transport specific substances. Because of the more complex functioning the flux rate is slower compared to channel proteins. Furthermore they can be compared with enzymes in their working method and there can also be saturation, in case all carriers are "occupied" with a substance. Examples: Glucose Transporter 4 (GLUT-4), Na+-K+ ATPase, Ca2+ ATPase.

Comparison Chart

Membrane channel Proteins/Ion channels	Carrier/Transporter
Integral membrane proteins that act as in channels (or ion pumps). **Permeability**: • voltage-gated (e.g. sodium channel) • ligand-gated (via neurotransmitters) • mechanically-gated (via touch/vibration/strech-sensors) • randomly-gated (percentages of open/closed channels remain constant) • thermo-gated	Integral membrane proteins wich release the bound molecules tot he other side oft he membrane via change in conformation. Involve active transport using energy from breakdown of ATP: • **Uniport**: Only one molecule is transported • **Symport**: Movement of substance up its concentration gradient in the same direction as its coupling-ion (Na+ glucose transport) • **Antiport**: Movement of substance up its concentration gradient in the oppsoite direction as its coupling-ion (Na+/H+ transport) Involve passive transport: **Facilitated diffusion** • Carrier-mediated: Movement of small polar molecule down its concentration gradient by a carrier protein (e.g. transport of glucose into cell by glucose carrier)



Scheme of the three types of active Carriers: I - Uniport, II - Symport, III - Antiport; M - (Cell)Membrane of phospholipidbilayer

References

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