



Medical Biology

How molecules cross the plasma membrane?

- The plasma membrane is semi permeable, allows some molecules to pass through (e.g. small, non charged, lipid- soluble molecules).
- Plasma membrane also is often regarded as differentially permeable.

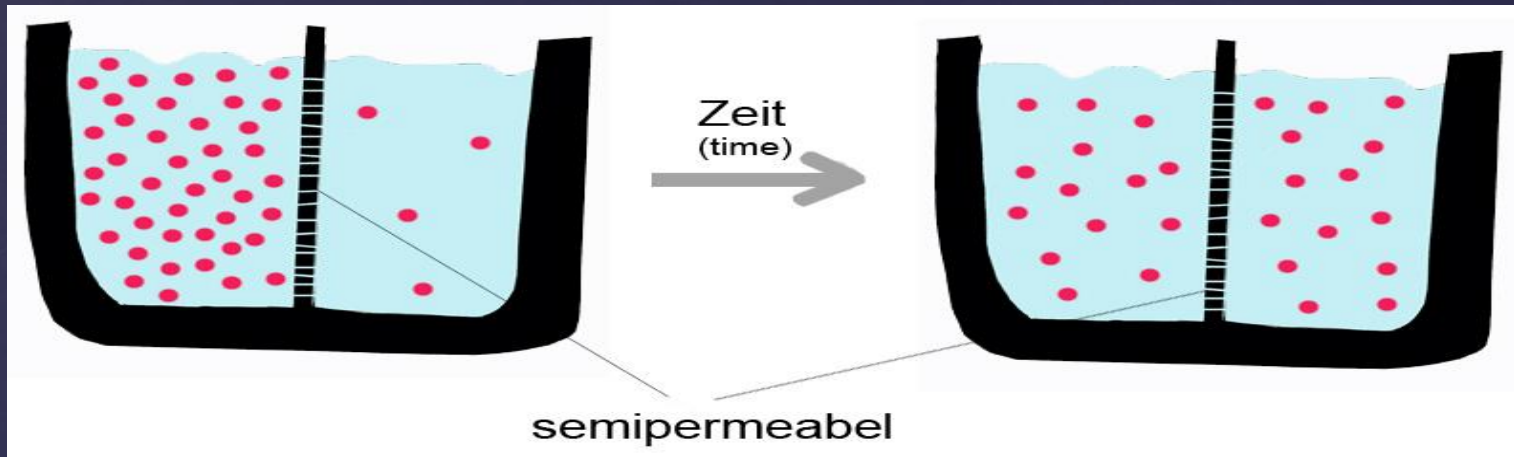
Molecules cross the plasma membrane in 2 ways:

passive ways: which do not use energy.

active ways: use energy.

Passive ways

1. Simple diffusion: occurs when molecules move from higher to lower concentration



Osmosis:

✓ the diffusion of water across a differentially permeable membrane has been given a special name it is called osmosis.

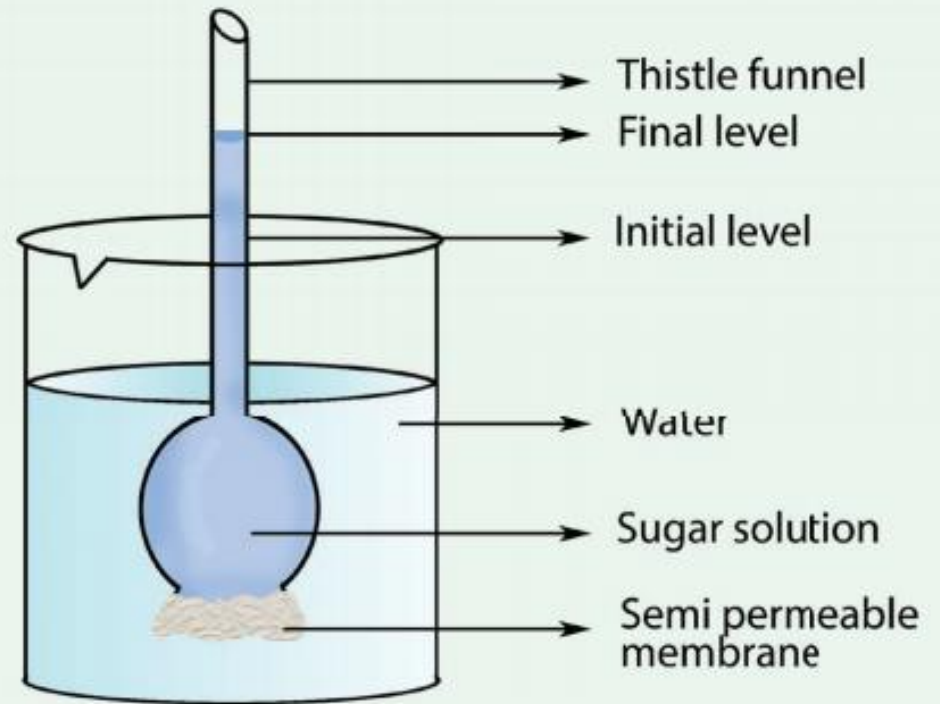
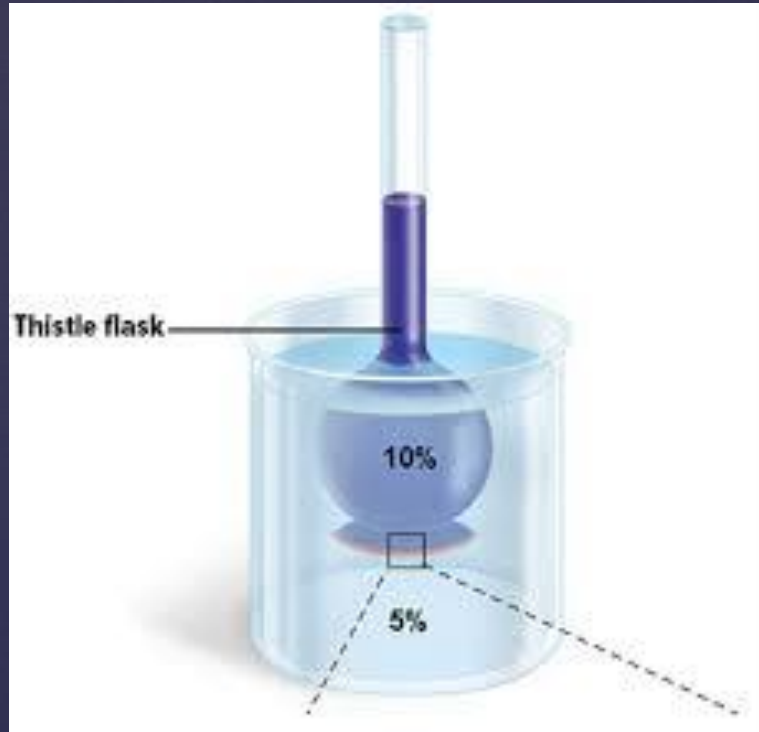


Figure 11.6: Thistle Funnel Experiment

Tonicity:

Tonicity refers to the strength of a solution in relation ship to osmosis.

❖ Isotonic solution:

solution that cause cells neither to gain nor to lose water, that is the solute concentration is the same on both sides of the membrane.

A 0.9% solution of the salt sodium chloride (NaCl) is known to be isotonic to red blood cells because the cells neither swell nor shrink when placed in this solution.

❖ Hypertonic solution:

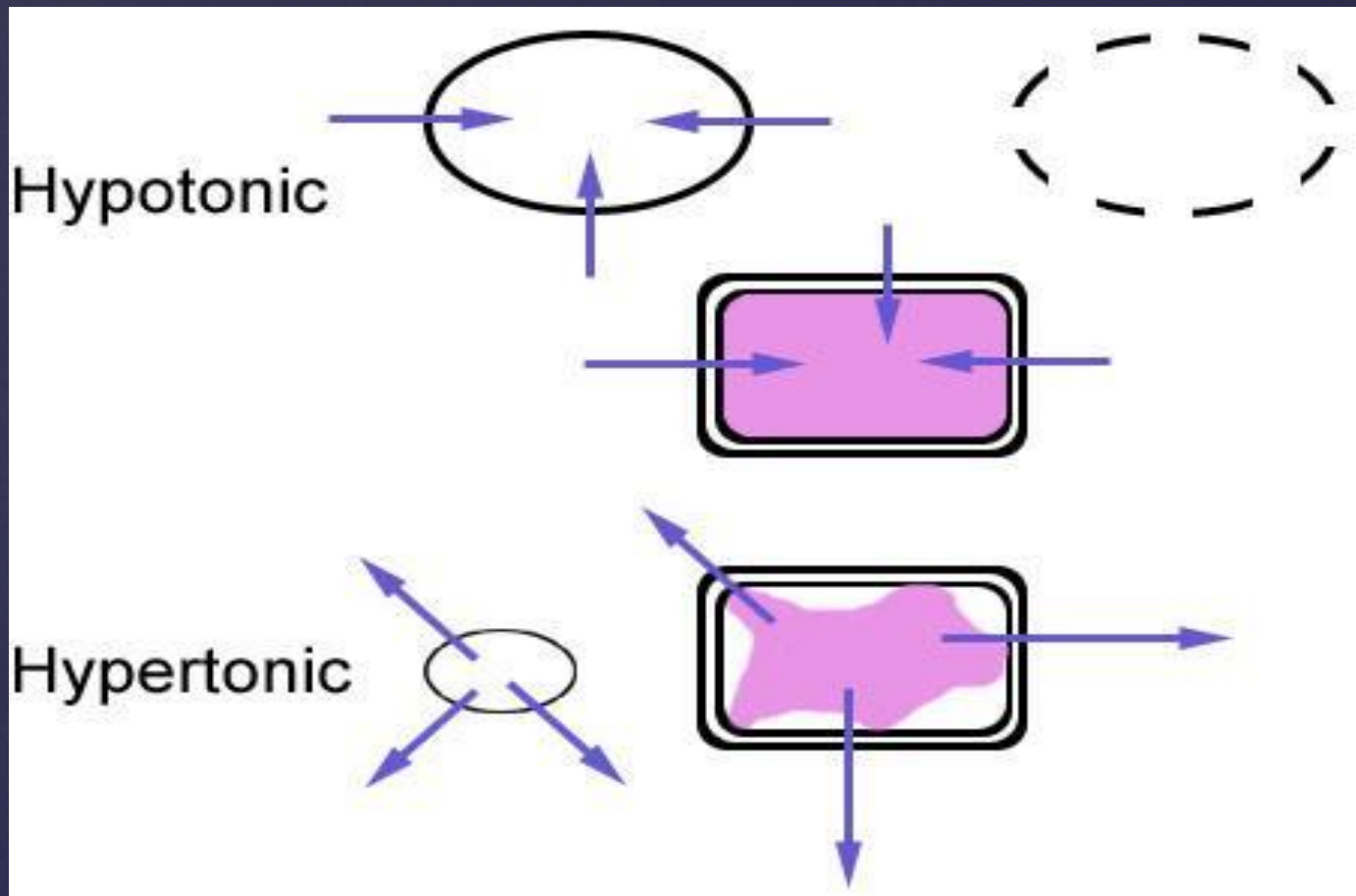
Solutions that cause cells to shrink due to loss of water.

Any concentration with a concentration higher than 0.9% sodium chloride is hypertonic to red blood cells.

❖ Hypotonic solution:

Solutions that cause cells to swell or even to burst, due to an intake of water.

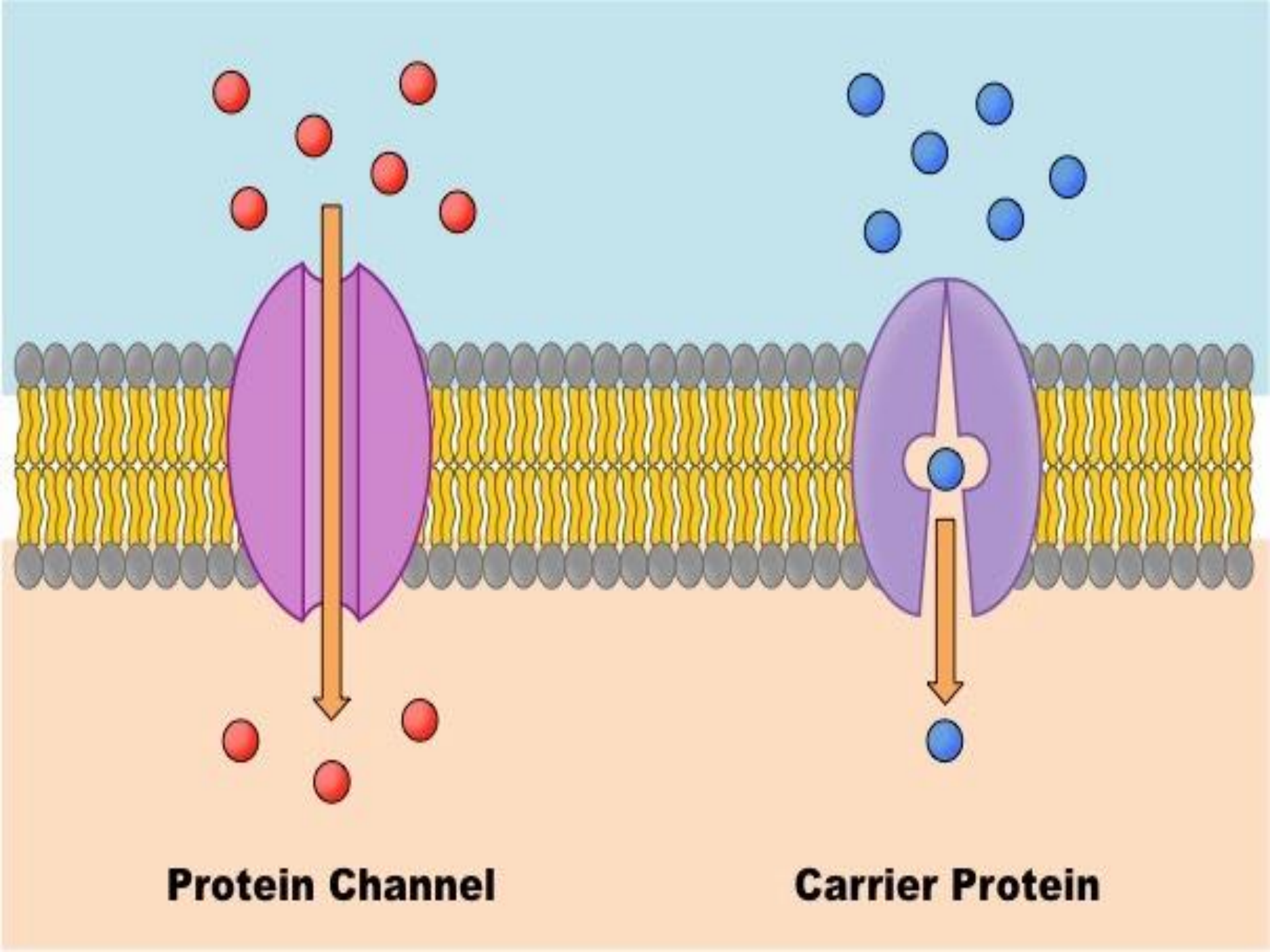
Any concentration of salt solution lower than 0.9% is hypotonic to red blood cell.



Facilitated diffusion

1. **Channel protein diffusion:** This type of passive transport system also **dosen't use energy**, used for movement of Ions (H⁻ or Cl⁻) required only **channel protein**.

2. **Carrier protein diffusion:** Another type of **passive** transport system **doesn't use energy** but requires a **carrier protein** assist the movement of glucose or amino acids. Each protein carrier, sometimes called a *transporter*, binds only to a particular molecule, such as glucose.

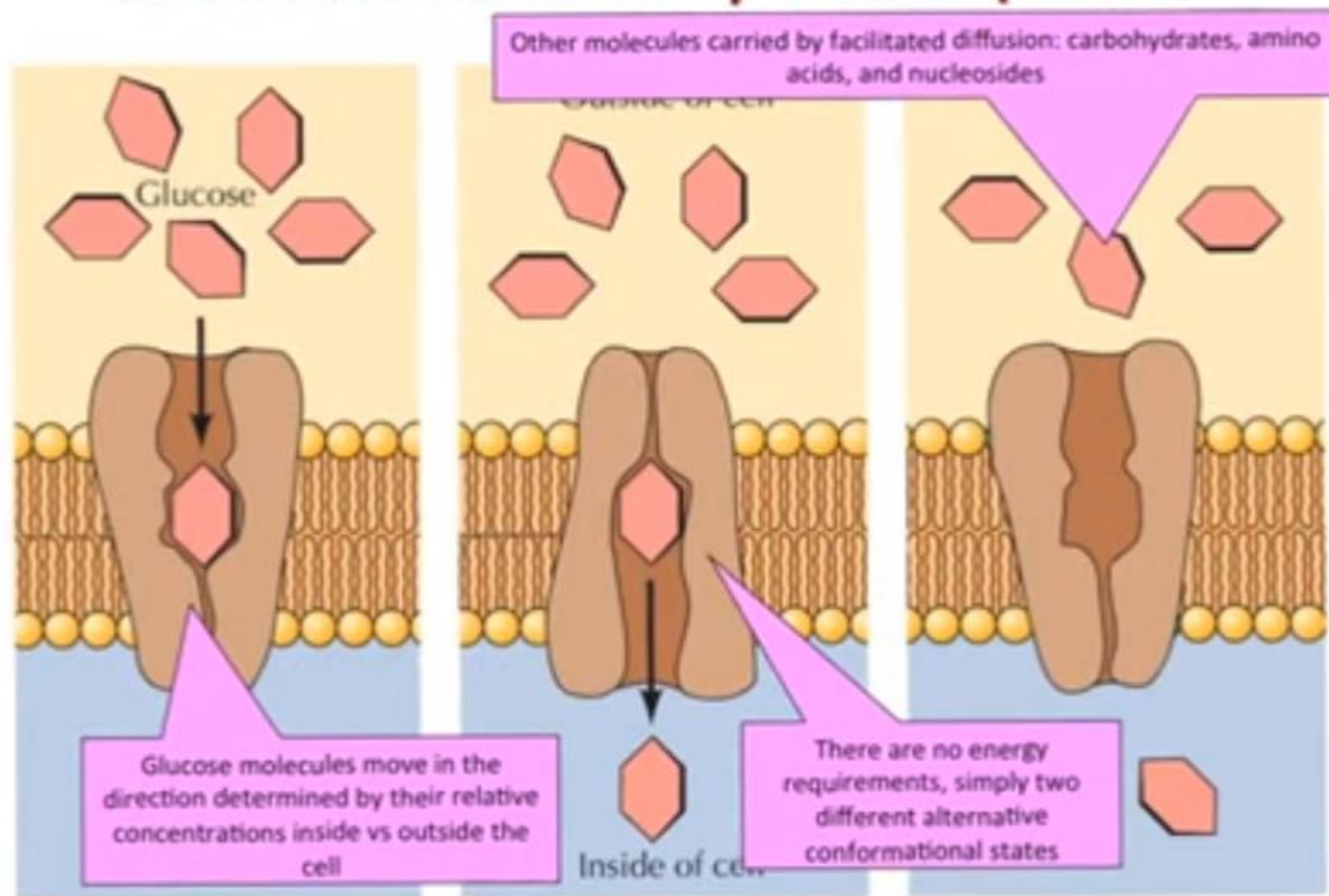




Type 2 diabetes mellitus results when cells lack a sufficient number of glucose transporters.

Medical application On simple diffusion

The Glucose Transporter exemplifies facilitated diffusion by carrier proteins

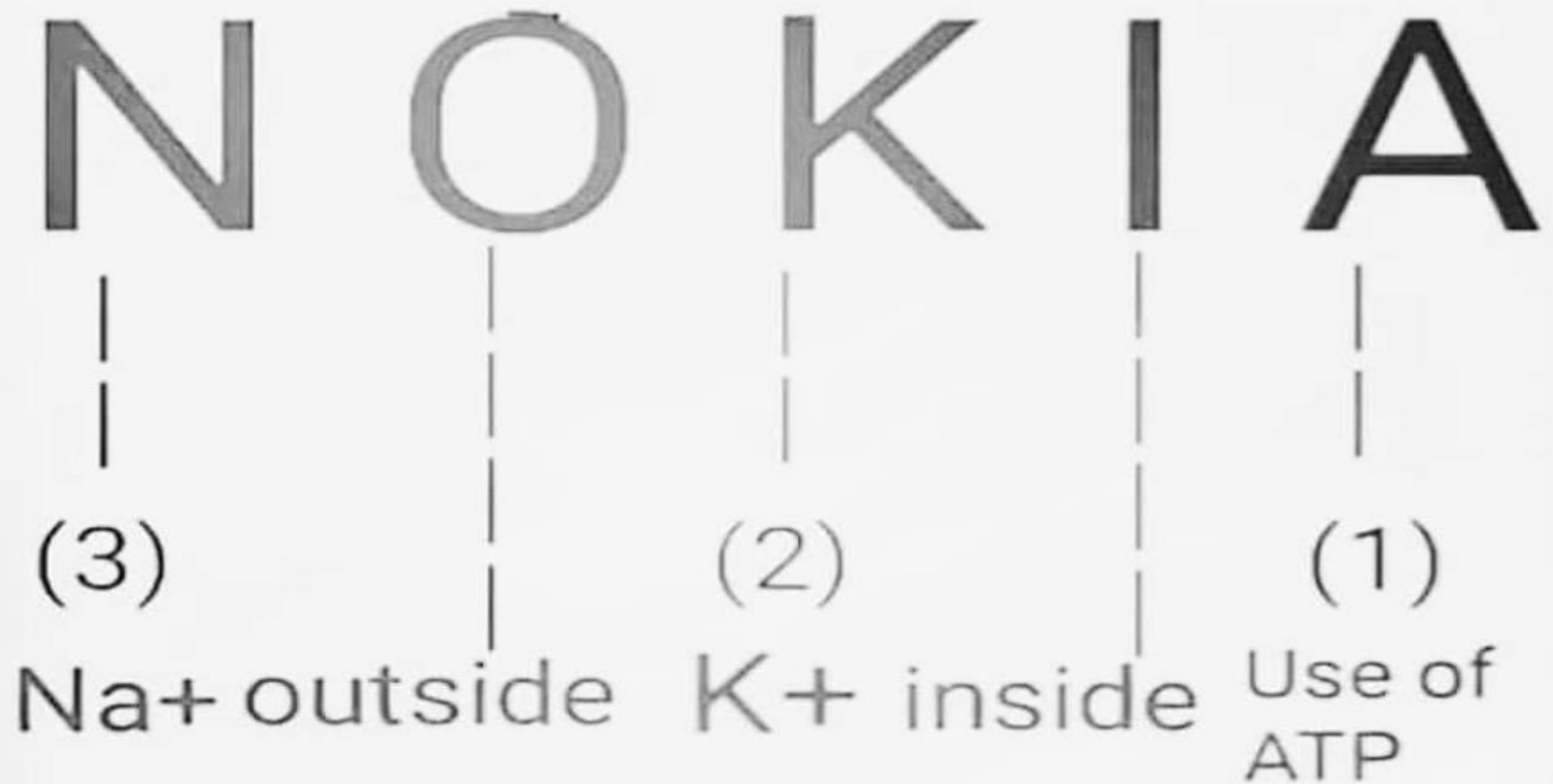


active ways

1. active transport:

some molecules and ions can be transported across cell membrane against their concentration gradient if the appropriate transport enzymes and a source of energy are available.

sodium potassium pump :-



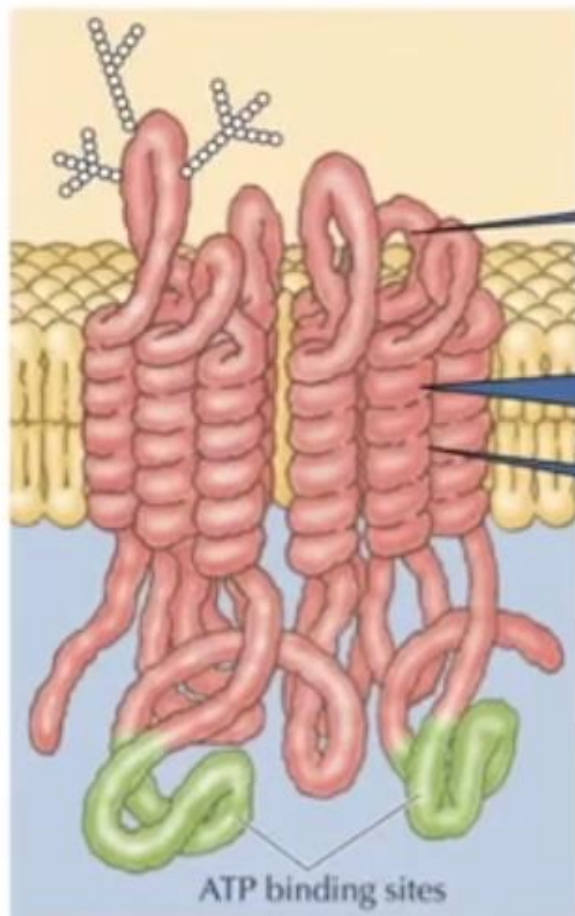
Cystic fibrosis is a genetic disorder occurs when there is a defects in a gene on chromosome 7 .This gene, called CFTR (cystic fibrosis Transmembrane conductance regulator), codes for the **CFTR protein is a channel protein** that controls the flow of H₂O and Cl⁻ ions in and out of cells inside the lungs. When the CFTR protein is working correctly, ions freely flow in and out of the cells. However, when the CFTR protein is malfunctioning, these ions cannot flow out of the cell due to a blocked channel. This causes cystic fibrosis, characterized by the **buildup of thick mucus in the lungs.**



Medical application On active transport

Mutations Affecting an ABC Transporter are the molecular cause of Cystic Fibrosis

(the most common lethal inherited disease of Caucasians)



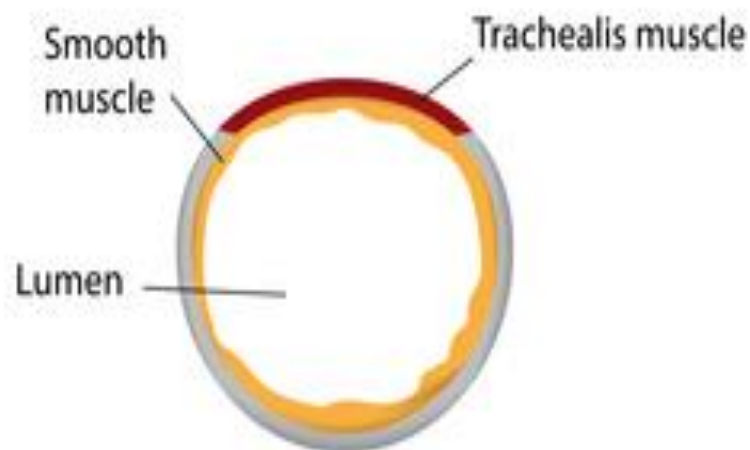
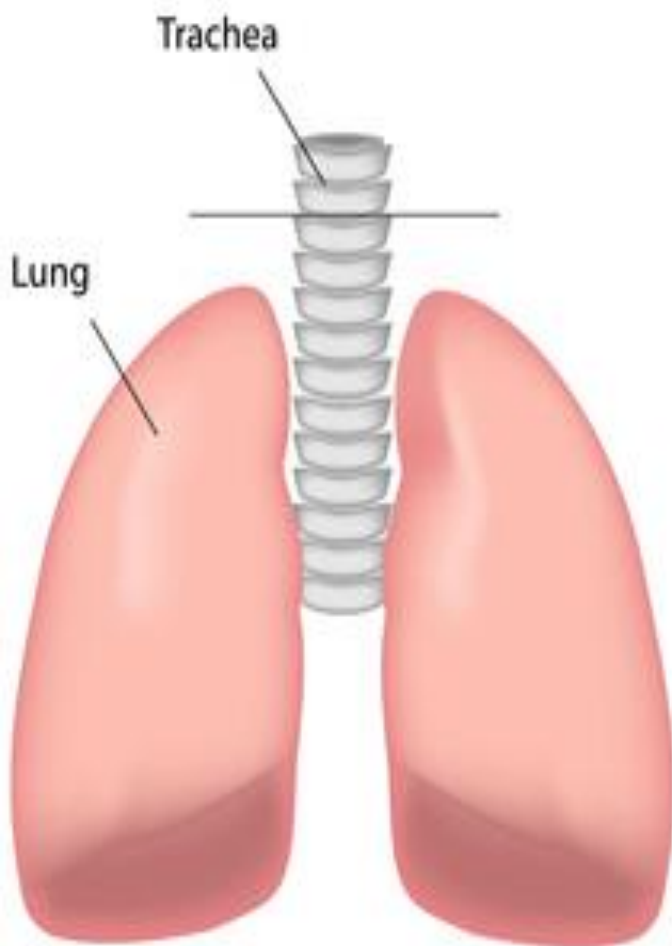
CFTR: Cystic Fibrosis Transmembrane-Conductance Regulator

Cl⁻ channel - Lack of function results in abnormally thick sticky mucus @ respiratory & digestive tracks

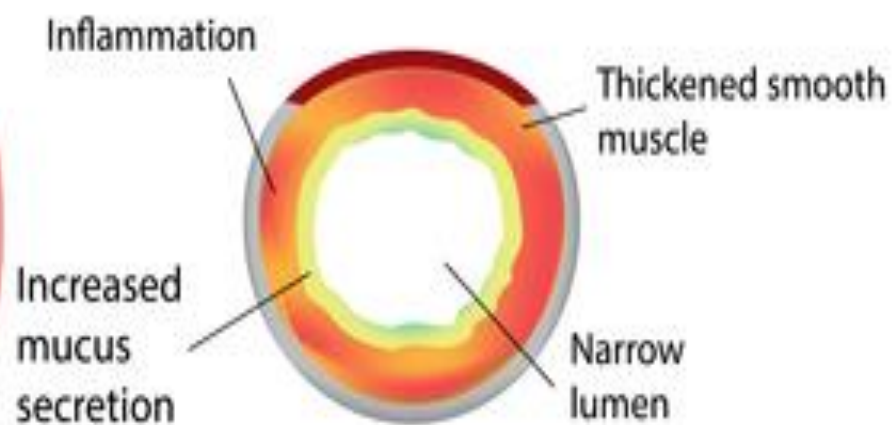
First human trial of gene therapy (introduction of a normal gene in affected individuals using Adenoviruses as vectors)

ATP binding sites

Cystic Fibrosis



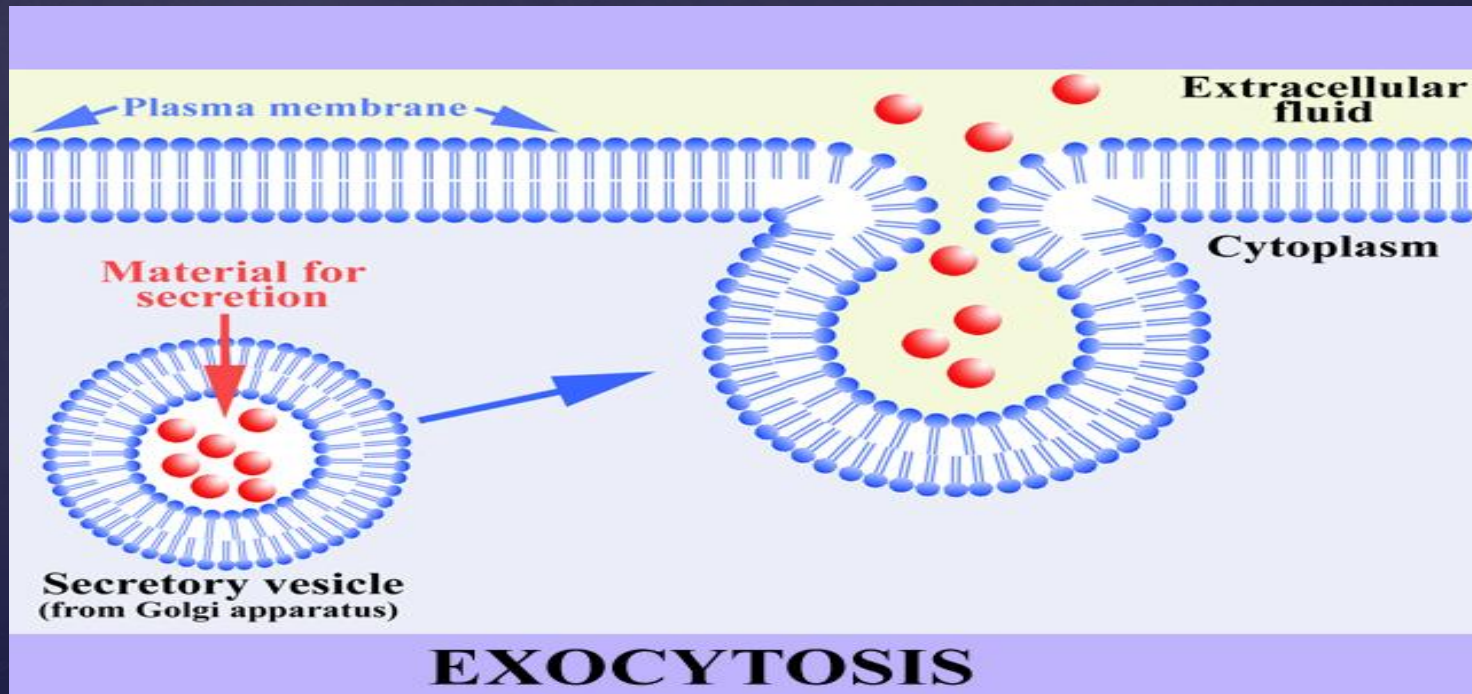
Healthy



Cystic Fibrosis

2. exocytosis:

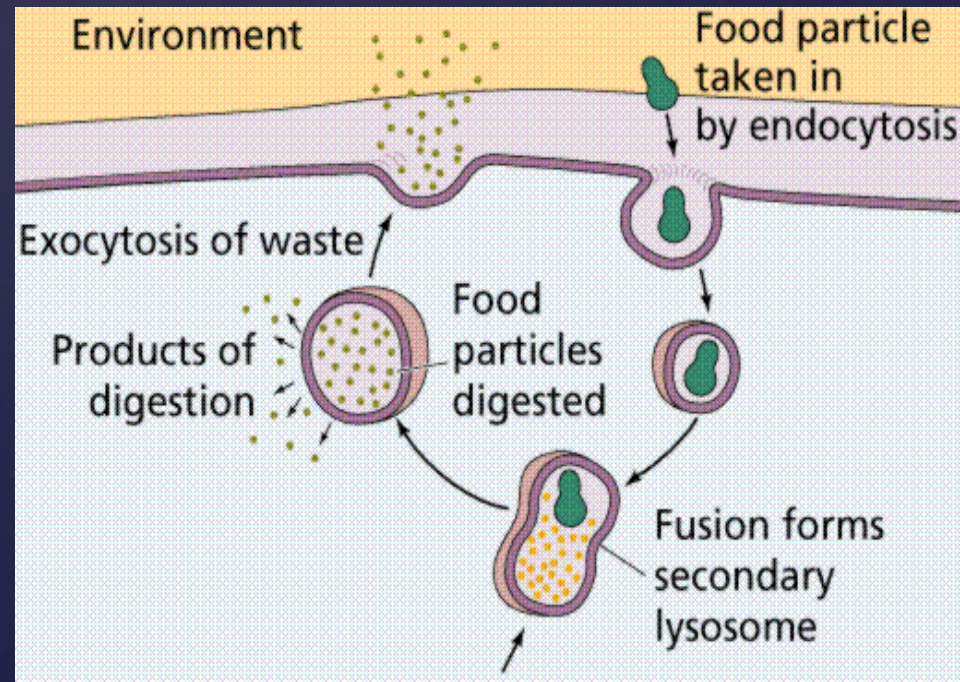
during exocytosis, vesicles often formed by the Golgi apparatus and carrying a specific molecules fuse with the plasma membrane and secretion occurs.



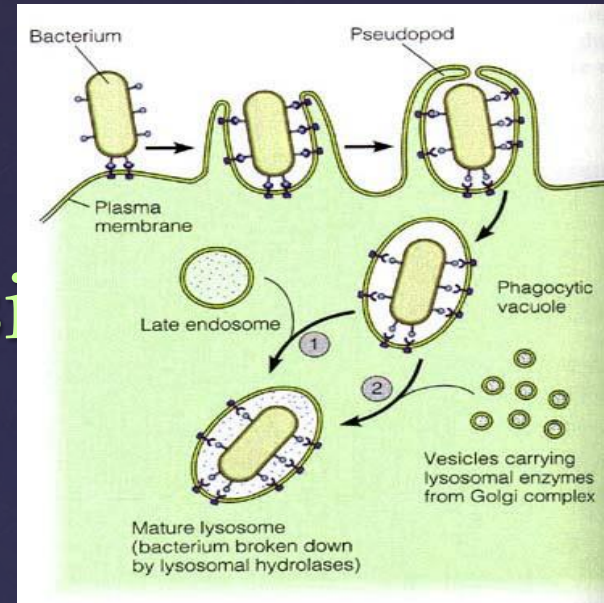
3. endocytosis:

during endocytosis, cells take in substances by vesicle formation.

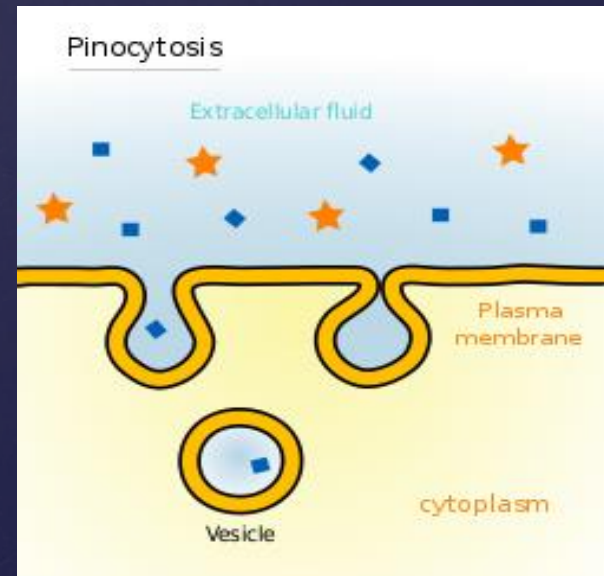
A portion of the plasma membrane invaginates to envelop the substance, and then the membrane pinches off to form an intracellular vesicle.



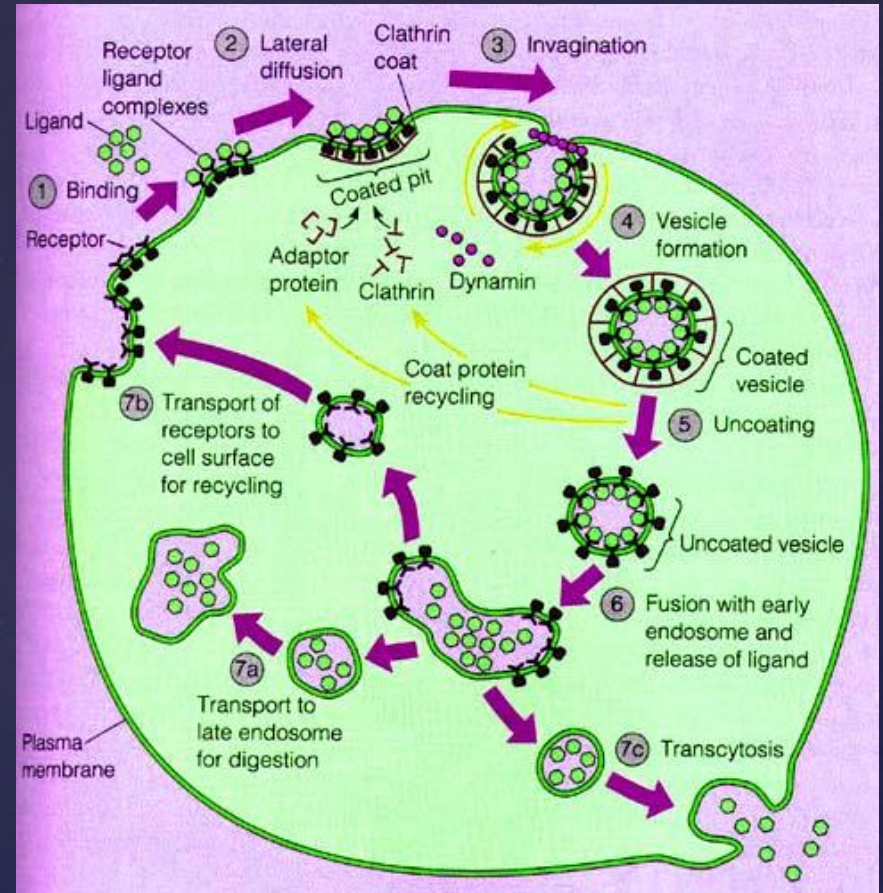
There are *three*
methods of endocytosis
& phagocytosis:
means "cell eating"



& pinocytosis: means
"cell drinking"



receptor-mediated endocytosis:



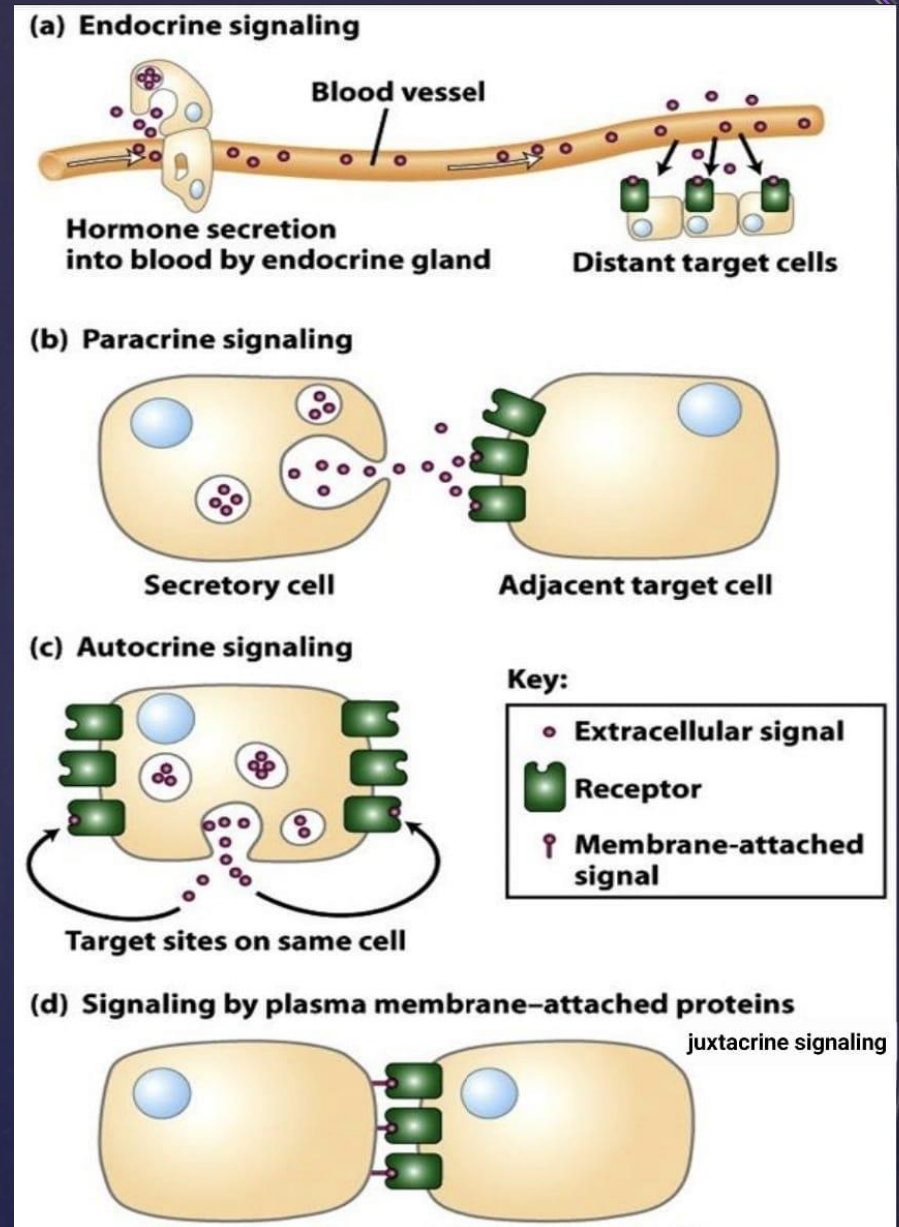


⌘ An inherited form of **cardiovascular disease** occurs when cells fail to take up a combined lipoprotein and cholesterol molecule from the blood by receptor-mediated endocytosis.

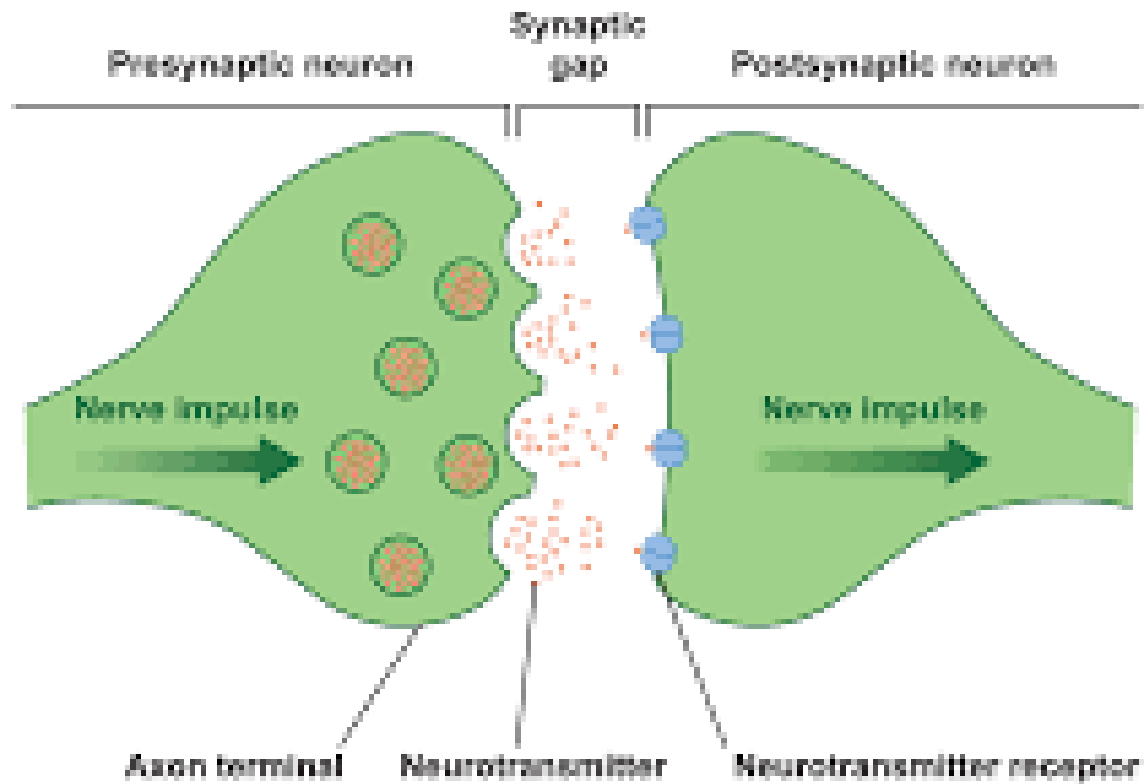
Medical application On endocytosis

Signal Reception And Transduction

endocrine signaling
paracrine signaling
synaptic signaling
autocrine signaling
juxtacrine signaling



Synaptic Transmission



Clinical notes:

Several diseases have been shown to be caused by defective receptors. For example, pseudohypoparathyroidism and a type of dwarfism are caused by nonfunctioning parathyroid and growth hormone receptors. In these two conditions the glands produce the respective hormones, but the target cells do not respond because they lack normal receptors.



Thank you