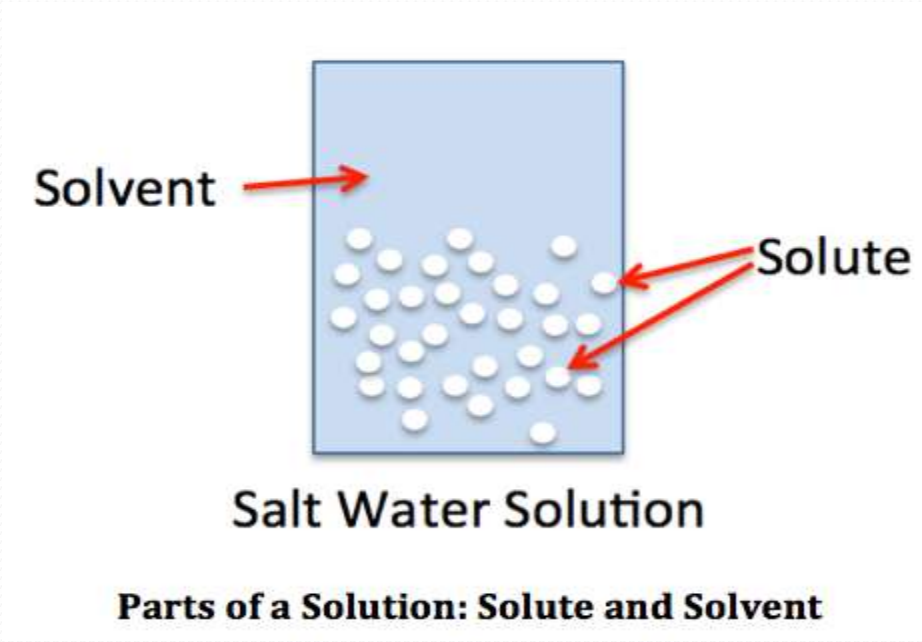
Lec (7)

Cellular transport

- **cell membrane** is membrane that surrounds every living cell, separate the cell from the environment around it.
- cell membrane also described as being a fluid mosaic.
- Transport of molecules through (into or out) the cell by cell membrane.

Solutions

- Solute- substance being dissolved
- Solvent- substance doing the dissolving (substance the solute is dissolved in).



- Types of transport across a cell membrane :

1- passive transport.

2- Active transport

passive transport.

- It means that the substance (molecules) move from an area of higher concentration to an area of lower concentration. \
- Does not require energy input from cells.
- Types of passive transport:

  1- Diffusion

  2- Facilitated Diffusion

  3- Osmosis

Diffusion

- Diffusion is the movement of small molecules (or ions) from a region of their high concentration to a region of their lower concentration.
- The molecules move down a concentration gradient
- Molecules have kinetic energy, which makes them move about randomly.
- As a result of diffusion molecules reach an equilibrium where they are evenly spread out.

Examples of diffusion

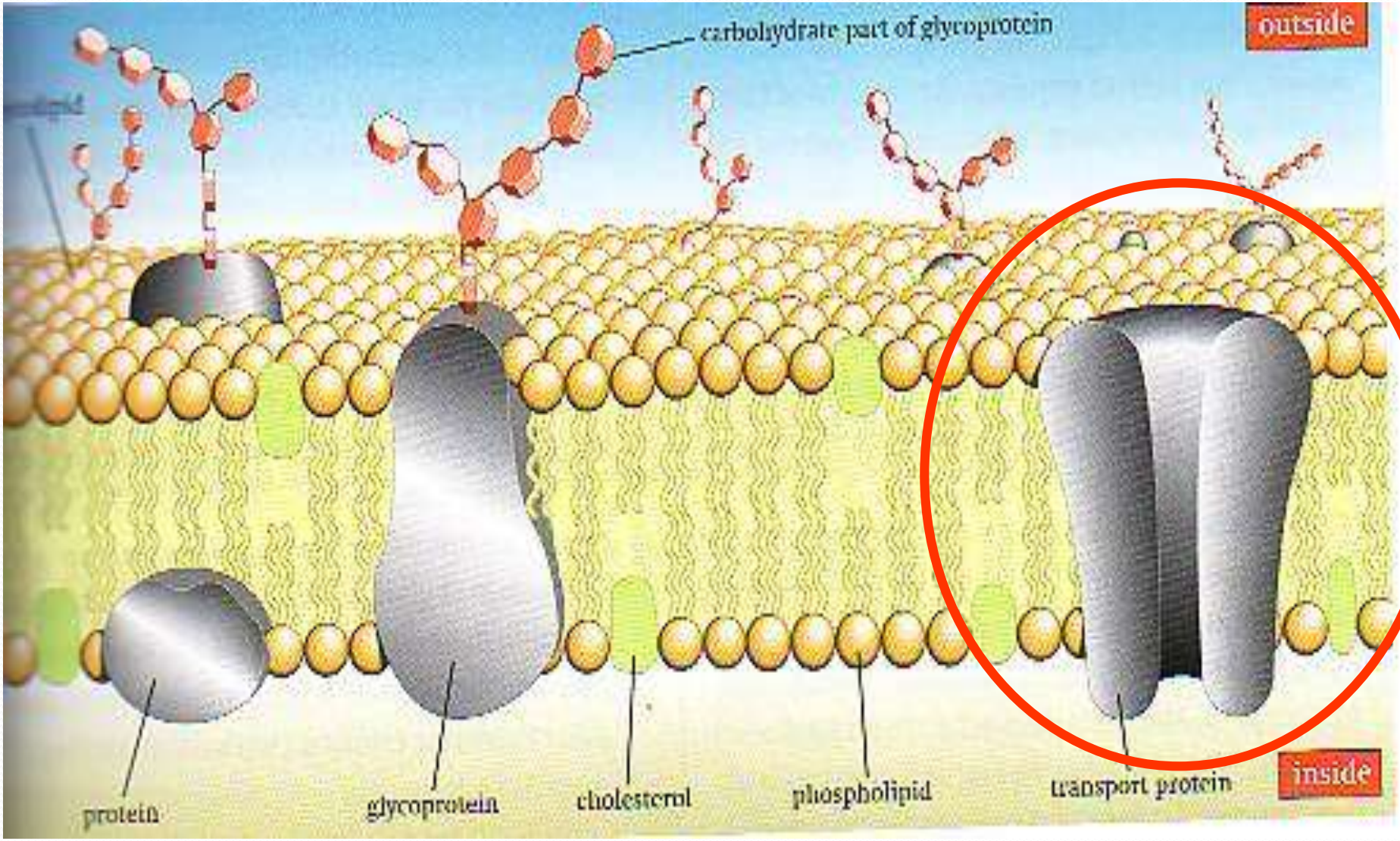
- A biological example of diffusion is the gas exchange that occurs during respiration within the human body.

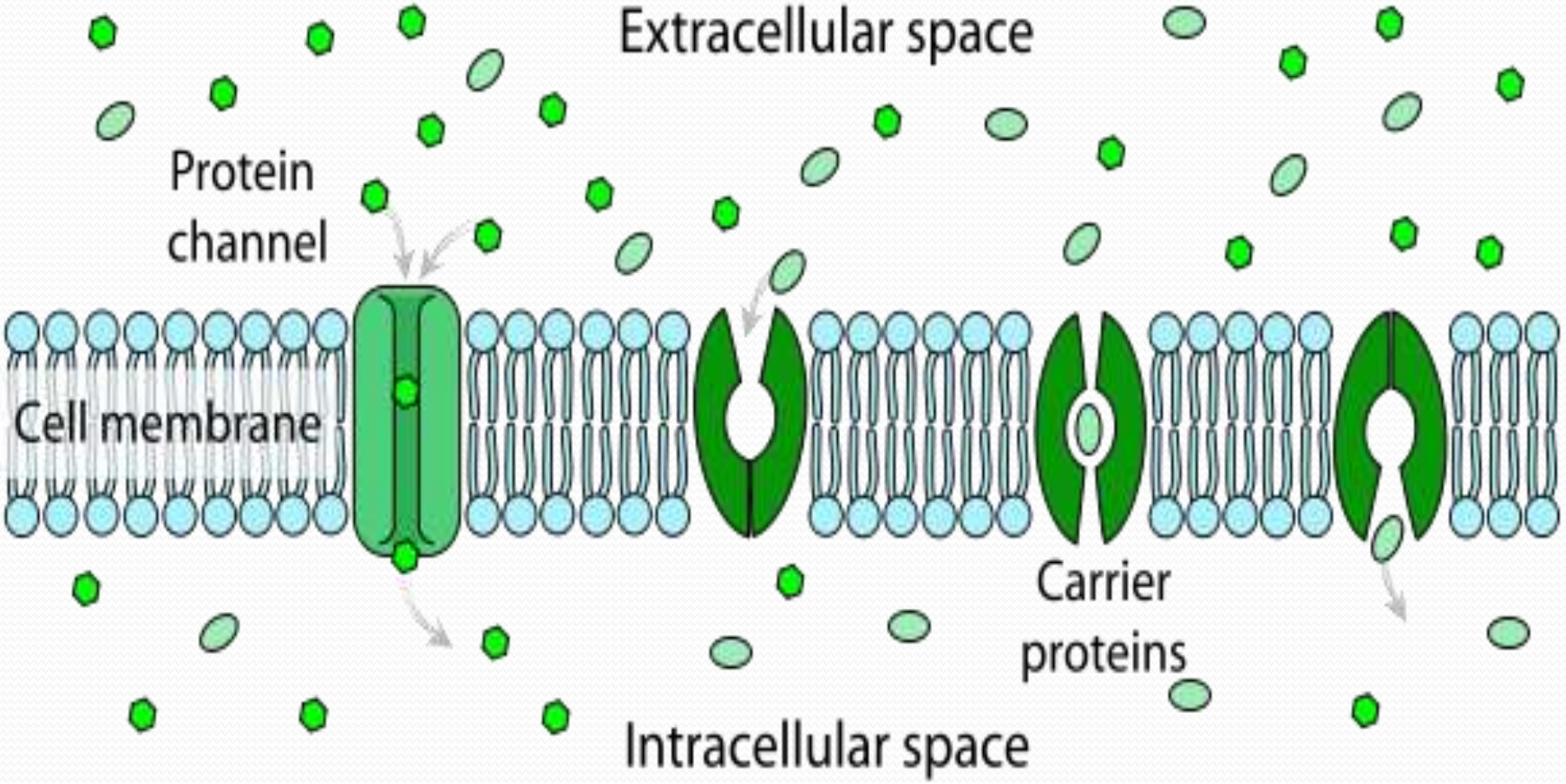
1- Oxygen – Non-polar so diffuses very quickly.

2- Carbon dioxide – Polar but very small so diffuses quickly.

Facilitated Diffusion

- Large polar molecules such as glucose and amino acids, cannot diffuse across the phospholipid bilayer. Also ions such as Na^+ or Cl^- cannot pass.
- These molecules pass through protein channels
- Diffusion through these channels is called FACILITATED DIFFUSION.
- Movement of molecules is still PASSIVE, the only difference is, the molecules go through a protein channel of passing between the phospholipids.


carbohydrate part of glycoprotein
outside
protein
glycoprotein
cholesterol
phospholipid
transport protein
inside


Extracellular space
Protein channel
Cell membrane
Carrier proteins
Intracellular space

Factors determine rate of diffusion

1- Size

2- Hydrophobicity

3- Charge

4- Temperature

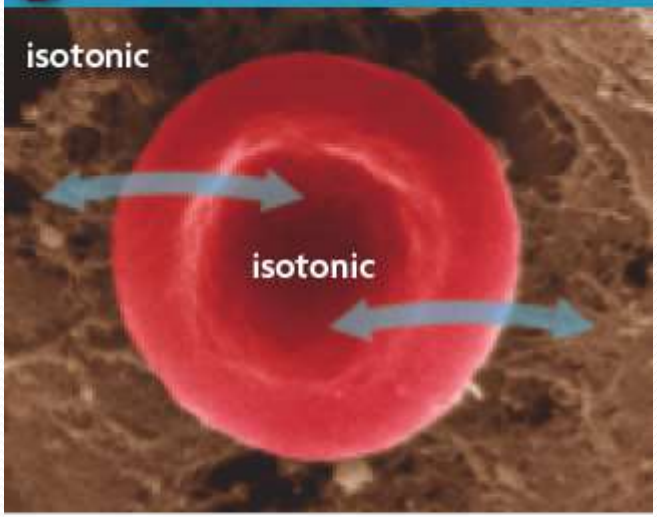
Osmosis

‘The diffusion of water from an area of high concentration of water molecules (high water potential) to an area of low concentration of water (low water potential) across a partially permeable membrane.

Tonicity

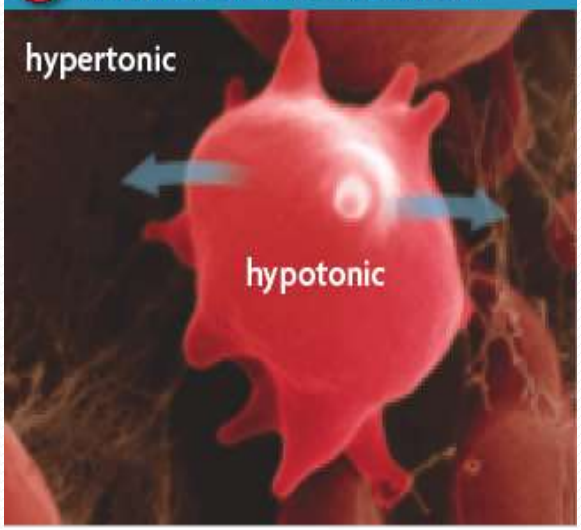
- Hypertonic: having a higher concentration of solute molecules than another solution.
- Hypotonic: having a lower concentration of solute molecules than another solution.
- isotonic: having equal concentrations of solute molecules.

1 ISOTONIC SOLUTION



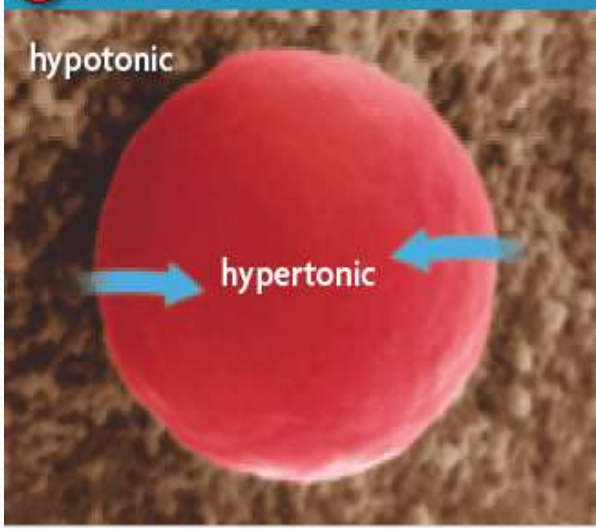
A solution is isotonic to a cell if it has the same concentration of solutes as the cell. Equal amounts of water enter and exit the cell, so its size stays constant.

2 HYPERTONIC SOLUTION



A hypertonic solution has more solutes than a cell. Overall, more water exits a cell in hypertonic solution, causing the cell to shrivel or even die.

3 HYPOTONIC SOLUTION



A hypotonic solution has fewer solutes than a cell. Overall, more water enters a cell in hypotonic solution, causing the cell to expand or even burst.

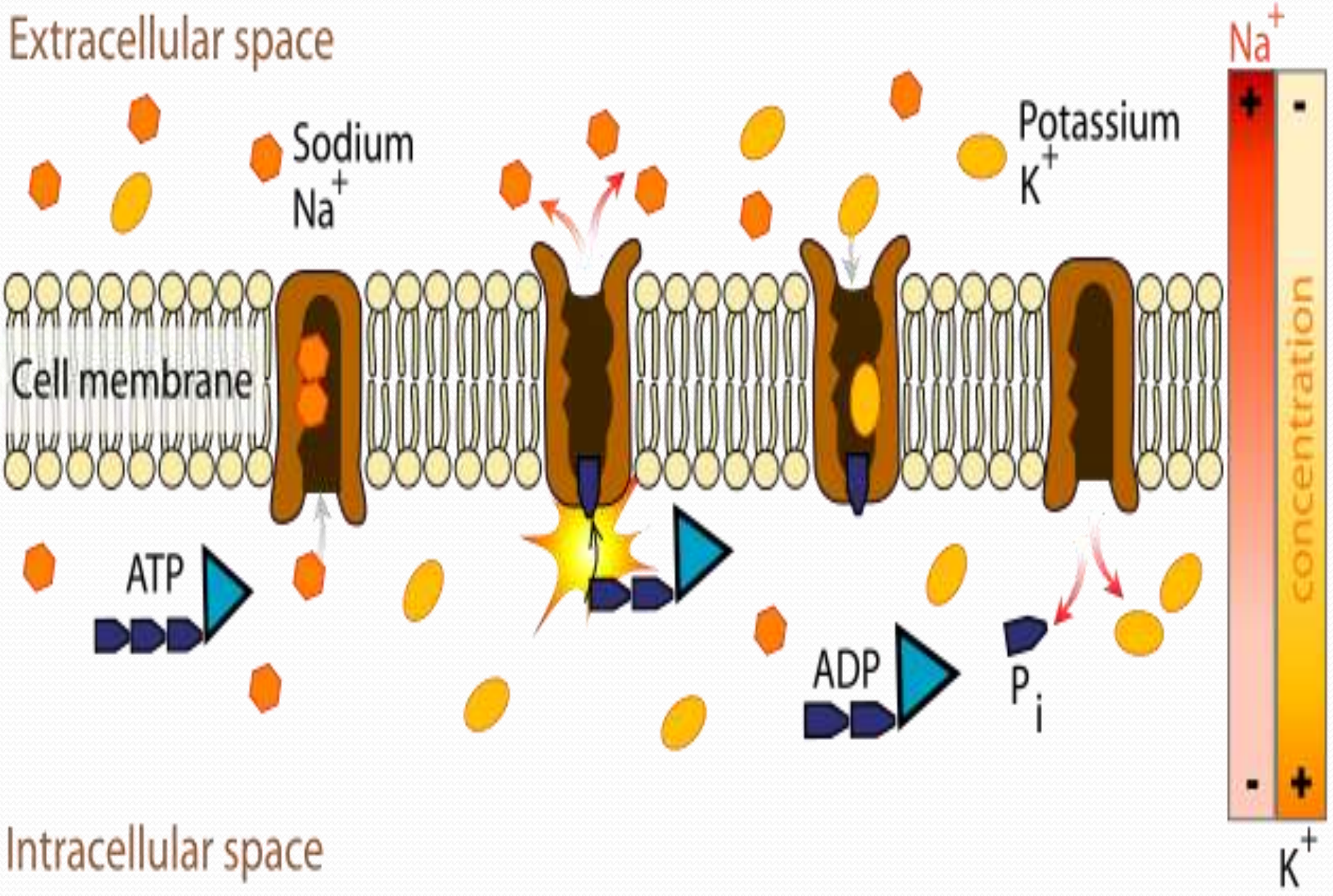
Active Transport

- Active transport is the substances move against a concentration gradient. This means that the direction is from an area of lower concentration to an area of higher concentration.
- Active transport need energy for movement of molecules
- Cells use active transport to maintain homeostasis.

Types of active transport

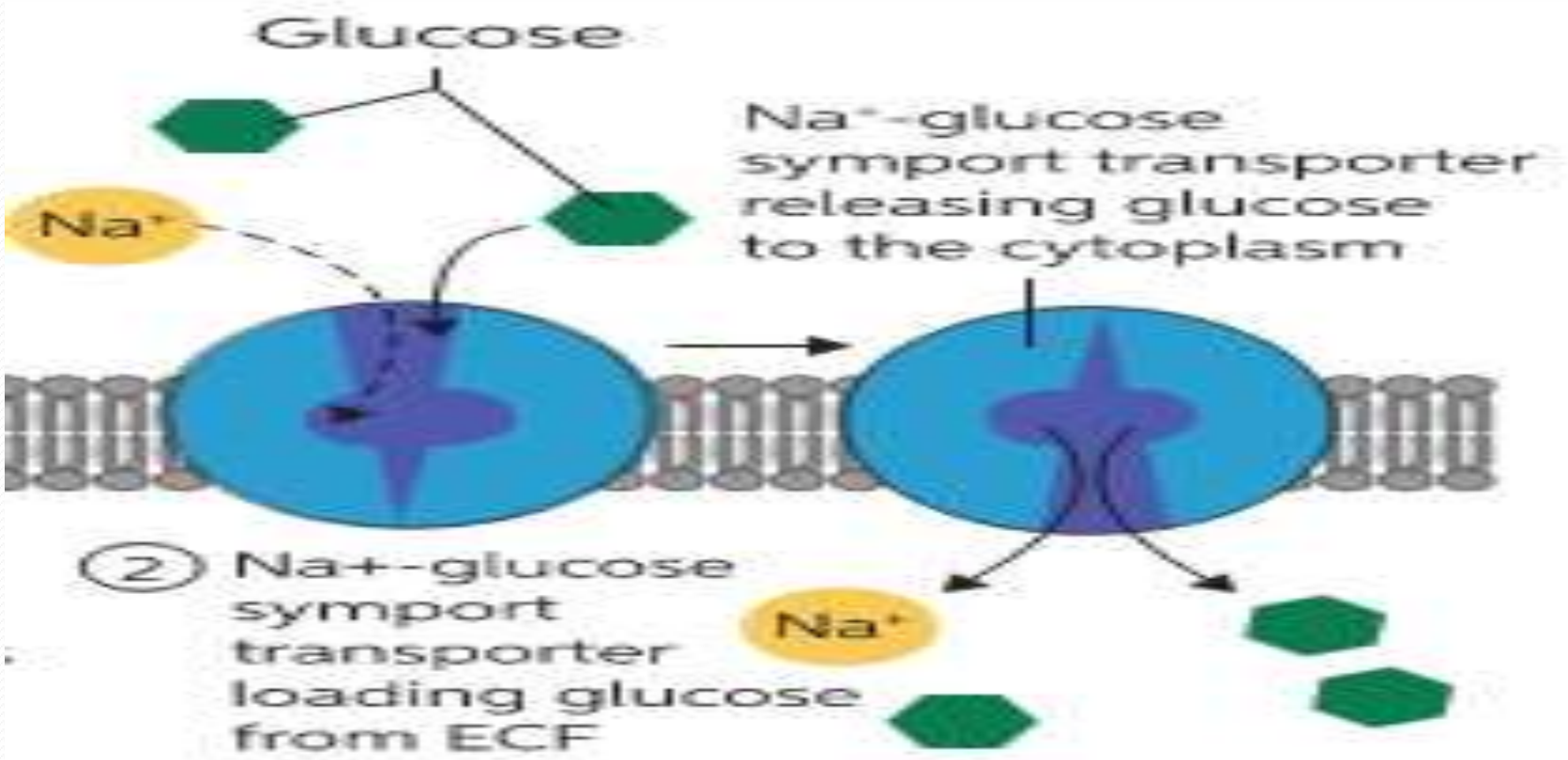
1-Primary active transport

- The energy from breakdown ATP is directly coupled to the movement of sodium ions across a biological membrane.
- Example of primary active transport **Sodium-potassium pump**, the most important pump in the animal cell .
- In this process of transportation, the sodium ions are moved to the outside of the cell and potassium ions are moved to the inside of the cell.


Extracellular space
Sodium
Na^+
Potassium
K^+
Cell membrane
ATP
ADP
P_i
Na^+
concentration
K^+
Intracellular space

2-Secondary active transport

- Secondary active transport its energy source is the electrochemical gradient that pumps ions into and out of the cells.
- The electrical gradient is created by the difference in charge within the internal and external environment of the cell.
- For example, the Na^+/glucose cotransporter found in the small intestine and kidney tubules,
- Transports 2 Na^+ ions and 1 glucose molecule into the cell across the plasma membrane.


Glucose
Na⁺-glucose symport transporter releasing glucose to the cytoplasm
Na⁺
2 Na+-glucose symport transporter loading glucose from ECF
Na⁺

3- Vesicles transport

- Some substances (ex. Food) are too BIG to pass through membrane

OR

- large quantities need to pass through the cell
- These situations use vesicle transport
- Two kinds

1- Endocytosis

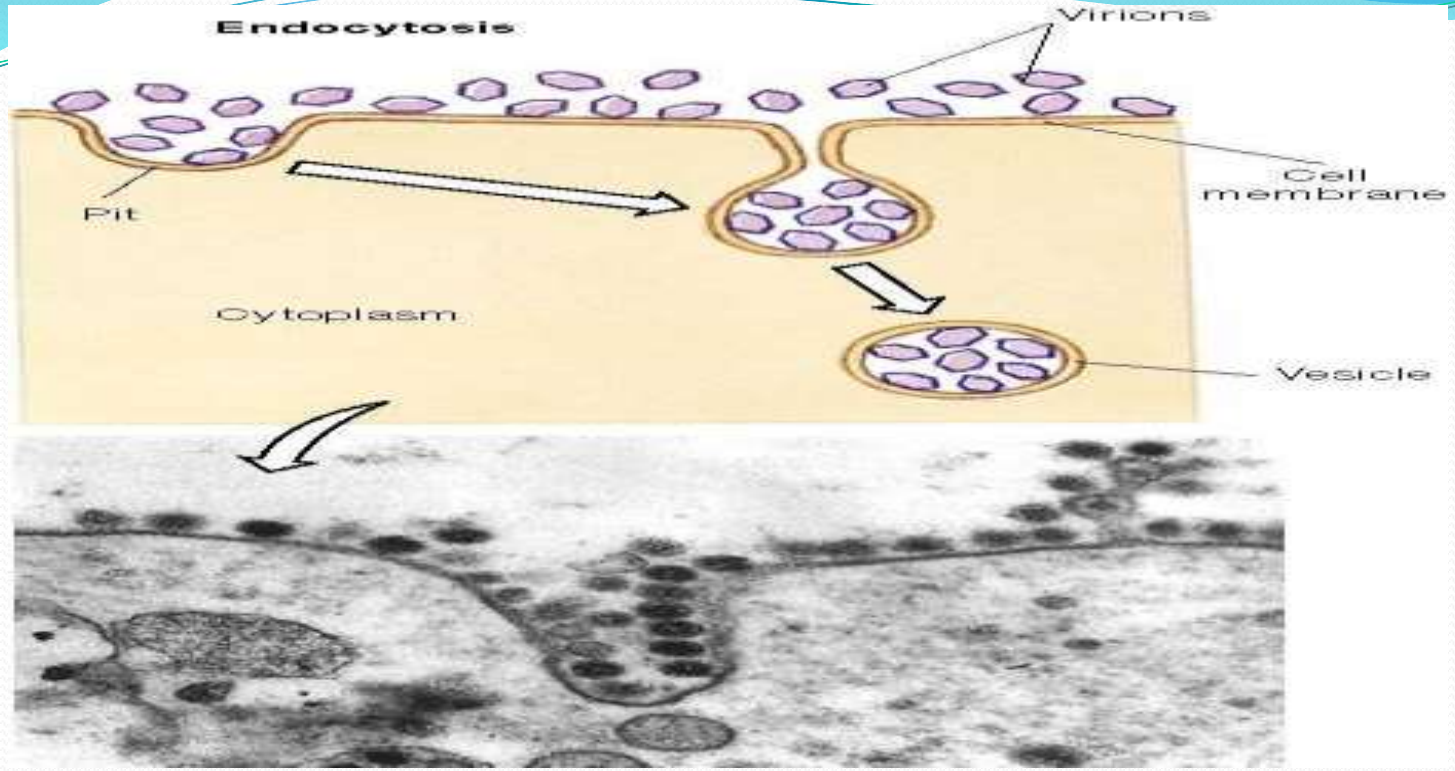
2- Exocytosis

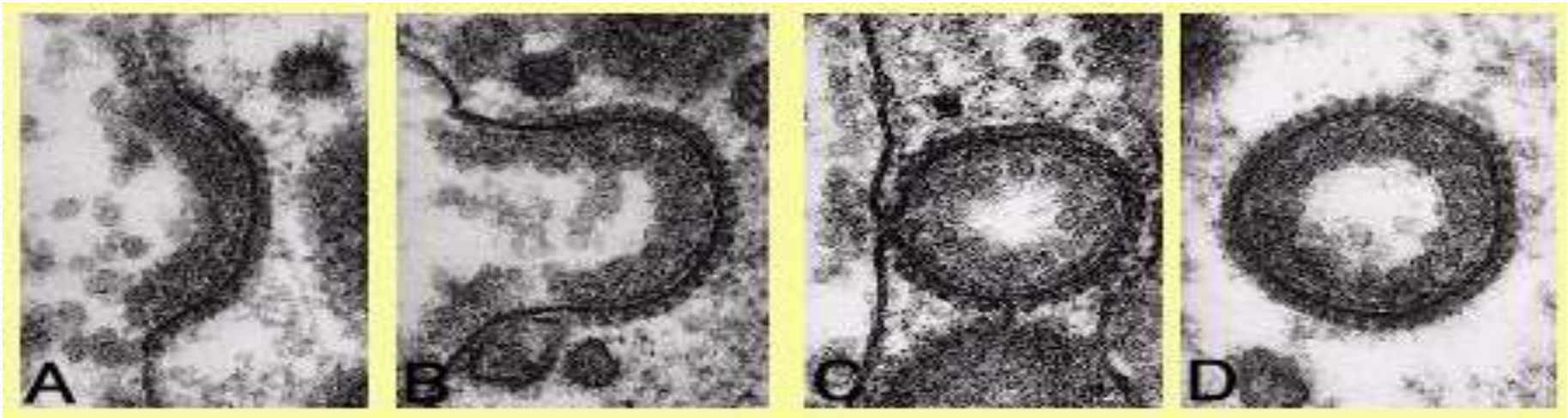
1- Endocytosis

- Process of taking macromolecules & large particles into the cell.

Two kinds of Endocytosis:

1. Phagocytosis – movement of large particles or whole cells. *Possible feeding method, or a method of defense to destroy bacteria/viruses
2. Pinocytosis – transport of solutes or liquids


Endocytosis
Virions
Cell membrane
Pit
Cytoplasm
Vesicle


A
B
C
D

Exocytosis

- Vesicles in cytoplasm fuse with cell membrane and RELEASE their contents into the external environment OUTSIDE the cell.
- Used to release large molecules such as proteins packaged by the golgi apparatus
- Used in nervous & endocrine system to control activities in other cells.

Exocytosis

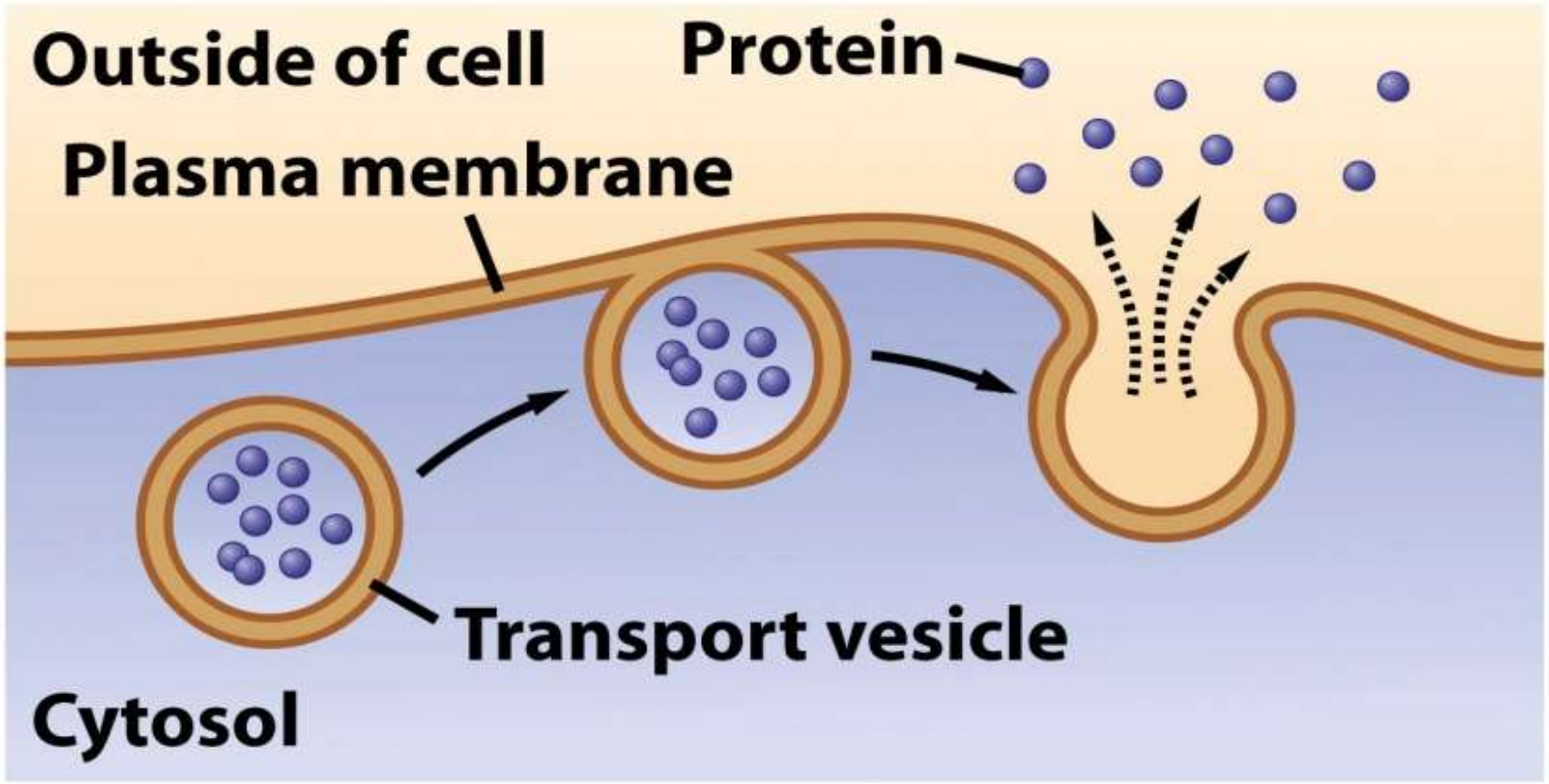
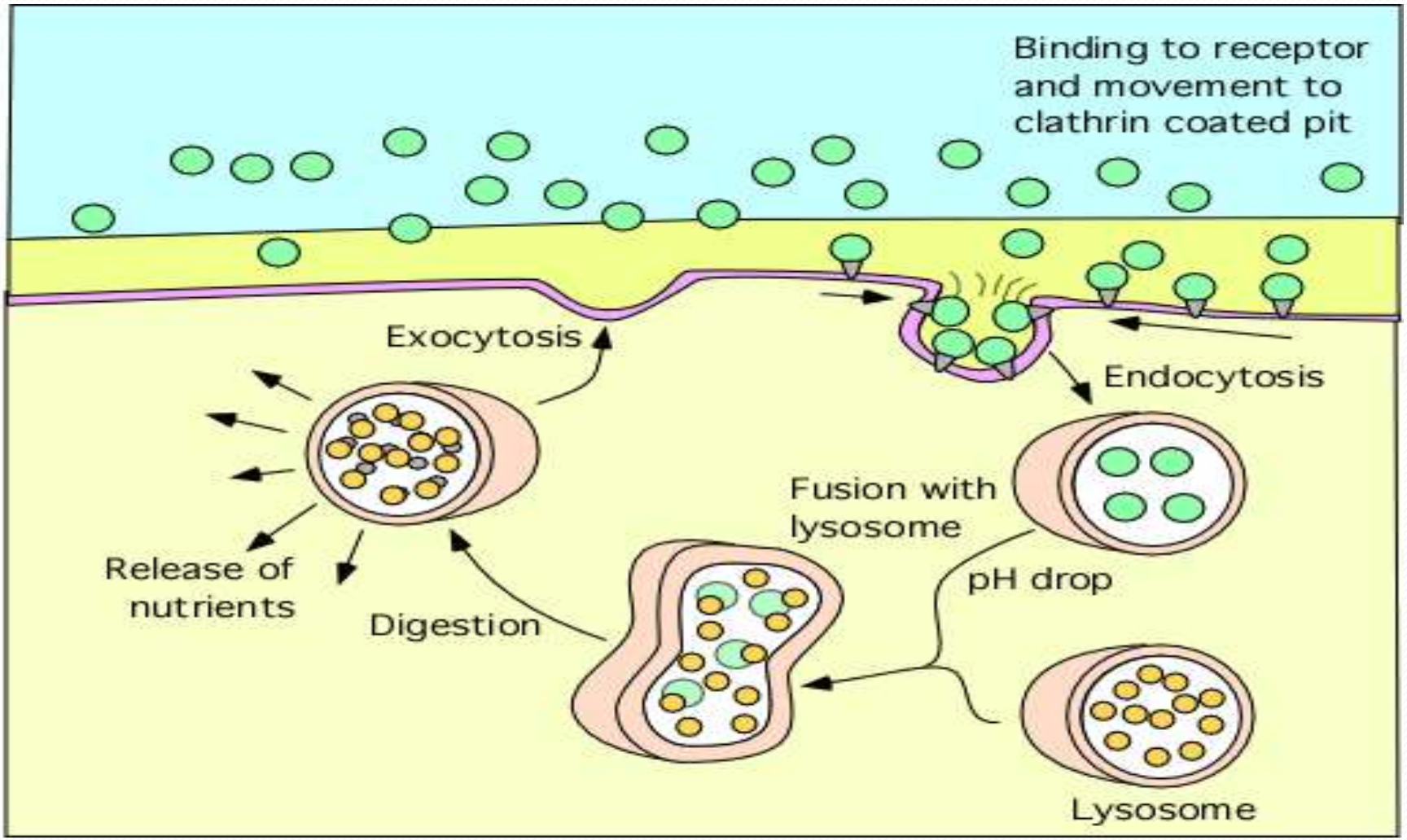


Figure 6-5a Discover Biology 3/e


Binding to receptor and movement to clathrin coated pit
Exocytosis
Endocytosis
Fusion with lysosome
pH drop
Release of nutrients
Digestion
Lysosome

Cell surface

- Surface area is the amount of space covering the outside of a three-dimensional shape.
- Morphological changes in the cell surface (Cell Surface Modifications):

1. Structures that provide transportation.
2. Structures that provide movement.
3. Structures that connecting the cells to each other.

Types of Cell Surface Modifications

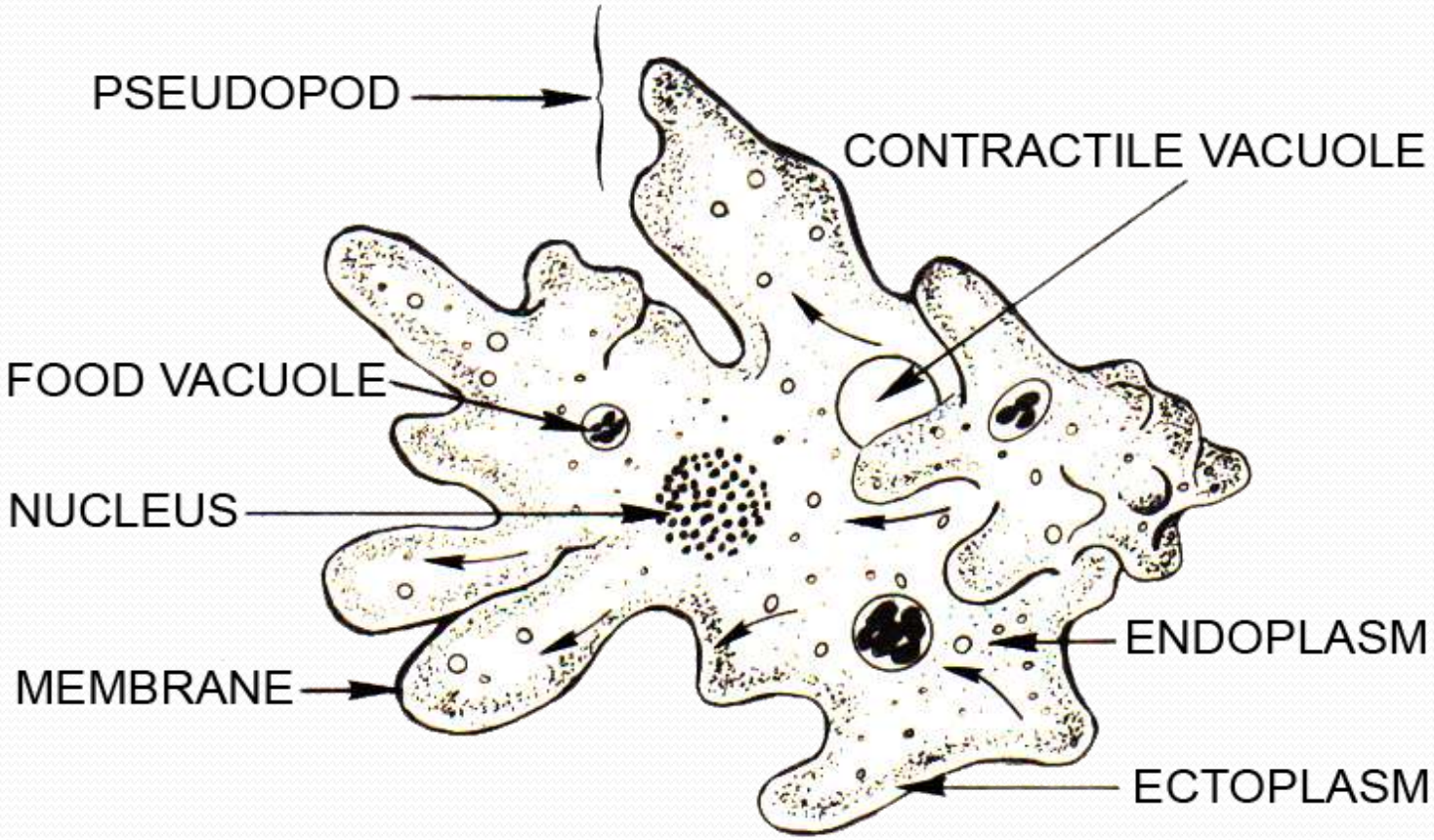
1- Pseudopodia.

2- Cilia and flagella.

3- Microvilli.

1- Pseudopodia

- A temporary extension or projections of the cytoplasm of a cell (such as an amoeba or a white blood cell).
- functions of Pseudopodia
- locomotion especially in an organ.
- taking up food or other particulate matter.
- Play role in immune system.


PSEUDOPOD
CONTRACTILE VACUOLE
FOOD VACUOLE
NUCLEUS
ENDOPLASM
MEMBRANE
ECTOPLASM

2- Cilia and flagella

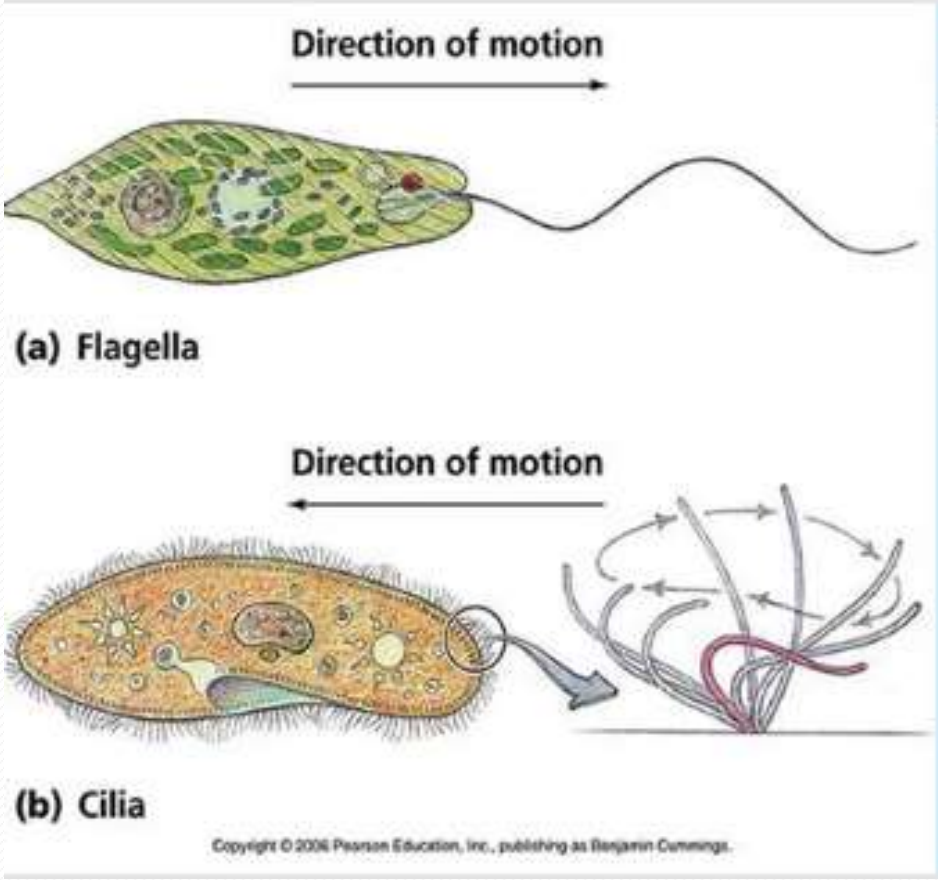
- Cell organelles that are structurally similar but different in length and function.
- Cilia are present in organisms such as paramecium, while flagella can be found in bacteria and sperm cells.
- Cilia are shorter and more numerous than flagella.
- Cilia are made up of microtubules coated by the plasma membrane.

❖Function of cilia:

1- Locomotion

2- keeps the internal passageways free from mucus or any foreign agent.

Difference Between Cilia And Flagella	
Cilia	**Flagella**
The number of cilia is comparatively more (typically ranges in the thousands)	The number of flagella is comparatively less (usually ranges from 1 to 8)
Cilia are usually shorter in length	Flagella are comparatively longer in length
The beating pattern of cilia is very complicated – It can move in a wide range of motions	The beating pattern of flagella involves circular, wave-like or propeller-like motion
Found in eukaryotic cells	Found in prokaryotic cells and eukaryotic cells
Cilia are of two types: non-motile cilia and motile cilia	Flagella are of three types: bacterial flagella, archaeal flagella and eukaryotic flagella


Direction of motion
(a) Flagella
Direction of motion
(b) Cilia
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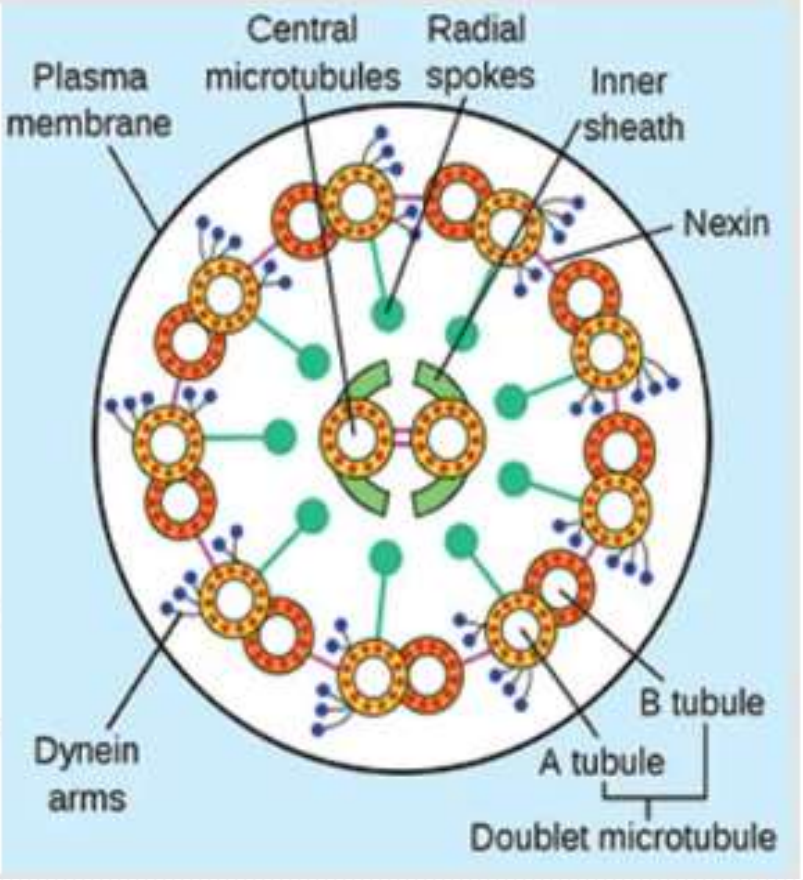
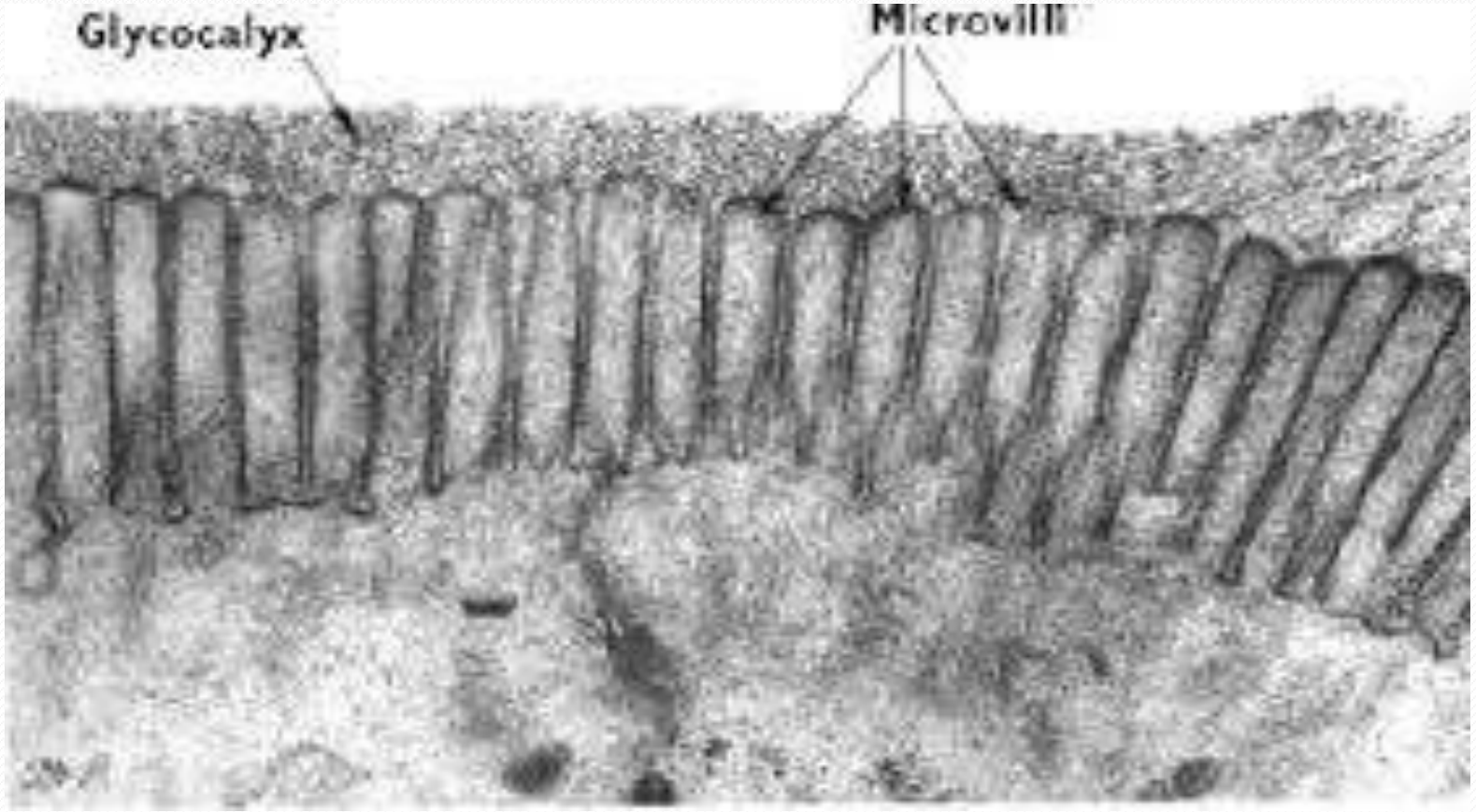

Plasma membrane
Central microtubules
Radial spokes
Inner sheath
Nexin
Dynein arms
B tubule
A tubule
Doublet microtubule

3- Microvilli

- Microvilli are finger like projections that are located on the surface of epithelial cells.
- Microvilli are extensions of villi and are made of microfilaments and cytoplasm .
- Function of microvilli
- increase surface area of a cell without significantly increasing the size of the cell.
- Microvilli are often seen in organs where the epithelium plays a primary role in the absorption of molecules.


Glycocalyx
Microvilli