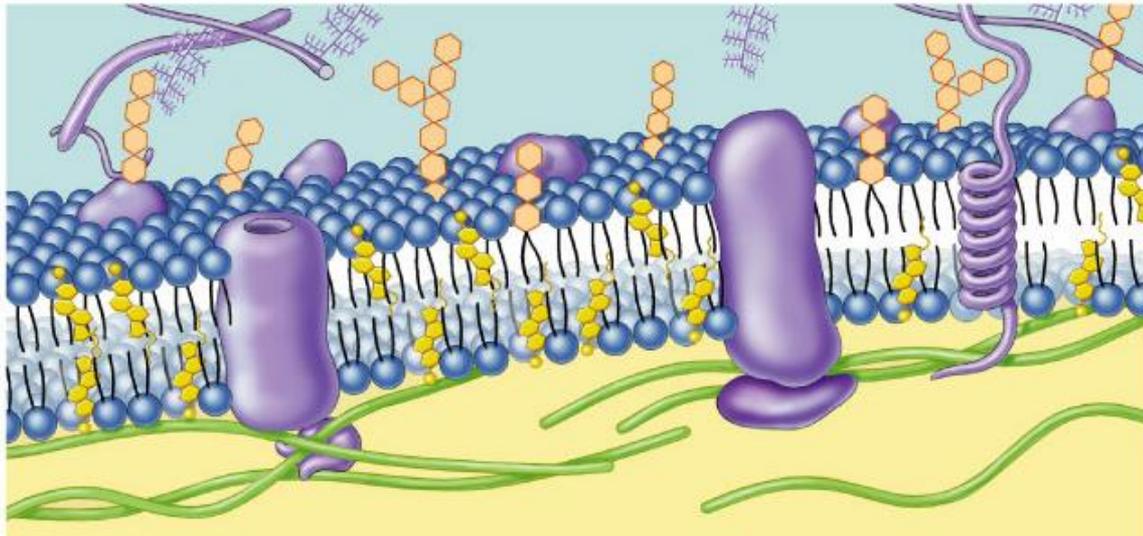


Cell membrane

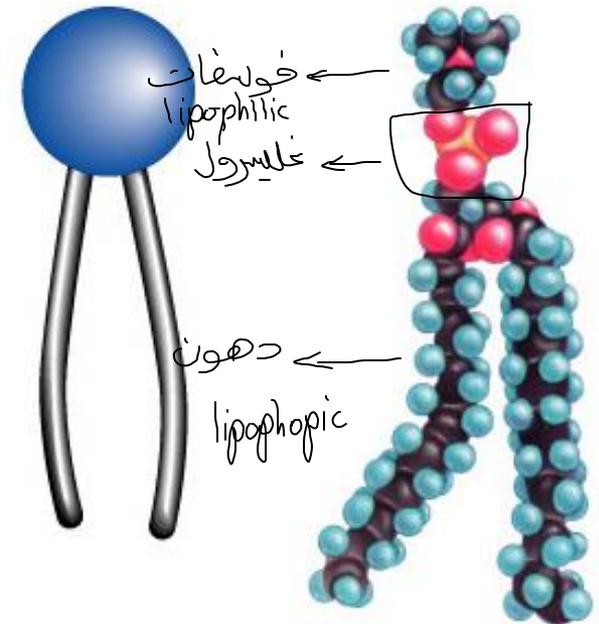


Function of the cell membrane

- Separation of the cell components from the nonliving surroundings (8 nm thick) *الفصل عن المحيط*
- It controls traffic into and out of the cell. → lipophilic enter without transporter
- Like other membranes, the plasma membrane is **selectively permeable**, allowing some substances to cross more easily than others (hydrophilic vs hydrophobic)

Composition of cell membrane

- The basic structural unit of biological membranes is a lipid bilayer
- Phospholipids are the **primary bilayer forming lipids**

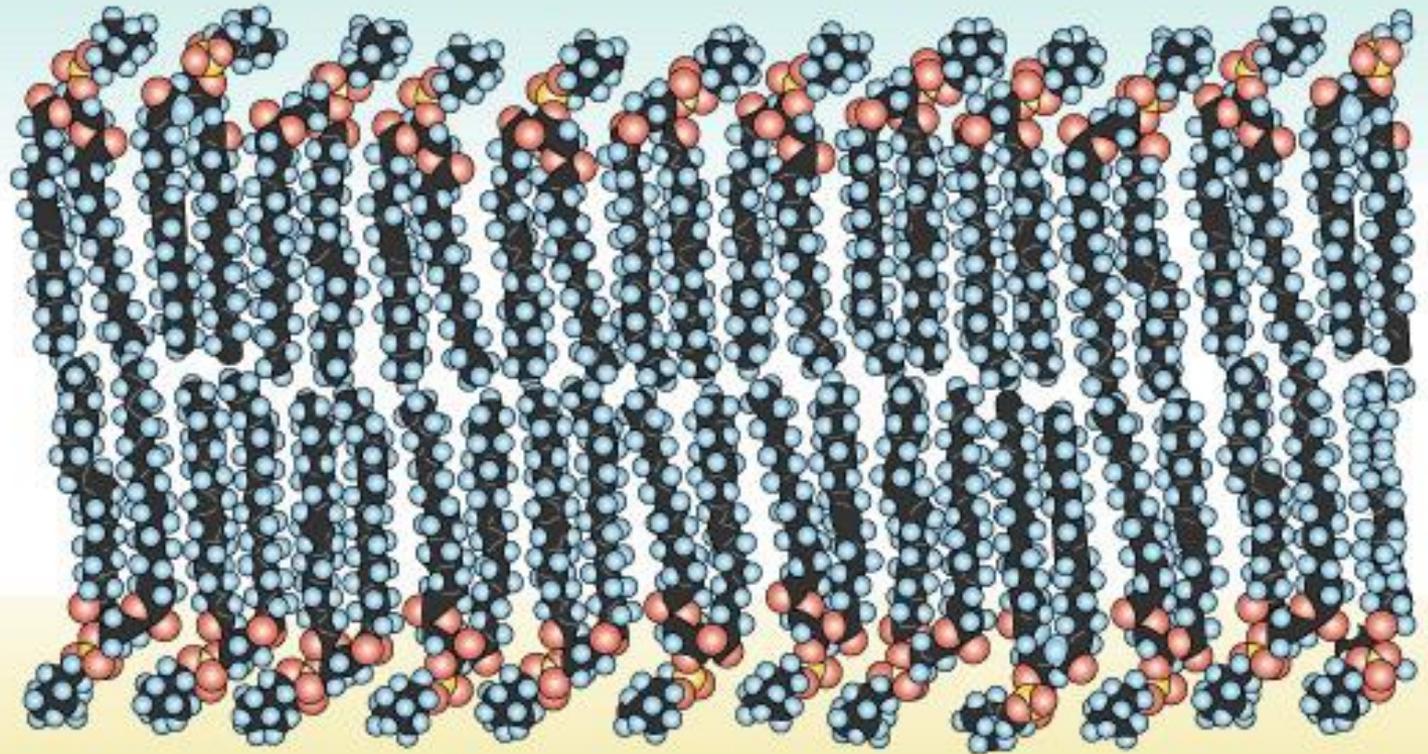


General membrane structures

polar
hydrophilic
heads

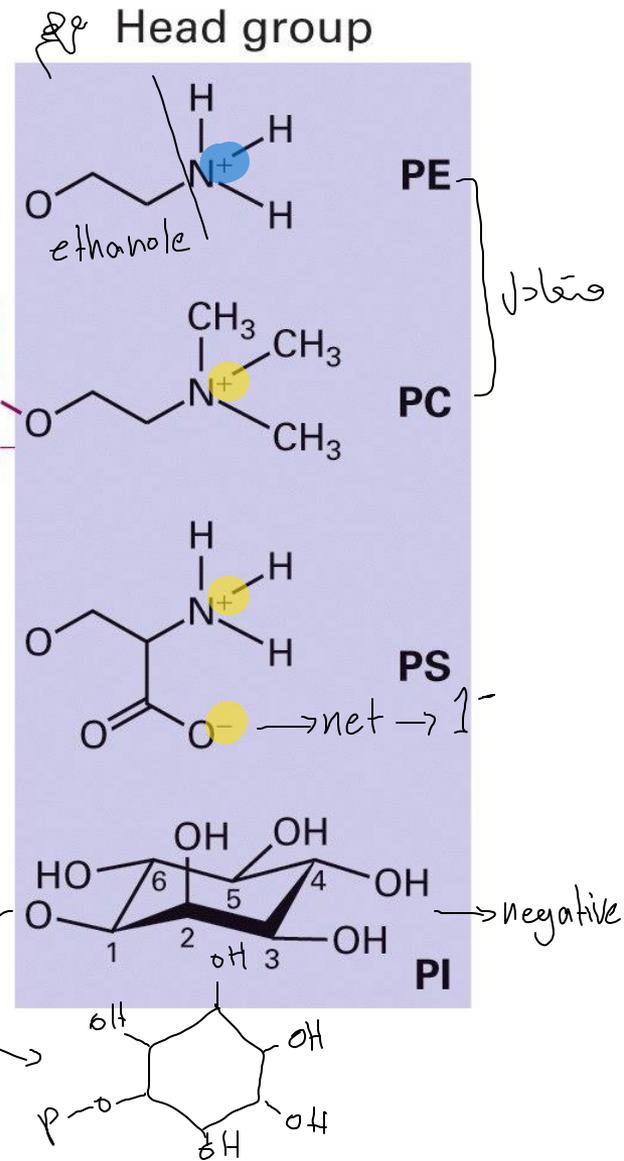
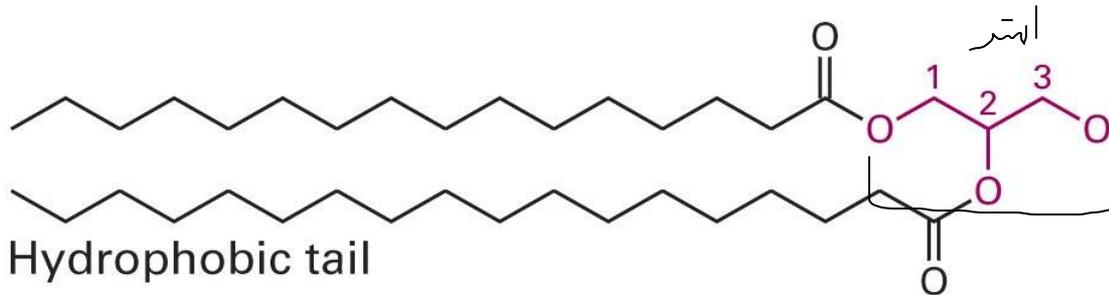
nonpolar
hydrophobic
tails

polar
hydrophilic
heads



Different types of phospholipids

(a) Phosphoglycerides



➤ Choline, ethanolamine are the most abundant PL classes. Head group has no net charge

➤ Serine and inositol head groups have net negative charges

Characteristics of membrane

- The main macromolecules in membranes are lipids and proteins, but include some carbohydrates
- Membranes are **fluid** → عابثة
- Membranes are **mosaics of structure and function** → السطح الداخلي هو زي الخارجي
- Membrane carbohydrates are **important for cell-cell recognition** → cell adhesion

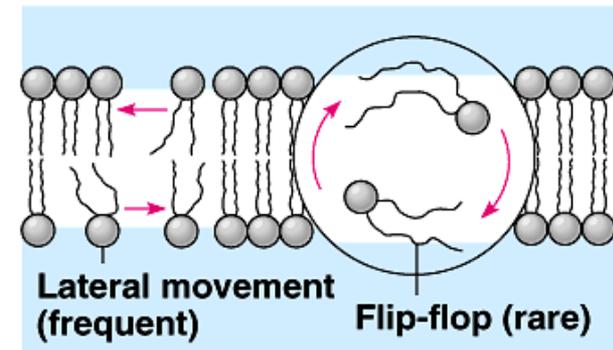
Membranes are fluid

- A membrane is held in together by weak **hydrophobic** interactions
- Most membrane lipids and some proteins can drift **laterally** within the membrane (**2 microns per second**)

↳ movement

← حركه القطبي في اتجاه الغير القطبي

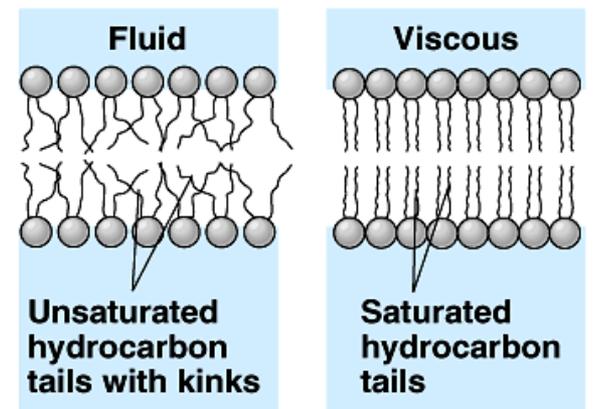
- Molecules **rarely flip transversely** (**flip-flop**) across the membrane, because hydrophilic parts would have to cross the membrane's hydrophobic core.



(a) Movement of phospholipids

Membranes are fluid

- Membrane fluidity is influenced by temperature and by its constituents.
- As temperatures cool, membranes switch from a fluid state to a solid state as the phospholipids are more closely packed. *↳ less fluid*
- Membranes rich in unsaturated fatty acids are more fluid than those dominated by saturated fatty acids because the kinks in the unsaturated fatty acid tails prevent tight packing. *↳ increase fluidity*

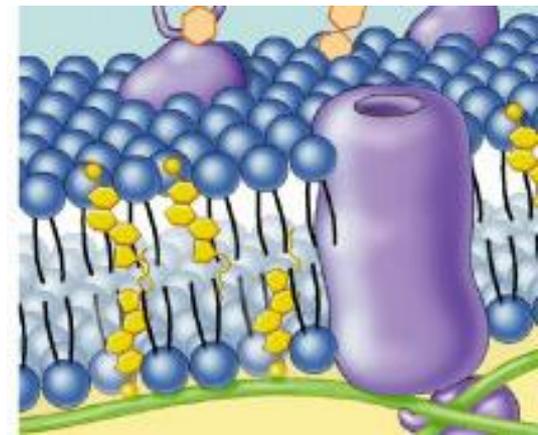


Membranes are fluid

- Short chain fatty acyl groups tend to increase lateral mobility
- **cholesterol** in membrane of eukaryotes, modulates **membrane fluidity** by making the membrane:
 - Less fluid at warm temperatures (e.g. 37 °C body temperature) by restraining the phospholipid movement.
 - More fluid at lower (cool) temperatures by preventing close packing of phospholipids.
 - Cells **may alter membrane lipid concentration in** response to changes in temperature

membrane fluidity buffer

↗ increase fluidity in cool T
↘ ↓ fluidity in high T



Membranes are mosaics of structure and function

➤ Membranes have **asymmetric** inside and outside faces. The membrane's synthesis and modification **by the ER** determines this asymmetric distribution of lipids, proteins and carbohydrates.

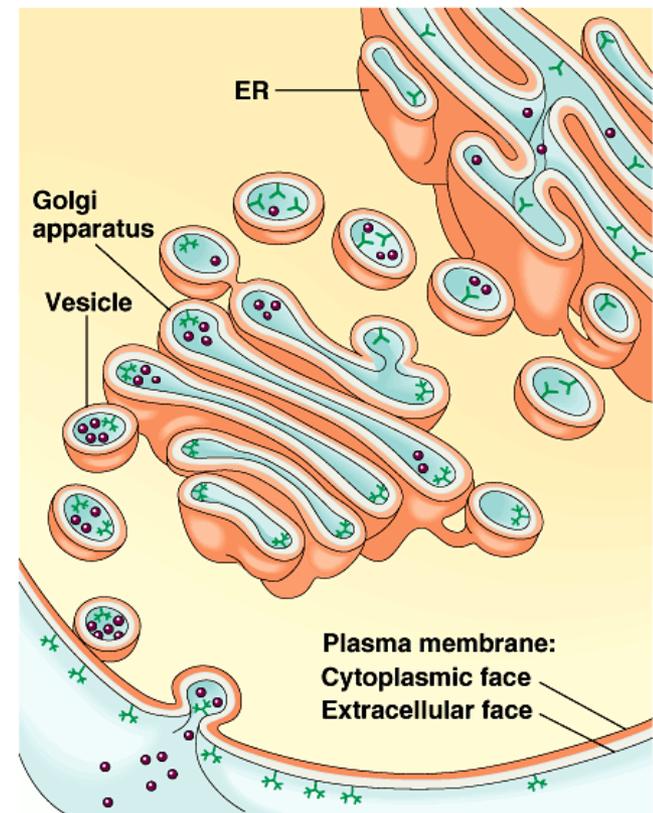
→ endoplasmic reticulum

➤ The two lipid layers may differ in lipid composition.

➤ Membrane proteins have a clear direction.

➤ When present, carbohydrates are restricted to the membrane's exterior

لجزء الخارجی



Membrane Proteins

➤ Proteins determine most of the membrane's specific functions

➤ Membrane proteins:

➤ **peripheral proteins** → by antigen التعرف

➤ loosely bound to surface of membrane ← بحيز محكم

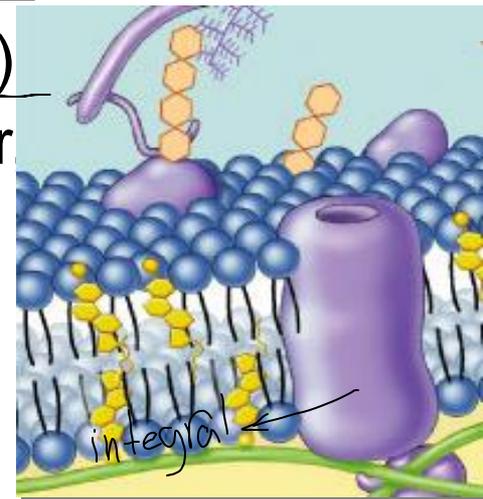
➤ cell surface identity marker (antigens)

➤ **integral proteins**: penetrate lipid bilayer usually across whole membrane ^{تخترق}

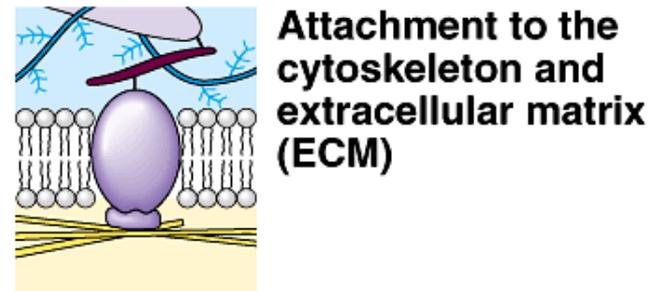
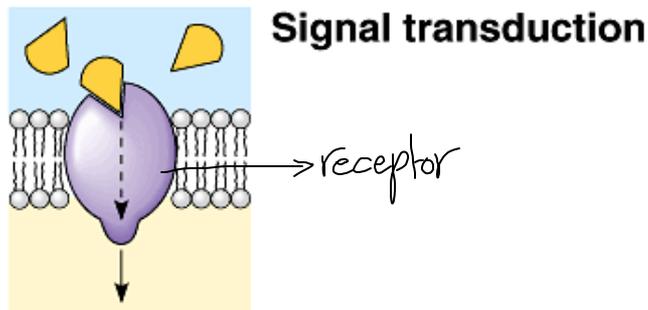
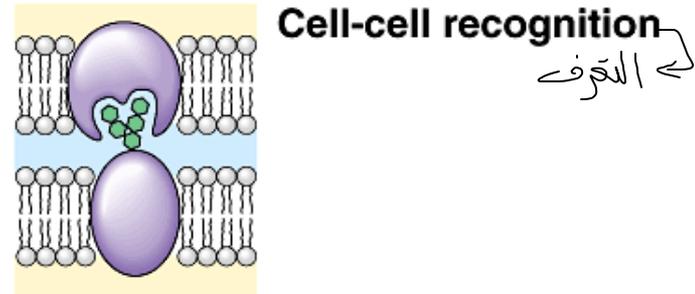
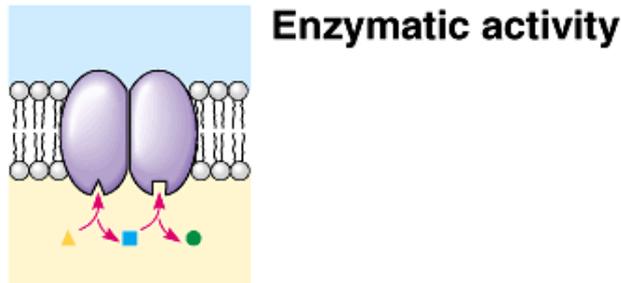
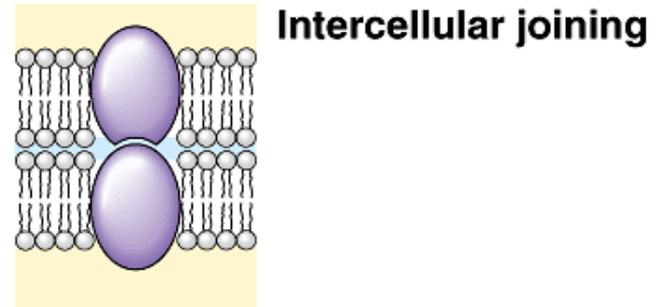
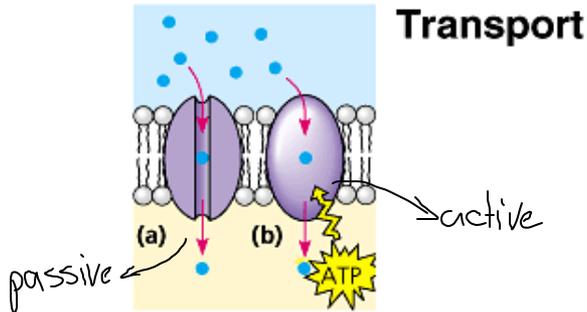
➤ transmembrane protein:

➤ transport proteins (channels,

permeases (pumps)) ← بروتينات النفاذ



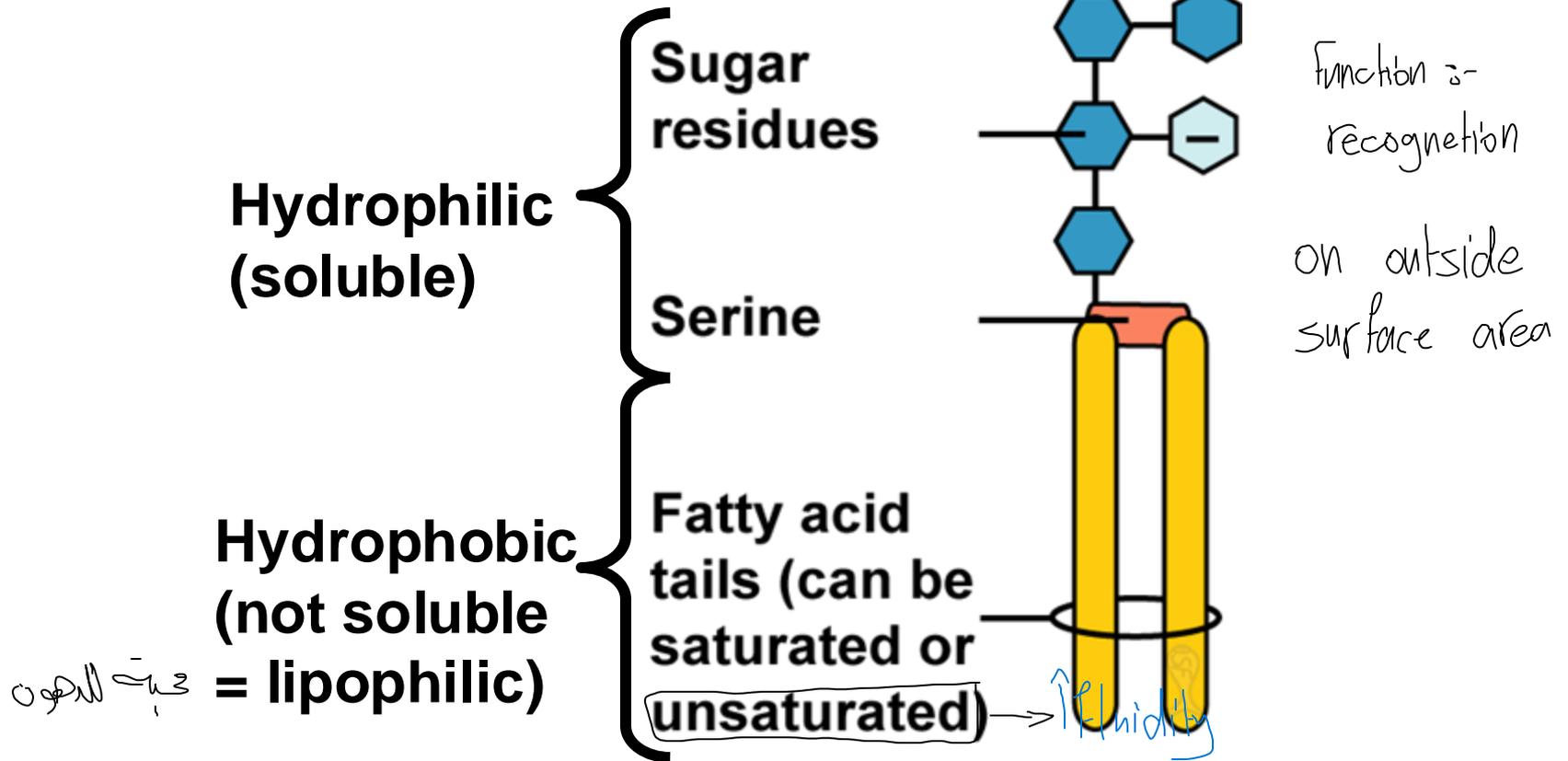
Many Functions of Membrane Proteins



Glycolipids (الدهون السكرية)

السلاسل السكرية الموجودة على glycolipid تختلف من خلية لأخرى ←

- Pattern of sugar residues is **variable**
- Always in outer leaflet of cell membrane, & inner leaflet of organelles



حبيبة الدهون

Membrane carbohydrates are important for cell-cell recognition

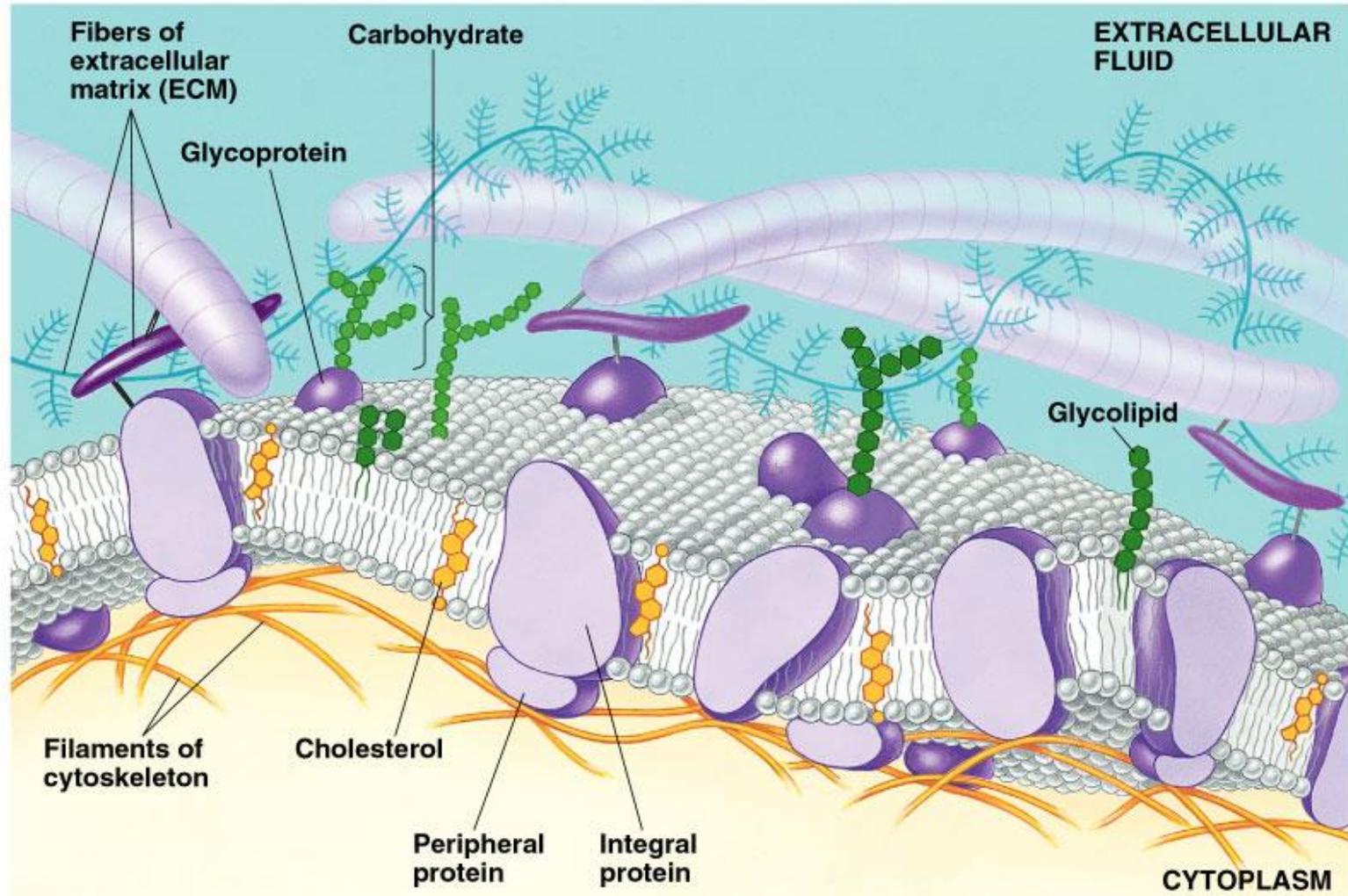
- **Cell-cell recognition:** The ability of a cell to distinguish ^{تَميز} one type of neighboring cell from another.
- Cell-cell recognition is crucial in the functioning of an organism. **It is the basis for:**
 - **Sorting** of cells into tissues and organs in an animal embryo's cell. ← فرز الخلايا
 - **Rejection** of foreign cells by the immune system. ← رفض الخلايا الغريبة
- The way cells recognize other cells is probably by keying on surface molecules (markers)

Membrane carbohydrates are important for cell-cell recognition

- Membrane carbohydrates are usually branched **oligosaccharides** with fewer than 15 sugar units.
- They may be **covalently bonded** either to lipids, forming **glycolipids**, or, more commonly, **to proteins**, forming **glycoproteins**.
- The **oligosaccharides** on the **external side** of the plasma membrane **vary** from species to species, individual to individual, and even from cell type to cell type within the same individual

في نفس الشخص

Movement across cell membrane



Movement across cell membrane

➤ **Passive Transport**

➤ **Simple diffusion**

- diffusion of nonpolar, hydrophobic molecules
- lipids
- high → low concentration gradient

➤ **Facilitated transport**

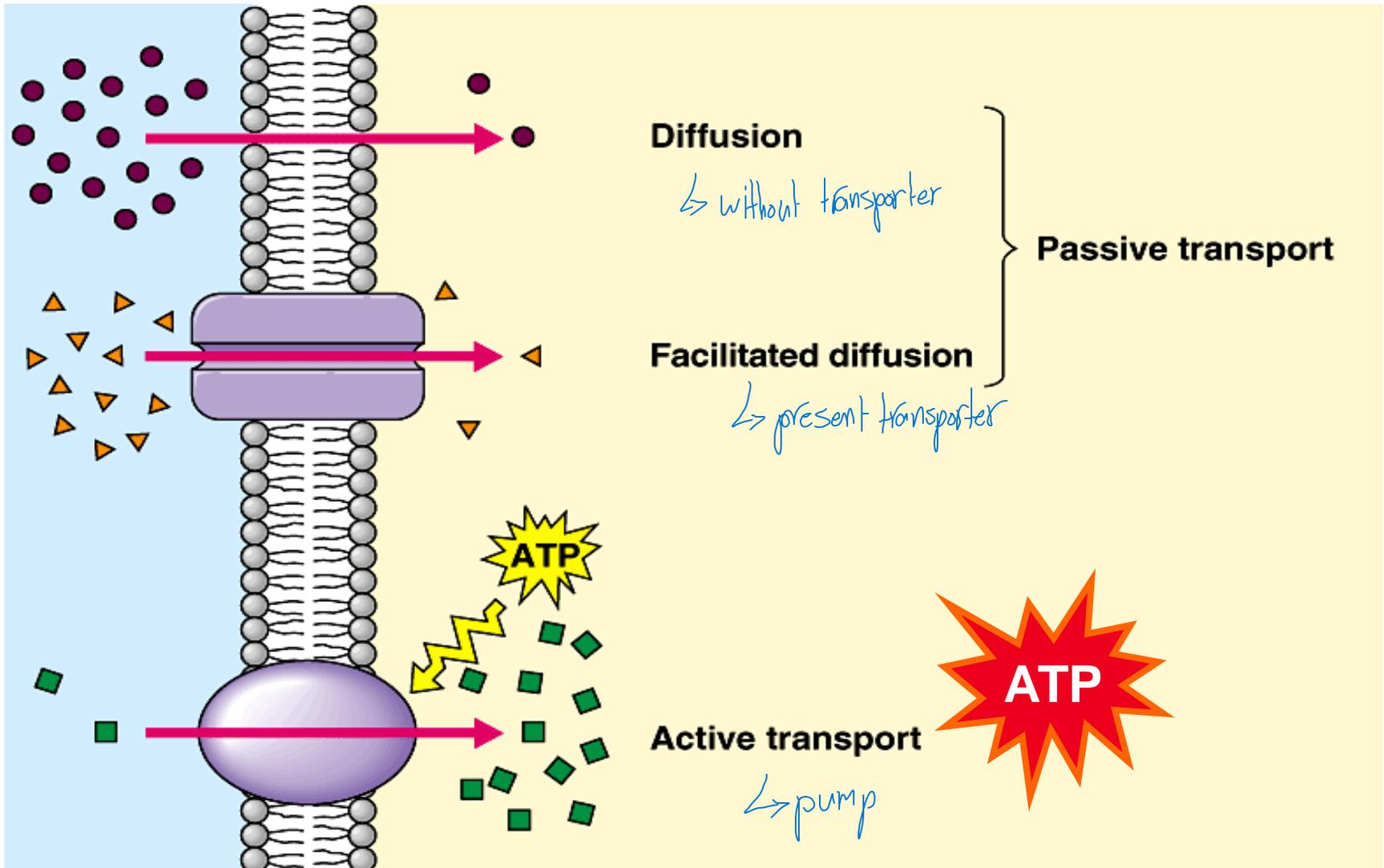
- diffusion of polar, hydrophilic molecules
- through a protein channel
- high → low concentration gradient

➤ **Active transport**

- diffusion against concentration gradient
- low → high
- uses a protein pump
- requires ATP

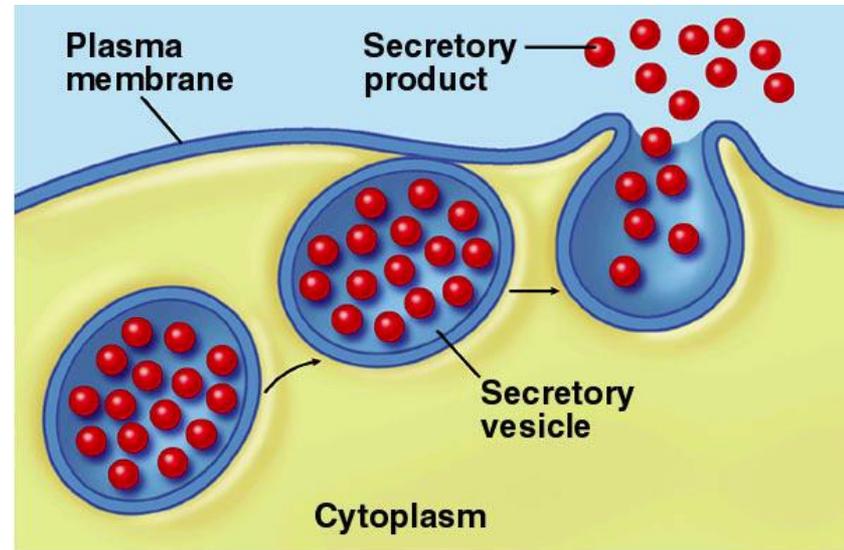
from high to low
concentration

Movement across cell membrane



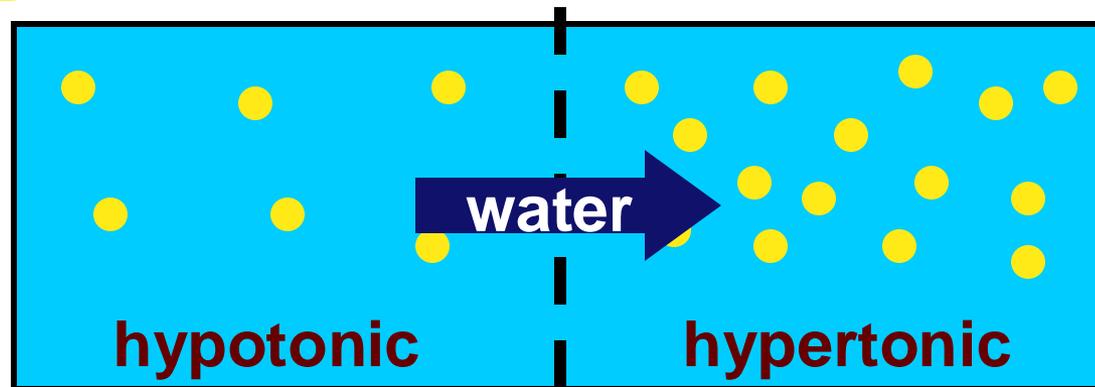
Transport of large molecules

- Moving large molecules into & out of cell
 - through vesicles & vacuoles
 - **endocytosis** → *inside cell*
 - phagocytosis = “cellular eating”
 - pinocytosis = “cellular drinking”
 - **exocytosis** → *outside cell*



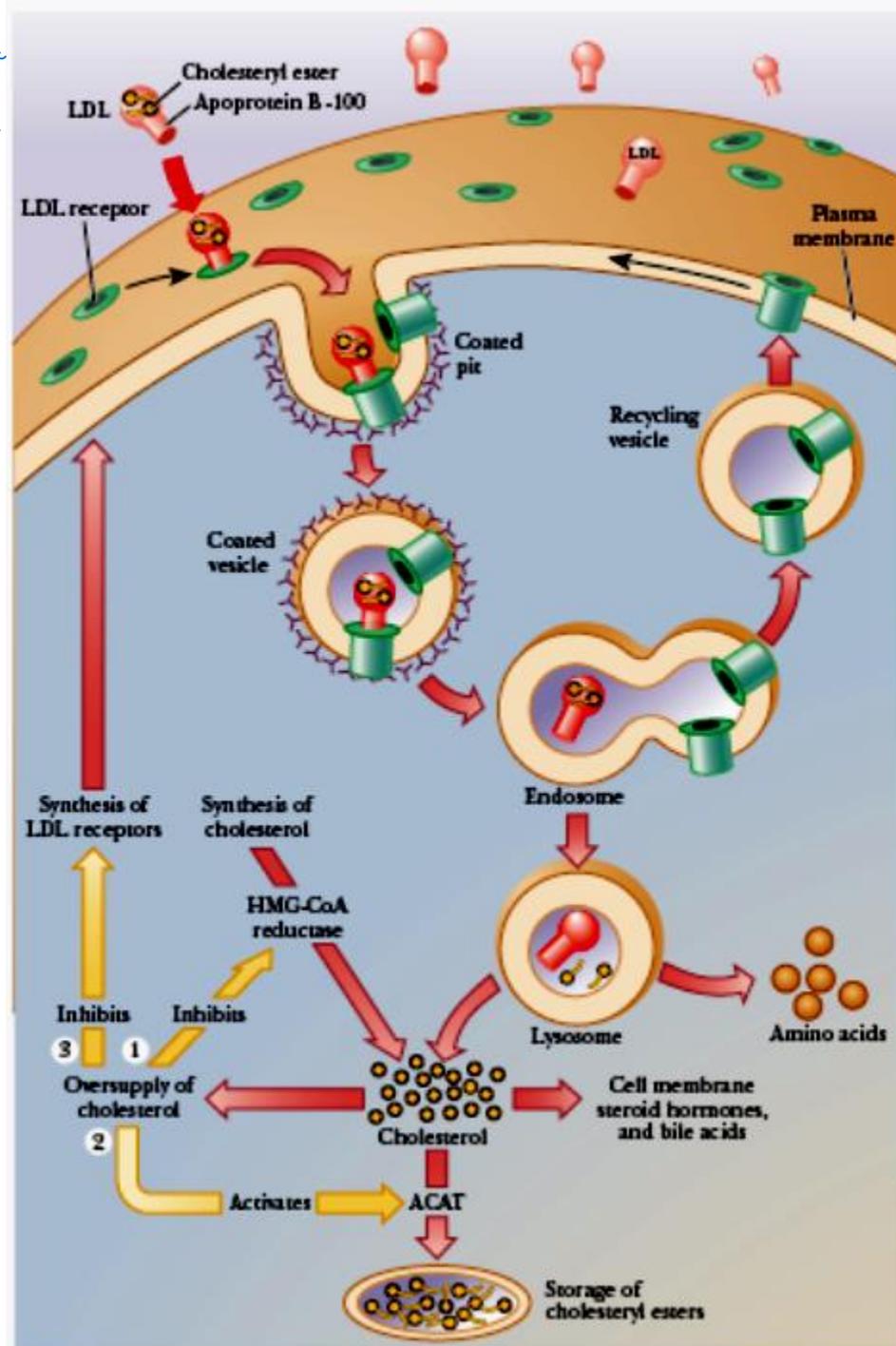
Diffusion of water

- Diffusion of water from high concentration of water to low concentration of water or from low concentration of solute to high concentration of solute
- Direction of osmosis is determined by comparing total solute concentrations
 - Hypertonic - more solute, less water
 - Hypotonic - less solute, more water
 - Isotonic - equal solute, equal water



net movement of water

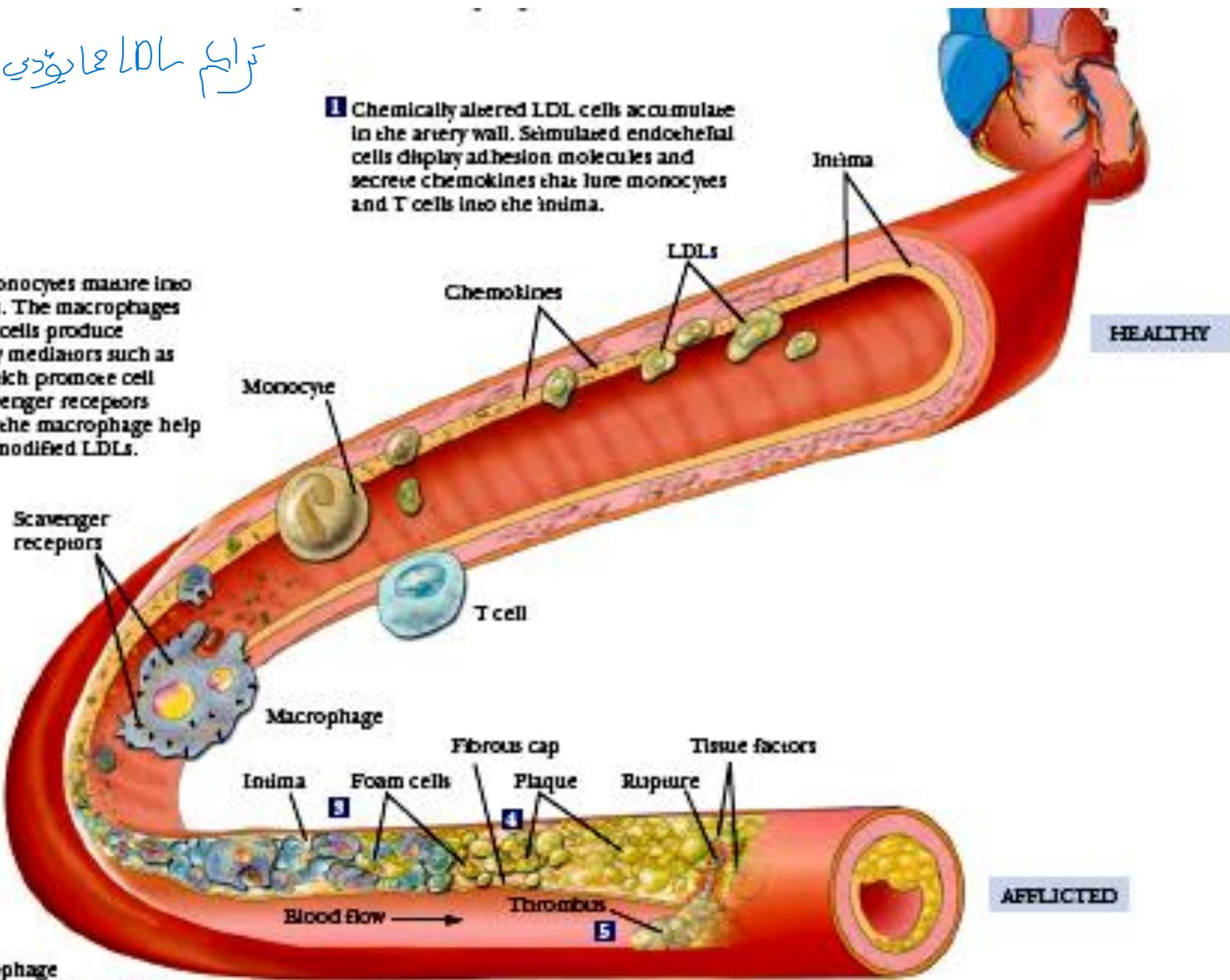
كيفية دخول (LDL) إلى داخل الخلية
القوة تنقل الجزيئات



تراكم LDL مما يؤدي إلى تصلب الشرايين

1 Chemically altered LDL cells accumulate in the artery wall. Stimulated endothelial cells display adhesion molecules and secrete chemokines that lure monocytes and T cells into the intima.

2 The lured monocytes mature into macrophages. The macrophages along with T cells produce inflammatory mediators such as cytokines, which promote cell division. Scavenger receptors help them digest modified LDLs.



HEALTHY

AFFLICTED

3 As the macrophage feed on the LDLs they become filled with fatty droplets. These fat-filled macrophages (called foam cells), along with T cells are the earliest form of atherosclerotic plaque.

4 Inflammatory molecules promote further growth of plaque and form a fibrous cap over the lipid core. The fibrous cap seals off the fatty core from the blood.

5 Foam cells weaken the cap by secreting digesting matrix molecules. If the weakened cap ruptures, tissue factors, which display on the foam cell, interact with clot-promoting elements in the blood causing a clot (thrombus).