تفريغ كيمياء حيوية

اسم الموضوع: cell membrane

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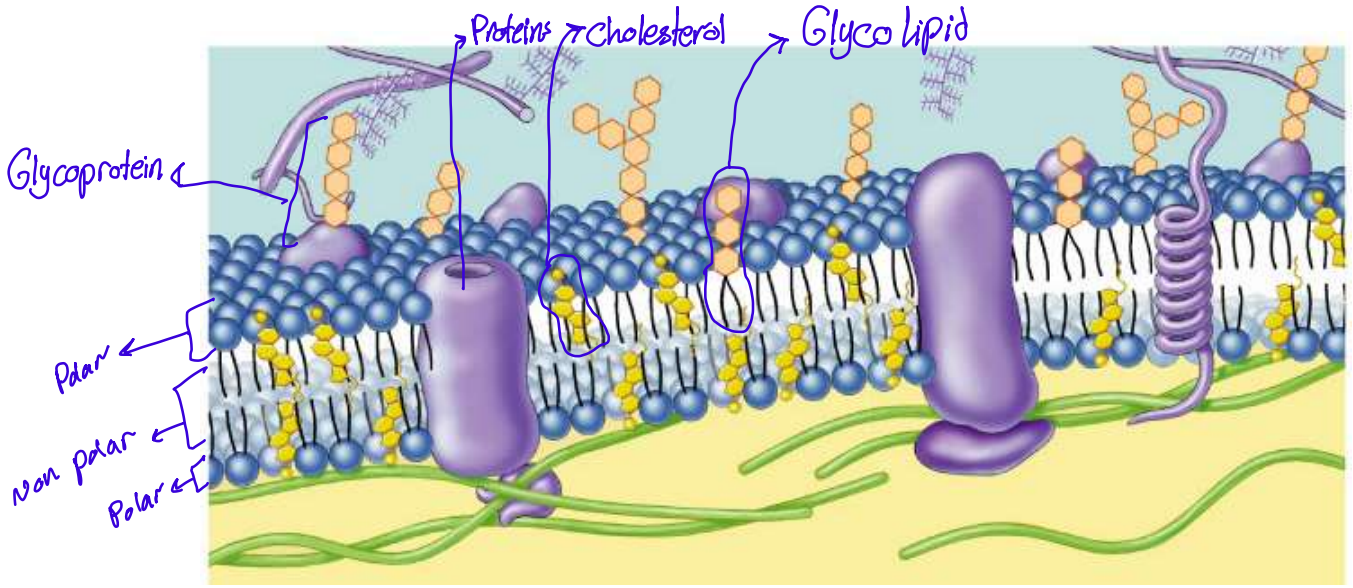
لجان الدُّفعات

Cell membrane



Function of the cell membrane

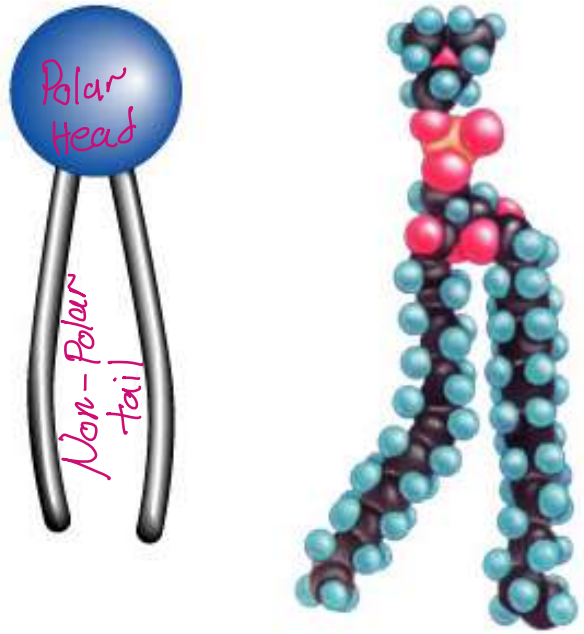
- Separation of the cell components from the nonliving surroundings (8 nm thick)
- It controls traffic into and out of the cell. – for ions –
- Like other membranes, the plasma membrane is **selectively permeable**, allowing some substances to cross more easily than others (hydrophilic vs hydrophobic)

عنده نفاذية انتقائية

Composition of cell membrane

- The basic structural unit of biological membranes is a lipid bilayer

- Phospholipids are the primary bilayer forming lipids

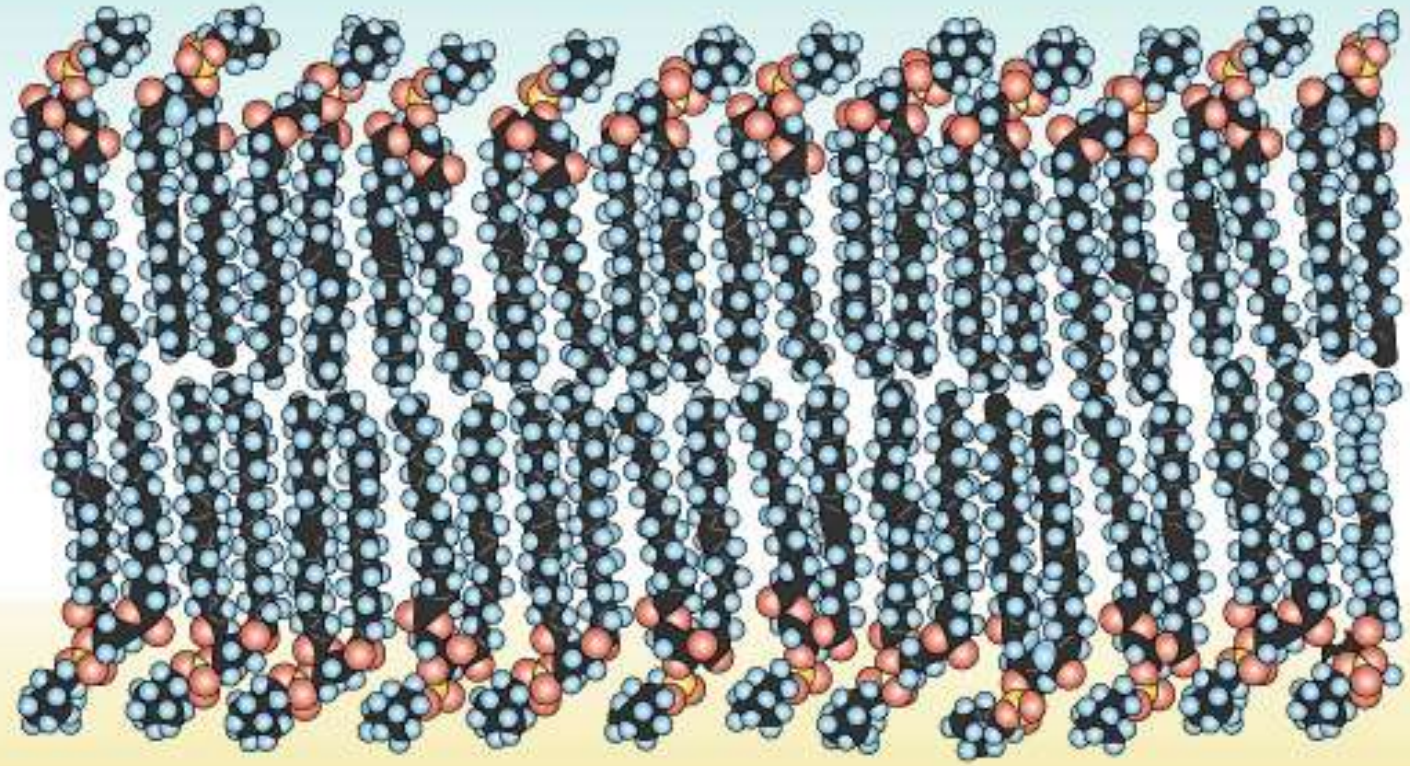


General membrane structures

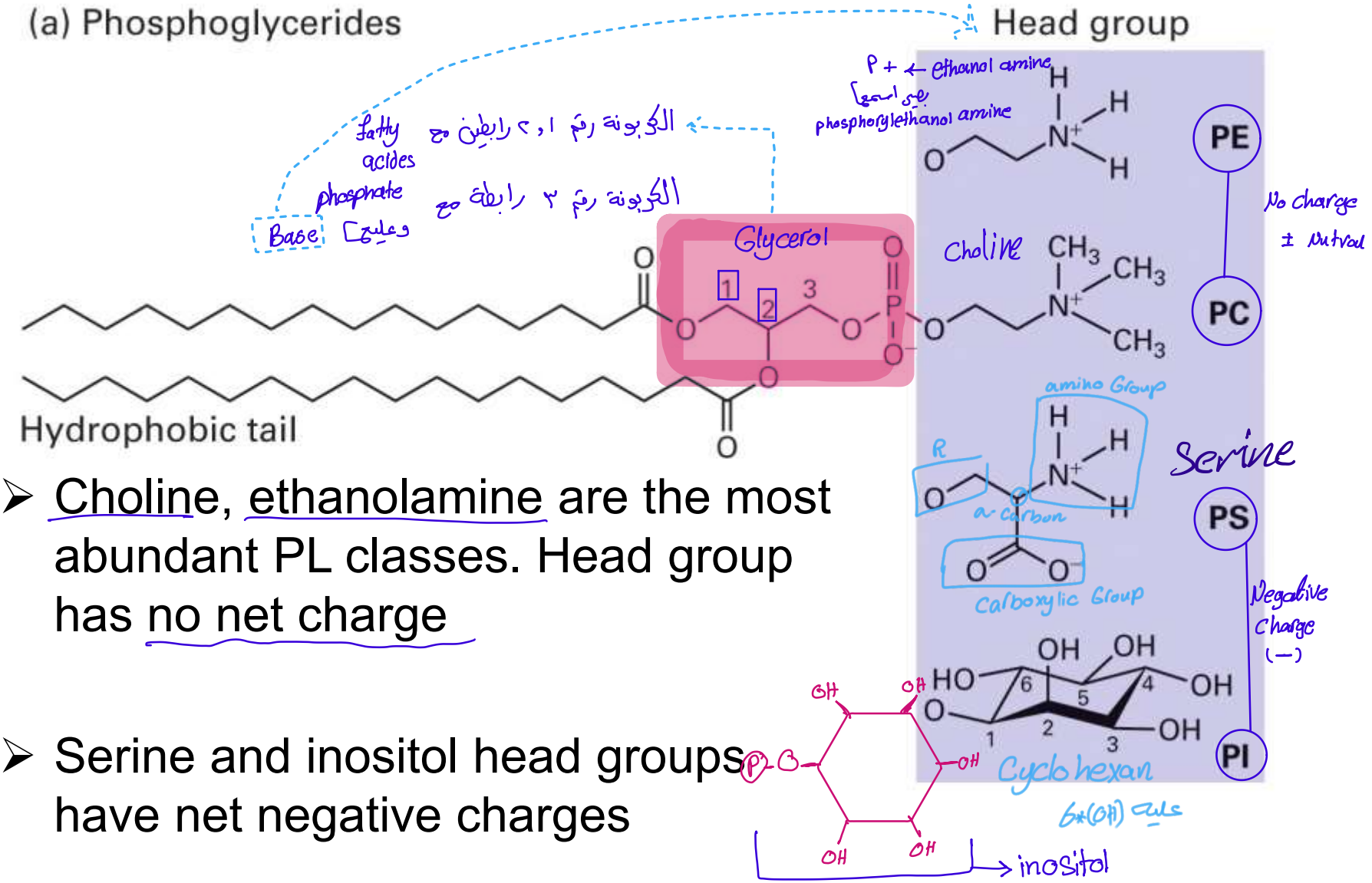
polar
hydrophilic
heads

nonpolar
hydrophobic
tails

polar
hydrophilic
heads



Different types of phospholipids



- 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
  - lateral
  - flip-flop
- Membranes are mosaics of structure and function

فسيفسائي

- Membrane carbohydrates are important for cell-cell recognition
  - glyco protein
  - glyco lipids

تعرف عن الخلية
مع الهرمونات او الفايروسات
او اي اشي ثاني

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)

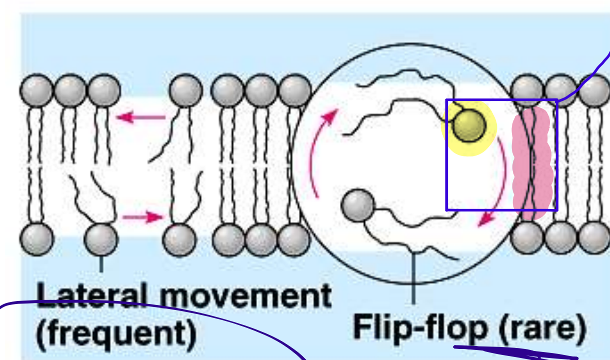
تتحرك بشكل جانبي

ليش Rare ؟

لانه صعب يمر الـ Polar head

جنب الـ Nonpolar tail

- 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

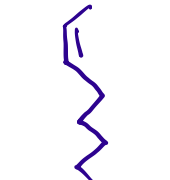
- Membrane fluidity is influenced by temperature and by its constituents.

(1) temperature
temp ↑ → energy ↑ → Movement ↑ → Fluidity ↑
(2) constituents

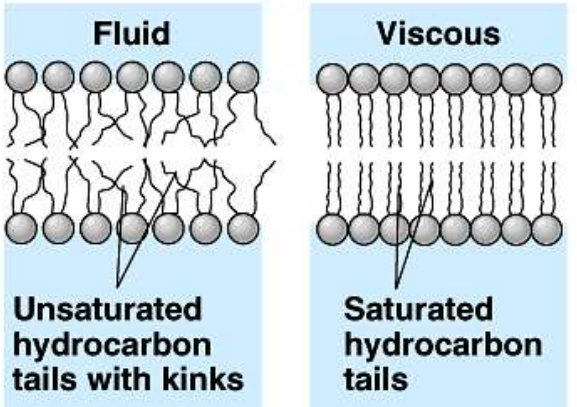
- As temperatures cool, membranes switch from a fluid state to a solid state as the phospholipids are more closely packed.

- Membranes rich in unsaturated fatty acids are more fluid that those dominated by saturated fatty acids because the kinks in the unsaturated fatty acid tails prevent tight packing

↑ fluidity
Cis



Fluid ↑ ← liquid يكون
Unsaturated → زيت الزيتون
Saturated → زيت النخيل
Fluid ↓ ← Solid يكون



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:

Work as a Buffer

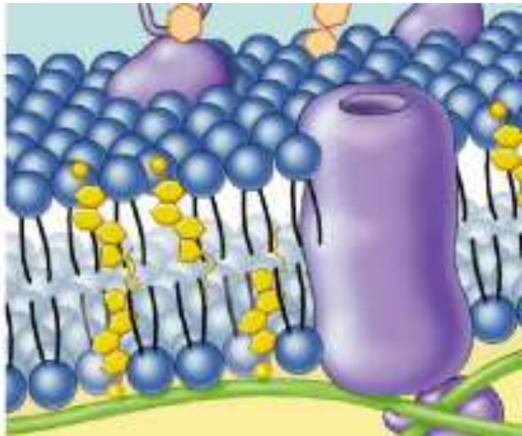
ليش ال membrane ما بفرط على درجة حرارة الجسم؟

  - Less fluid at warm temperatures (e.g. 37 ^{o}C body temperature) by restraining the phospholipid movement.

Cholesterol في 18 -
بثبت ال phospholipids Bilayer وبقلل من ال fluidity

  - More fluid at lower (cool) temperatures by preventing close packing of phospholipids.
  - Cells may **alter** membrane lipid concentration in response to changes in temperature

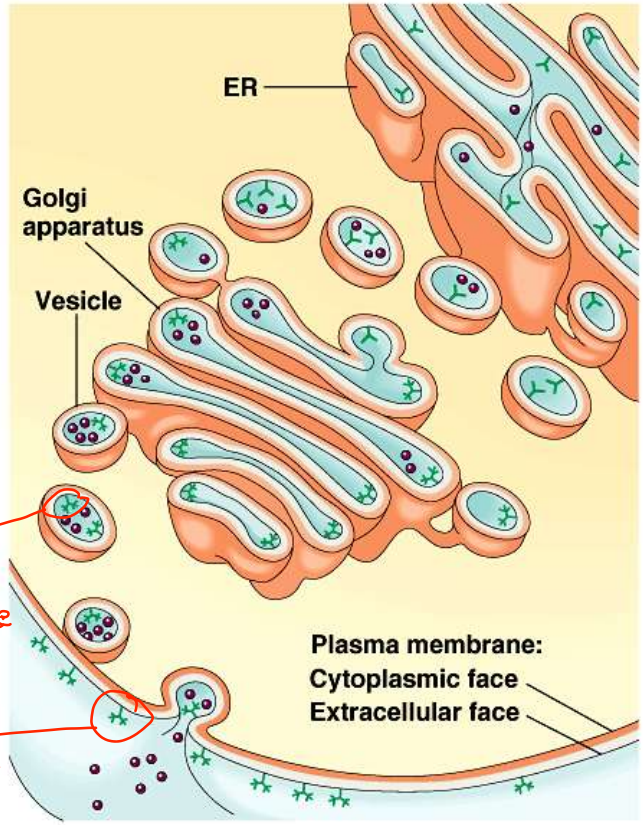
لما الحرارة بتنخفض Phospholipid بتقرب على بعض، بعمل Packing ⇐ بمنعها ← Cholesterol ← fluidity↑



Membranes are mosaics of structure and function

الوجه الداخلي مختلف عن الوجه الخارجي

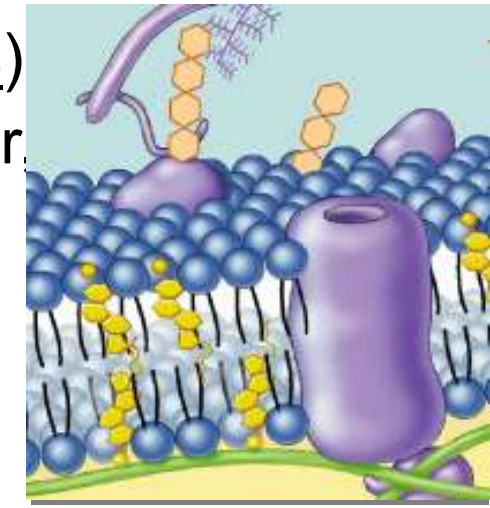
- Membranes have **asymmetric** inside and outside faces. The membrane's synthesis and modification by the ER determines this asymmetric distribution of lipids, proteins and carbohydrates.
  - The two lipid layers may differ in lipid composition.
  - Membrane proteins have a clear direction.
  - When present, carbohydrates are restricted to the membrane's exterior



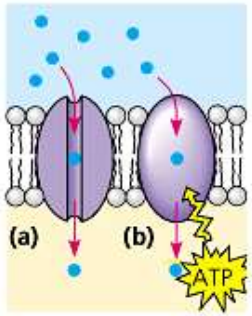
Membrane Proteins

- Proteins determine most of the membrane's specific functions

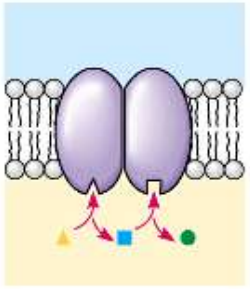
- Membrane proteins:
  - **peripheral proteins**
    - loosely bound to surface of membrane
    - cell surface identity marker (antigens)
  - **integral proteins:** penetrate lipid bilayer, usually across whole membrane
    - transmembrane protein:
    - transport proteins (channels, permeases (pumps))



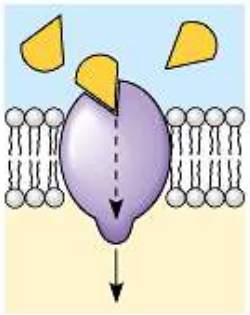
Many Functions of Membrane Proteins



Transport

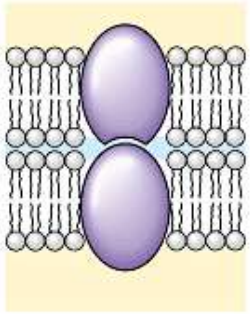


Enzymatic activity

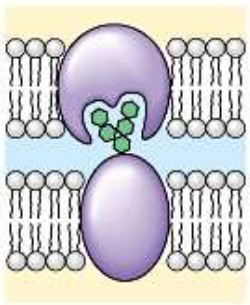


Signal transduction

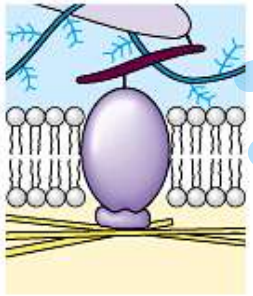
(hormon, neurotransmeter)



Intercellular joining

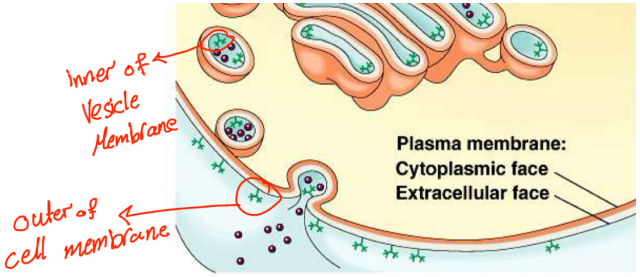


Cell-cell recognition

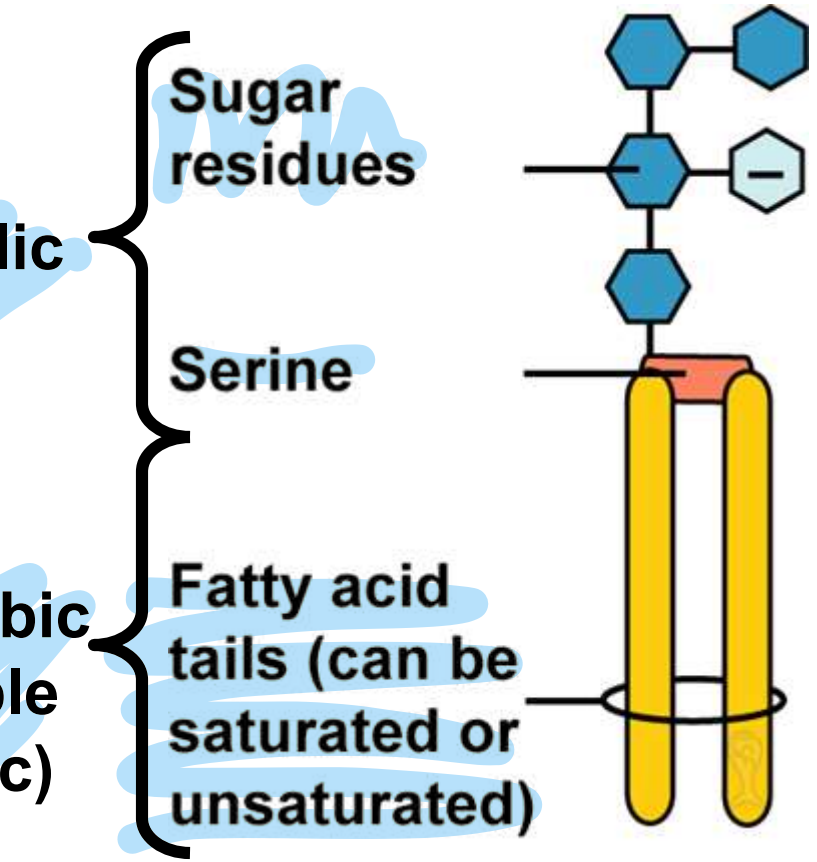


Attachment to the cytoskeleton and extracellular matrix (ECM)

Glycolipids



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



Membrane carbohydrates are important for cell-cell recognition

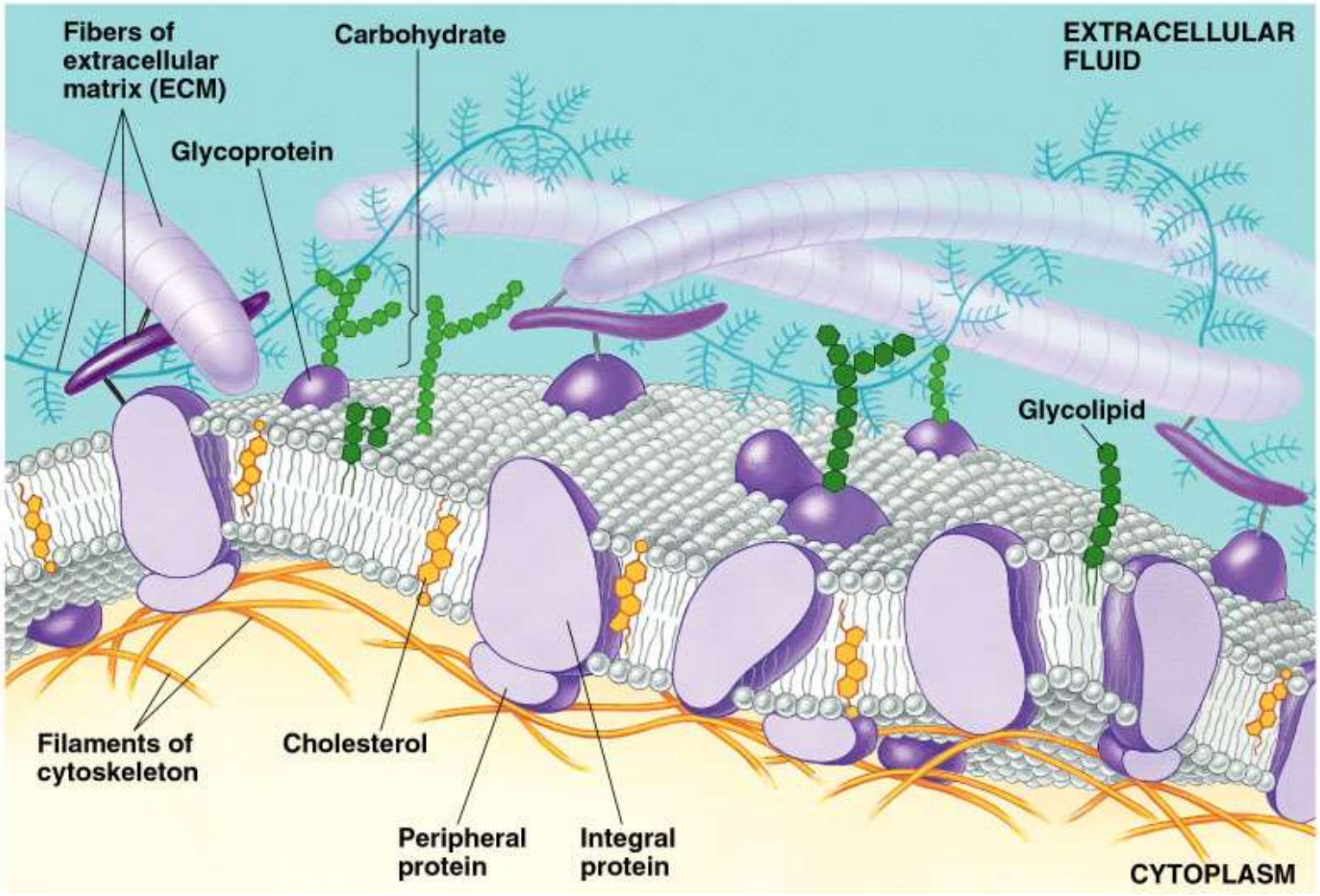
- Cell-cell recognition: The ability of a cell to distinguish one type of neighboring cell from another.
- Cell-cell recognition is crucial in the functioning of an organism. It is the basis for:
  - **Sorting** of cells into tissues and organs in an animal embryo's cell.
  - **Rejection** of foreign cells by the immune system.
- 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

Movement across cell membrane

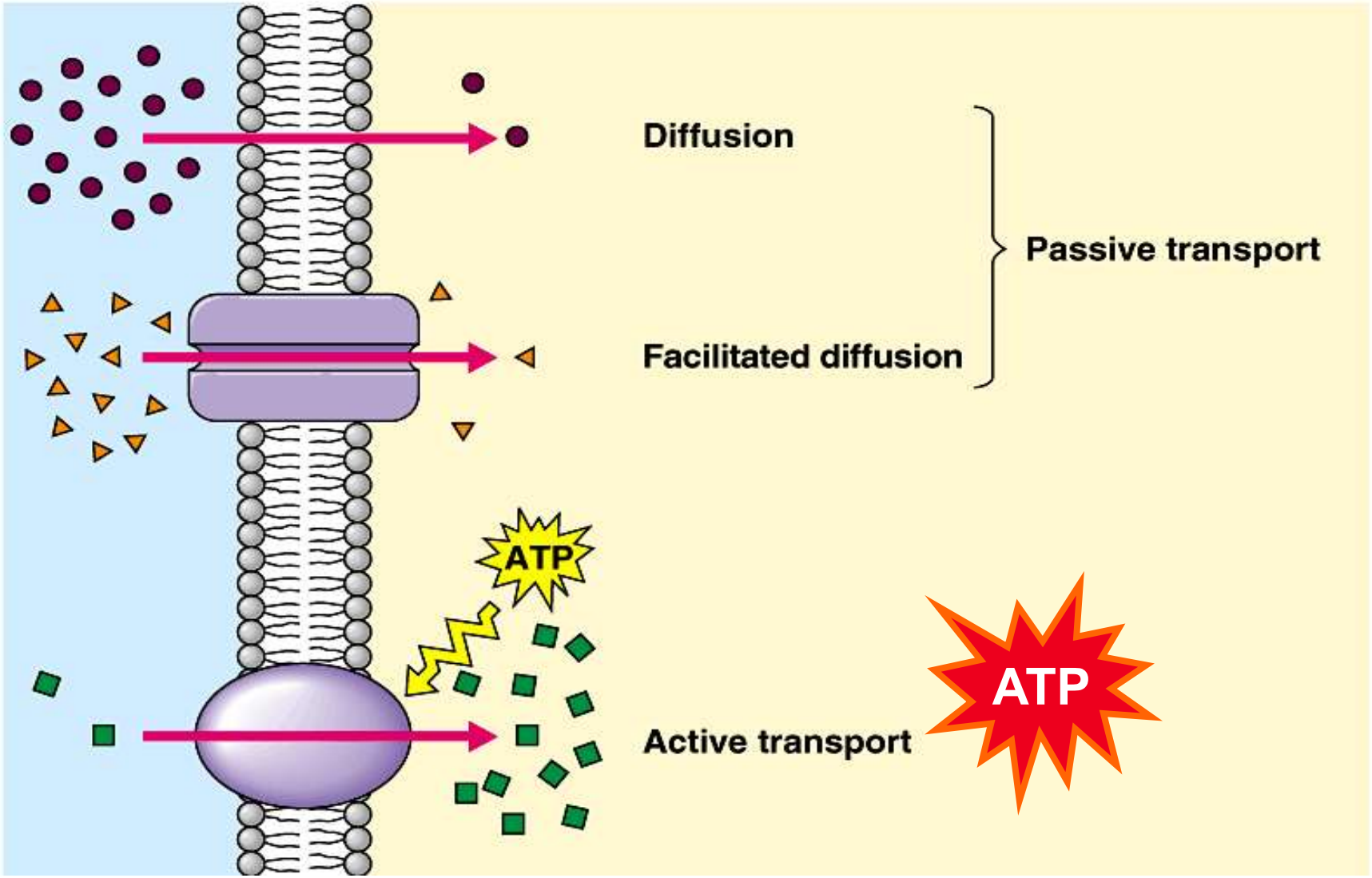
active passive



Movement across cell membrane

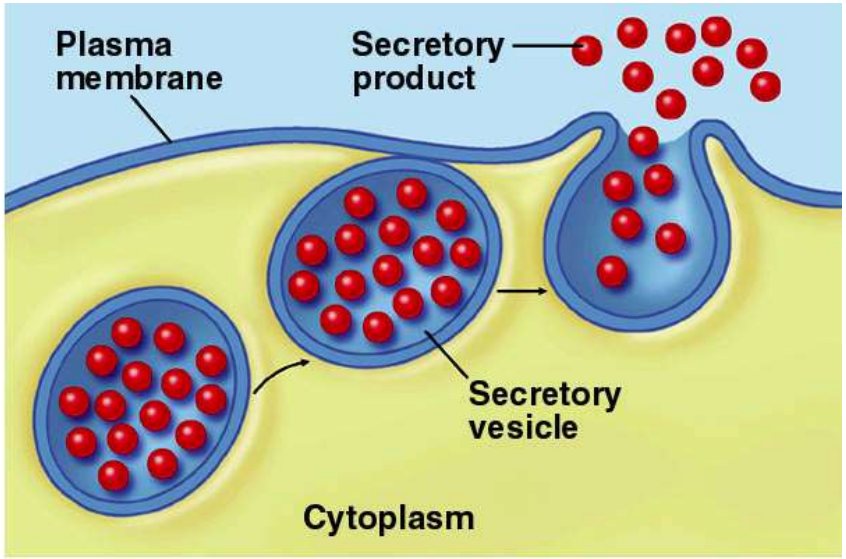
- **Passive Transport**
  - **Simple diffusion** → Solution بتخليني تذوب بالـ Polarity عندها نشوية
    - diffusion of nonpolar, hydrophobic molecules
      - → lipophilic
      - ✓ lipids
        - high → low concentration gradient → Heads & tails مباشرة بين membrane عبر بتعوت with concentration gradient
  - **Facilitated transport**
    - diffusion of polar, hydrophilic molecules
    - through a protein channel Carrier → Fructose carrier
      - high → low concentration gradient
- **Active transport**
  - diffusion *against* concentration gradient
    - low → high
  - uses a protein pump
  - requires ATP

Movement across cell membrane



Transport of large molecules

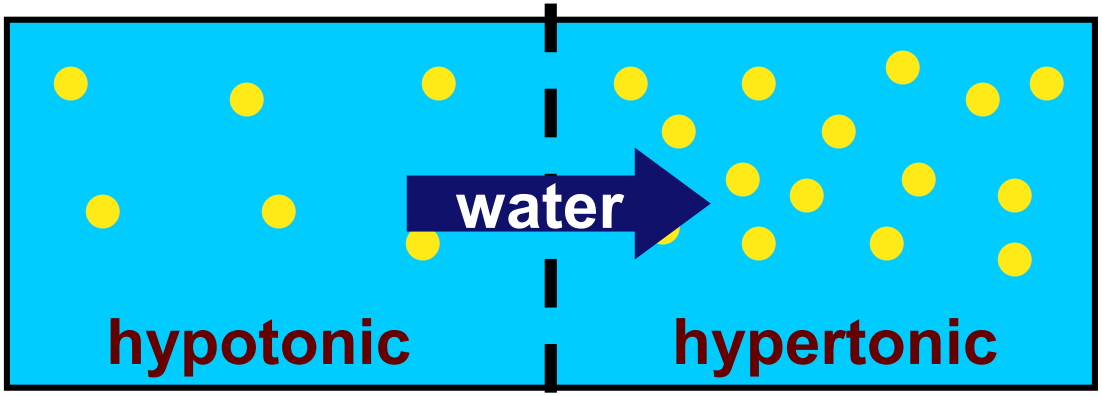
- Moving large molecules into & out of cell
  - through vesicles & vacuoles
  - **endocytosis**
    - phagocytosis = "cellular eating"
    - pinocytosis = "cellular drinking"
  - **exocytosis**



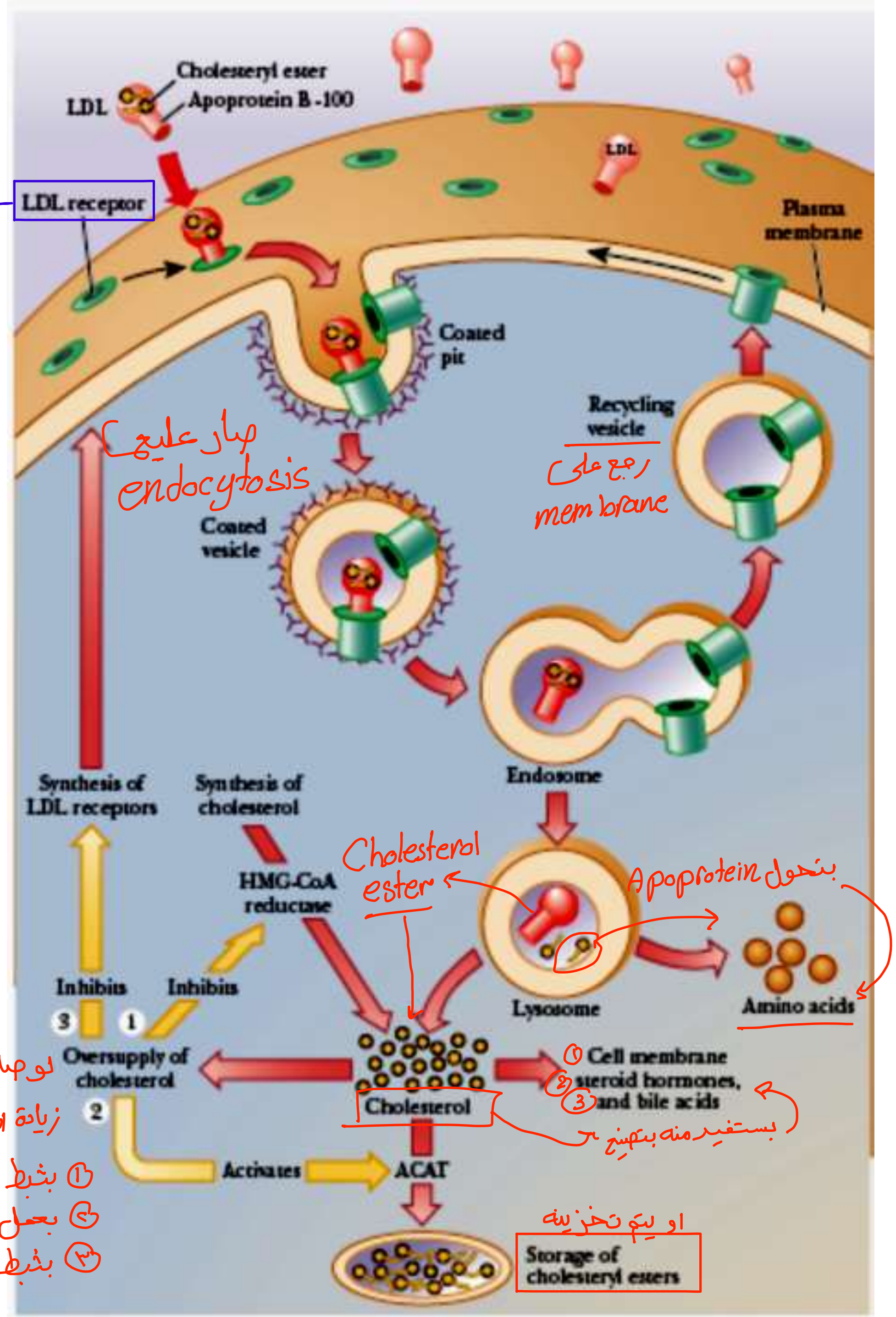
لما بنحكي عن انتقال الماء بكون
حسب تركيز الماء او المذاب
الماء ← بينتقل من high ← low
المذاب ← الماء بينتقل من المكان [low solute] ← [high solute]
hypotonic ← hypertonic

Diffusion of water

- Diffusion of water from ***high concentration*** of water to ***low concentration*** of water
- 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



Liver cells موجودين على

اعدادهم مرتبطة بالوراثة

لو صار عندي

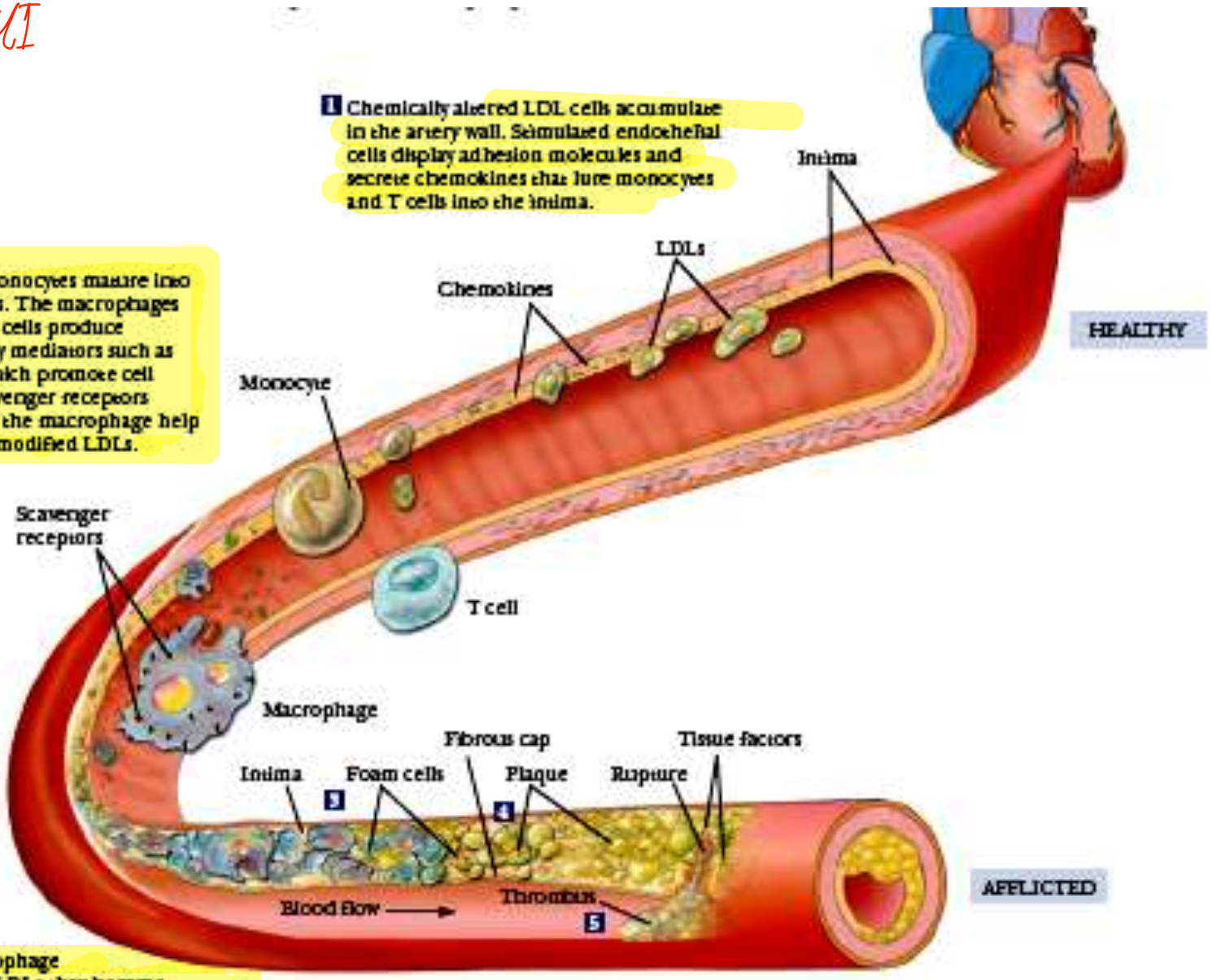
زيادة Cholesterol

① بثبط صناعة الـ Cholesterol

② بعمل زيادة بالتخزين

③ بثبط صناعة LDL Receptors

LDL & MI


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.
Intima
LDLs
Chemokines
HEALTHY
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 displayed on the macrophage help them digest modified LDLs.
Monocyte
Scavenger receptors
T cell
Macrophage
Fibrous cap
Tissue factors
Intima
Foam cells
Plaque
Rupture
3
4
Blood flow
Thrombus
5
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).