

Ankara University, Faculty of Agriculture , Department of Fisheries and Aquaculture, Programme of Fisheries and Aquaculture

# AQS104: Biochemistry

Reference: Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). ***Lehninger Principles of Biochemistry (5<sup>th</sup> edition)***. Macmillan.

# AQS104 BIOCHEMISTRY: Weekly Programme

**1. Week:**

- The foundations of biochemistry
- Water

**2. Week:**

- Amino acids, peptides, and proteins
- The three-dimensional structure of proteins

**3. Week:**

- Protein function
- Enzymes

**4. Week:**

- Carbohydrates and Glycobiology
- Nucleotides and Nucleic Acids

**5. Week:**

- DNA-based information technologies
- Lipids

**6. Week:**

Biological membranes and transport  
Biosignaling

**7. Week:**

Bioenergetics and biochemical reaction types  
Glycolysis, gluconeogenesis, and the pentose phosphate pathway

**8. Week:**

Principles of metabolic regulation  
The citric acid cycle

**9. Week:**

Fatty acid catabolism  
Aino acid oxidation and the production of urea

**10. Week:**

Oxidative phosphorylation and photophosphorylation  
Carbohydrate biosynthesis in plants and bacteria

**11. Week:**

Lipid biosynthesis  
Biosynthesis of amino acids, nucleotides, and related molecules

**12. Week:**

Hormonal regulation and integration of mammalian metabolism  
Genes and chromosomes

**13. Week:**

DNA metabolism  
RNA metabolism

**14. Week:**

Protein metabolism  
Regulation of gene expression

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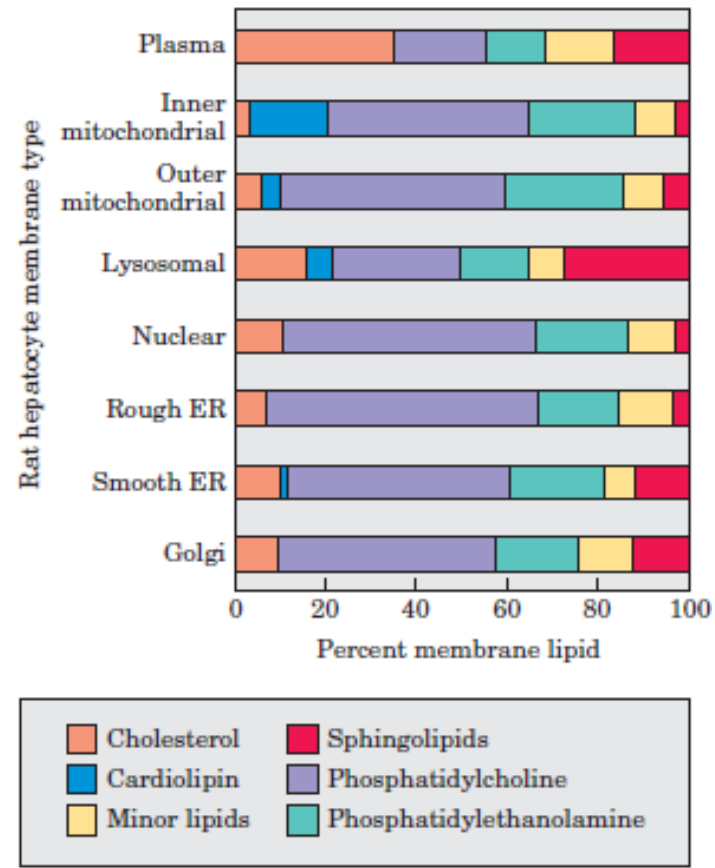
## AQS104: Biochemistry

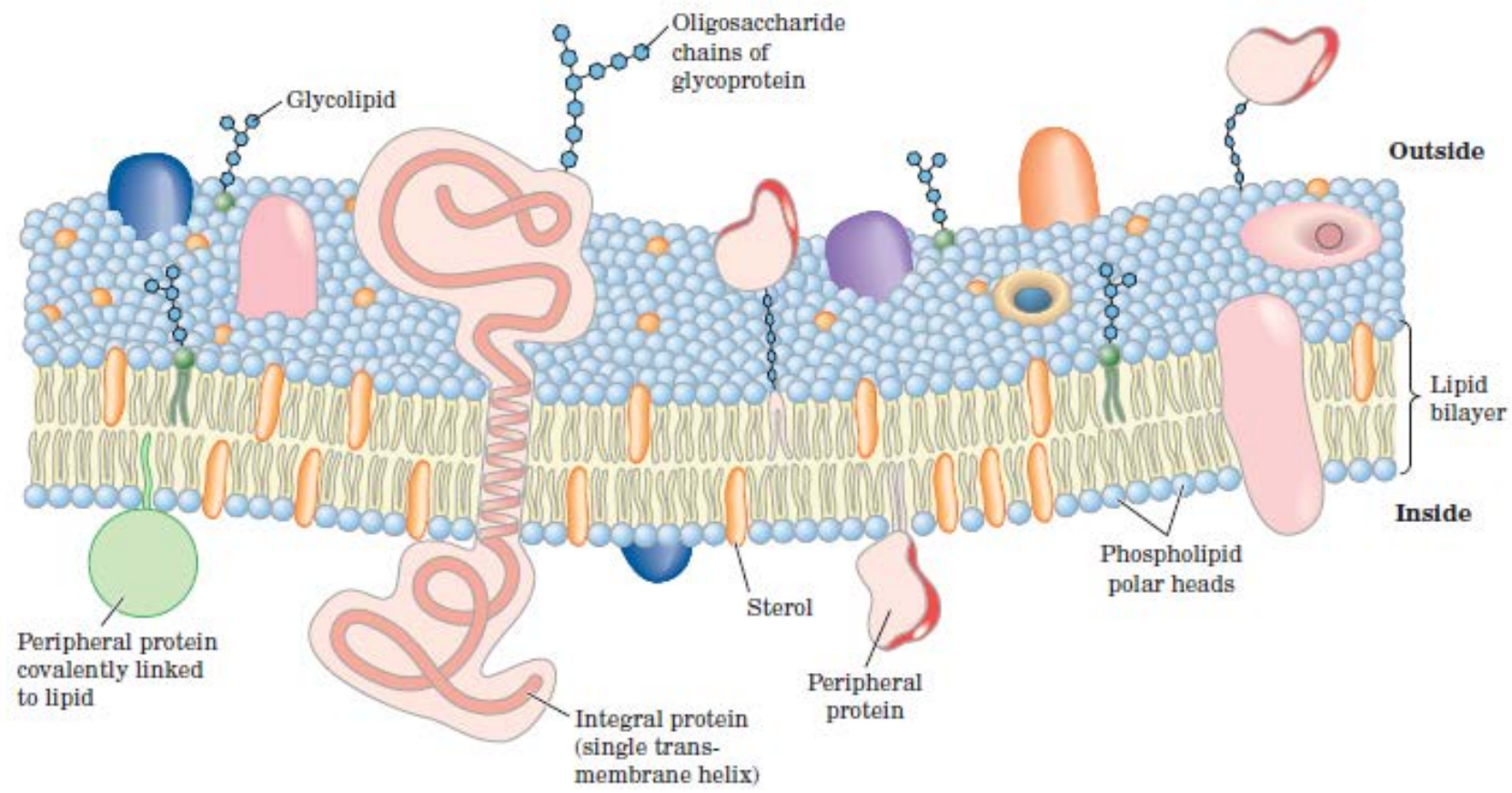
### 6. Week:

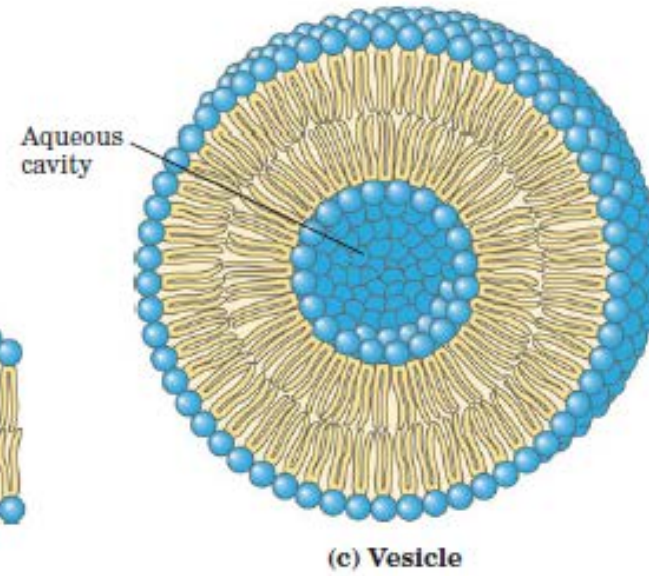
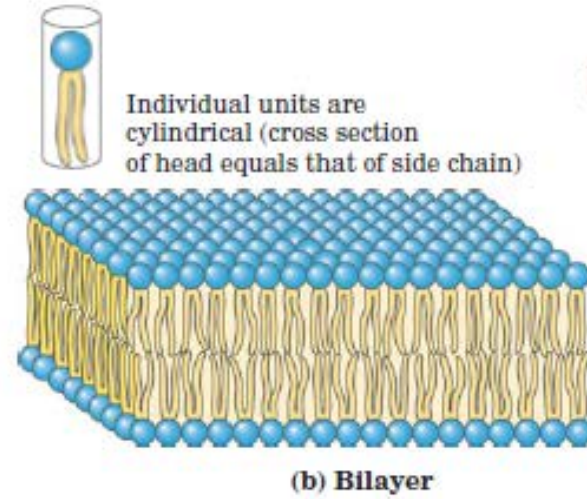
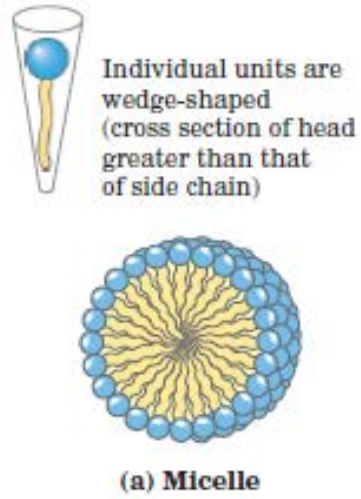
Biological Membranes and Transport

Biosignaling

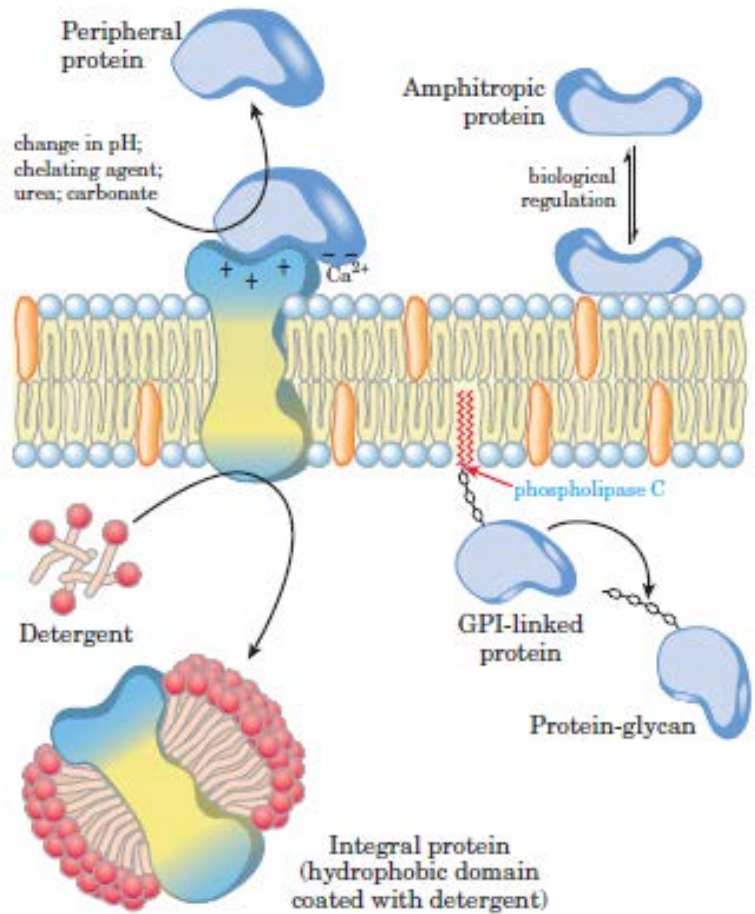
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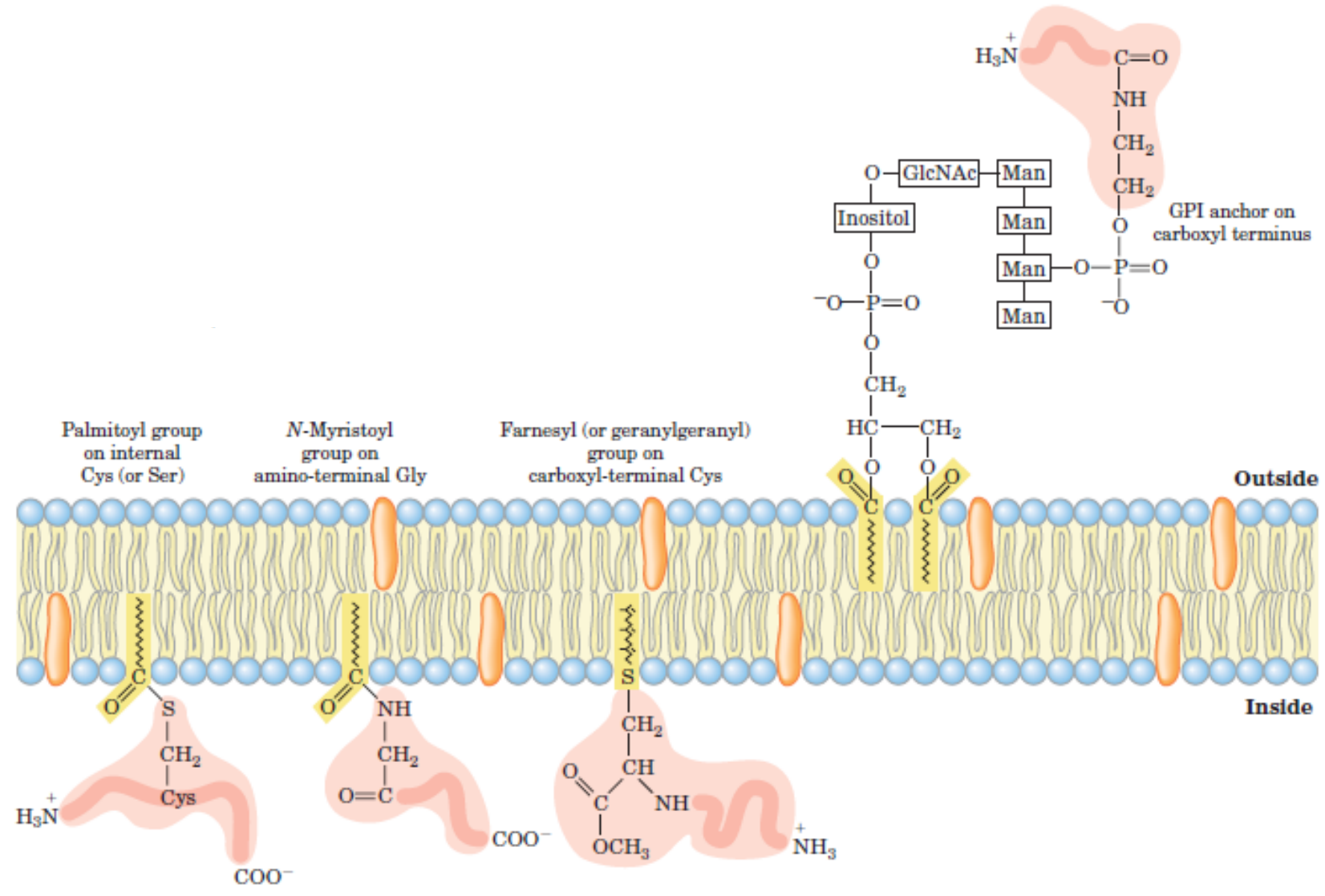




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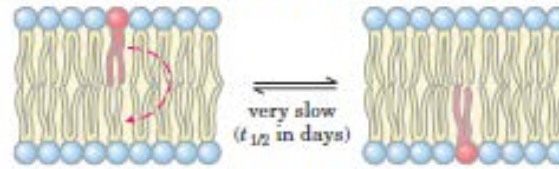


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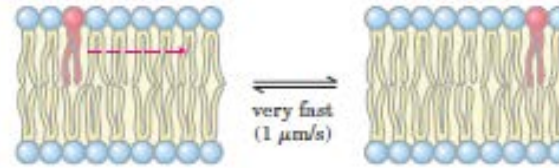




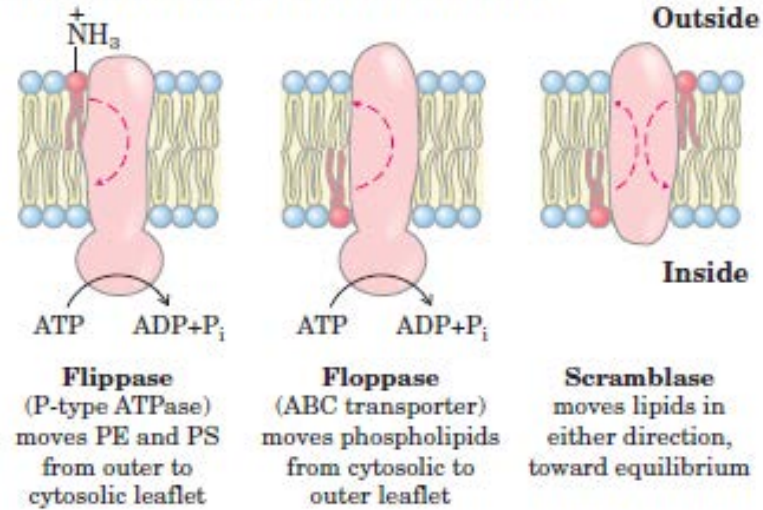
**(a) Uncatalyzed transbilayer ("flip-flop") diffusion**

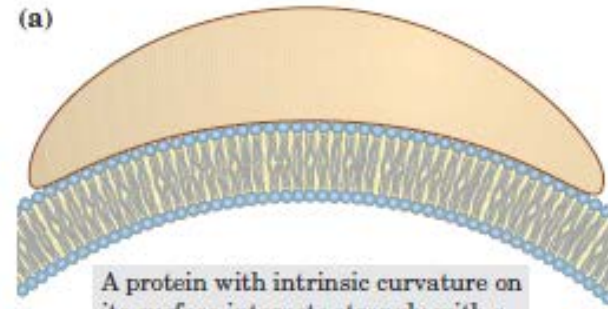
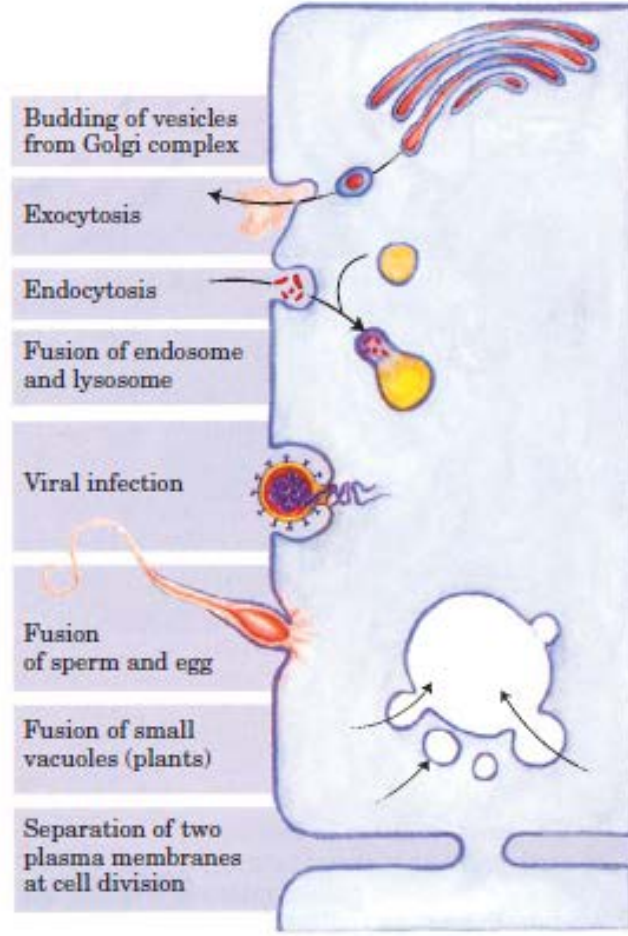


**(b) Uncatalyzed lateral diffusion**

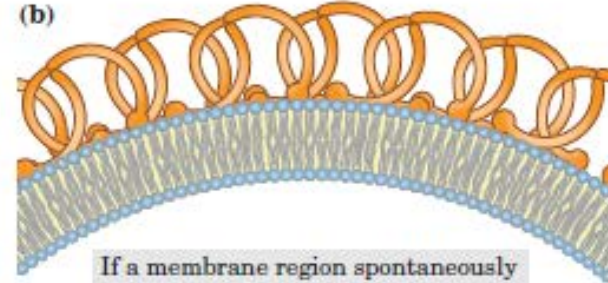


**(c) Catalyzed transbilayer translocations**

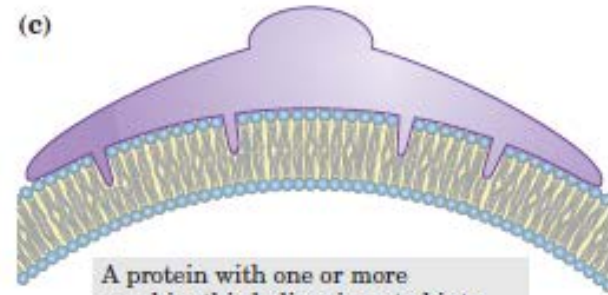




A protein with intrinsic curvature on its surface interacts strongly with a curved membrane surface, allowing both membrane and protein to achieve their lowest energy.

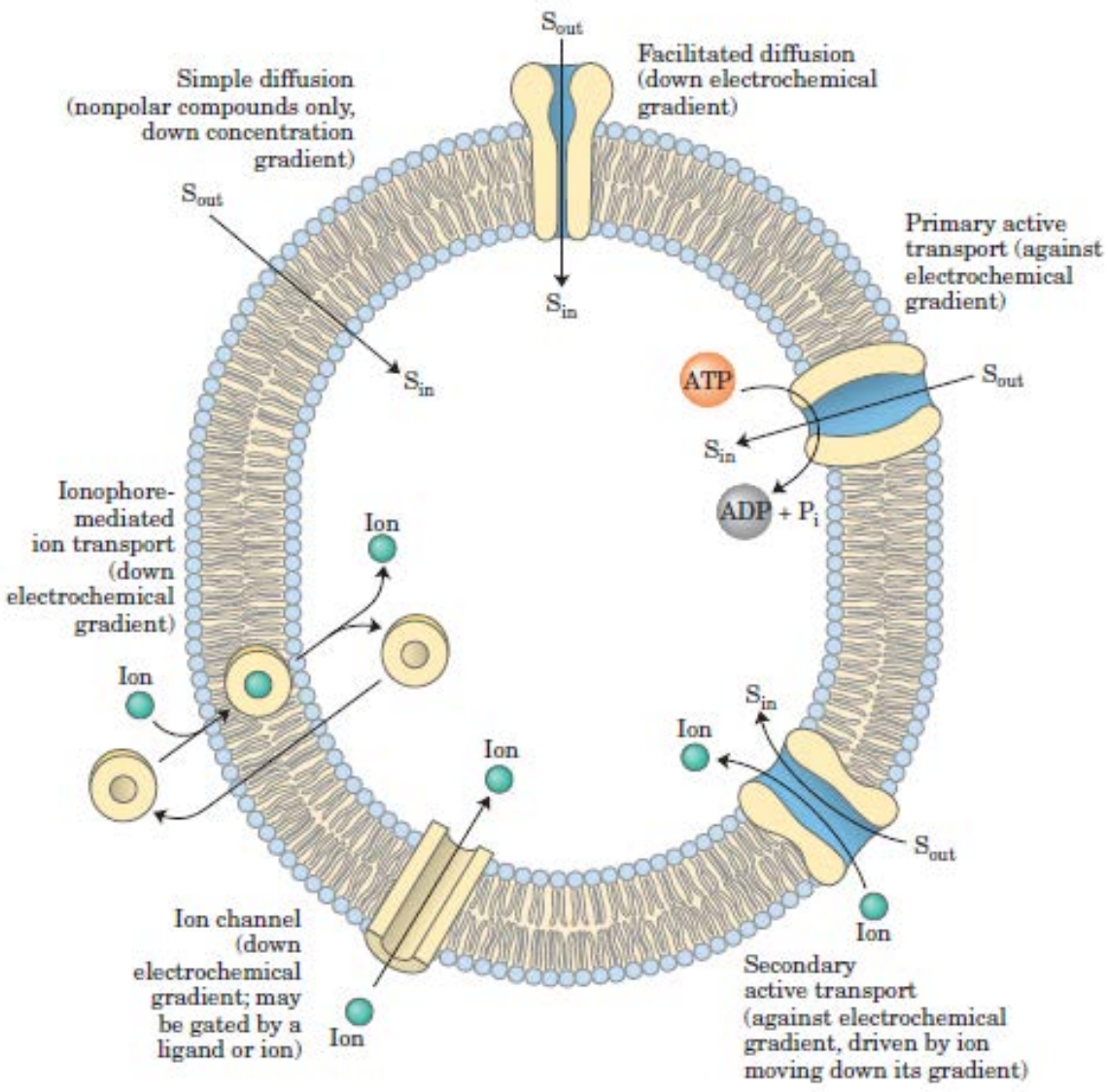


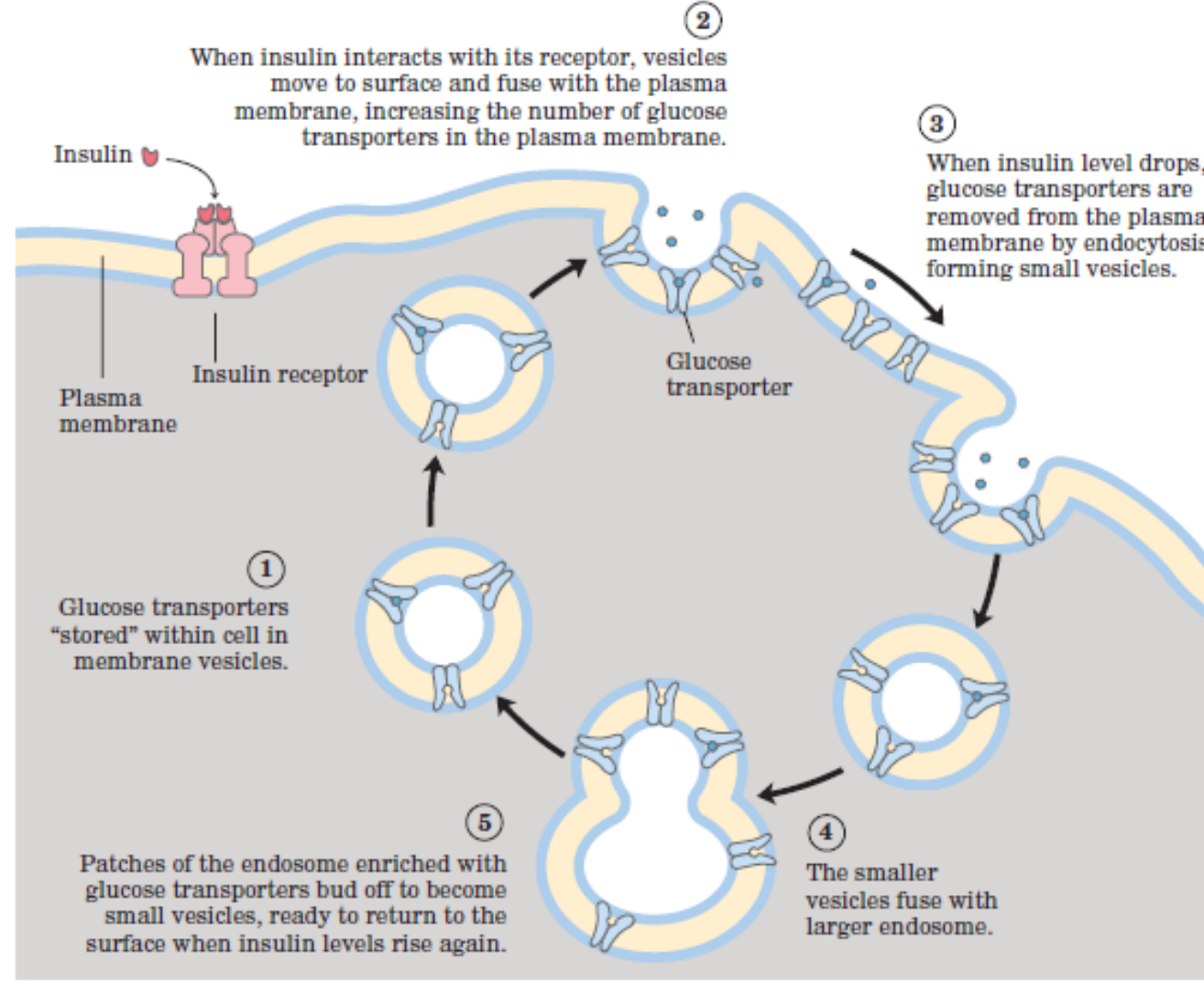
If a membrane region spontaneously curves, monomeric subunits of certain proteins can polymerize into a superstructure that favors and maintains the curvature.

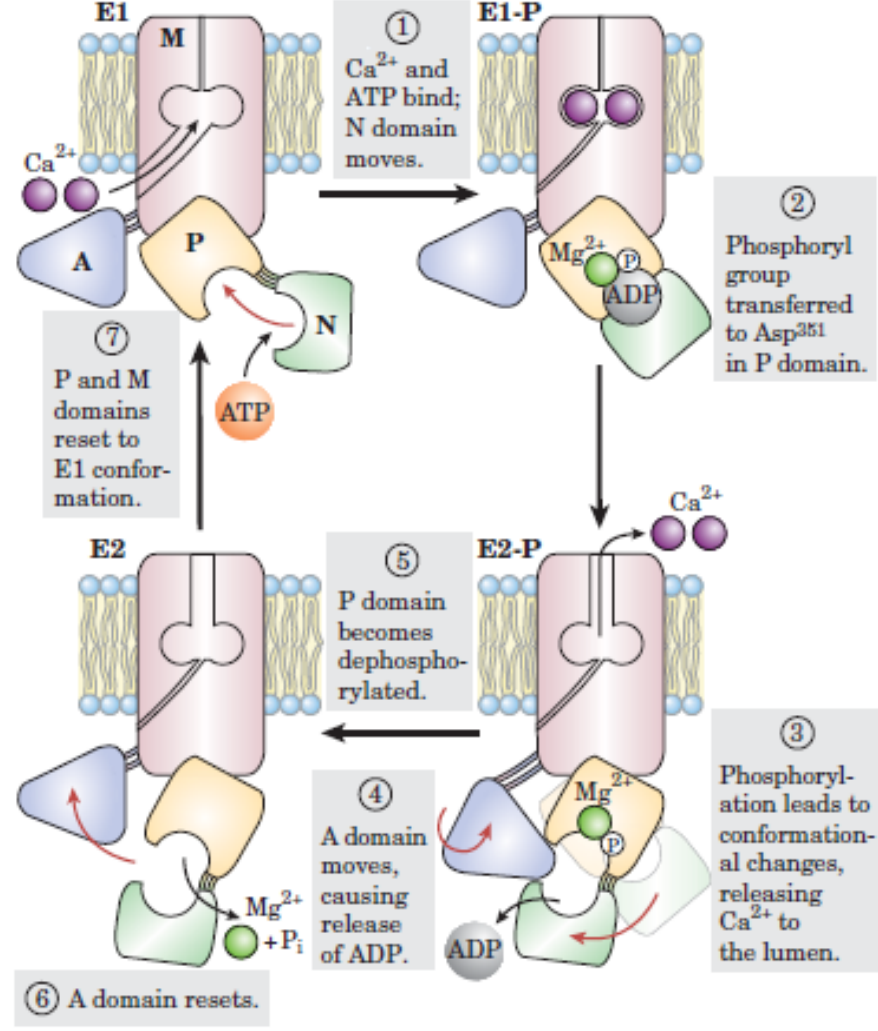


A protein with one or more amphipathic helices inserted into one leaflet of the bilayer crowds the lipids in that leaflet, forcing the membrane to bend.

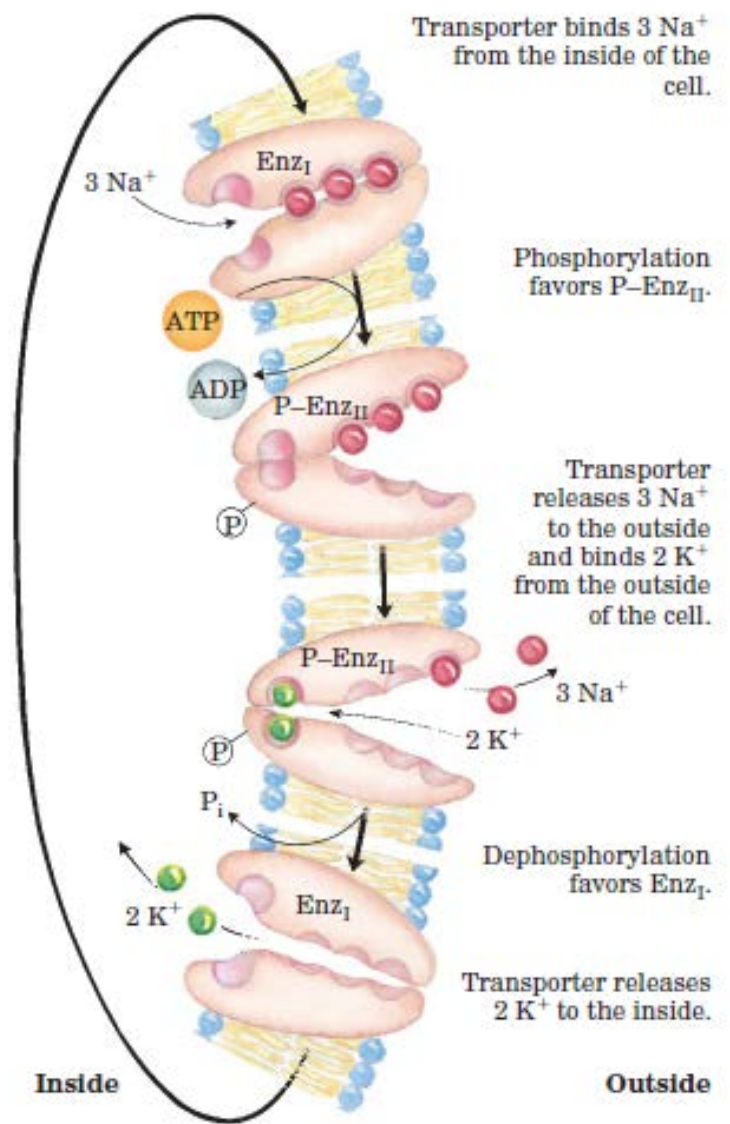
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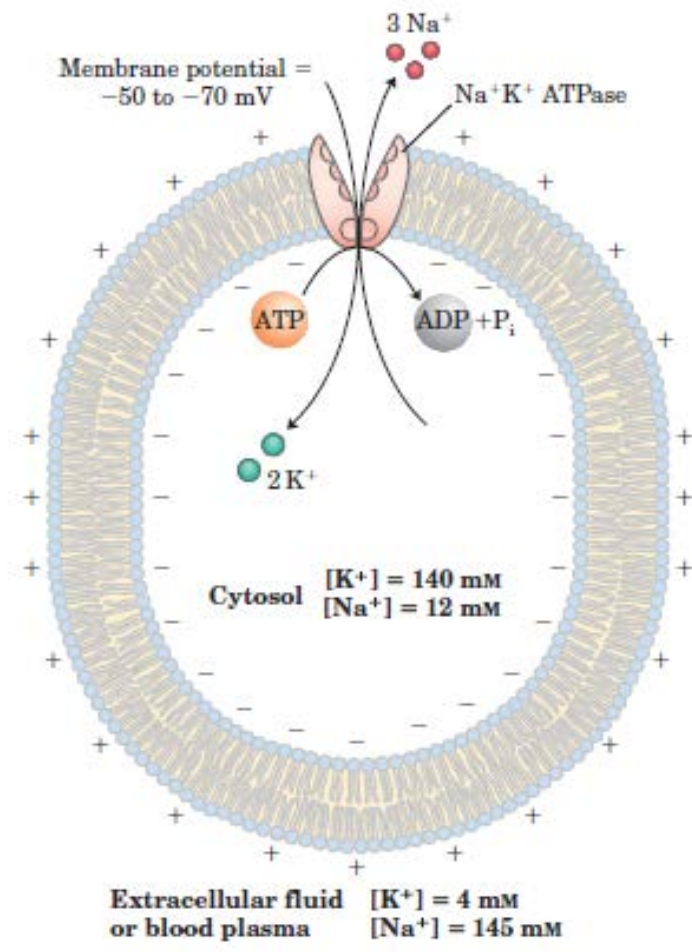


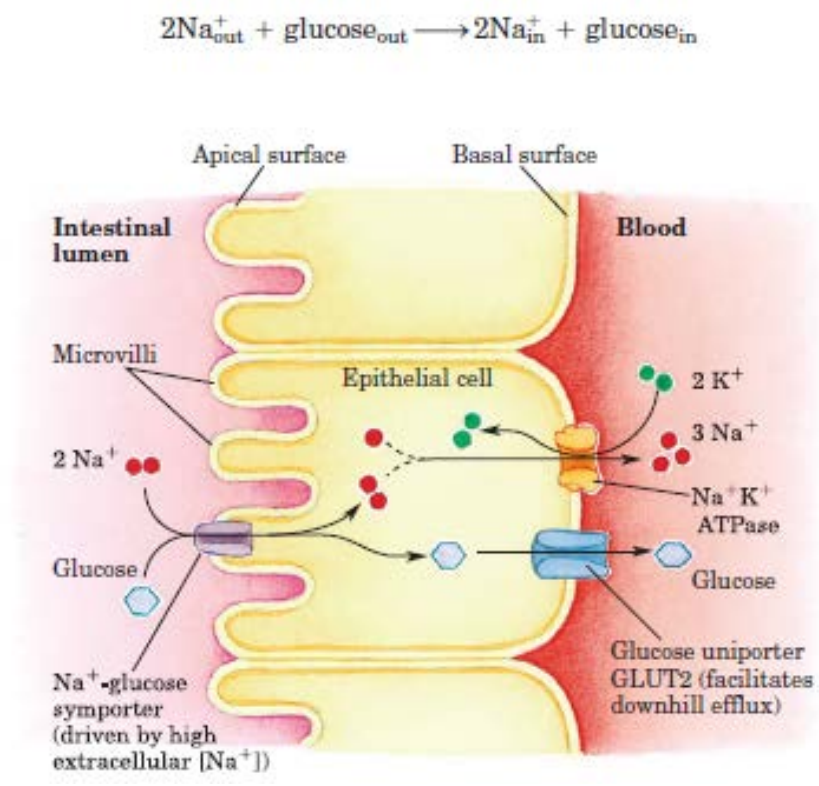




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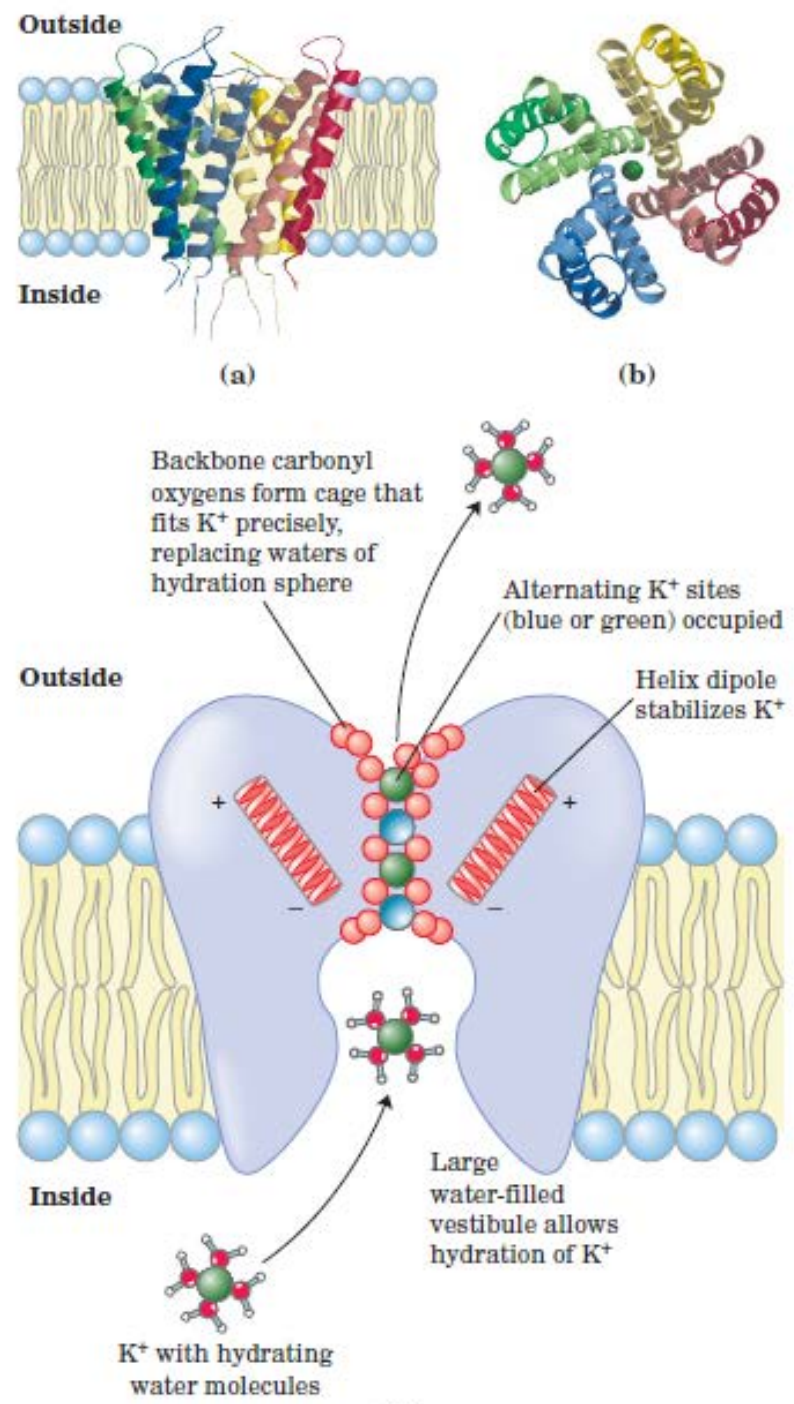


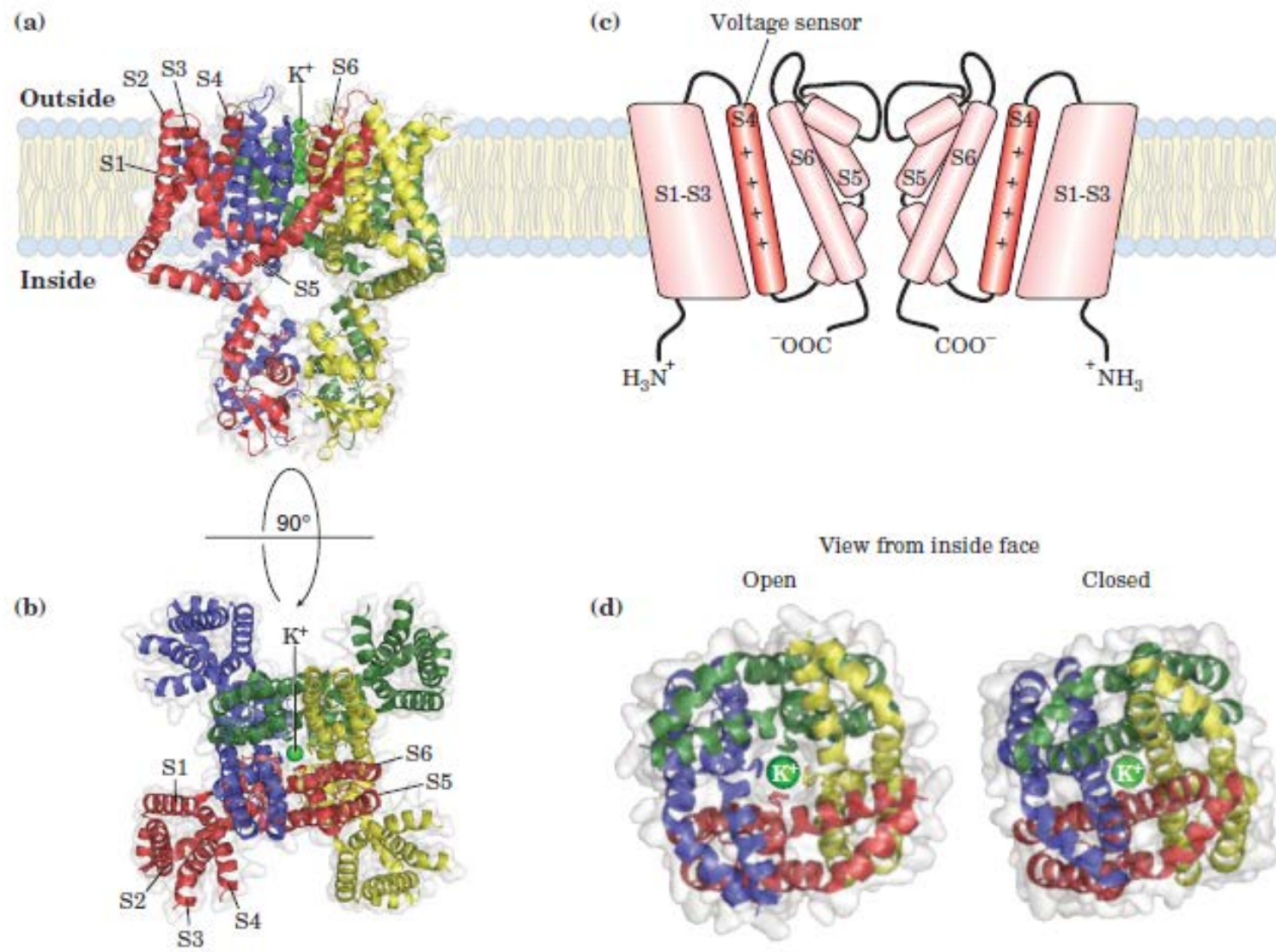
Aquaporin	Permeant (permeability)	Tissue distribution	Subcellular distribution*
AQP-0	Water (low)	Lens	Plasma membrane
AQP-1	Water (high)	Erythrocyte, kidney, lung, vascular endothelium, brain, eye	Plasma membrane
AQP-2	Water (high)	Kidney, vas deferens	Apical plasma membrane, intracellular vesicles
AQP-3	Water (high), glycerol (high), urea (moderate)	Kidney, skin, lung, eye, colon	Basolateral plasma membrane
AQP-4	Water (high)	Brain, muscle, kidney, lung, stomach, small intestine	Basolateral plasma membrane
AQP-5	Water (high)	Salivary gland, lacrimal gland, sweat gland, lung, cornea	Apical plasma membrane
AQP-6	Water (low), anions ( $\text{NO}_3^- > \text{Cl}^-$ )	Kidney	Intracellular vesicles
AQP-7	Water (high), glycerol (high), urea (high), arsenite	Adipose tissue, kidney, testis	Plasma membrane
AQP-8 <sup>†</sup>	Water (high)	Testis, kidney, liver, pancreas, small intestine, colon	Plasma membrane, intracellular vesicles
AQP-9	Water (low), glycerol (high), urea (high), arsenite	Liver, leukocyte, brain, testis	Plasma membrane
AQP-10	Water (low), glycerol (high), urea (high)	Small intestine	Intracellular vesicles

**Source:** Data from King, L.S., Kozono, D., & Agre, P. (2004) From structure to disease: the evolving tale of aquaporin biology. *Nat. Rev.* **5**, 688.

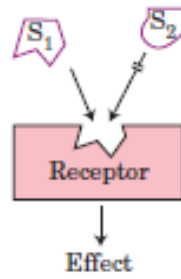
\*Aquaporins that are present primarily in the apical or in the basolateral membrane are noted as localized in one of these membranes; those present in both membranes are described as localized in the plasma membrane.

<sup>†</sup>AQP-8 might also be permeated by urea.

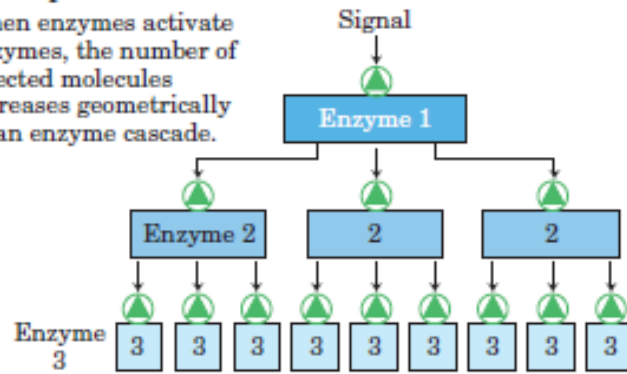




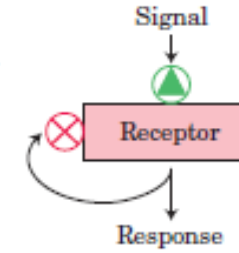
**(a) Specificity**  
Signal molecule fits binding site on its complementary receptor; other signals do not fit.



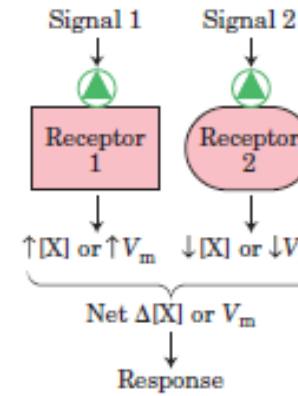
**(b) Amplification**  
When enzymes activate enzymes, the number of affected molecules increases geometrically in an enzyme cascade.

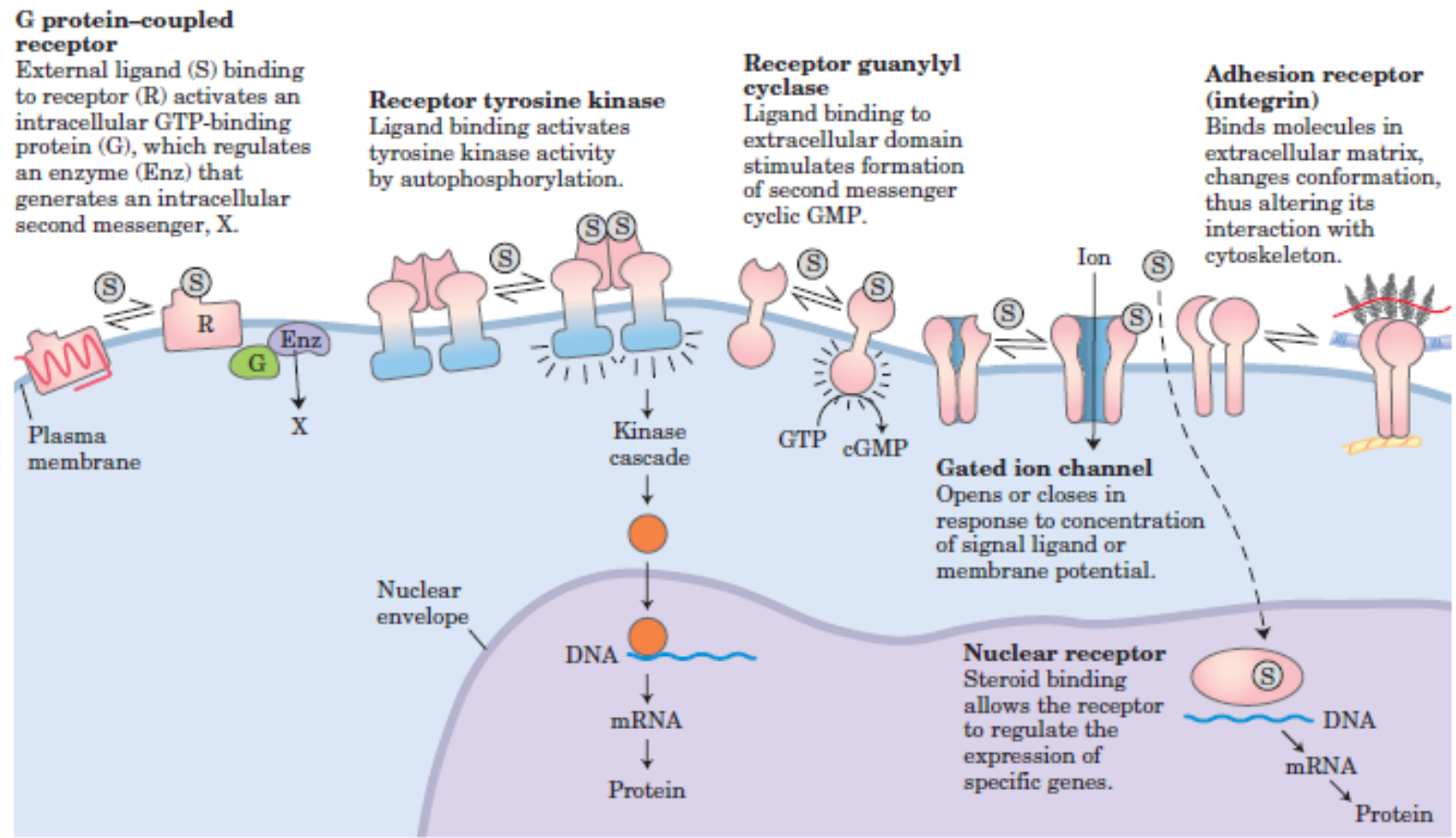


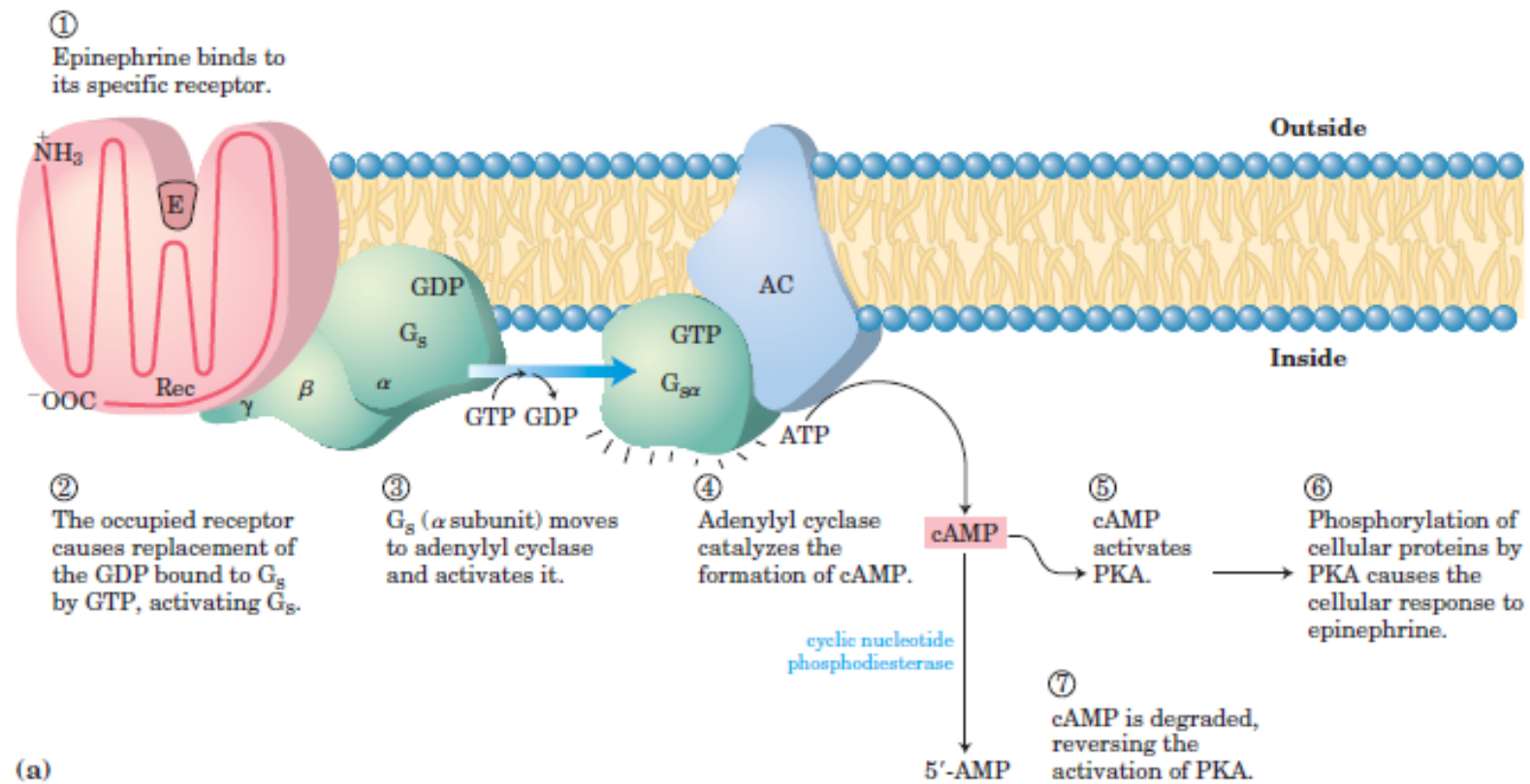
**(c) Desensitization/Adaptation**  
Receptor activation triggers a feedback circuit that shuts off the receptor or removes it from the cell surface.



**(d) Integration**  
When two signals have opposite effects on a metabolic characteristic such as the concentration of a second messenger  $X_i$  or the membrane potential  $V_m$ , the regulatory outcome results from the integrated input from both receptors.







(a)

