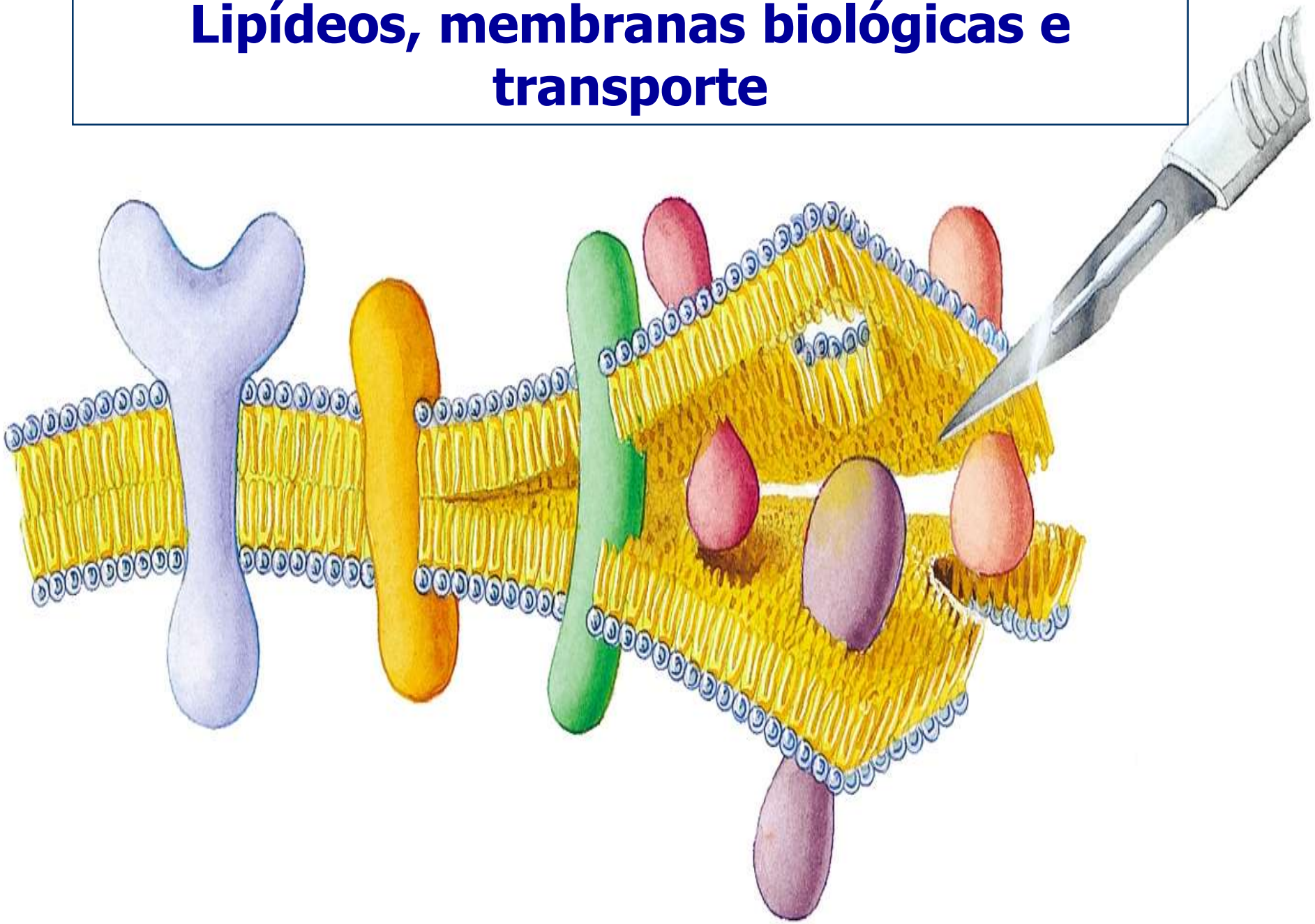
Lipídeos, membranas biológicas e transporte



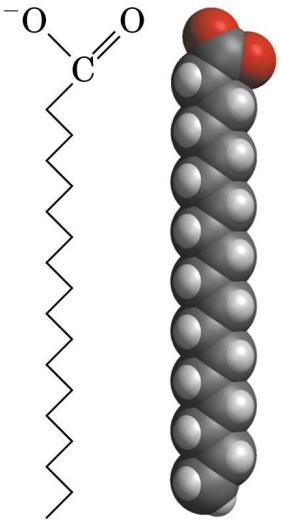
LIPÍDEOS DE ARMAZENAMENTO

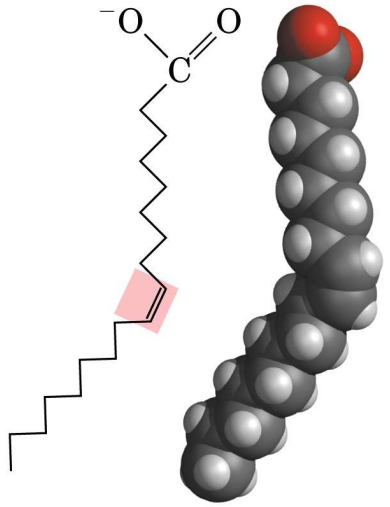
Some Naturally Occurring Fatty Acids

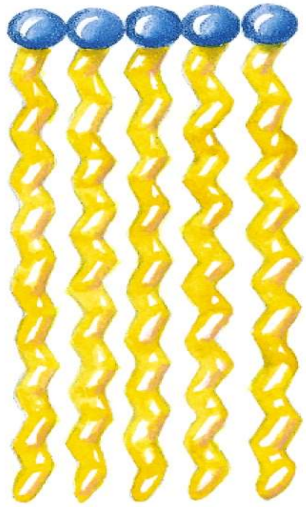
Carbon skeleton	Structure*	Systematic name†	Common name (derivation)	Melting point (°C)	Solubility at 30 °C (mg/g solvent)	
					Water	Benzene
12:0	$CH_3(CH_2)_{10}COOH$	*n*-Dodecanoic acid	Lauric acid (Latin *laurus*, "laurel plant")	44.2	0.063	2,600
14:0	$CH_3(CH_2)_{12}COOH$	*n*-Tetradecanoic acid	Myristic acid (Latin *Myristica*, nutmeg genus)	53.9	0.024	874
16:0	$CH_3(CH_2)_{14}COOH$	*n*-Hexadecanoic acid	Palmitic acid (Latin *palma*, "palm tree")	63.1	0.0083	348
18:0	$CH_3(CH_2)_{16}COOH$	*n*-Octadecanoic acid	Stearic acid (Greek *stear*, "hard fat")	69.6	0.0034	124
20:0	$CH_3(CH_2)_{18}COOH$	*n*-Eicosanoic acid	Arachidic acid (Latin *Arachis*, legume genus)	76.5		
24:0	$CH_3(CH_2)_{22}COOH$	*n*-Tetracosanoic acid	Lignoceric acid (Latin *lignum*, "wood" + *cera*, "wax")	86.0		
16:1(Δ^9)	$CH_3(CH_2)_5CH{=}CH(CH_2)_7COOH$	*cis*-9-Hexadecenoic acid	Palmitoleic acid	−0.5		
18:1(Δ^9)	$CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$	*cis*-9-Octadecenoic acid	Oleic acid (Latin *oleum*, "oil")	13.4		
18:2($\Delta^{9,12}$)	$CH_3(CH_2)_4CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$	*cis*-,*cis*-9,12-Octadecadienoic acid	Linoleic acid (Greek *linon*, "flax")	−5		
18:3($\Delta^{9,12,15}$)	$CH_3CH_2CH{=}CHCH_2CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$	*cis*-,*cis*-,*cis*-9,12,15-Octadecatrienoic acid	α-Linolenic acid	−11		
20:4($\Delta^{5,8,11,14}$)	$CH_3(CH_2)_4CH{=}CHCH_2CH{=}CHCH_2CH{=}CHCH_2CH{=}CH(CH_2)_3COOH$	*cis*-,*cis*-,*cis*-,*cis*-5,8,11,14-Icosatetraenoic acid	Arachidonic acid	−49.5		

Carboxyl group

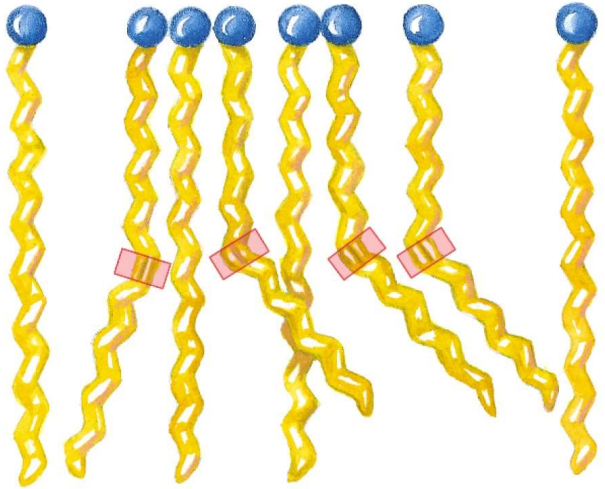
Hydrocarbon chain





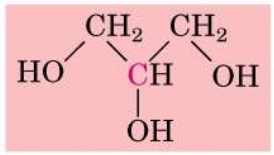


Saturated fatty acids

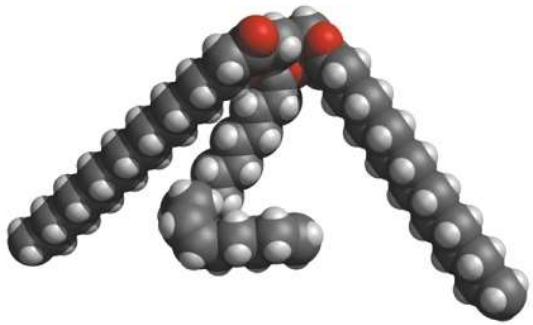


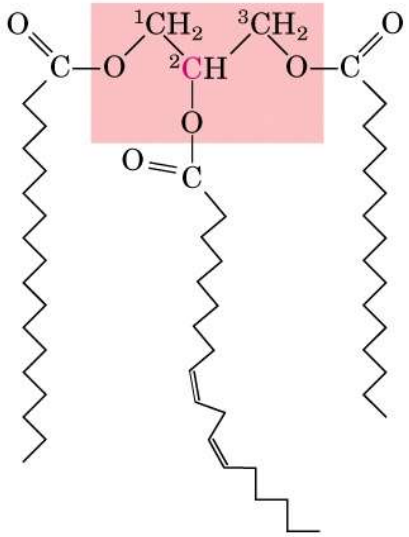
Mixture of saturated and unsaturated fatty acids

Triacilgliceróis



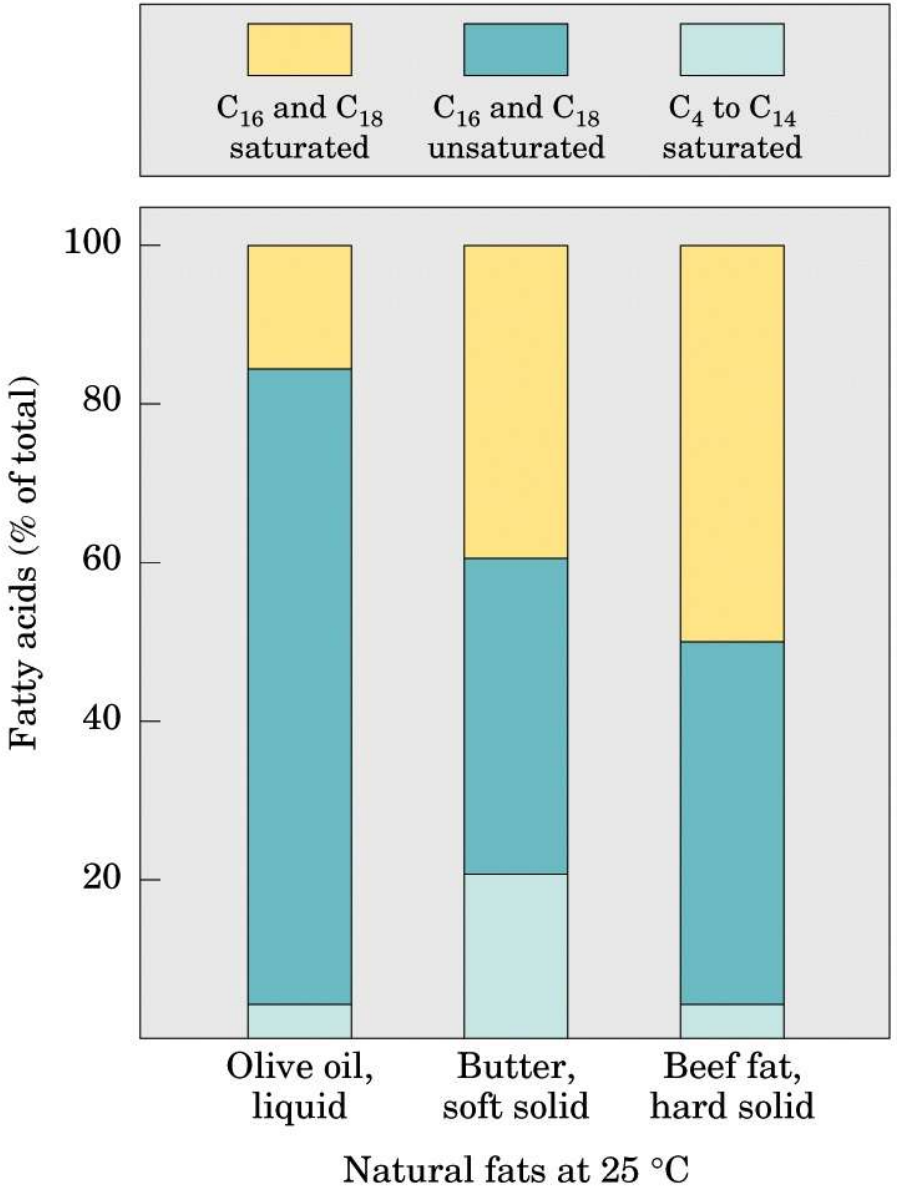
Glycerol



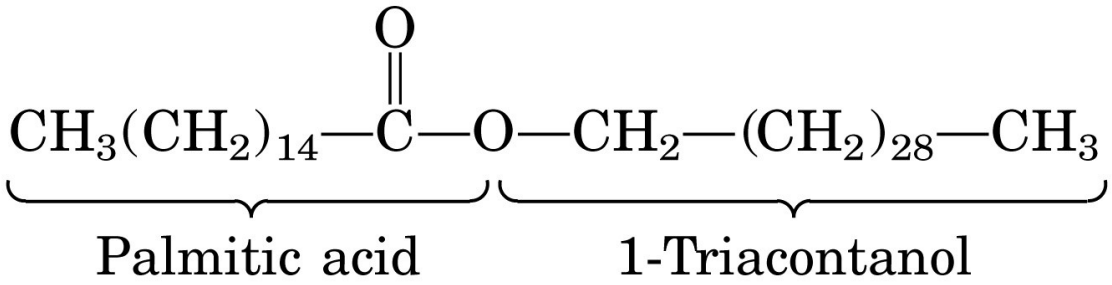


1-Stearoyl, 2-linoleoyl, 3-palmitoyl glycerol,
a mixed triacylglycerol

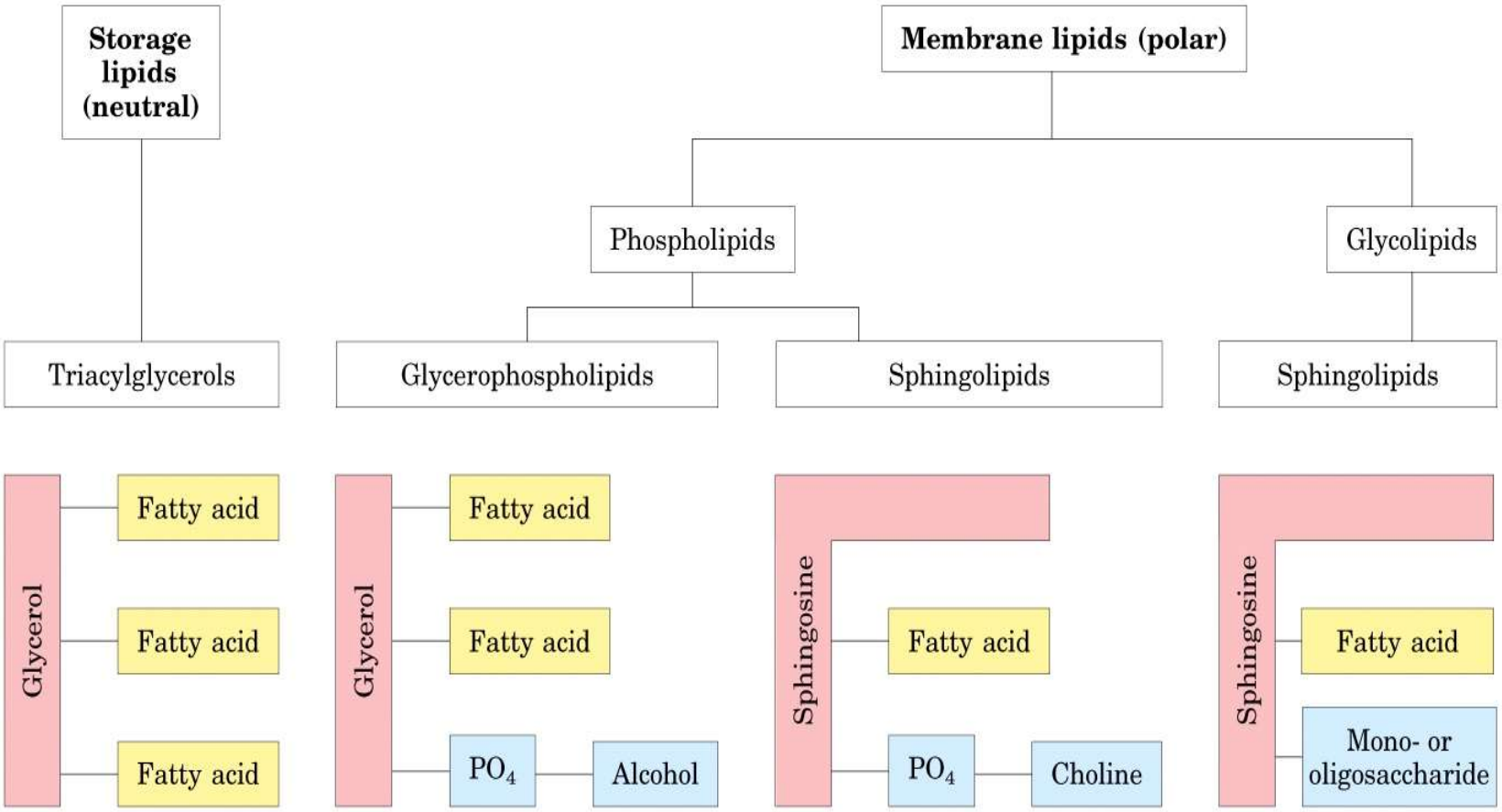
Composição de ácidos graxos



Ceras

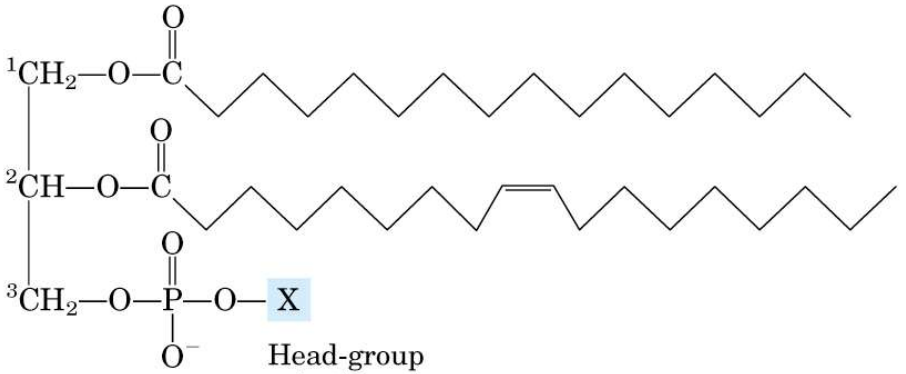


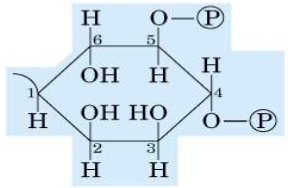
LIPÍDEOS ESTRUTURAIS DE MEMBRANA



GLICEROFOSFOLIPÍDEO

Glycerophospholipid (general structure)

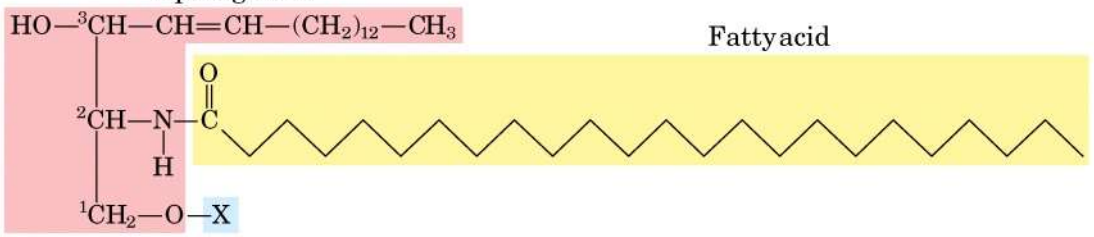


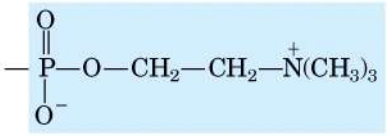
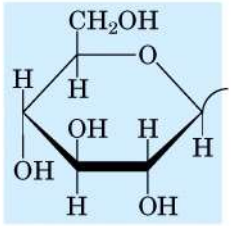
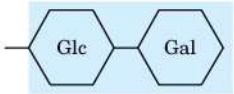
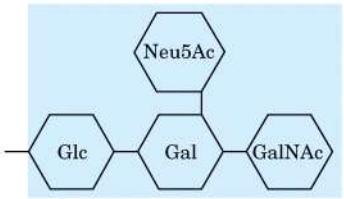
Name of glycerophospholipid	Name of X	Formula of X	Net charge (at pH 7)
Phosphatidic acid	—	— H	−1
Phosphatidylethanolamine	Ethanolamine	— $CH_2—CH_2—\overset{+}{N}H_3$	0
Phosphatidylcholine	Choline	— $CH_2—CH_2—\overset{+}{N}(CH_3)_3$	0
Phosphatidylserine	Serine	— $CH_2—CH(COO^-)—\overset{+}{N}H_3$	−1
Phosphatidylglycerol	Glycerol	— $CH_2—CH(OH)—CH_2—OH$	−1
Phosphatidylinositol 4,5-bisphosphate	*myo*-Inositol 4,5-bisphosphate		−4
Cardiolipin	Phosphatidyl-glycerol	— CH_2, $CHOH$, $CH_2—O—P(O^-)—O—CH_2$, $CH—O—C(=O)—R^1$, $CH_2—O—C(=O)—R^2$	−2

ESFINGOLIPÍDEOS

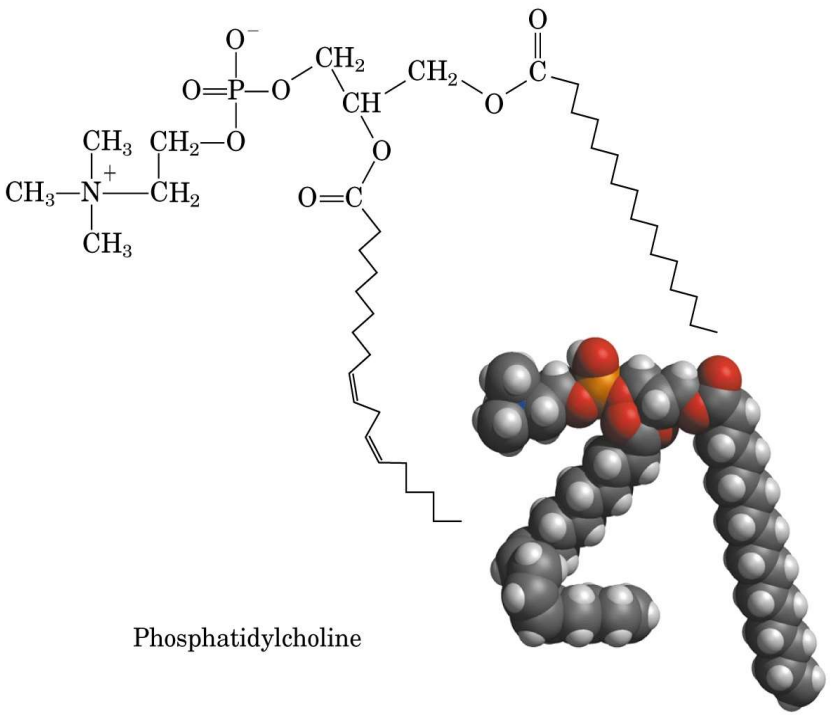
Sphingosine

Sphingolipid (general structure)

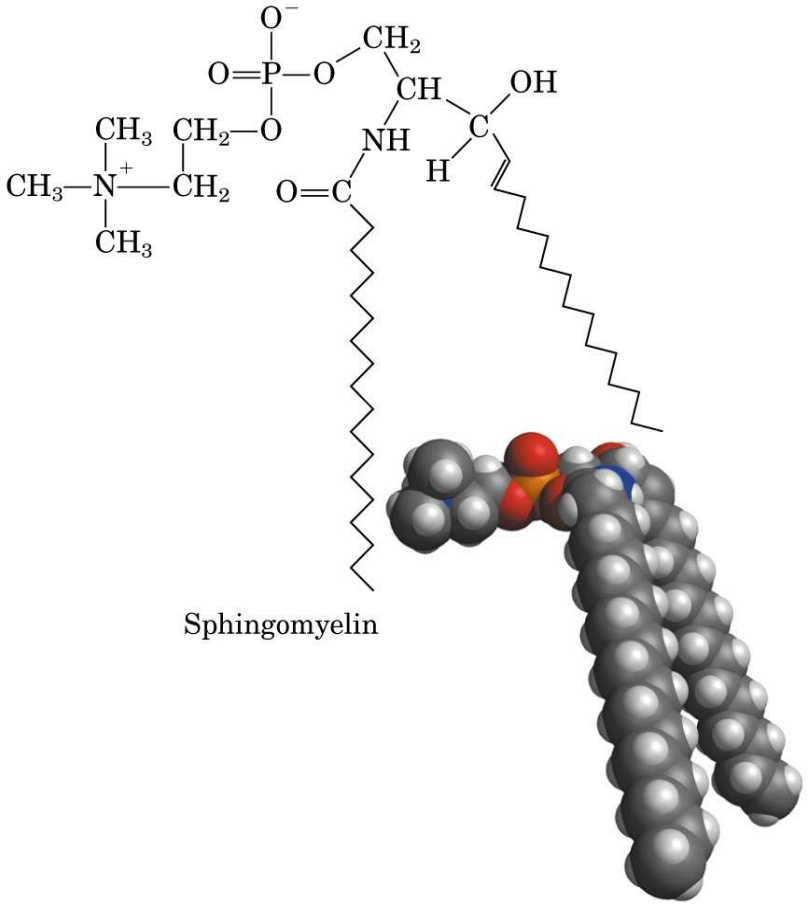


Name of sphingolipid	Name of X	Formula of X
Ceramide	—	—H
Sphingomyelin	Phosphocholine	
Neutral glycolipids Glucosylcerebroside	Glucose	
Lactosylceramide (a globoside)	Di-, tri-, or tetrasaccharide	
Ganglioside GM2	Complex oligosaccharide	

Estrutura molecular

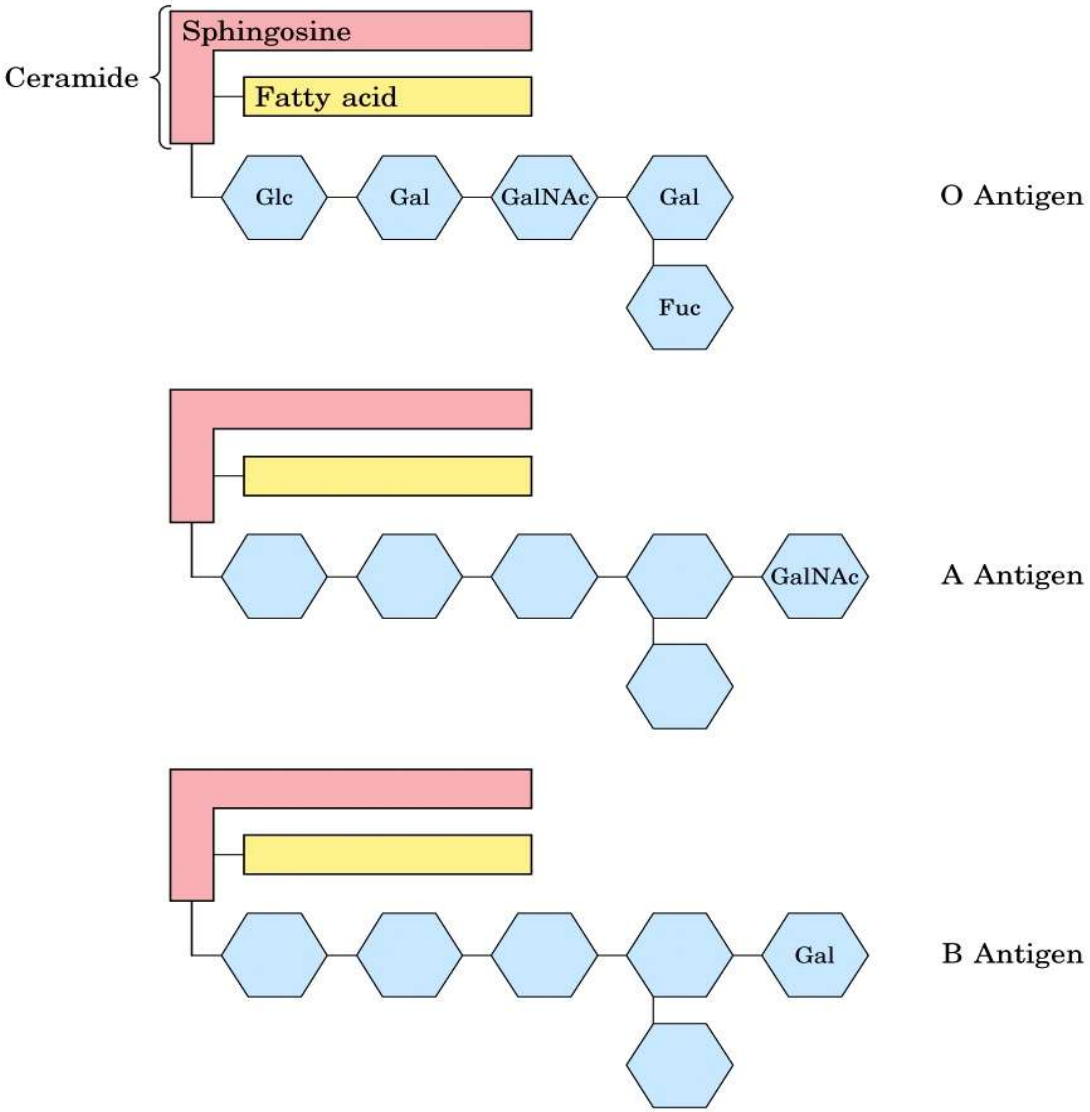


Phosphatidylcholine

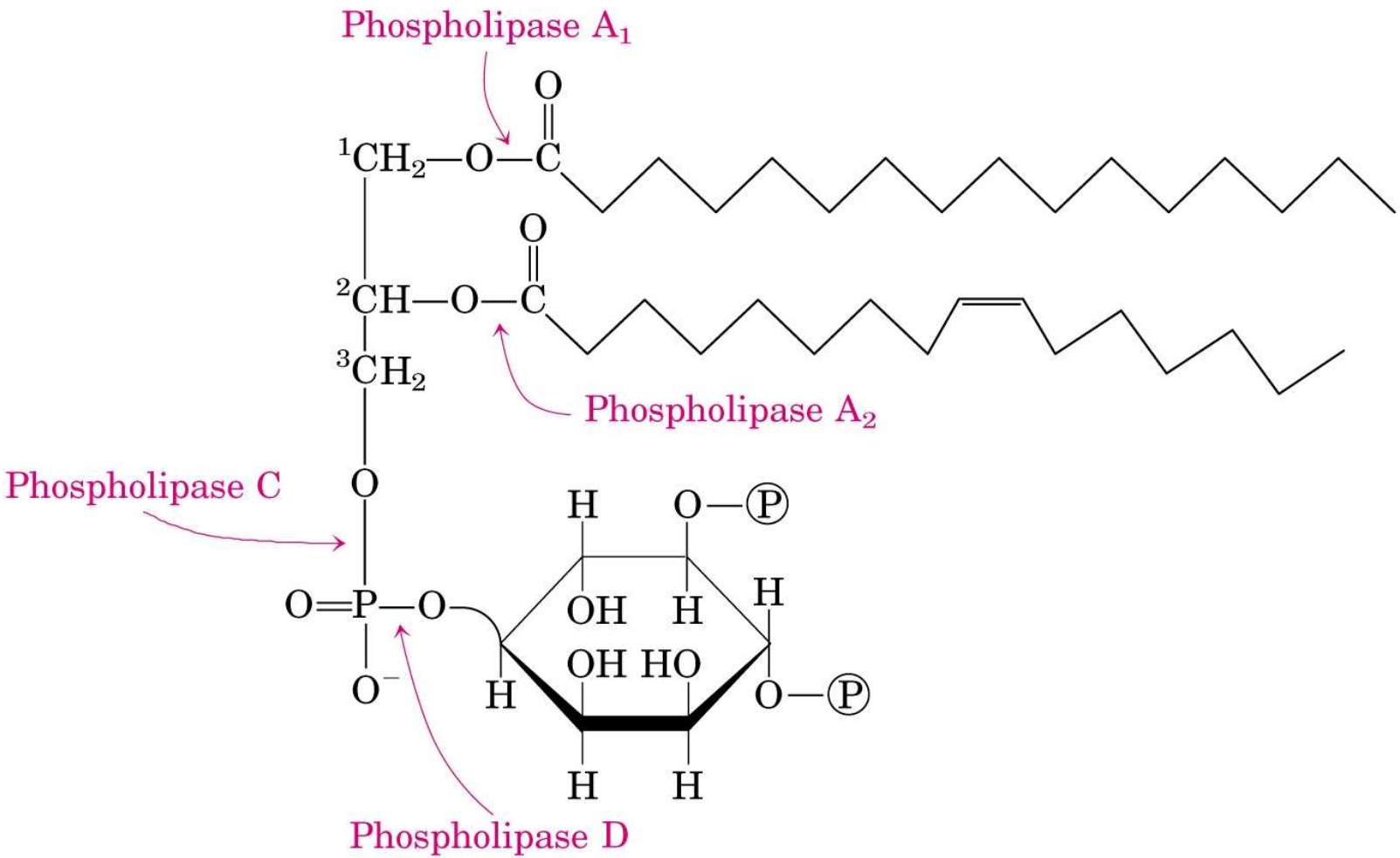


Sphingomyelin

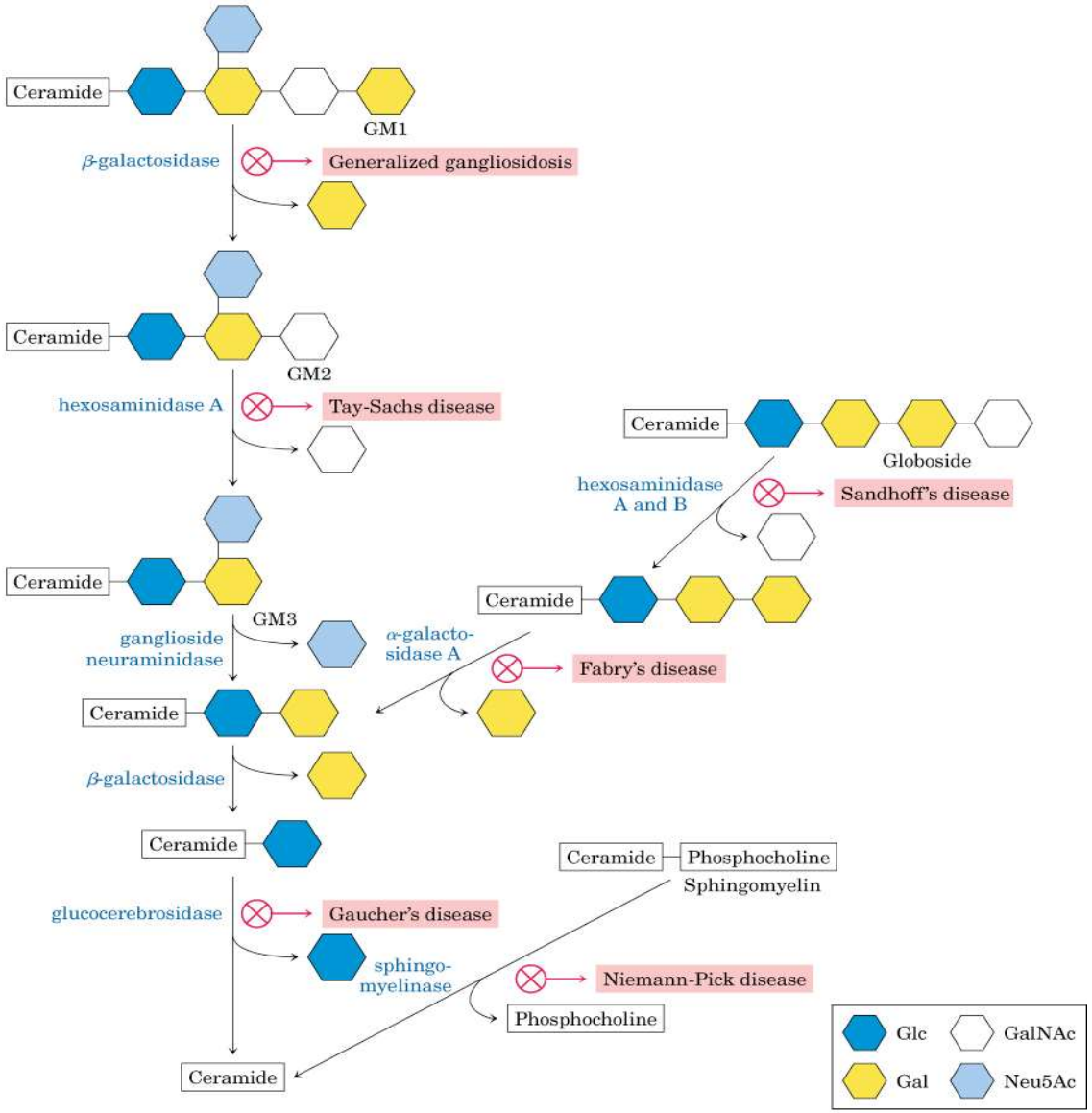
Determinantes de grupos sanguíneos



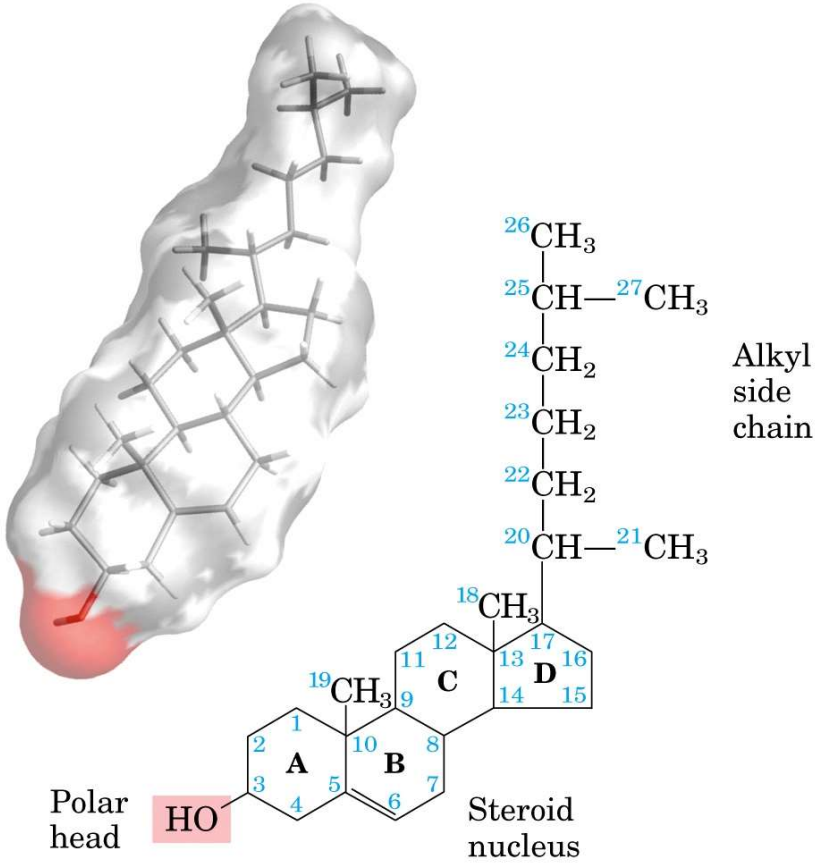
Degradação de lipídeos de membrana

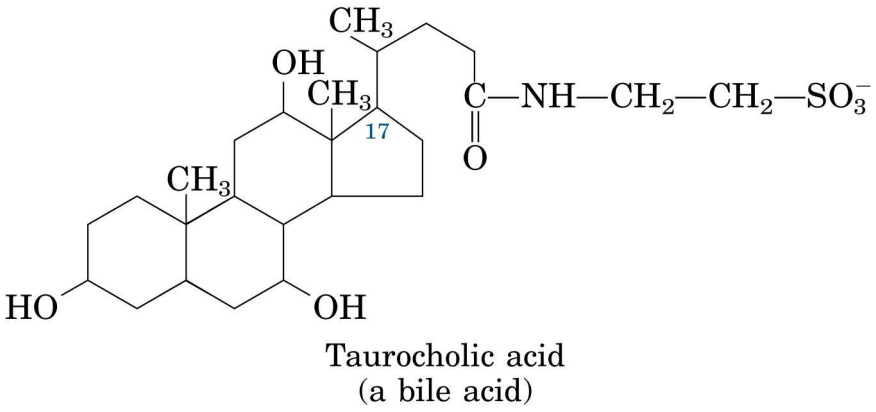


Degradação de esfingolipídeos

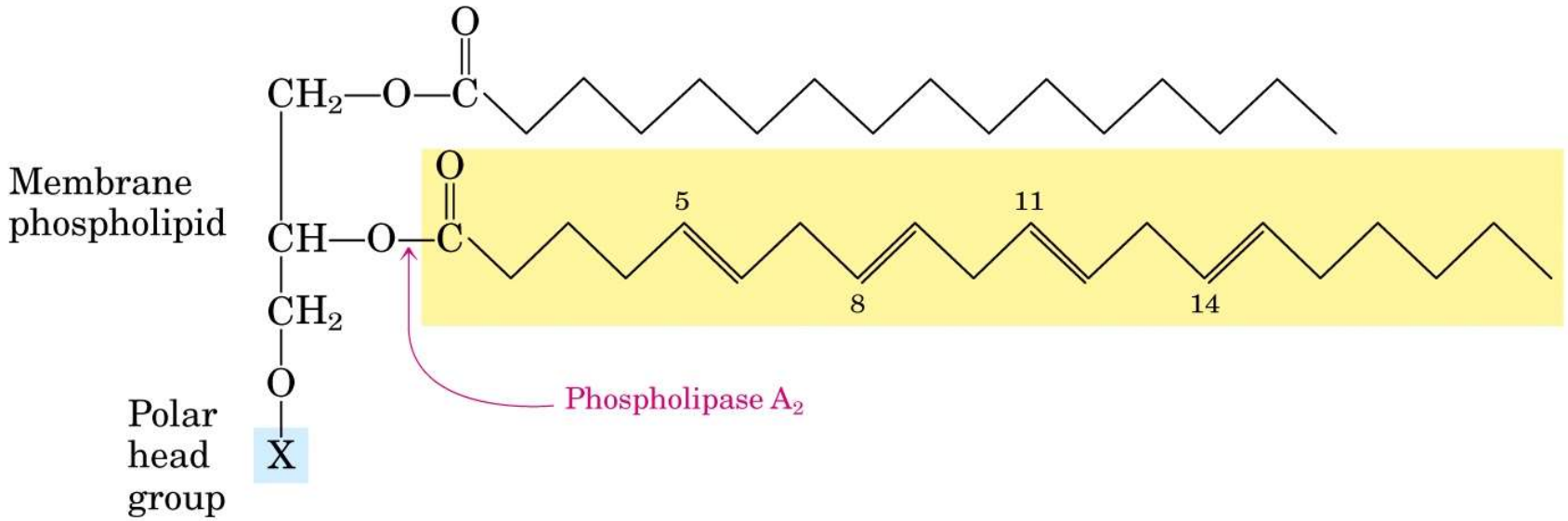


LIPÍDEOS COMO SINAIS E PIGMENTOS

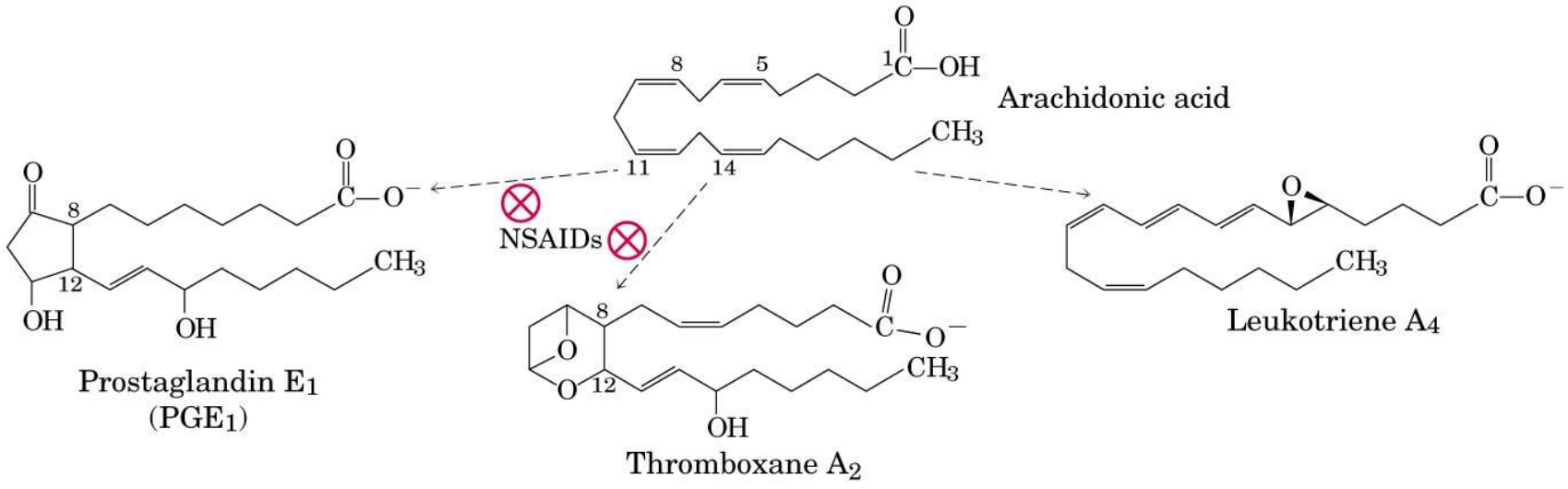




EICOSANÓIDES



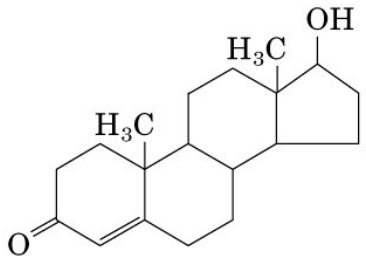
(a)



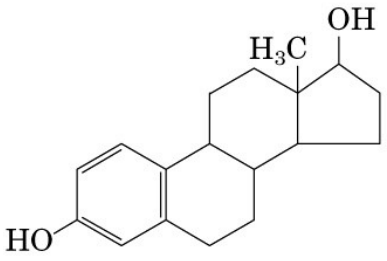
Eicosanoids

(b)

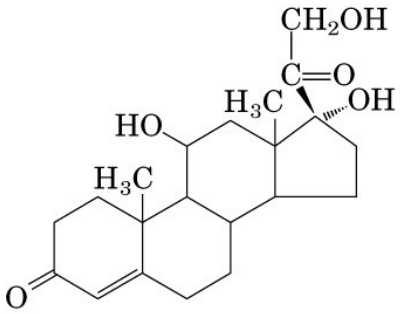
Hormônios derivados do colesterol



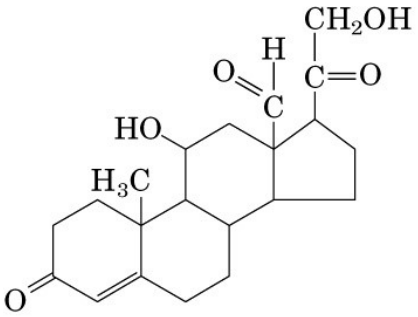
Testosterone



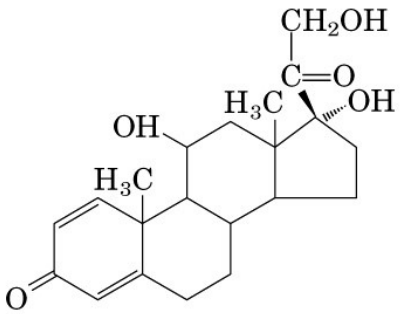
Estradiol



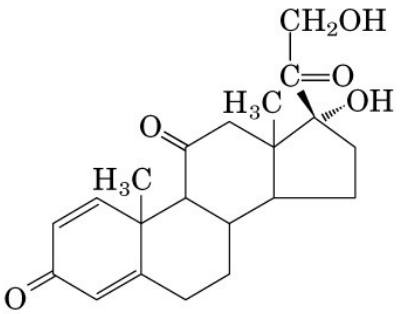
Cortisol



Aldosterone

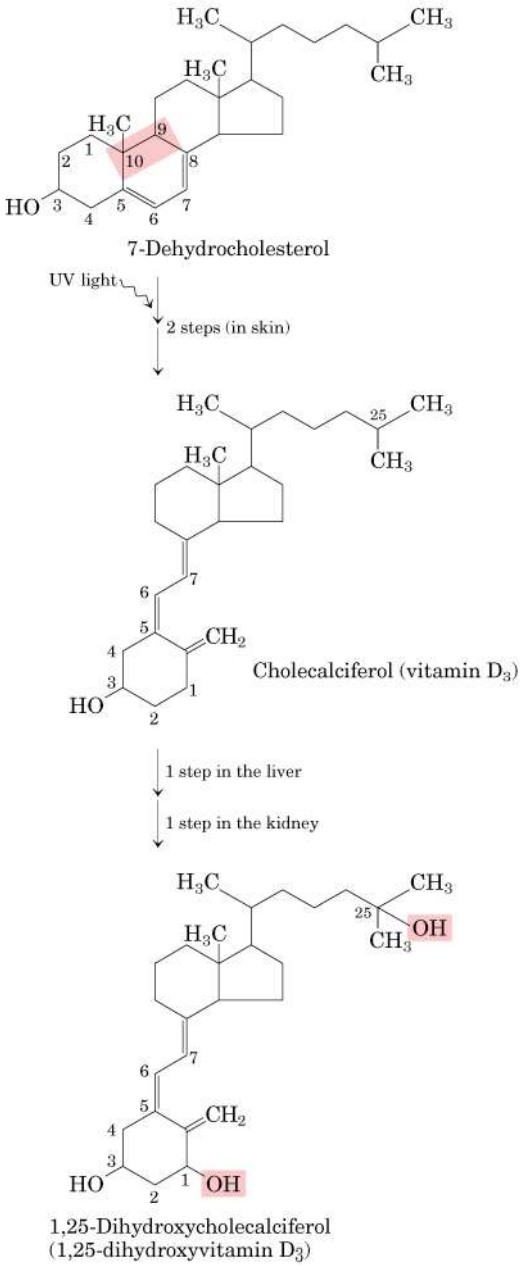


Prednisolone



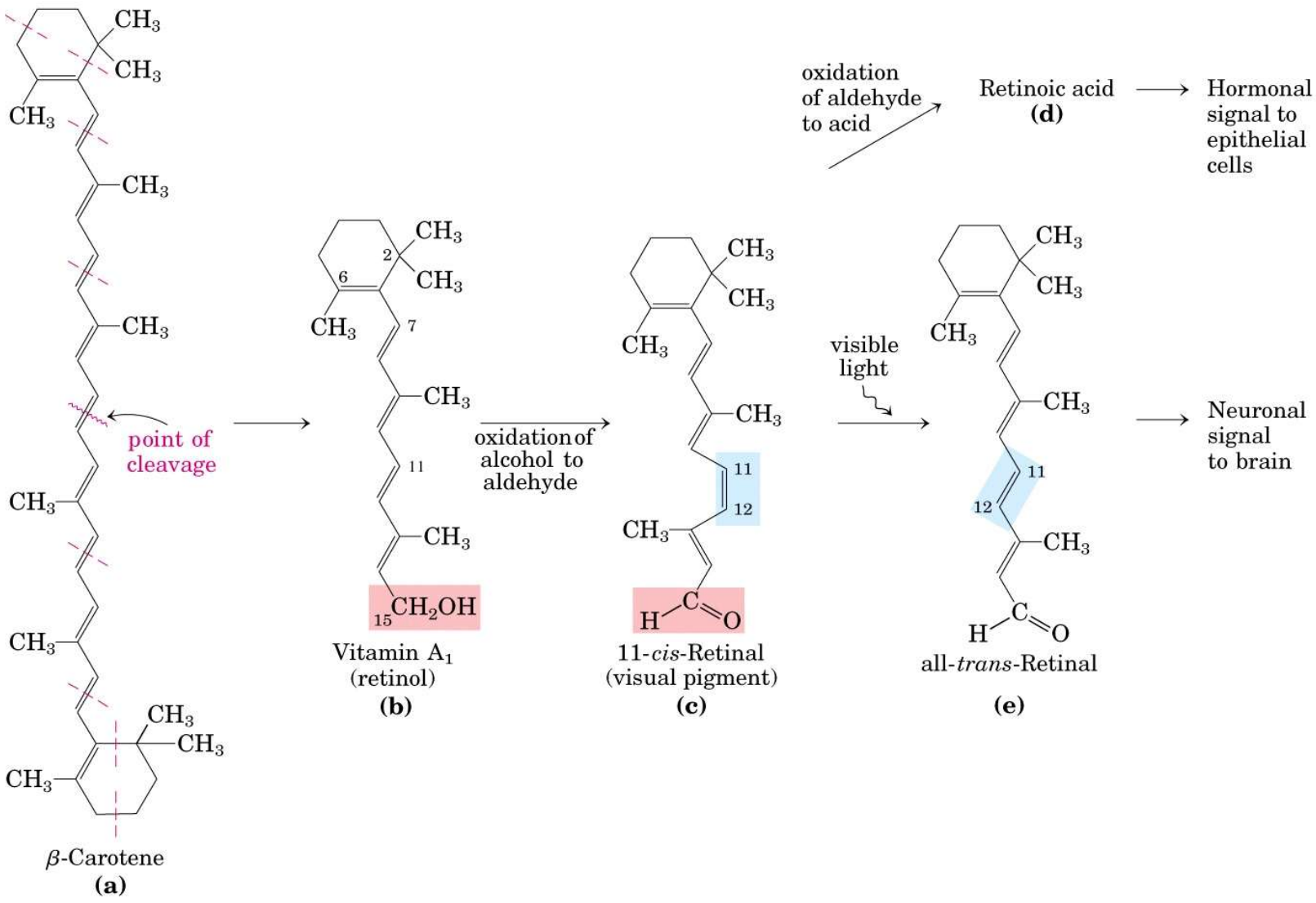
Prednisone

Vitamina D

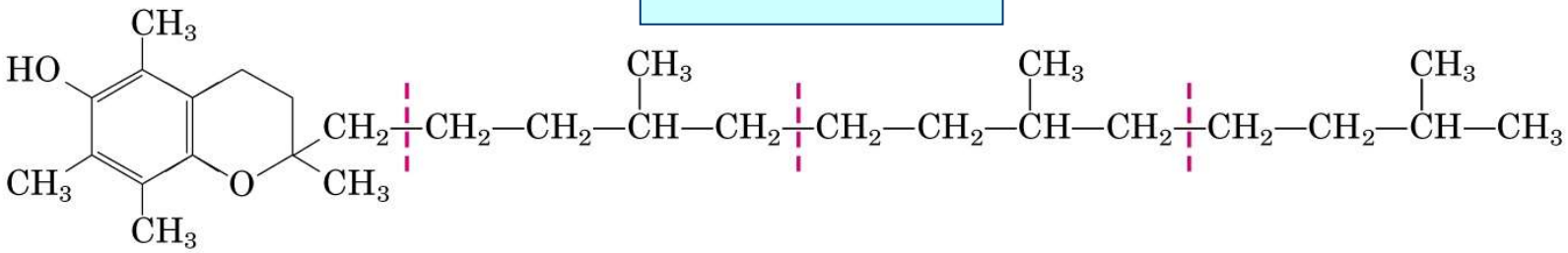

7-Dehydrocholesterol
UV light
2 steps (in skin)
Cholecalciferol (vitamin D3)
1 step in the liver
1 step in the kidney
1,25-Dihydroxycholecalciferol
(1,25-dihydroxyvitamin D3)

(a)

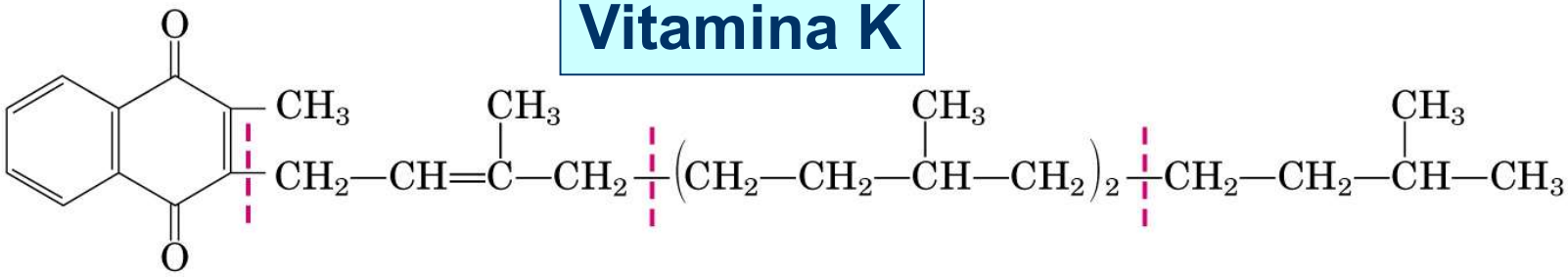
Vitamina A


point of cleavage
β-Carotene
(a)
Vitamin A1
(retinol)
(b)
oxidation of alcohol to aldehyde
11-cis-Retinal
(visual pigment)
(c)
oxidation of aldehyde to acid
Retinoic acid
(d)
Hormonal signal to epithelial cells
visible light
all-trans-Retinal
(e)
Neuronal signal to brain

Vitamina E

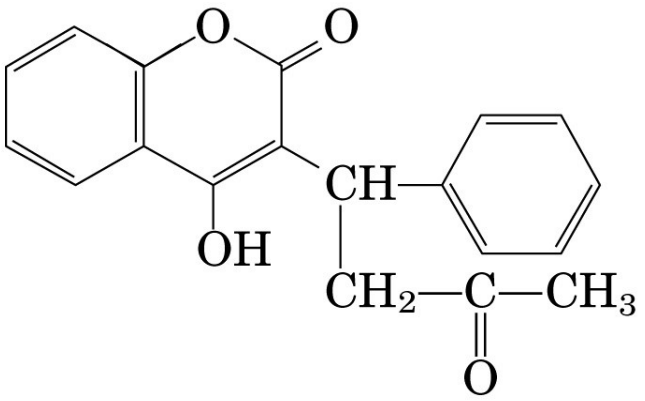


Vitamina K

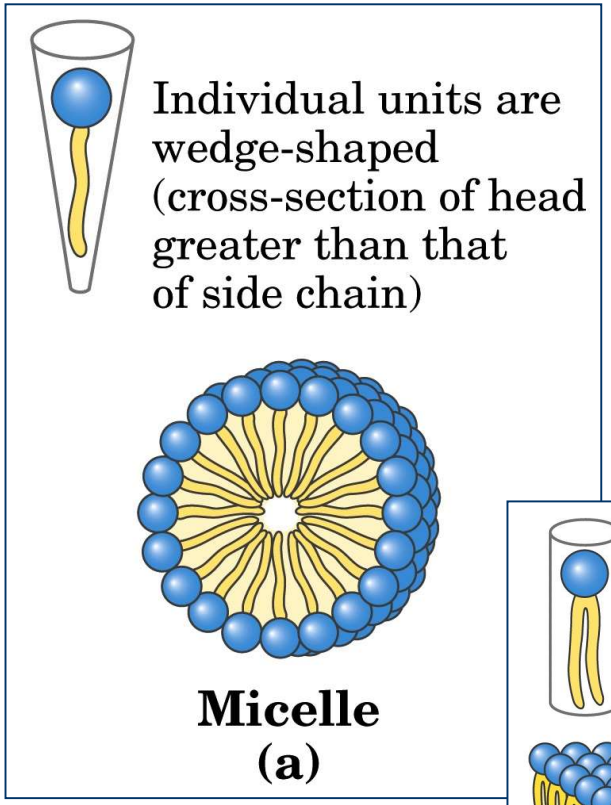


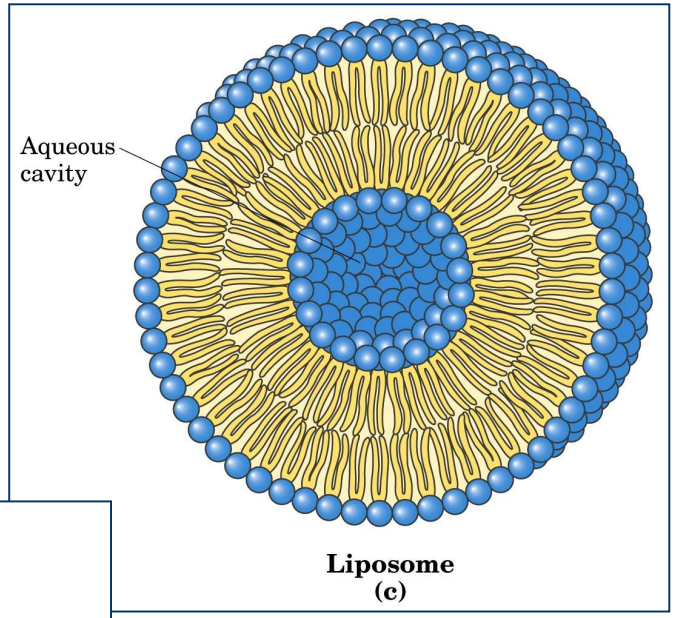
(c)

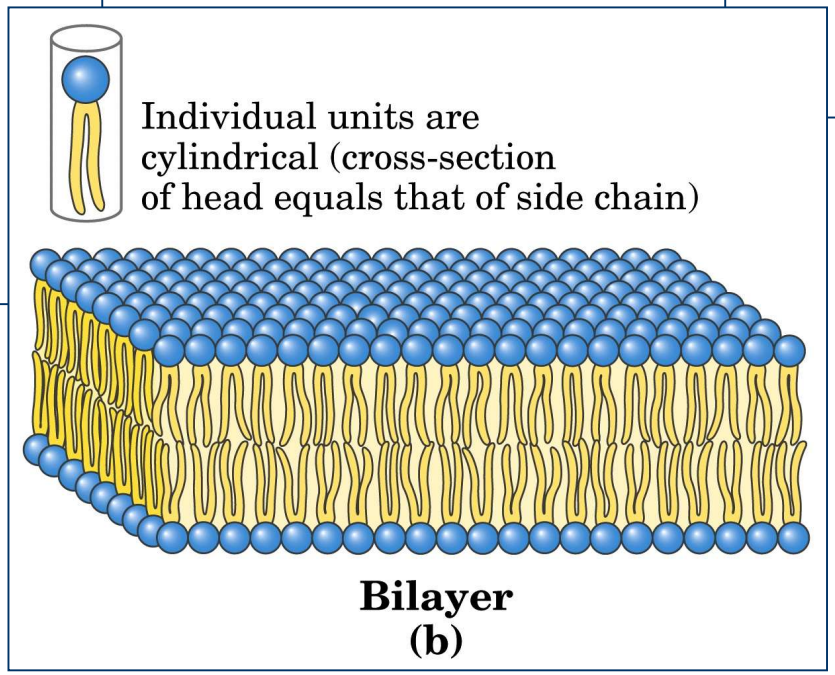
Warfarin: a blood anticoagulant



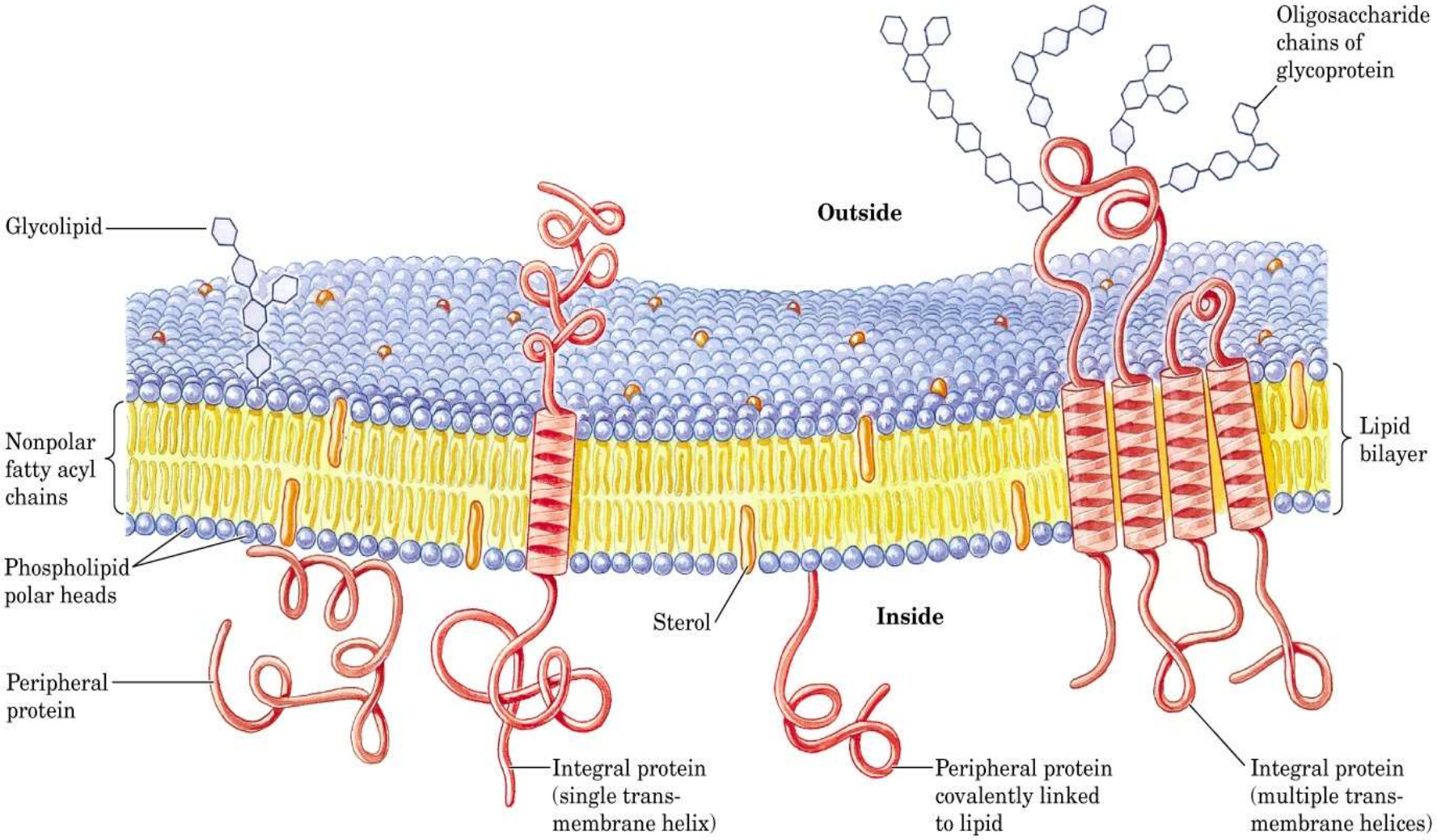
MEMBRANAS BIOLÓGICAS E TRANSPORTE



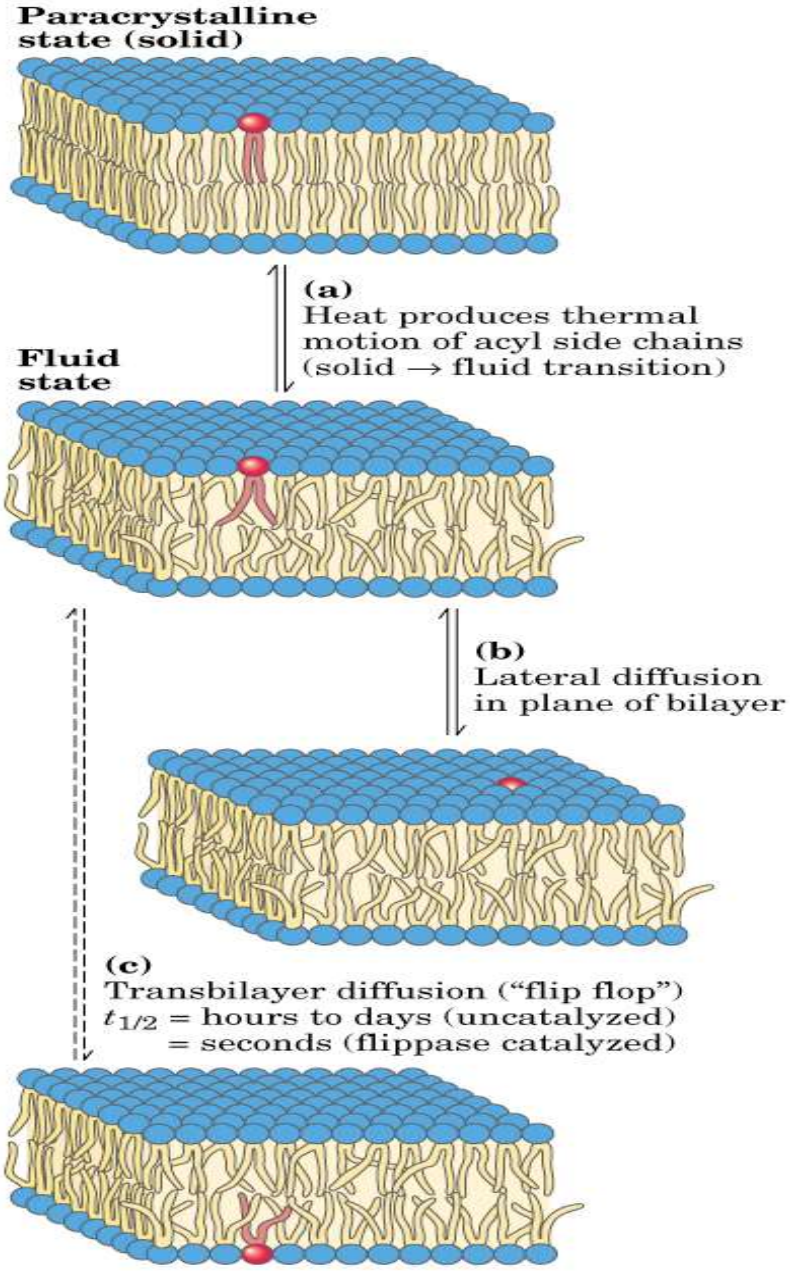




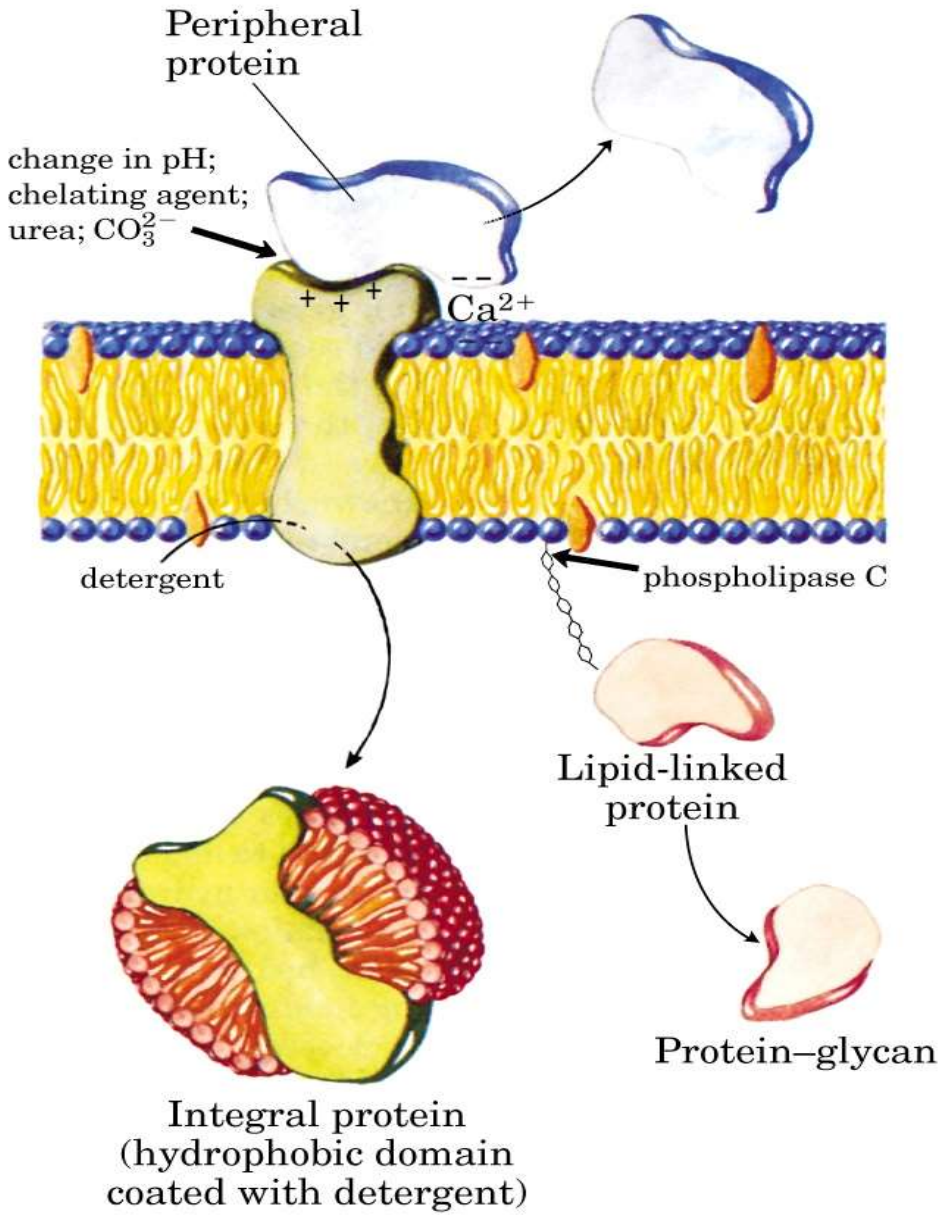
MODELO DO MOSÁICO FLUIDO



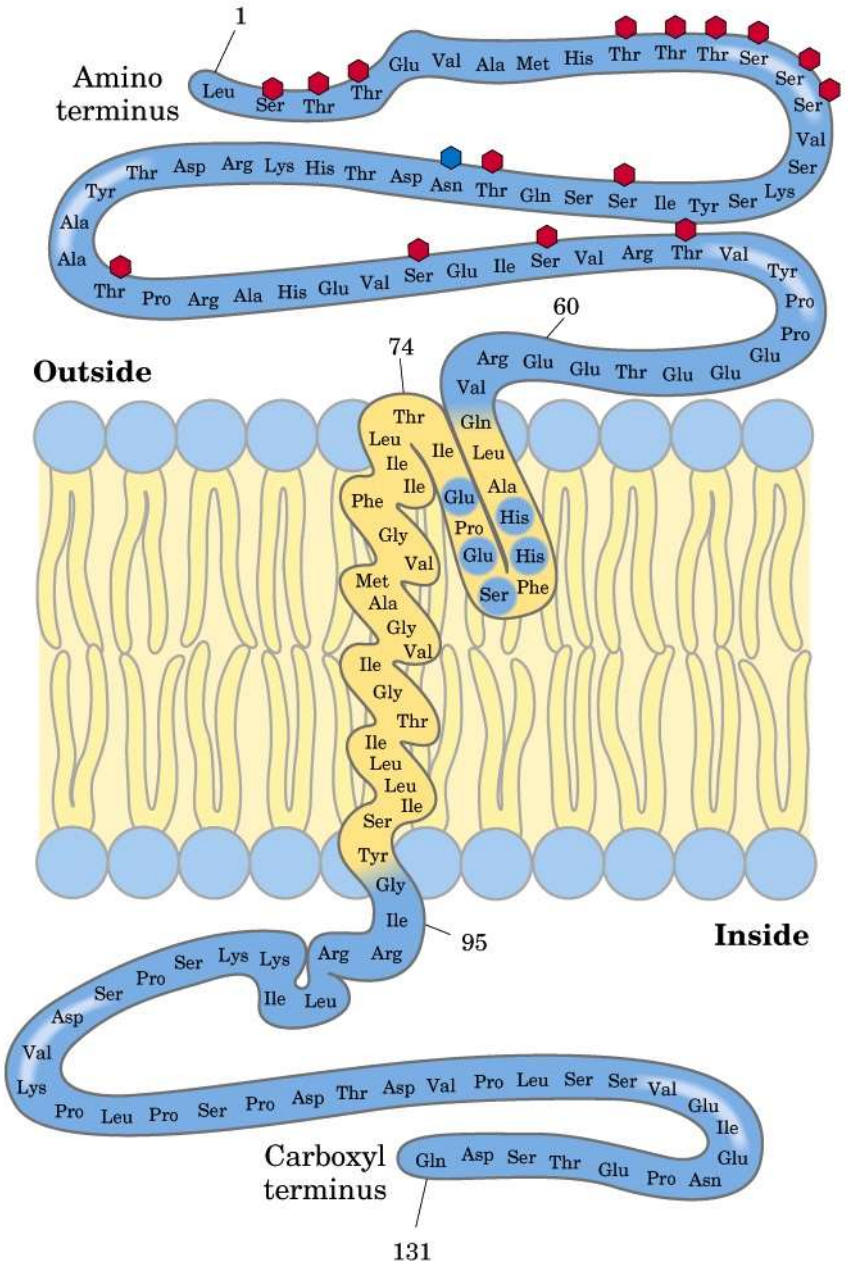
Movimentação dos lipídeos da membrana



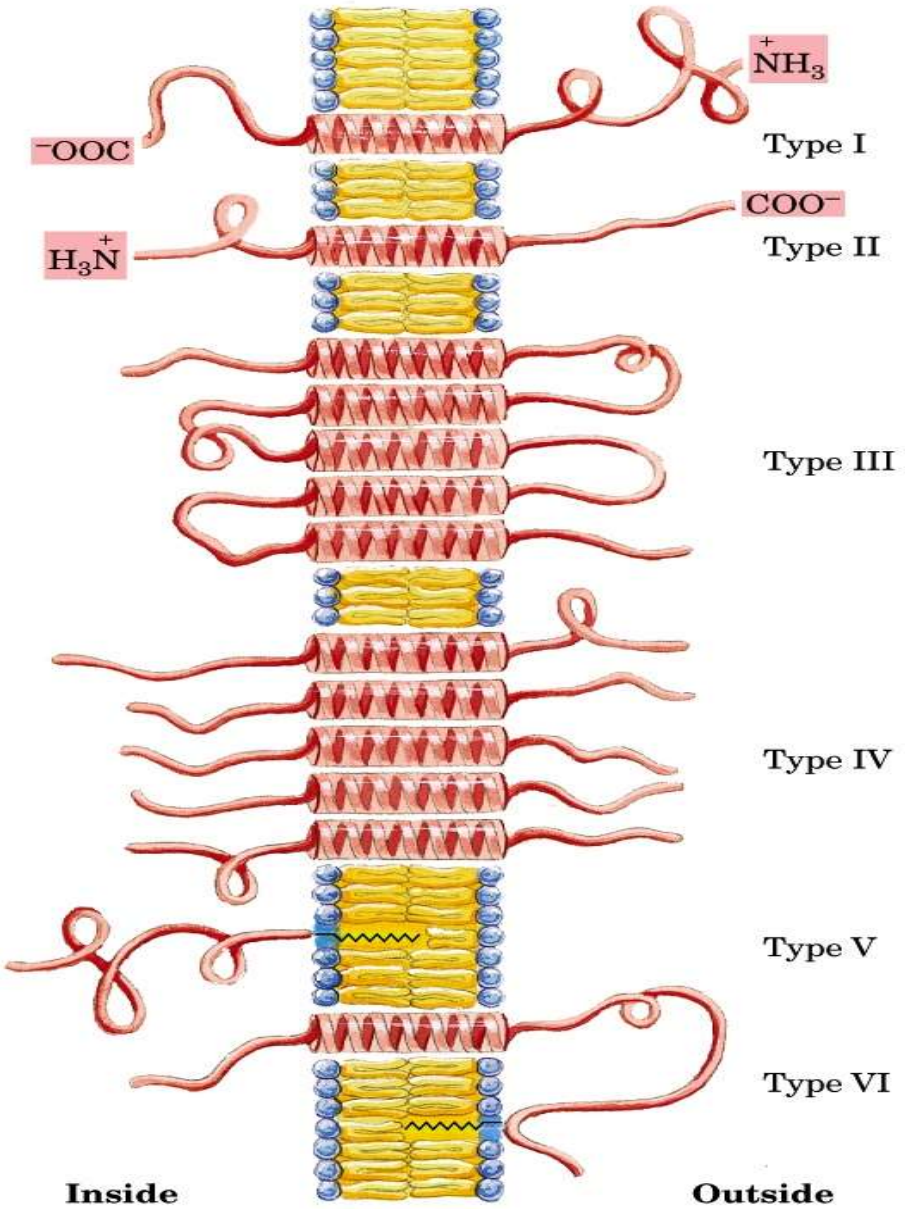
Proteínas integrais e periféricas



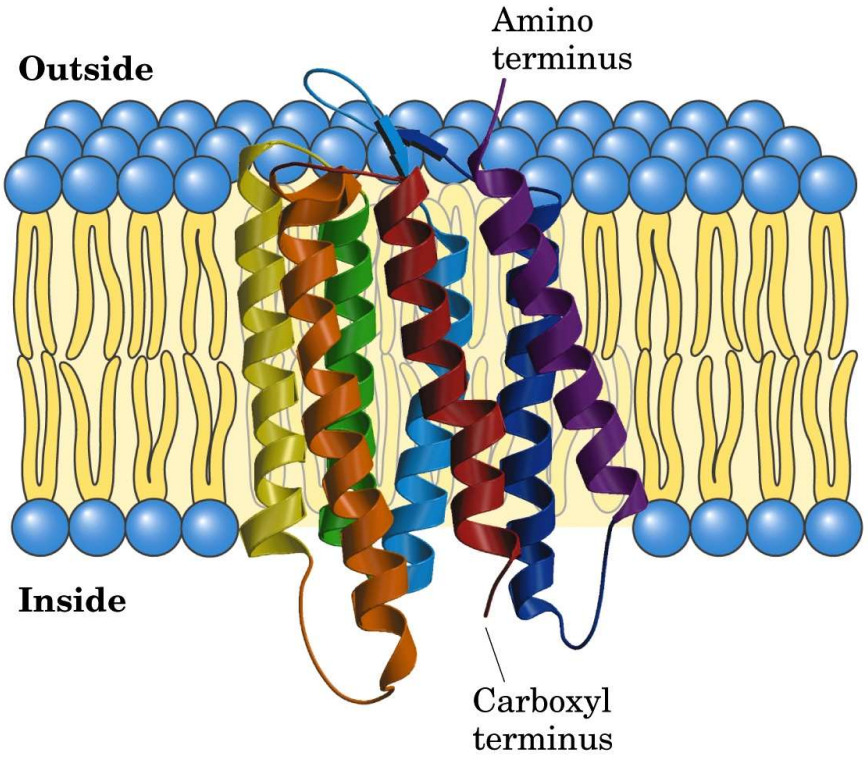
Proteínas integral (glicoforina)

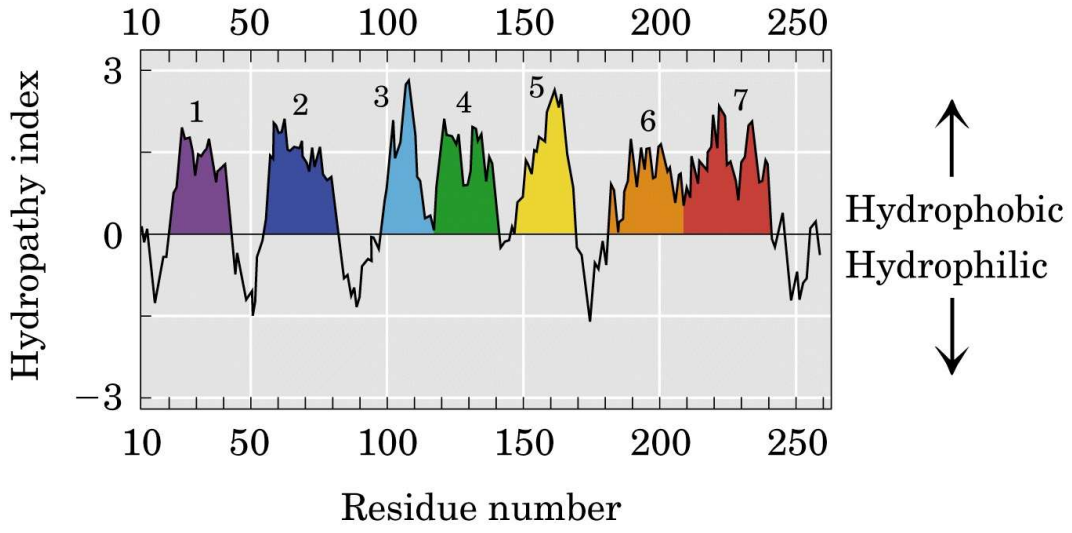


Tipos de proteínas integrais de membranas



Bacteriorrodopsina

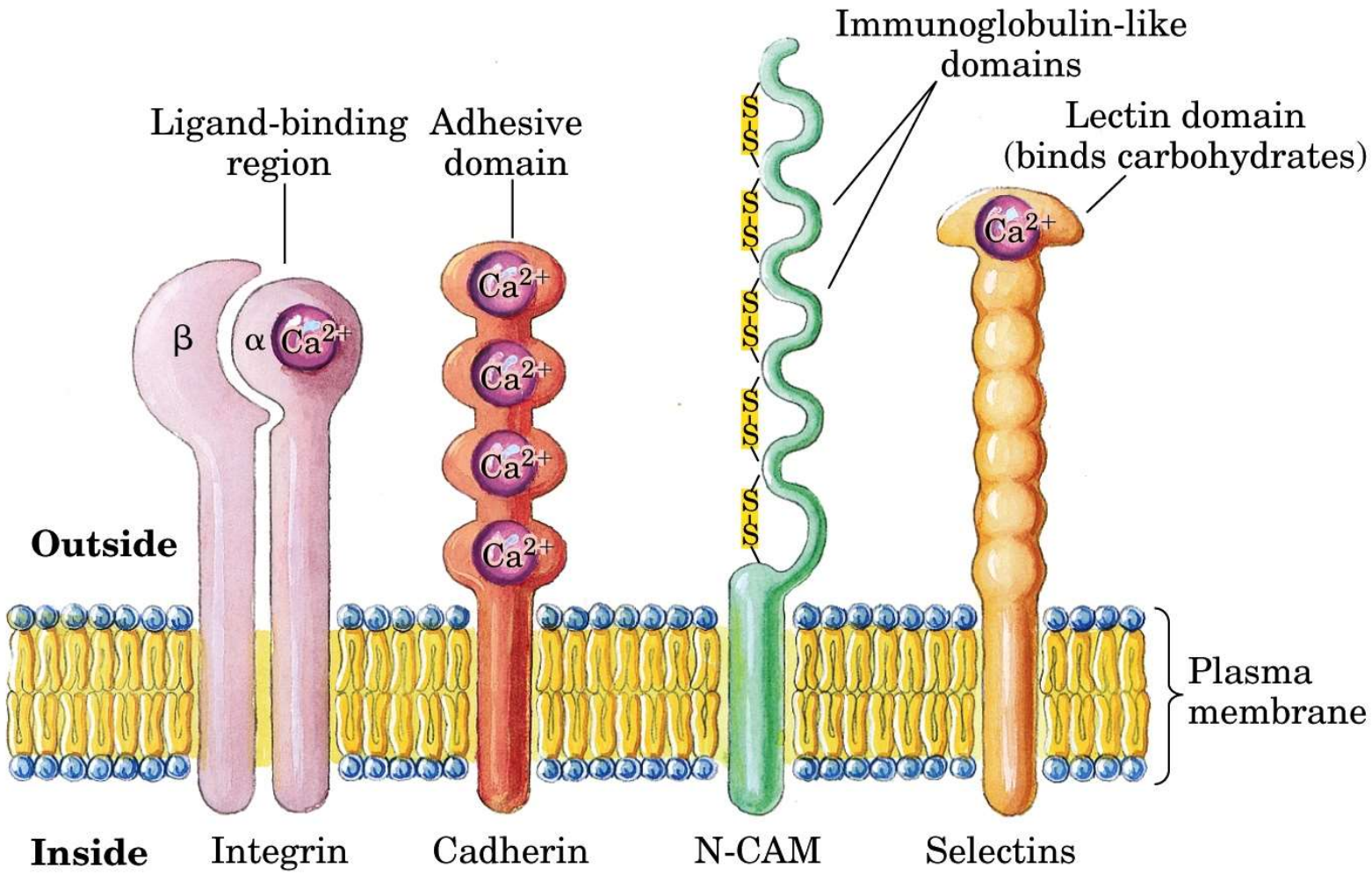




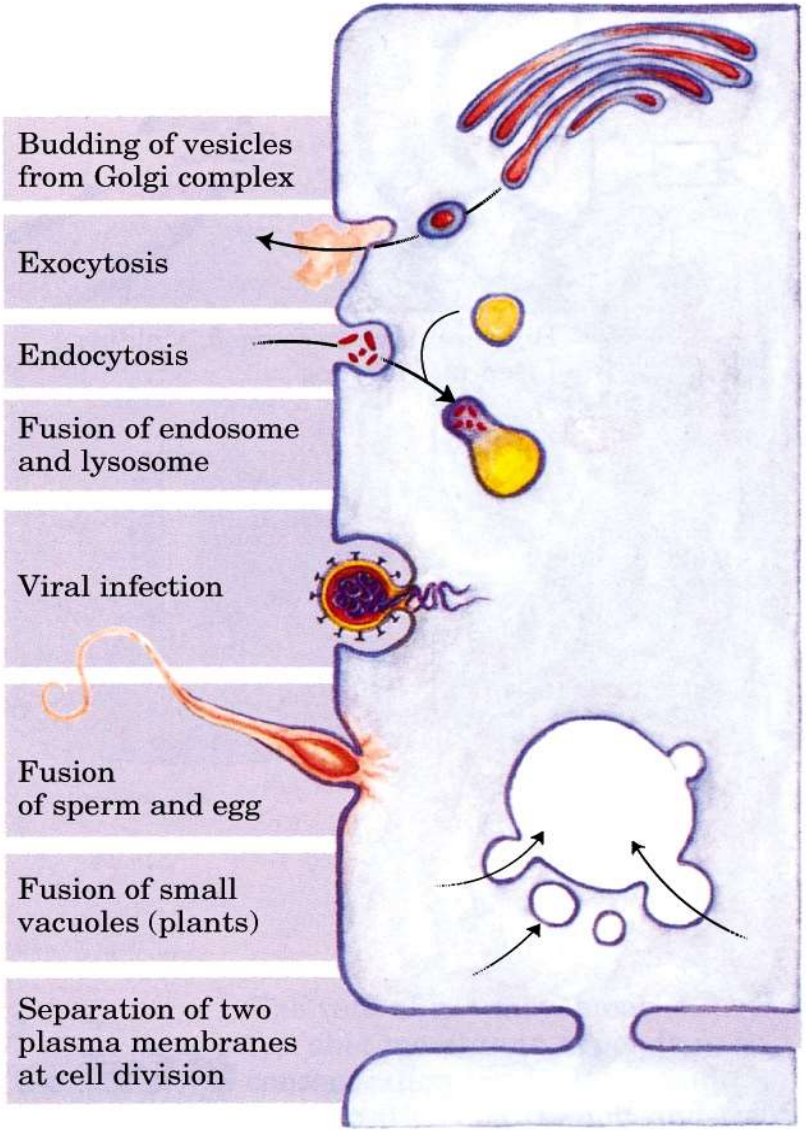
Bacteriorhodopsin

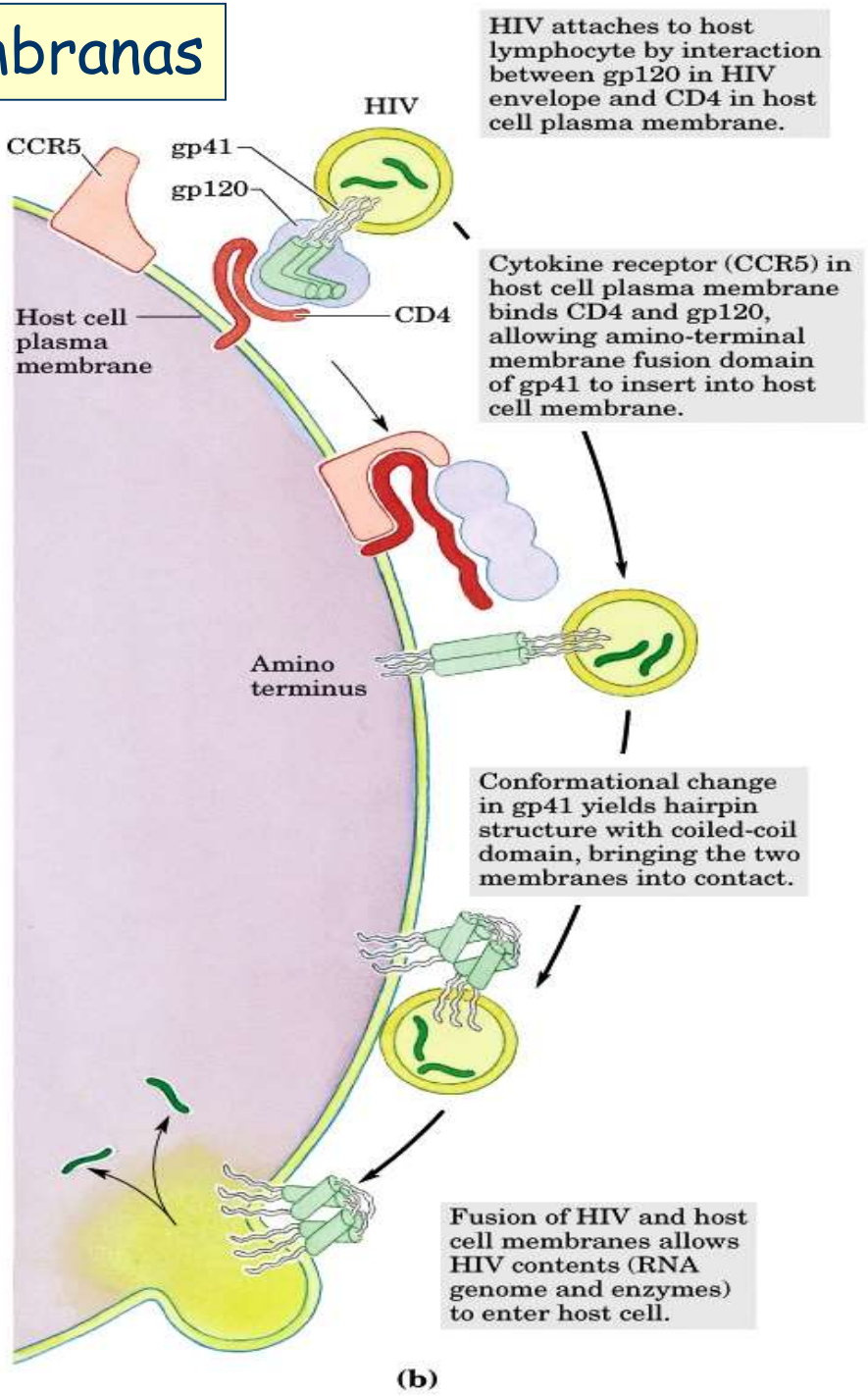
(b)

Proteínas envolvidas nas interações célula-célula

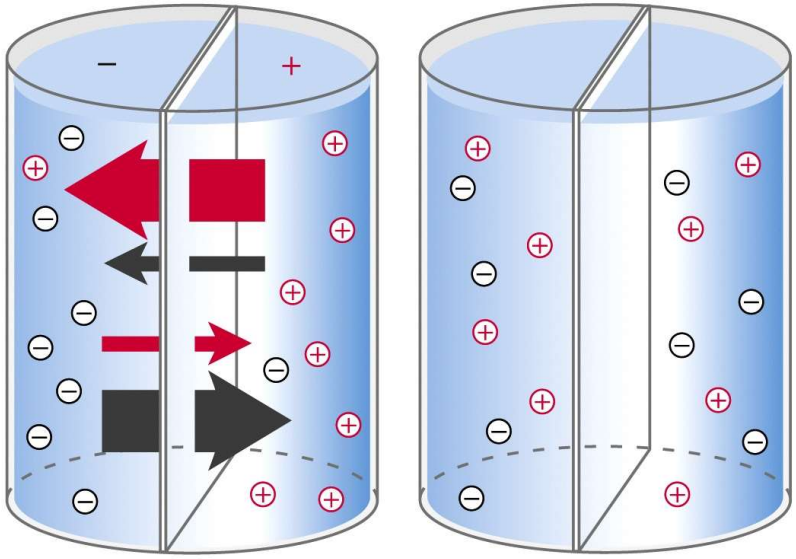


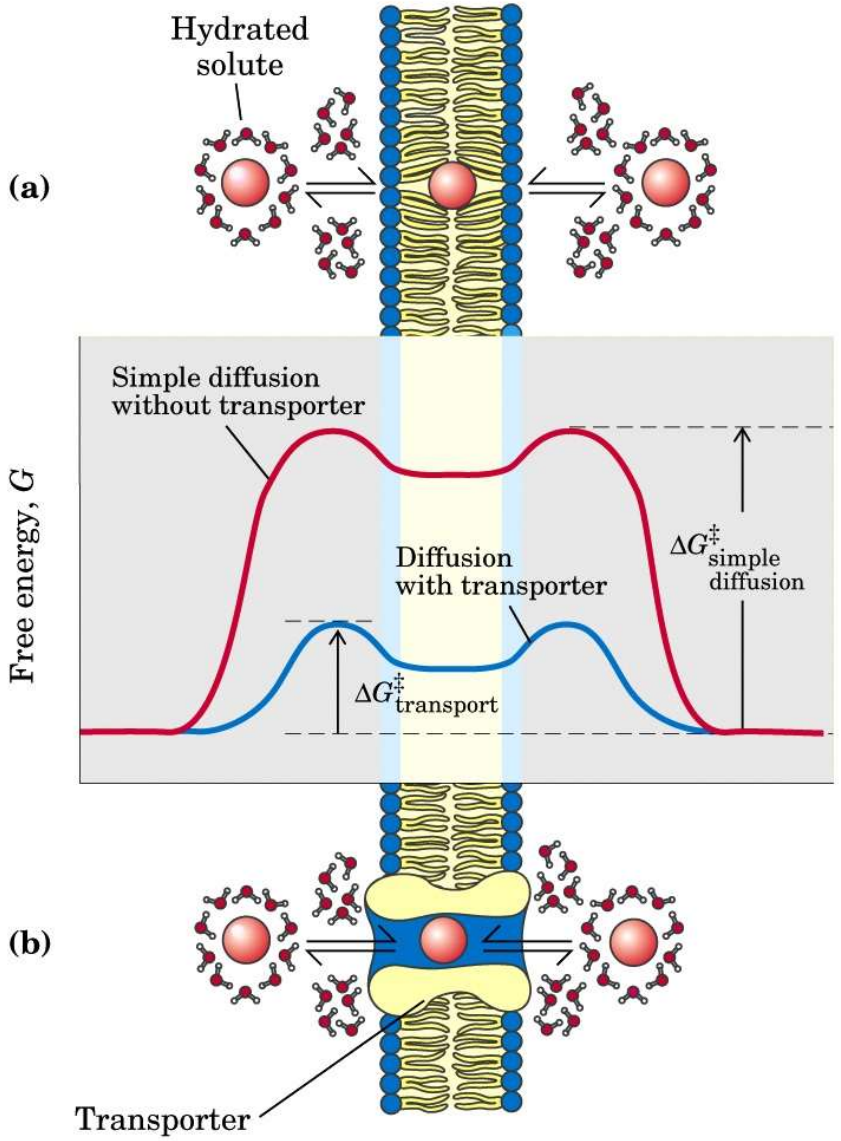
Fusão de membranas



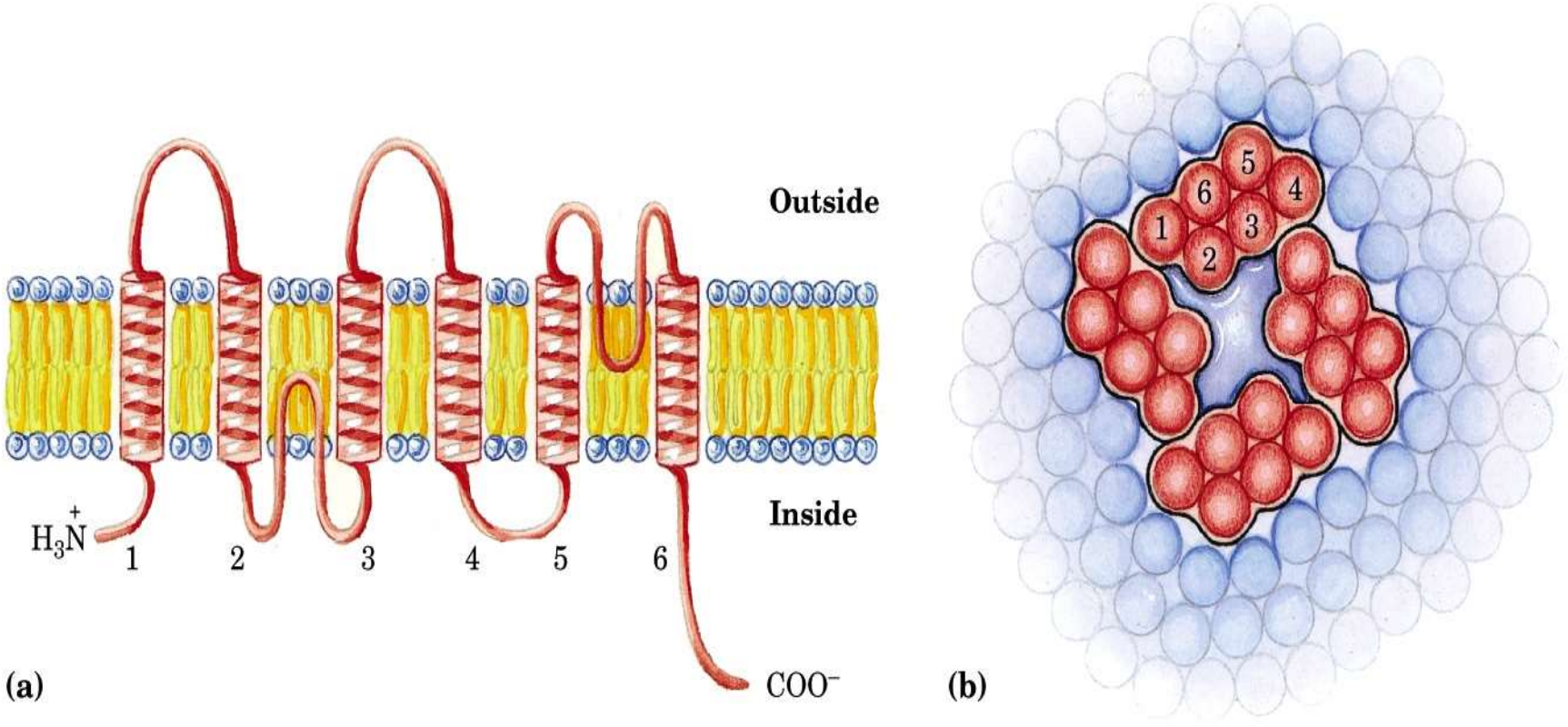


Transporte de solutos através de membranas

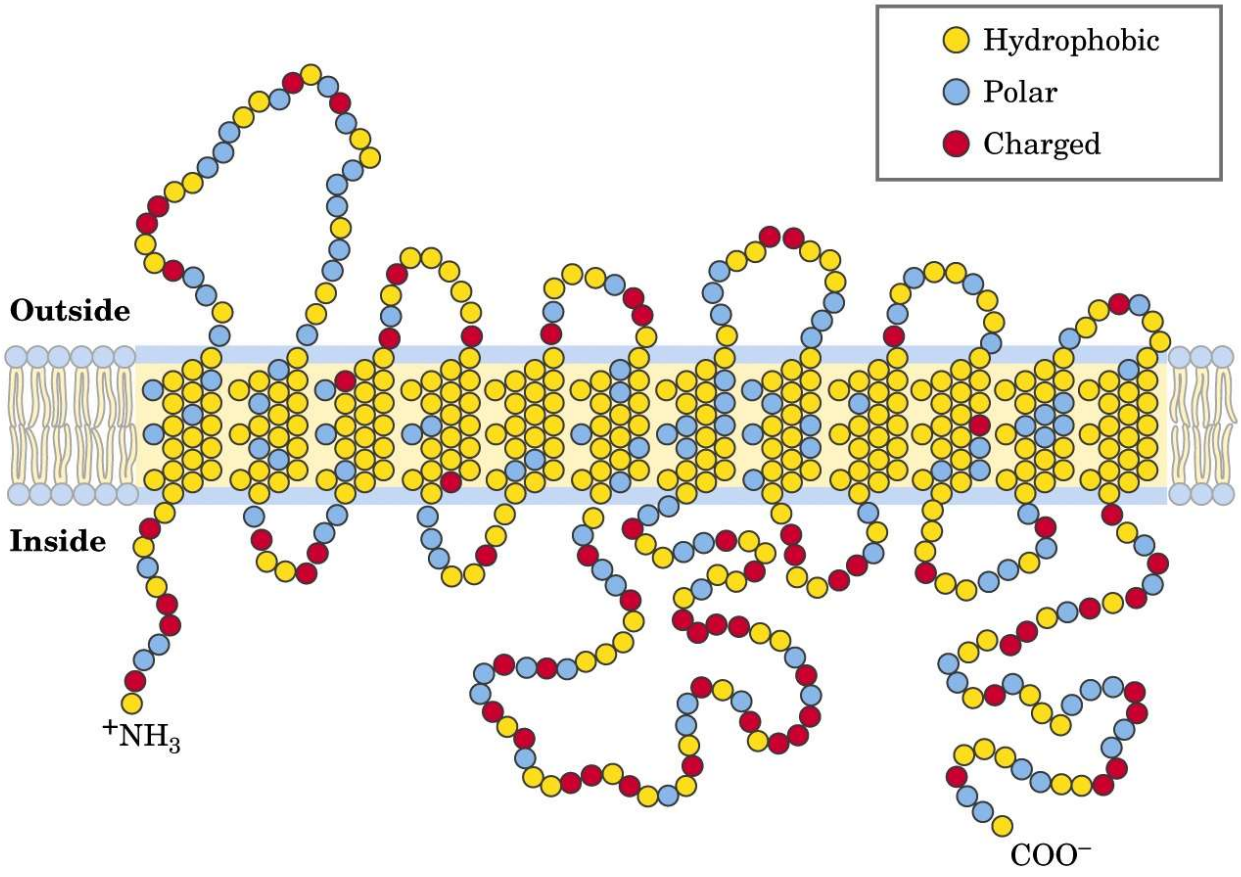




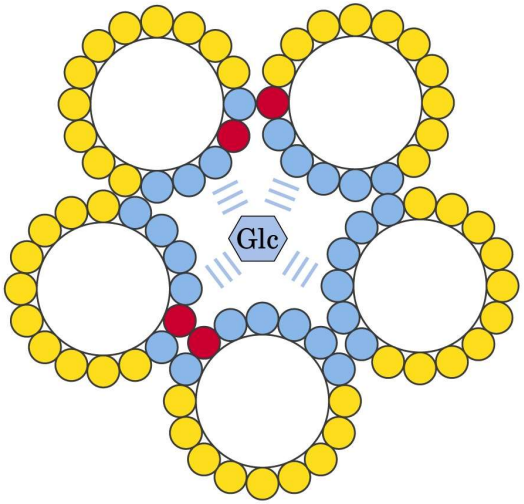
Aquaporinas (proteína transportadora de água)



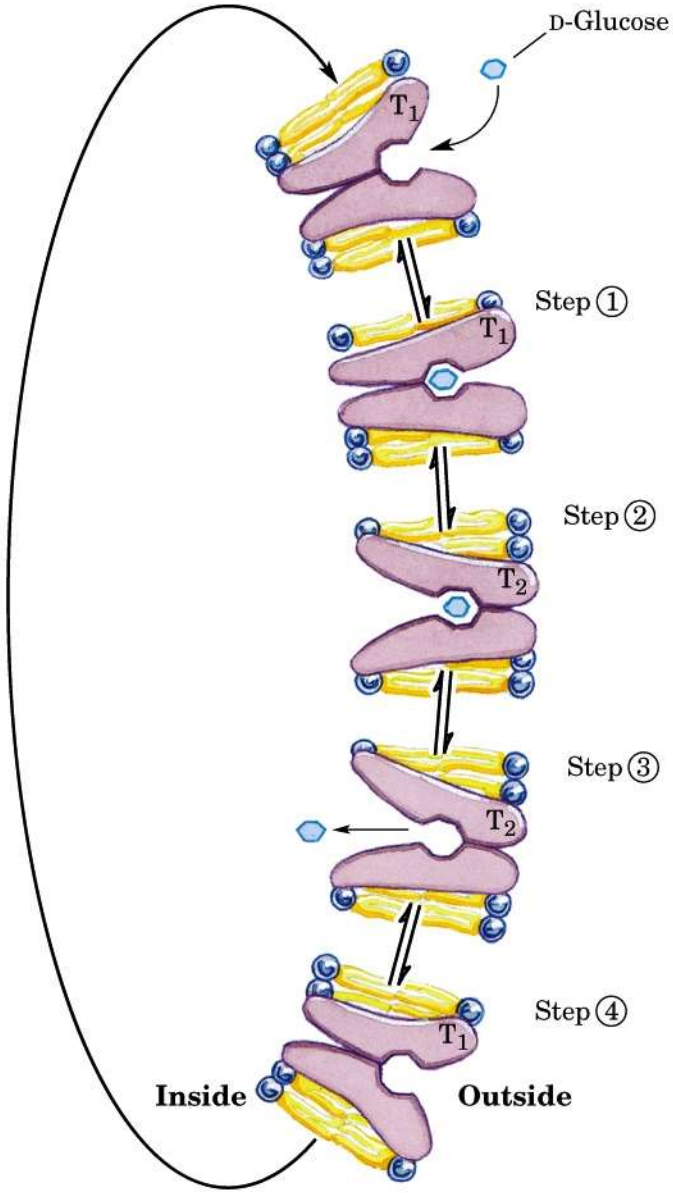
Transportador de glicose nos eritrócitos



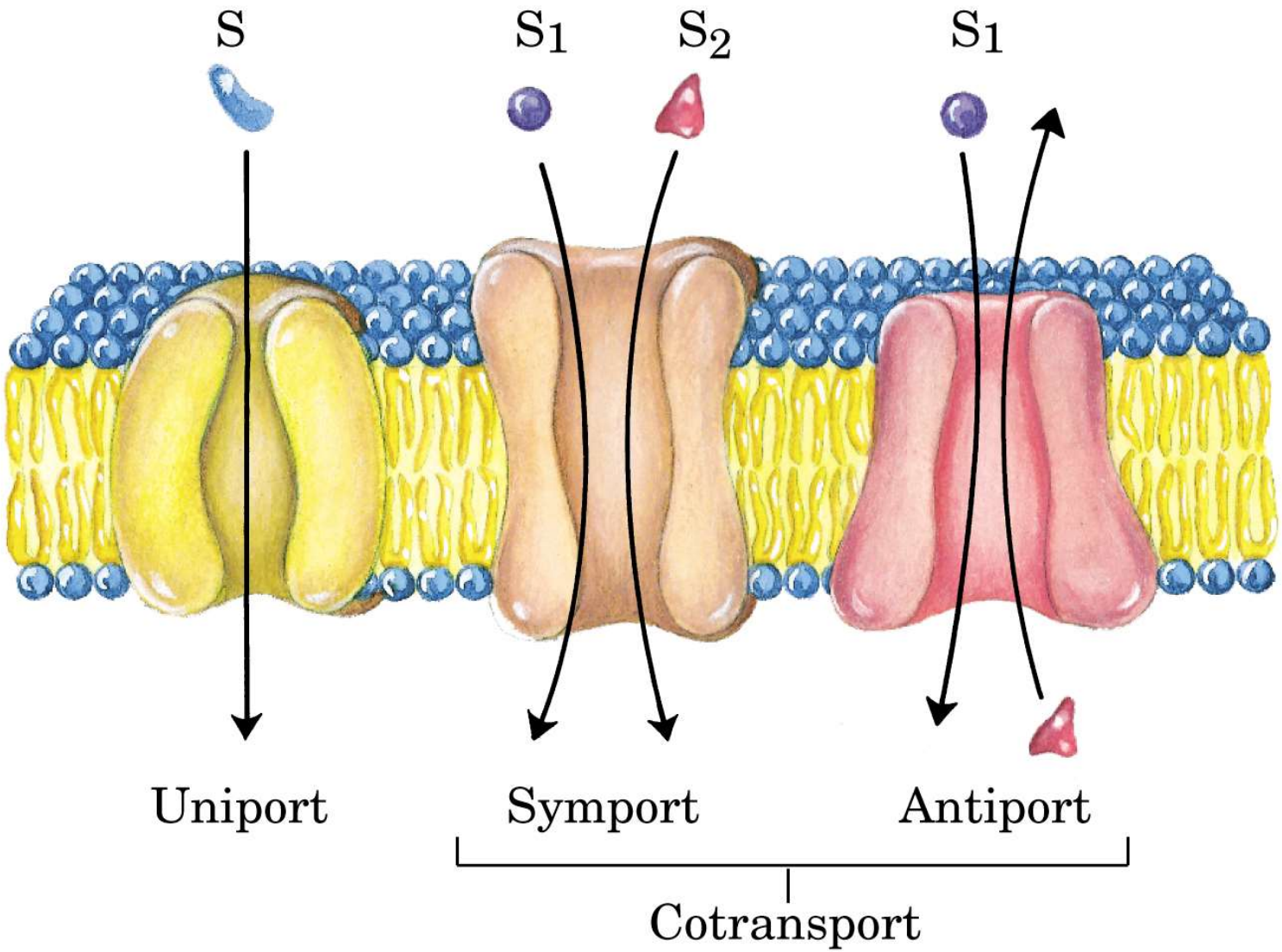
(a)



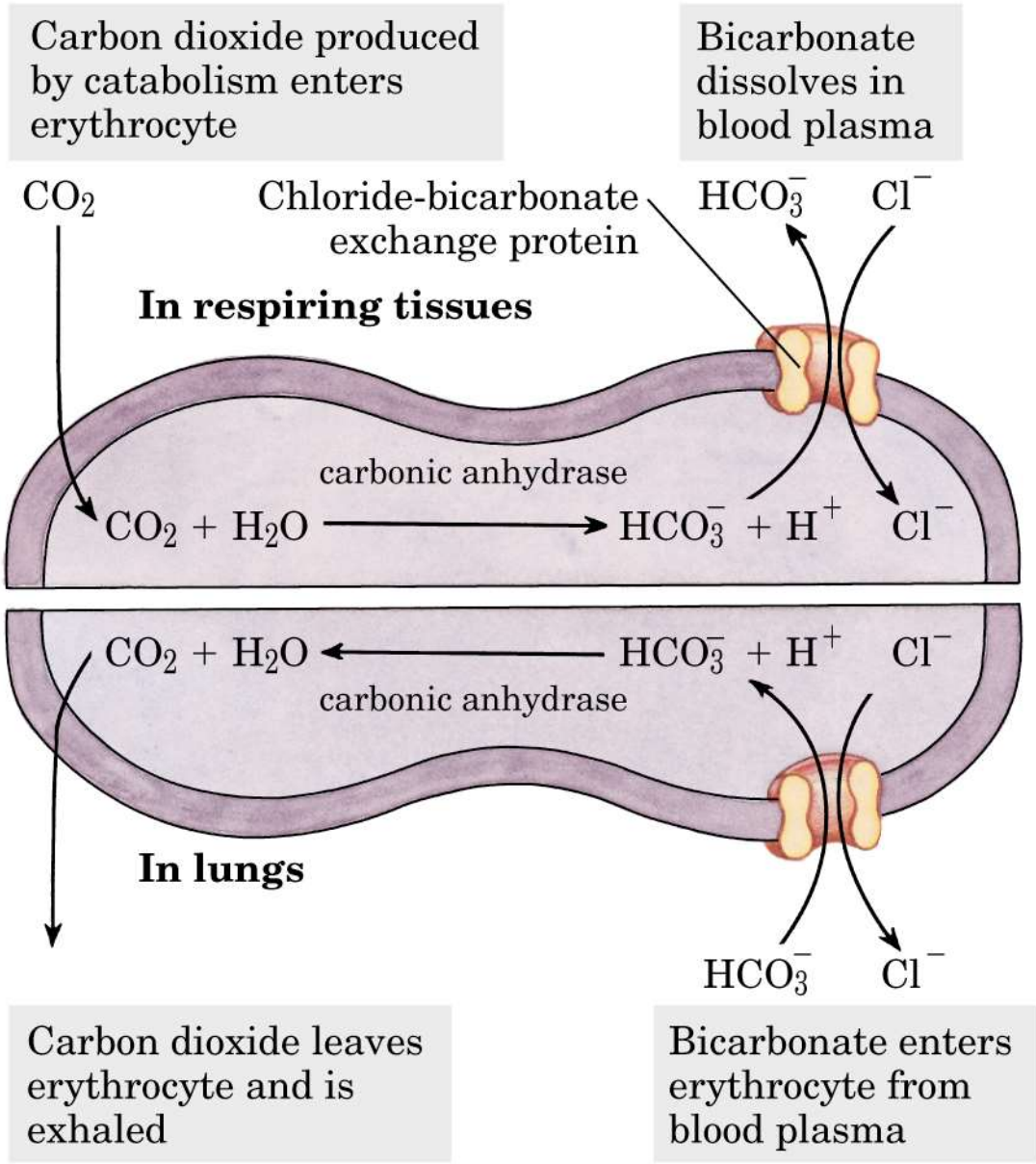
(c)


D-Glucose
T1
Step ①
T1
Step ②
T2
Step ③
T2
Step ④
T1
Inside
Outside

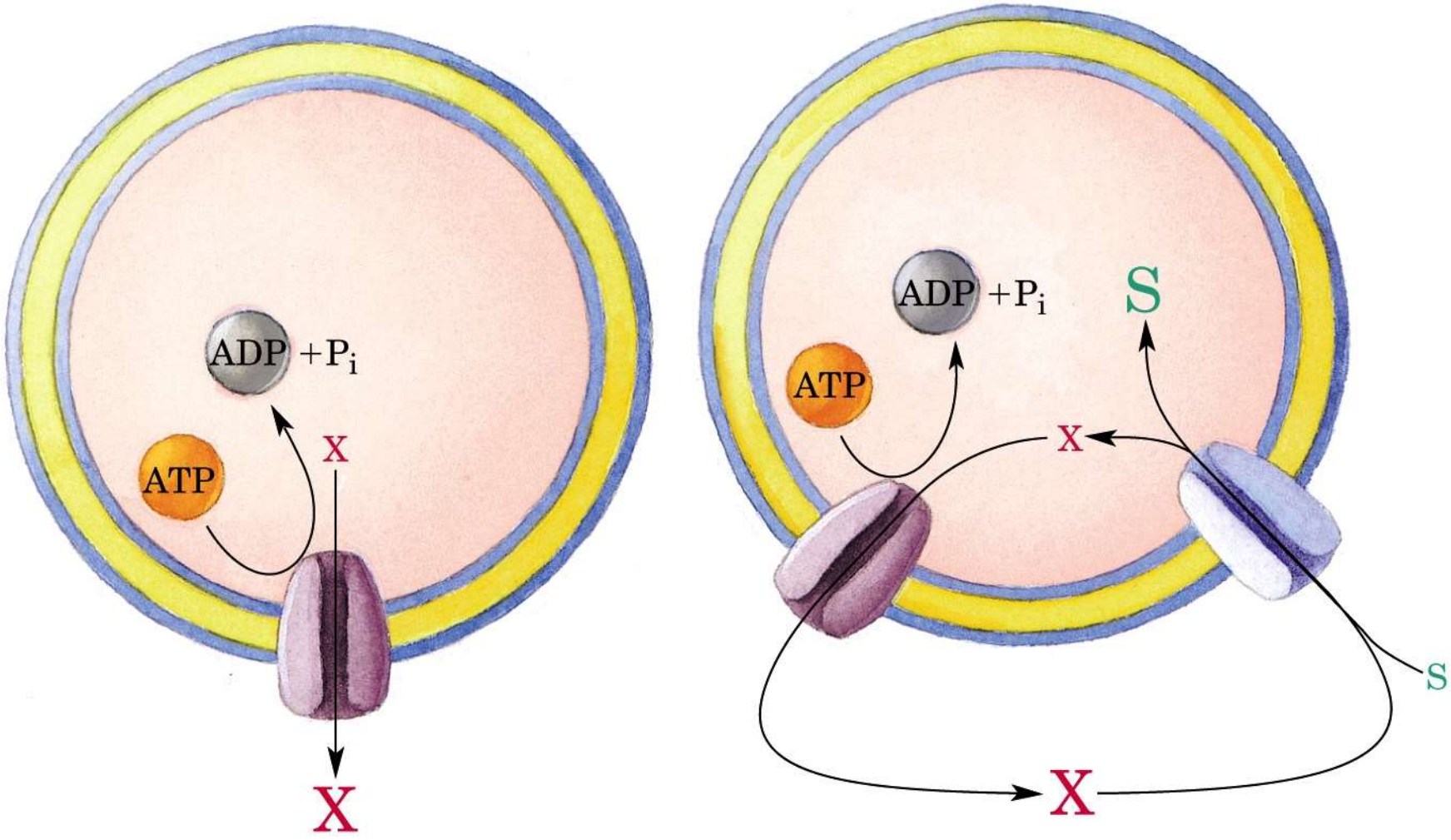
Sistemas de transporte



Co-transporte (cloreto bicarbonato)



Transporte ativo



Primary active transport
(a)

Secondary active transport
(b)

ATases de transporte

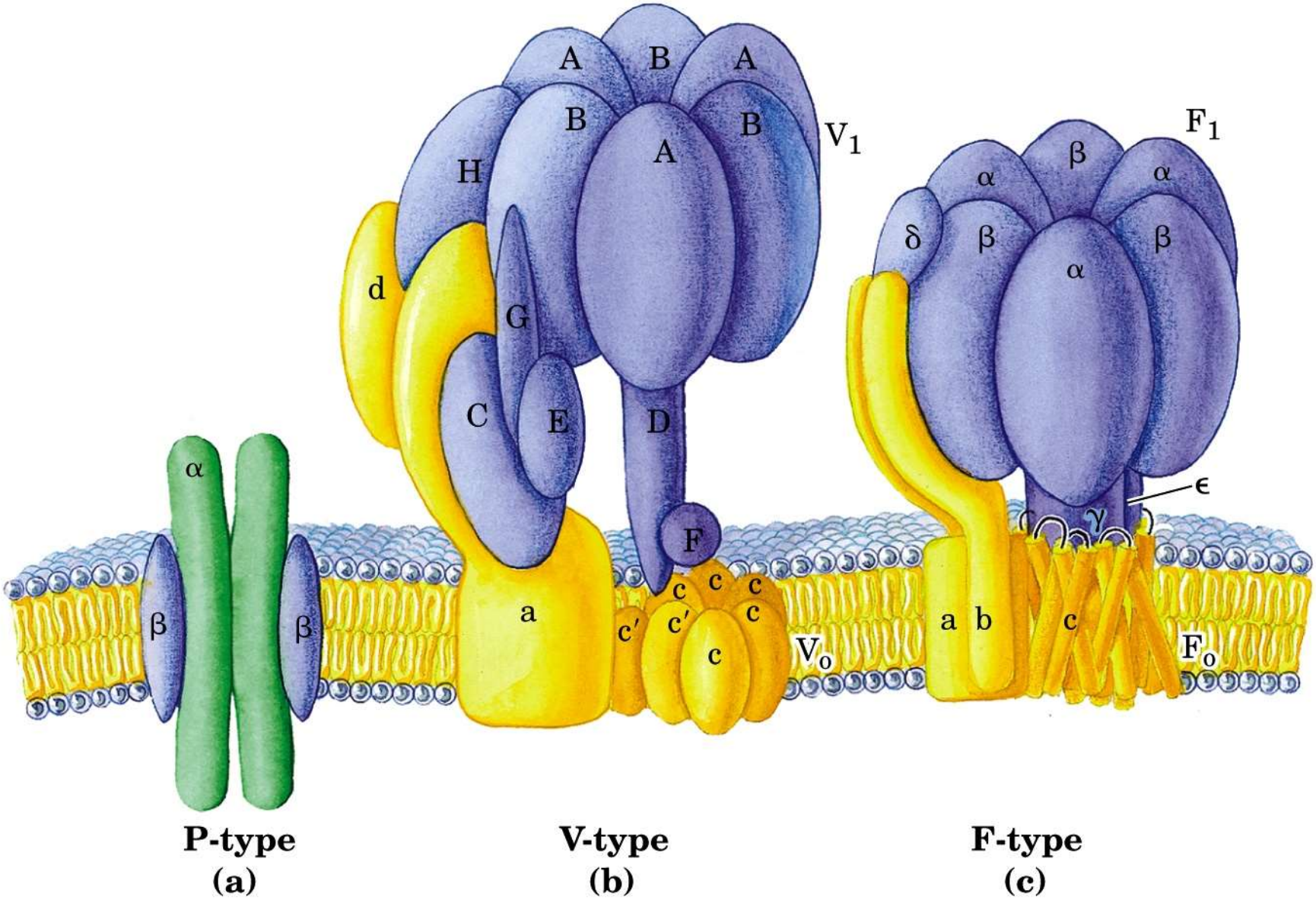
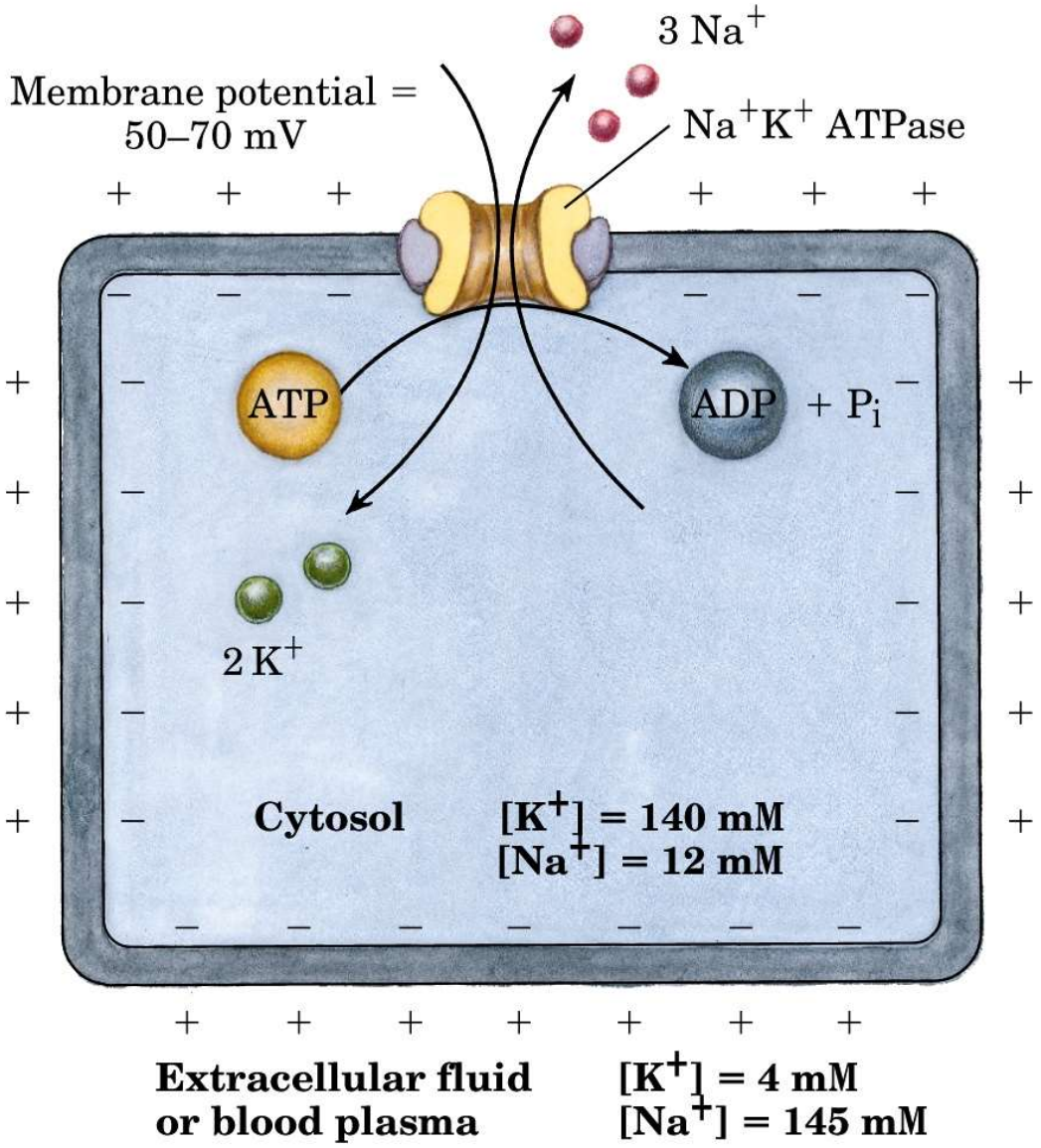


table 12–4

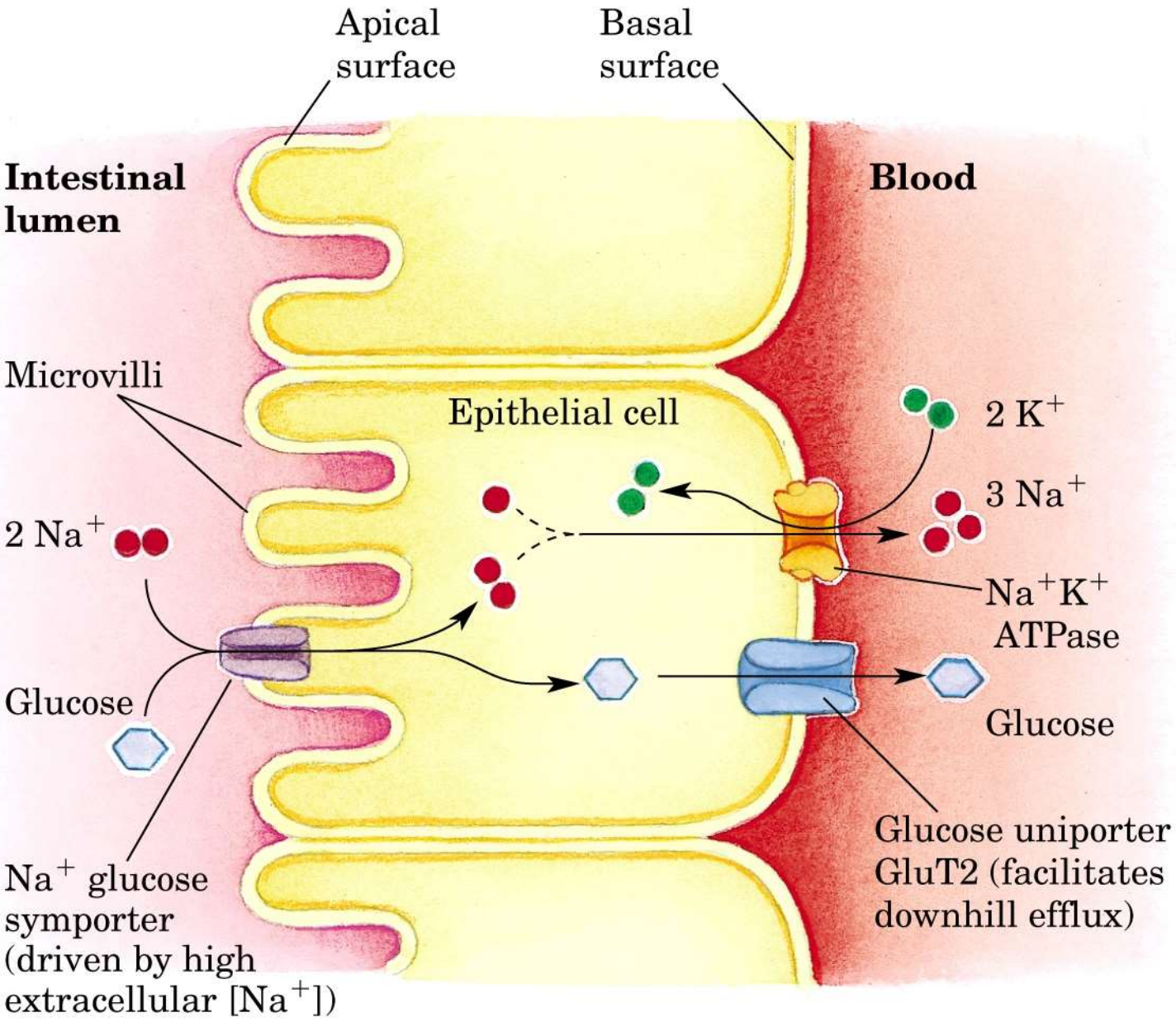
Four Classes of Transport ATPases

	Organism or tissue	Type of membrane	Role of ATPase
P-type ATPases			
Na^+K^+	Animal tissues	Plasma	Maintains low $[Na^+]$, high $[K^+]$ inside cell; creates transmembrane electrical potential
H^+K^+	Acid-secreting (parietal) cells of mammals	Plasma	Acidifies contents of stomach
H^+	Fungi *(Neurospora)*	Plasma	Create H^+ gradient to drive secondary transport of extracellular solutes into cell
H^+	Higher plants	Plasma	
Ca^{2+}	Animal tissues	Plasma	Maintains low $[Ca^{2+}]$ in cytosol
Ca^{2+}	Myocytes of animals	Sarcoplasmic reticulum (endoplasmic reticulum)	Sequesters intracellular Ca^{2+}, keeping cytosolic $[Ca^{2+}]$ low
Cd^{2+}, Hg^{2+}, Cu^{2+}	Bacteria	Plasma	Pumps heavy metal ions out of cell
V-type ATPases			
H^+	Animals	Lysosomal, endosomal, secretory vesicles	Create low pH in compartment, activating proteases and other hydrolytic enzymes
H^+	Higher plants	Vacuolar	
H^+	Fungi	Vacuolar	
F-type ATPases			
H^+	Eukaryotes	Inner mitochondrial	Catalyze formation of ATP from ADP + P_i
H^+	Higher plants	Thylakoid	
H^+	Prokaryotes	Plasma	
Multidrug transporter			
	Animal tumor cells	Plasma	Removes a wide variety of hydrophobic natural products and synthetic drugs from cytosol, including vinblastine, doxorubicin, actinomycin D, mitomycin, taxol, colchicine, and puromycin

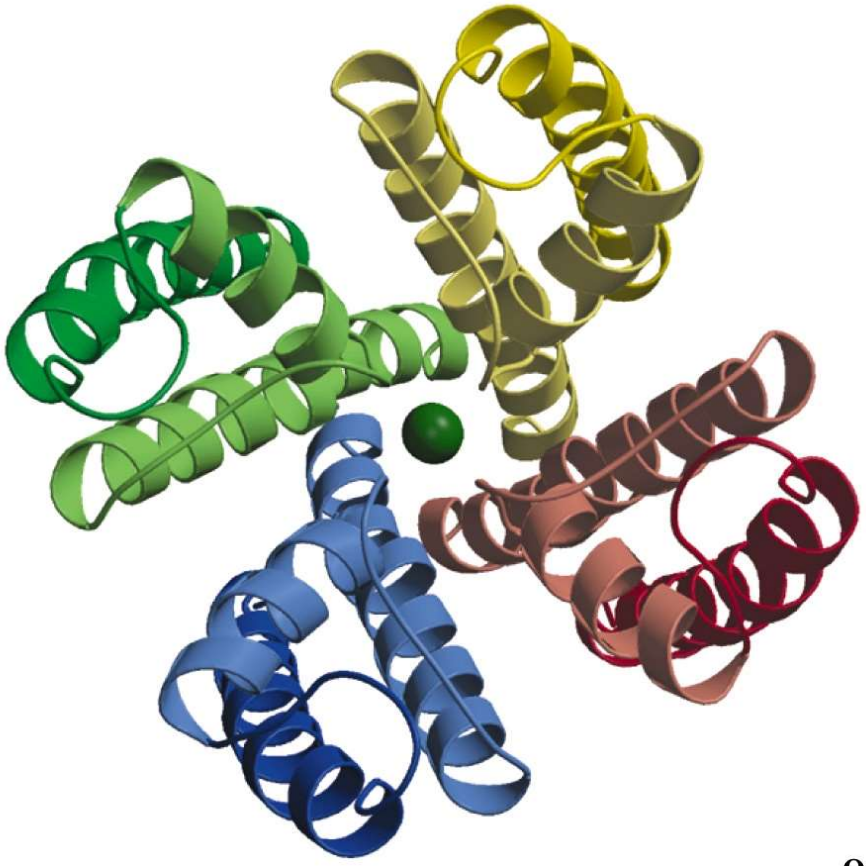
ATPase do tipo P



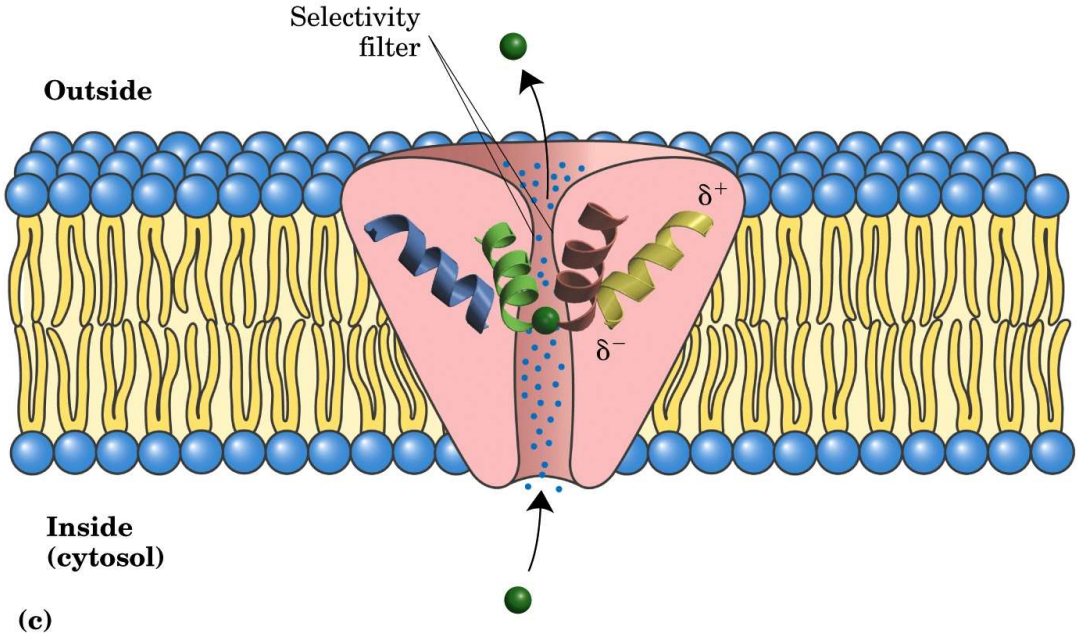
Transporte de glicose nas células epiteliais do intestino



Canal de potássio

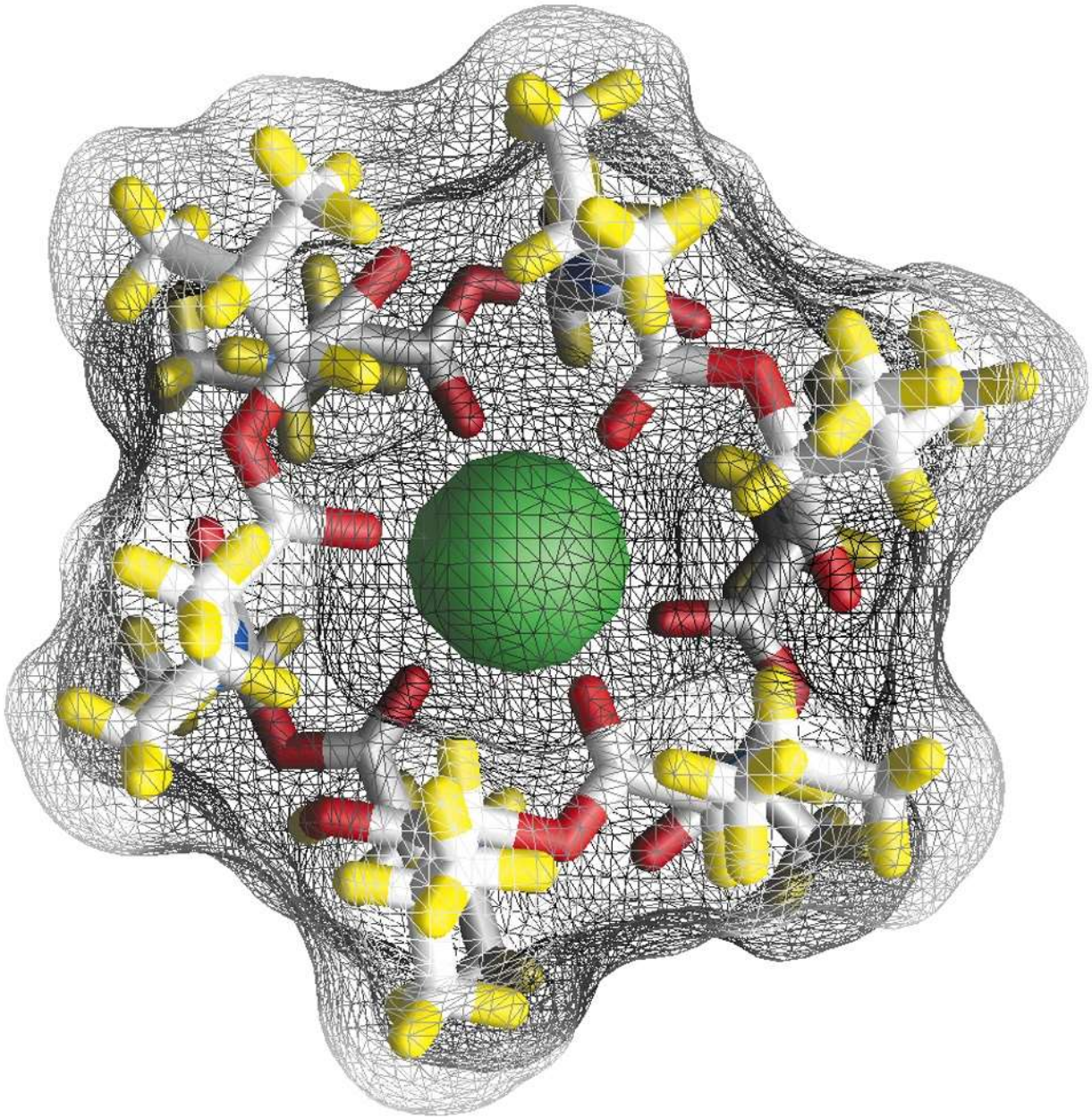


(b)

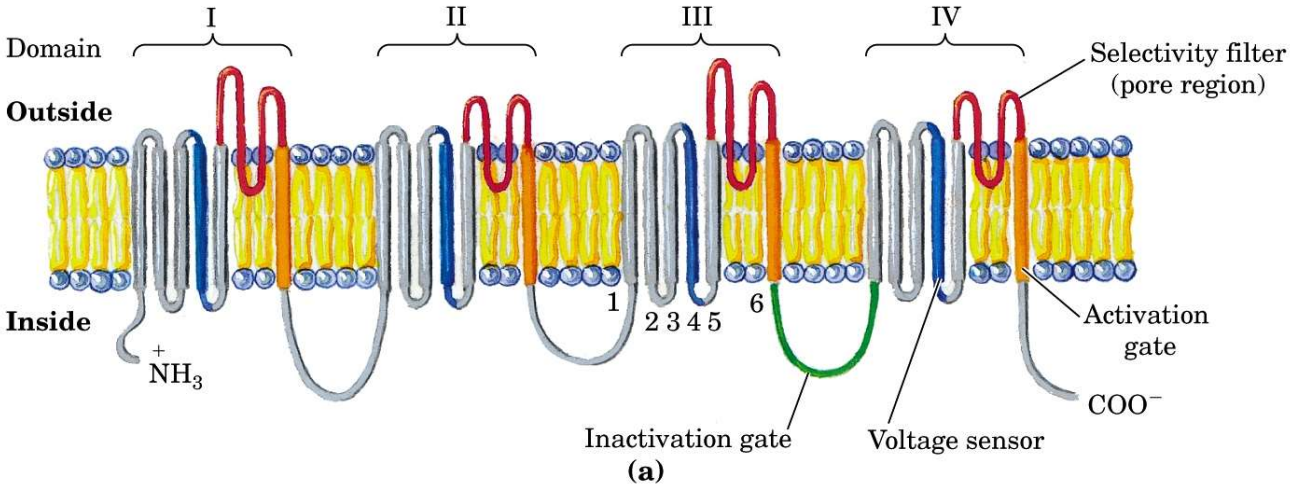


(c)

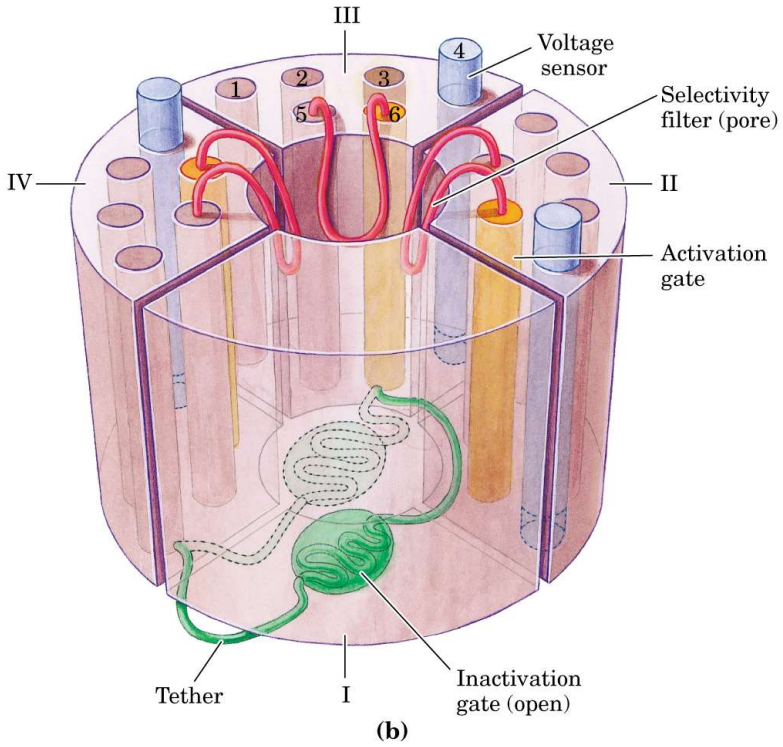
Valinomicina



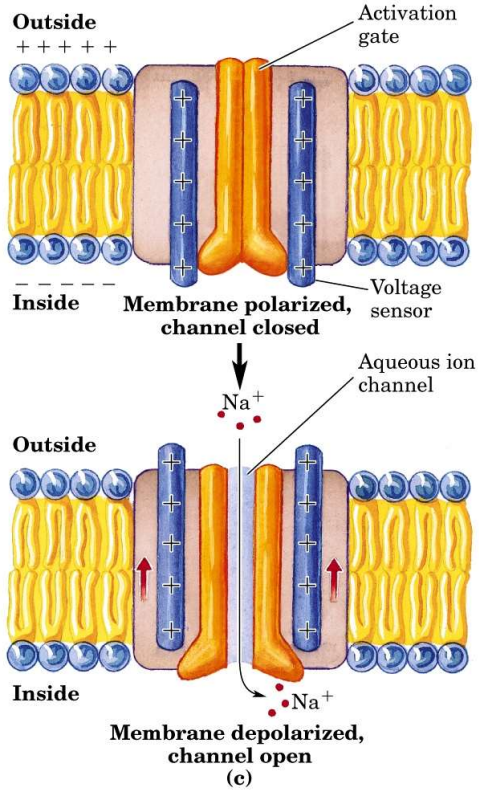
Canal de sódio



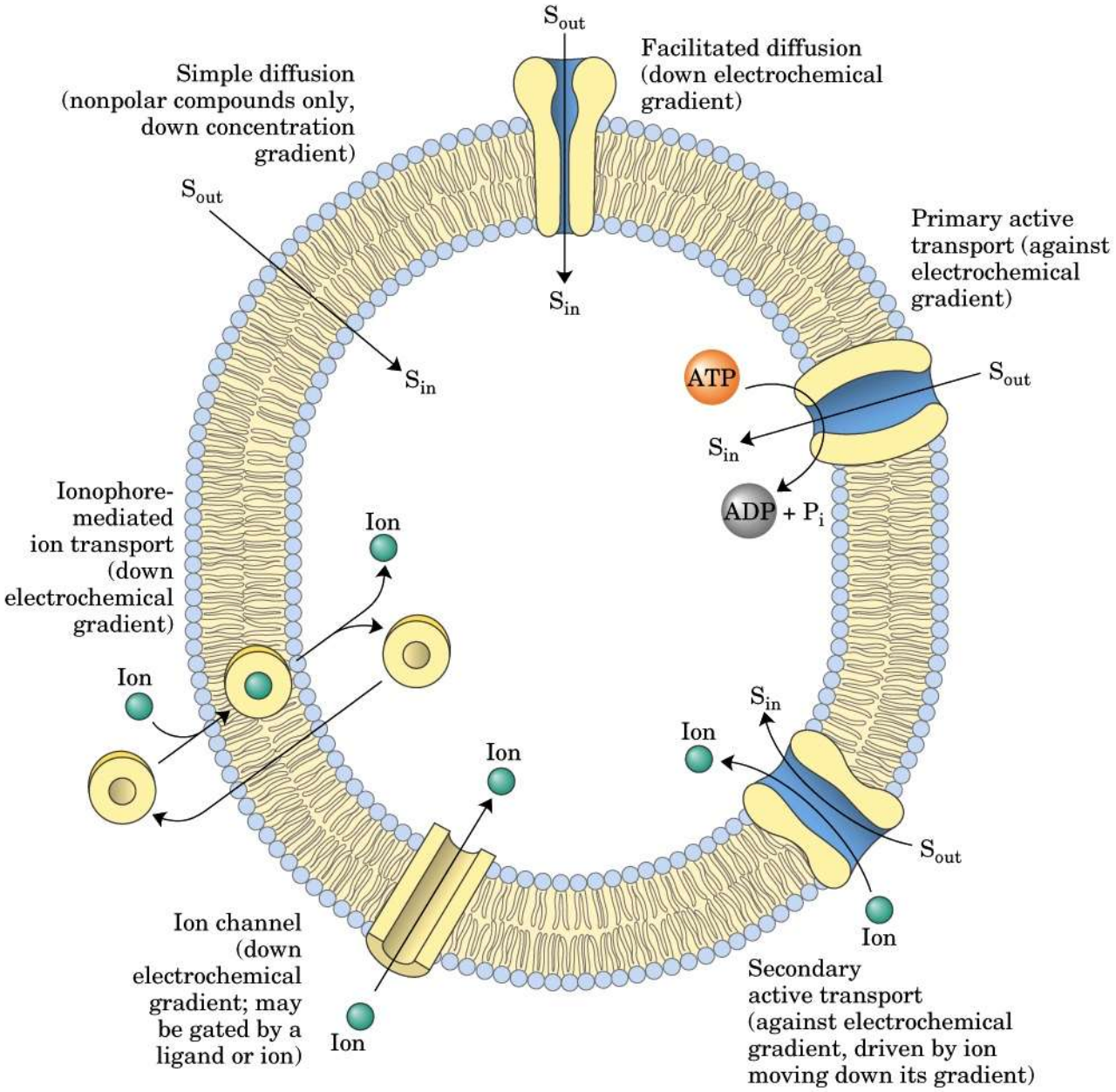
(a)



(b)



(c)


S_{out}
Facilitated diffusion (down electrochemical gradient)
Simple diffusion (nonpolar compounds only, down concentration gradient)
S_{out}
S_{in}
S_{in}
Primary active transport (against electrochemical gradient)
ATP
S_{out}
S_{in}
ADP + P_i
Ionophore-mediated ion transport (down electrochemical gradient)
Ion
Ion
Ion
Ion
S_{in}
Ion
S_{out}
Ion
Ion channel (down electrochemical gradient; may be gated by a ligand or ion)
Ion
Secondary active transport (against electrochemical gradient, driven by ion moving down its gradient)