

Lípidos

Características generales

- Grupo muy heterogéneo
- Insolubles en soluciones acuosas
- Solubles en solventes no-polares
- No forman polímeros
- En general se forman por condensación de moléculas de acetato

Funciones

- Reserva energética
- Estructural
- Aislante térmico
- Hormonal
- Formación de membranas

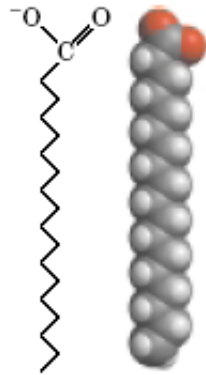
table 11-1

| Carbon skeleton | Structure* | Systematic name† | Common name (derivation) | Melting point (°C) | Solubility at 30 °C (mg/g solvent) | |
|------------------------------|--|--|--|--------------------|------------------------------------|---------|
| | | | | | Water | Benzene |
| 12:0 | $\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$ | <i>n</i> -Dodecanoic acid | Lauric acid (Latin <i>laurus</i> , "laurel plant") | 44.2 | 0.063 | 2,600 |
| 14:0 | $\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$ | <i>n</i> -Tetradecanoic acid | Myristic acid (Latin <i>Myristica</i> , nutmeg genus) | 53.9 | 0.024 | 874 |
| 16:0 | $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ | <i>n</i> -Hexadecanoic acid | Palmitic acid (Latin <i>palma</i> , "palm tree") | 63.1 | 0.0083 | 348 |
| 18:0 | $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ | <i>n</i> -Octadecanoic acid | Stearic acid (Greek <i>stear</i> , "hard fat") | 69.6 | 0.0034 | 124 |
| 20:0 | $\text{CH}_3(\text{CH}_2)_{18}\text{COOH}$ | <i>n</i> -Eicosanoic acid | Arachidic acid (Latin <i>Arachis</i> , legume genus) | 76.5 | | |
| 24:0 | $\text{CH}_3(\text{CH}_2)_{22}\text{COOH}$ | <i>n</i> -Tetracosanoic acid | Lignoceric acid (Latin <i>lignum</i> , "wood" + <i>cera</i> , "wax") | 86.0 | | |
| 16:1(Δ^9) | $\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ | <i>cis</i> -9-Hexadecenoic acid | Palmitoleic acid | -0.5 | | |
| 18:1(Δ^9) | $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ | <i>cis</i> -9-Octadecenoic acid | Oleic acid (Latin <i>oleum</i> , "oil") | 13.4 | | |
| 18:2($\Delta^{9,12}$) | $\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ | <i>cis</i> -, <i>cis</i> -9,12-Octadecadienoic acid | Linoleic acid (Greek <i>linon</i> , "flax") | -5 | | |
| 18:3($\Delta^{9,12,15}$) | $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ | <i>cis</i> -, <i>cis</i> -, <i>cis</i> -9,12,15-Octadecatrienoic acid | α -Linolenic acid | -11 | | |
| 20:4($\Delta^{5,8,11,14}$) | $\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_3\text{COOH}$ | <i>cis</i> -, <i>cis</i> -, <i>cis</i> -, <i>cis</i> -5,8,11,14-Icosatetraenoic acid | Arachidonic acid | -49.5 | | |

Propiedades fisicoquímicas

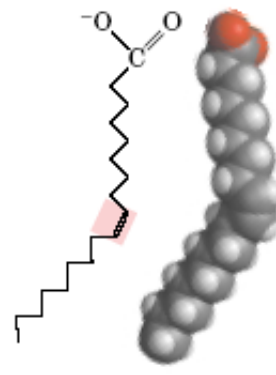
- C3-C4 son líquidos solubles en agua y volátiles
- c1 se denomina alfa, el resto, beta, gamma, etc.
- Son ácidos débiles
- C6 en adelante insolubles en agua
- C10 en adelante sólidos
- saturados o insaturados
- En general configuración *cis*
- La temperatura de fusión aumenta con el número de átomos de C.
- La temperatura de fusión disminuye con el número de insaturaciones
- La solubilidad en agua disminuye con el aumento del número de átomos de C y la disminución de las insaturaciones.
- Solubles en soluciones alcalinas (jabones)

Carboxyl group



Hydrocarbon chain

(a)

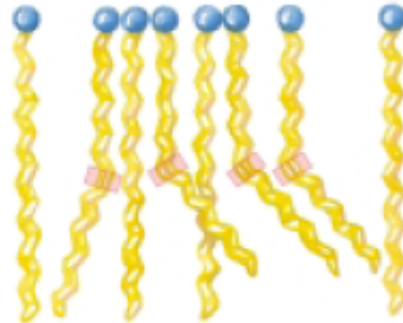


(b)



Saturated fatty acids

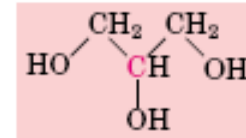
(c)



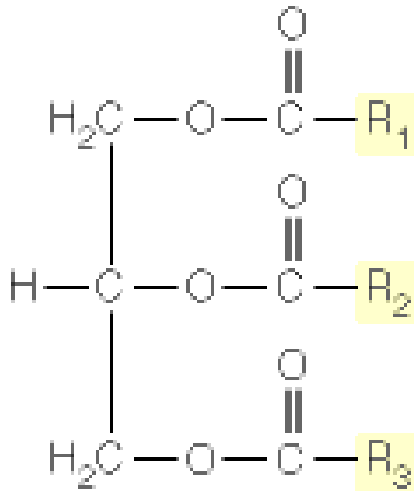
Mixture of saturated and unsaturated fatty acids

(d)

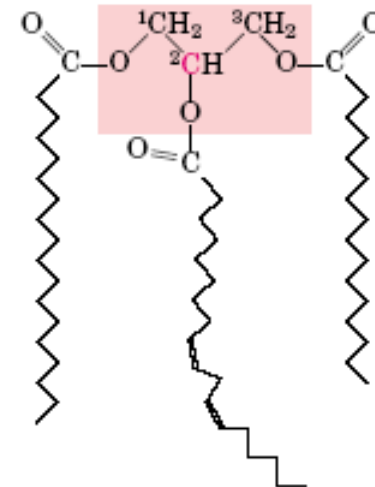
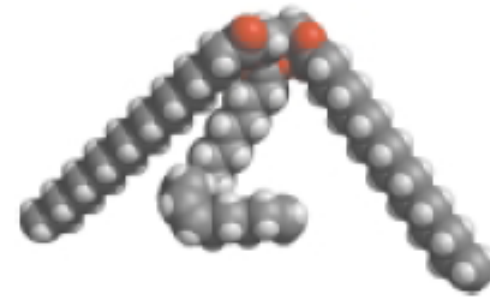
Triacilgliceroles



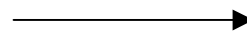
Glycerol



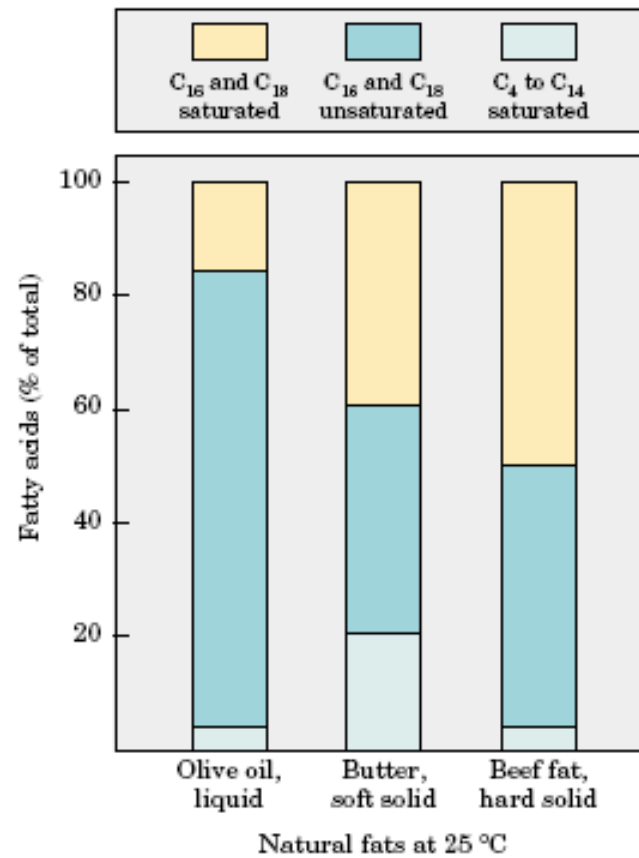
Triacylglycerol

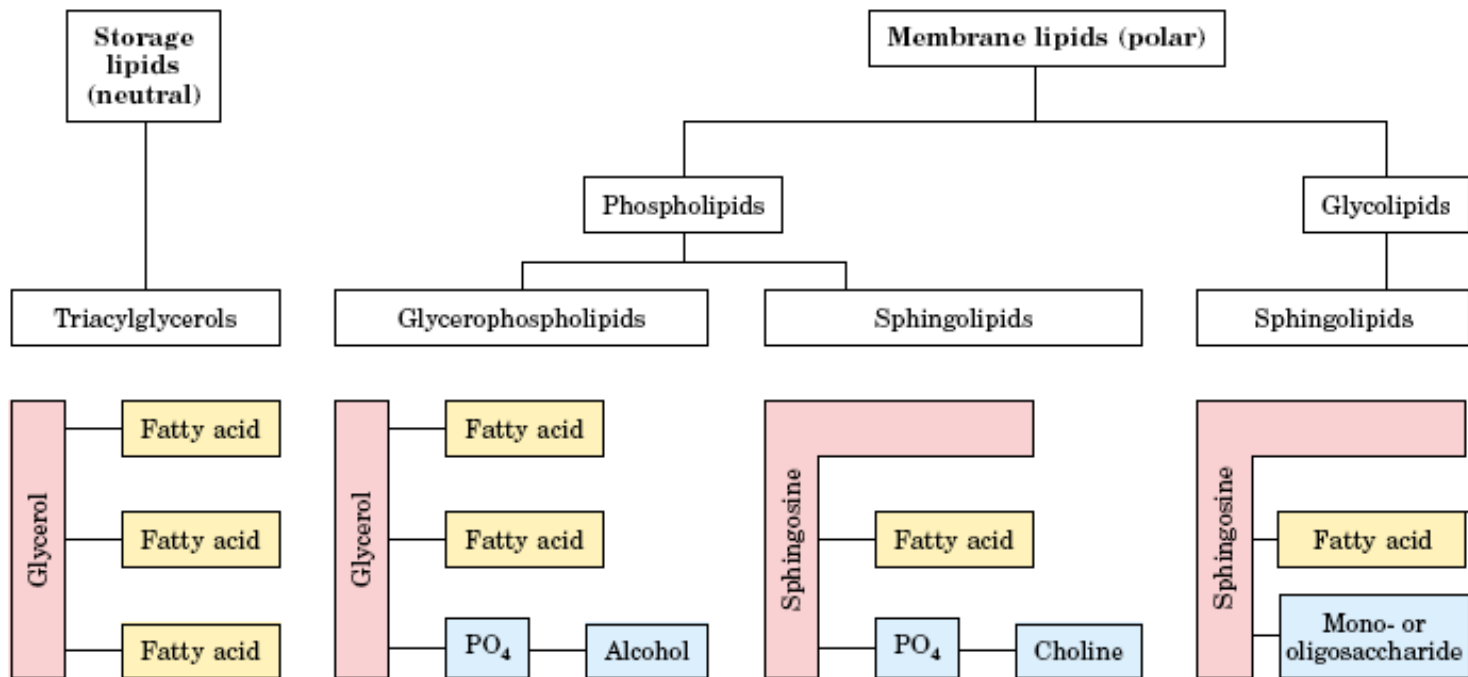


nomenclatura

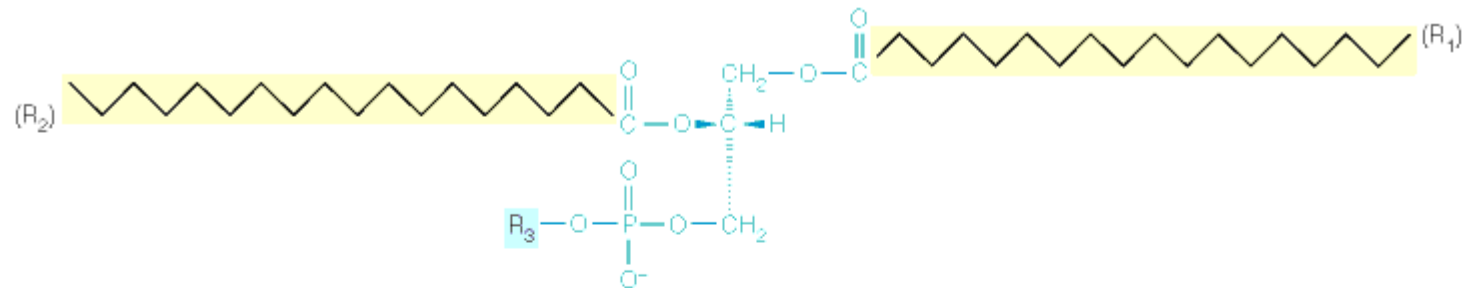


1-Stearoyl, 2-linoleoyl, 3-palmitoyl glycerol,
a mixed triacylglycerol

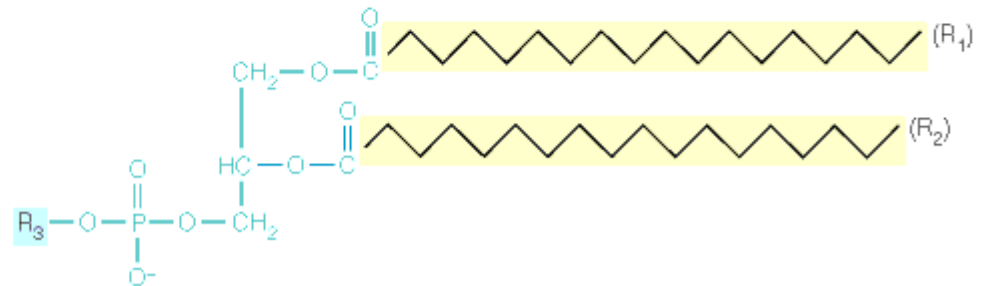




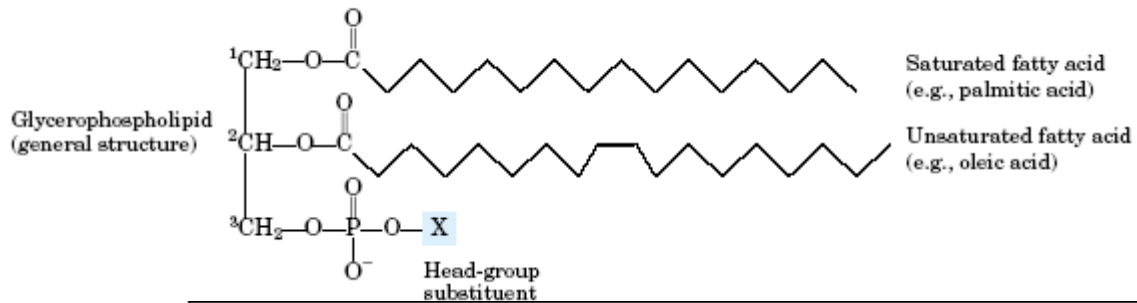
Fosfolípidos



(a)



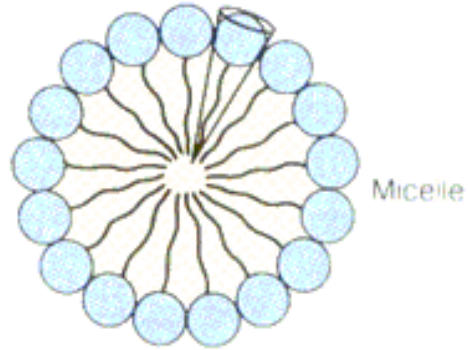
(b)



Molécula
asimétrica
(isómeros L y D)



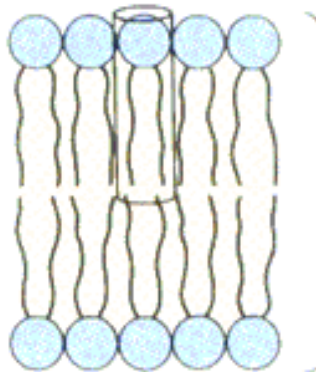
| Name of glycerophospholipid | Name of X | Formula of X | Net charge (at pH 7) |
|---------------------------------------|---------------------------------------|--|----------------------|
| Phosphatidic acid | — | — H | -1 |
| Phosphatidylethanolamine | Ethanolamine | — CH ₂ -CH ₂ -NH ₃ ⁺ | 0 |
| Phosphatidylcholine | Choline | — CH ₂ -CH ₂ -N ⁺ (CH ₃) ₃ | 0 |
| Phosphatidylserine | Serine | — CH ₂ -CH(NH ₃ ⁺) COO ⁻ | -1 |
| Phosphatidylglycerol | Glycerol | — CH ₂ -CH(OH)-CH ₂ -OH | -1 |
| Phosphatidylinositol 4,5-bisphosphate | <i>myo</i> -Inositol 4,5-bisphosphate | <chem>O=C1OC(O)C(O)C(O)C(O)C1OP(=O)(O)OP(=O)(O)O</chem> | -4 |
| Cardiolipin | Phosphatidyl-glycerol | — CH ₂ -CHOH-CH ₂ -O-P(=O)(O ⁻)-O-CH ₂ -CH(O-C(=O)-R ¹)-CH ₂ -O-C(=O)-R ² | -2 |



Micelle

(a)

Ac. grasos

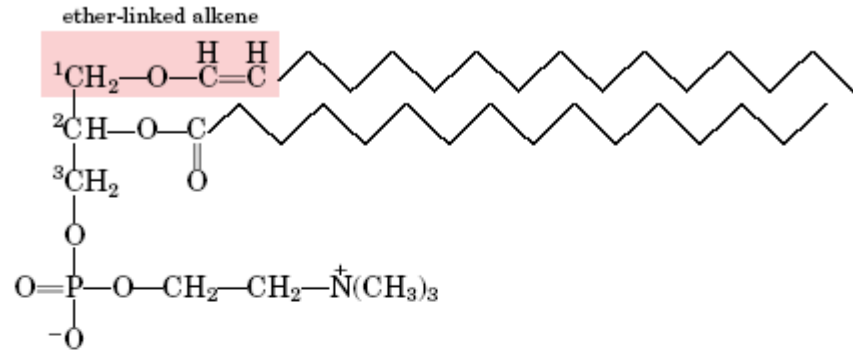


Bilayer

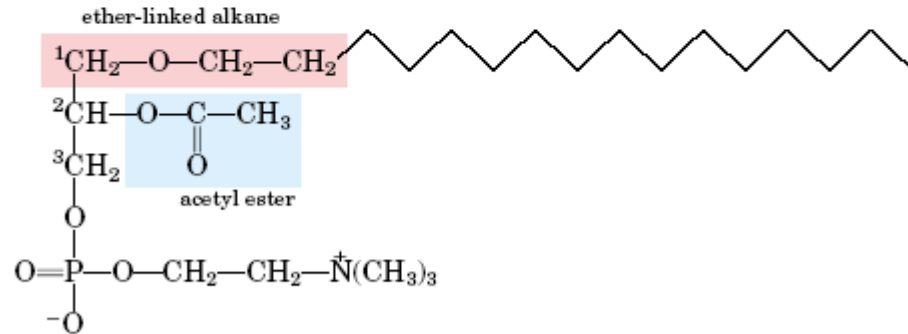
(b)

fosfolípidos

Lípidos con enlace eter

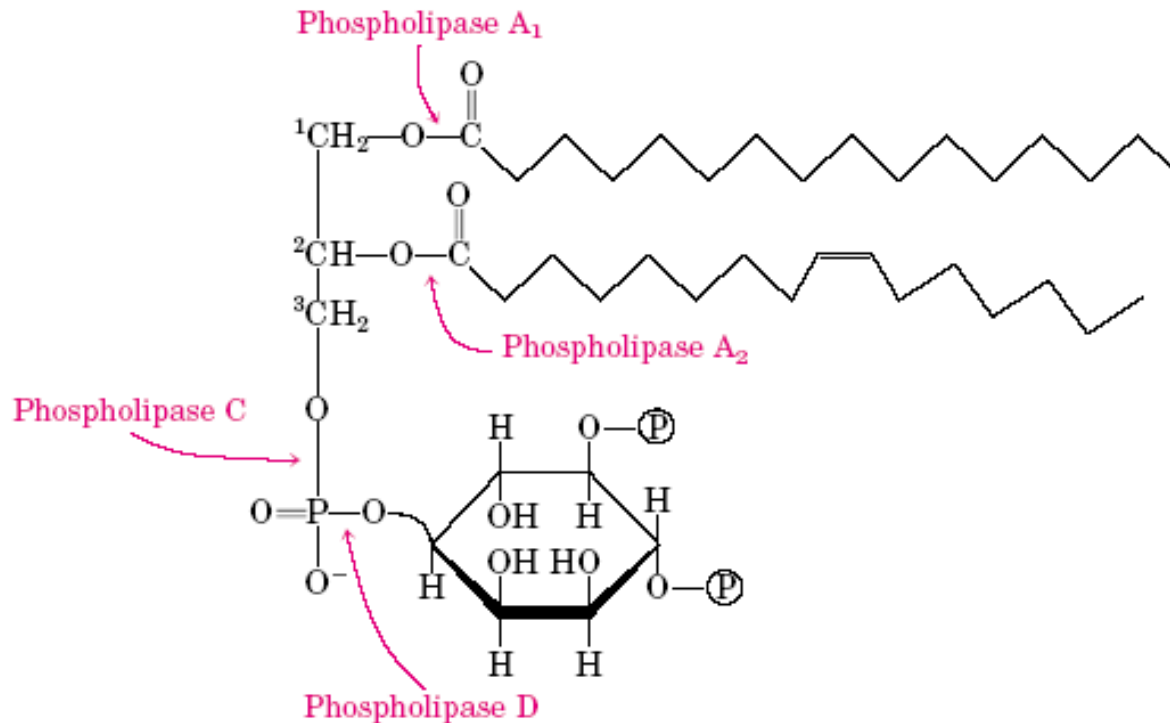


Plasmalogen



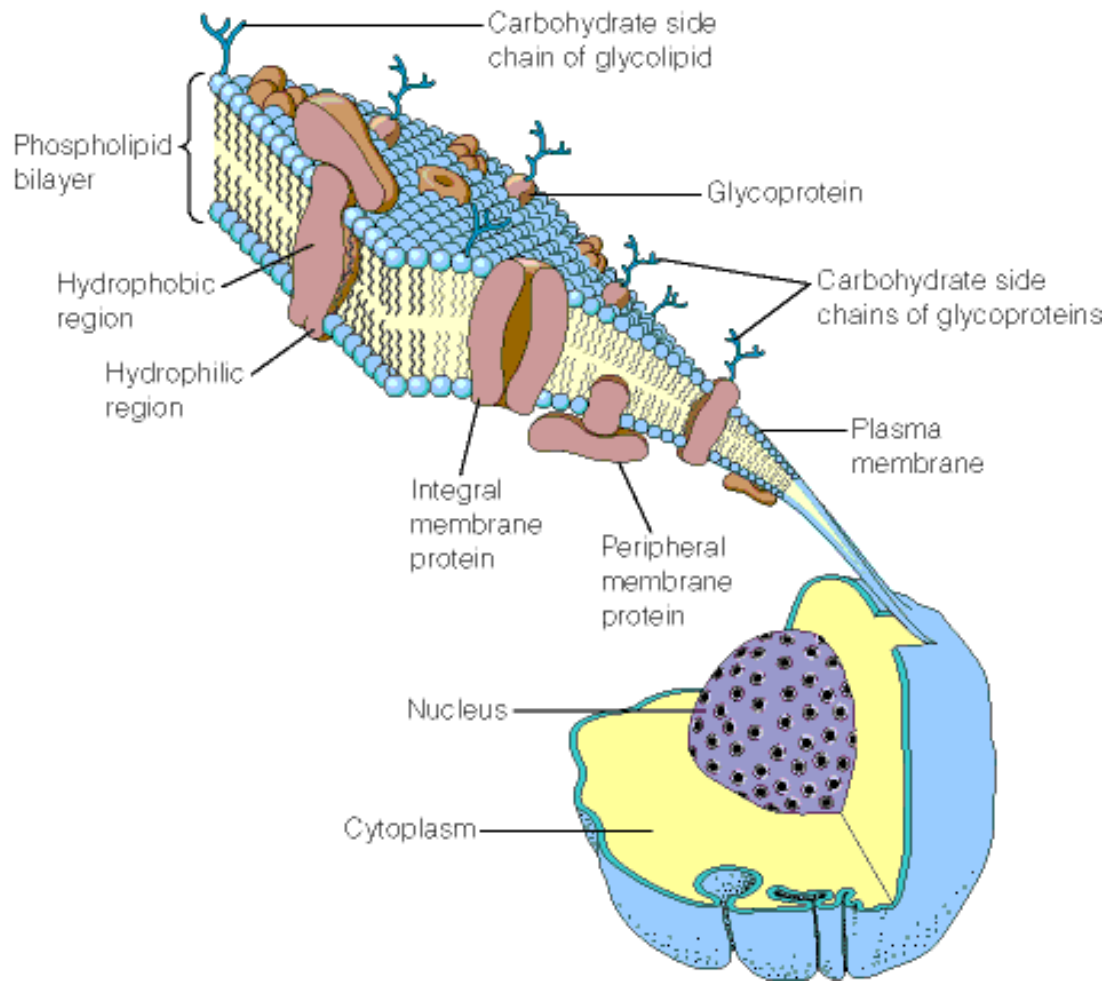
Platelet-activating factor

Degradación enzimática de los fosfolípidos



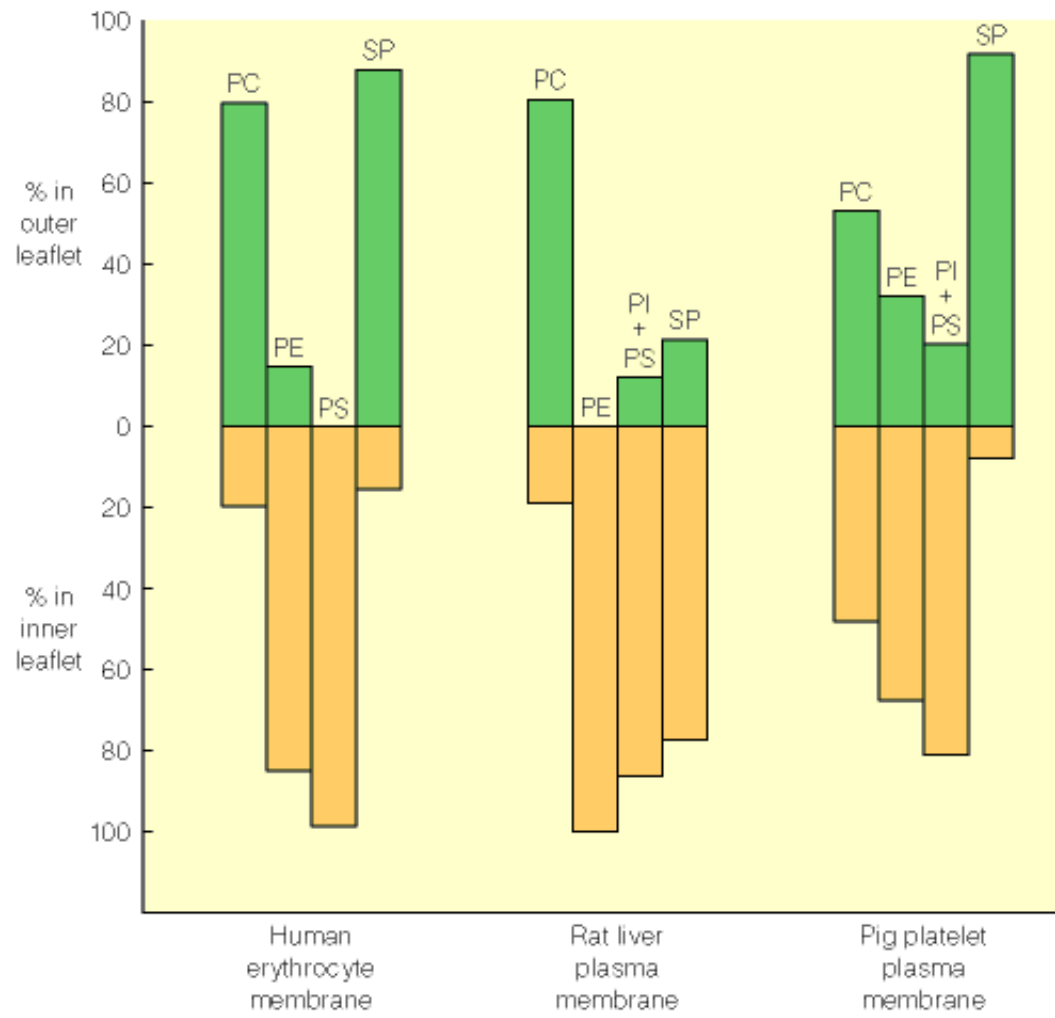
Fosfolipasas A1 y A2 generan los derivados lisofosfogliceridos (de tipo 1 y 2)

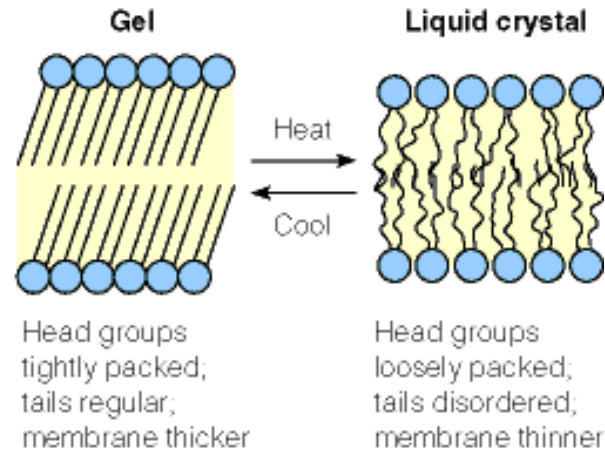
Membranas



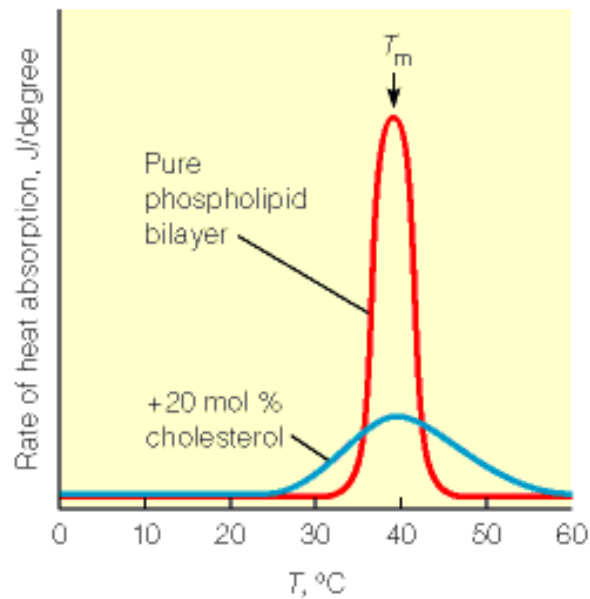
| Lipid | Percentage of Total Composition in | | | |
|--------------------------|------------------------------------|--------------|-------------------------|------------------------------|
| | Human Erythrocyte Plasma Membrane | Human Myelin | Beef Heart Mitochondria | <i>E. coli</i> Cell Membrane |
| Phosphatidic acid | 1.5 | 0.5 | 0 | 0 |
| Phosphatidylcholine | 19 | 10 | 39 | 0 |
| Phosphatidylethanolamine | 18 | 20 | 27 | 65 |
| Phosphatidylglycerol | 0 | 0 | 0 | 18 |
| Phosphatidylinositol | 1 | 1 | 7 | 0 |
| Phosphatidylserine | 8.0 | 8.0 | 0.5 | 0 |
| Sphingomyelin | 17.5 | 8.5 | 0 | 0 |
| Glycolipids | 10 | 26 | 0 | 0 |
| Cholesterol | 25 | 26 | 3 | 0 |
| Others | 0 | 0 | 23.5 | 17 |

Source: Data from C. Tanford, *The Hydrophobic Effect* (New York: Wiley, 1973).



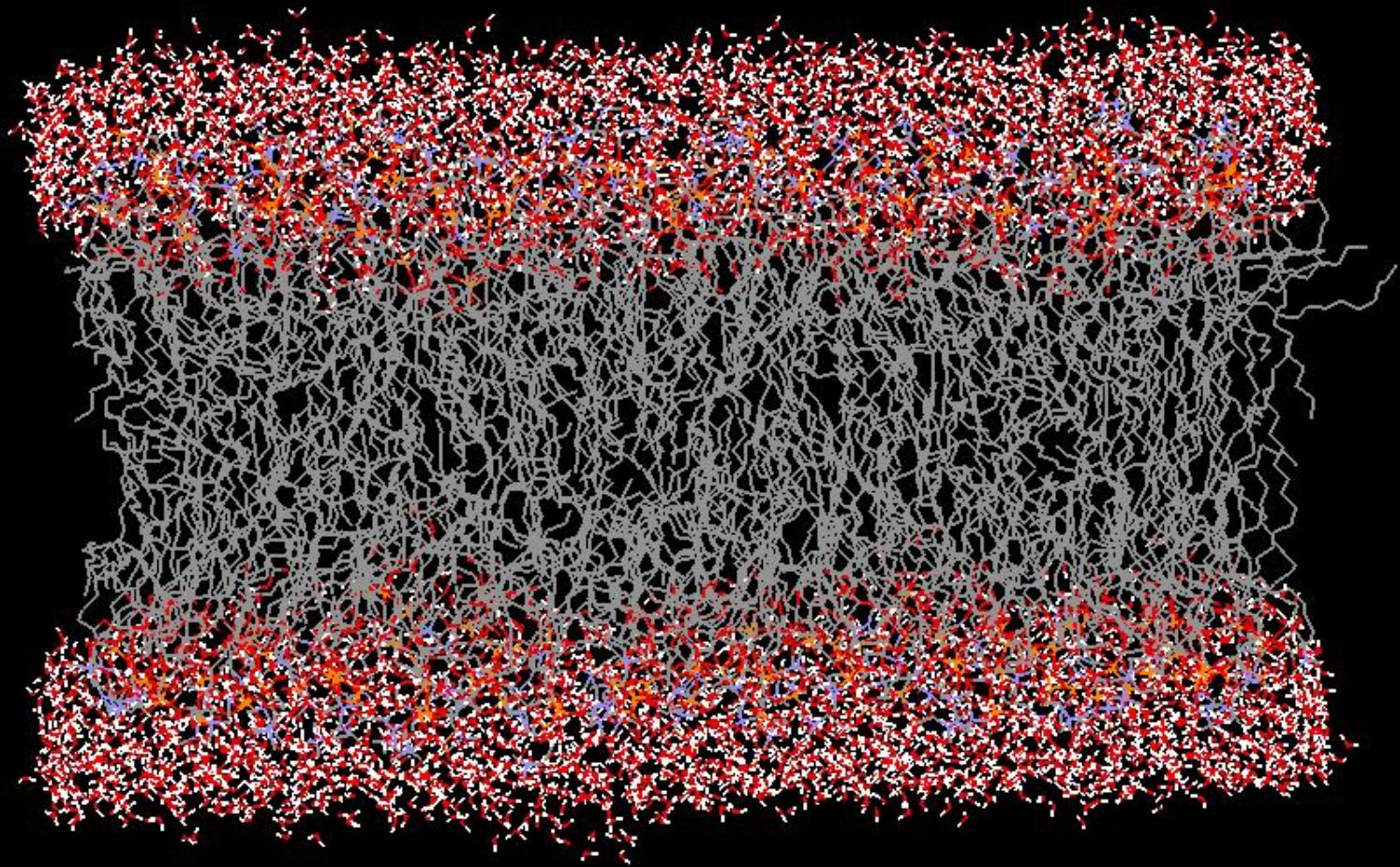


(a) Transition

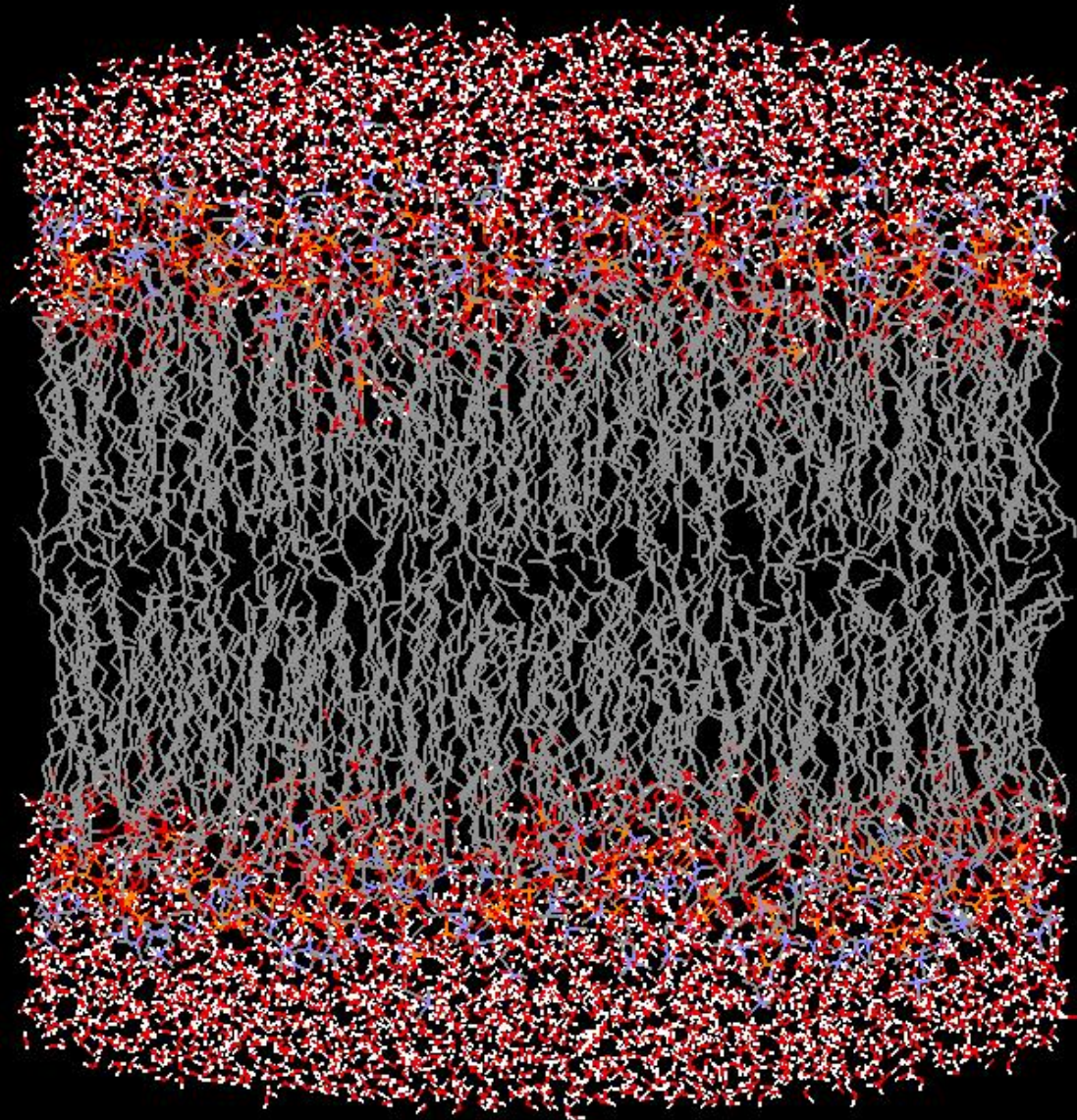


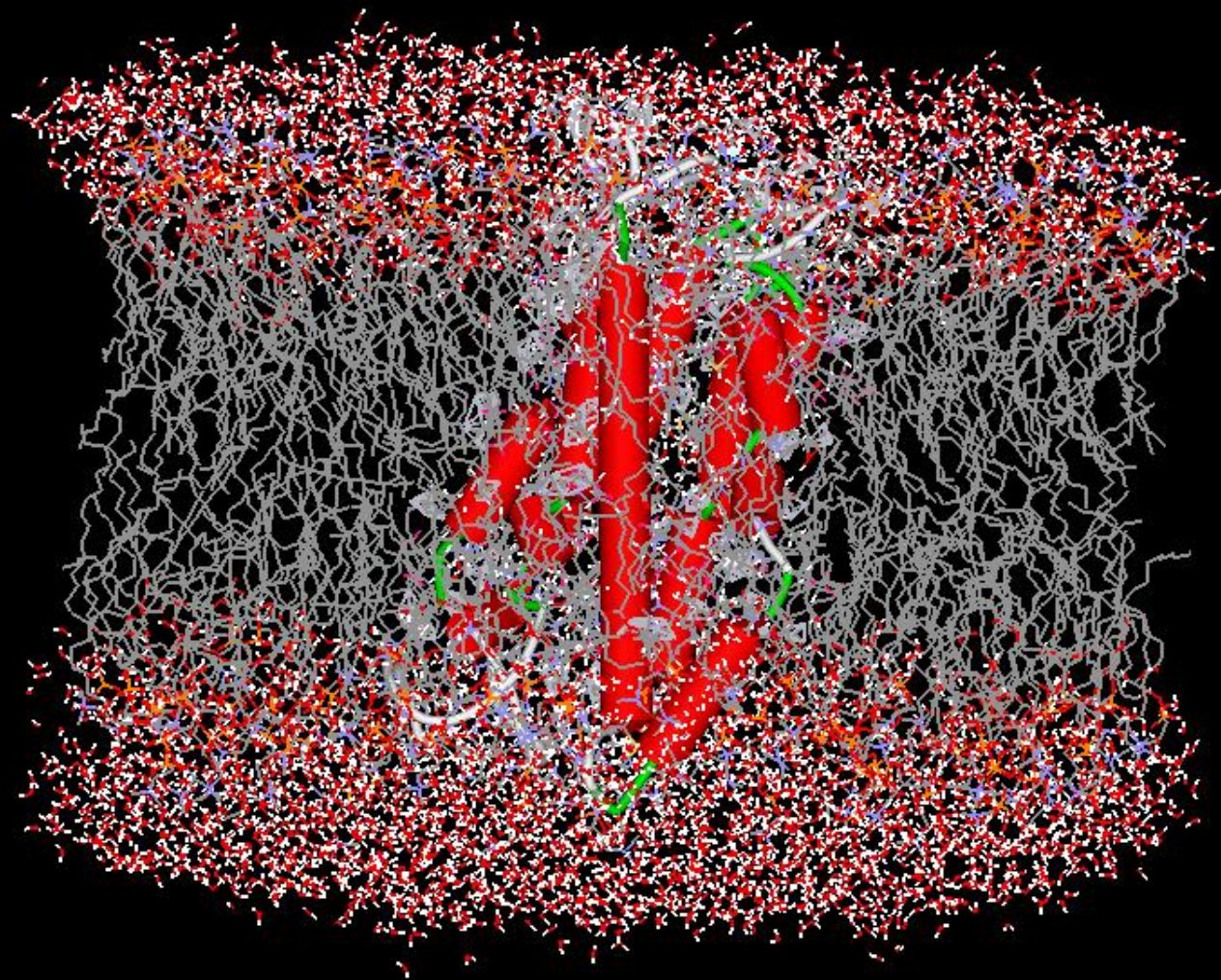
(b) Transition with and without cholesterol

Cristal liquido (sol)

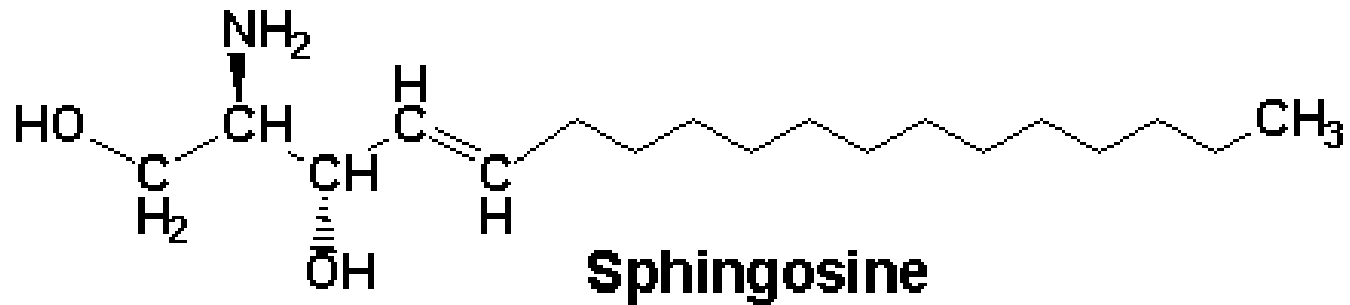
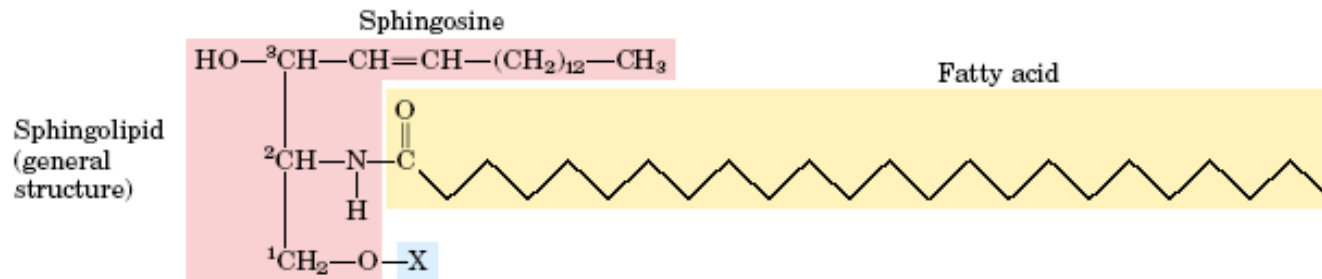


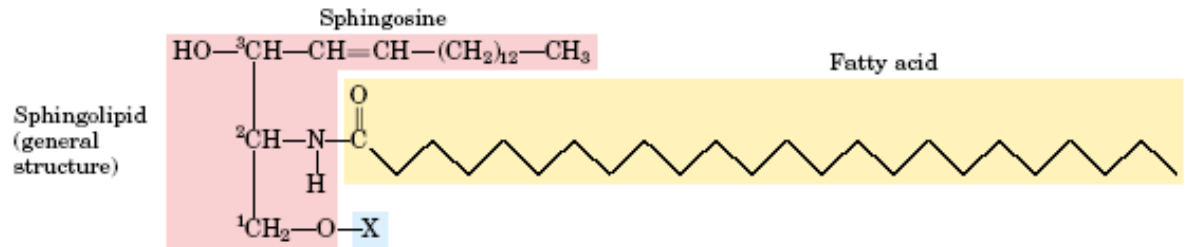
Gel





Esfingolípidos





| 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 | |

Esfingomielinas

Glicoesfingolípidos

Gangliósidos

Cerebrósidos

Globósidos

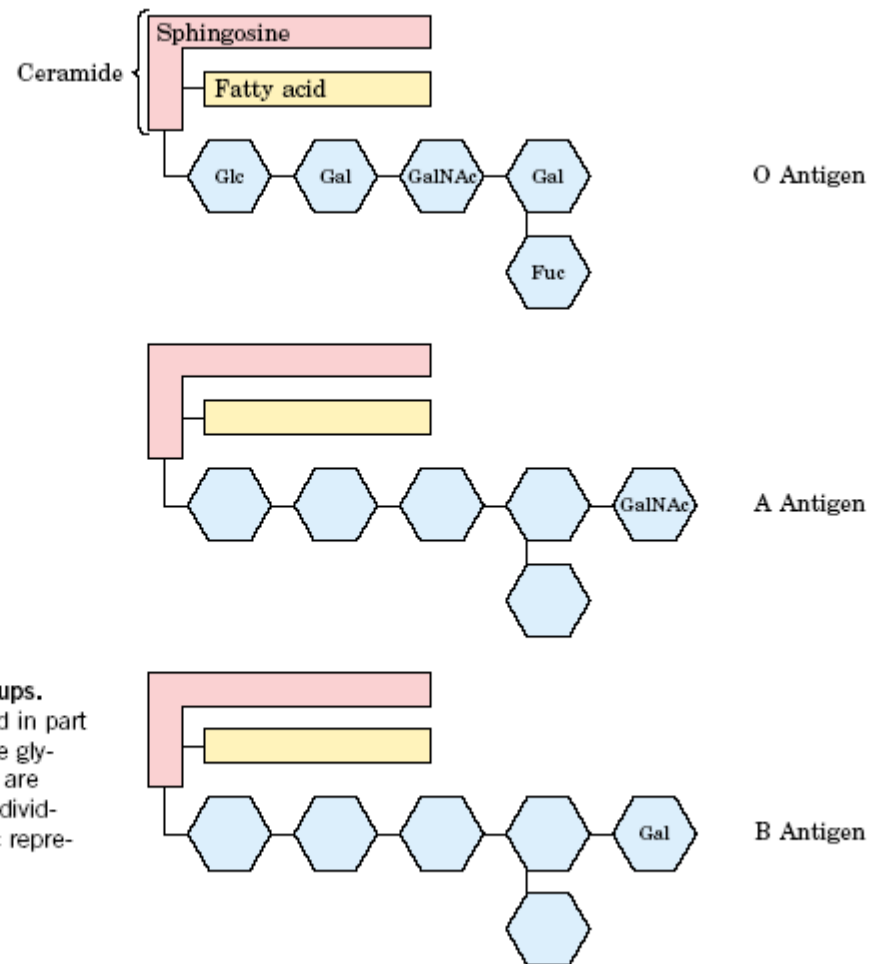


figure 11-12

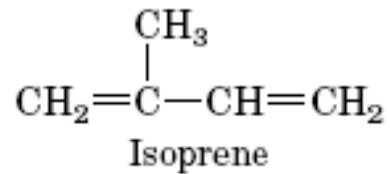
Glycosphingolipids as determinants of blood groups.

The human blood groups (O, A, B) are determined in part by the oligosaccharide head groups (blue) of these glycosphingolipids. The same three oligosaccharides are also found attached to certain blood proteins of individuals of blood types O, A, and B, respectively. (Fuc represents the sugar fucose.)

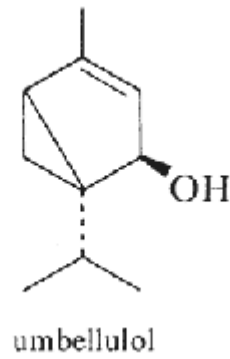
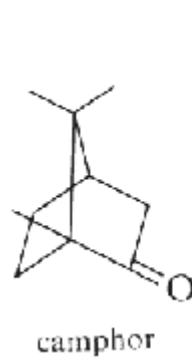
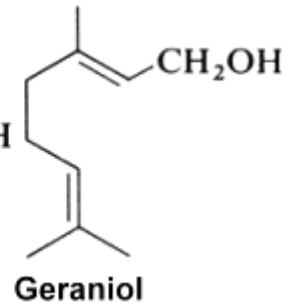
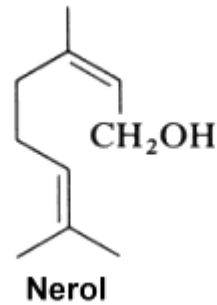
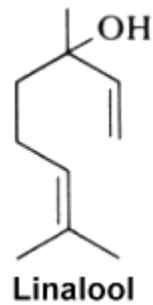
Terpenoides

Derivan de la unión de unidades de isopreno. Grupo muy diverso

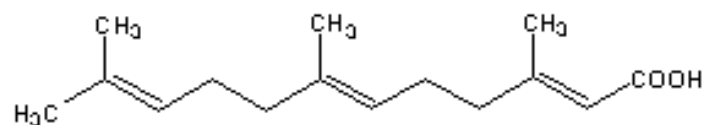
Hormonas sexuales, hormonas de insectos, vitaminas liposolubles, aceites esenciales, alcaloides, polímeros(caucho)



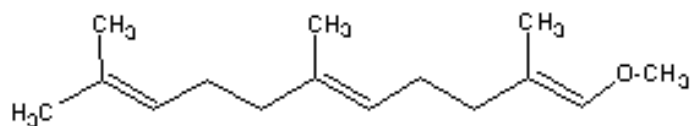
Monoterpenos (2 unidades de terpenos)



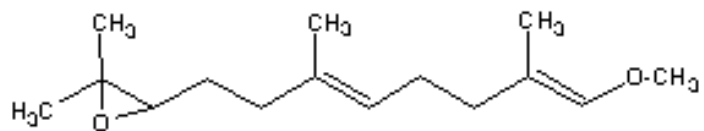
Sesquiterpenos (3 unidades de terpenos)



Farnesoic acid



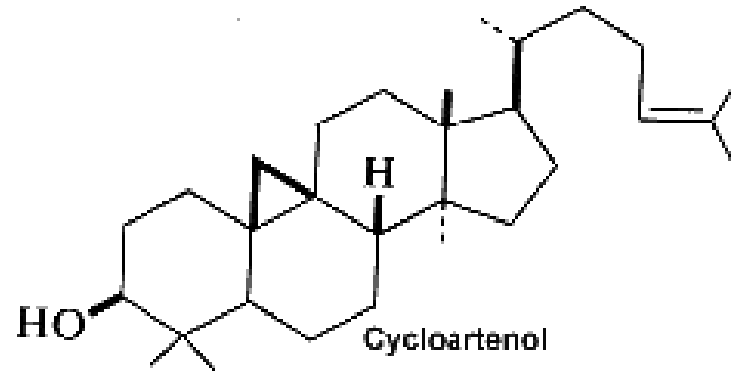
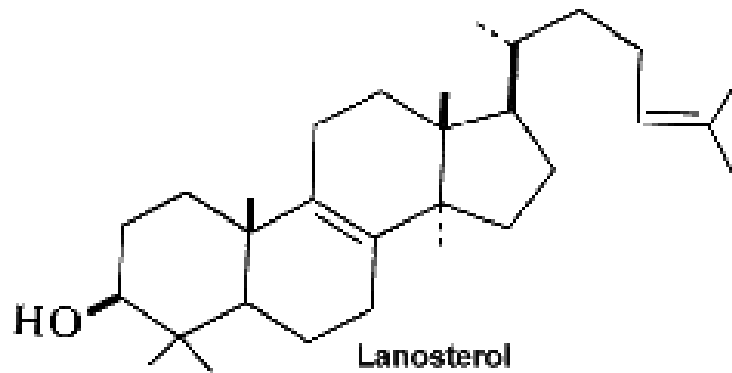
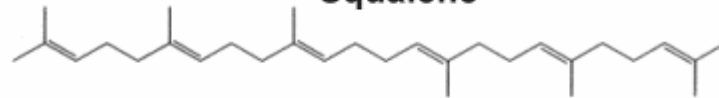
Methyl farnesoate



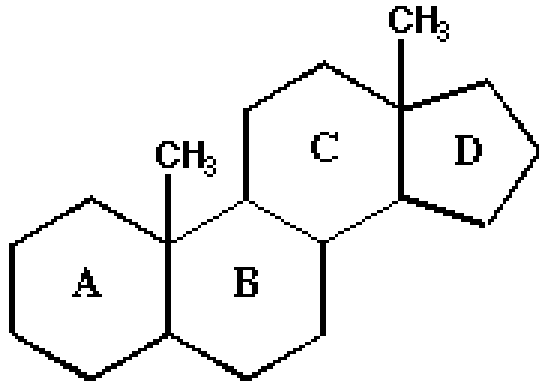
Juvenile hormone III

Triterpenoides (6 unidades de isopreno)

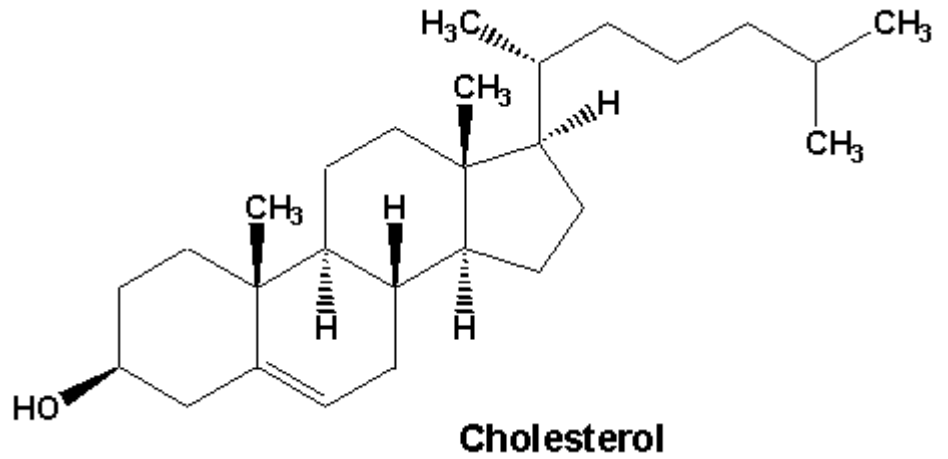
Squalene

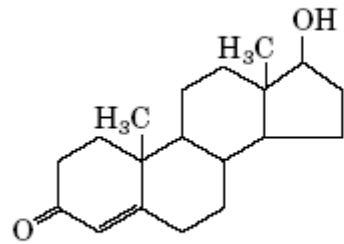


Esteroles

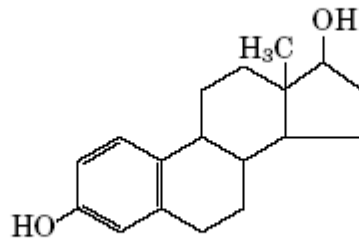


ciclopentanoperhidrofenantreno

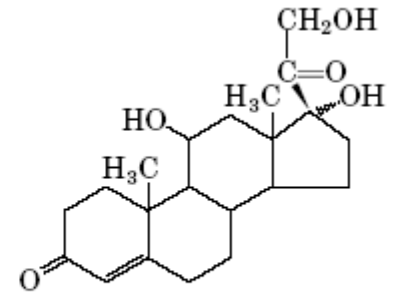




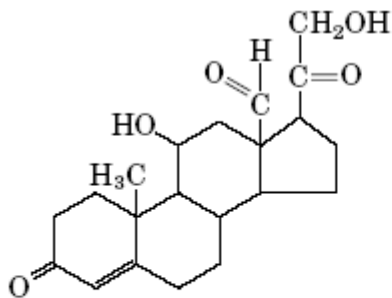
Testosterone



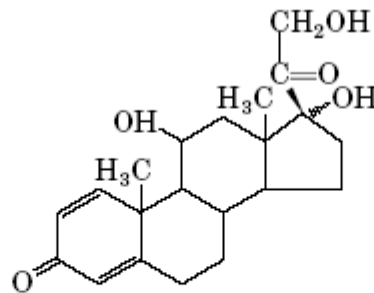
Estradiol



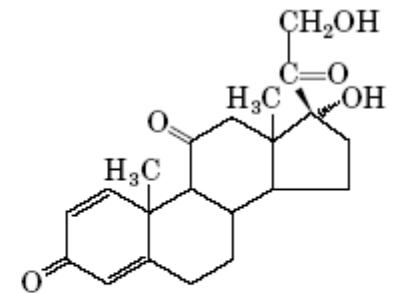
Cortisol



Aldosterone



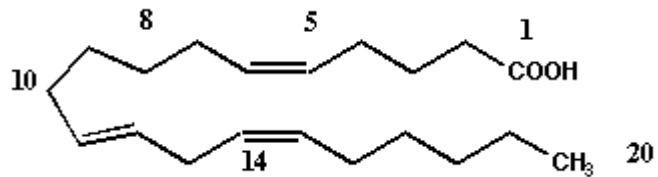
Prednisolone



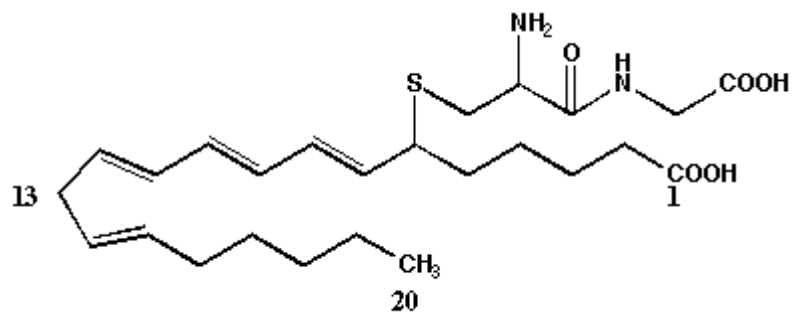
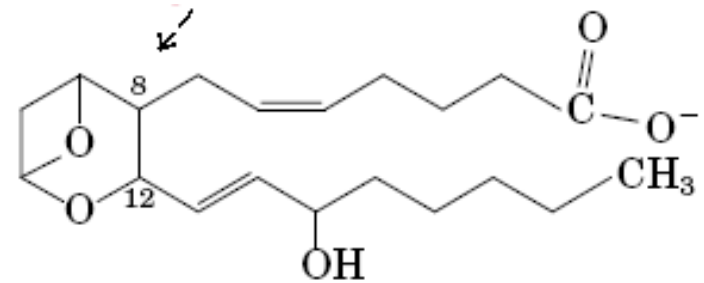
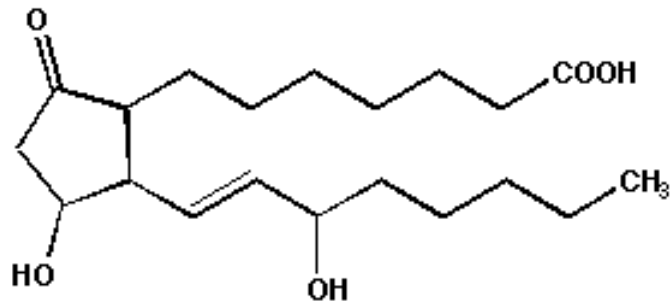
Prednisone

Hormonas esteroideas

Eicosanoides: Prostaglandinas, leucotrienos y tromboxanos

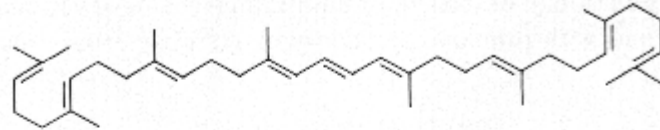


Ac. araquidónico 20:4($\Delta^{5,8,11,14}$)

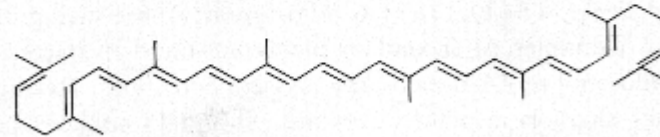


Carotenoides

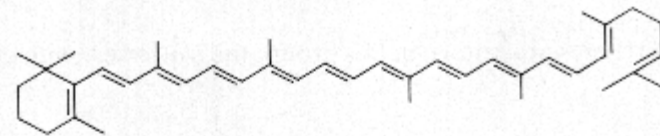
phytoene (C₄₀H₆₄; colorless; λ_{\max} , 285 nm)



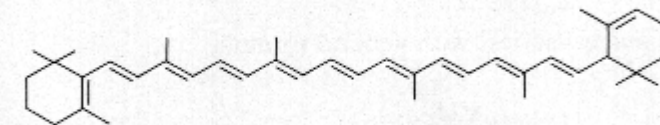
lycopene (C₄₀H₅₆; red; λ_{\max} , 476 nm)



γ -*carotene* (C₄₀H₅₆; orange; λ_{\max} , 460 nm)



α -*carotene* (C₄₀H₅₆; orange; λ_{\max} , 456 nm)



β -*carotene* (C₄₀H₅₆; orange; λ_{\max} , 463 nm)

