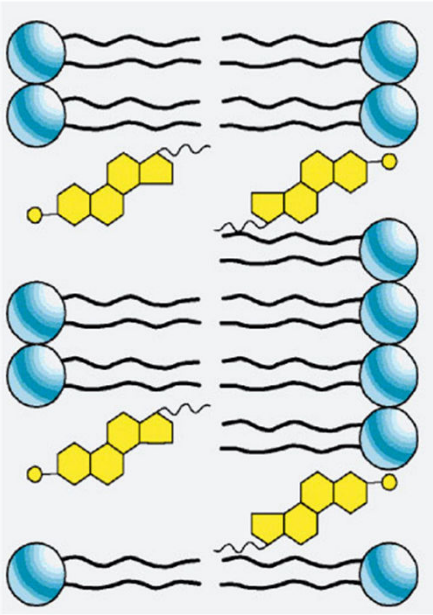
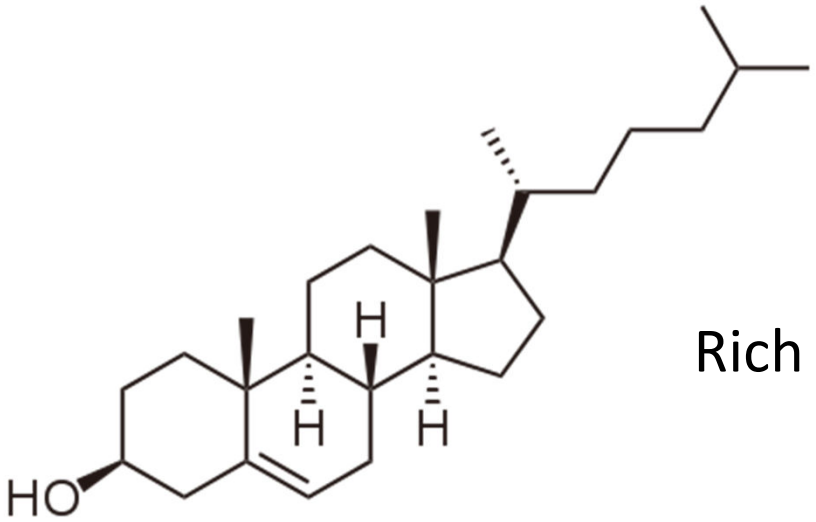


Lipids


SAINSBURY'S
PURE LARD
FOR DEEP AND SHALLOW FRYING AND BAKING
250 gram
Best before end
SAINSBURY'S
PURE LARD

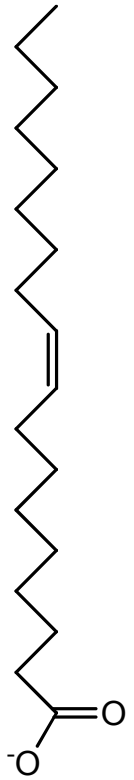
Lipids are hydrophobic or amphiphilic molecules with widely varying structures



Cholesterol

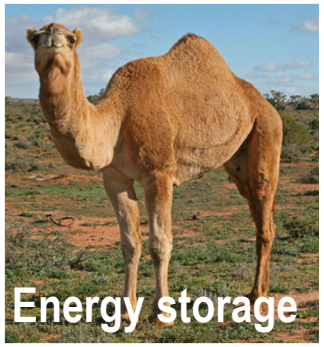
Rich in hydrocarbon

Polar group (usually small)

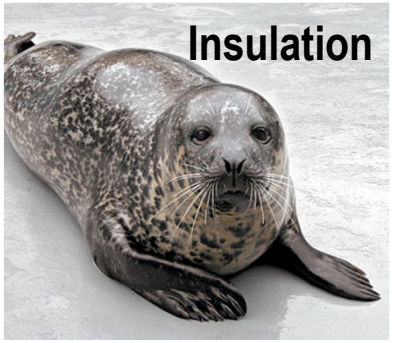


Oleic acid

Lipids serve a wide variety of functions

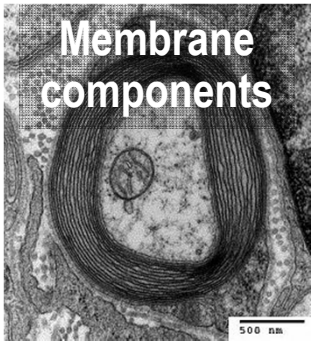


Triacylglycerols

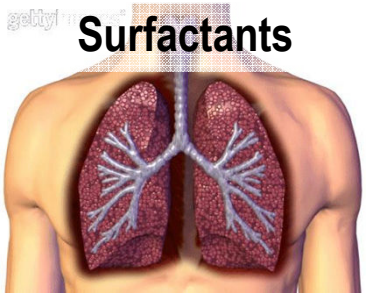


Triacylglycerols

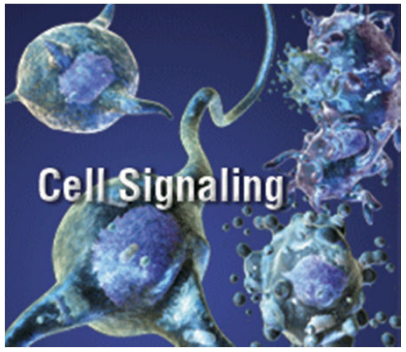
Waxes



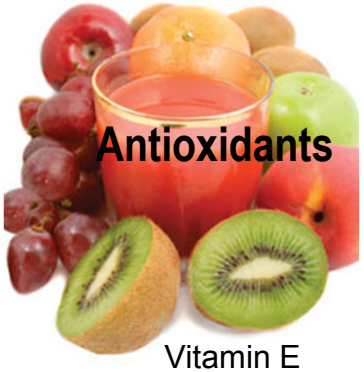
Phospholipids



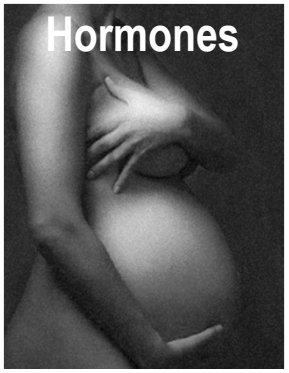
Dipalmitoyl-phosphatidylcholine



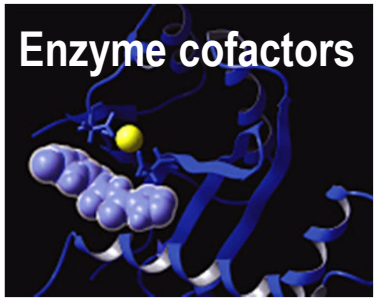
Eicosanoids



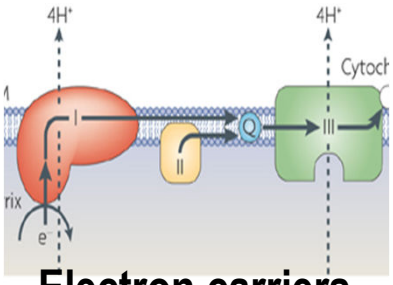
Vitamin E



Estrogens

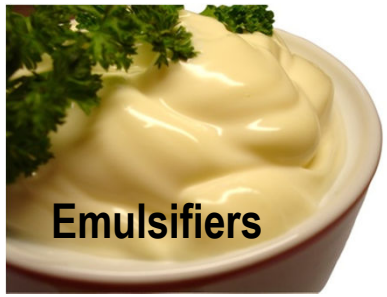


Vitamin K



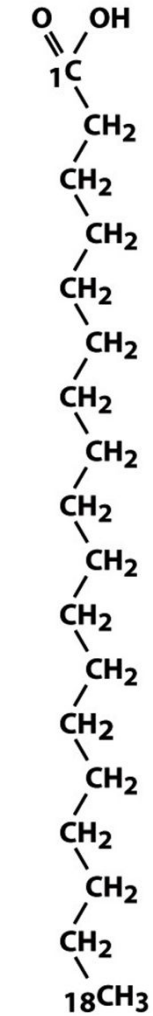
Coenzyme Q

Chlorophyll

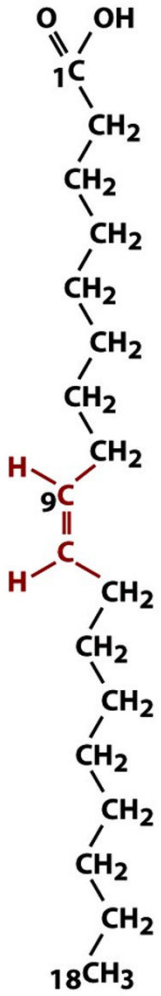


Bile acids

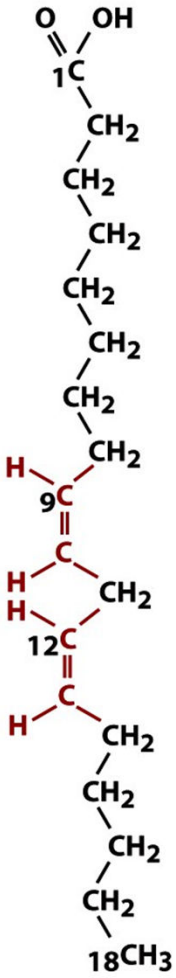
Fatty acids (soaps) vary in chain length and degree of unsaturation



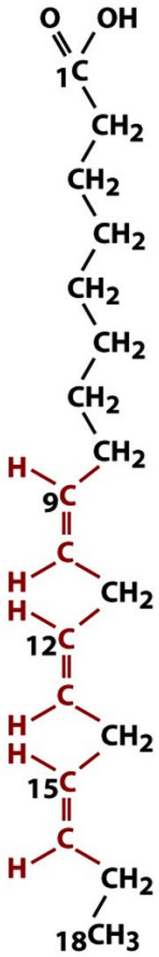
Stearic acid



Oleic acid

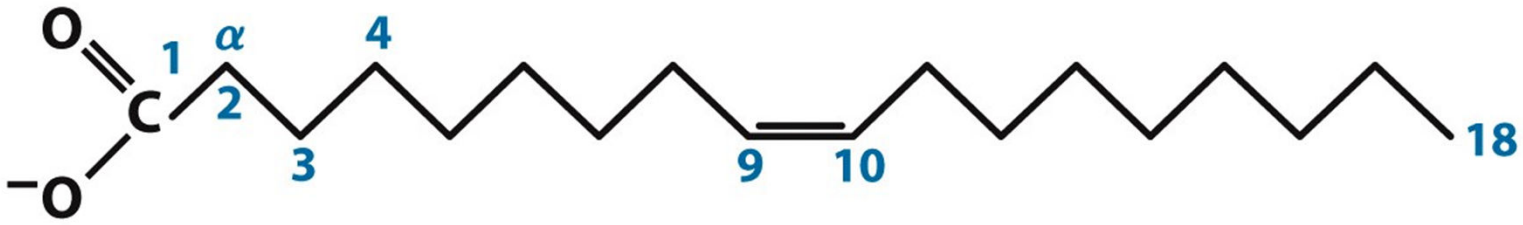


Linoleic acid

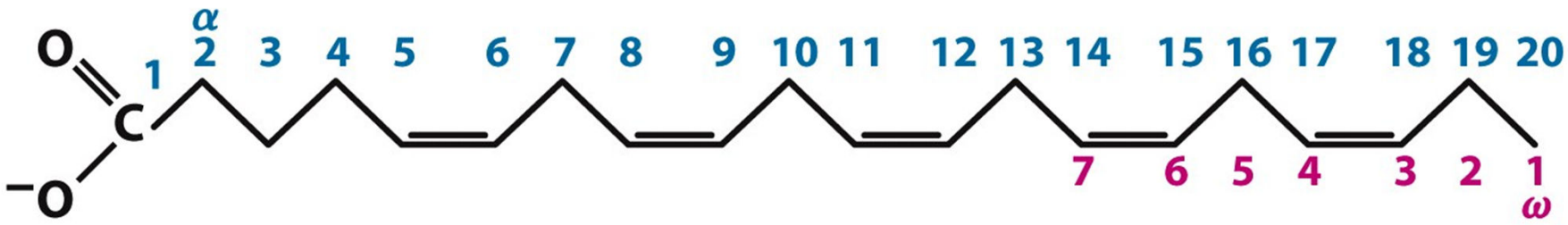


α-Linolenic acid

Fatty acids can be named from either the carboxyl (standard; Δ) or methyl (ω) end



(a) 18:1(Δ^9) *cis*-9-Octadecenoic acid



(b) 20:5($\Delta^{5,8,11,14,17}$) Eicosapentaenoic acid (EPA), an omega-3 fatty acid

Figure 10-1
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Fatty acid melting point increases with chain length and increasing saturation

Table 9-1 The Common Biological Fatty Acids

Symbol[a]	Common Name	Systematic Name	Structure	mp (°C)
Saturated fatty acids				
12:0	Lauric acid	Dodecanoic acid	$CH_3(CH_2)_{10}COOH$	44.2
14:0	Myristic acid	Tetradecanoic acid	$CH_3(CH_2)_{12}COOH$	53.9
16:0	Palmitic acid	Hexadecanoic acid	$CH_3(CH_2)_{14}COOH$	63.1
18:0	Stearic acid	Octadecanoic acid	$CH_3(CH_2)_{16}COOH$	69.6
20:0	Arachidic acid	Eicosanoic acid	$CH_3(CH_2)_{18}COOH$	77
22:0	Behenic acid	Docosanoic acid	$CH_3(CH_2)_{20}COOH$	81.5
24:0	Lignoceric acid	Tetracosanoic acid	$CH_3(CH_2)_{22}COOH$	88
Unsaturated fatty acids (all double bonds are cis)				
16:1*n*–7	Palmitoleic acid	9-Hexadecanoic acid	$CH_3(CH_2)_5CH=CH(CH_2)_7COOH$	−0.5
18:1*n*–9	Oleic acid	9-Octadecanoic acid	$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$	12
18:2*n*–6	Linoleic acid	9,12-Octadecadienoic acid	$CH_3(CH_2)_4(CH=CHCH_2)_2(CH_2)_6COOH$	−5
18:3*n*–3	α-Linolenic acid	9,12,15-Octadecatrienoic acid	$CH_3CH_2(CH=CHCH_2)_3(CH_2)_6COOH$	−11
18:3*n*–6	γ-Linolenic acid	6,9,12-Octadecatrienoic acid	$CH_3(CH_2)_4(CH=CHCH_2)_3(CH_2)_3COOH$	−11
20:4*n*–6	Arachidonic acid	5,8,11,14-Eicosatetraenoic acid	$CH_3(CH_2)_4(CH=CHCH_2)_4(CH_2)_2COOH$	−49.5
20:5*n*–3	EPA	5,8,11,14,17-Eicosapentaenoic acid	$CH_3CH_2(CH=CHCH_2)_5(CH_2)_2COOH$	−54
22:6*n*–3	DHA	4,7,10,13,16,19-Docosohexenoic acid	$CH_3CH_2(CH=CHCH_2)_6CH_2COOH$	−44
24:1*n*–9	Nervonic acid	15-Tetracosenoic acid	$CH_3(CH_2)_7CH=CH(CH_2)_{13}COOH$	39

Cis-double bonds (normal for fatty acids) kink the hydrocarbon chain

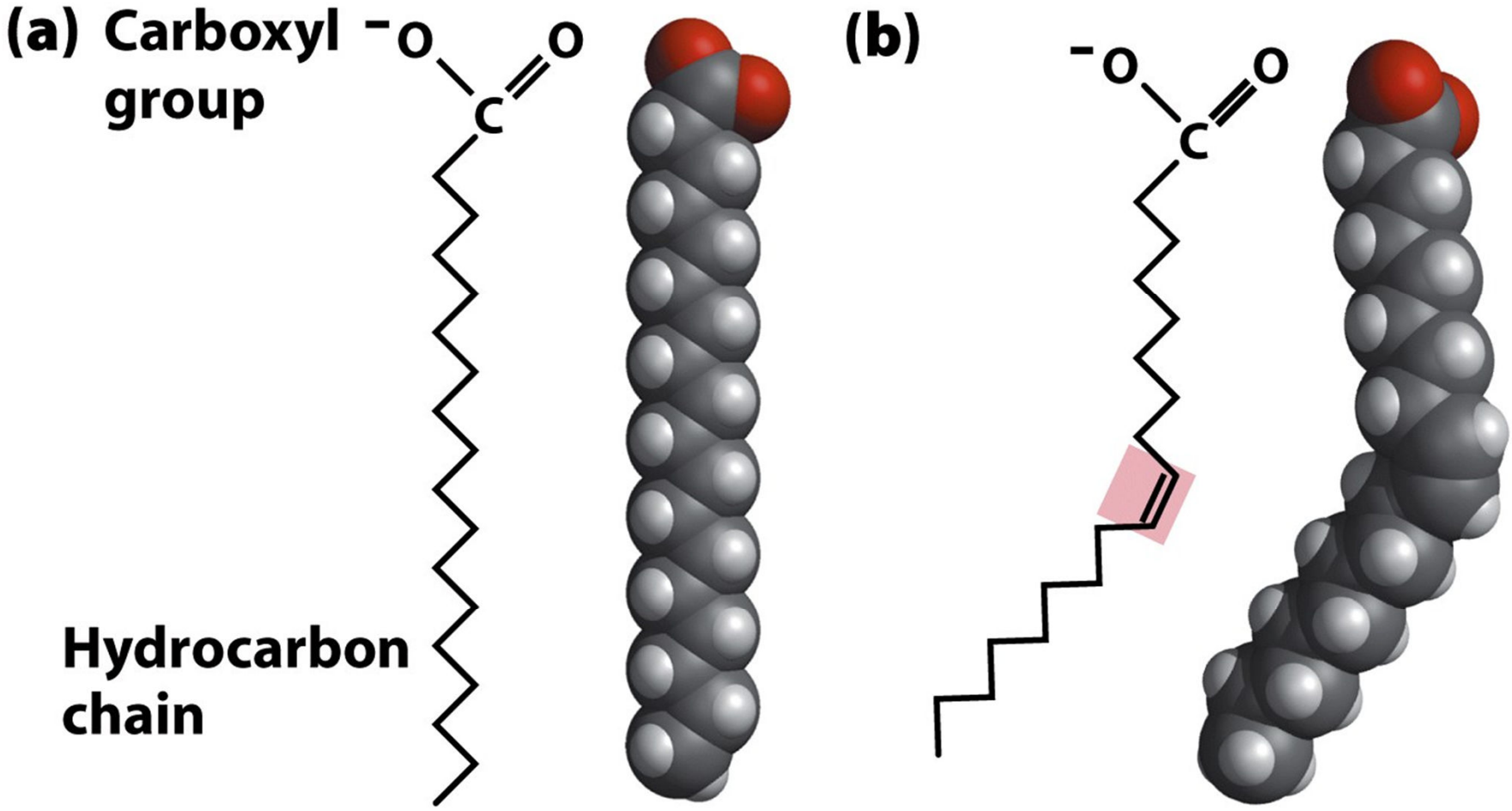


Figure 10-2ab
Lehninger Principles of Biochemistry, Fifth Edition

Unsaturations prevent close packing and lower the melting point (increase fluidity)

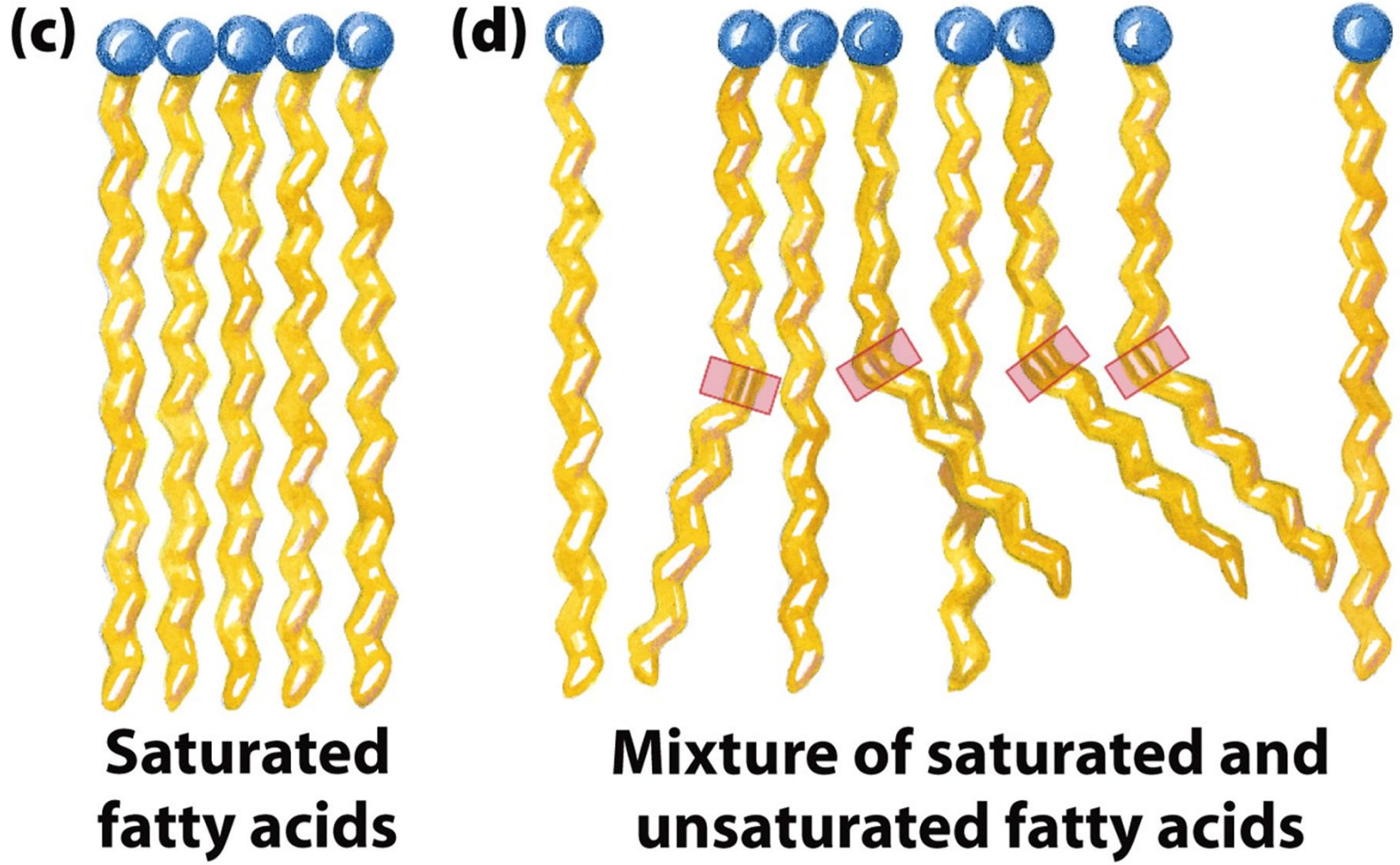


Figure 10-2cd
Lehninger Principles of Biochemistry, Fifth Edition

The FA composition of natural fats explains their consistency at room temperature

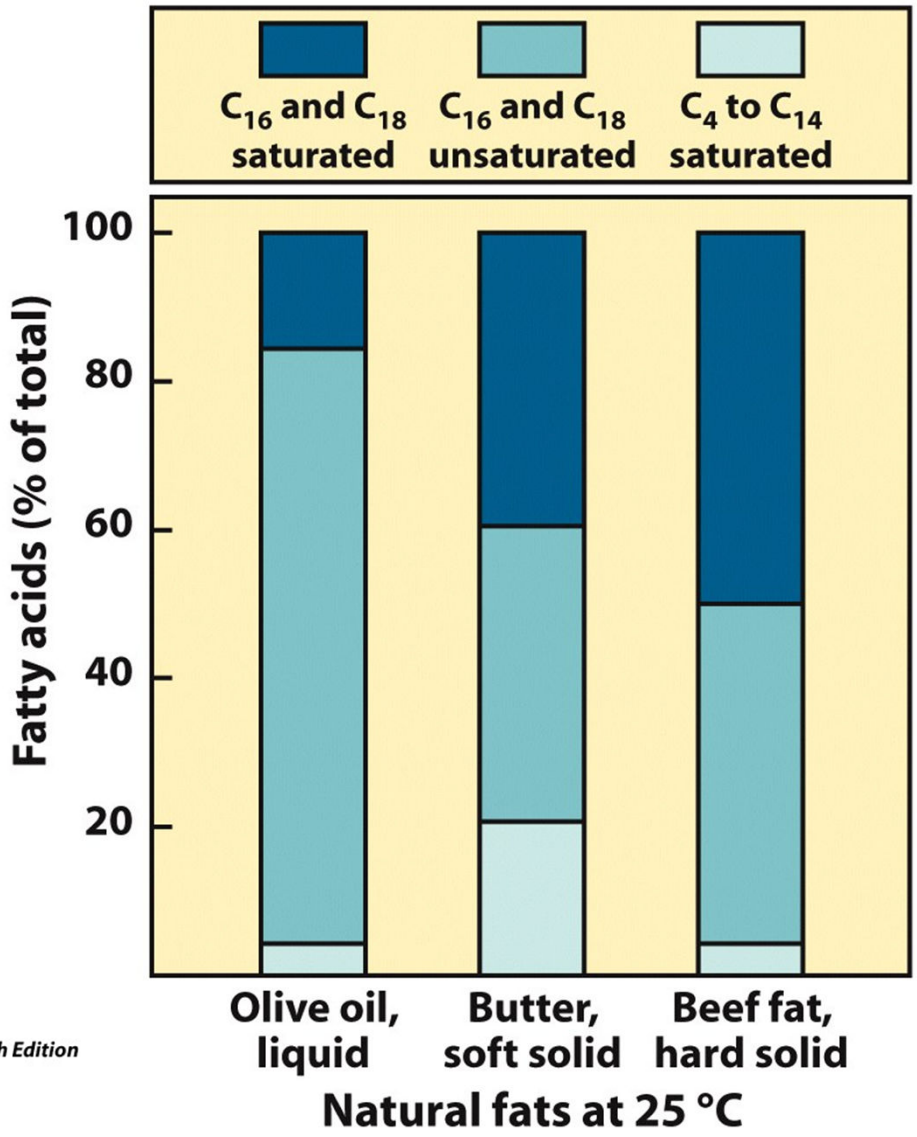
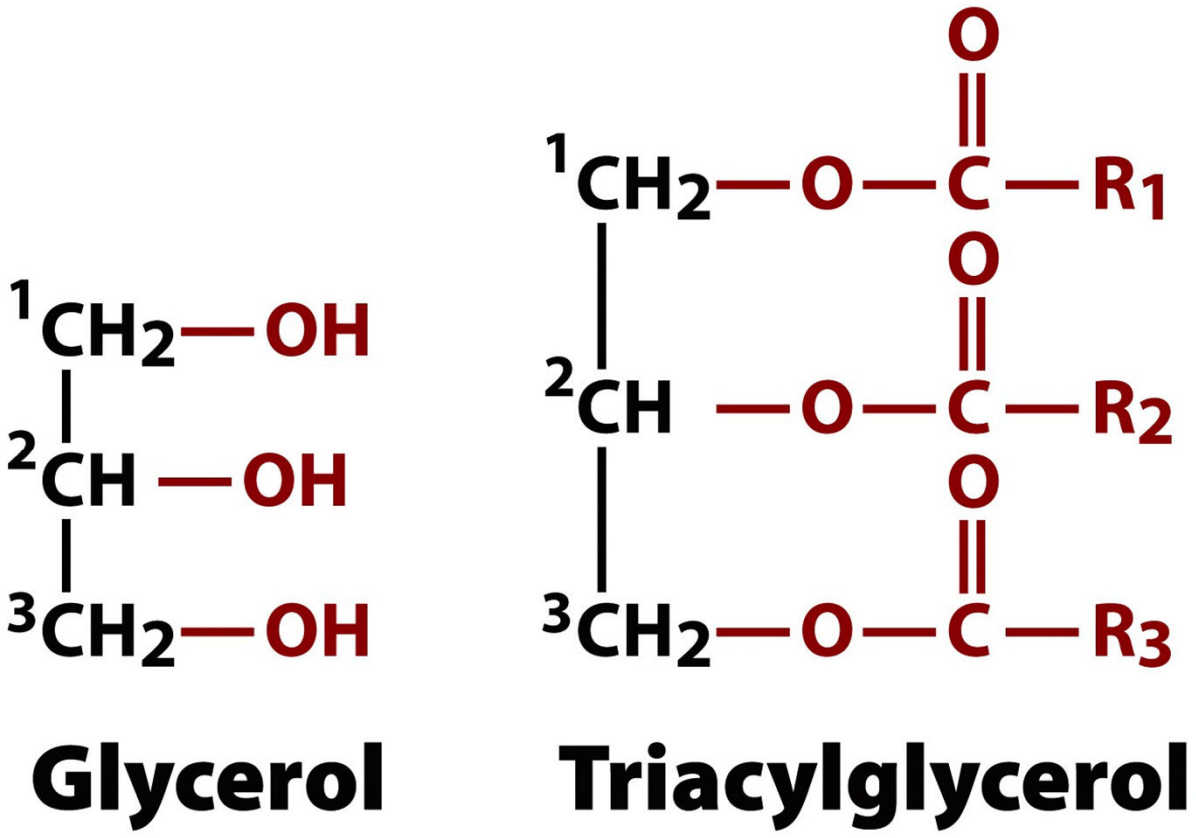
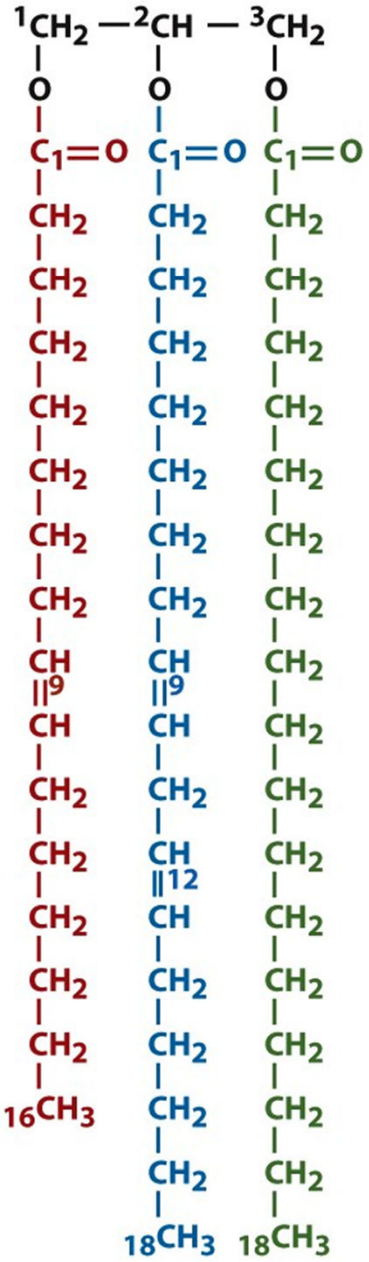


Figure 10-5
Lehninger Principles of Biochemistry, Fifth Edition

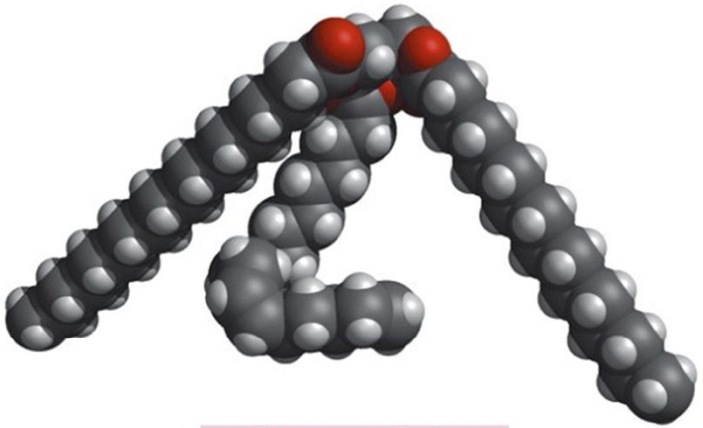
Lipids are used for energy storage

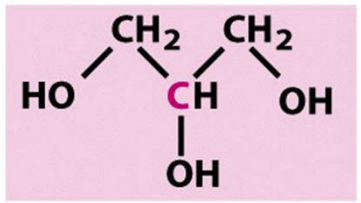
Triacylglycerols (triglycerides), composed of glycerol and FAs, are energy-storage lipids



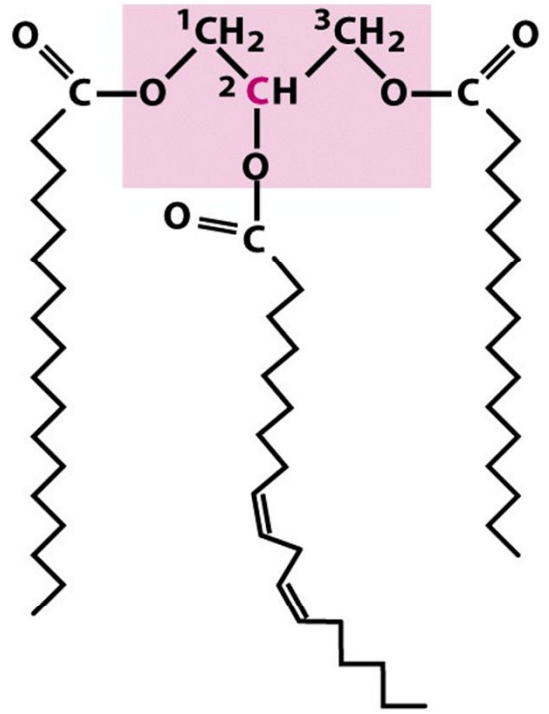


1-Palmitoleoyl-2-linoleoyl-
3-stearoyl-glycerol





Glycerol



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

Figure 10-3
Lehninger Principles of Biochemistry, Fifth Edition

Adipocytes are filled with fat (triacylglycerols)

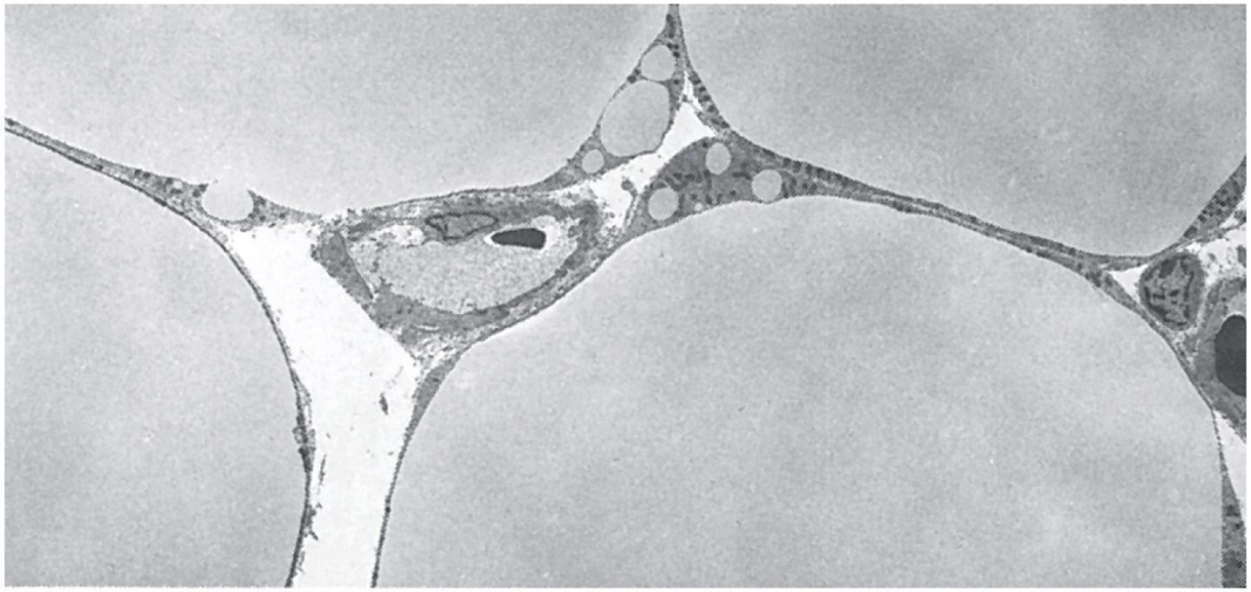
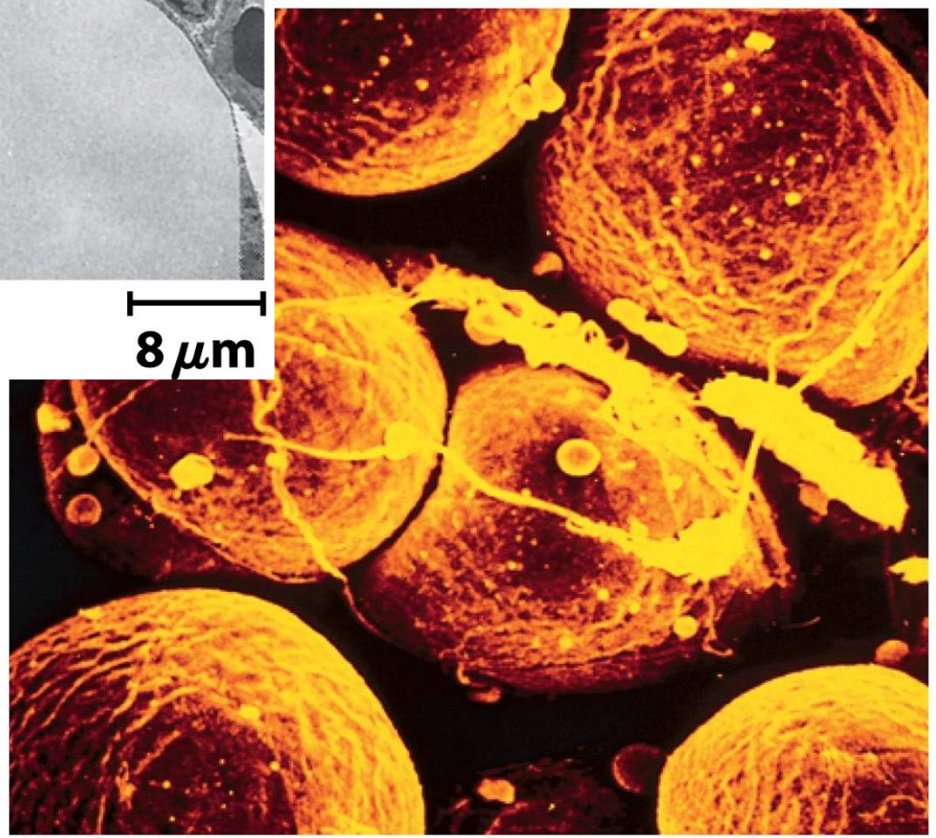


Figure 10-4a
Lehninger Principles of Biochemistry, Fifth Edition



Waxes combine a fatty acid and an alcohol

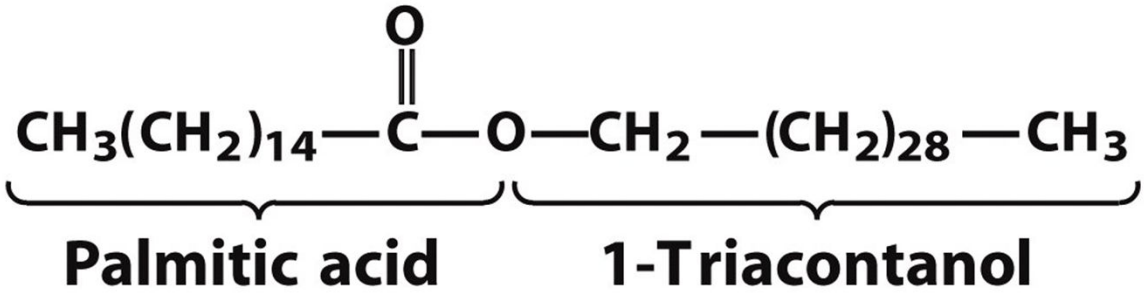
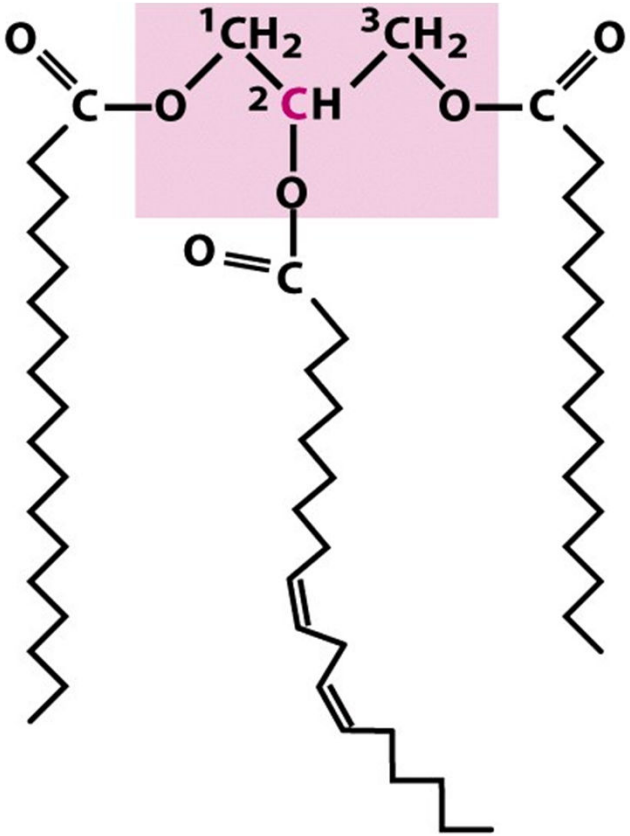
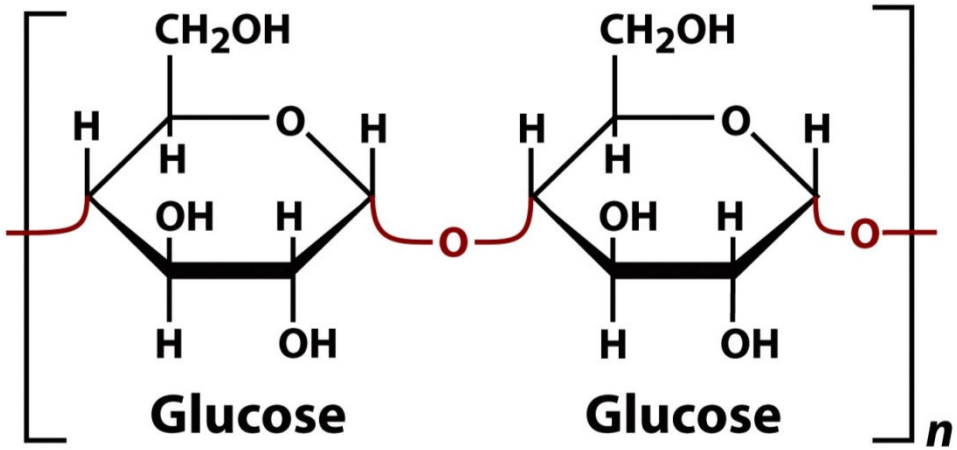


Figure 10-6
Lehninger Principles of Biochemistry, Fifth Edition

Lipids provide a more efficient form of energy storage than carbohydrates





Carbohydrates are:

- More oxidized
- Hydrated

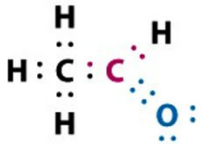
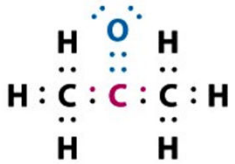
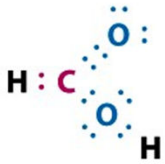
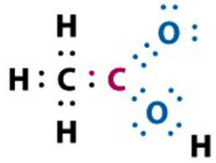
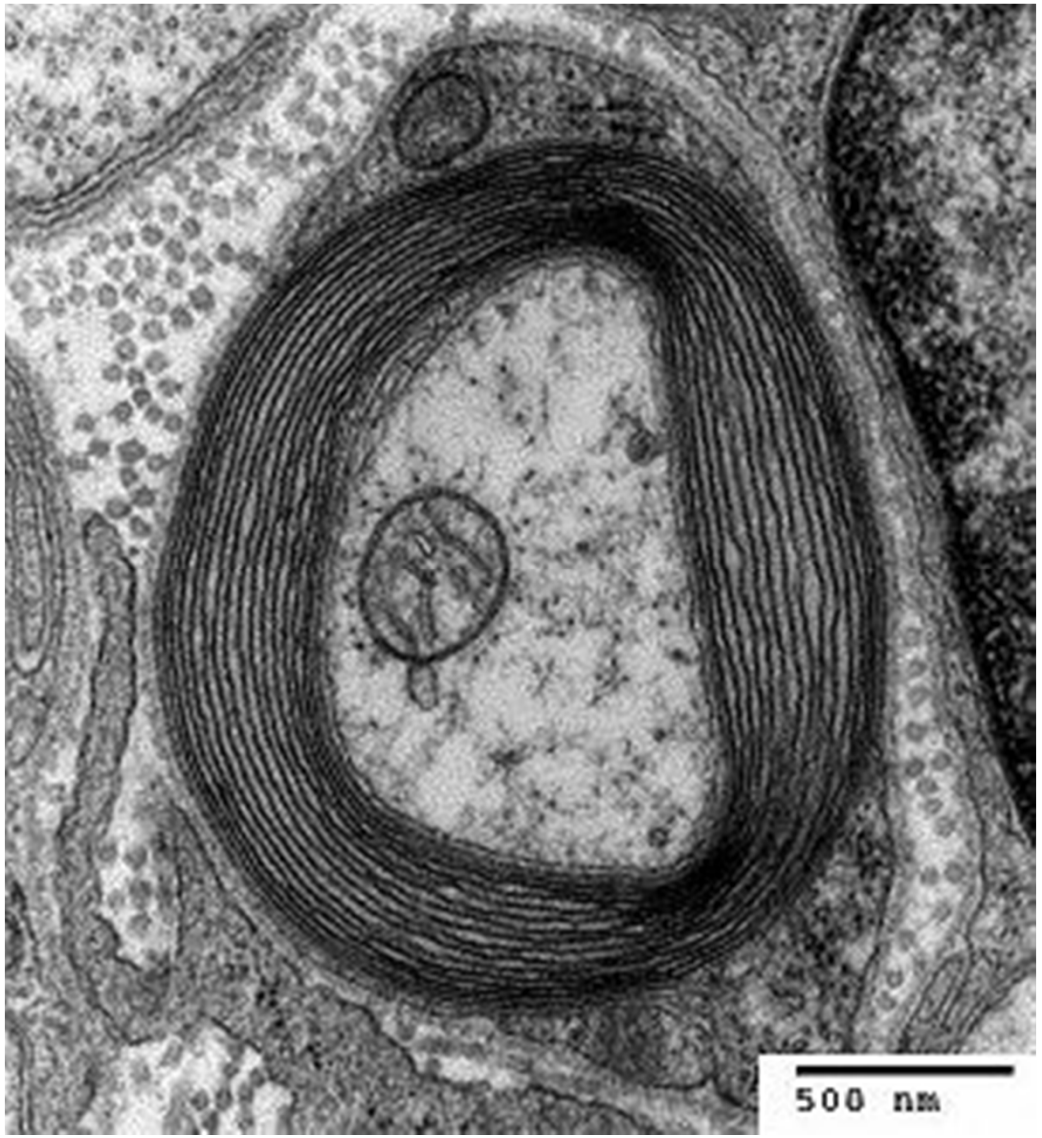
Methane		**8**
Ethane (alkane)		**7**
Ethene (alkene)		**6**
Ethanol (alcohol)		**5**
Acetylene (alkyne)		**5**
Formaldehyde		**4**
Acetaldehyde (aldehyde)		**3**
Acetone (ketone)		**2**
Formic acid (carboxylic acid)		**2**
Carbon monoxide		**2**
Acetic acid (carboxylic acid)		**1**
Carbon dioxide		**0**

Figure 13-22
Lehninger Principles of Biochemistry, Fifth Edition

Oxidation states of carbon in the biosphere. Focus on the red carbon atom and its bonding electrons. When this carbon is bonded to the less electronegative H atom, both bonding electrons (red) are assigned to the carbon. When carbon is bonded to another carbon, bonding electrons are shared equally, so one of the two electrons is assigned to the red carbon. When the red carbon is bonded to the more electronegative O atom, the bonding electrons are assigned to the oxygen. The number to the right of each compound is the number of electrons "owned" by the red carbon, a rough expression of the oxidation state of that carbon. As the red carbon undergoes oxidation (loses electrons), the number gets smaller. Thus the oxidation state increases from top lwft to bottom right of the figure.

Lipids are a major component of biological membranes



Membrane lipids can be divided into groups based on their parent compound

Glycerol-based lipids (glycerolipids)

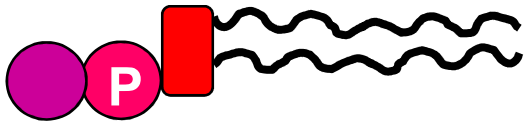
glycerol + 2 fatty acids + …

Sphingosine-based lipids (sphingolipids or ceramides)

sphingosine + 1 fatty acid + …

phospholipids

glycerophospholipids



phosphate + alcohol

sphingomyelins

phosphate + alcohol

glycolipids

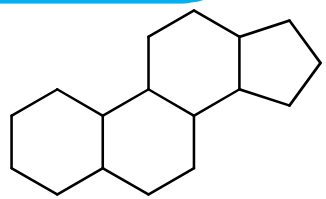
galactolipids & sulfolipids

sugar(s)

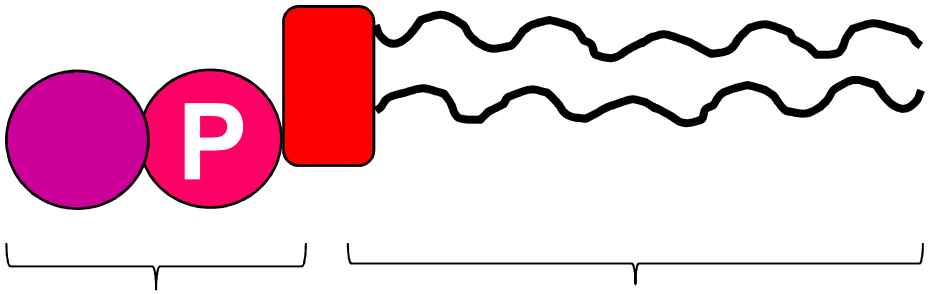
cerebrosides, globosides, & gangliosides

sugar(s)

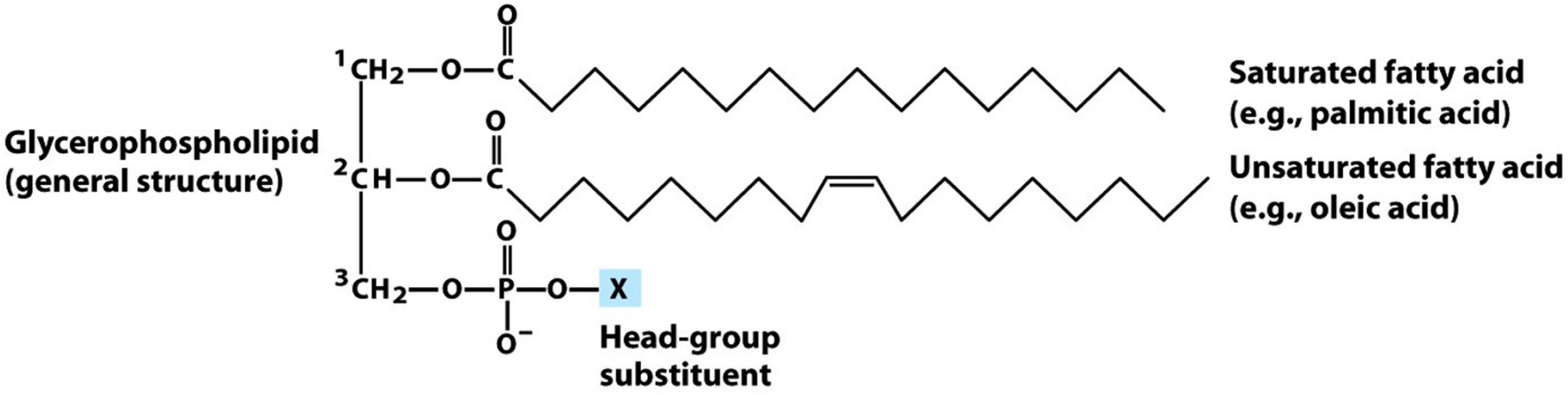
Cyclopentanoperhydrophen-anthrene-based lipids (sterols)

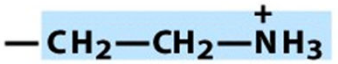
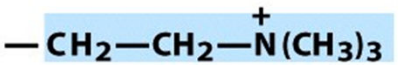
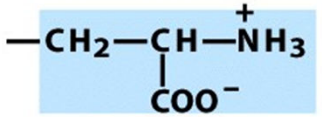
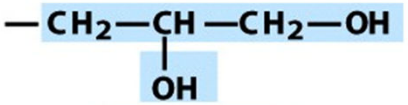
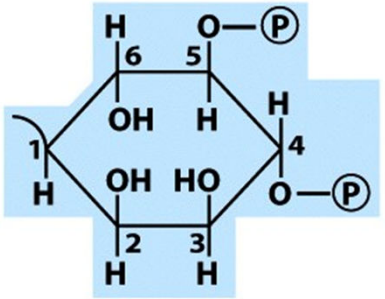
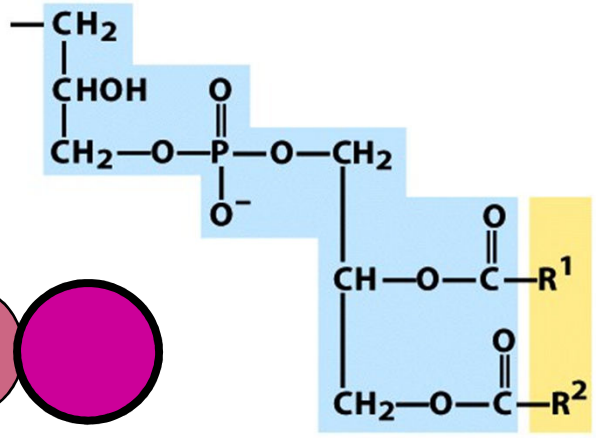


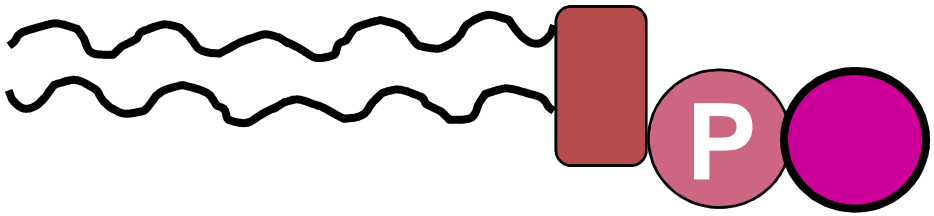
Glycerophospholipids vary in the alcohol of their 'head group'



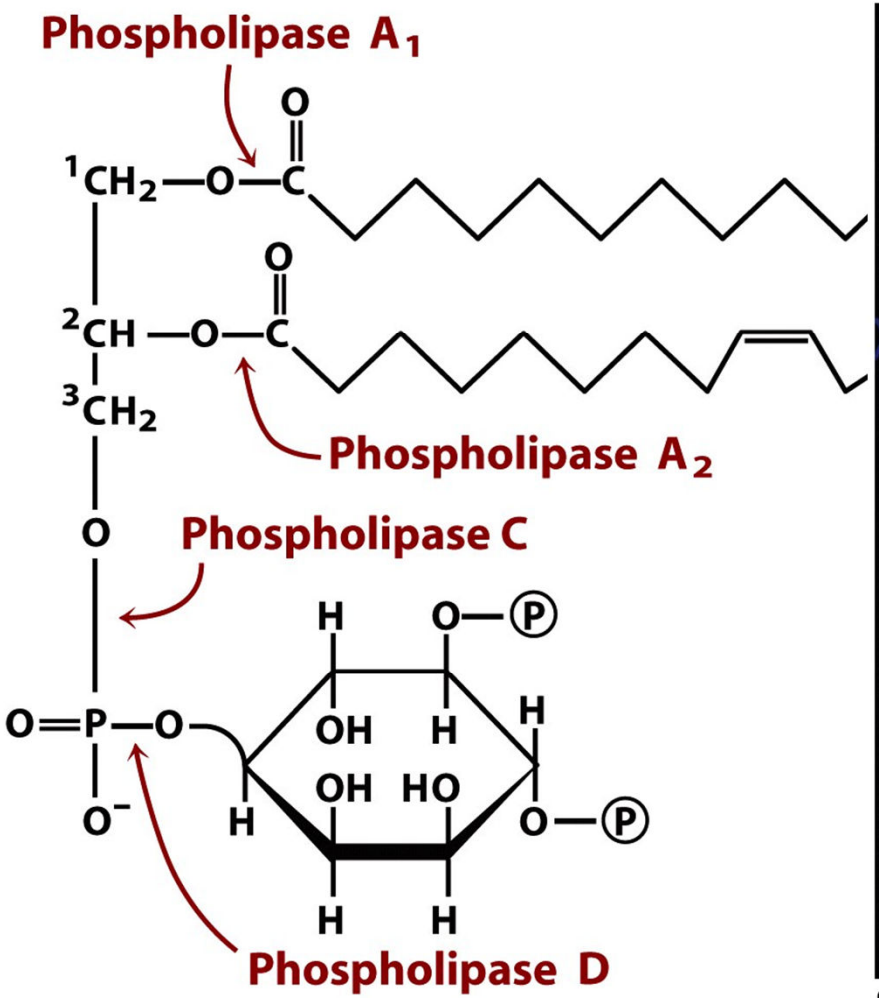
Polar head group Hydrophobic tails

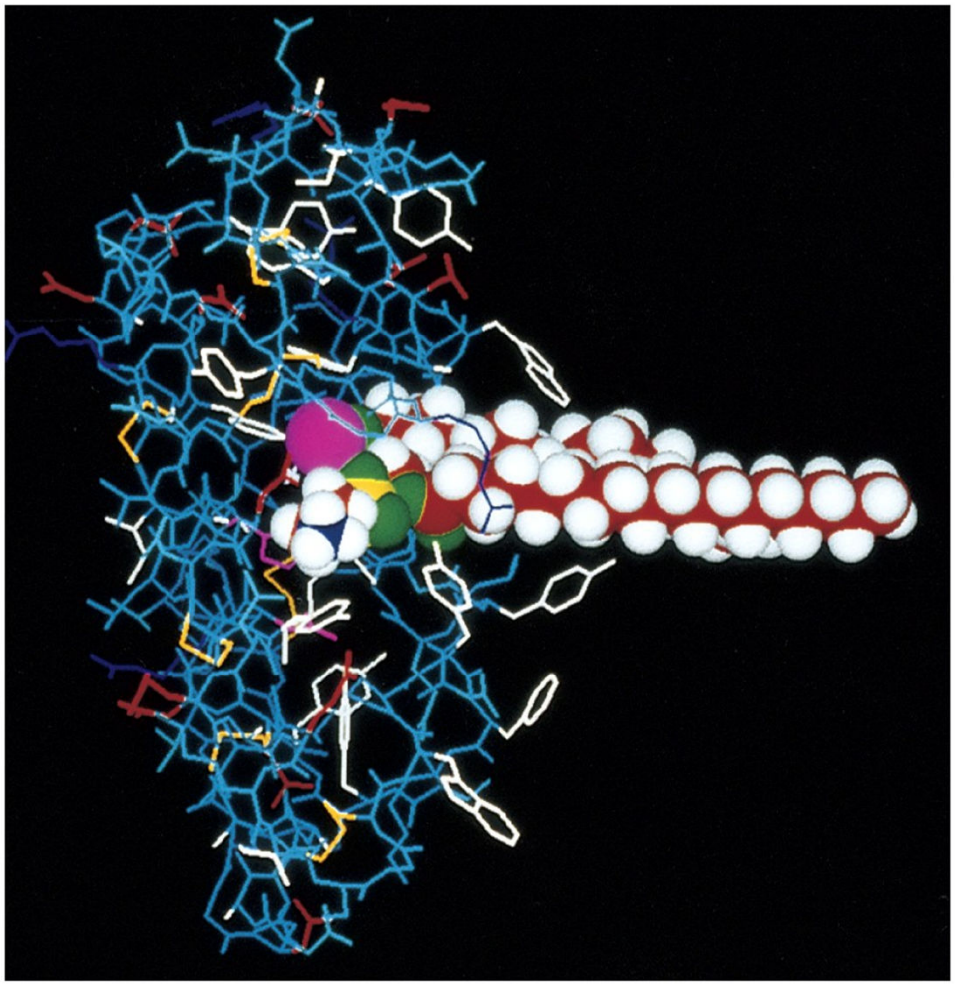


Name of glycerophospholipid	Name of X	Formula of X	Net charge (at pH 7)
Phosphatidic acid	—		– 1
Phosphatidylethanolamine	Ethanolamine		0
Phosphatidylcholine	Choline		0
Phosphatidylserine	Serine		– 1
Phosphatidylglycerol	Glycerol		– 1
Phosphatidylinositol 4,5-bisphosphate	*myo*-Inositol 4,5-bisphosphate		– 4
Cardiolipin	Phosphatidyl-glycerol		– 2



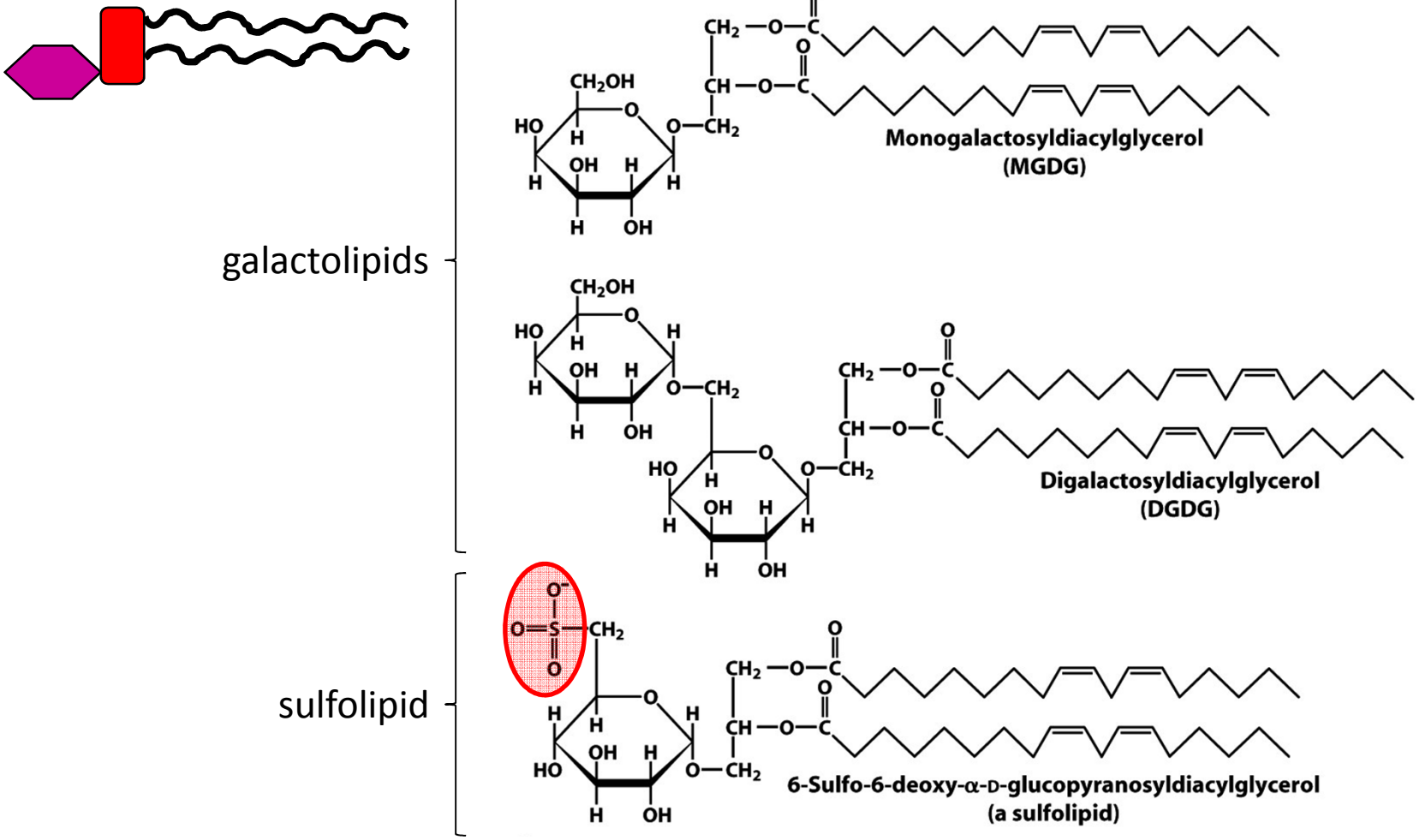
Phospholipases are enzymes that hydrolyze glycerophospholipids



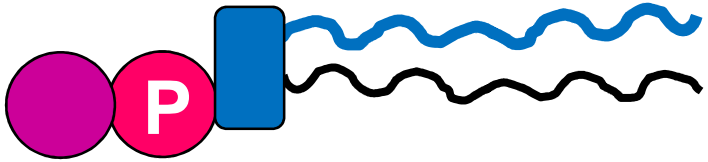


Courtesy of Edward A. Dennis, University of California at San Diego

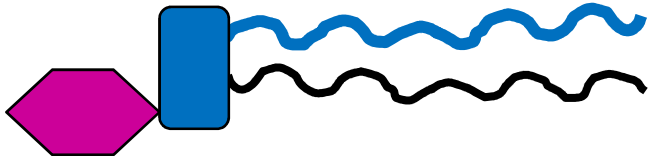
Chloroplast (plant) membranes contain glycerol-based glycolipids



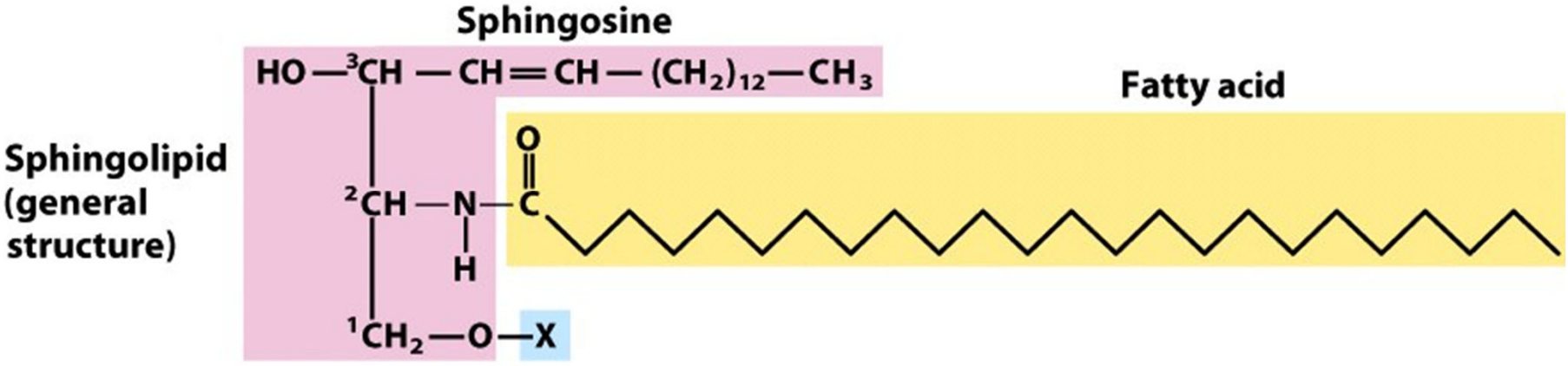
Sphingolipids contain sphingosine, a fatty acid, and a variable polar head group



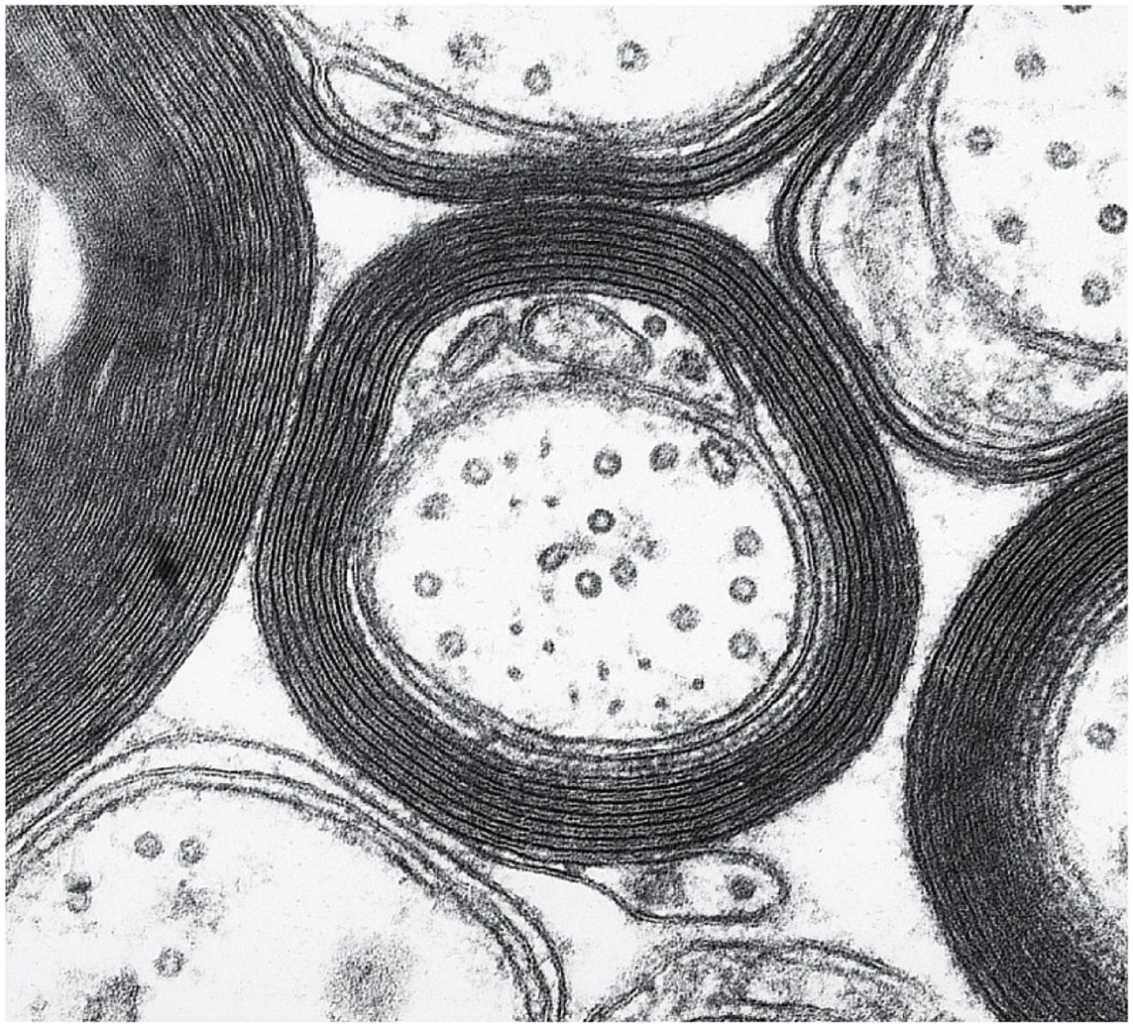
Sphingomyelins – phosphocholine or phosphoethanolamine



Cerebrosides – neutral monosaccharide
Globosides – neutral di/tri/tetrasaccharide
Gangliosides – charged oligosaccharide

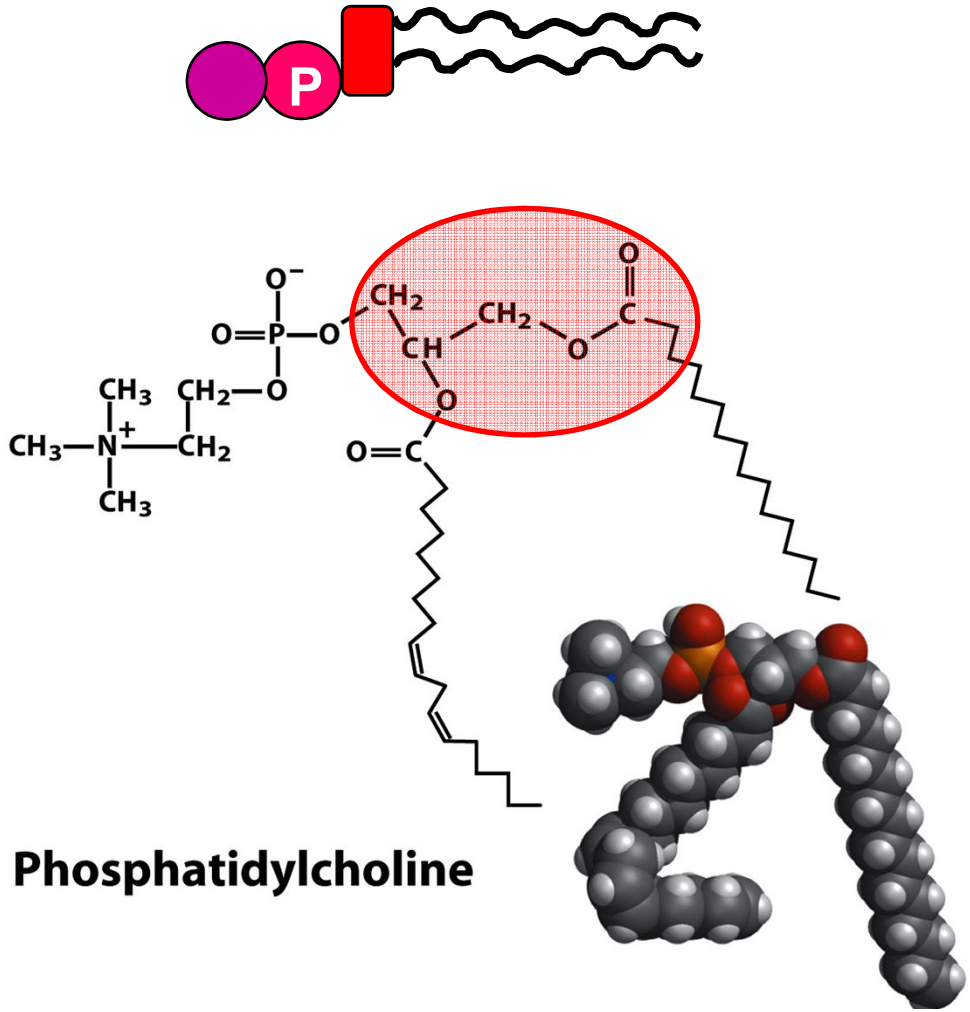


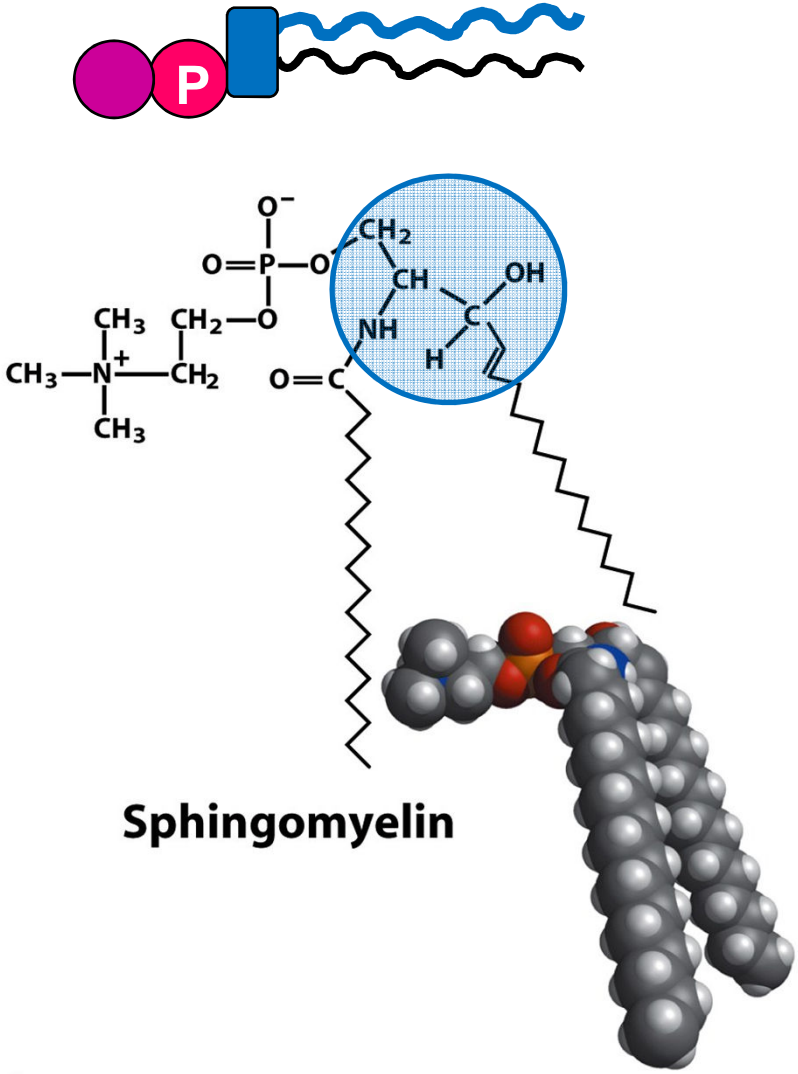
Sphingomyelins are enriched in the myelin sheath of neurons



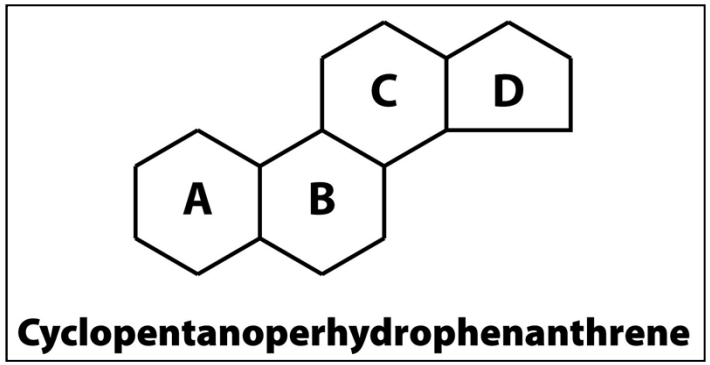
Courtesy of Cedric S. Raine, Albert Einstein College of Medicine

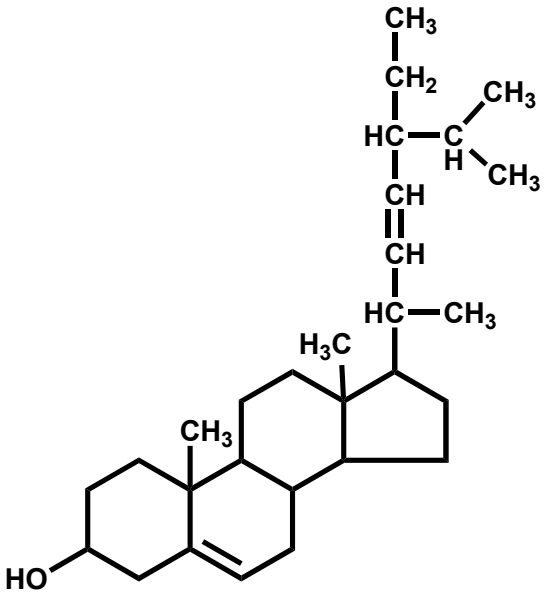
Glycerophospholipids and sphingo-myelins have similar structures



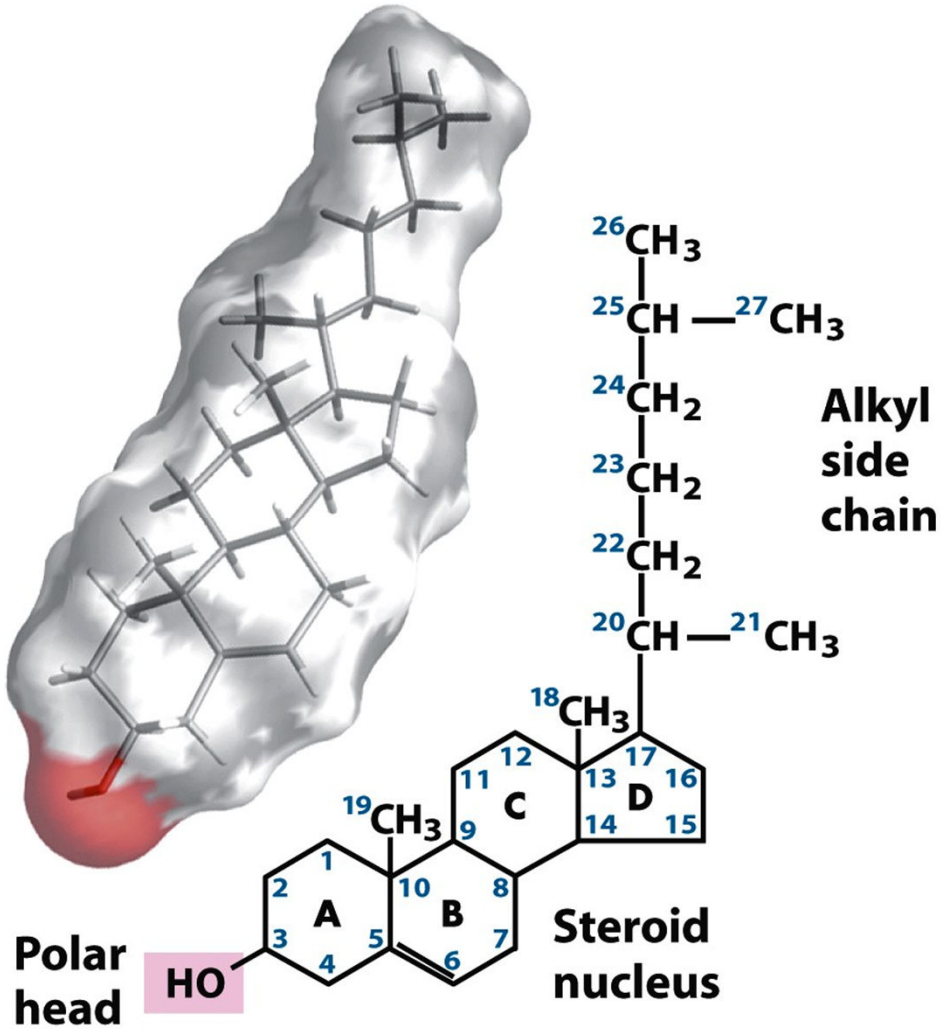


Steroids and sterols are derivatives of a non-planar fused-ring compound





Stigmasterol – found in plants



Cholesterol – found in animals