Structure of lipids

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Lipids

= group of biological molecules that are insoluble in aqueous solutions

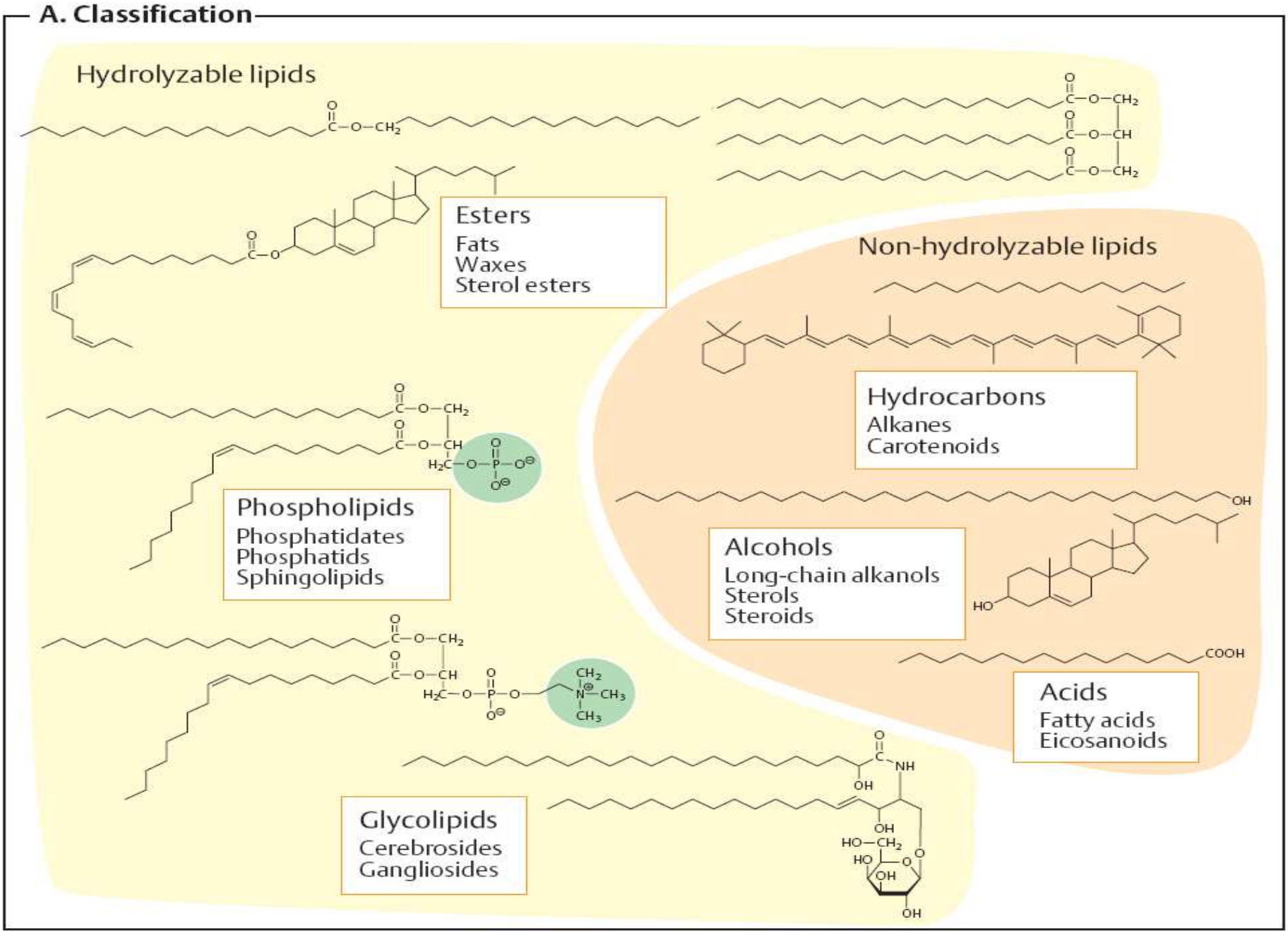
and soluble in organic solvents

- **structural** components of biological membranes
- **energy** reserves, predominantly in the form of triacylglycerols (TAG)
- excellent mechanical and thermal **insulators**
- **biologically active** compounds
  (vitamins, hormones, bile acids, visual pigment)

Classification of lipids

1. **by composition**
   - simple lipids
   - complex lipids (lipid + other compound)

2. **by structure**
   - hydrolyzable lipids
   - nonhydrolyzable lipids

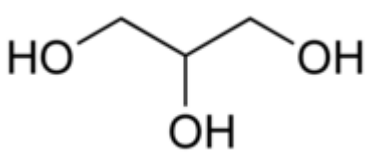


The figure was adopted from: J.Koolman, K.H.Röhm / Color Atlas of Biochemistry, 2nd edition, Thieme 2005

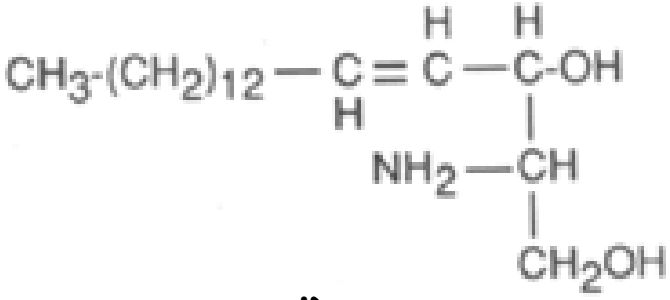
Structural components of lipids

- **alcohols**
  - glycerol (a)
  - sfingosine (b)
  - cholesterol (c)
  - inositol (d)

a)



b)



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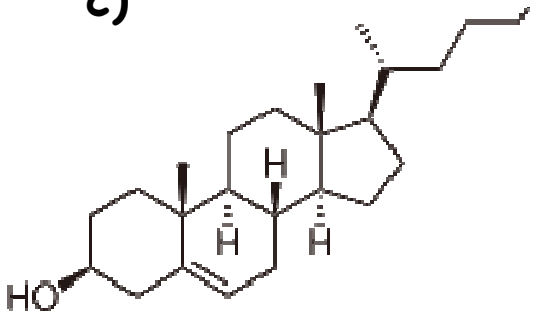

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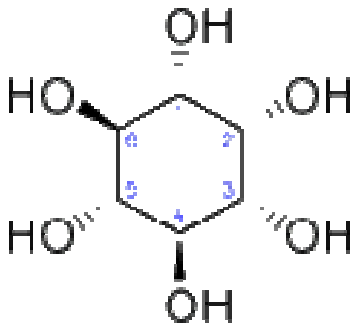
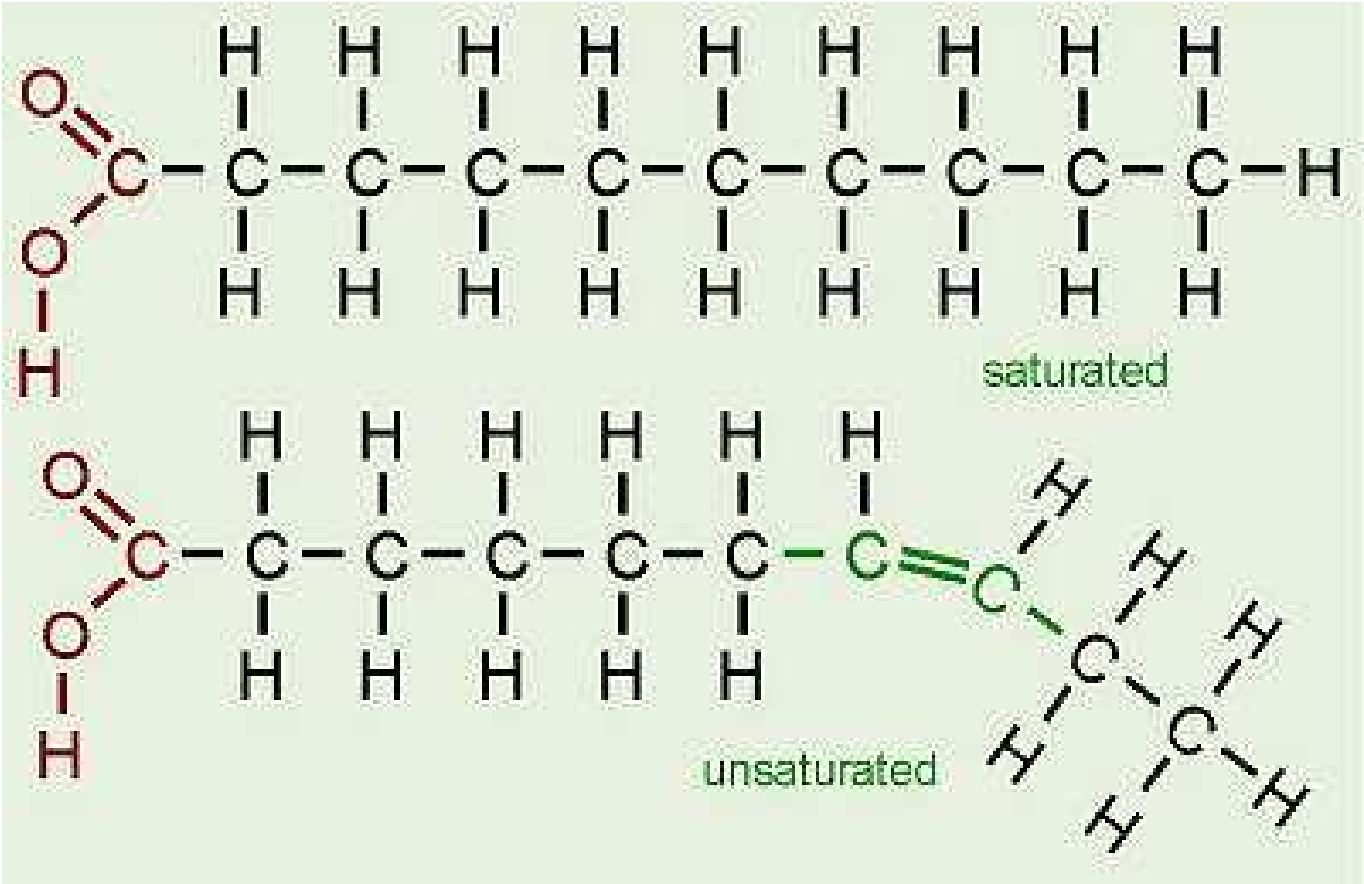


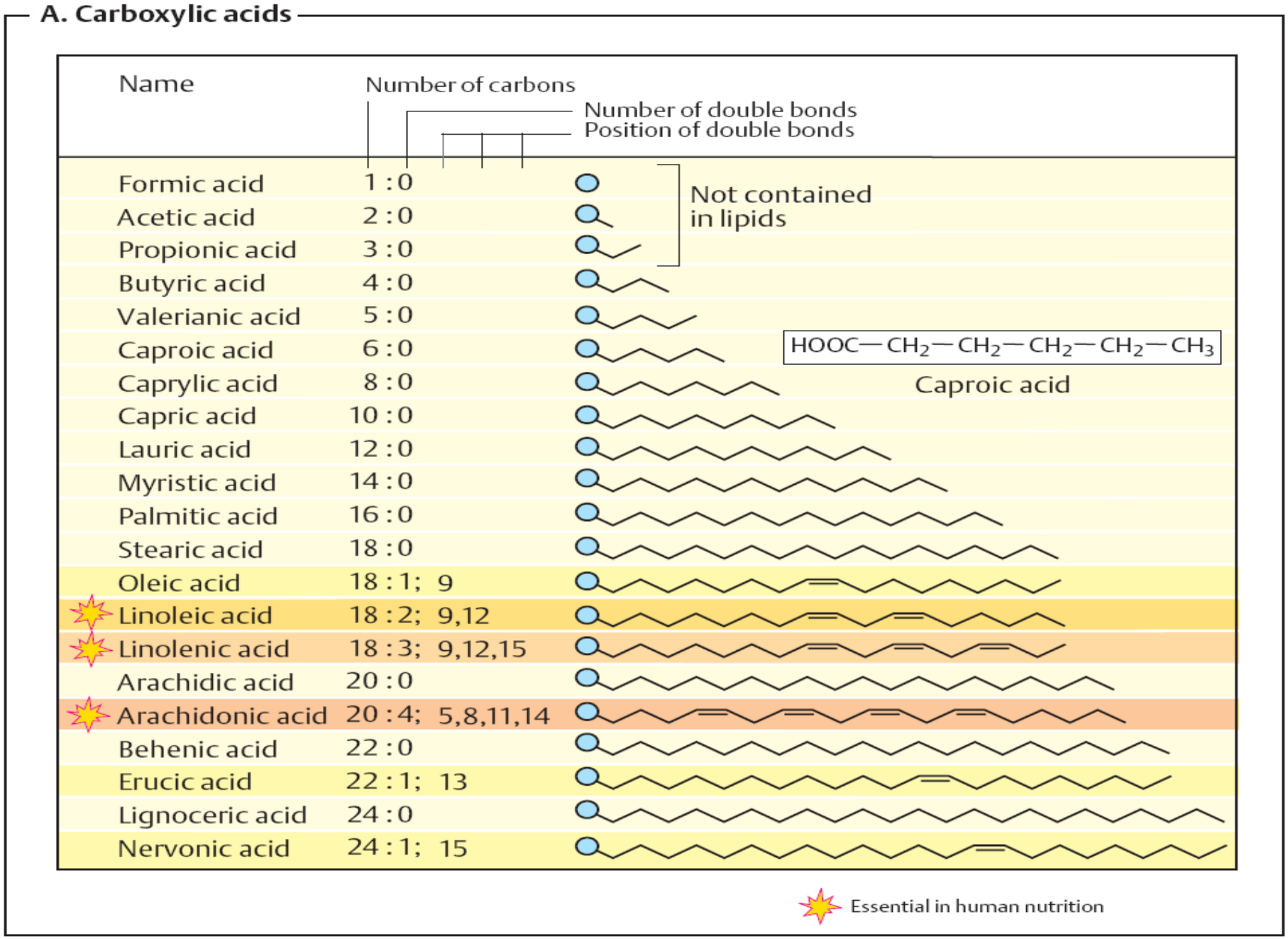
- long chain carboxylic acids acids (= **fatty acids**)

The figures are adopted from http://en.wikipedia.org (April 2007)

Free Fatty Acids
(FFA)



The figure is found at http://www.tvdsb.on.ca/saunders/courses/online/SBI3C/Cells/Lipids.htm (Jan 2007)



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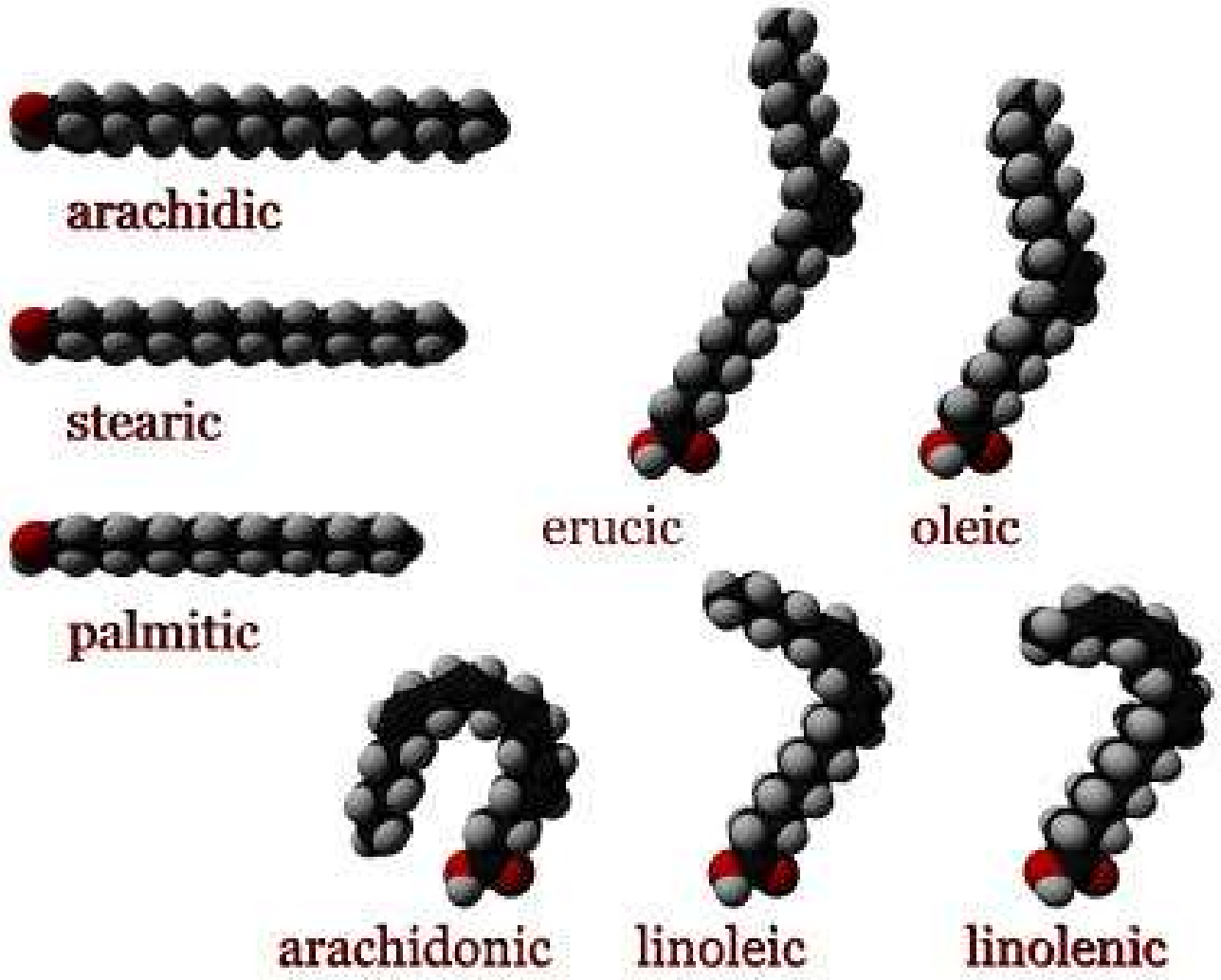
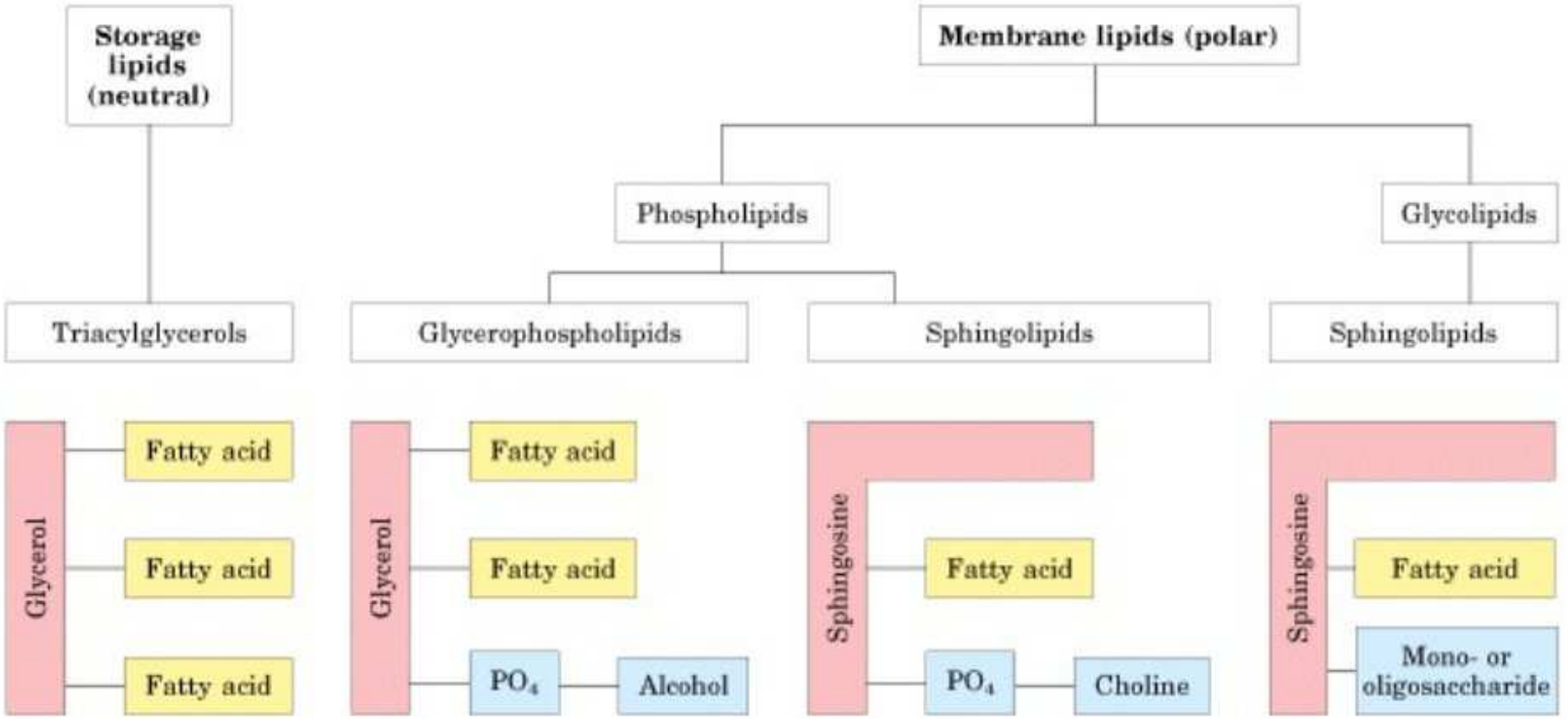


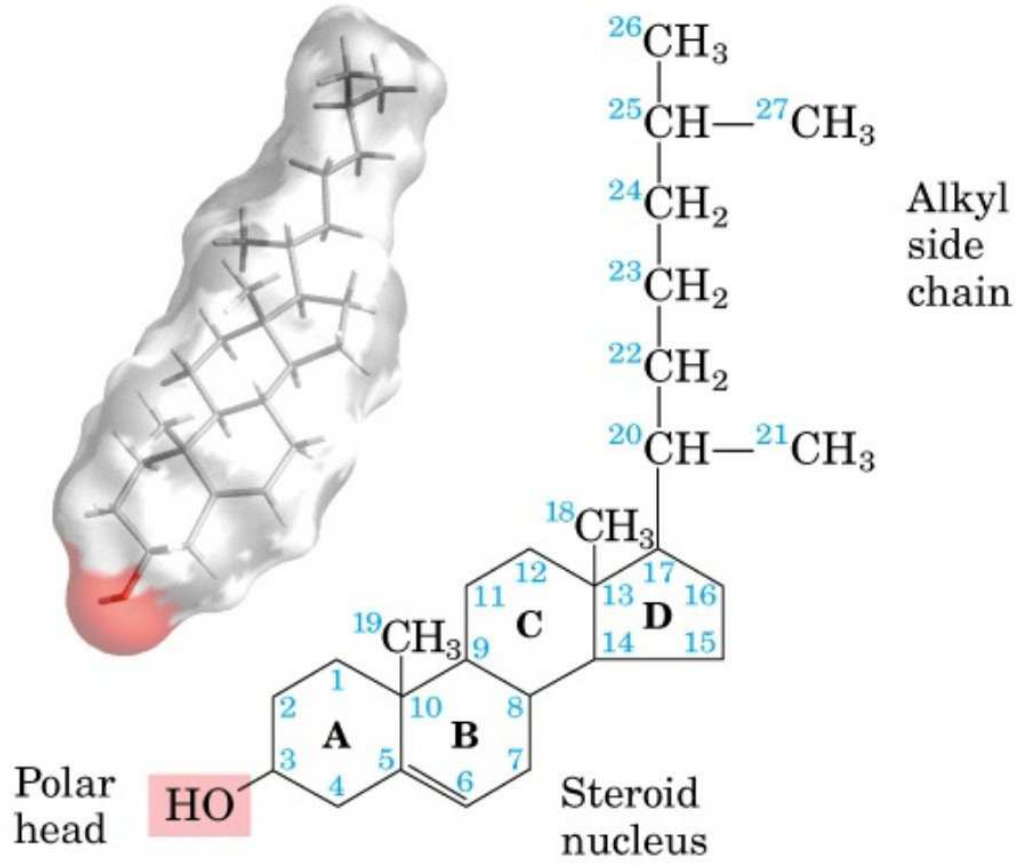
The figure was adopted from http://en.wikipedia.org/wiki/Fatty_acid (April 2007)

Strcture of lipids

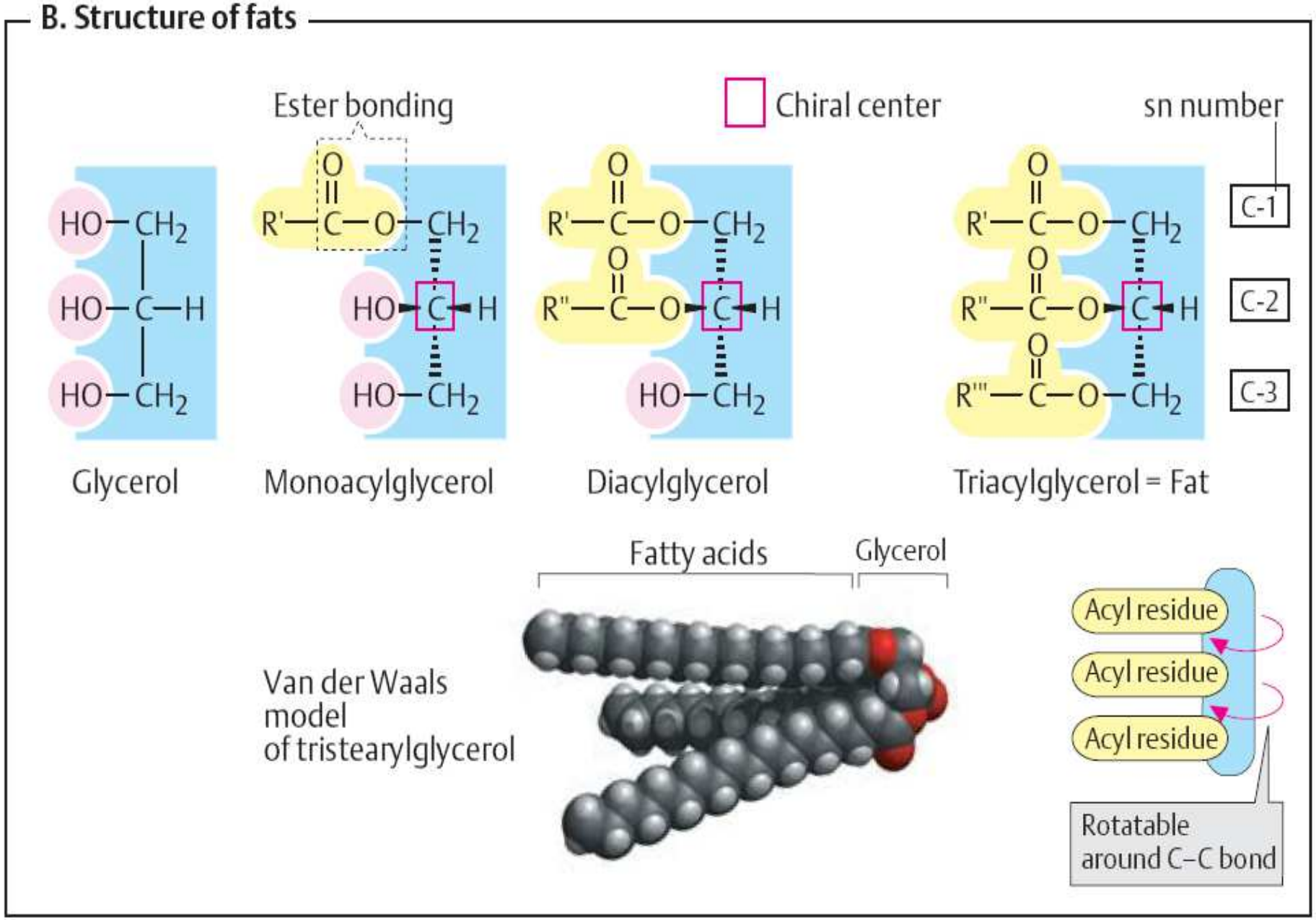


The figure is found at http://courses.cm.utexas.edu/archive/Spring2002/CH339K/Robertus/overheads-2/ch11_lipid-struct.jpg (Jan 2007)

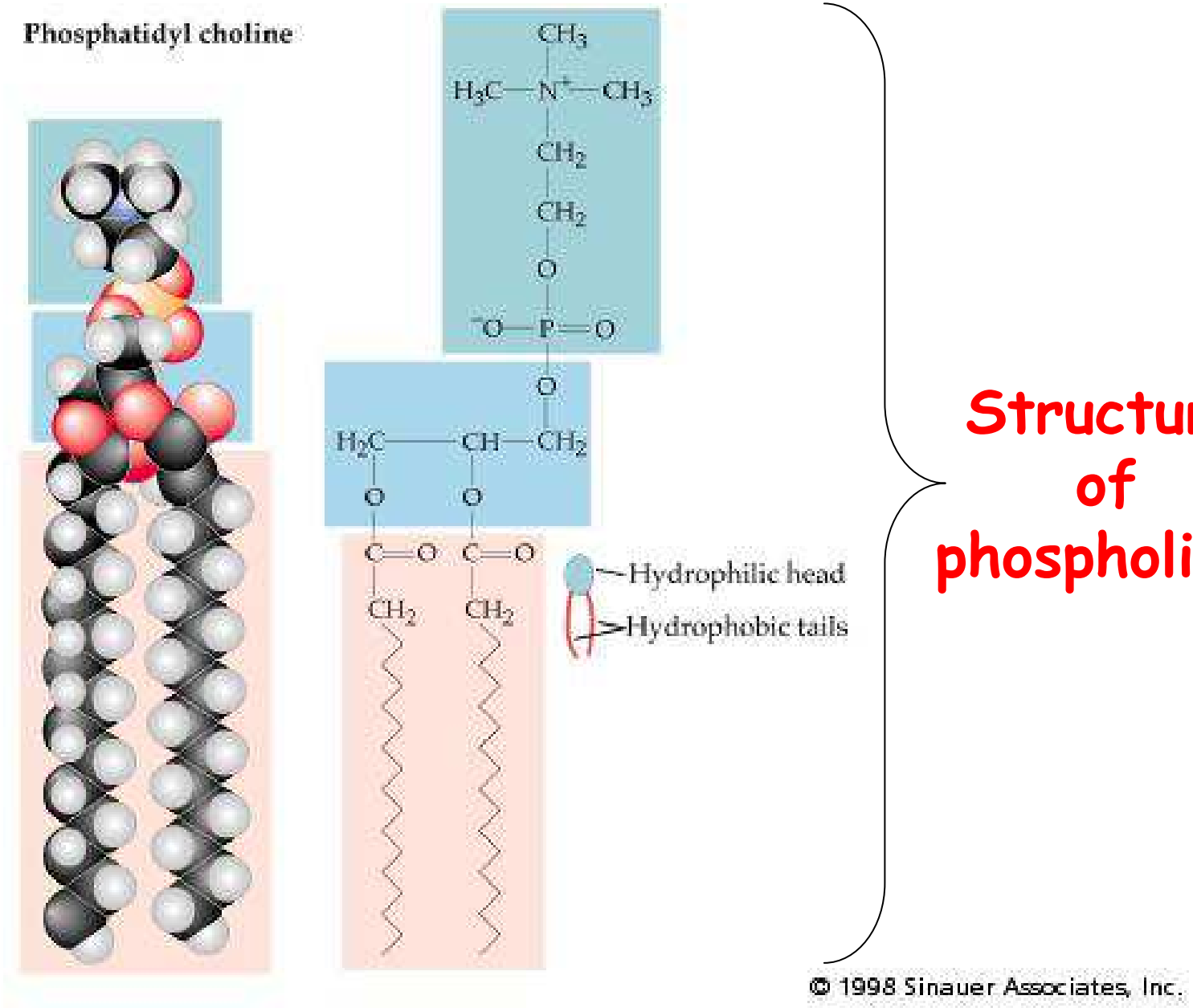
Cholesterol



The figure is found at http://courses.cm.utexas.edu/archive/Spring2002/CH339K/Robertus/overheads-2/ch11_cholesterol.jpg (Jan 2007)

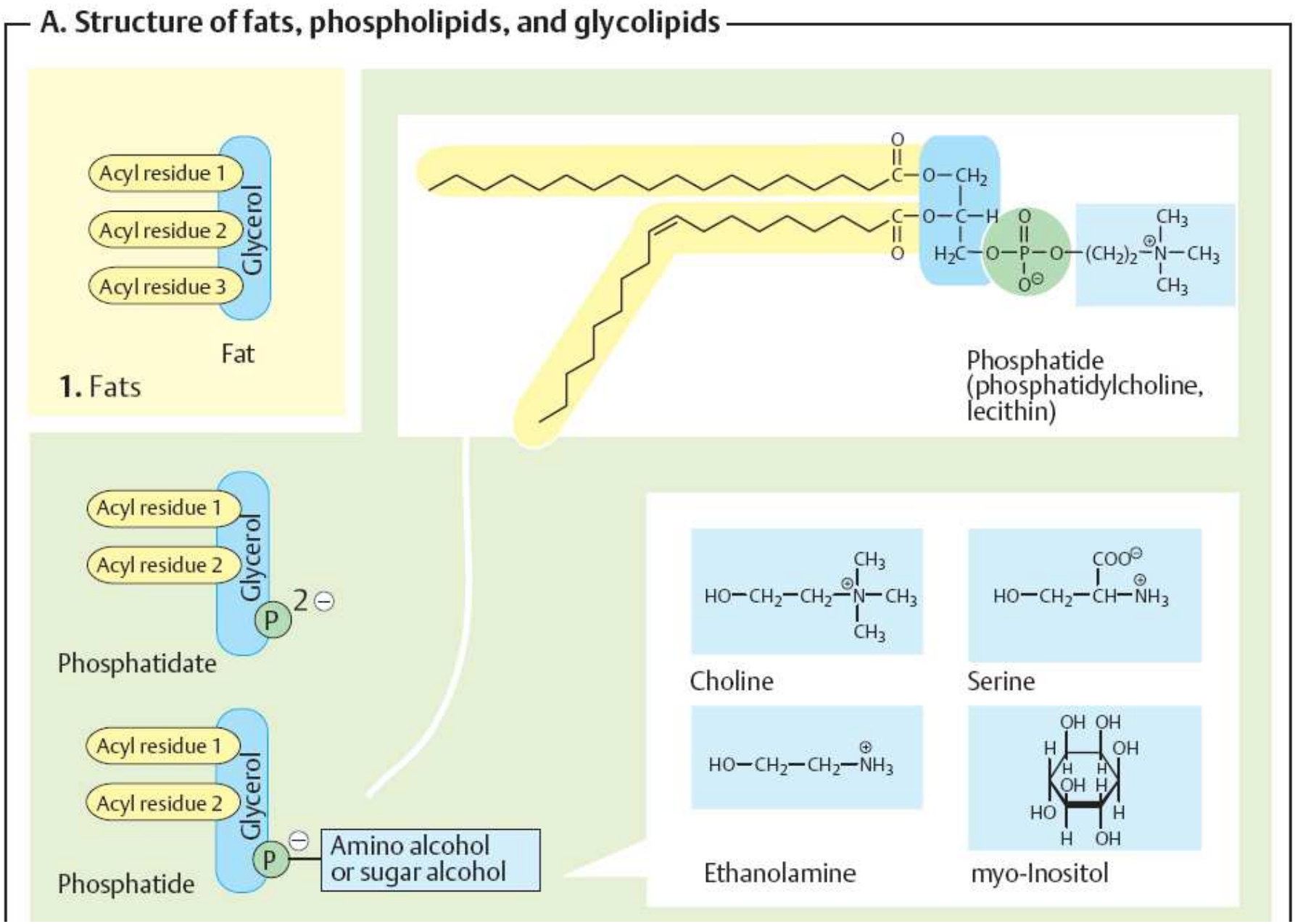


The figure was adopted from: J.Koolman, K.H.Röhm / Color Atlas of Biochemistry, 2nd edition, Thieme 2005



Structure of phospholipid

The figure is found at http://www.mie.utoronto.ca/labs/lcdlab/biopic/fig/3.21.jpg (Jan 2007)



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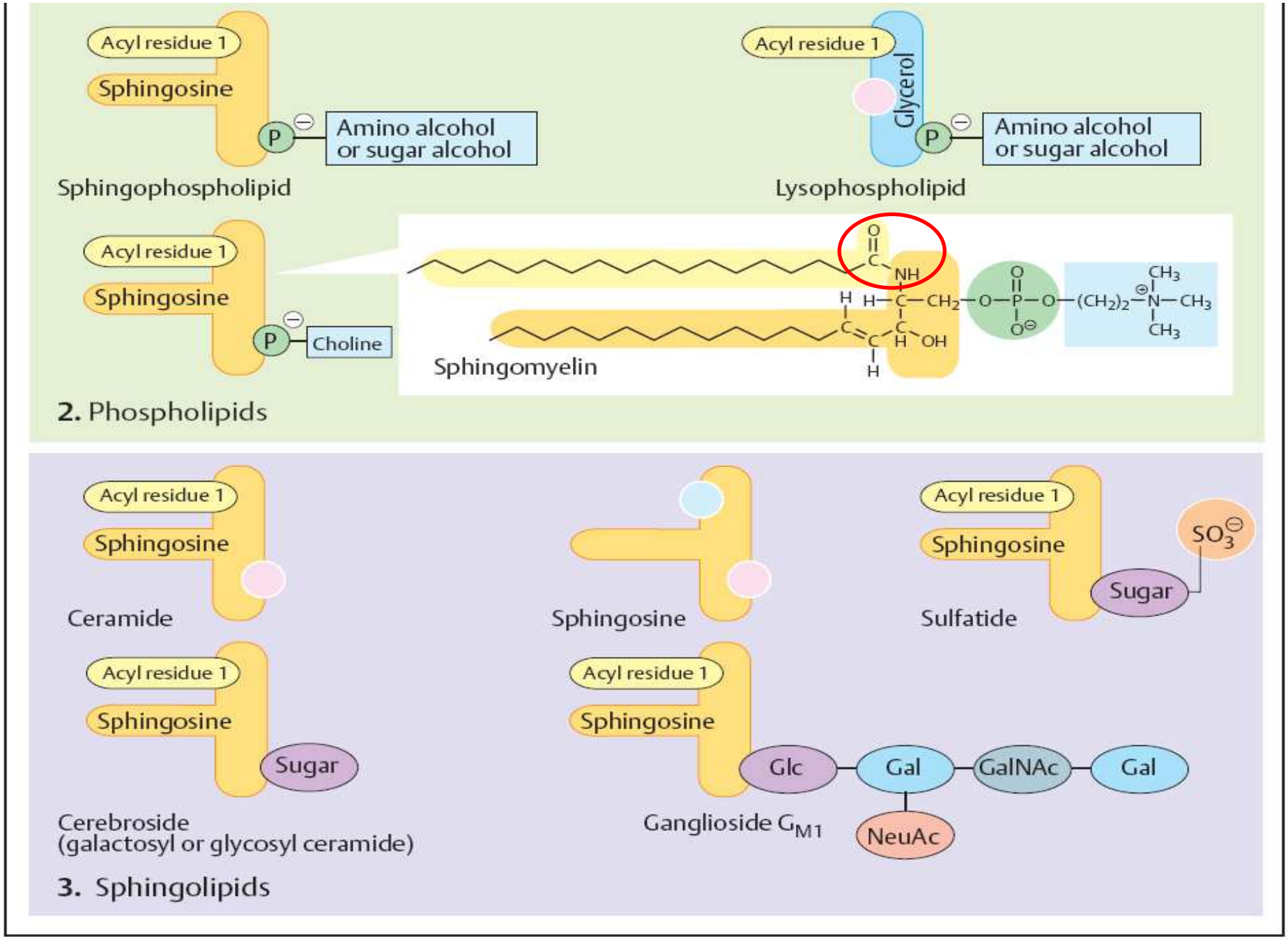

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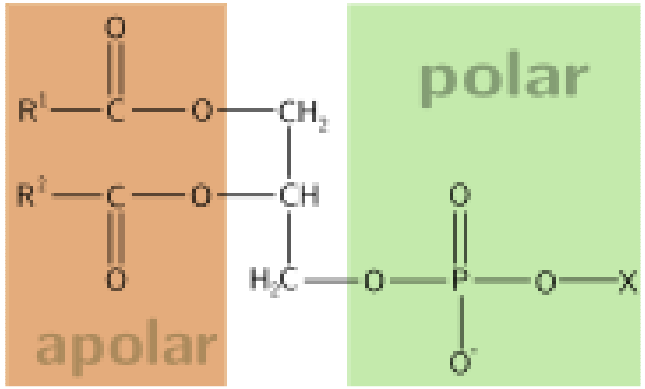
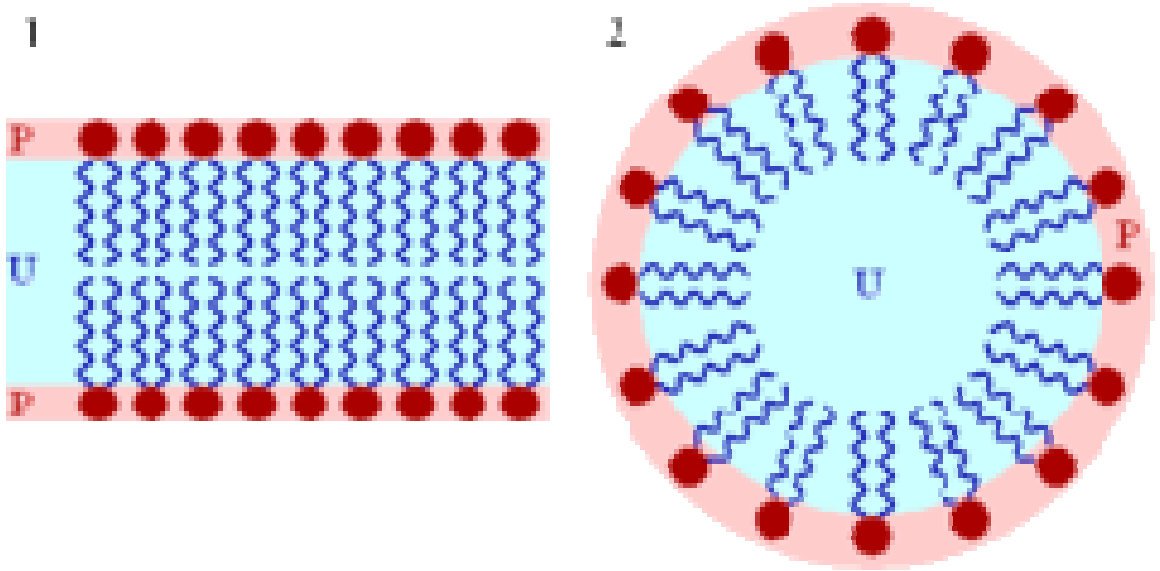


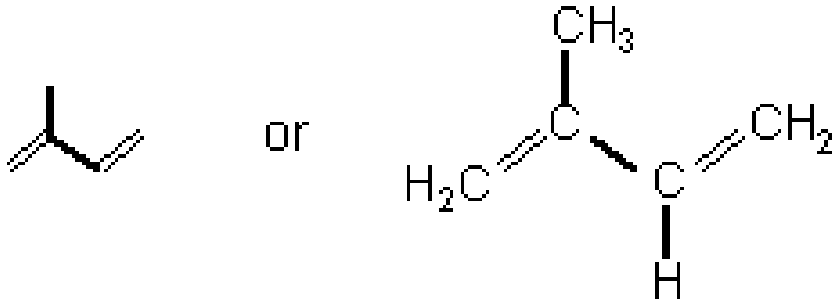


Self-organization of phospholipids. A lipid bilayer is shown on the left and a micelle on the right.

The figures are adopted from http://en.wikipedia.org/wiki/Lipids (April 2007)

Terpenes

- derivatives of **isoprene** (= 2-methylbuta-1,3-diene)



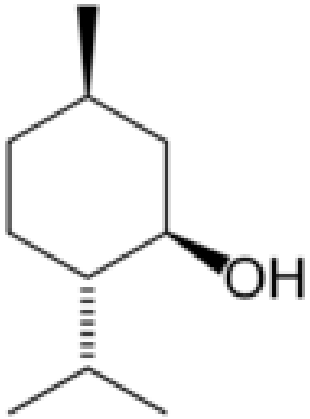
- found in oils of plants and flowers
- characteristic odour (geraniol, menthol,...)
- **steroids** are derived from triterpenes

Terpenes – classification:

- monoterpenes (C_{10}) 2 x isoprene
- sesquiterpenes (C_{15}) 3 x isoprene
- diterpenes (C_{20}) 4 x isoprene
- triterpenes (C_{30}) 6 x isoprene
- tetraterpenes (C_{40}) 8 x isoprene

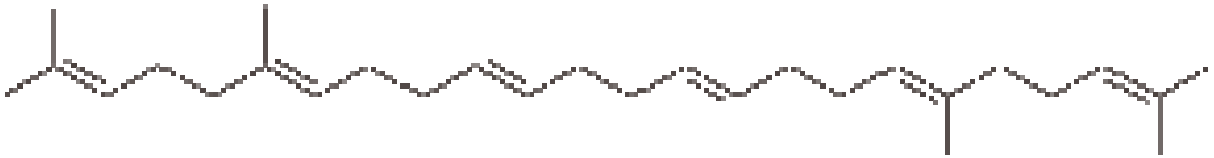
- formed by bonding **„head to tail" or „tail to tail"**
- different degree of **unsaturation**
- variety of **functional groups**

Examples of terpenes



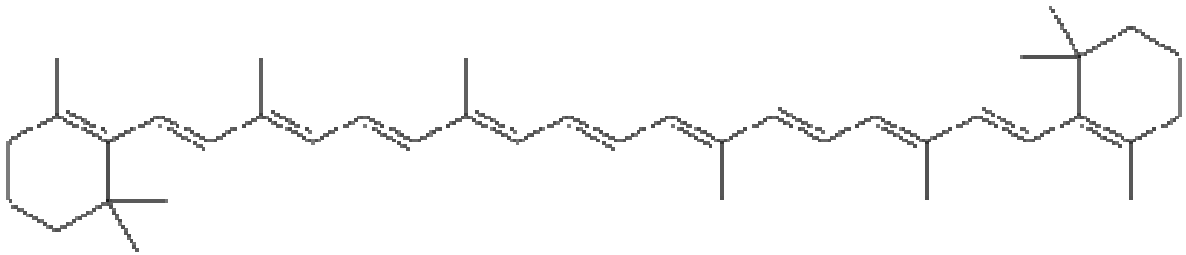
menthol (C10)

phytol (C 20)



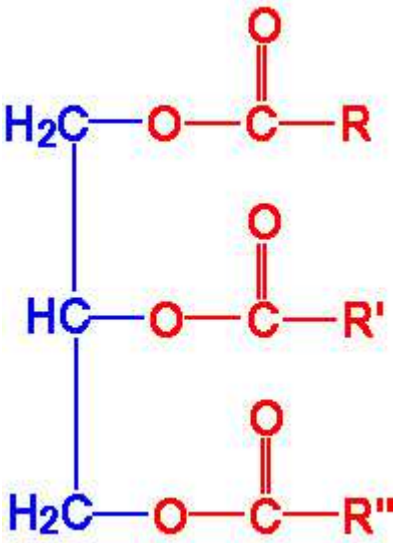
squalene (C 30)

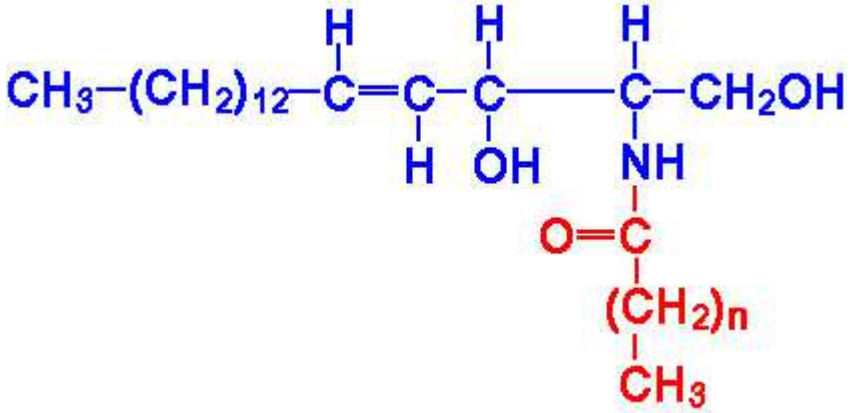
β-carotene (C40)

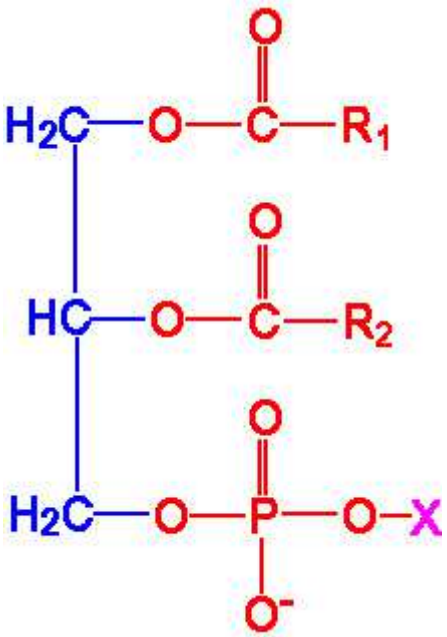


The figures are adopted from http://en.wikipedia.org (April 2007)

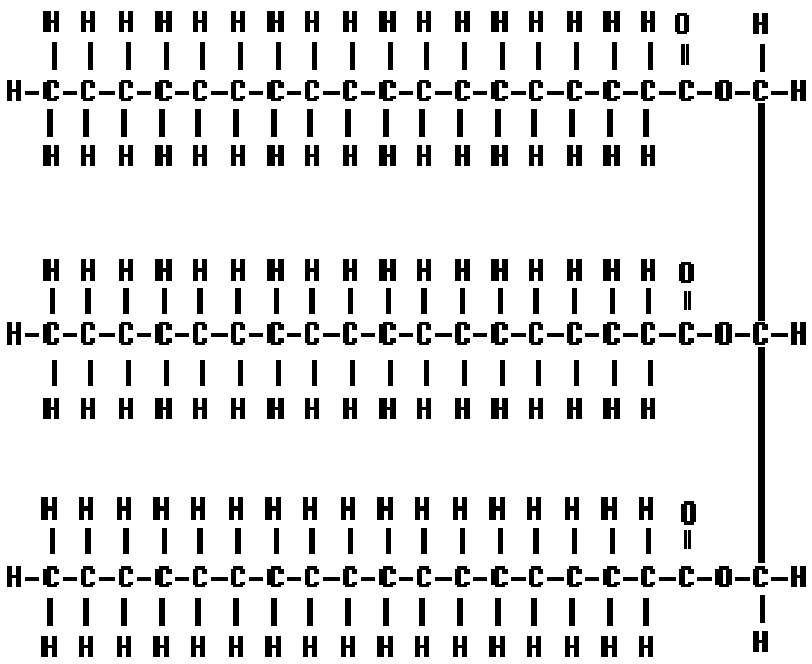
EXERCISE



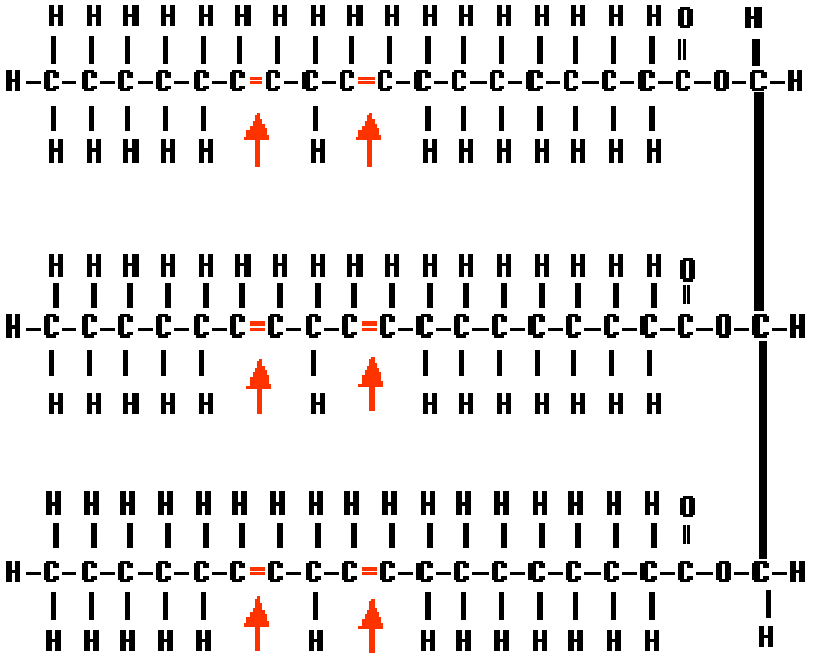




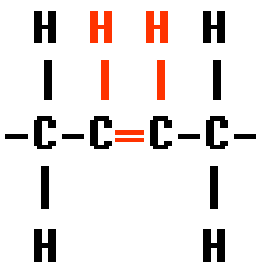
The figures are adopted from http://web.indstate.edu/thcme/mwking/lipids.html (April 2007)



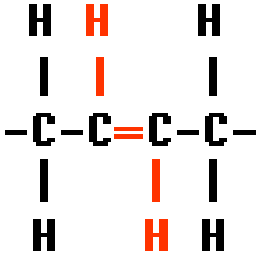
Tristearin



Trilinolein



cis



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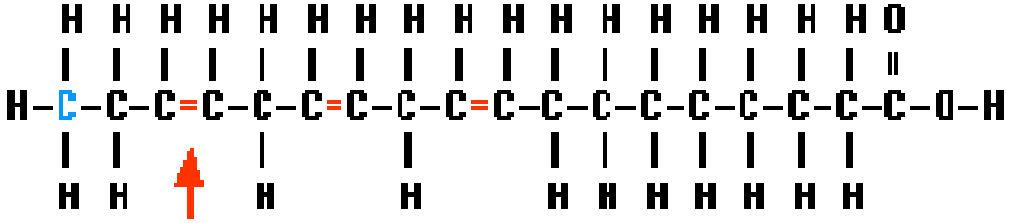

linolenic acid, an omega-3 fatty acid

(the omega carbon atom is shown in blue)

The figures are adopted from http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/F/Fats.html (April 2007)