

LIPIDS

Biological Molecules

```
graph TD; A[Biological Molecules] --- B[Carbohydrates]; A --- C[Lipids]; A --- D[Nucleic Acids]; A --- E[Proteins]
```

Carbohydrates

Lipids

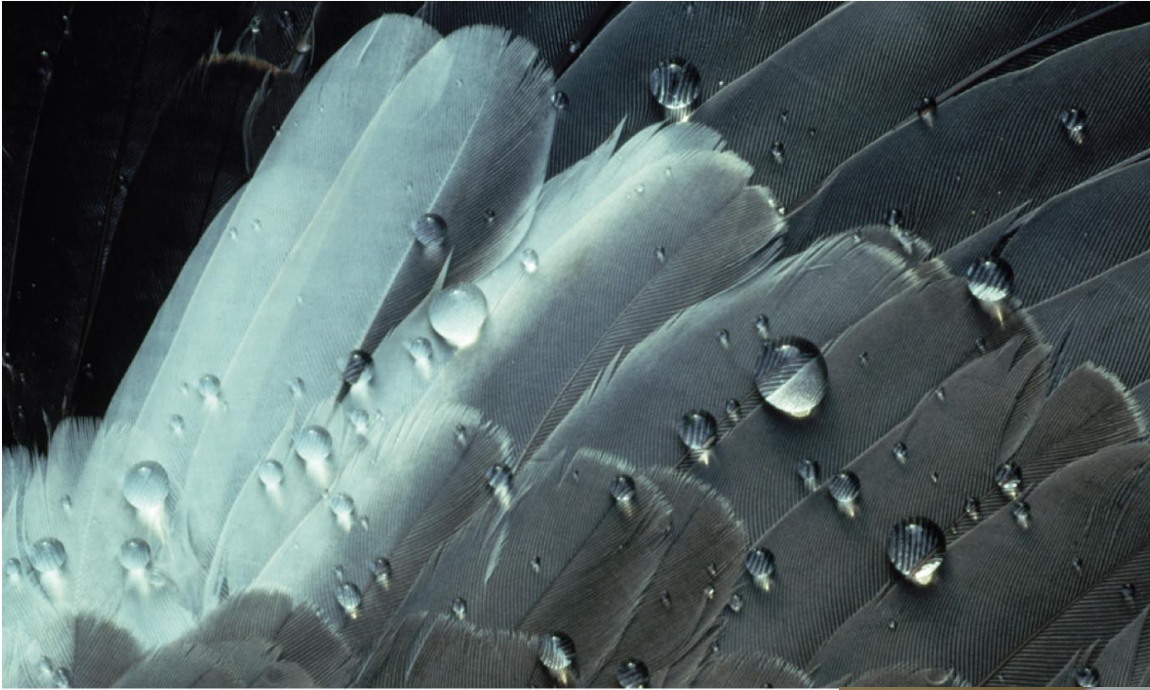
Nucleic Acids

Proteins

| Biological Molecule | Monomer | Polymer(s) |
|----------------------------|---|---|
| Carbohydrates | Monosaccharide | Disaccharide, Polysaccharide |
| Lipids | None, but bigger lipid molecules are generally made of glycerol and fatty acid chains | Big molecules include: triglycerides, steroids, and phospholipids |
| Nucleic Acids | Nucleotide | DNA, RNA |
| Proteins | Amino Acid | Dipeptide, Polypeptide |

What do all **lipids** have in common?

Nonpolar
(Hydrophobic) – at
least in part



Copyright © 2009 Pearson Education, Inc.



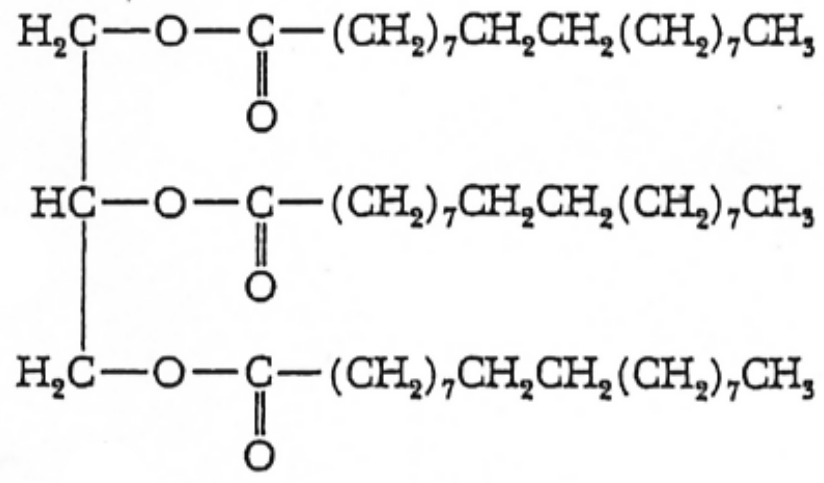
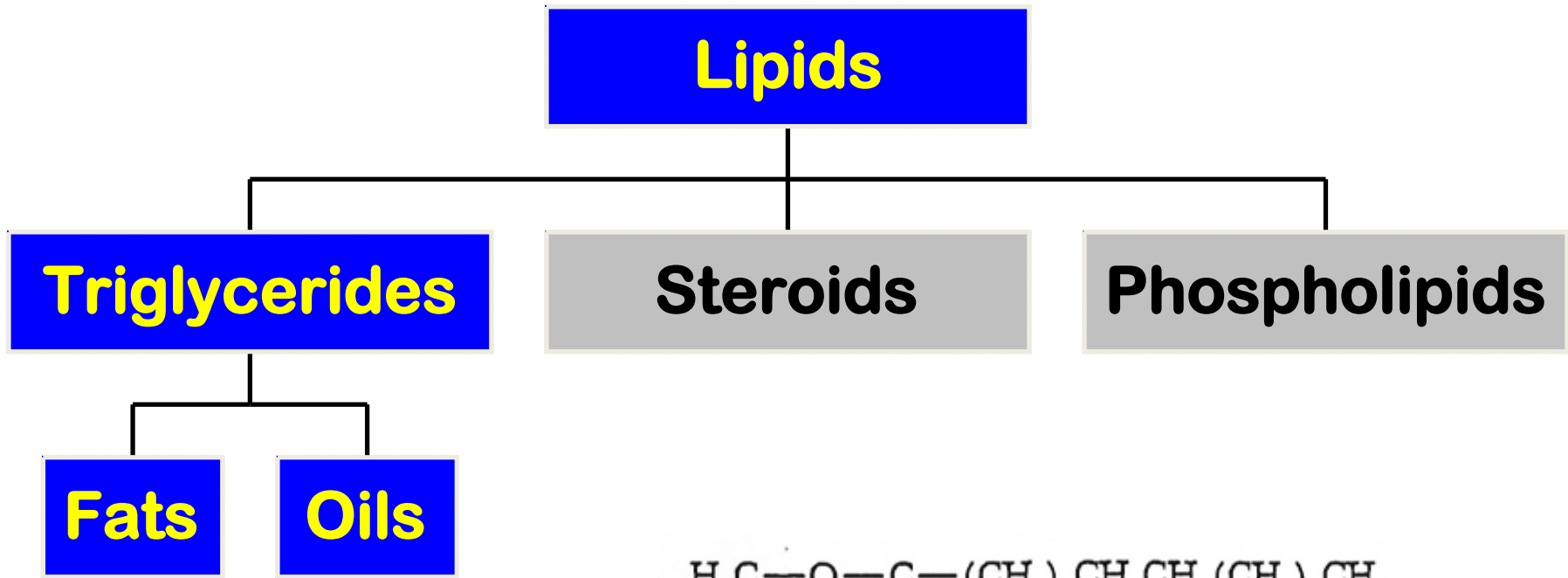


Fig. 3-8b

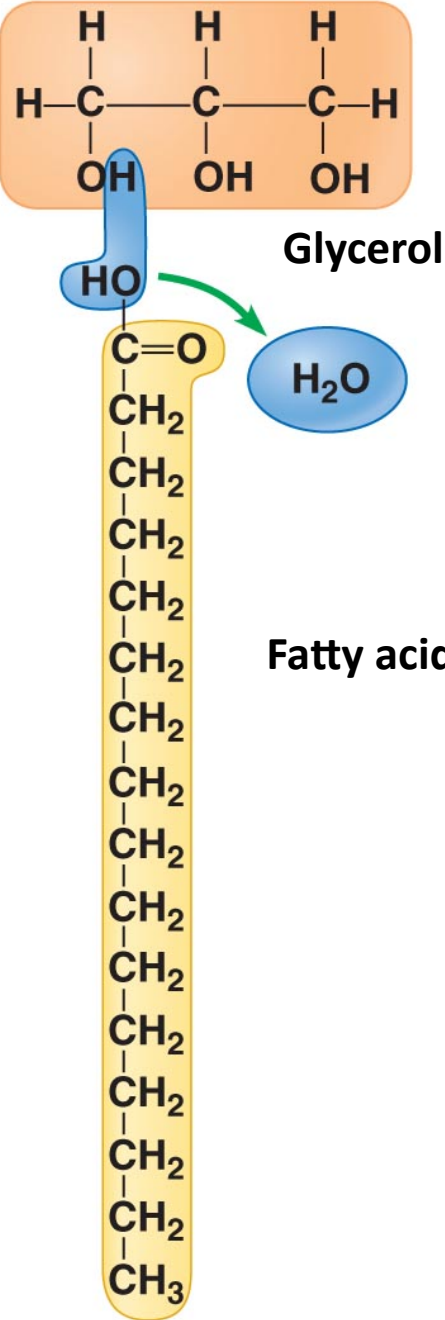
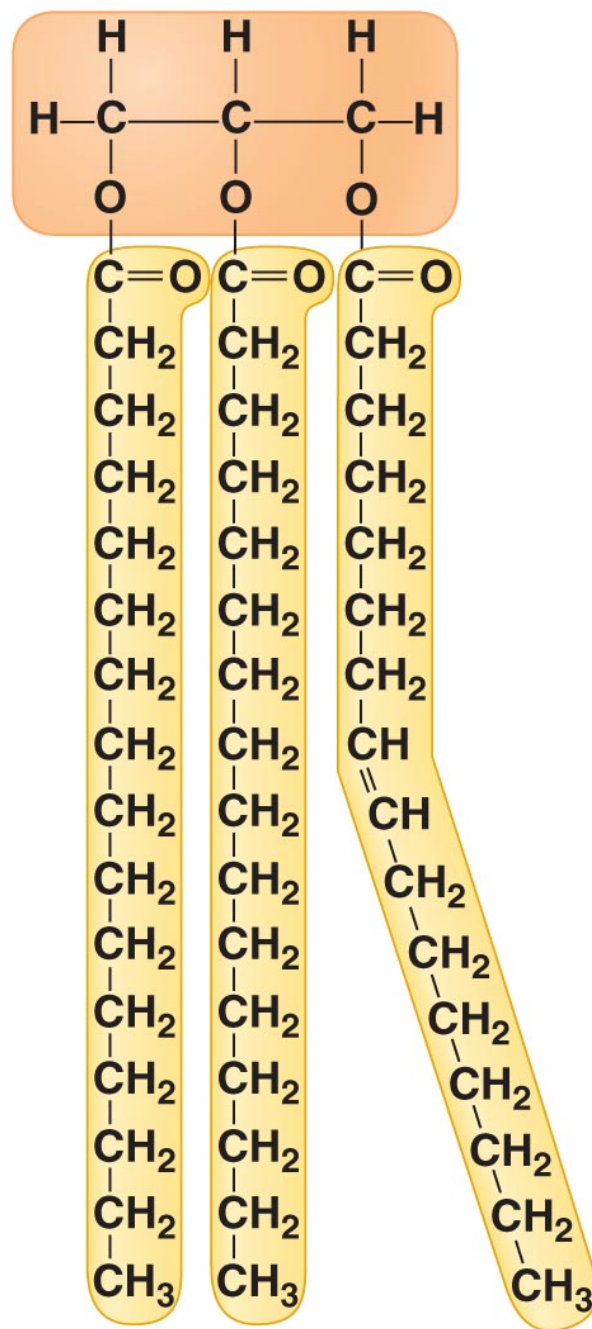
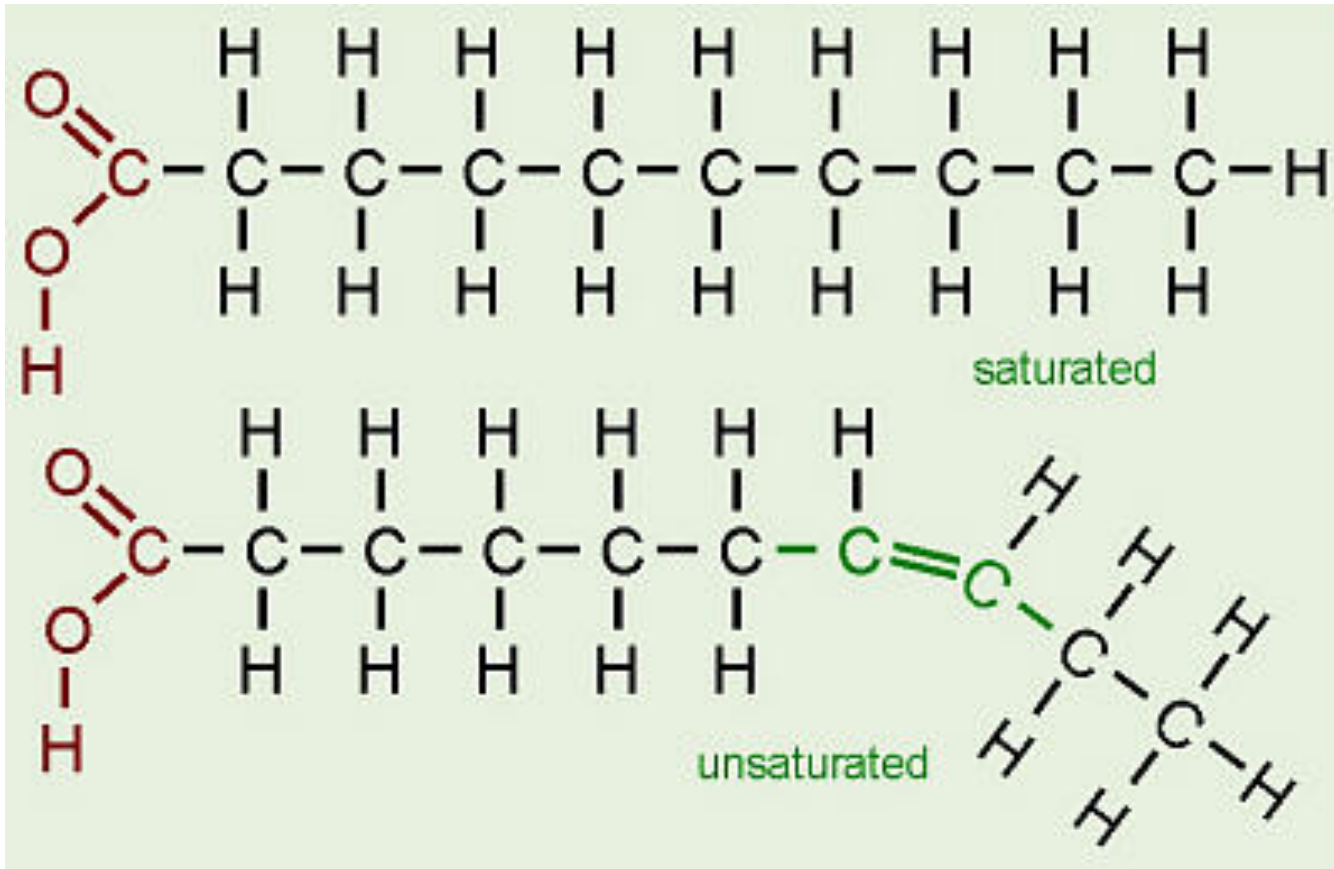


Fig. 3-8c



FATTY ACIDS



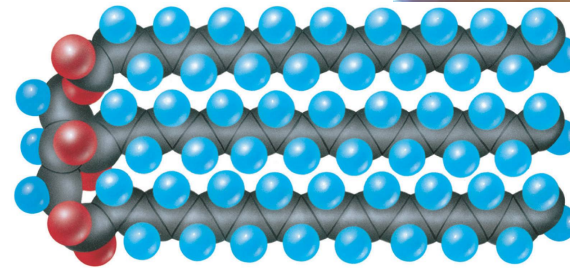
saturated: no
double bonds

artery-clogging

unsaturated: at least
one double bond

better for health

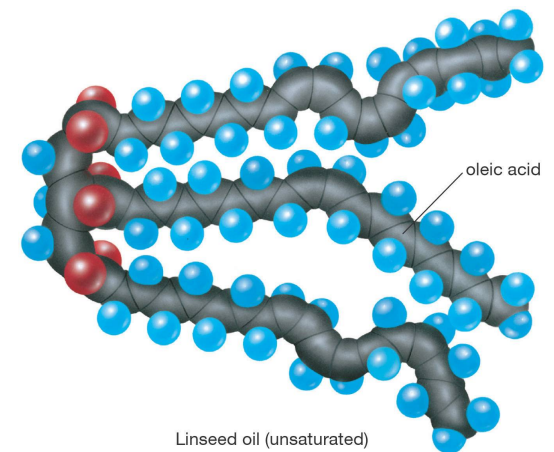
- **Saturated Fatty Acids**
 - **No double bonds between carbon atoms**
 - **Animal sources (mostly)**
 - **Solid at room temp**
 - **Form FATS**



Beef fat (saturated)

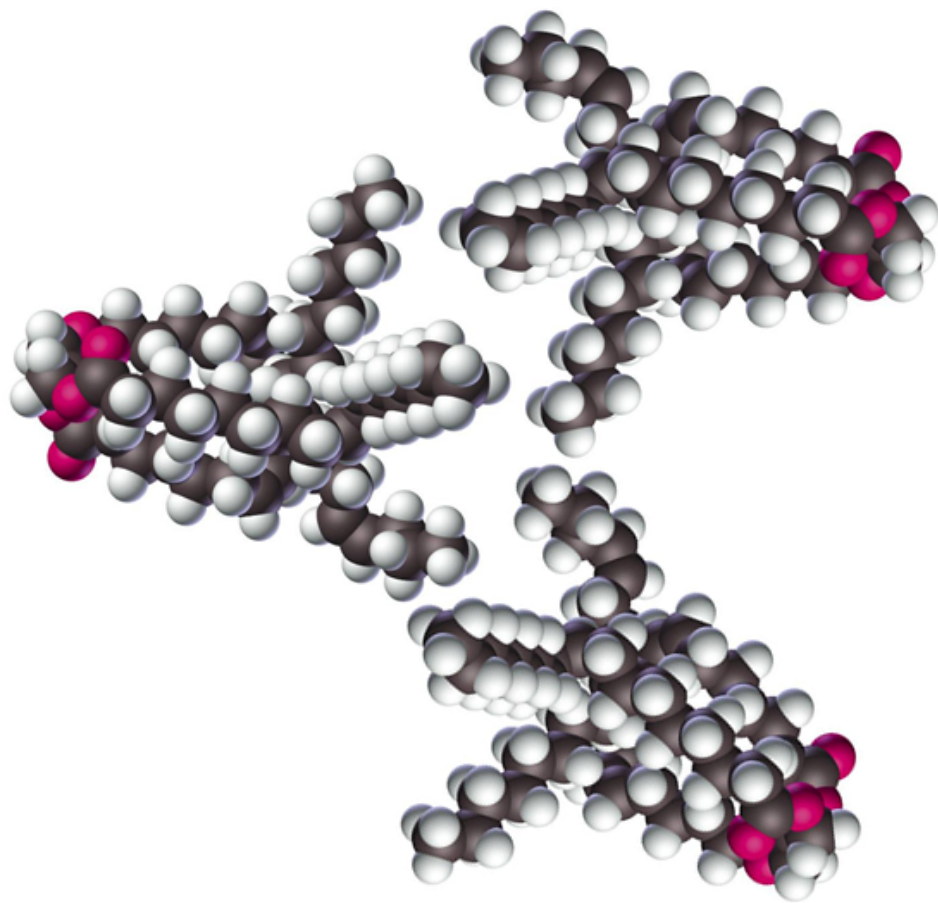
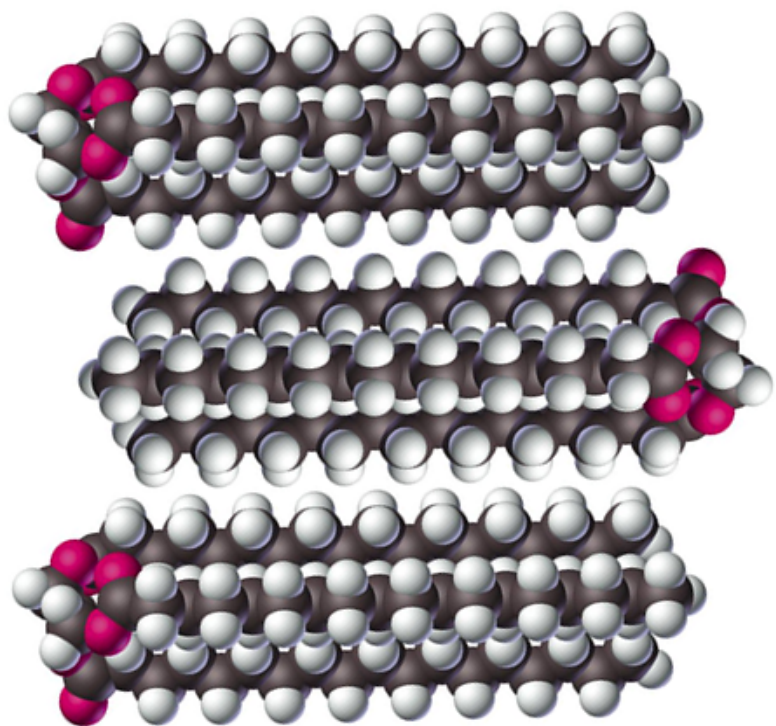
Copyright © 2005 Pearson Prentice Hall, Inc.


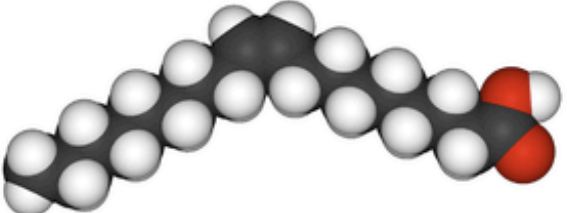
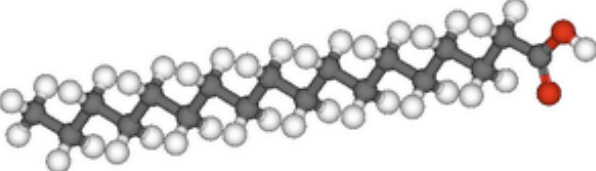

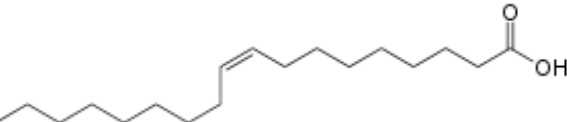
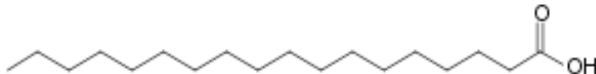
- **Unsaturated Fatty Acids**
 - **Double bonds between carbon atoms**
 - **Plant sources (mostly)**
 - **Liquid at room temp**
 - **Form OILS**



Linseed oil (unsaturated)

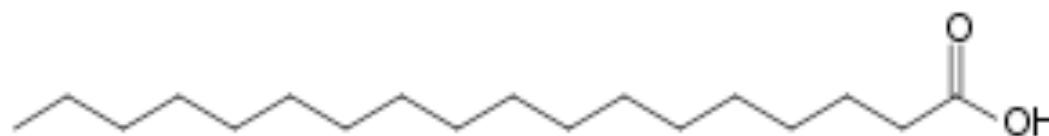
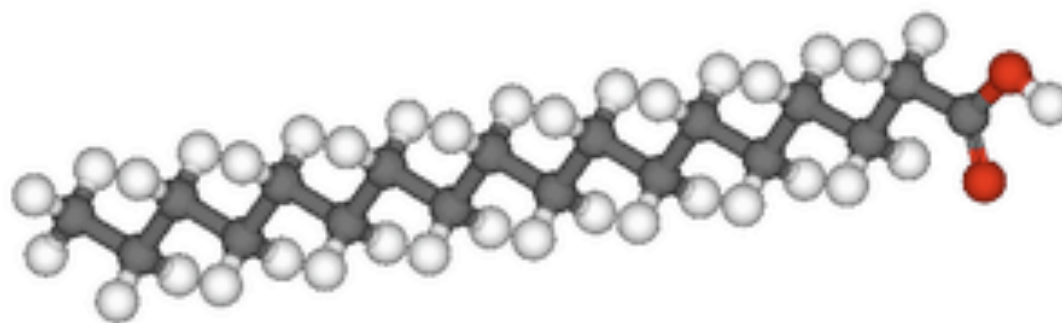
Copyright © 2005 Pearson Prentice Hall, Inc.



| Trans (Elaidic acid) | Cis (Oleic acid) | Saturated (Stearic acid) |
|---|--|---|
| <p>Elaidic acid is a <i>trans</i> unsaturated fatty acid often found in partially hydrogenated vegetable oils.</p> | <p>Oleic acid is a <i>cis</i> unsaturated fatty acid that comprises 55–80% of olive oil.</p> | <p>Stearic acid is a saturated fatty acid found in animal fats and is the intended product in full hydrogenation. Stearic acid is neither <i>cis</i> nor <i>trans</i> because it has no double bonds.</p> |
|  |  |  |
|  |  |  |
| <p>These fatty acids are geometric isomers (structurally identical except for the arrangement of the double bond).</p> | | <p>This fatty acid contains no double bond and is <i>not</i> isomeric with the previous two.</p> |

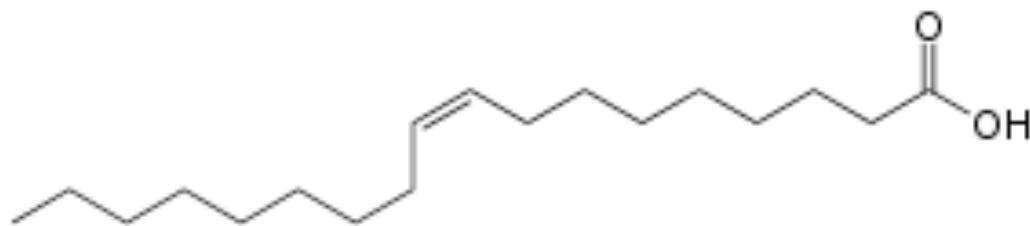
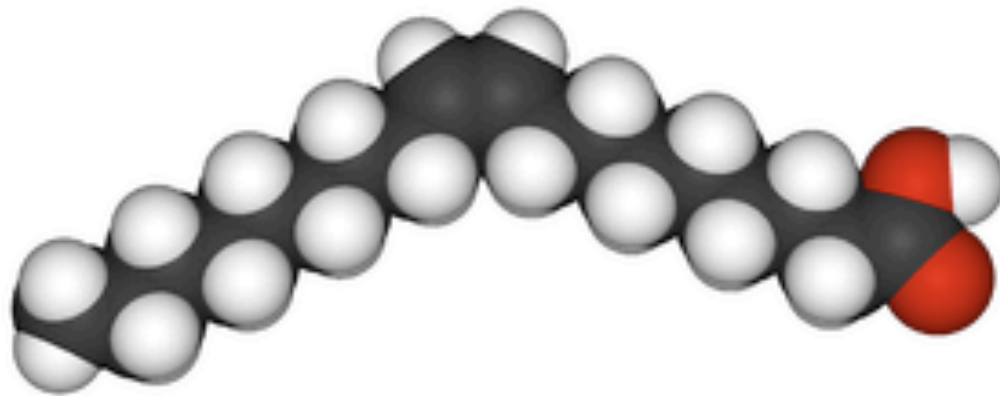
Saturated (Stearic acid)

Stearic acid is a saturated fatty acid found in animal fats and is the intended product in full hydrogenation. Stearic acid is neither *cis* nor *trans* because it has no double bonds.



Cis (Oleic acid)

Oleic acid is a *cis* unsaturated fatty acid that comprises 55–80% of olive oil.

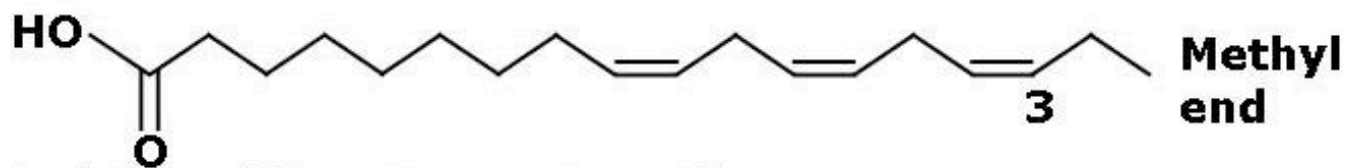


Trans (**Elaidic acid**)

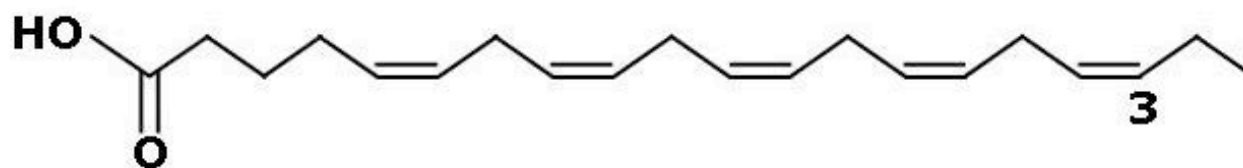
Elaidic acid is a *trans* unsaturated fatty acid often found in partially hydrogenated vegetable oils.



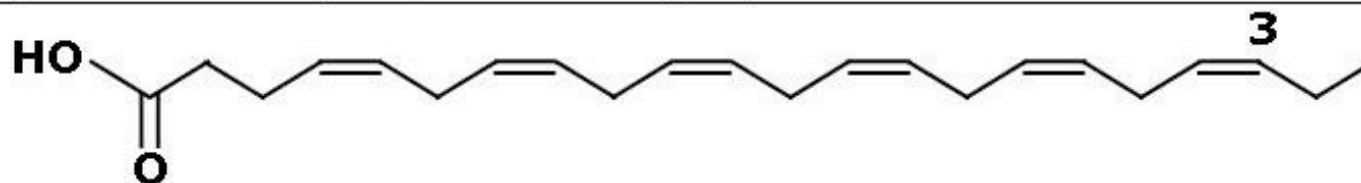
FIG. 1 OMEGA-3 AND OMEGA-6 FATTY ACIDS



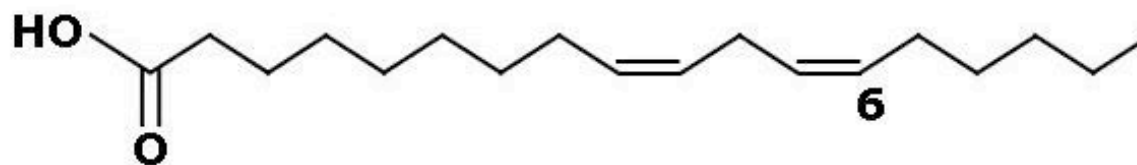
Alpha-linolenic acid (ALA, C18:3, omega-3)



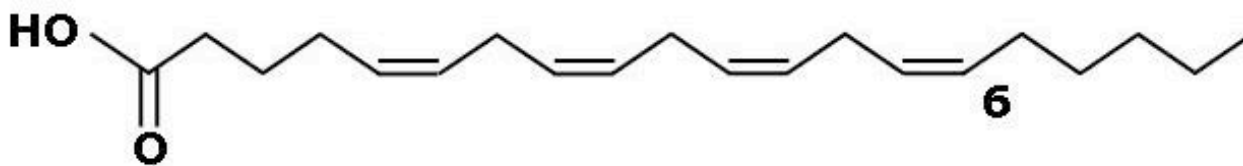
Eicosapentaenoic acid (EPA, C20:5, omega-3)



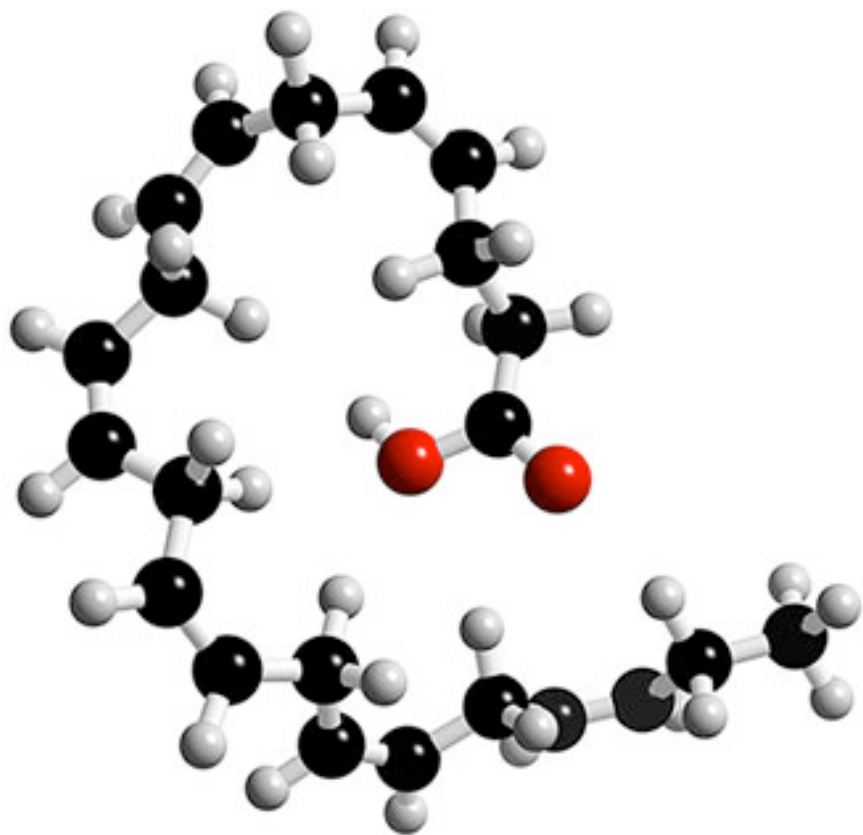
Docosahexaenoic acid (DHA, C22:6, omega-3)



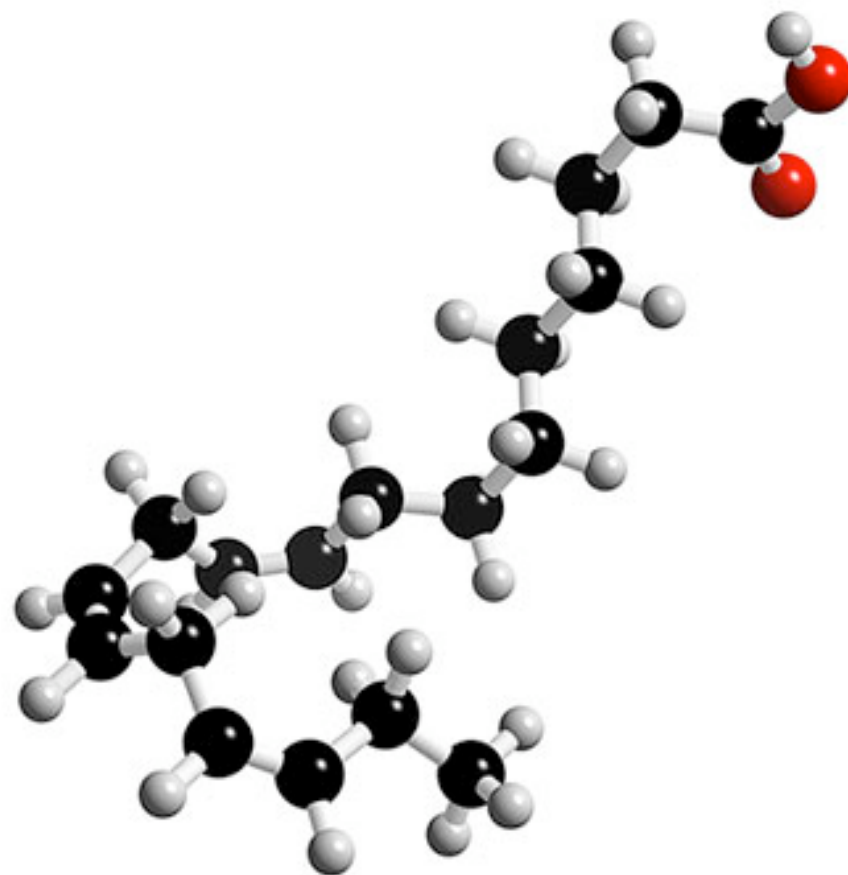
Linoleic acid (LA, C18:2, omega-6)



Arachidonic acid (AA, C20:4, omega-6)



DHA



Linoleic acid

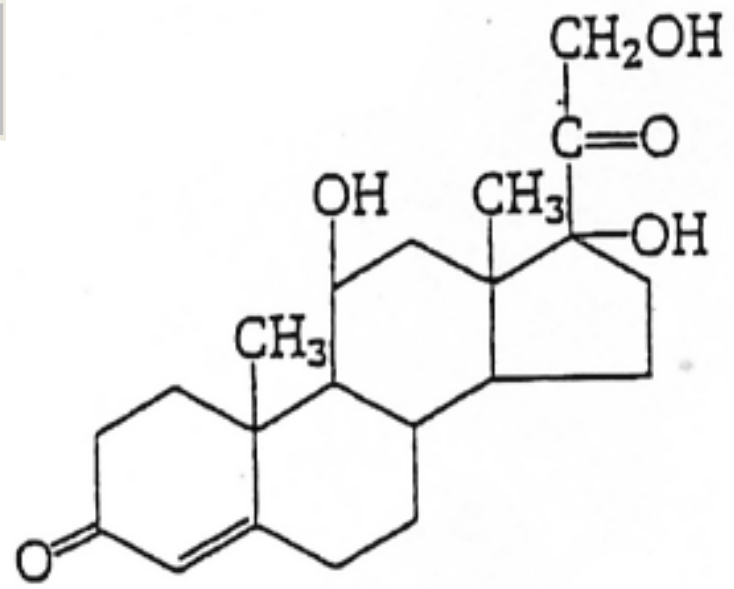
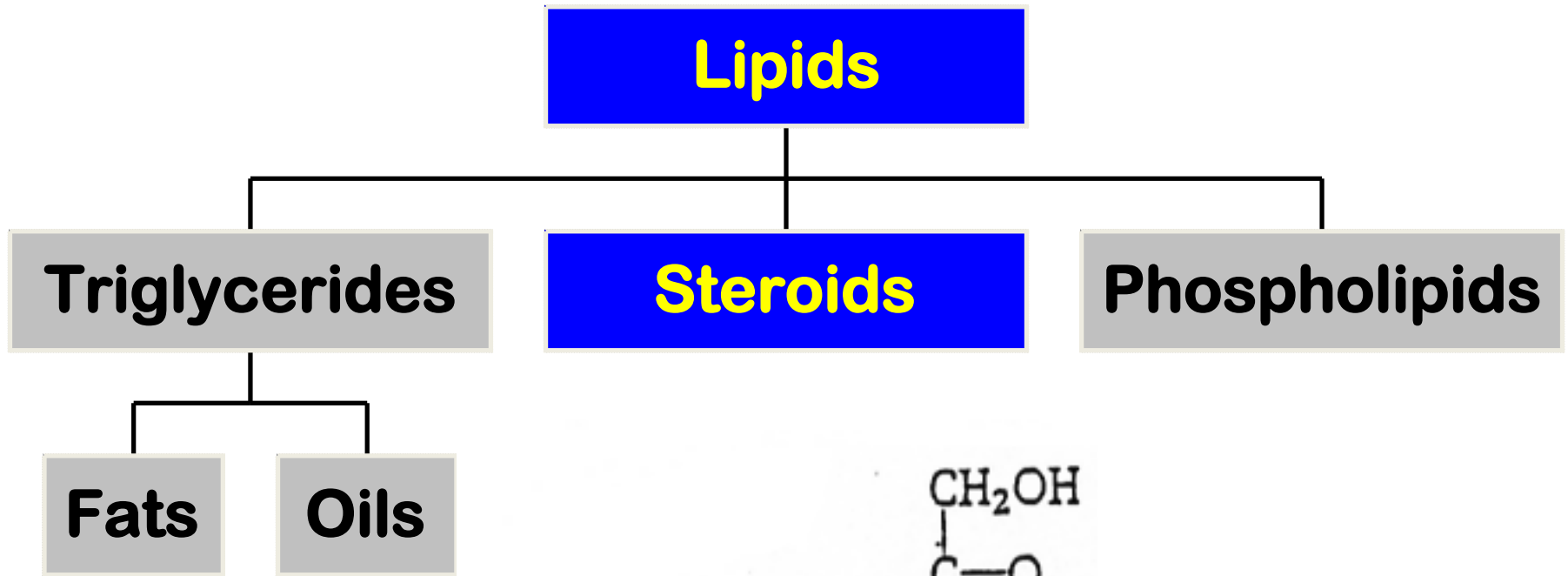
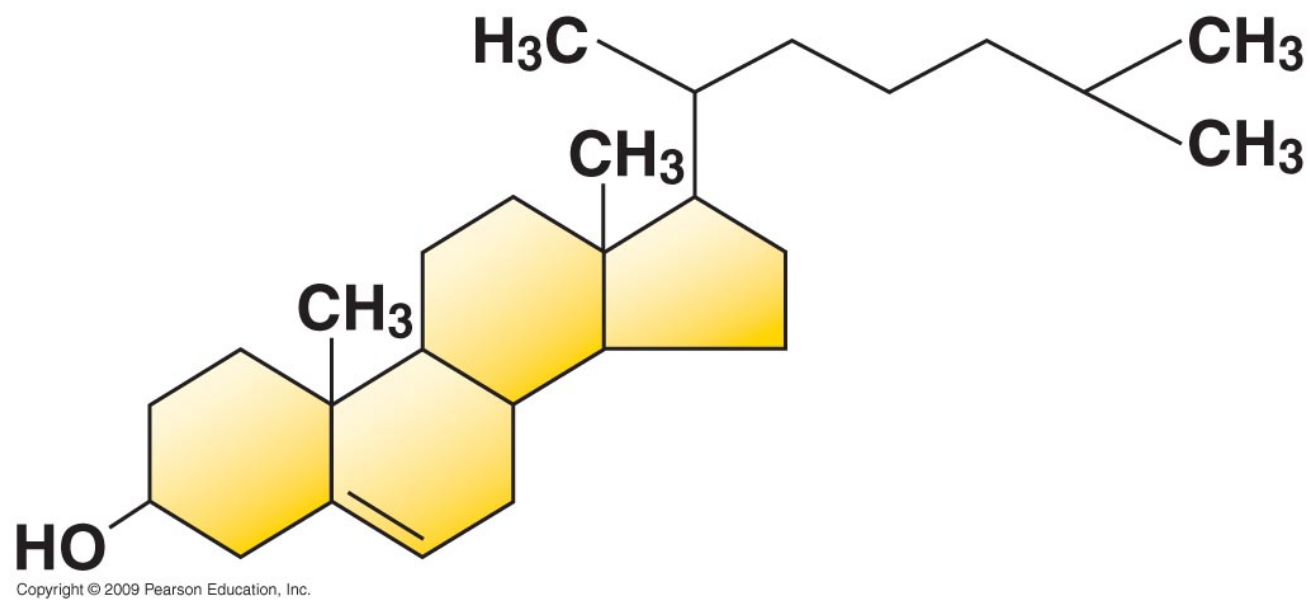
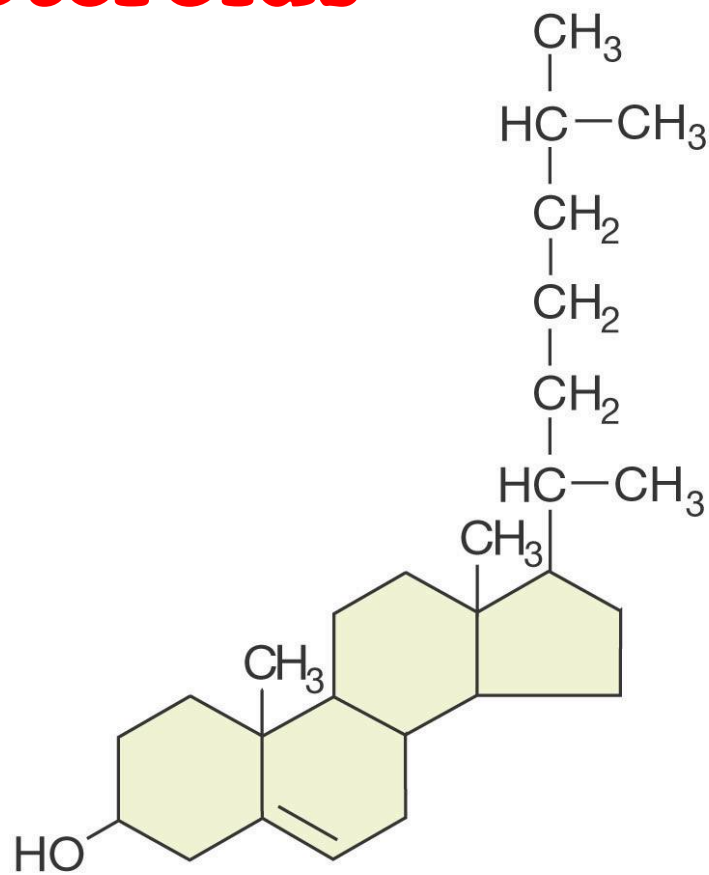


Fig. 3-9b

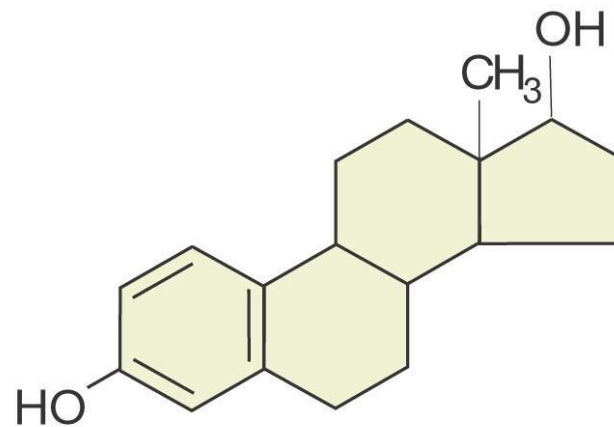


Cholesterol

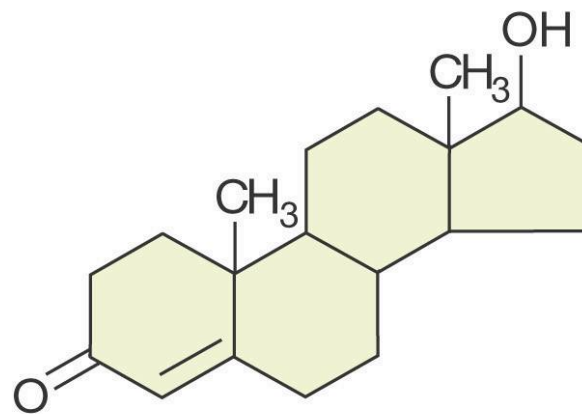
Steroids



cholesterol



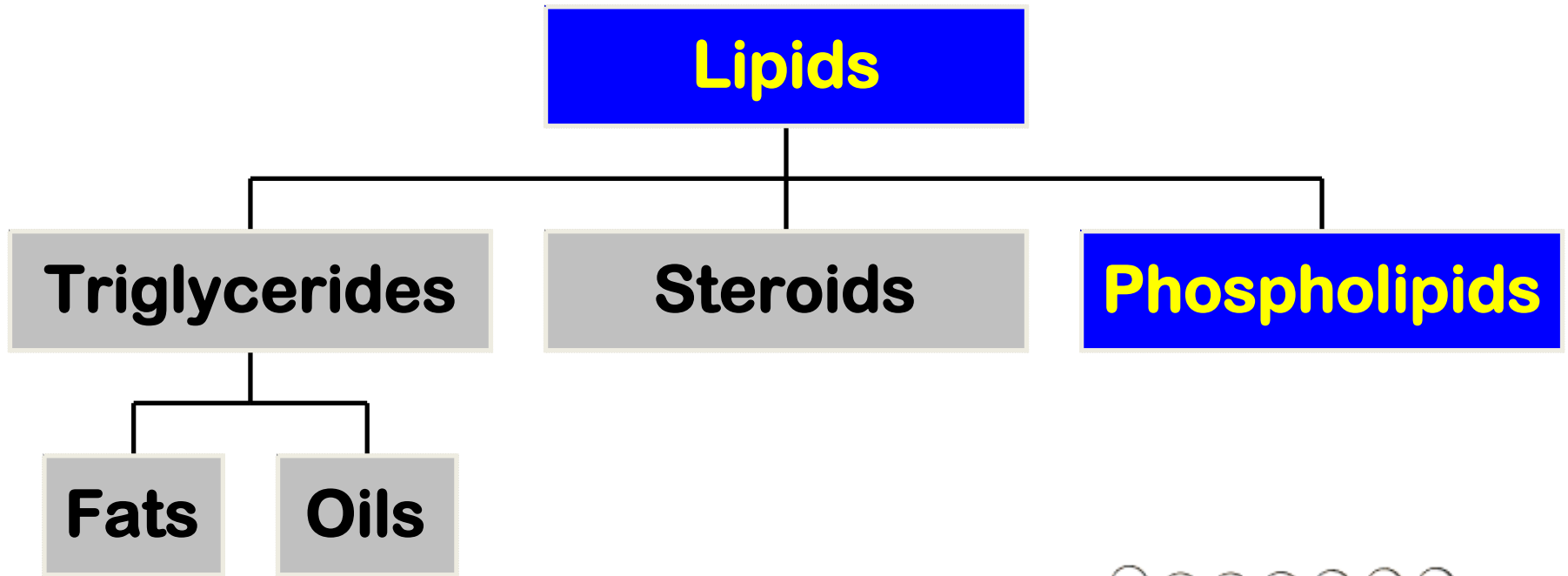
estradiol

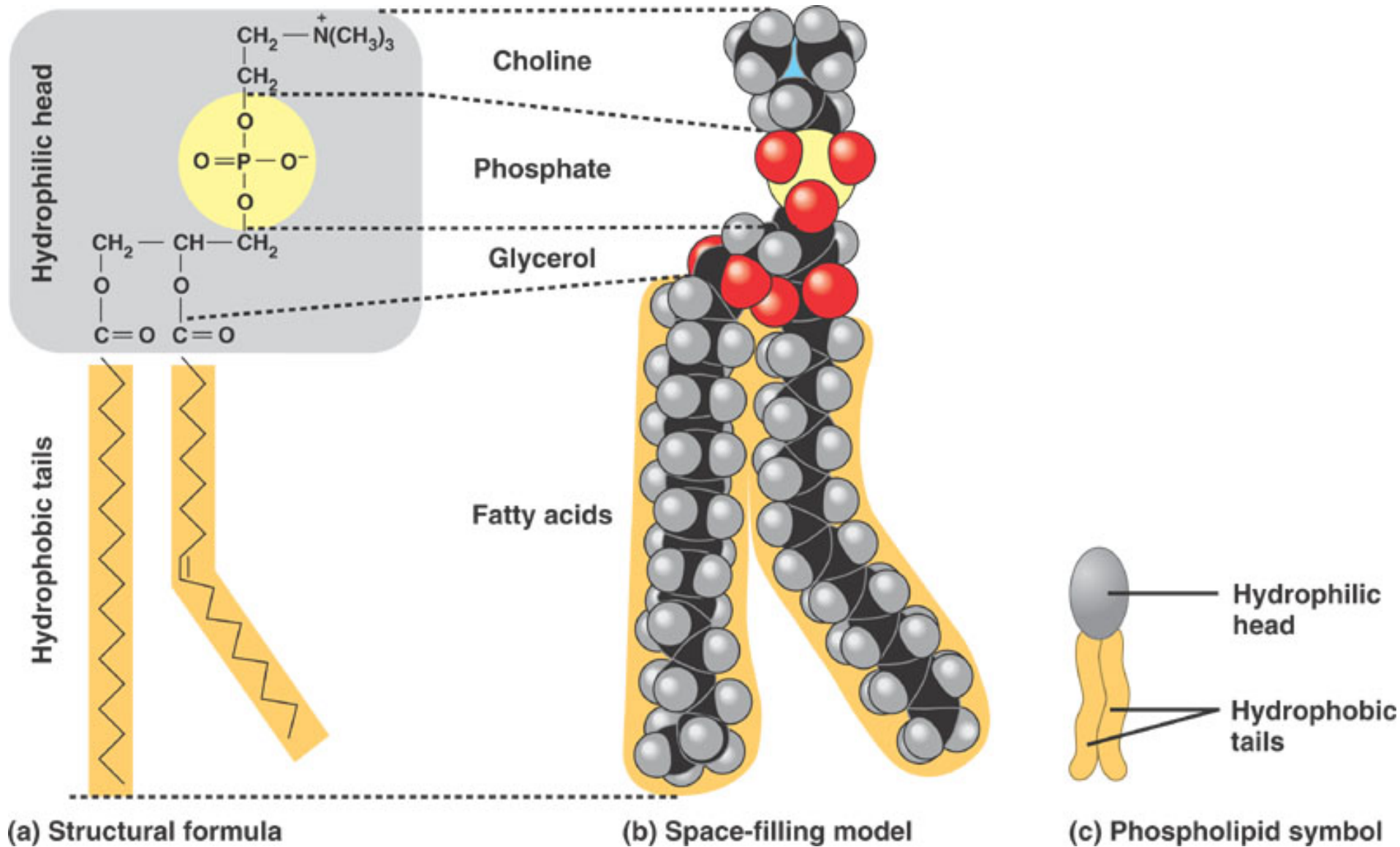


testosterone

Fig. 3-10

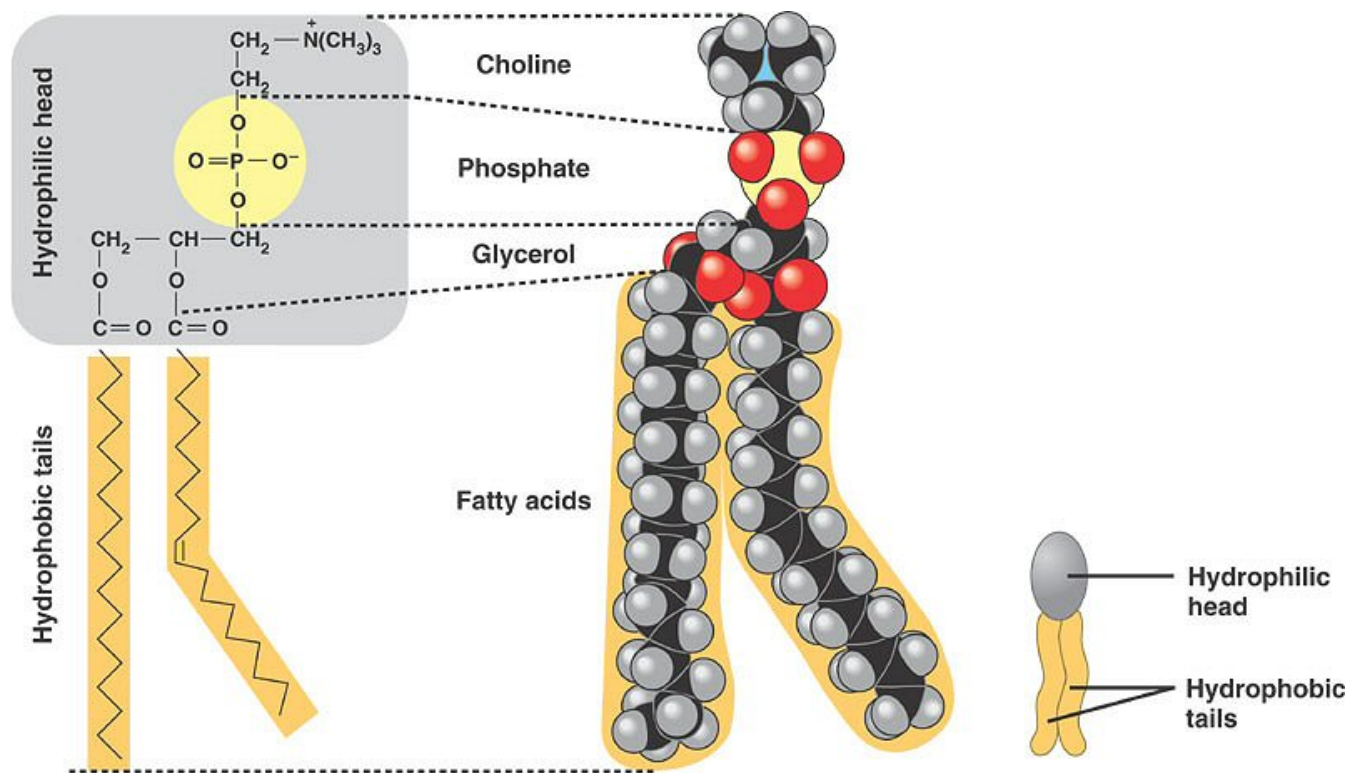




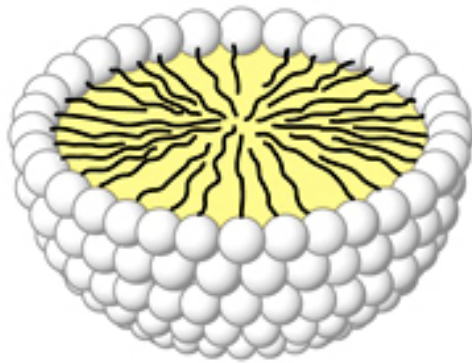


Phospholipids: Amphiphilic (Amphipathic) Molecules

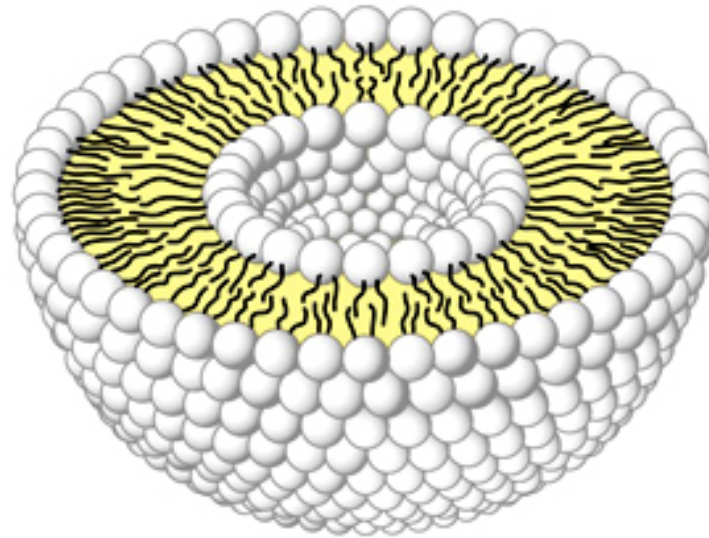
- Molecules with both polar and nonpolar regions/properties
- Phospholipids – used in soap (micelles) and cell membranes



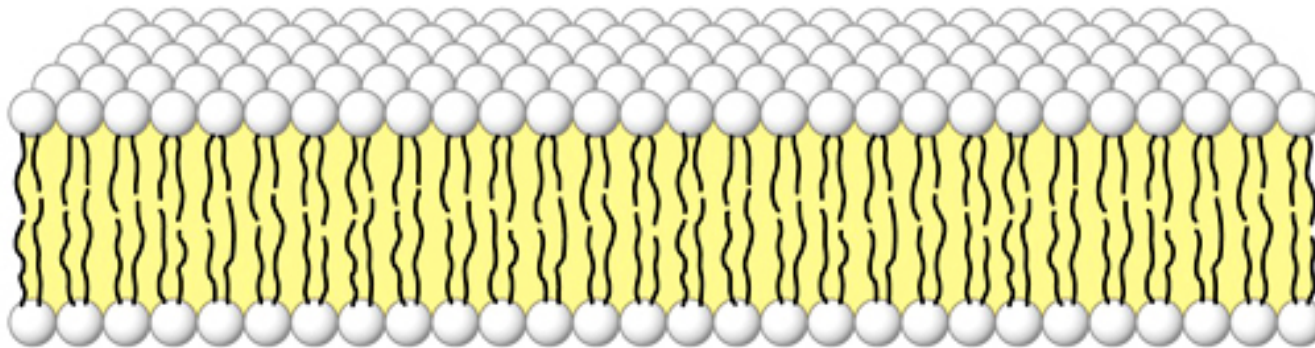
Phospholipids



Micelle

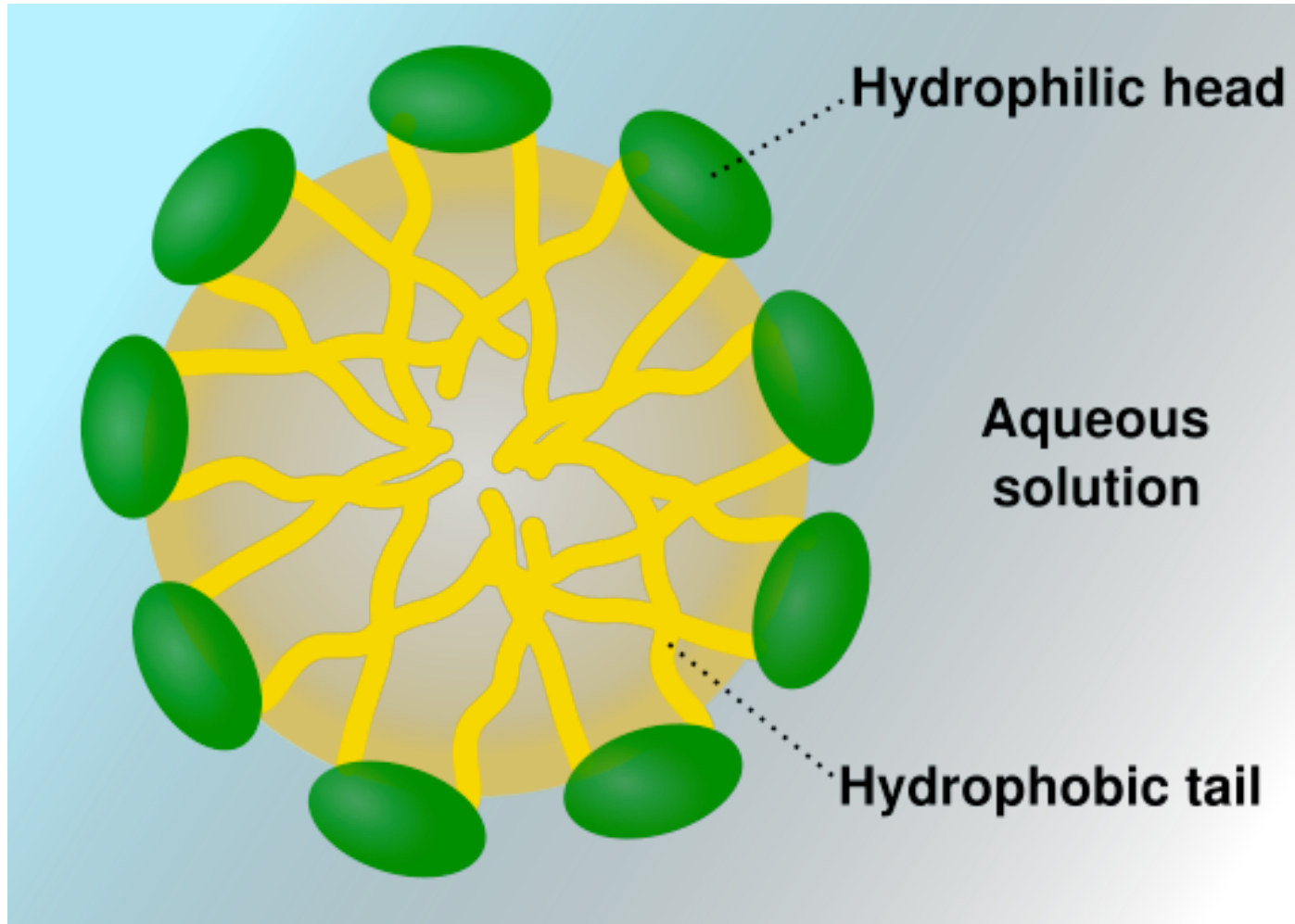


Liposome

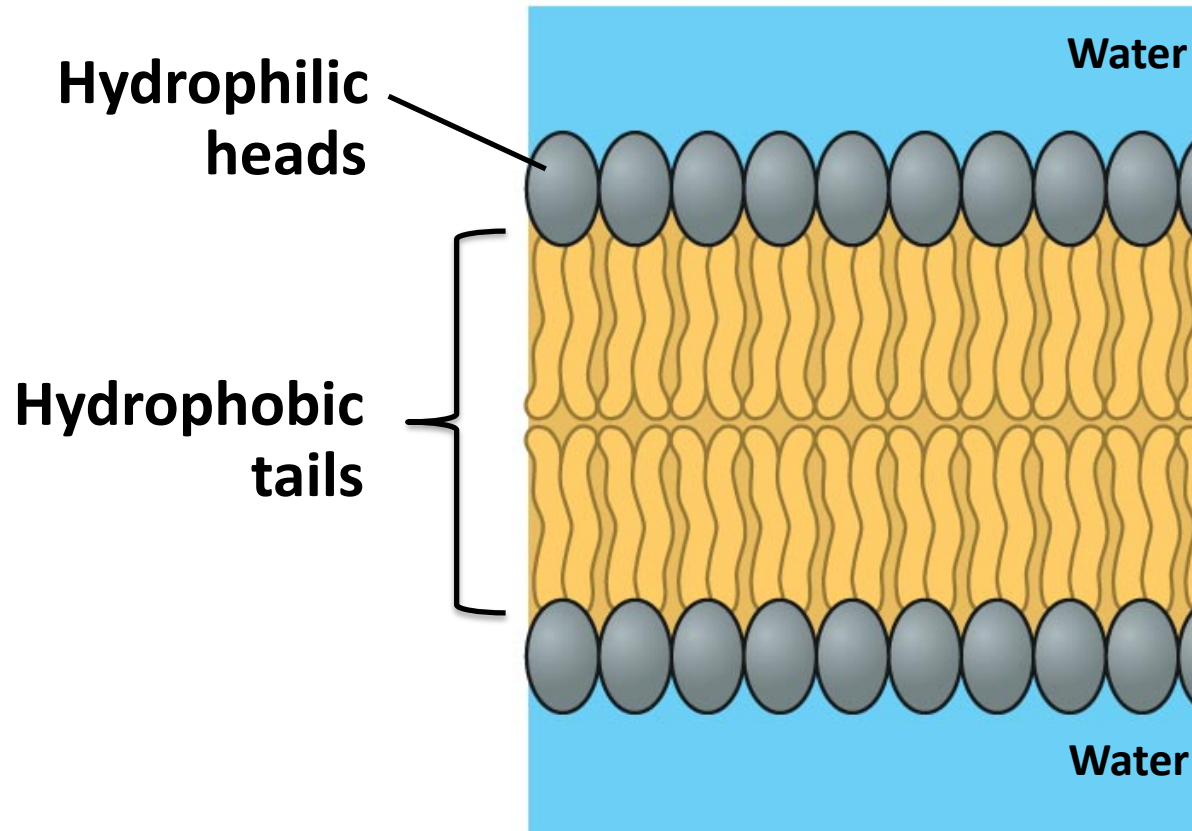


Phospholipid bilayer

Micelle



Cell Membranes



Cell Membrane

