Lipids- Greek *lipos* meaning “fat” or “lard” -a class of compounds that are soluble in non-polar solvents. Non-polar solvents such as ether, chloroform, acetone.

Five major types

1. WAX
   
   ![WAX diagram](image1)

2. Triglyceride, fat or oil
   
   ![Triglyceride diagram](image2)

3. Phospholipid
   
   ![Phospholipid diagram](image3)

4. Glycolpide
   
   ![Glycolpide diagram](image4)

5. Steroid
   
   ![Steroid diagram](image5)

Saturated acids- no double bonds-

Monounsaturated- 1 double bond

Polyunsaturated- 2 or more double bonds, most double bonds are cis.

Show table 15-2.

Essential fatty acids- body can’t synthesize, usually have more than 1 double bond. Must eat them to get them. Most people are not deficient.

Ex. Linoleic acid, linolenic acid

B. Saturated fats- animals-
better packing ability so have a higher mp, solids at room temp, such as fat, milk butter, cheese. Research shows that polyunsaturated fats are better.
Saturated fats have been associated with atherosclerosis and heart disease.
Except for Eskimos that eat omega-3 acids (first double bond at 3, vegetable oils are omega-6) omega-3 in fish tens to prevent blood platelets to stick together. Can possibly lead to increased bleeding time.

C. Unsaturated fats- plants.
Cis bonds so molecule can’t pack as well, higher mp, liquids at room temp.
olive oil, peanut oil.

Show overhead.


A. Wax

\[
\text{fatty acid} \quad \text{long chain alcohol}
\]

\[n = 12-28 \text{ carbons}
\]

Plants- wax cover to prevent water loss and pest damage Animals- provides waterproof coating.
B. Fat, oil

Most have mixed fatty acids
Fats are solids at room temp. animal source.
Oils are liquids. Plat sources.

C. Rxns.

1. Partially hydrogenated oil.- take unsaturated vegetable oil and hydrogenated it.

During the process convert cis bonds to trans and get trans fatty acids. These have been tested and are controversial. Might be harmful to health.

B. Oxidation-
Short chain aldehydes and acids smell. Happens in sweat. Increase in temp when working out.

3. Phospholipids, Glycolipids -

A. Phosphoglycerides - most abundant in cell membranes, make cell semi-permeable and myelin sheath.

3 Amino Alcohols found

Two types of phosphoglycerides that are abundant in brain, nerve cells, egg yolks, wheat germ, and yeast.

Lecithins -

A cephalin
Both molecules contain polar and non-polar regions. “head” is polar “tail” non-polar.

Get figure 15.1

B. Sphingolipids- abundant in brain and nerve cells.

Back bone instead of a glycerol.

Specific one- sphingomylin- white matter of myelin sheath. Purpose- to increase the speed of nerve impulses and insulates and protects nerve cells.

C. Glycolipids- abundant in brain and myelin sheaths of nerves.
D. cerebrosides-

sphingosine

fatty acid

sugar

cerebroside
ganglosides are similar to cerebrosides but contain two or more monosaccharides such as galactose and glucose. Important in membranes of neurons and act as receptors for hormones, viruses, and several drugs.

2. Steroid- Latin word *stereos* for solid steroid nucleus

A.Cholesterol- is a component in cellular membranes, myelin sheath, brain and nerve tissue.

Sources by eating milk, eggs or can be synthesized from the liver from fats, carbohydrates, proteins.
Excess cholesterol leads to:
A. Gallstone formation. Gallstones are almost 100% cholesterol with calcium salts, fatty acids, phospholipids.
B. Leads to lipid deposits in coronary arteries. Sat. Fats may stimulate cholesterol production in the liver.

B. Lipoproteins- proteins and phospholipids attach to triglycerides and cholesterol to make them soluble. Form a complex called lipoprotein.

Four major types-
1. chyomicrons-
2. VLDL- (very low density lipoproteins) both chyomicrons and VLDL are the major carriers between the intestines or the liver and the cells where they are used for energy or stored.
3. LDL- (low-density lipoproteins) carry cholesterol to the tissue to be used in the synthesis of cell membranes and steroid hormones.
4. HDL- (high density lipoproteins) – carry cholesterol from the tissue to the liver where it produces bile salts which are excreted.

High LDL levels are bad, high HDL levels are good.

C. Bile salts- synthesized in the liver from cholesterol and stored in the gall bladder. Bile slats mix with water, insoluble fats and oils. Act like soap emulsifiers. Produce larger surface area for fat enzymes to break apart.
D. Fat soluble vitamins- non-polar A,D,E,K. Stored in fat.

*Show overhead of vitamins functions.

E. Steroid hormones- greek “hormone” to arouse or excite. Chemical messengers.

*Show overhead of steroid functions.

F. Adrenal steroids- produced by the adrenal glands on the top of each kidney.

1. Aldosterone- responsible for electrolyte and water balance in kidneys.
2. Cortisone- increase blood glucose levels and stimulates the synthesis of glycogen in the liver from amino acids.

3. Plasma (cell) membranes- lipid bilayer.

Most lipids in the bi-layer contain fatty acids that are cis. Gives a phospholipids a dynamic structure because they can not pack too closely.
**Animals-**

C. 20% cholesterol in the bilayer which adds strength and rigidity. Are located in the non-polar tails.

D. 5% unclear function, but for communication. And growth of cell membrane. Glycolipids on outside of membrane. Hydrophilic.

E. Proteins are also embedded- are used for channels for $\text{H}_2\text{O}$, $\text{K}^+$, $\text{Cl}^-$, $\text{HCO}_3^-$. Also are used for receptors for hormones, neurotransmitters and antibiotics.