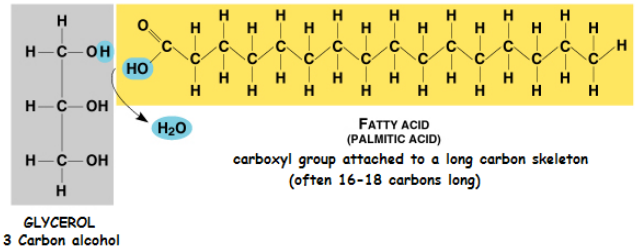
LIPIDS - DIVERSE GROUP OF HYDROPHOBIC MOLECULES

Many **NONPOLAR** C—H bonds/long hydrocarbon skeleton

HYDROPHOBIC - insoluble in water (dissolve in nonpolar solvents)



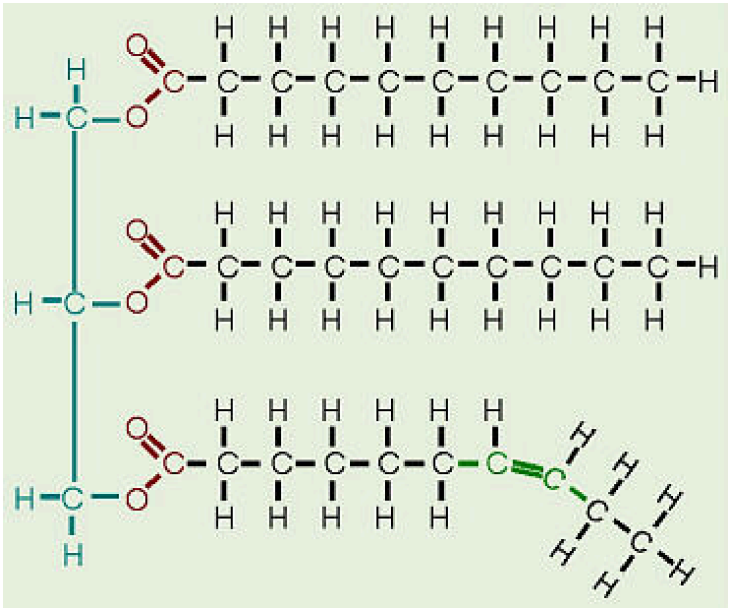
FATS = TRIACYLGLYCEROL = TRIGLYCERIDE

- store large amounts of energy
- **NOT polymers** but assembled from smaller molecules by dehydration synthesis reactions
- Adipose tissue is made primarily of tri-acylglycerols (fat)
- **FAT = 1 glycerol + 3 fatty acids**

FATTY ACID:

Hydrocarbon chain of 10-50 carbons in length

Fatty acids vary in length (number of carbons) and in the number and locations of double bonds



Three fatty acids can be the same or different

SATURATED - no double bonds in carbon chains
- Form straight chains
- Most animal fats are saturated (butter, lard)
- Solid at room temperature

UNSATURATED –one/more double bonds in tails
- have kinks wherever there is a double bond
- prevents tight packing of molecules so not solid
- Plant and fish fats = liquid at room temperature = oils (olive oil, cod liver oil)

POLYUNSATURATED = many double bonds

"HYDROGENATED VEGETABLE OILS" on food labels means unsaturated fats have been synthetically converted to saturated fats by adding hydrogen also makes unsaturated fats with *trans* double bonds (*trans fats*)

- Peanut butter and margarine are hydrogenated to prevent lipids from separating out as oil
- Both saturated fats & trans-fats in diet contribute to cardiovascular disease (atherosclerosis) through plaque deposits

FUNCTION (fats, oils)

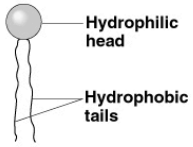
ENERGY STORAGE

- Compact energy storage; energy stored in C-H bonds; about 3X the energy of carbohydrates
- Humans and other mammals store fats as long-term energy reserves in adipose cells
- Adipose tissue also functions to cushion vital organs, such as the kidneys
- A layer of fat can also function as insulation (especially in whales, seals, and most other marine mammals)

PHOSPHOLIPIDS

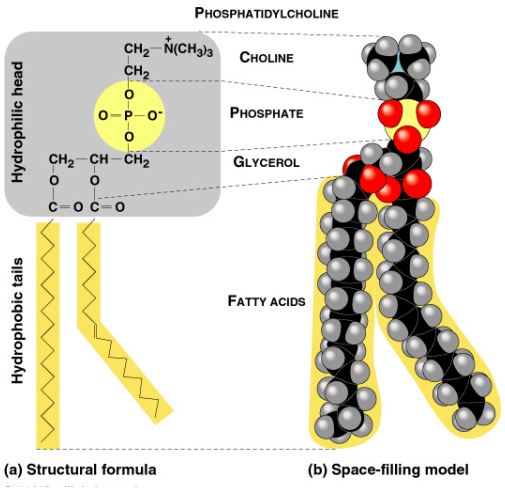
FAT with one fatty acid replaced by a phosphate group

- The phosphate group carries a negative charge
- Additional sugars, amines, or other groups may be attached to the phosphate group to form a variety of phospholipids
- Heads are often **zwitterions:** they have both + and -charge.



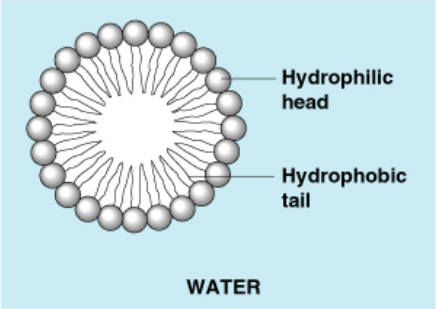
(c) Phospholipid symbol

AMPHIPATHIC –
- Both phobic AND philic parts

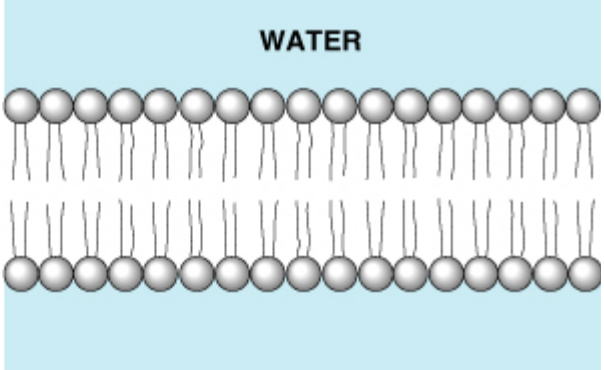


- polar head
- non-polar tails

ADDING PHOSPHOLIPIDS TO WATER



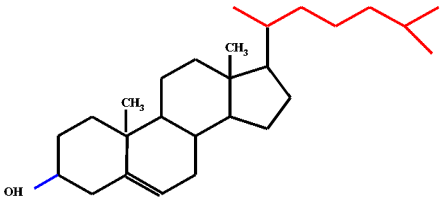
- self-assemble into MICELLES
- sphere with hydrophobic tails toward interior
- polar/philic heads toward outside



FUNCTION OF PHOSPHOLIPIDS

- Major component in cell membranes
- Arranged as a bilayer
- Hydrophilic heads toward the outside of the bilayer in contact with the aqueous solution
- Hydrophobic tails point toward the interior of the bilayer away from aqueous solution
- Forms a barrier between the cell and the external environment.

STEROIDS

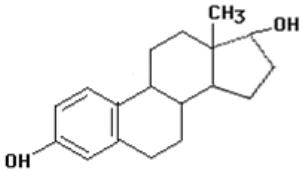


- Lipids with a carbon skeleton with four fused rings

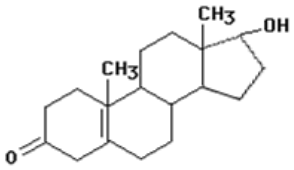
  and a small ACYL (carbon chain) tail

- Insoluble in water (nonpolar)

- Different steroids vary in the functional groups attached to the rings



Estradiol
Female sex hormone



Testosterone
Male sex hormone

CHOLESTEROL

- Important precursor for all other steroids
  Hormones: cortisone, cortisol, testosterone, estradiol, estrogen
- Cholesterol also found in animal cell membranes
- Synthesized in the liver
- Obtained in the diet (meat, cheese,eggs)
- Essential in animals, but high levels of cholesterol in the blood may contribute to cardiovascular disease (atherosclerosis)

• Negative effect of saturated fats and *trans*-fats due to their impact on cholesterol levels
  - LDL's (low density lipoproteins)
    'bad' cholesterol (deposits in coronary blood vessels)

  - HDL's (high density lipoproteins)
    'good' cholesterol

WAXES-protective, waterproof coatings:
• fur, feathers, and skin
• leaves/fruits of plants
• insect exoskeletons