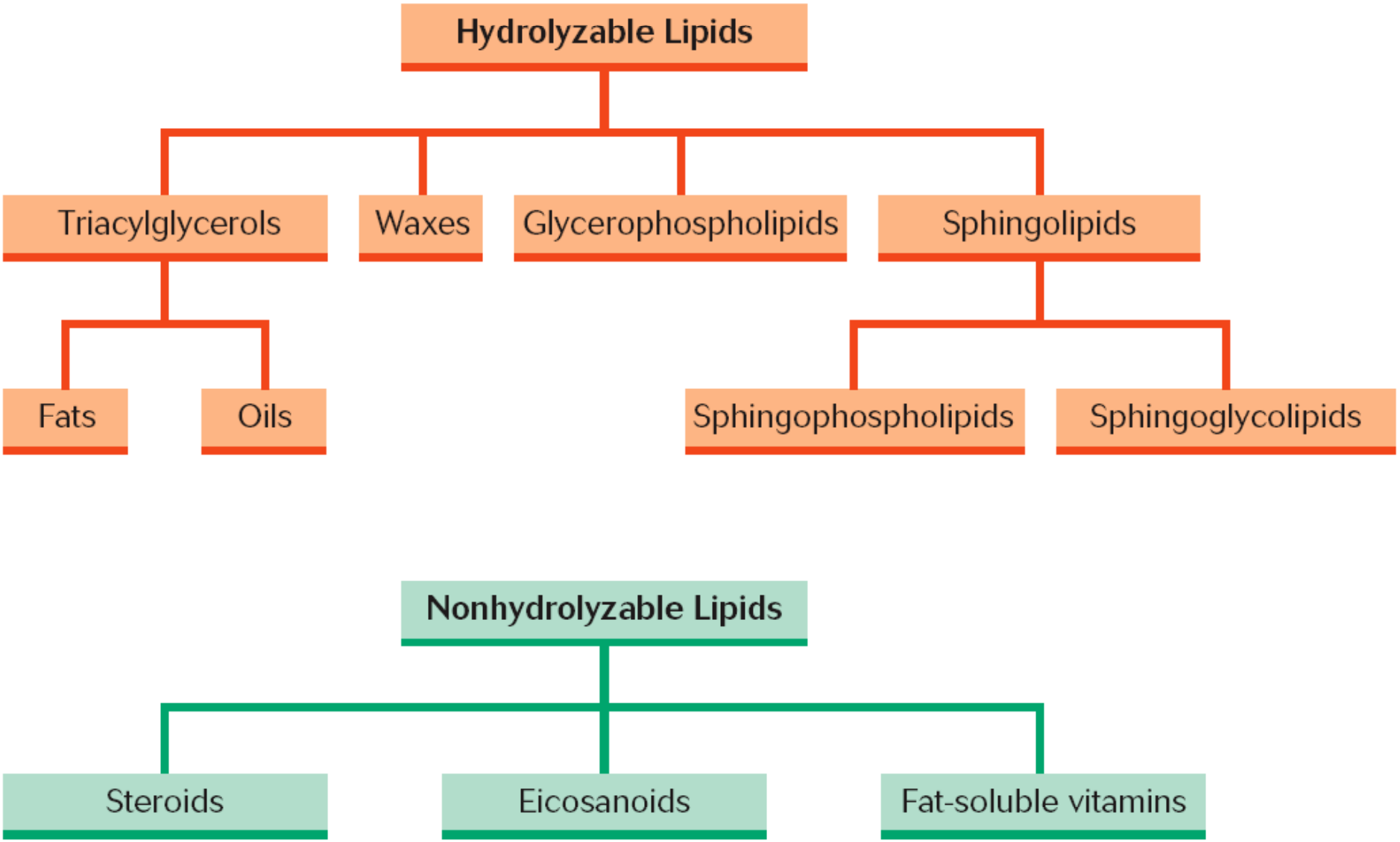
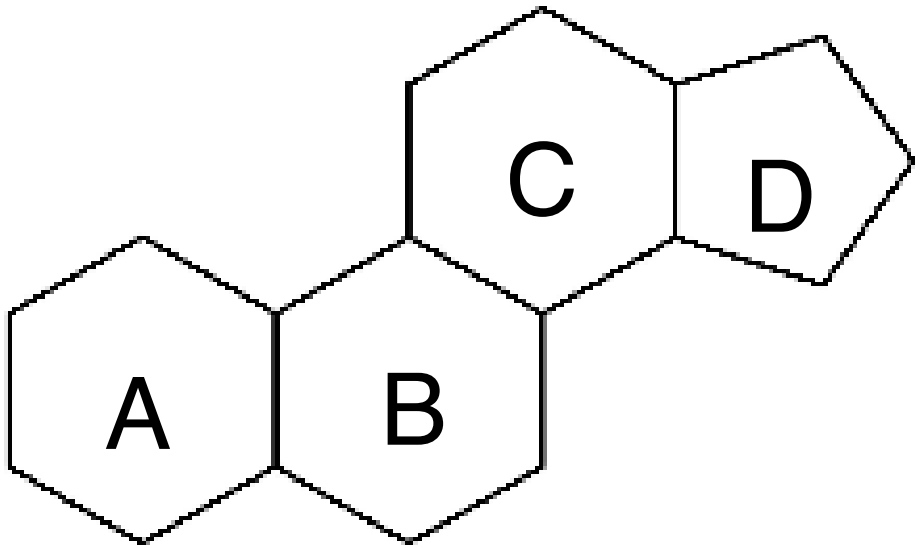
Classification of Lipids



Nonhydrolyzable Lipids - Steroids

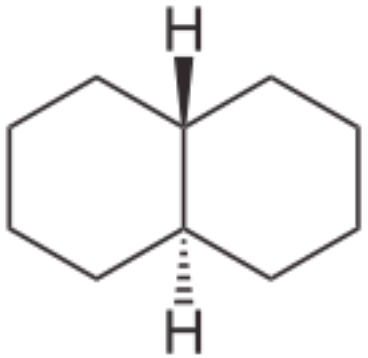
Steroids are high molecular weight, nonhydrolyzable lipids that contain the **steroid ring structure**:

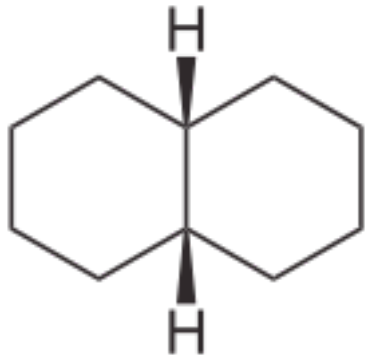


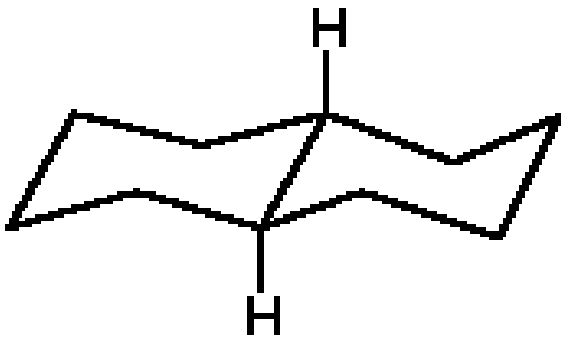
Steroids include **cholesterol, adrenocortical and sex hormones, and bile salts**. The biological effects vary considerably and depend on functional groups attached to the rings and shape.

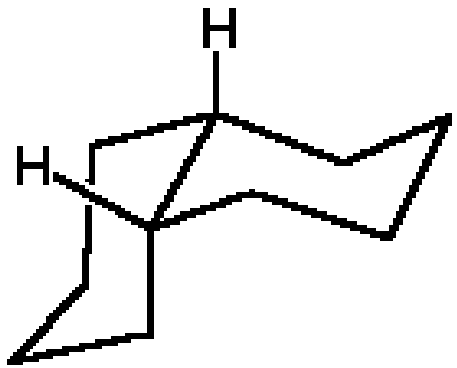
Nonhydrolyzable Lipids - Steroids

From a structural standpoint, it is important to consider the characteristics of a **fused ring system**.



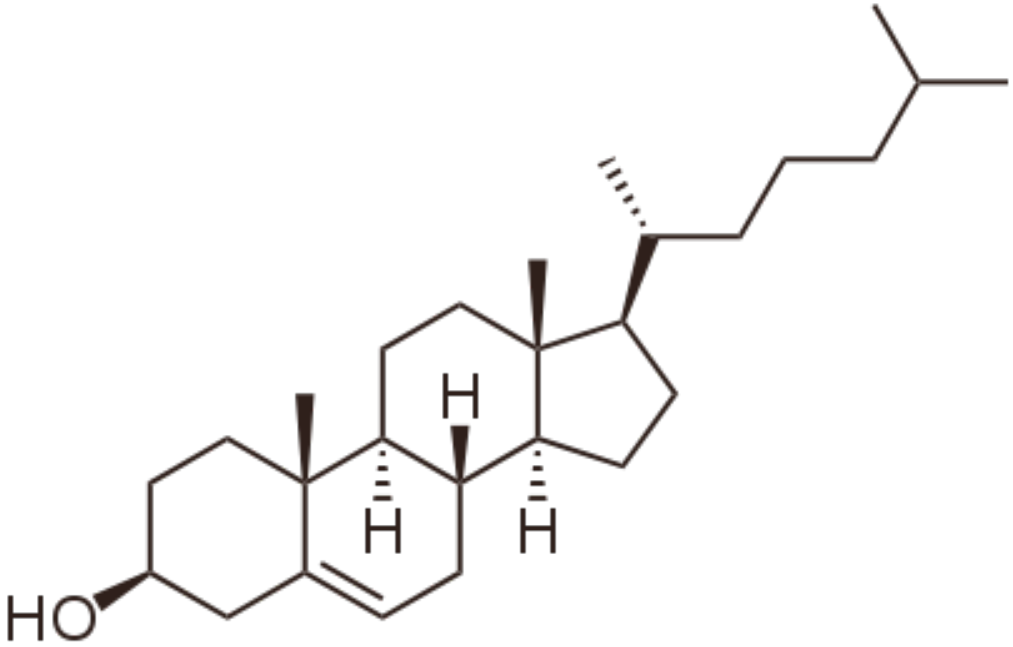






trans-decalin

cis-decalin

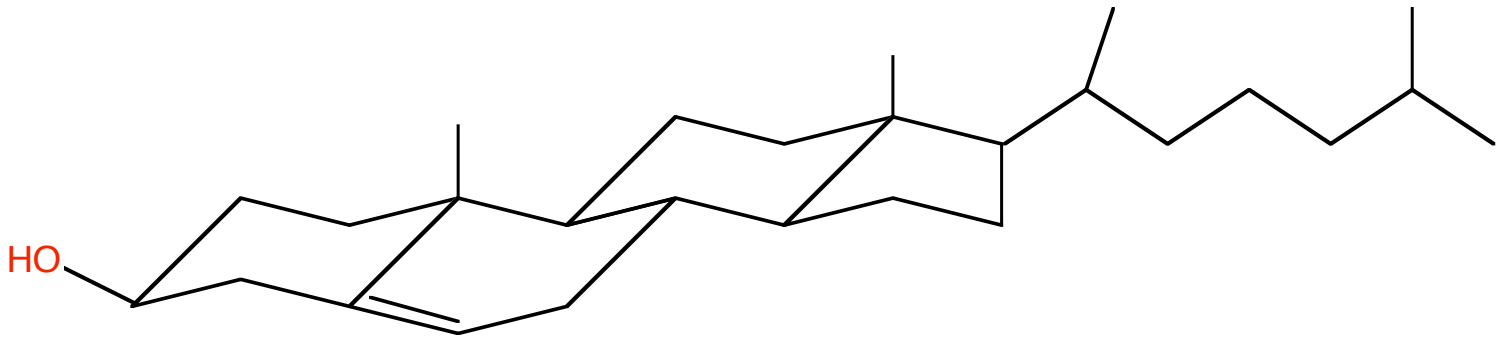


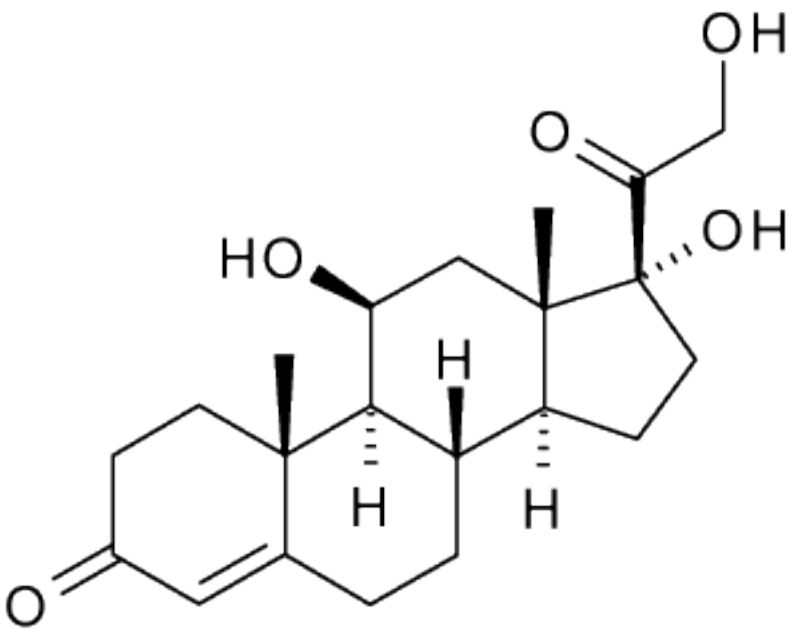
Cholesterol is the major steroid in animals. It contains 8 tetrahedral stereocenters, but exists as a single stereoisomer.

1) Cardiovascular disease

2) Membrane component

3) Precursor to other steroids.



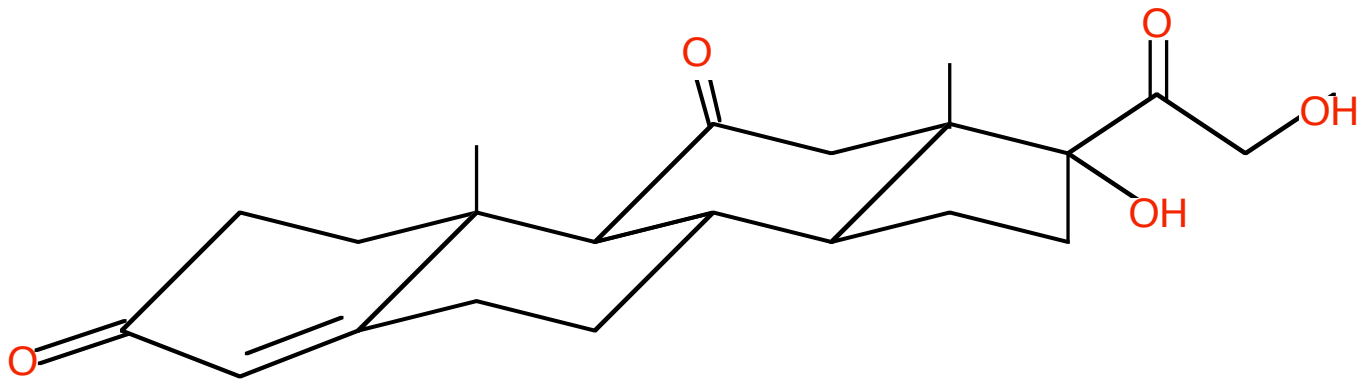


Cortisol:

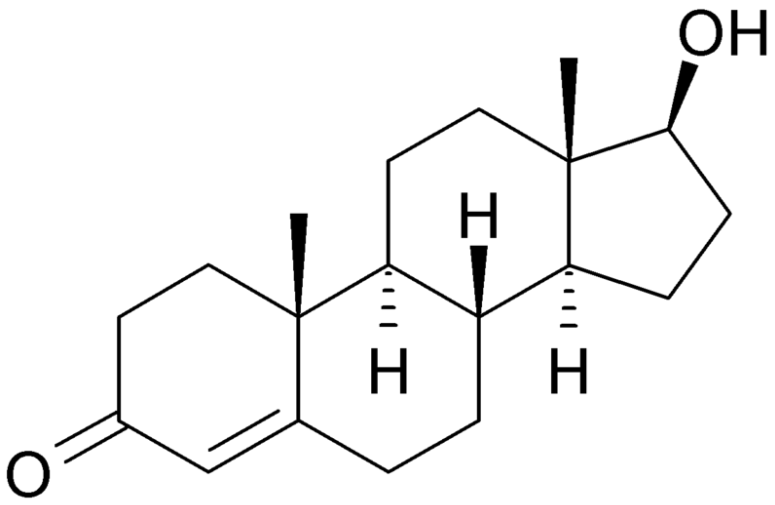
1) Adrenocortical hormone

2) Metabolic regulator

3) Immune regulator



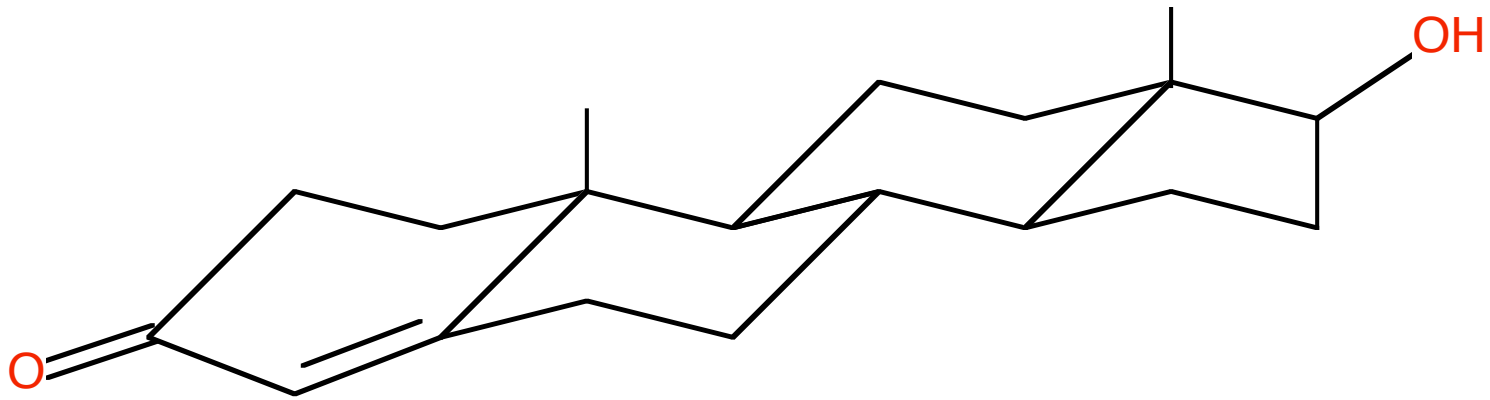
Testosterone:

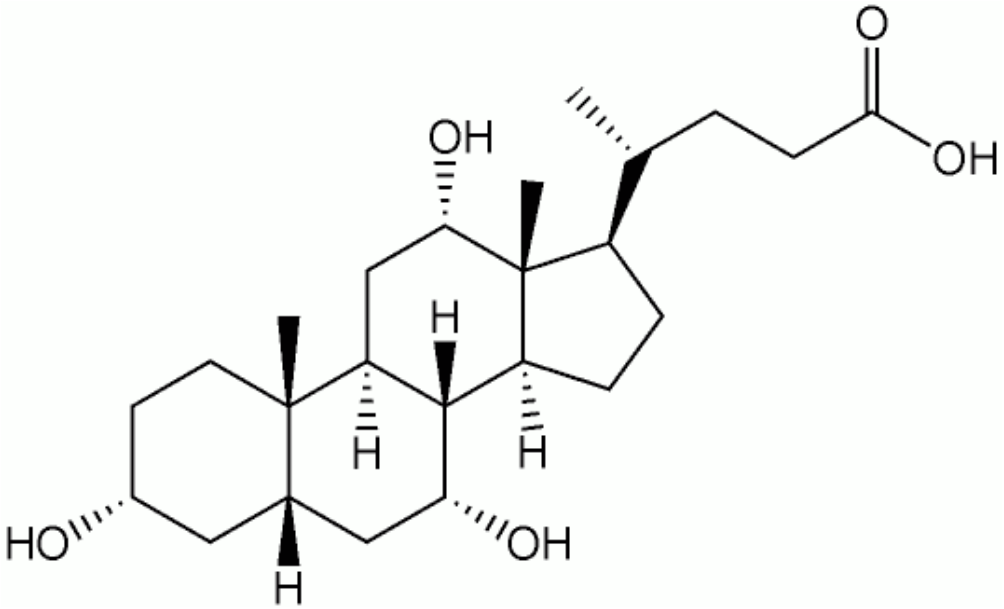


1) Sex hormone

2) Reproductive cycle

3) Growth and development



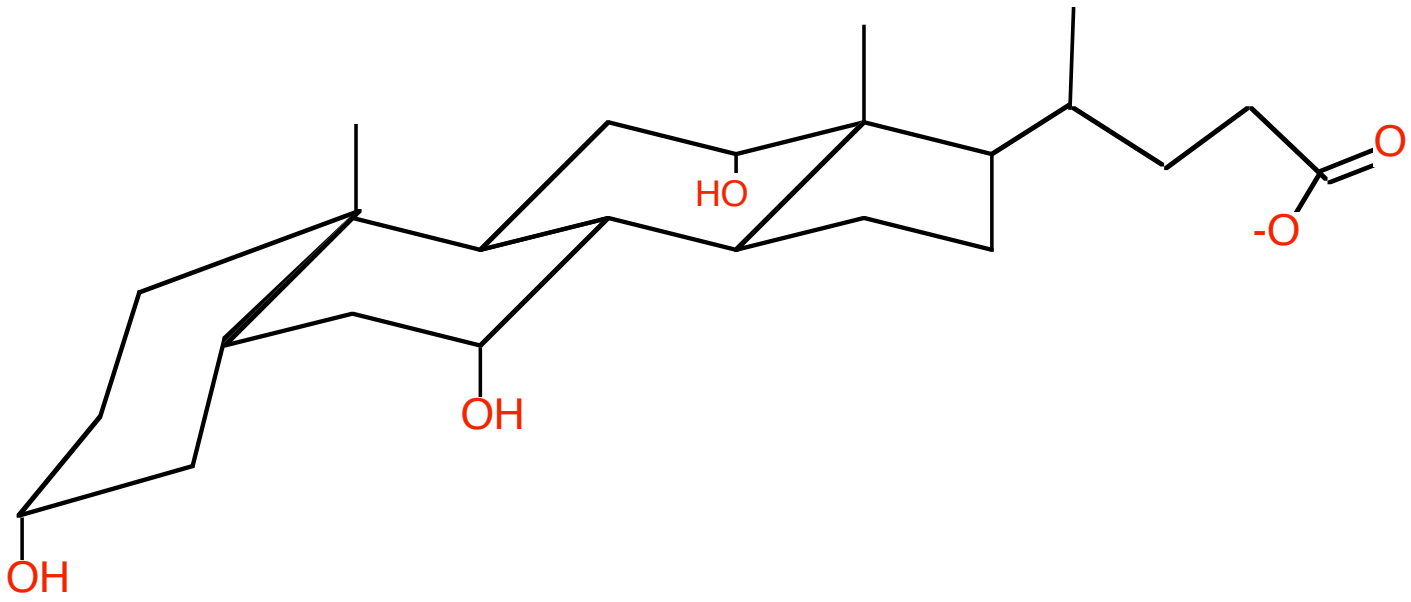


Cholic acid:

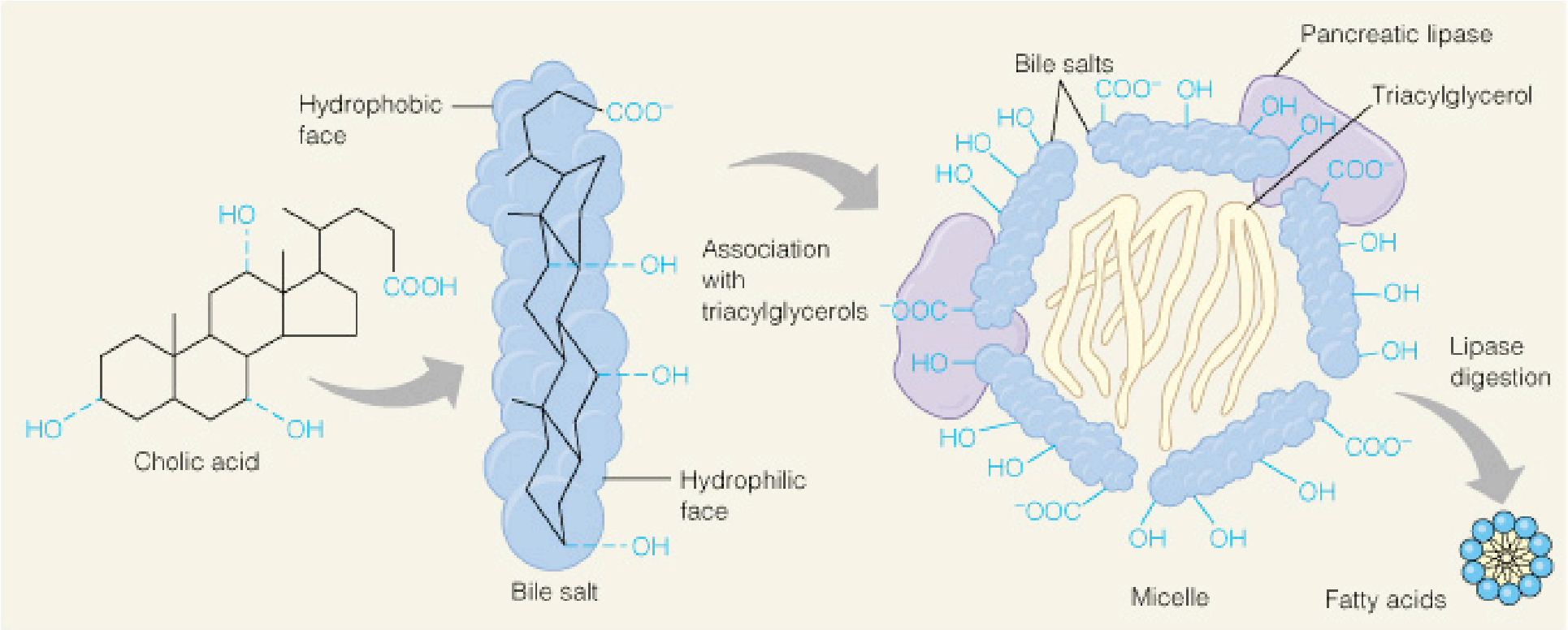
1) Secreted by gall bladder

2) Active in digestion of fats

3) A/B ring cis fused



Action of Cholic Acid



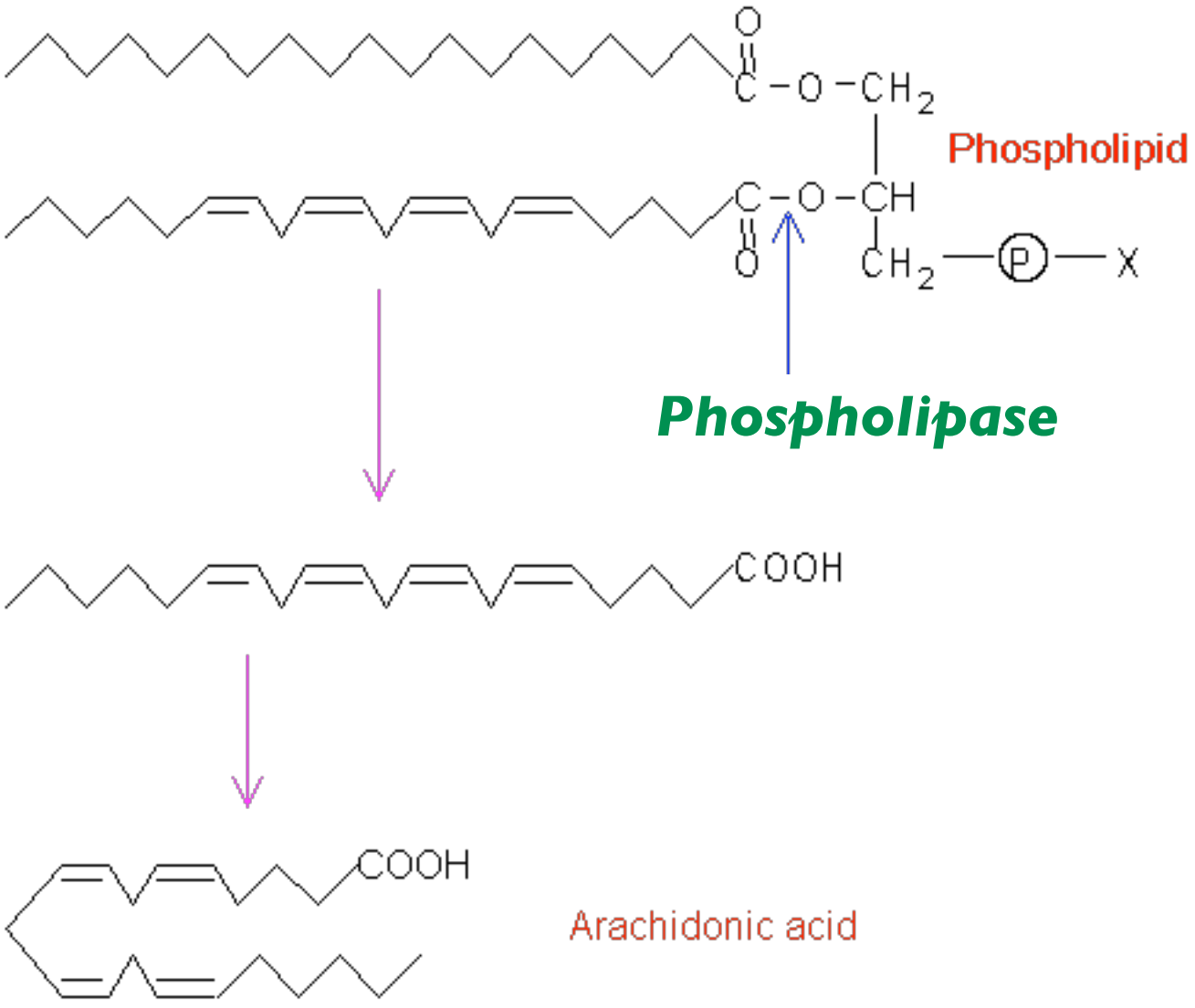
Lipases only function at the surface of fat globules in the intestines.

Bile salts function as soaps to break up larger fat globules into smaller ones in order to increase the total surface area and thus increase the rate of digestion.

Bile salts also help to solubilize cholesterol in the bile which aids in the elimination of excess cholesterol through the intestinal tract.

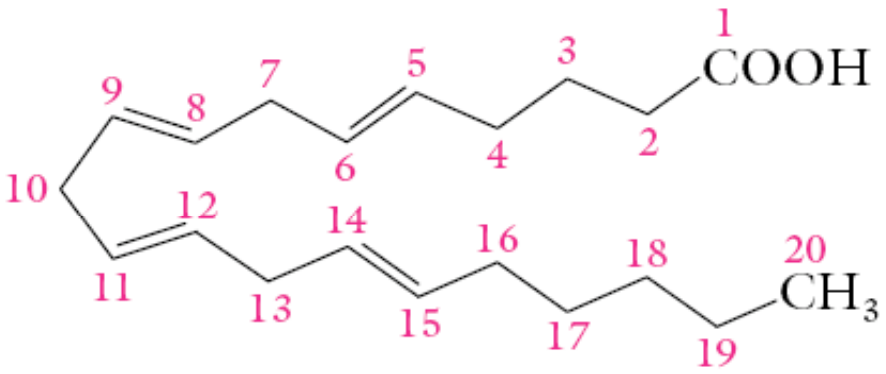
Bile salts are also involved in the absorption of the fat soluble vitamins from the intestines (A, D, E, and K).

Nonhydrolyzable Lipids - Eicosanoids

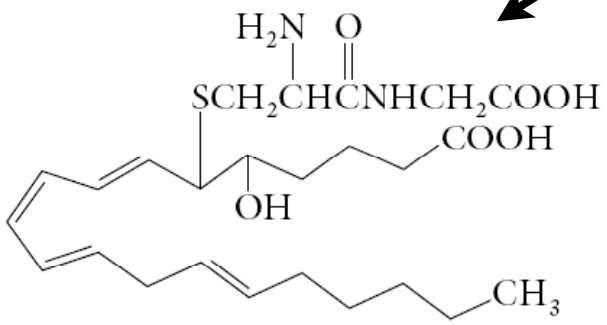


Nonhydrolyzable Lipids - Eicosanoids

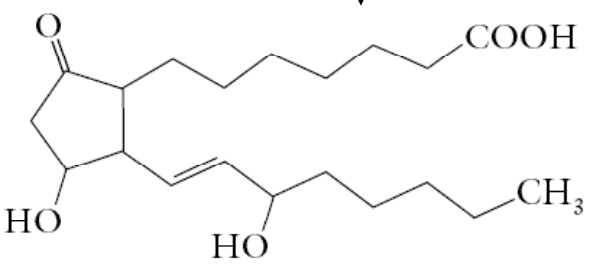
Eicosanoids are nonhydrolyzable lipids derived from arachidonic acid.



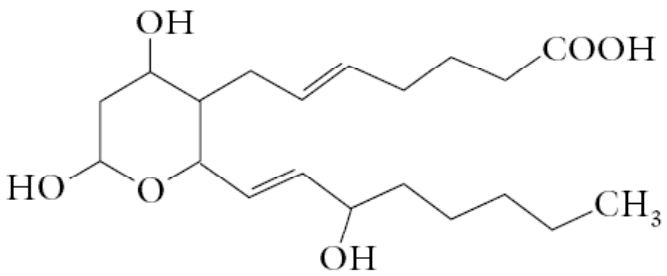
Arachidonic acid



Leukotriene D_4



Prostaglandin E_1



Thromboxane B_2

Nonhydrolyzable Lipids - Eicosanoids

Eicosanoids act as local hormones.

They are not transported through the bloodstream.

Eicosanoids are produced in most tissues and play roles in:

1) inflammatory response in joints, skin, muscle, eyes*

2) production of pain and fever in disease and injury

3) regulation of blood pressure

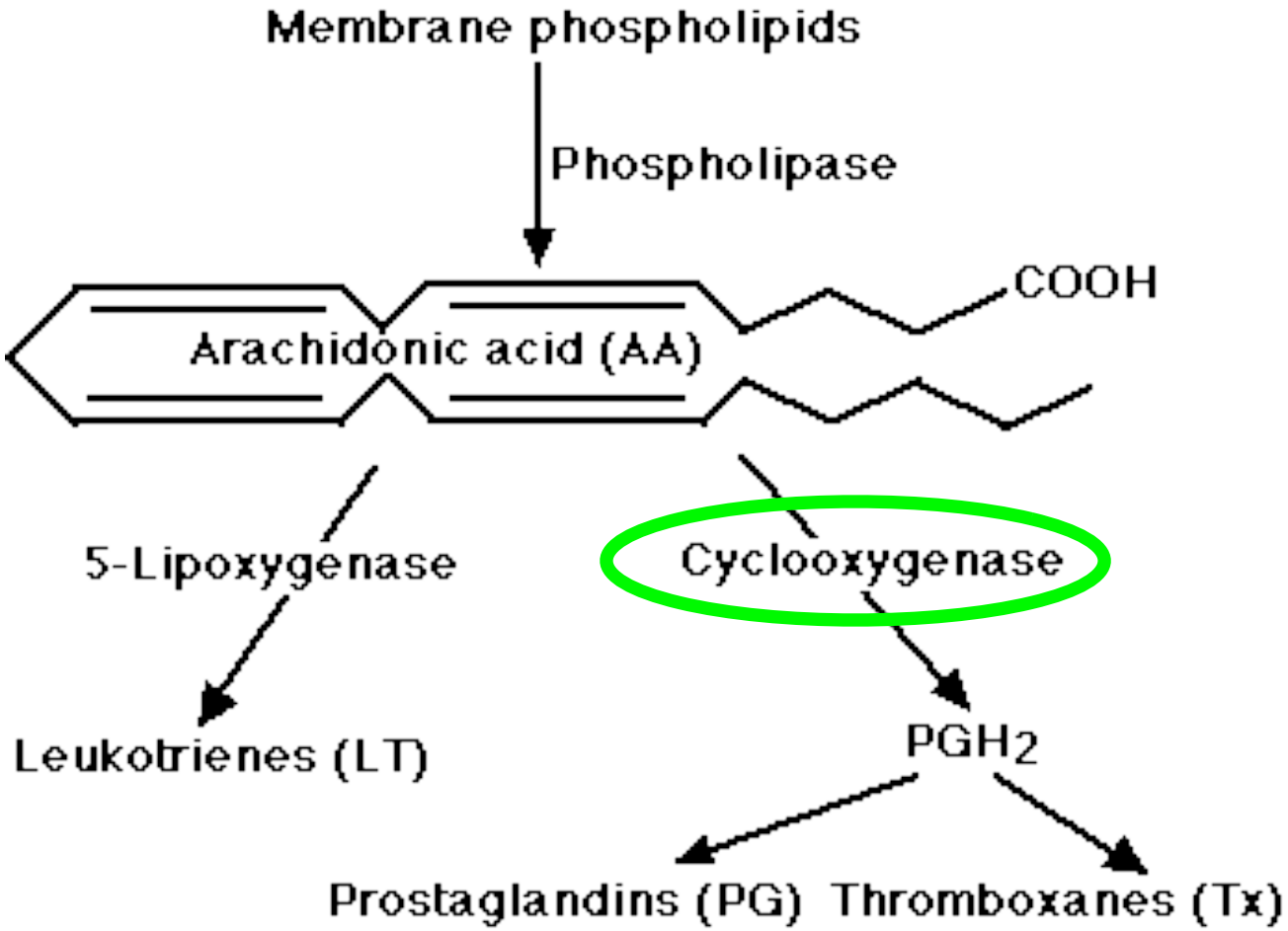
4) blood clotting

5) induction of labor

6) regulation of the sleep cycle

7) allergic and asthmatic reactions

Nonhydrolyzable Lipids - Eicosanoids



***Pain and swelling (arthritis and related illnesses) result from the production of prostaglandins.**

The anti-inflammatory drugs aspirin, ibuprofen, acetaminophen, naproxen sodium, and indomethacin sodium prevent the synthesis of these prostaglandins through inhibition of cyclooxygenase enzymes.

Vitamins are organic compounds needed in trace amounts for normal metabolism but not synthesized by the organism that requires them.

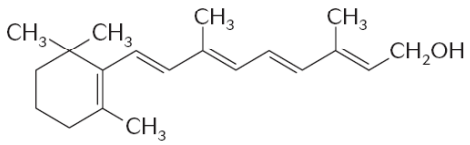
Vitamins can be subclassified:

Water soluble: B and C complex

Fat soluble: A, D, E, K

Fat-Soluble Vitamins

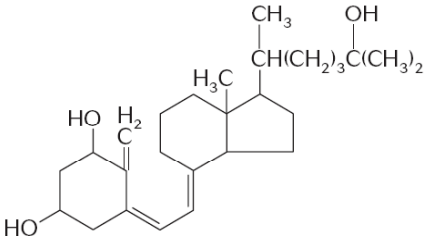
vitamin A (*trans*-retinol)



Plays key role in vision by its conversion into *cis*-11-retinal and subsequently into rhodopsin (see Box 12.2). Aids proper functioning of mucous membranes and epithelial tissues.

Deficiency: dry eyes and skin, sterility in males, night blindness

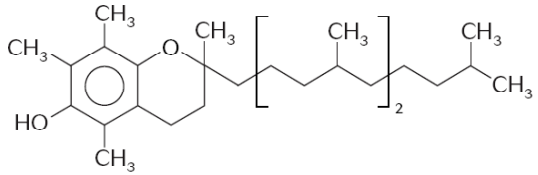
1,25-dihydroxyvitamin D_3
(active form of Vitamin D)



Regulates calcium and phosphate use and deposition in bone and cartilage.

Deficiency: rickets in children (bowlegs, spinal curvature, knock-knees, pelvic and thoracic deformities); osteomalacia in adults (weakened bones susceptible to fracture)

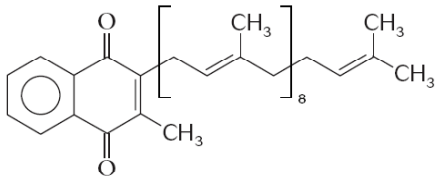
vitamin E (α-tocopherol)



Acts as antioxidant to protect unsaturated fatty acid components of cell-membrane lipids against oxidation by air and free radicals (see Section 10.5).

Deficiency: scaly skin, muscular weakness and atrophy, sterility

vitamin K_2



Regulates formation of prothrombin, needed for blood clotting.

Deficiency: increased time for blood clotting, a serious problem when a person is bruised, wounded, or undergoing surgery