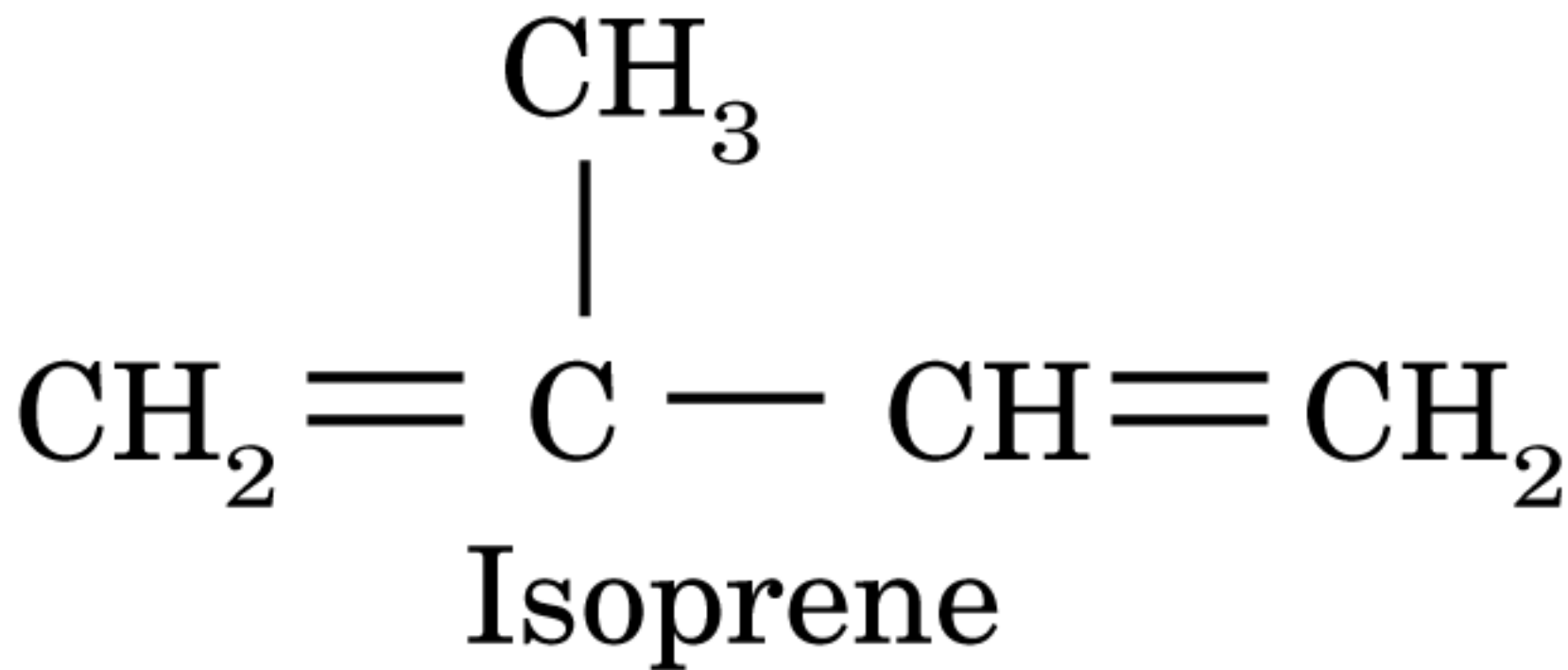
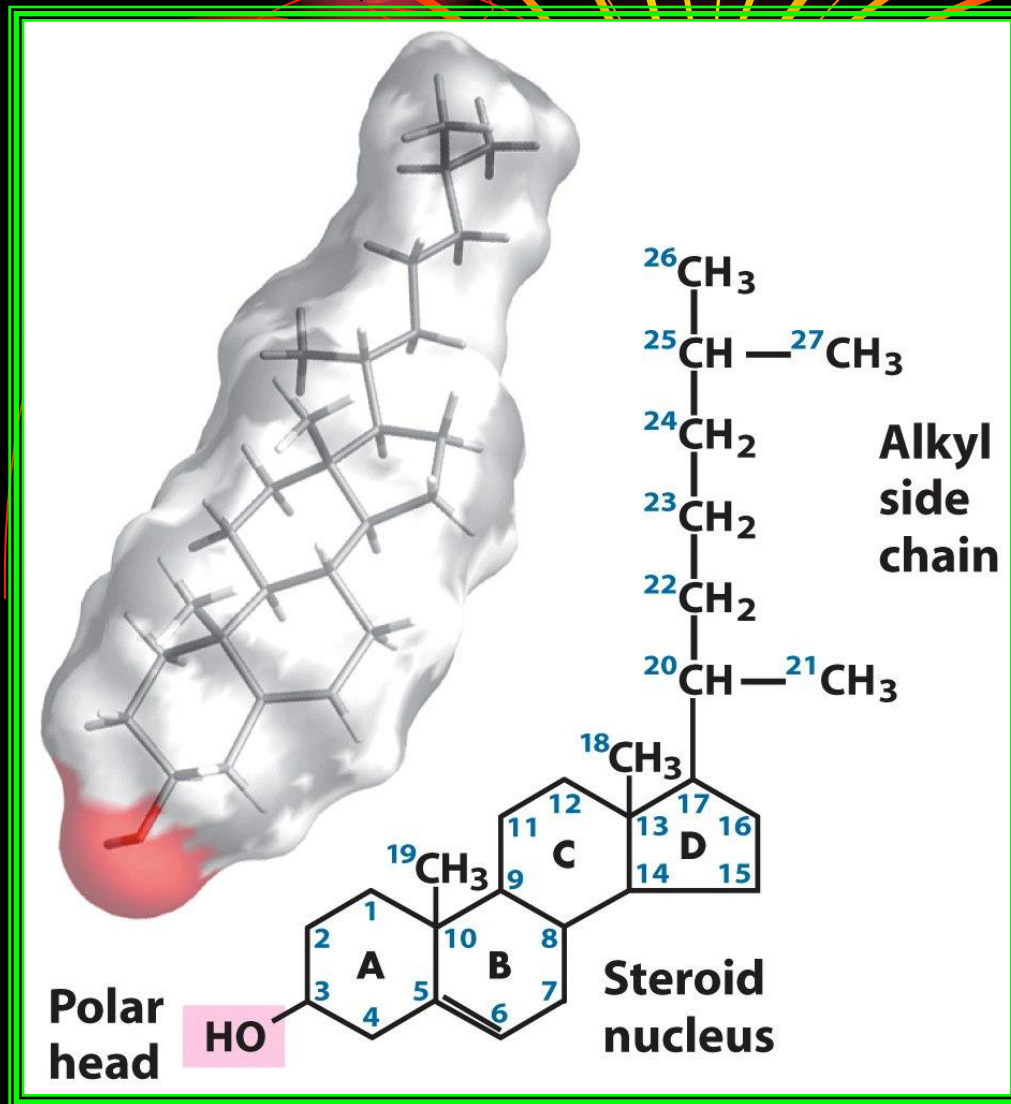
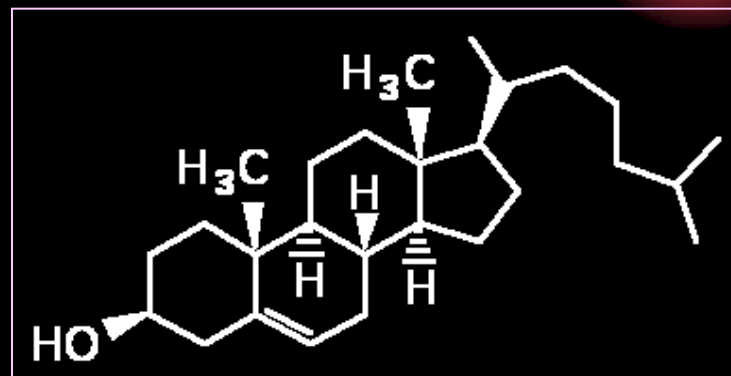
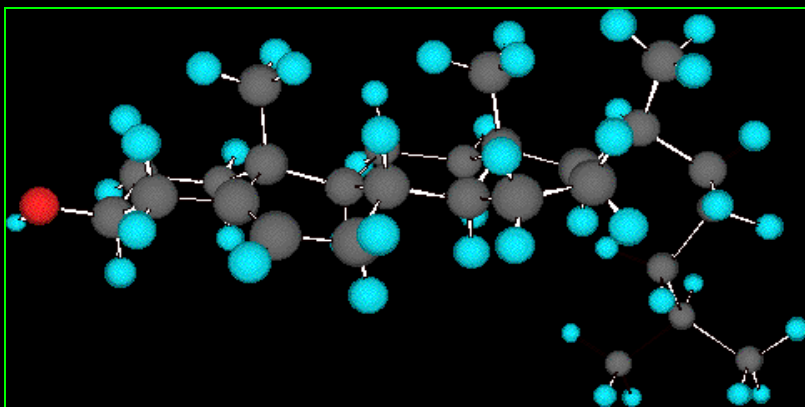
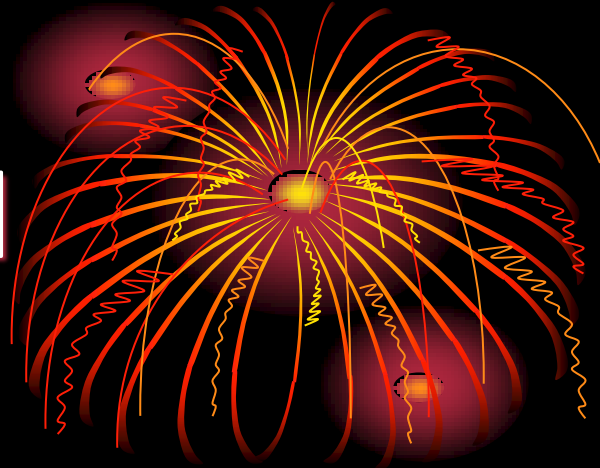


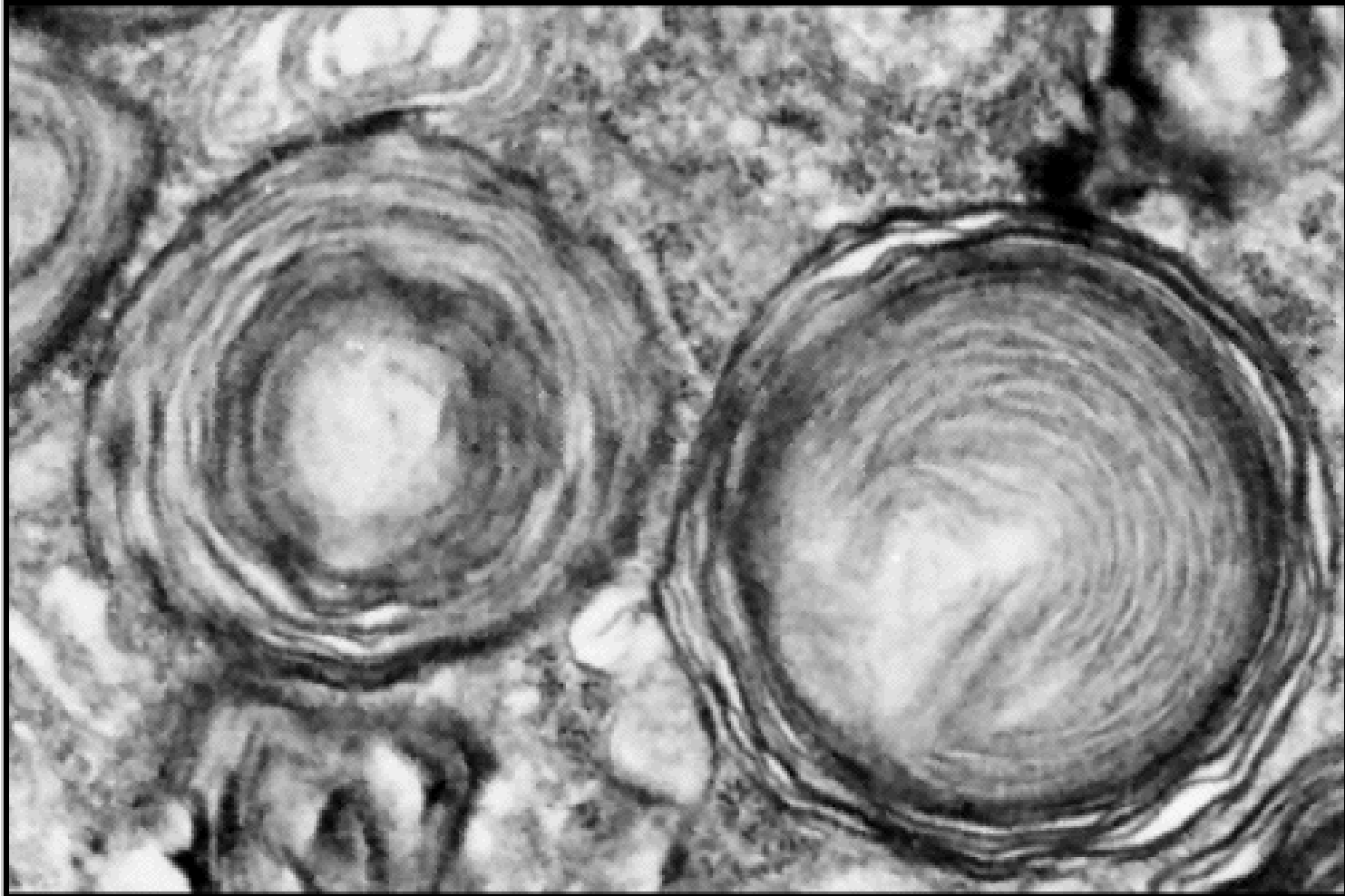


Cholesterol Structure

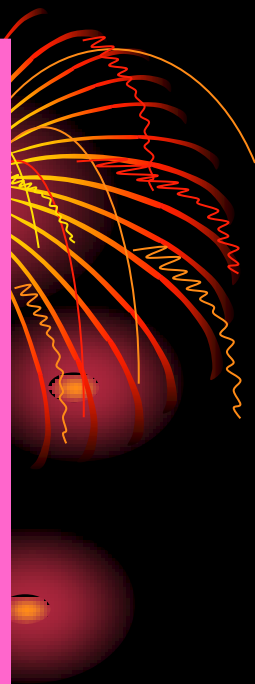


Cholesterol



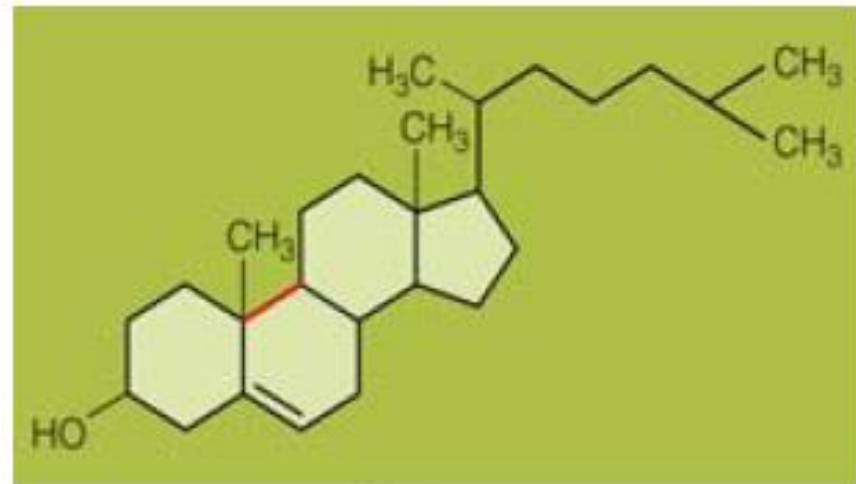


1 μm

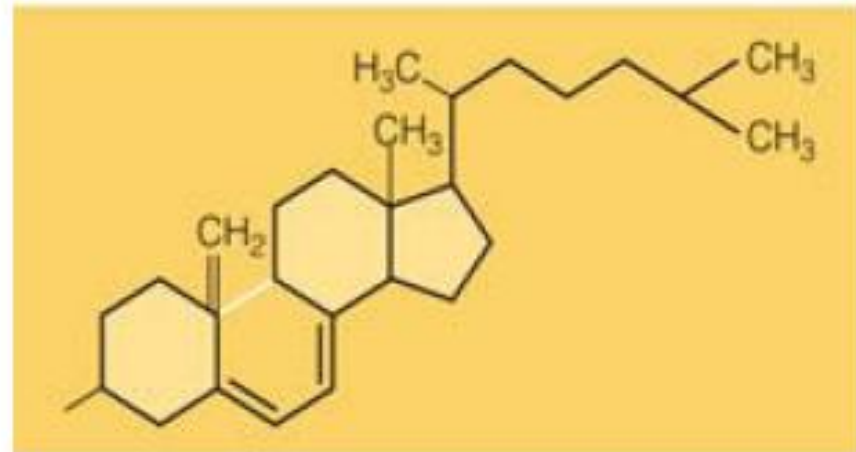


Sterols

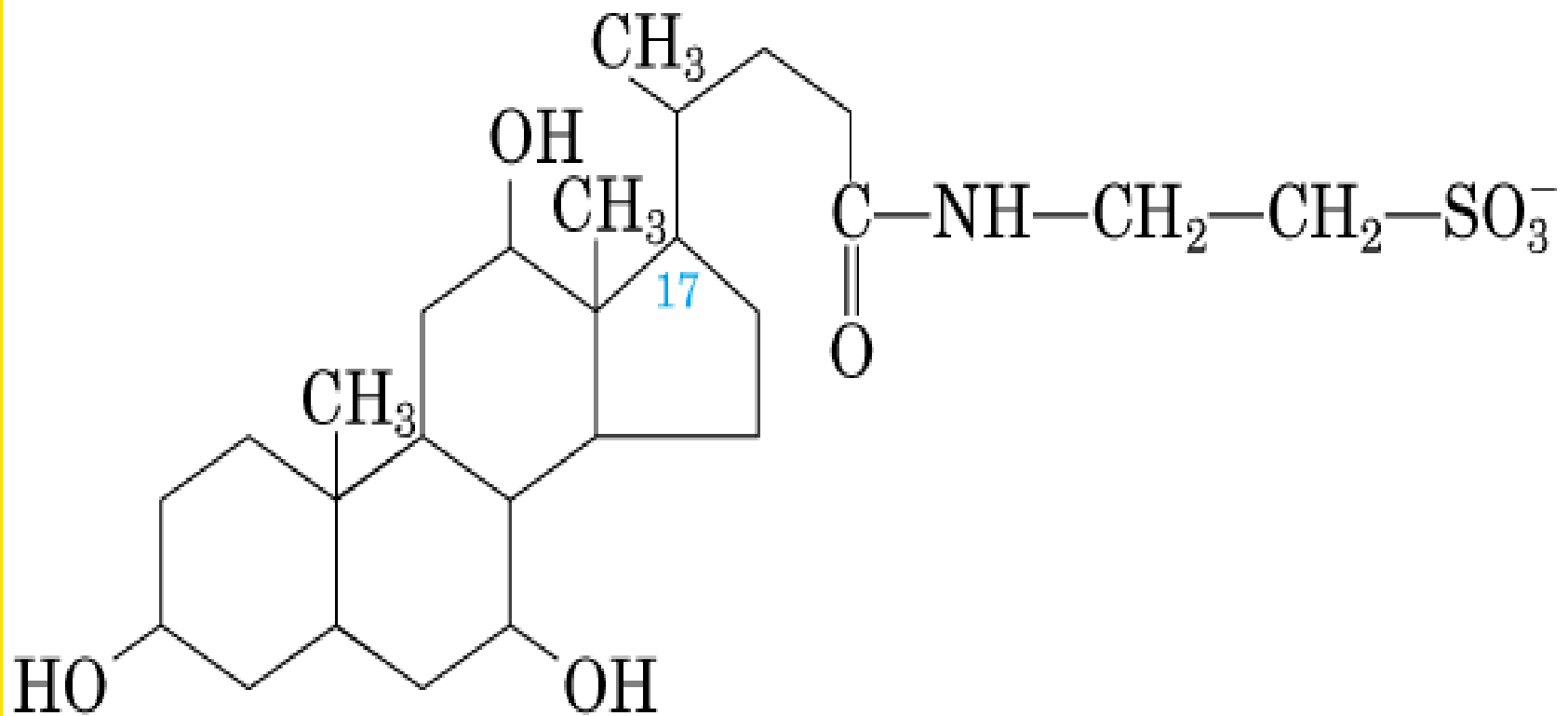
- Bile acids
 - Sex hormones
 - Adrenal hormones
 - Vitamin D
 - Cholesterol
- Plant and animal foods contain sterols but only animal foods contain cholesterol
 - Why? Cholesterol is made in the liver, and plants do not have a liver



Cholesterol

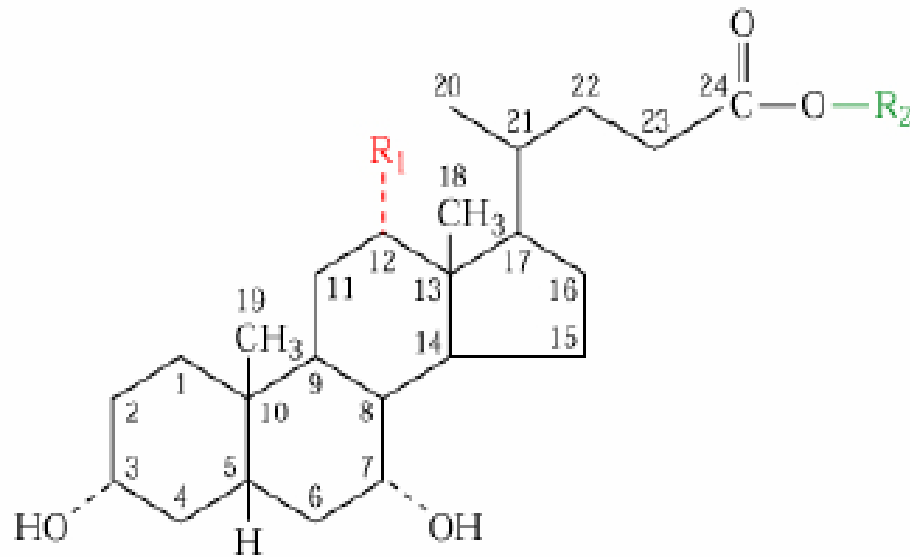


Vitamin D₃



Taurocholic acid
(a bile acid)

Absorption & Digestion: Bile Acids



$R_1 = \text{OH}$

$R_1 = \text{H}$

$R_2 = \text{H}$

$R_2 = \text{NH}-\text{CH}_2-\text{COOH}$

$R_2 = \text{NH}-\text{CH}_2-\text{CH}_2-\text{SO}_3\text{H}$

Cholic acid

Glycocholic acid

Taurocholic acid

Chenodeoxycholic acid

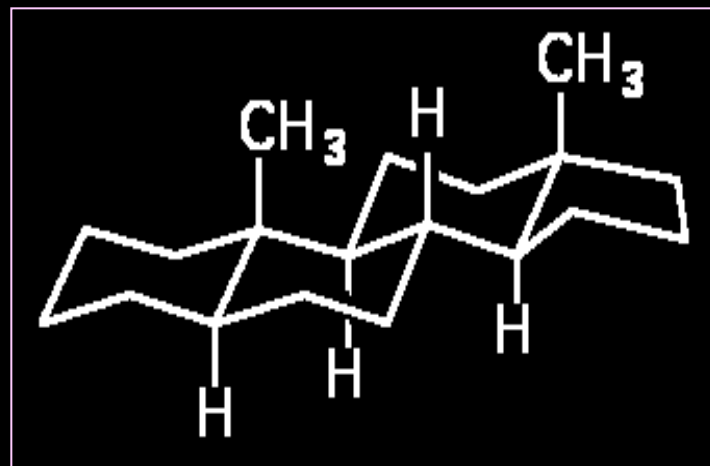
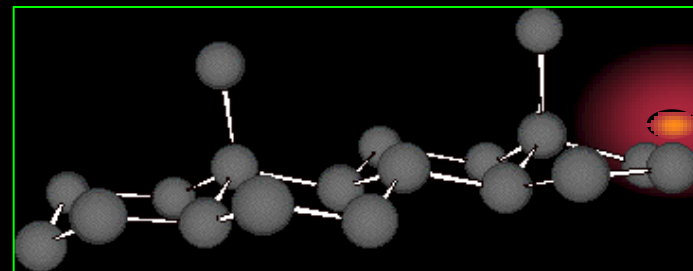
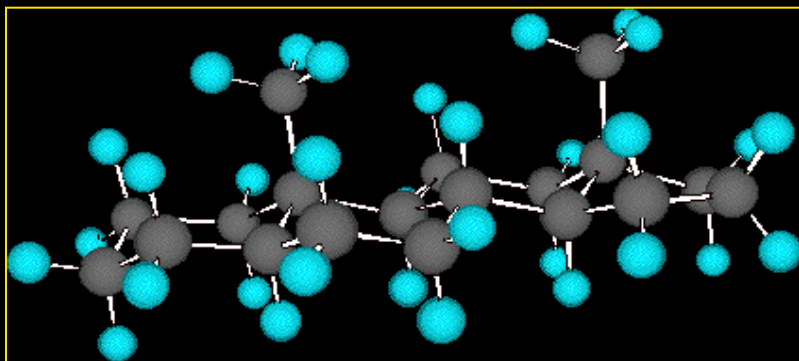
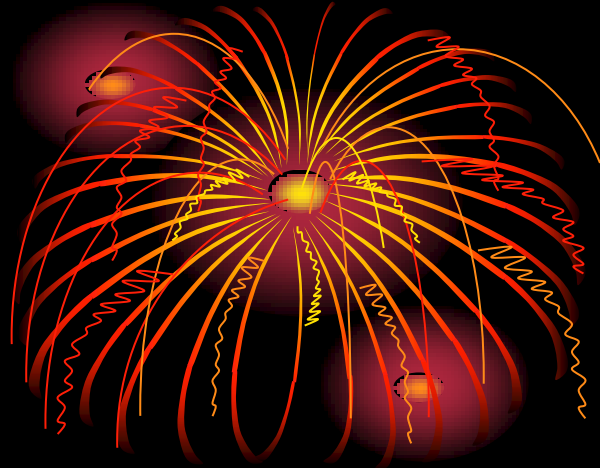
Glychenodeoxycholic acid

Taurochenodeoxycholic acid

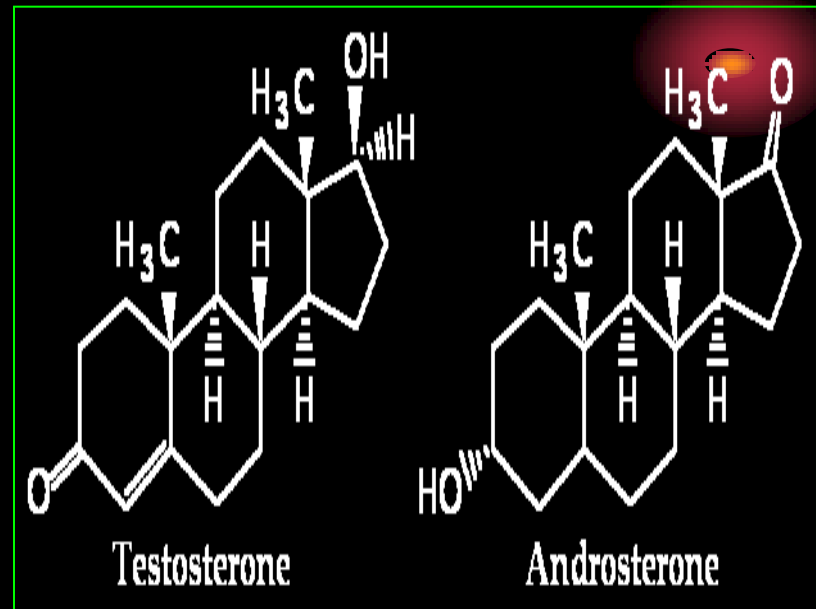
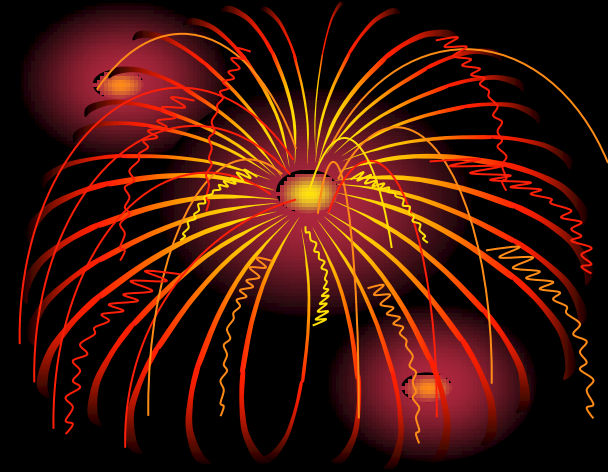
3. Lipids as vitamins and hormones

- ❑ Steroid hormones – sex steroids, corticoids
- ❖ Fat-soluble vitamins
 - ❑ vitamin A – derived from b-carotene .
 - Retinol, retinoic acid are involved in growth and development of epithelial tissues (Retin-A for acne and wrinkles) and reproduction.
 - Retinal is a visual pigment.

Steroids

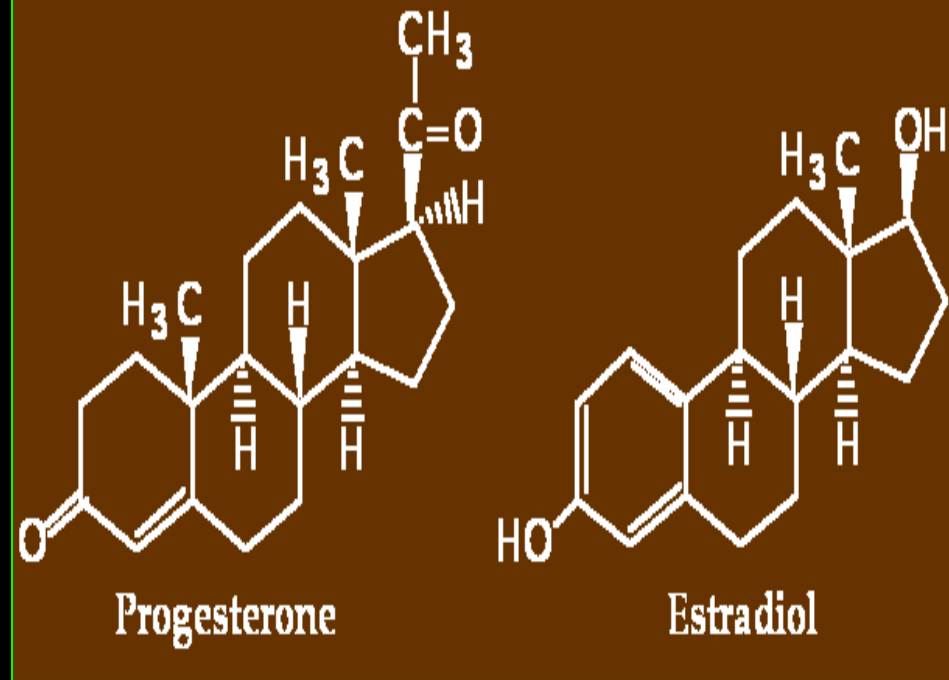
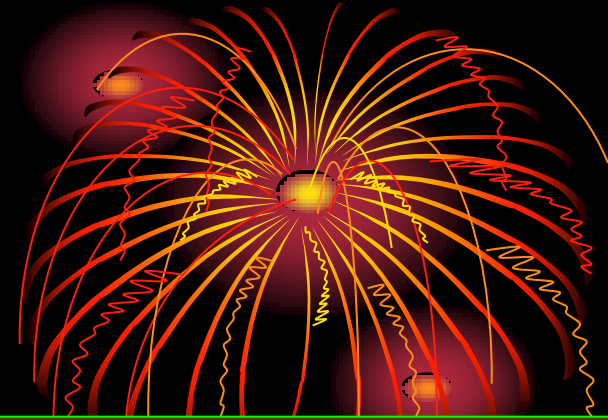


- **Androgens**
 - **Androgens - male sex hormones**
 - **synthesized in the testes**
 - **responsible for the development of male secondary sex characteristics**

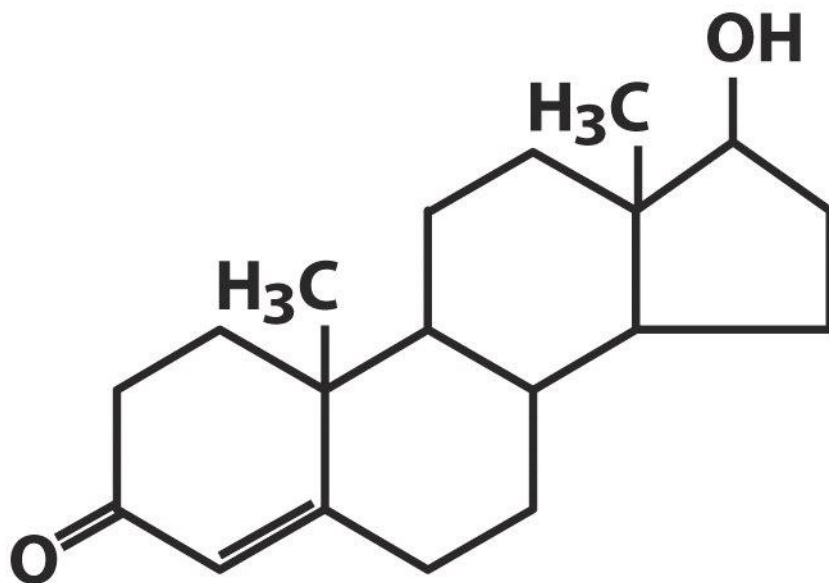


• Estrogens

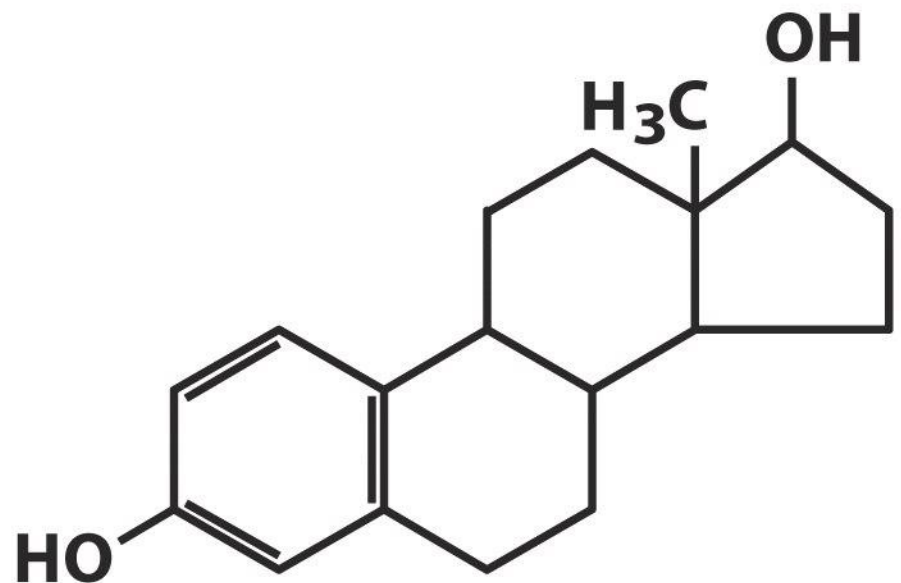
- **Estrogens - female sex hormones**
- **synthesized in the ovaries**
- **responsible for the development of female secondary sex characteristics and control of the menstrual cycle**



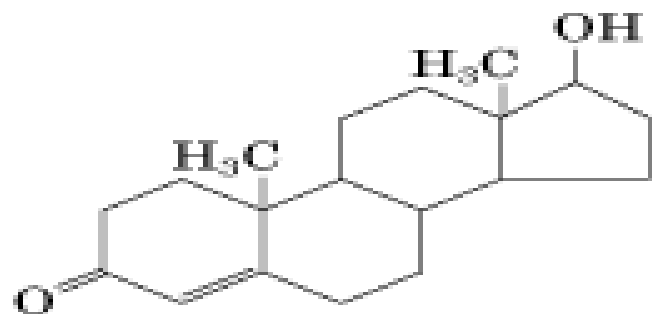
Examples of Steroid Hormones



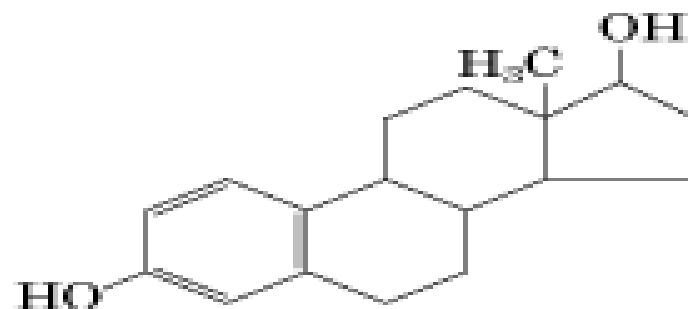
Testosterone



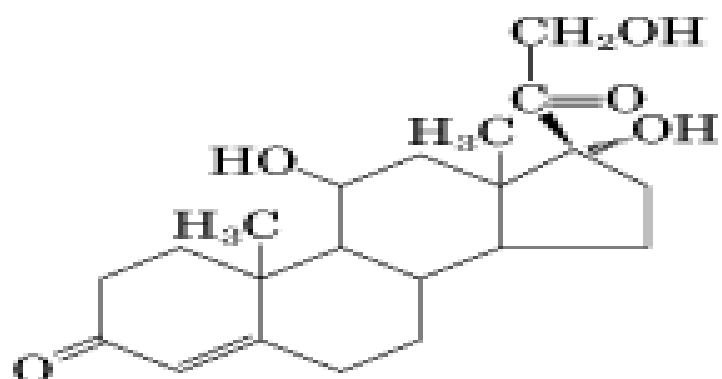
Estradiol



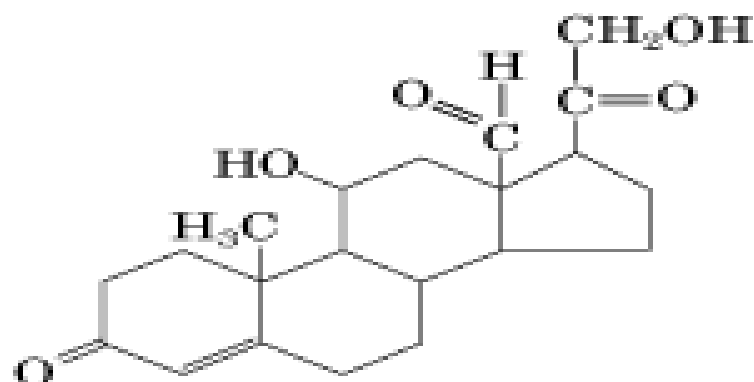
Testosterone



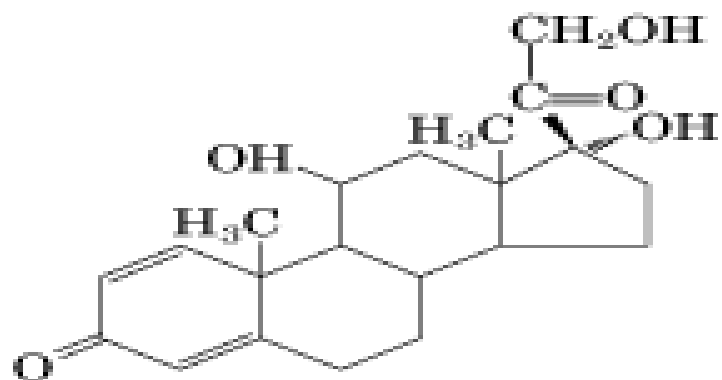
Estradiol



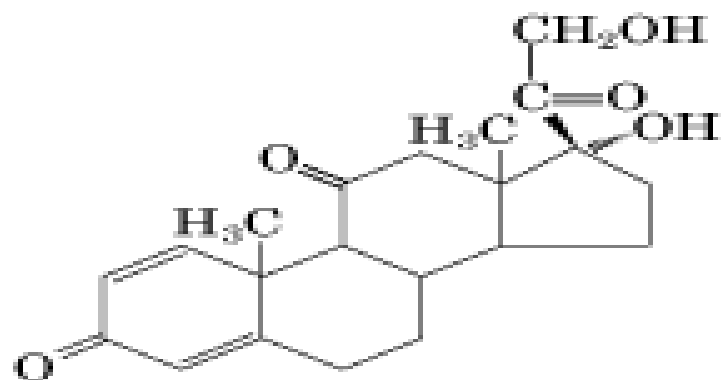
Cortisol



Aldosterone

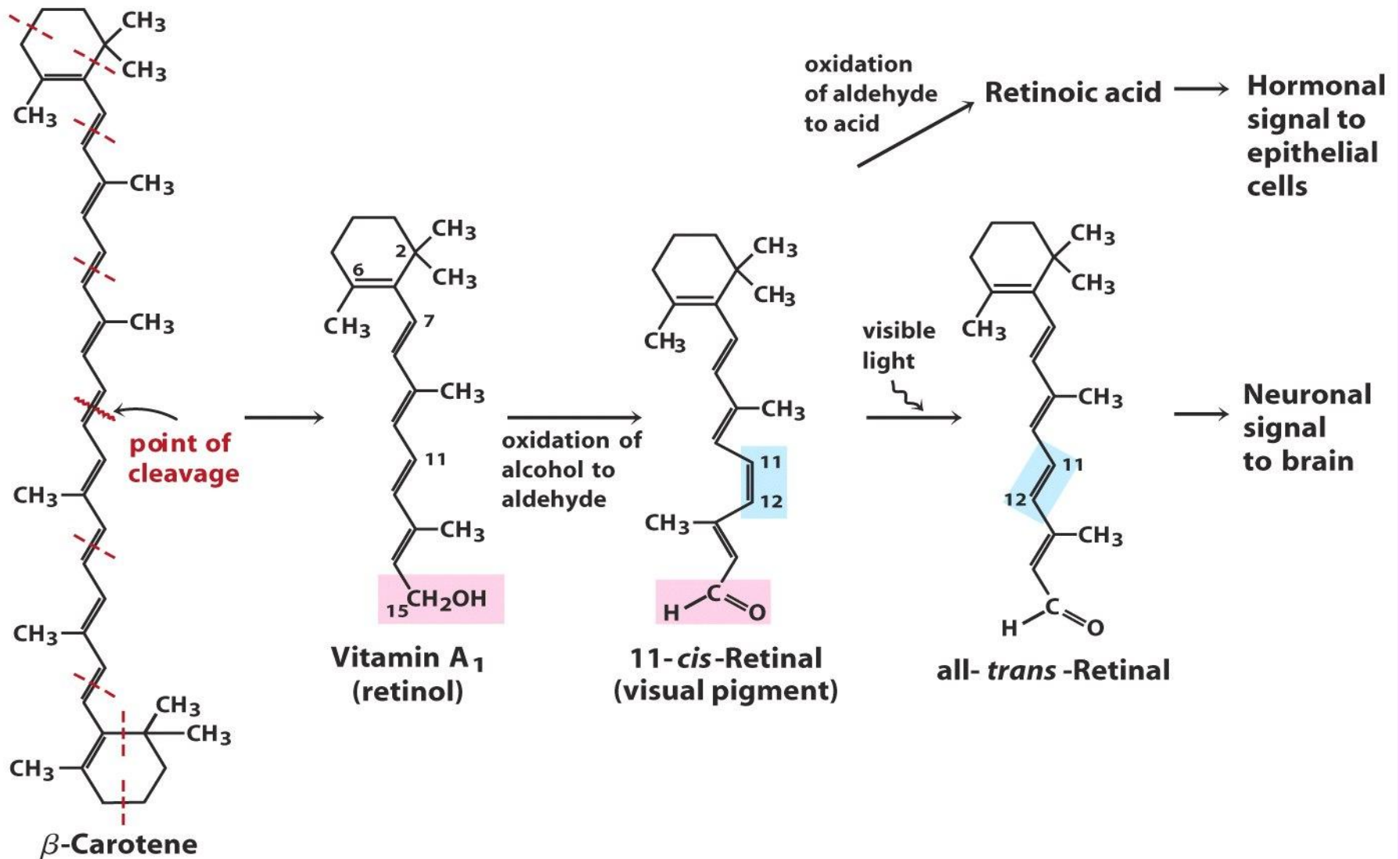


Prednisolone



Prednisone

Vitamin A structure





❑ vitamin D (steroid derivative).

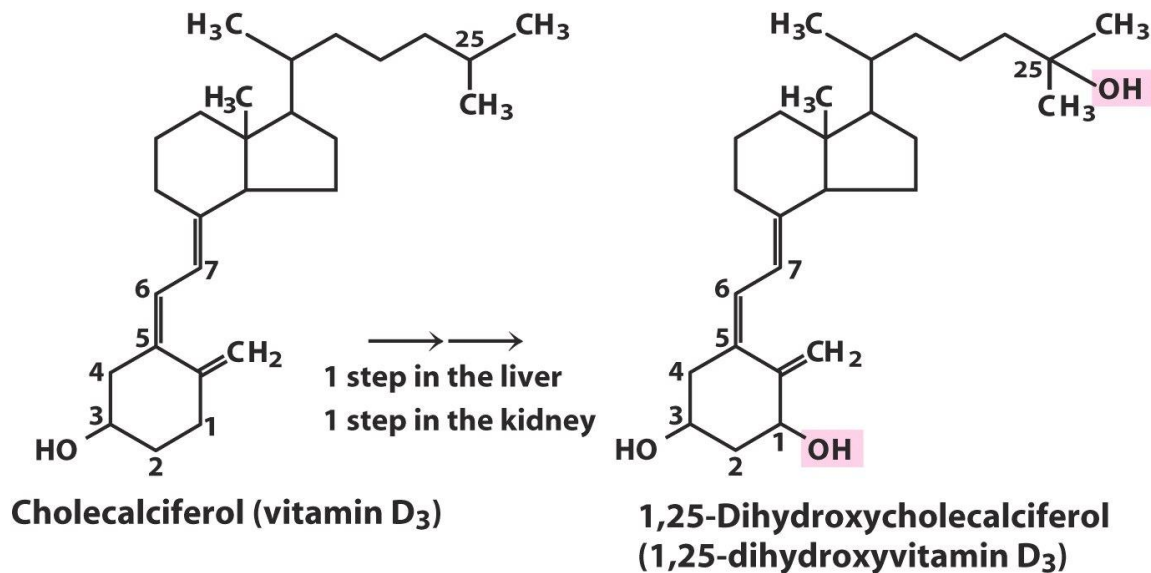
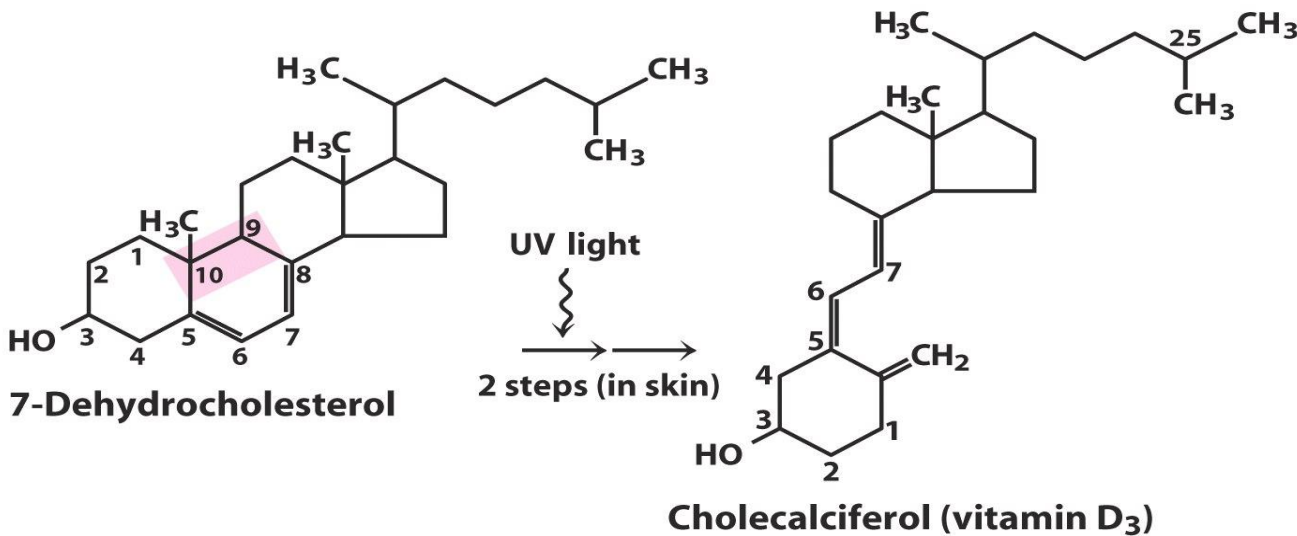
➤ Requires light to convert to active form.

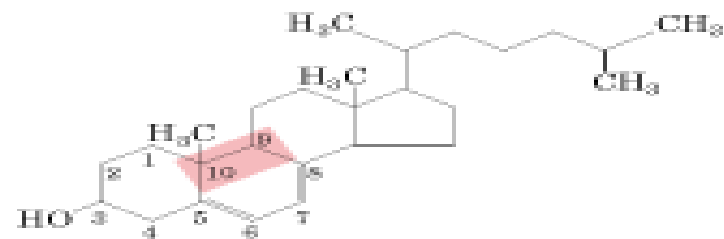
➤ It is involved in calcium and phosphate metabolism in bone; deficiency leads to rickets.

❑ vitamin K – involved in coagulation

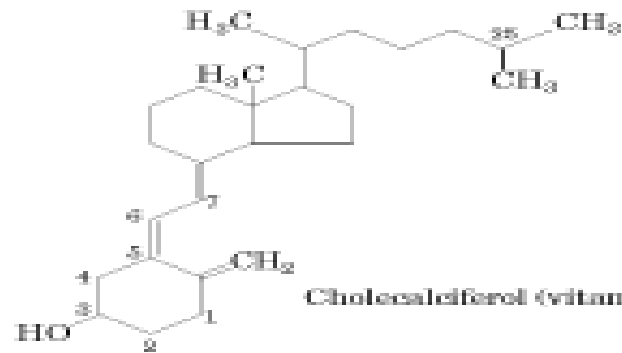
❑ vitamin E – an antioxidant; deficiency leads to fragile erythrocytes

Vitamin D Production

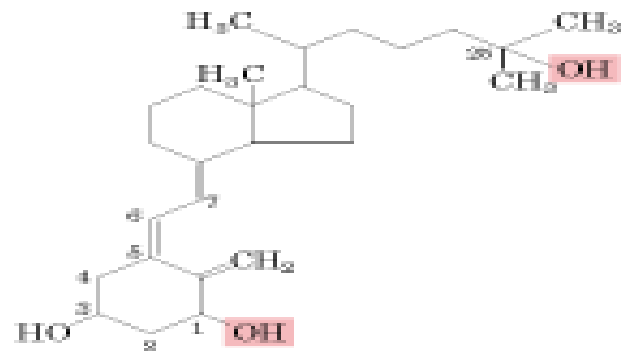
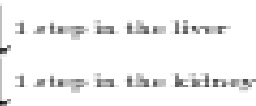




7-Dehydrocholesterol

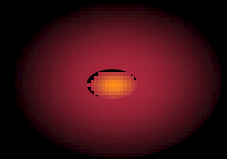
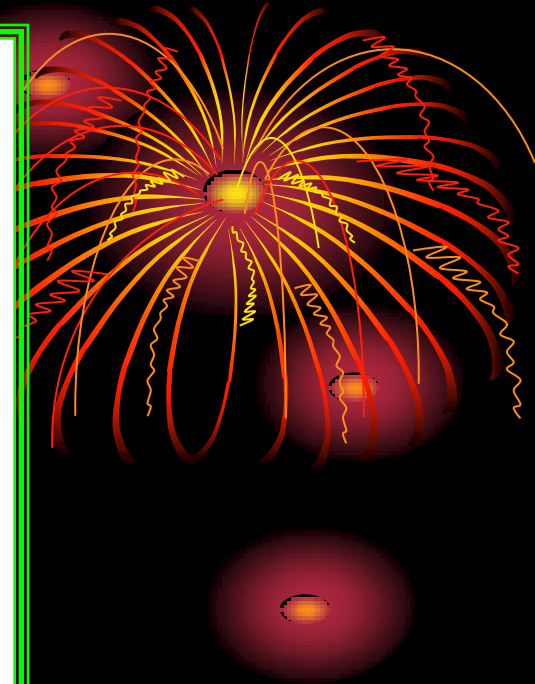


Cholecalciferol (vitamin D₃)

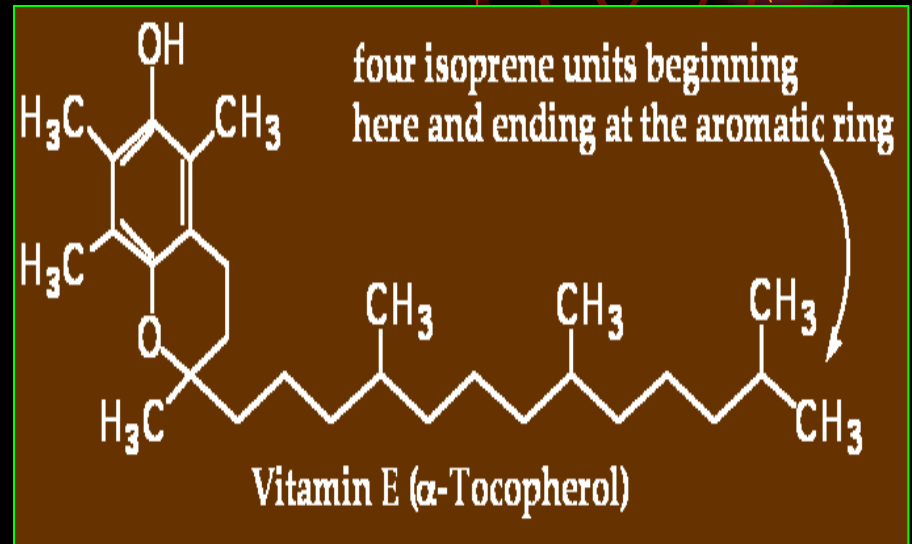
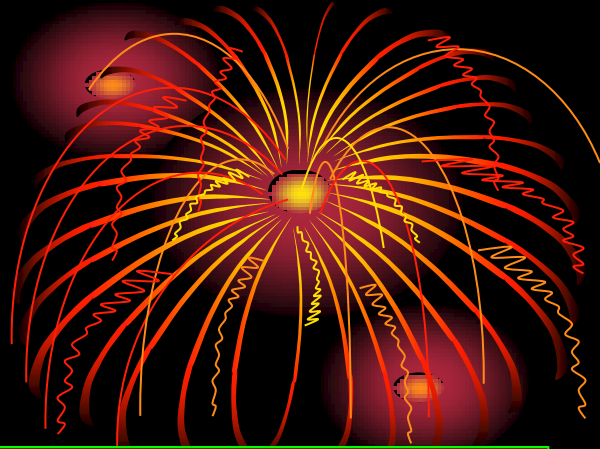


1,25-Dihydroxycholecalciferol
(1,25-dihydroxyvitamin D₃)

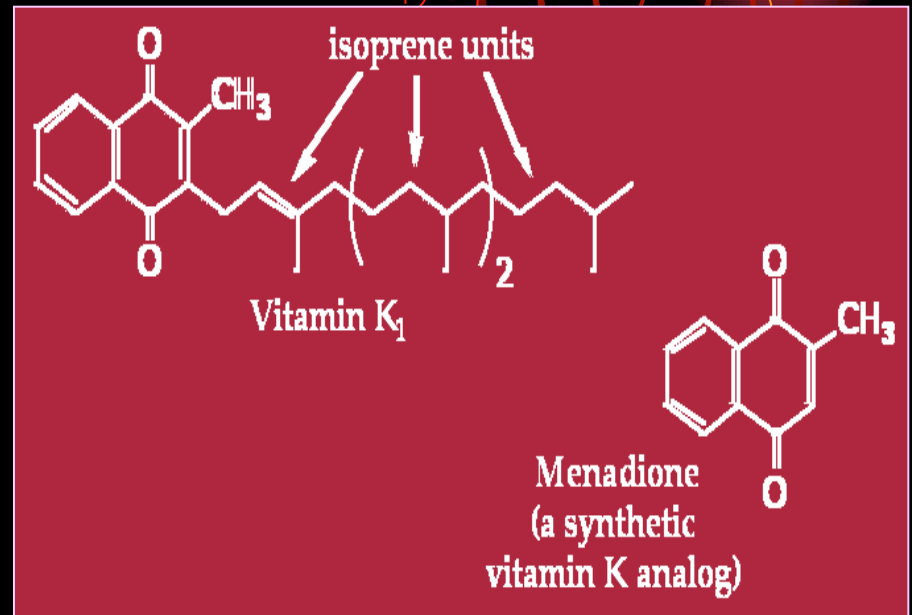
(a)



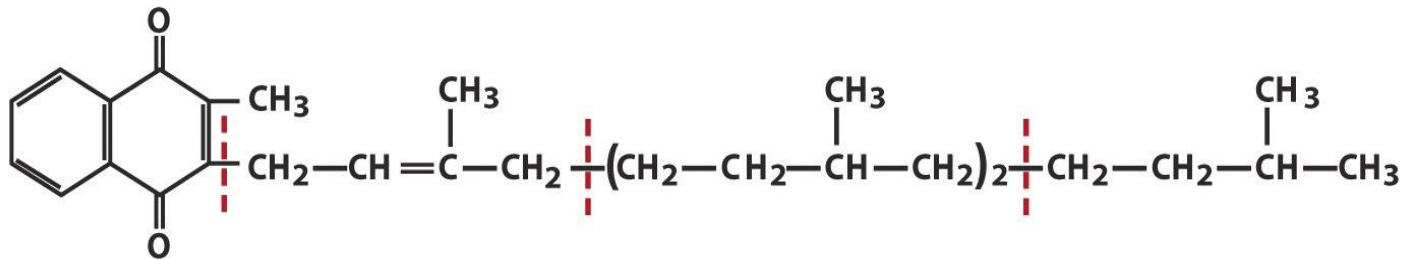
- **Vitamin E**
 - **Vitamin E is a group of compounds of similar structure; the most active is α -tocopherol**
 - **an antioxidant; traps $\text{HOO}\cdot$ and $\text{ROO}\cdot$ radicals formed as a result of oxidation by O_2 of unsaturated hydrocarbon chains in membrane phospholipids**



- **Vitamin K**
- **The name of this vitamin comes from the German word Koagulation, signifying its important role in the blood-clotting process**

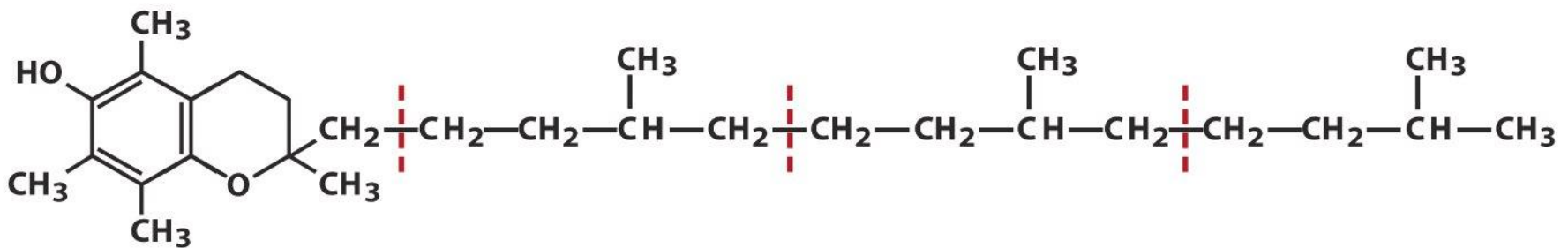


Vitamins K and E



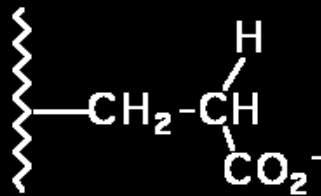
(b)

Vitamin K₁: a blood-clotting cofactor (phylloquinone)

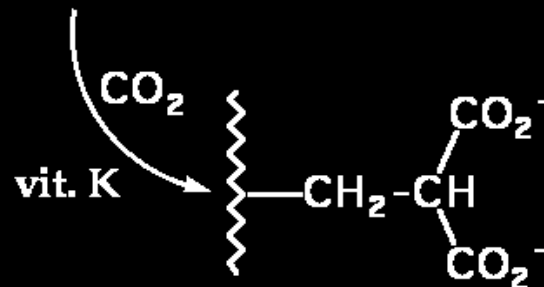


(a)

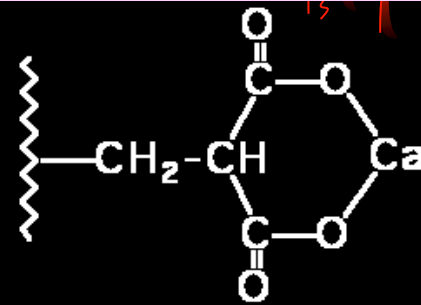
Vitamin E: an antioxidant



Glutamate side
chain of prothrombin



Carboxylated glutamate
side chain of prothrombin



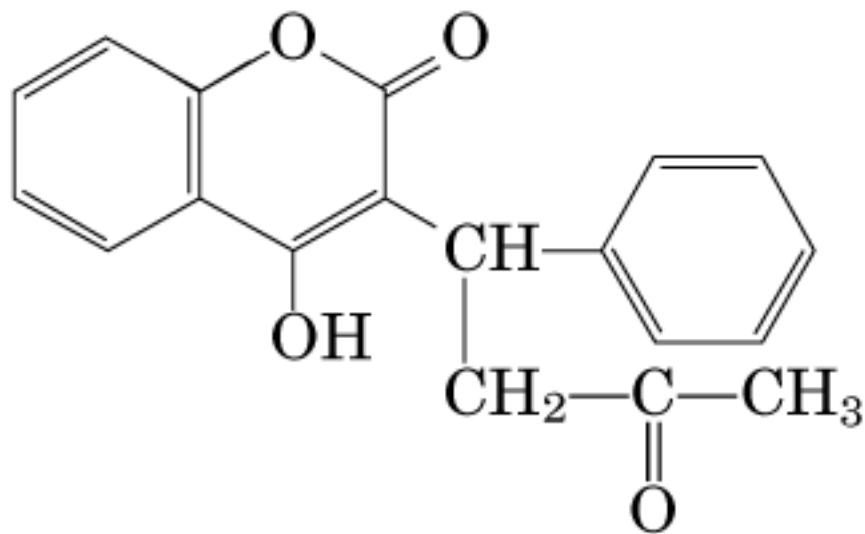
Carboxylated glutamate
side chain binding
calcium ion

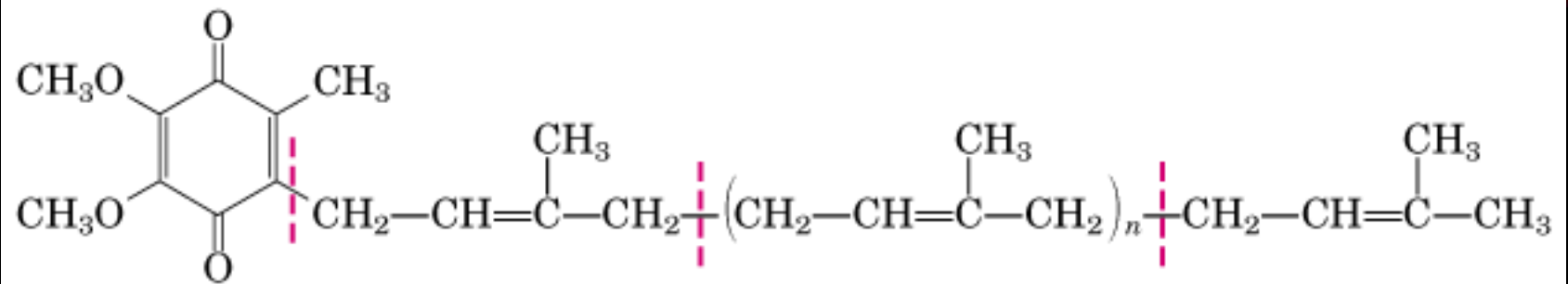
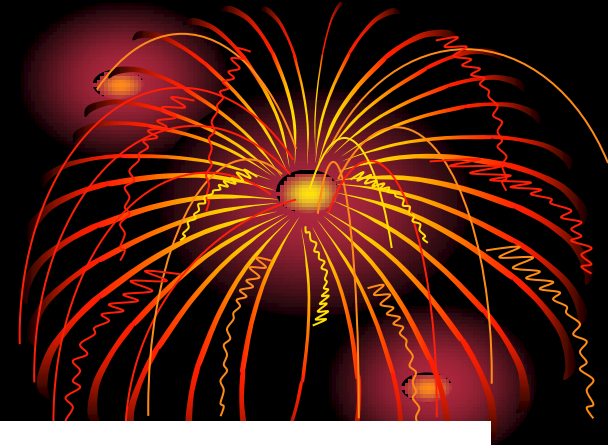




(c)

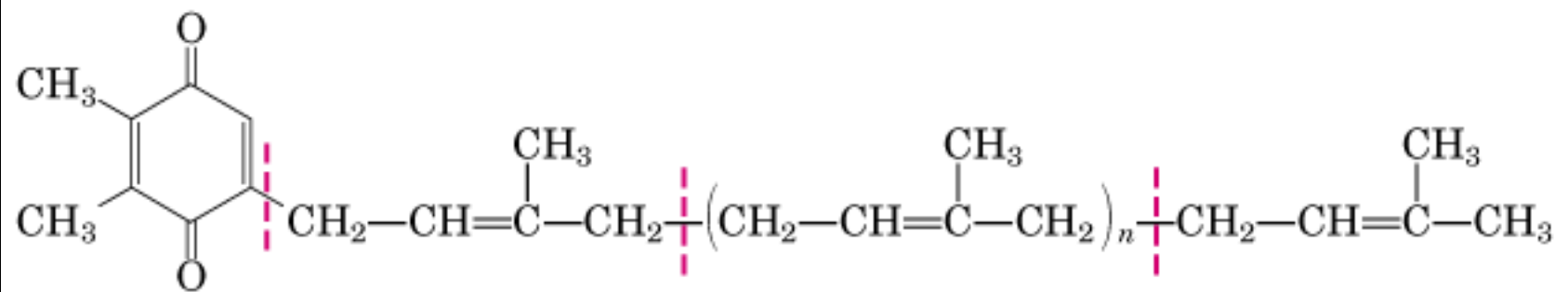
Warfarin: a blood
anticoagulant





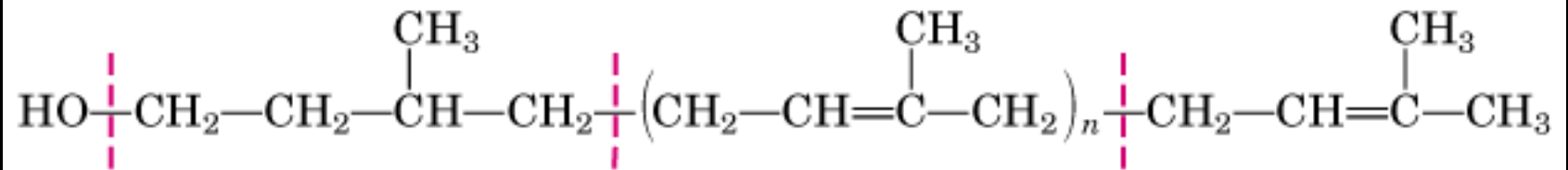
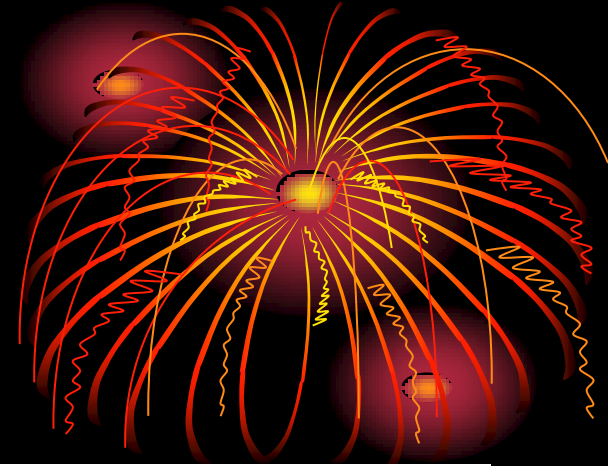
(d)

Ubiquinone: a mitochondrial
electron carrier (coenzyme Q)
($n = 4-8$)



(e)

Plastoquinone: a chloroplast
electron carrier ($n = 4-8$)



(f)

Dolichol: a sugar carrier
($n = 9-22$)

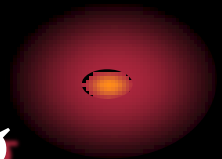
❖ Phosphatidylinositols .

✓ Involved in intracellular signaling

❖ Eicosanoids – arachidonic acid derivatives, *e.g.* prostaglandins.

✓ They are involved in pain sensing, inflammation, fever, etc.

✓ Pathways are targets of non-steroidal anti-inflammatory drugs such as aspirin, acetaminophen (Tylenol), and ibuprofen (Advil).



Phosphatidylinositol

phosphorylation
in plasma
membrane

2ATP → 2ADP

Phosphatidylinositol 4,5-bisphosphate

hormone-sensitive
phospholipase C
in plasma
membrane

H₂O

Inositol 1,4,5-trisphosphate

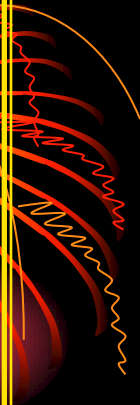
Diacylglycerol

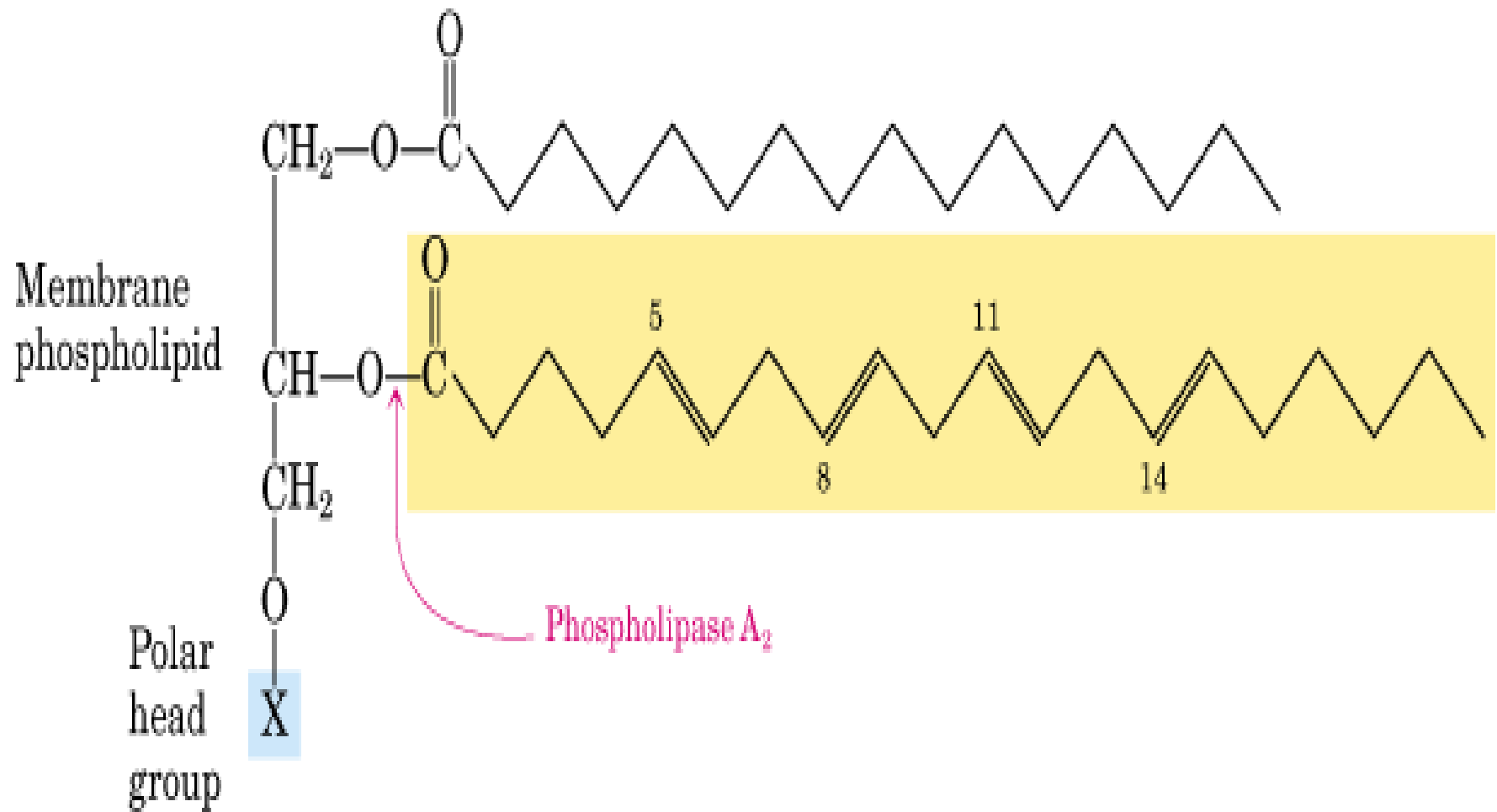
Release of intracellular Ca²⁺

Activation of
protein kinase C

Regulation of other enzymes
(by Ca²⁺)

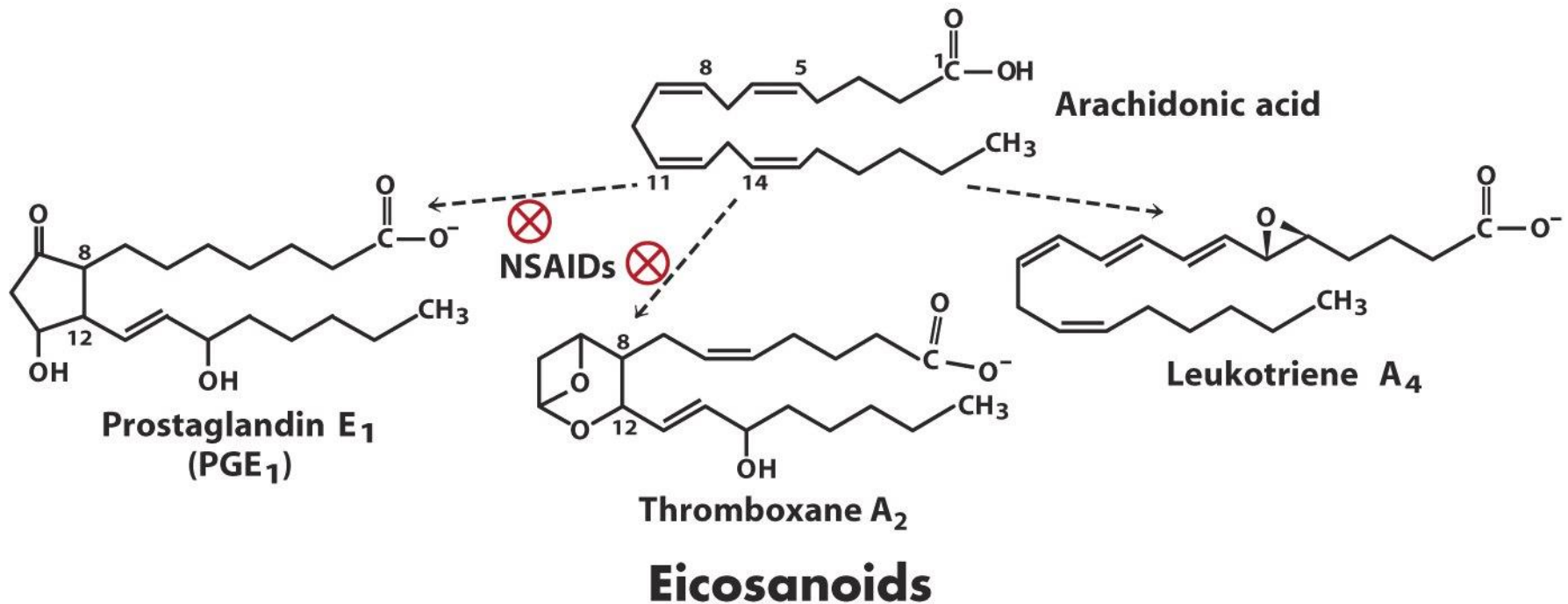
Regulation of other enzymes
(by protein phosphorylation)



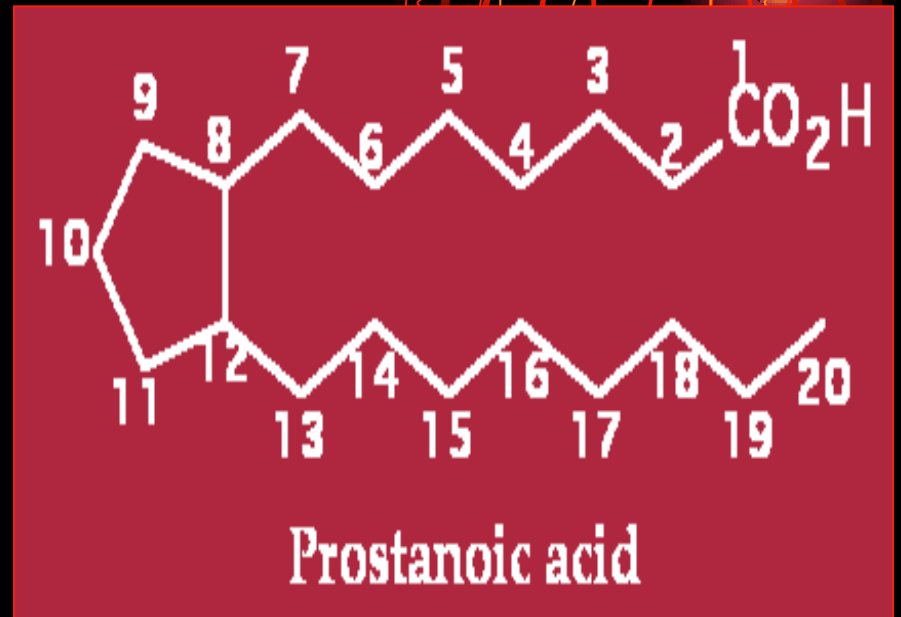


(a)

Eicosanoids: Pain sensing

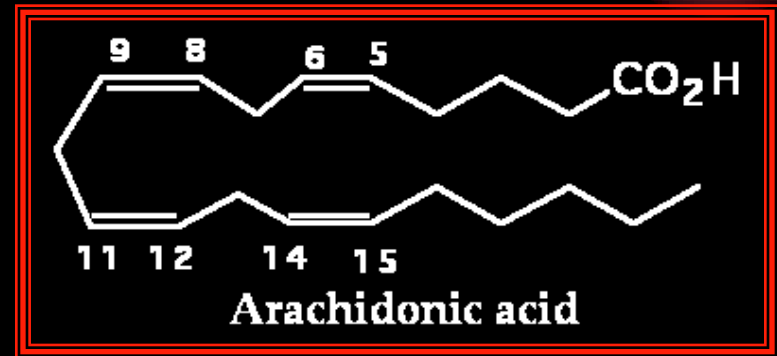
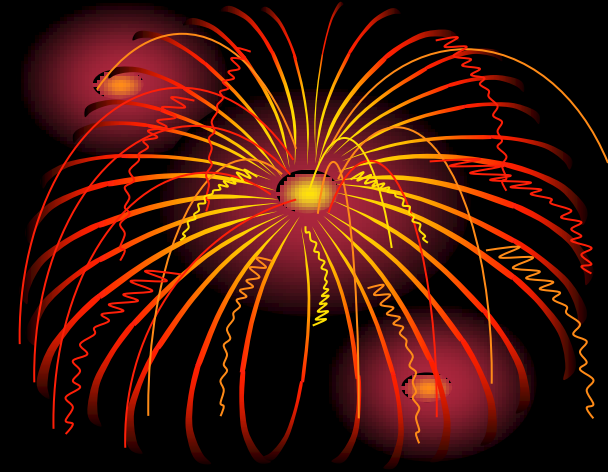


- **Prostaglandins**
- **Prostaglandins:**
a family of
compounds that
have the 20-
carbon skeleton
of prostanoic
acid

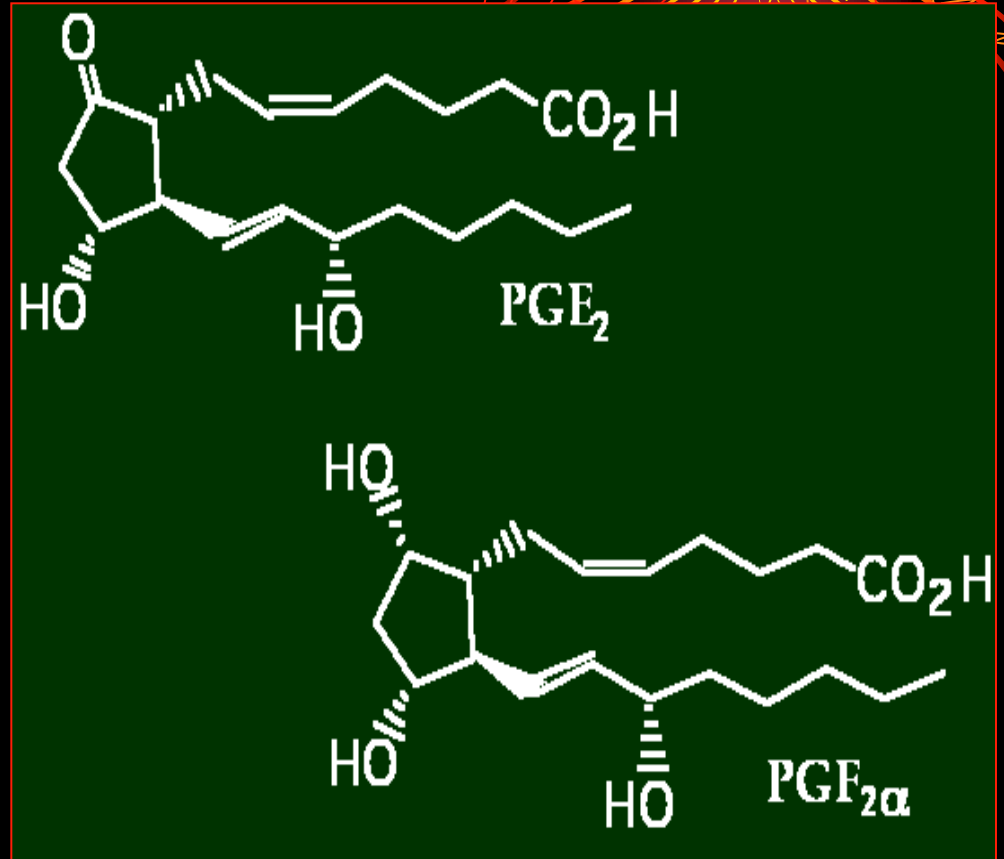


- **Prostaglandins**

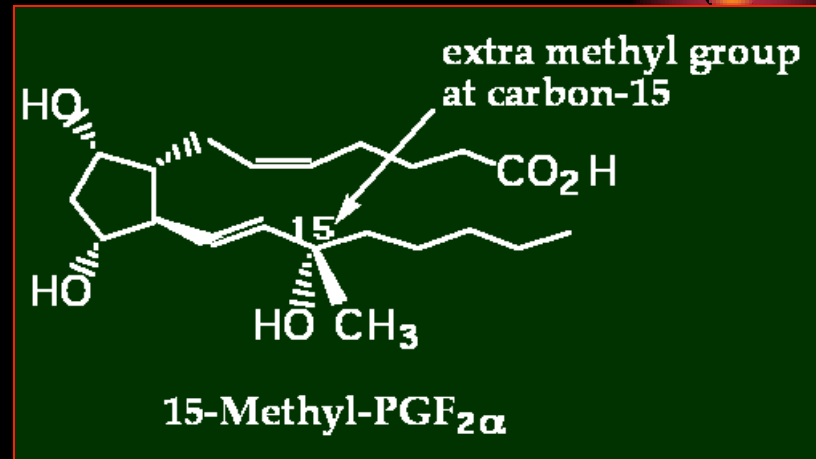
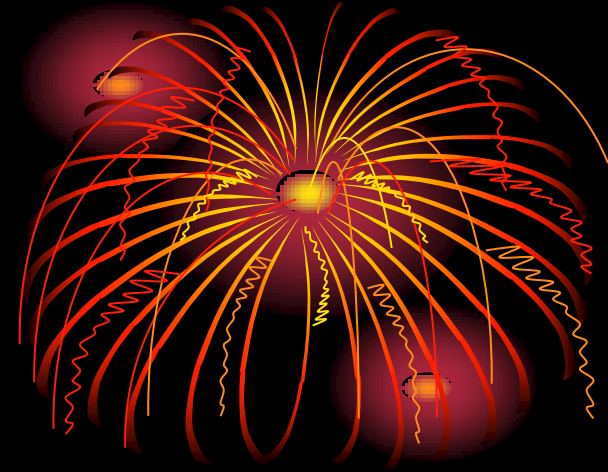
- Prostaglandins are not stored in tissues as such, but are synthesized from membrane-bound 20-carbon polyunsaturated fatty acids in response to specific physiological triggers
- one such polyunsaturated fatty acid is arachidonic acid



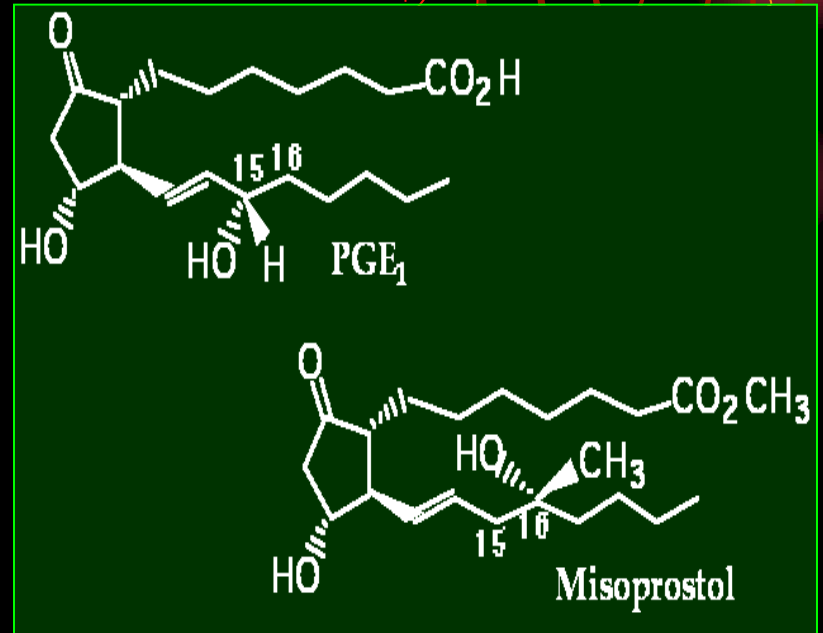
- Prostaglandins
- among those synthesized from arachidonic acid are



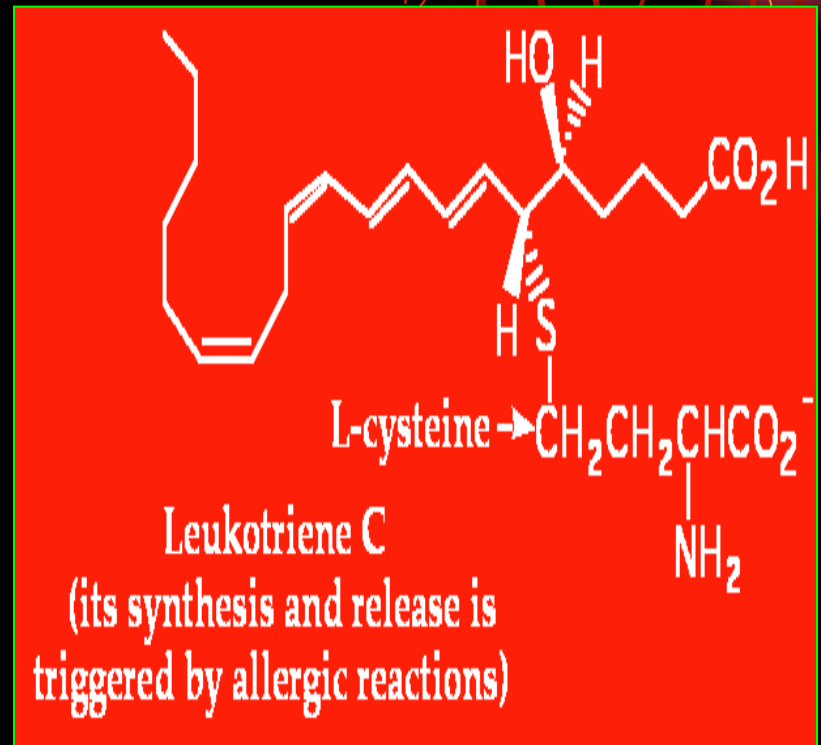
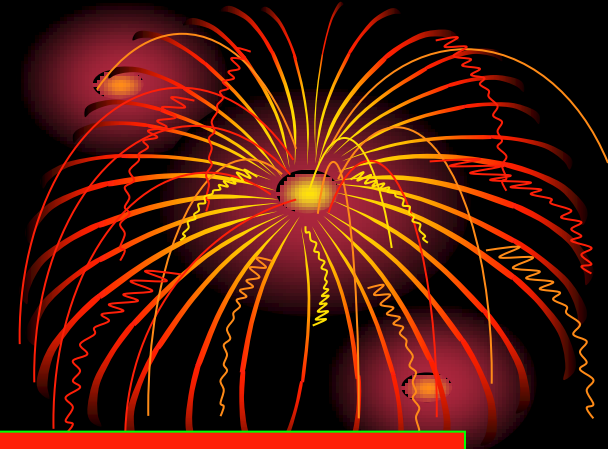
- **Prostaglandins**
 - Research on the involvement of PGs in reproductive physiology has produced several clinically useful derivatives
 - 15-Methyl-PGF₂α is used as a therapeutic abortifacient



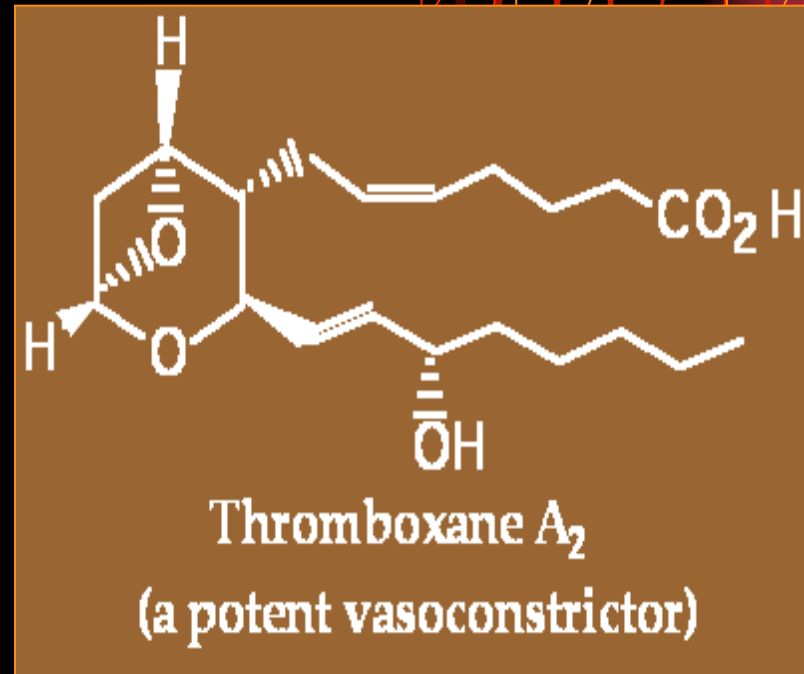
- Prostaglandins
- the PGE₁ analog, misoprostol, is used for prevention of ulceration associated with the use of aspirin-like nonsteroidal antiinflammatory drugs (NSAIDs)



- **Leukotrienes**
 - **Leukotrienes:** derived from arachidonic acid
 - found in white blood cells (leukocytes)
 - an important property is constriction of smooth muscles, especially in the lungs



- **Thromboxanes**
- **derived from arachidonic acid**
- **contain a four-membered cyclic ether within a six-membered ring induce platelet aggregation and smooth muscle contraction**



- **Glycolipids**
 - **Glycolipid: a compound in which a carbohydrate is bound to an -OH of the lipid**
 - **many glycolipids are derived from ceramides**

