



Molecular Biology

Lec : 7

Done by : Abdallah
Harahshah

دولة حيا

Lipids of biological importance -3

Steroids & Eicosanoids

Steroids

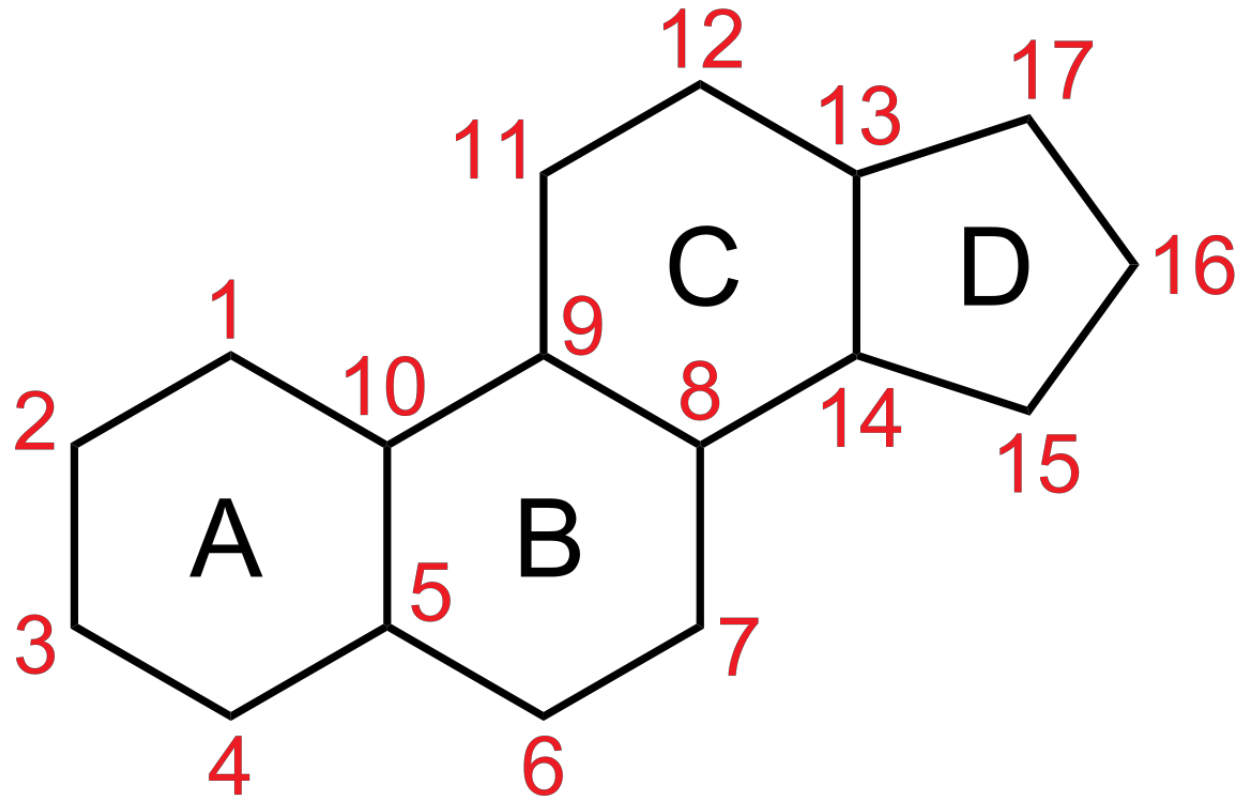
Substances which are derived from C17
cyclopentanoperhydrophenanthrene ring (**steroid nucleus**)

- Steroids include **sterols**, **bile acids** and **steroid hormones**

Comments on the terminology used for steroids:

Cyclopentanoperhydrophenanthren ring is due to:

- Cyclo → cyclic
- Pentano → 5 carbon ring (ring D)
- Phenanthrene ring → 3 hexagonal rings (A, B & C)
- Perhydro → saturated with hydrogen (unless noted otherwise)

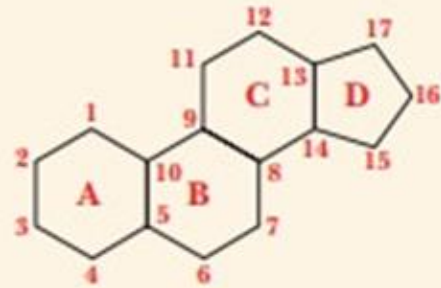


Cyclopentanoperhydrophenanthrene ring

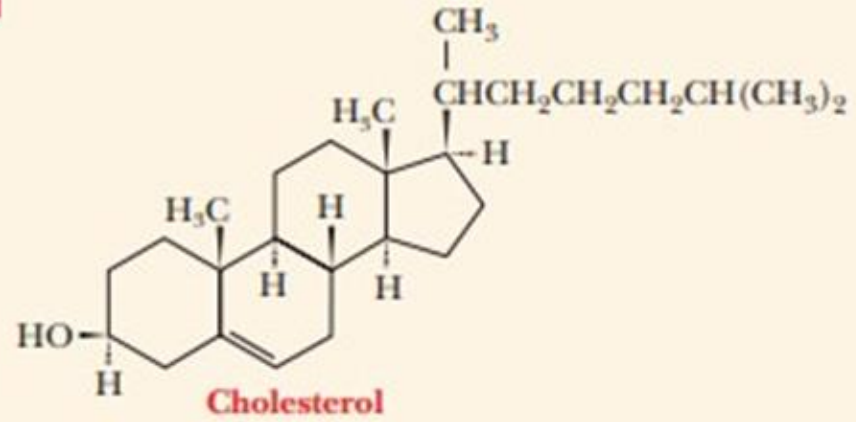
General criteria of the steroids:

1. All steroids are derived from **cyclopentanoperhydrophenanthren** nucleus
2. Natural steroids contain:
 - Methyl group attached to C10 (except estrogens)
 - Methyl group attached to C13 (except aldosterone)
 - Side chain at C17 or oxygen or hydroxyl group
 - *Ring C & D are always saturated* but ring A & B may contain double bond

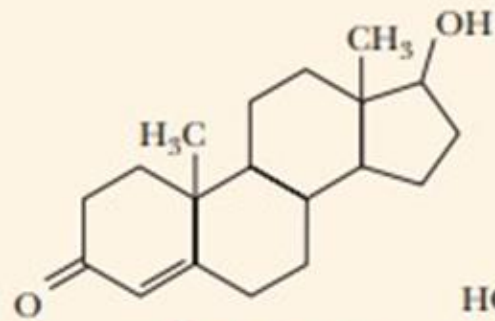
1



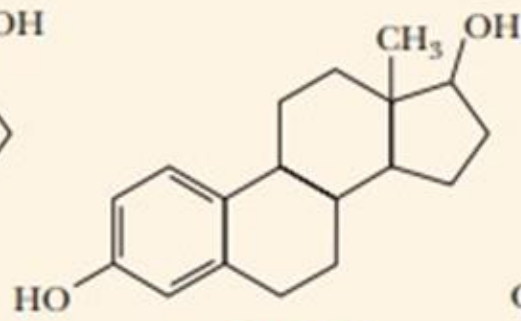
2



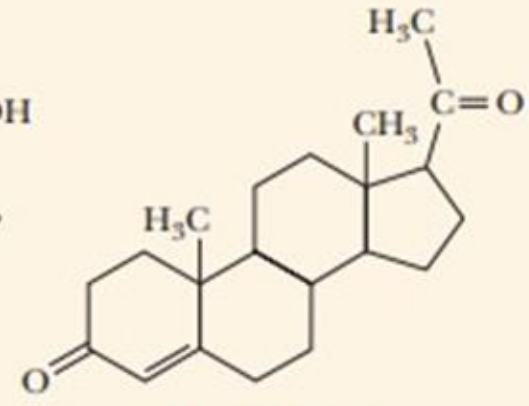
3



Testosterone



Estradiol

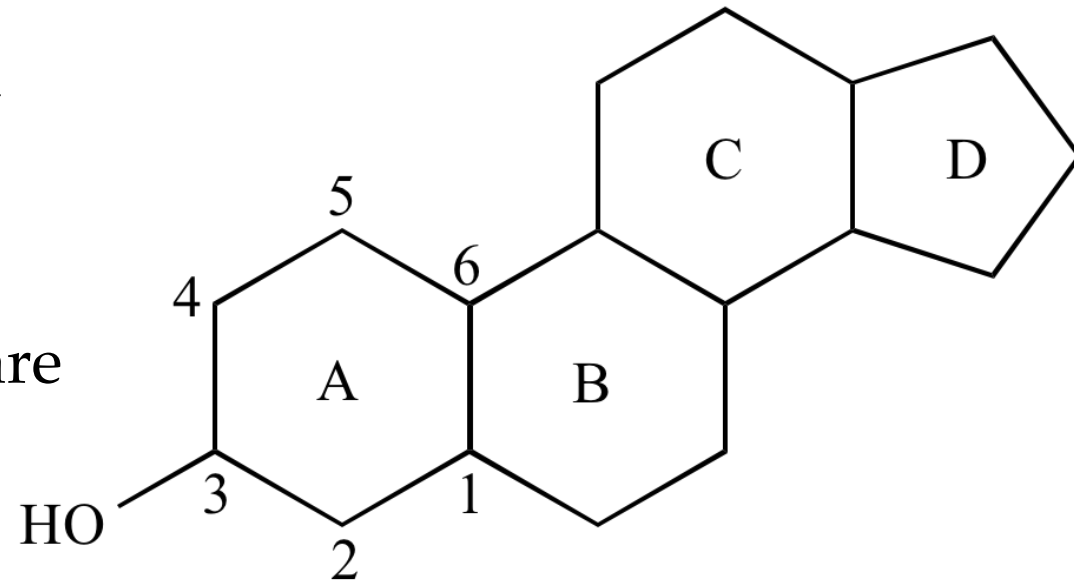


Progesterone

Sterols

These are steroid alcohols containing **OH at C3**

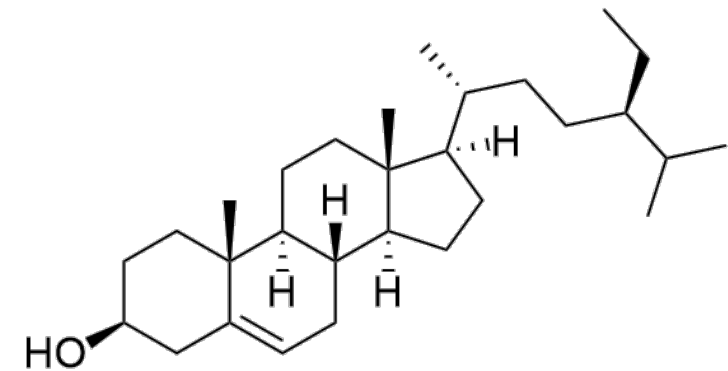
- There are 3 types of sterols which are **phytosterol**, **mycosterols** and **zoosterols**



Phytosterols

- Are of plant origin
- **Sitosterol** is an example phytosterol
- It is present in plant oil
- Sitosterol can inhibit the absorption of cholesterol

are poorly absorbed by humans (5% absorbed as compared to 40% for cholesterol)

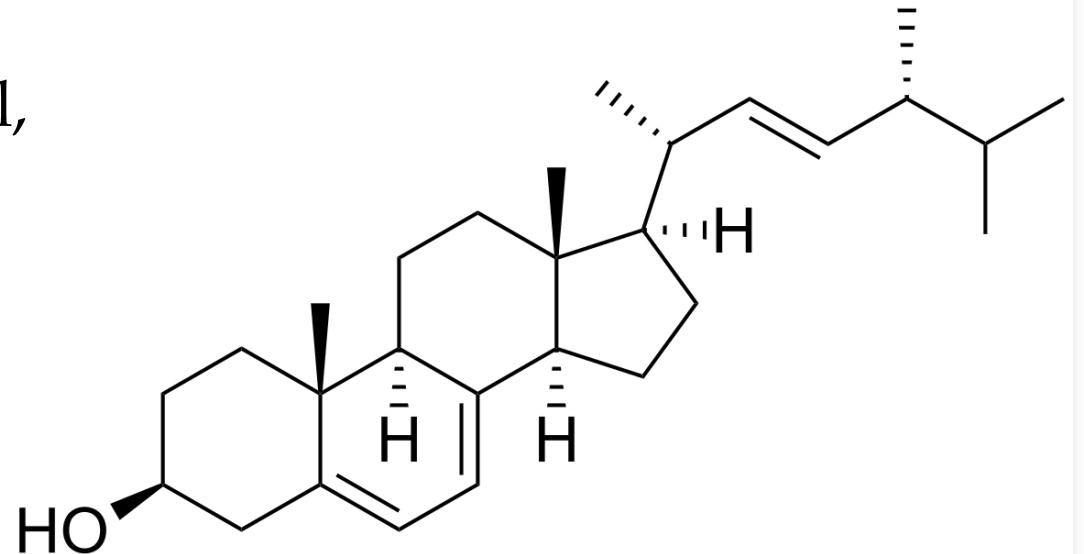


β -Sitosterol

Mycosterols

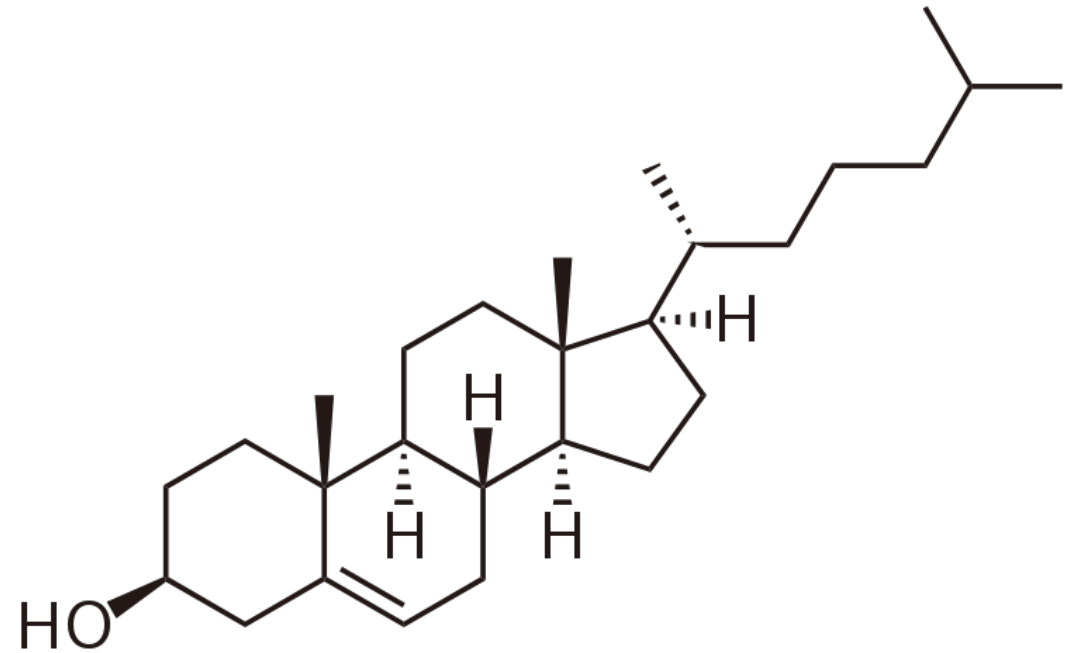
- Are of mycotic origin
- **Ergosterol** is an example of mycosterol, it is the precursor of vitamin D2
- It is present in yeast


(Extra double bond between C7-8, unsaturated side chain, extra methyl group)



Zosterols

- Of animal origin
- Cholesterol is an example of zoosterol





Types of steroids and sterols

- Cholesterol (animal origin)
- Ergosterol (plant origin)
- Vitamin D group (D2 and D3)
- Bile acids and salts
- Steroid hormones
- Digitalis

Digitalis

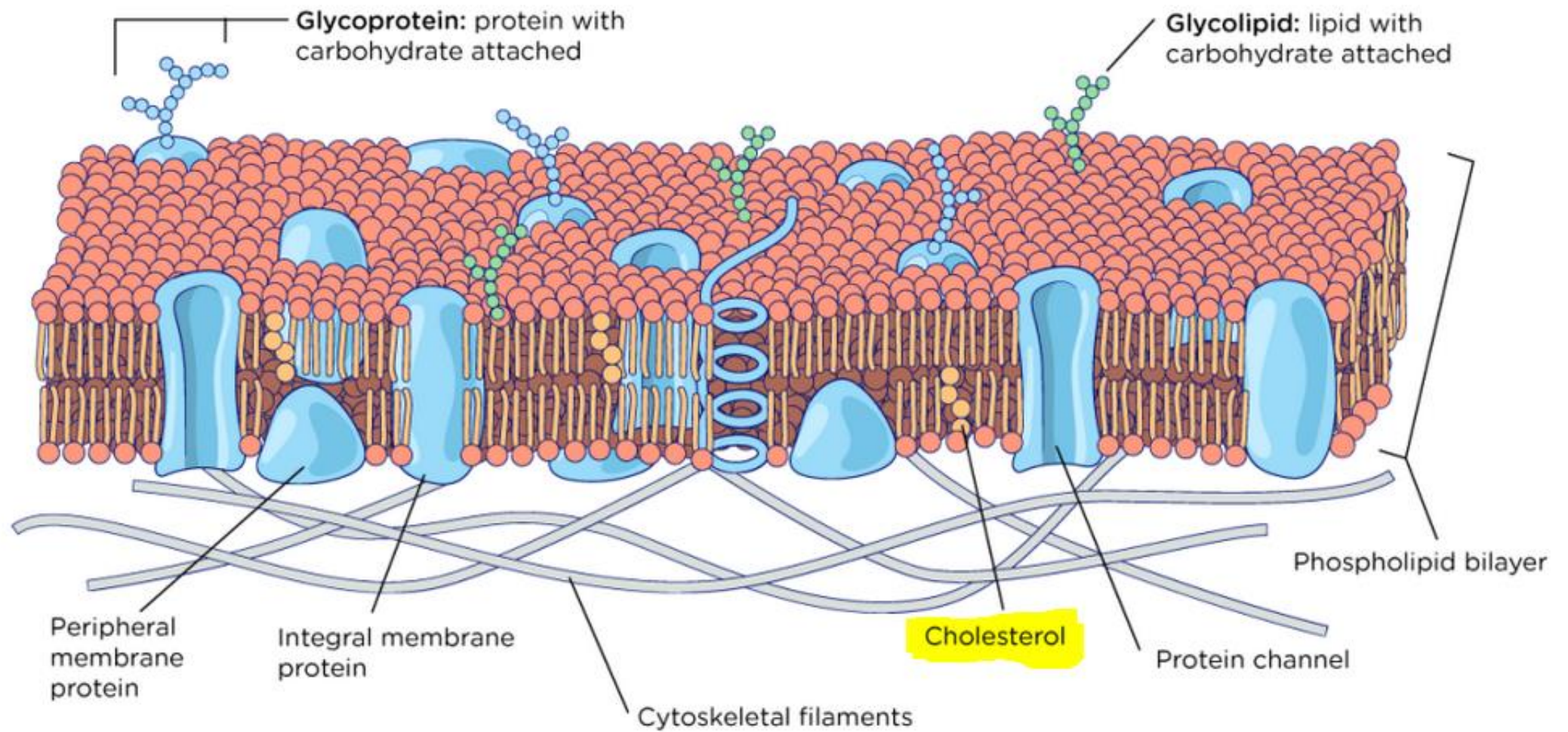
- A cardiac stimulant, composed of galactose and a steroid alcohol
- Digitalis is used in treatment of heart failure
(stimulate cardiac muscle contraction)





Cholesterol

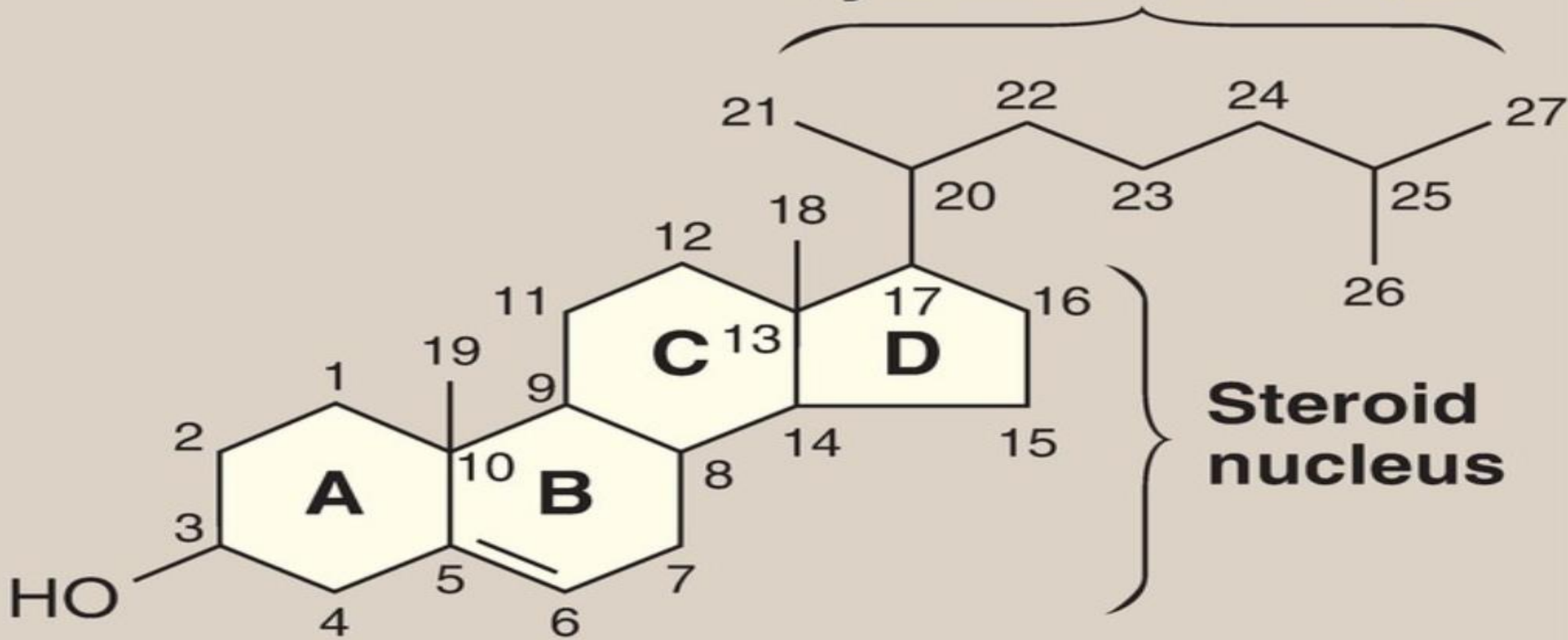
- It is the main steroid in humans (present in all cells especially nervous system & plasma)
- It is a precursor that forms all other steroids
- Egg yolk, red meat, liver, kidney, butter and brain are rich in cholesterol



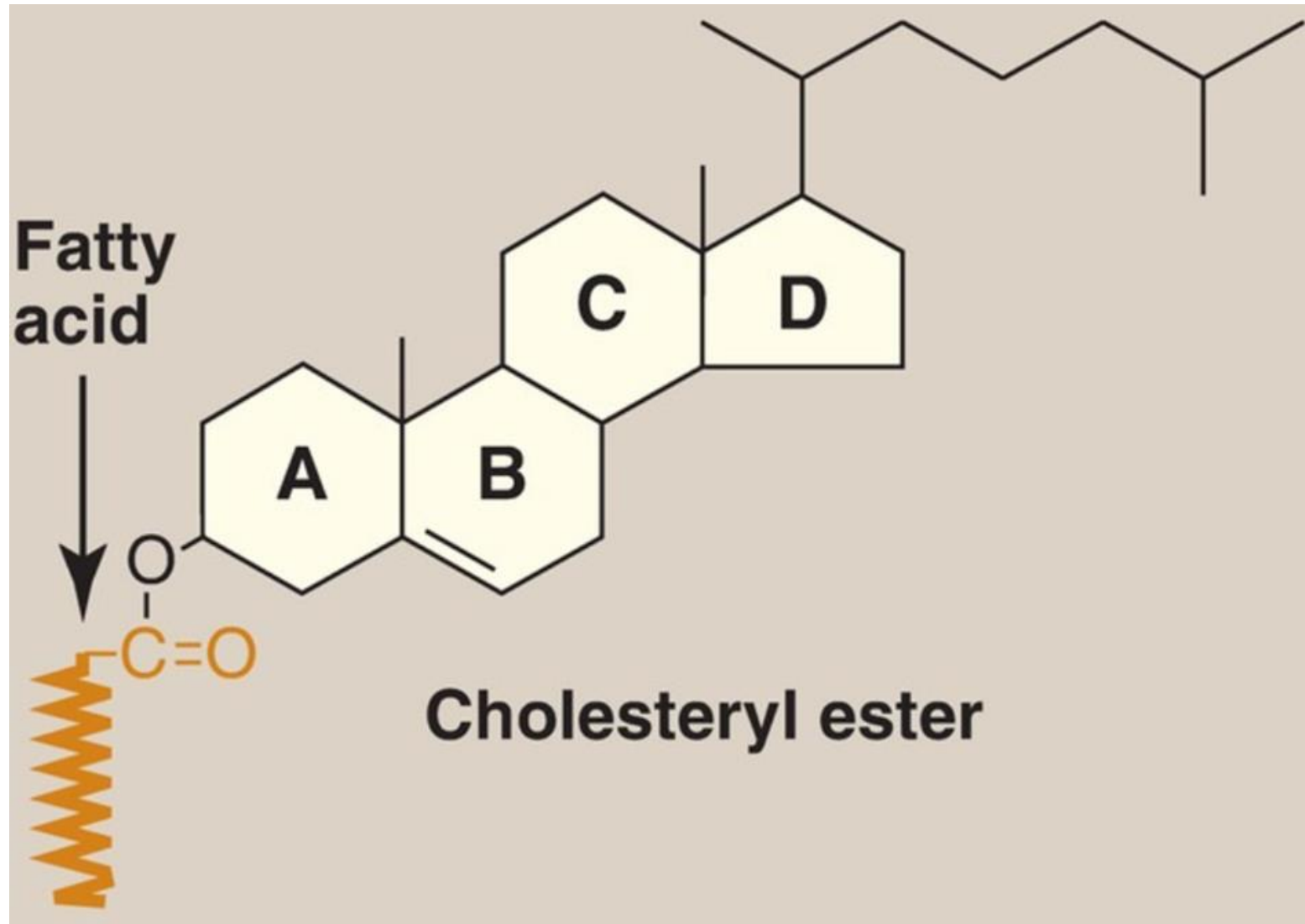
Cholesterol

- Contains unsaturated double bond between C5 and C6
- It can accept two hydrogen atoms
- It can be esterified into cholesteryl esters
cholesterol has – OH at C3, so it can form esters with any fatty acid

Hydrocarbon chain



Cholesterol



Cholesterol

- Blood cholesterol is either present in:
 1. Free form (33%) or
 2. Esterified form (67%)
- Normal level of cholesterol in blood is less than 220 mg/dL
if increased it is called hypercholesterolemia

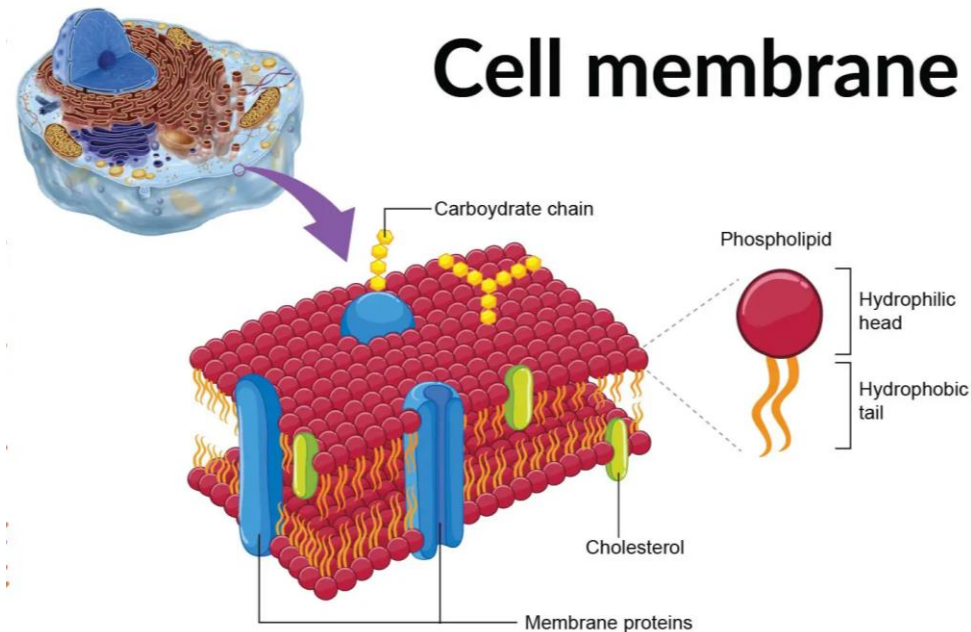
It is oxidized in liver, intestine & skin to give **7-dehydrocholesterol** which is the precursor of vitamin D3 by exposure to UVR under the skin

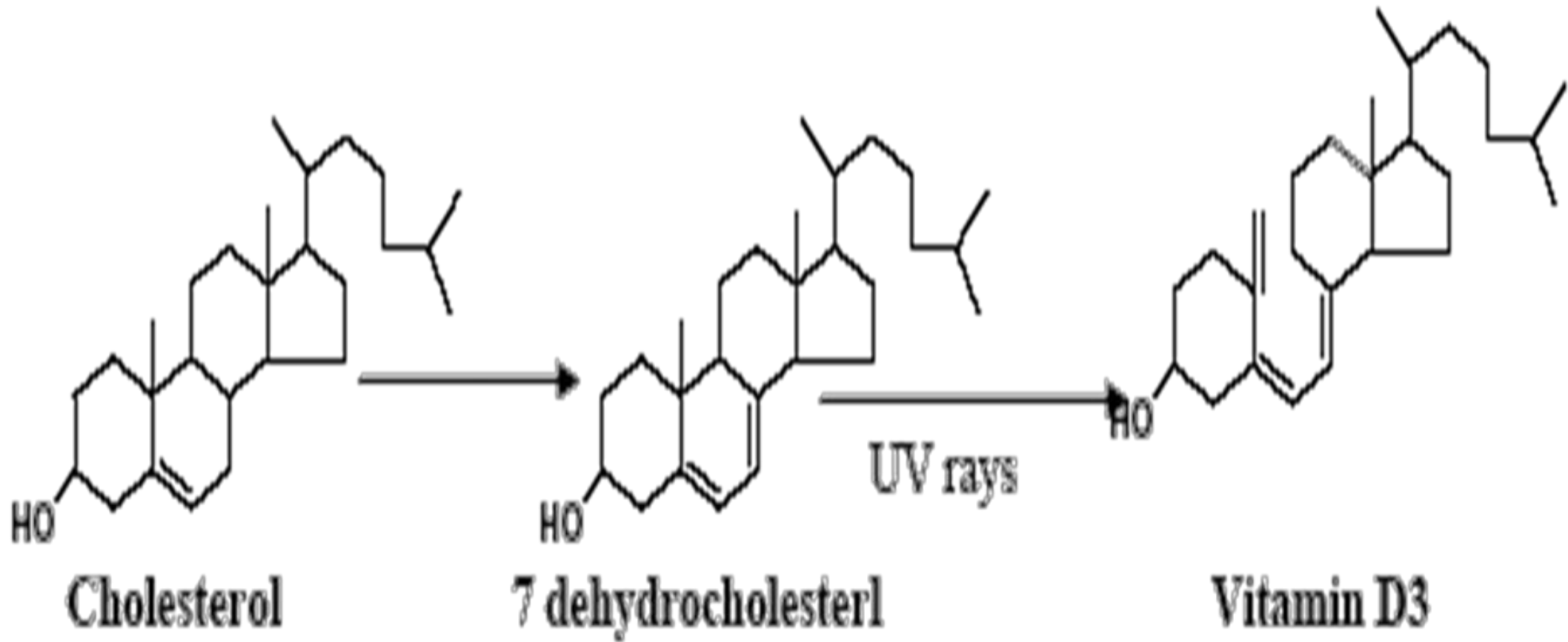
Function of cholesterol

Enters in structure of every body cell especially nervous system + cell membranes

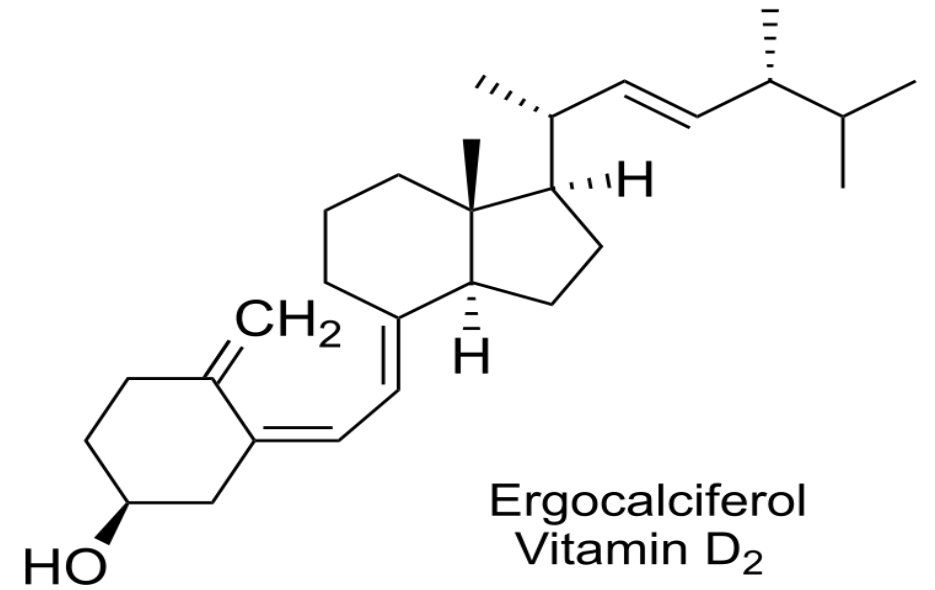
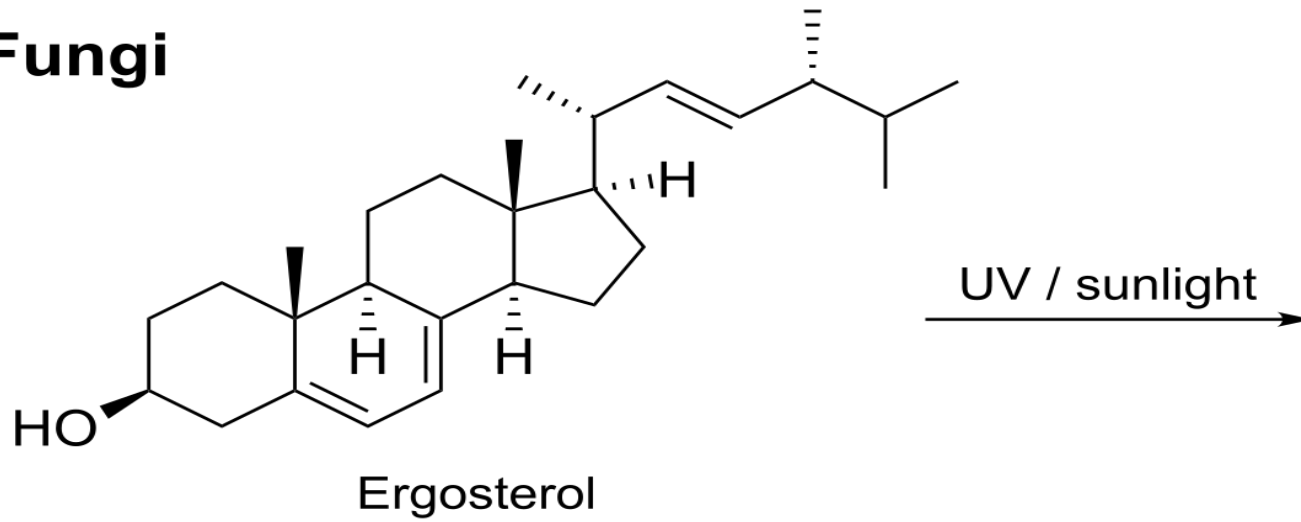
Synthesis of:

- Steroid hormones
- Bile acids, salts
- Vit D3

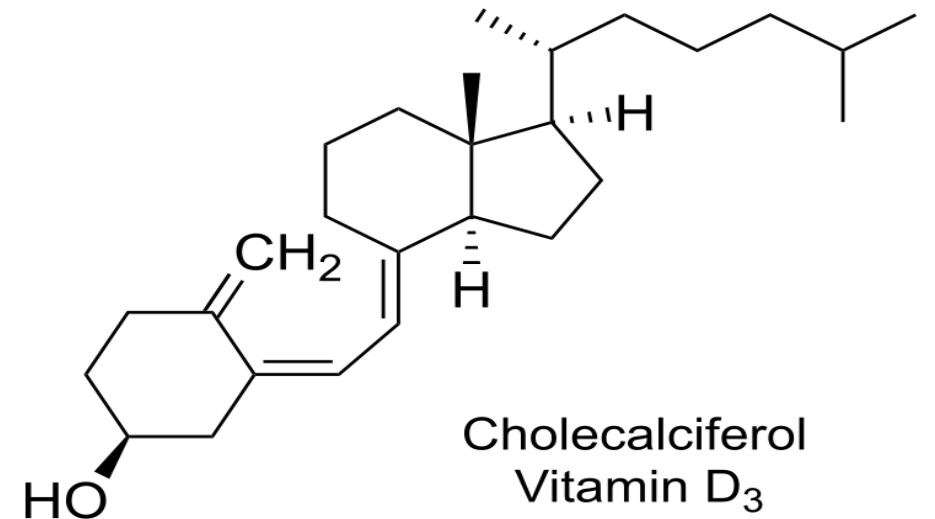
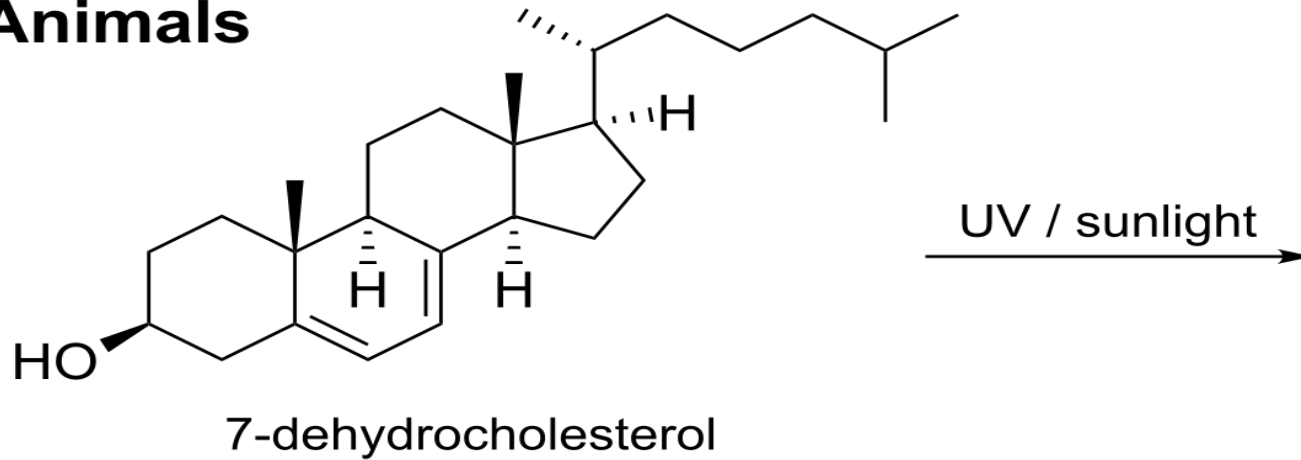




Fungi



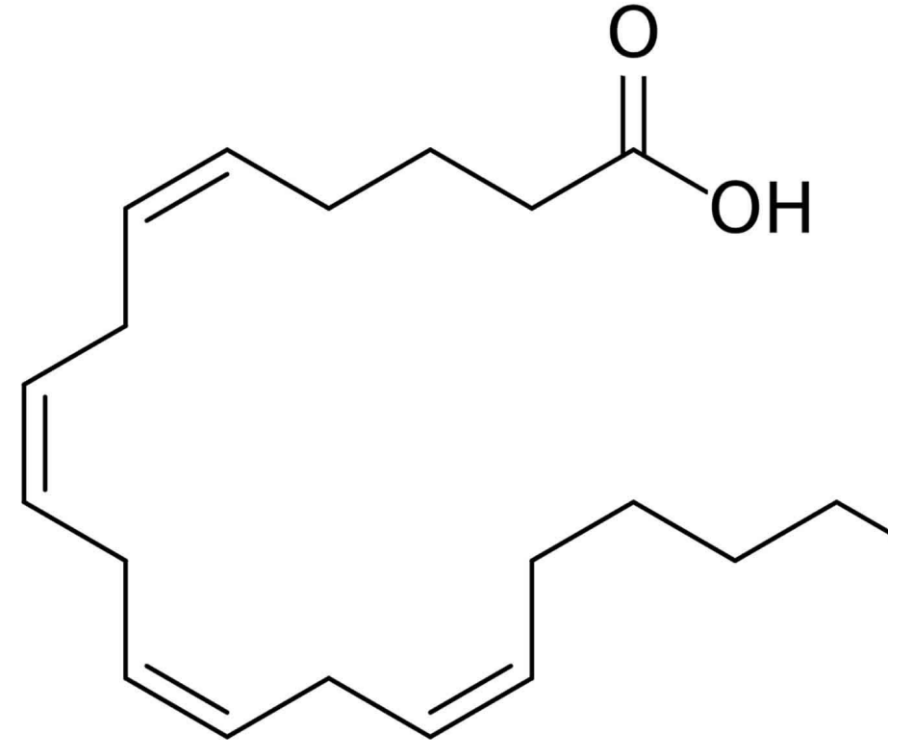
Animals



Eicosanoids

- Eicosanoids are derived from arachidonate (arachidonic acid; 20:4) and eicosapentaenoic acid (EPA; 20:5)
- Derived from Eicosa (20 carbons) polyenoic FAs (arachidonic acid 20:4)
- The dietary precursor is the essential FA linoleic acid (18:2)

Arachidonic acid



Eicosanoids

- Produced by most mammalian cells
- Paracrine hormones
- Have physiological and pharmacological actions
- Subscript number in an eicosanoid denotes n of double bond (e.g. PGE₂)

Classification of eicosanoids

1. Cyclic compounds (prostanoids)

Prostaglandins (PG) - via cyclooxygenase pathway

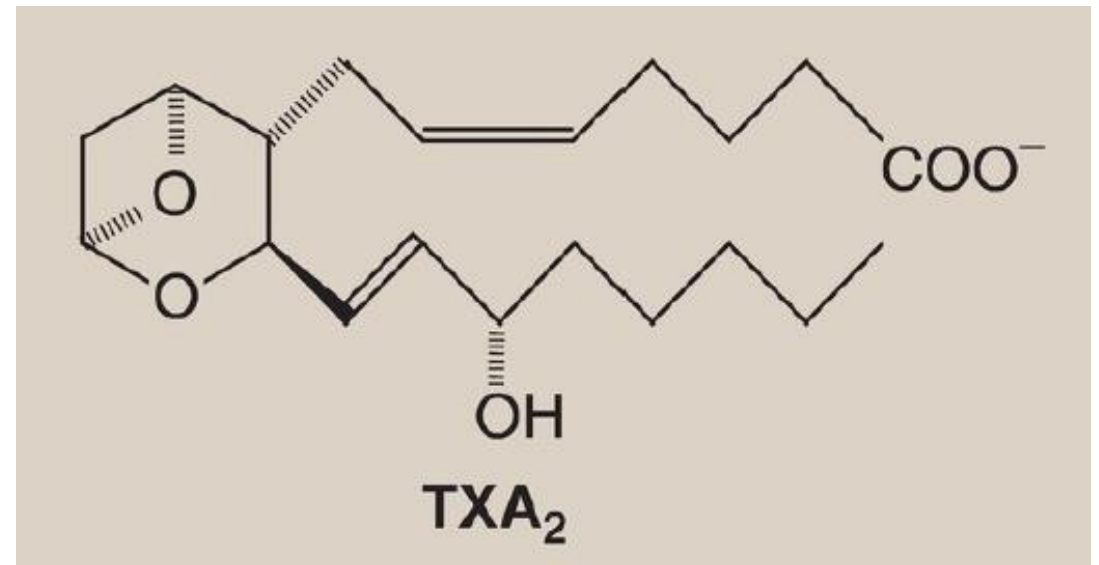
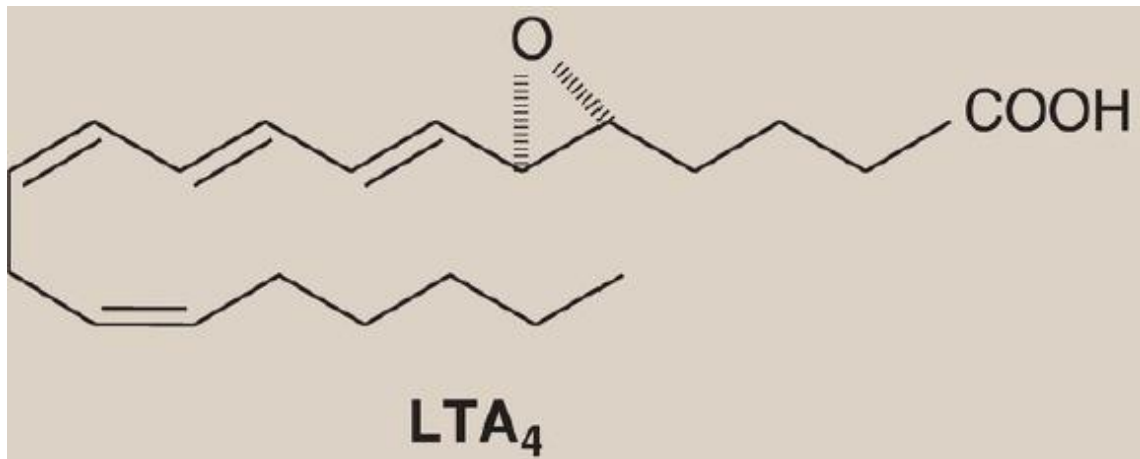
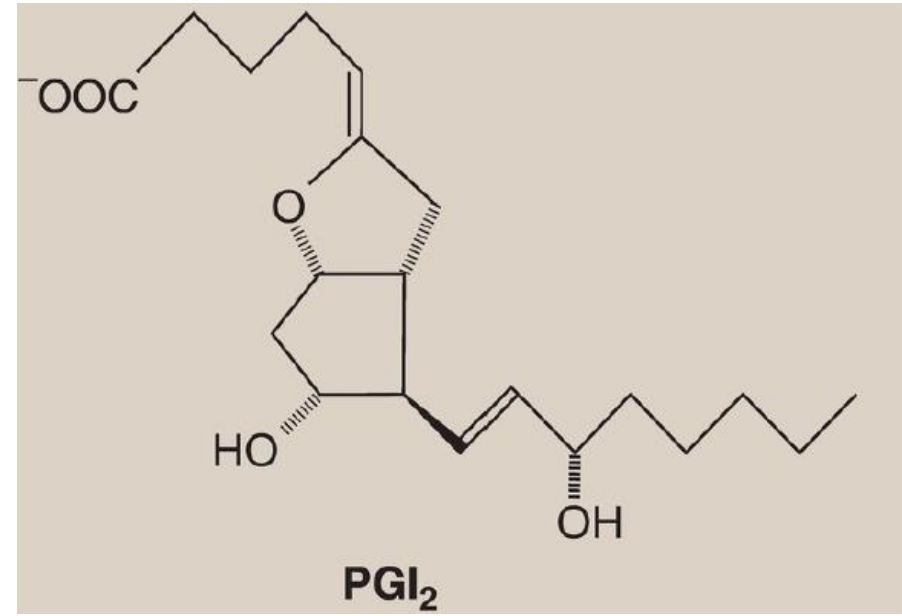
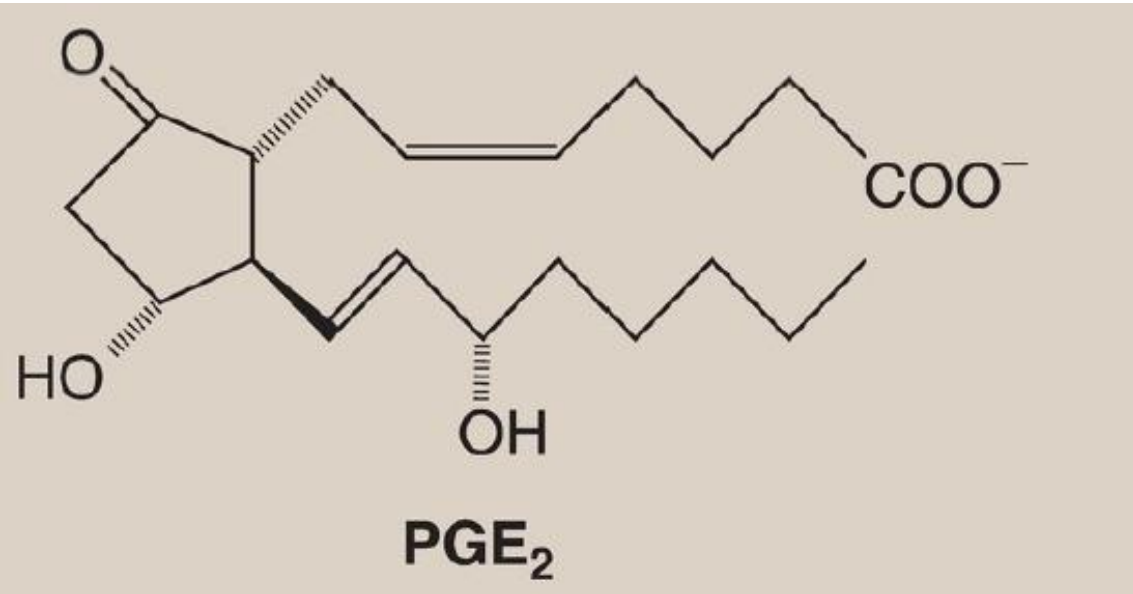
Prostacyclins (PGI) - via cyclooxygenase pathway

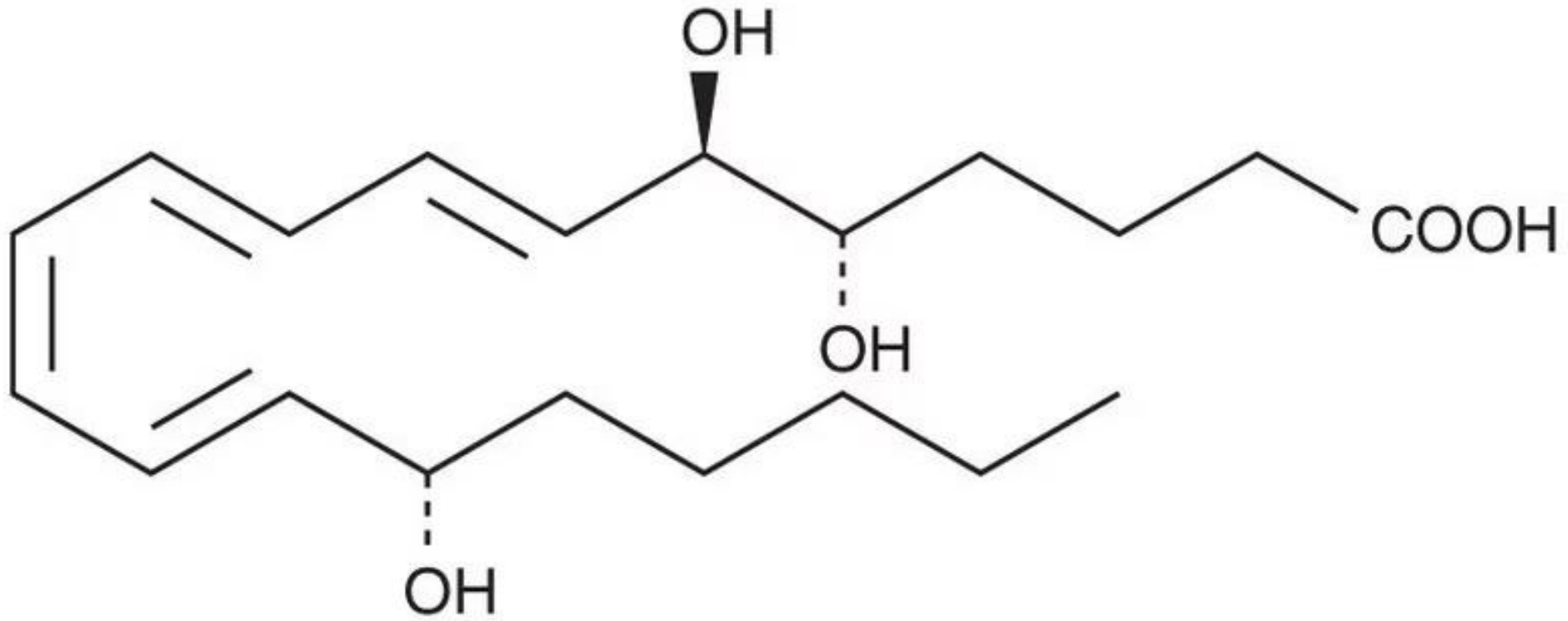
Thromboxane (TX) - via thromboxane synthase

2. Acyclic compounds (via lipoxygenase pathway)

Leukotrienes (LT) 3 conjugated double bonds

Lipoxins (LX) 4 conjugated double bonds, contains more oxygen





Lipoxin A₄

Prostaglandins

First discovered in prostate

- Present in most human tissues (males & females)
- All have a cyclopentane ring in the middle (C8-12)
- Many types: PGA, PGB, PGE, PGF, PGG, PGH



Effects of eicosanoids

PGE2 - vasodilation, relaxation of uterus & intestines

PGF2 - vasoconstriction, contraction of uterus & intestines

PGI2 - vasodilation + inhibits platelet aggregation

TXA2 - vasoconstriction + stimulates platelet aggregation

Leukotrienes - allergic mediators

Lipoxins - inflammatory functions

Thank you