Study Of Derived Lipids Alcohols

Alcohols Involved In Lipid Structures

3 Alcohols Involved In Various Forms Of Lipids

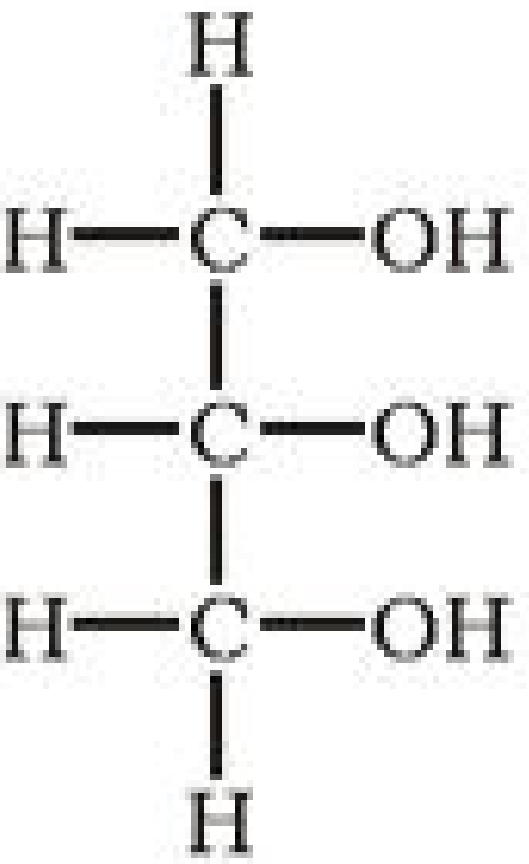
1. Glycerol
   (C3-Trihydric Alcohol)
2. Sphingol/Sphingosine
   (C18-Dihydric Alcohol)
3. Cholesterol
   (C27-Monohydric Alcohol)

Alcohols Of Lipids Are Classified As Derived Lipids

Glycerol is a Derived Lipid

Obtained from Hydrolysis of Simple and Compound Lipids

Figure 1. Structure of Glycerol



Glycerol/ Glycerin

- Glycerol [C3]is a **POLYOL**
- Glycerol is chemically **Trihydric Alcohol** (3 –OH groups)
- **Glycerol has potency to interact with 3 same or different Fatty acids .**

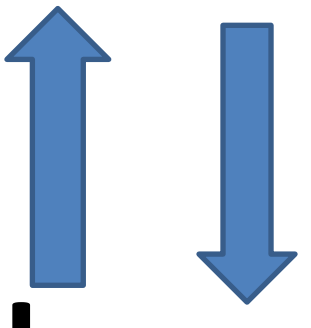
❖Glycerol is a **backbone of Glycerol based Lipids** viz:

- ❖ **Triacylglycerol**
- ❖ **Glycerophospholipids**

Glycerol Sources To Human Body

Endogenous and Exogenous Sources

Glycerol



Glucose

Source Of Glycerol To Human body

- Glucose is responsible for **biosynthesis of Glycerol** in human body

- Glucose transforms to **Glyceraldehyde,**

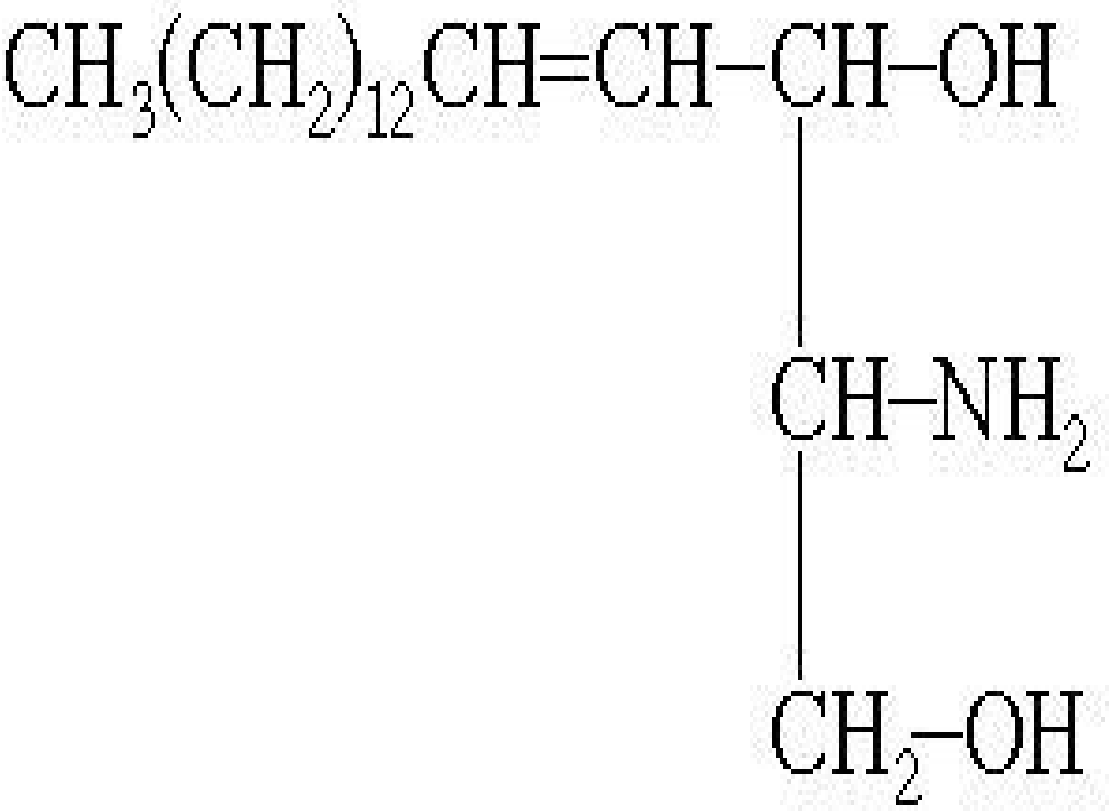
- **Glyceraldehyde on reduction forms Glycerol.**

- **Glycerol formed is then used for Biosynthesis of Glycerol based Lipids.**

- **Glycerol released from hydrolysis of Glycerol based Lipids is transformed to Glucose.**

SPHINGOSINE/SPHINGOL

Sphingosine



- **Sphingosine** is a **derived Lipid**.

- **Obtained from Hydrolysis of Sphingolipids**

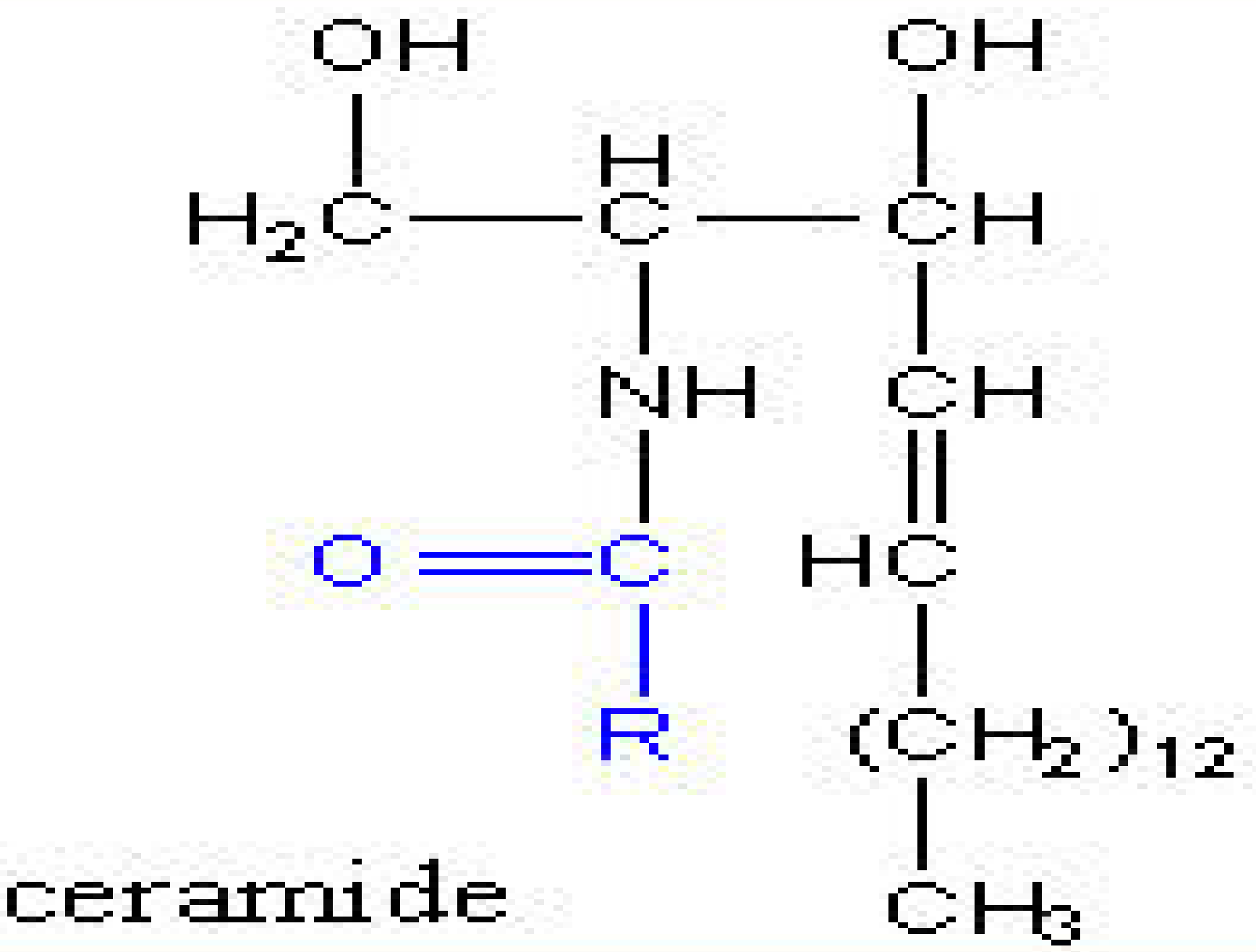
- Sphingosine is a **C18**, **complex Dihydric**, **Amino alcohol**.

- **Sphingosine is biosynthesized in human body using amino acid Serine.**

- **Serine** provides **NH2 group** of Sphingosine.

- **Sphingosine forms Sphingolipids /Compound Lipids with Alcohol Sphingol**

- **Examples of Sphingolipids:**
  - **Sphingophospholipids**
  - **Sphingoglycolipids**



ceramide

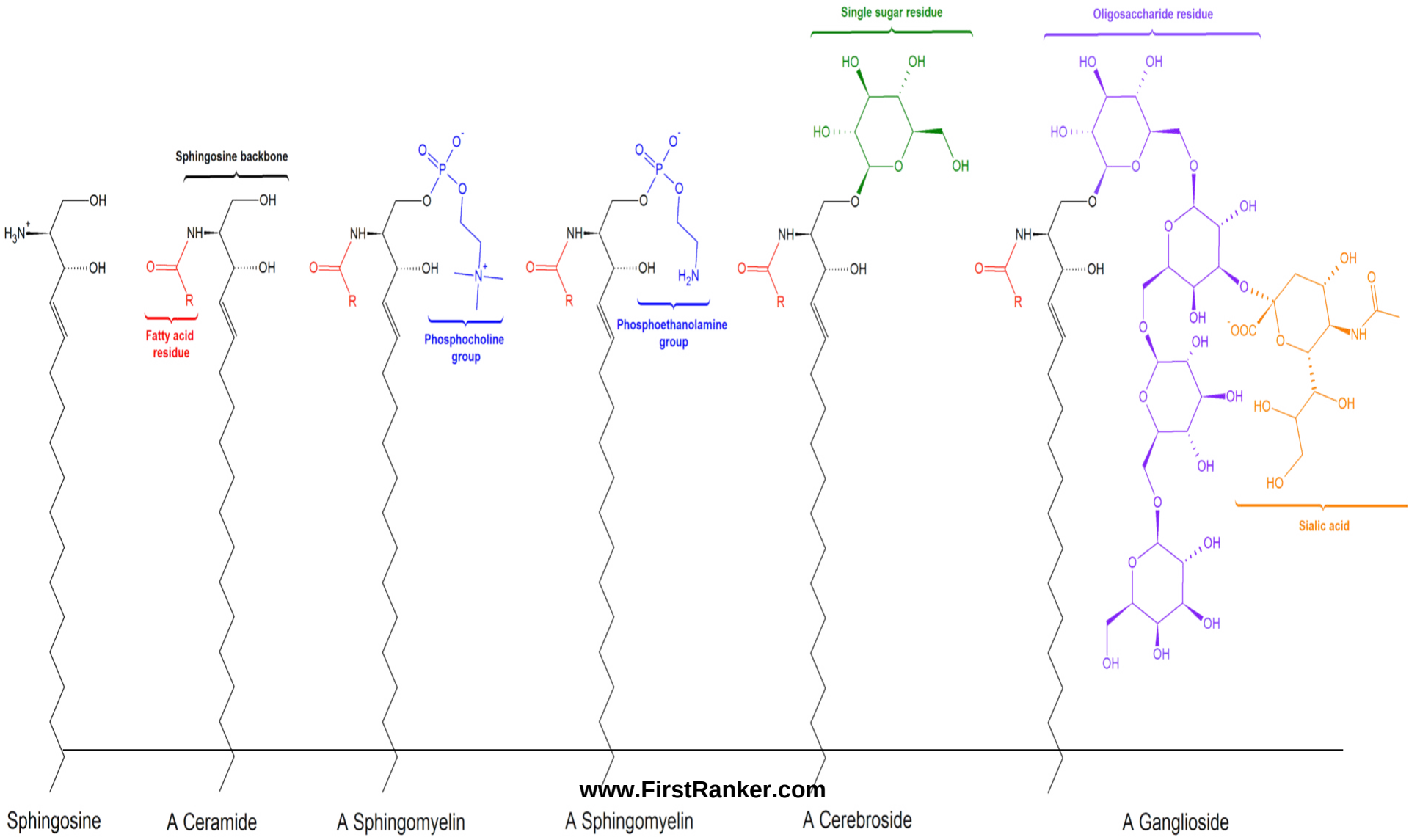
What Is a Ceramide?

- A Fatty acid linked to an **amino group** of **Sphingosine**
- With an **amide linkage** form a **Ceramide.**

- **Ceramide** if linked to **Phosphate and Nitrogenous** groups forms **Sphingophospholipids.**

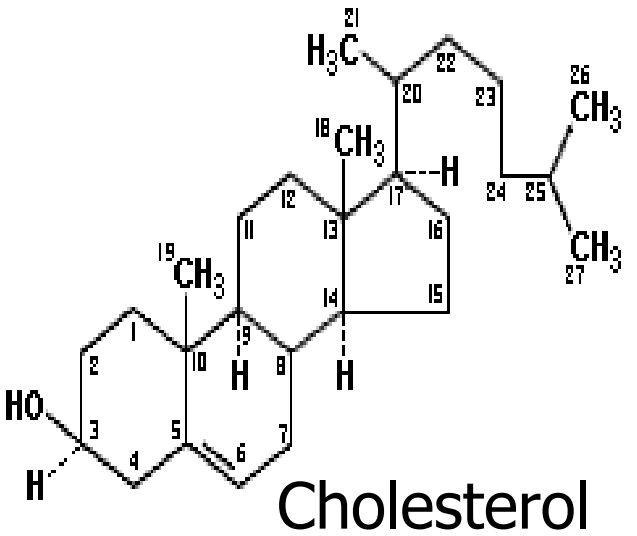
- **Ceramide** linked to **Carbohydrate moieties** form **Sphingoglycolipids.**

Sphingosine Based Lipids

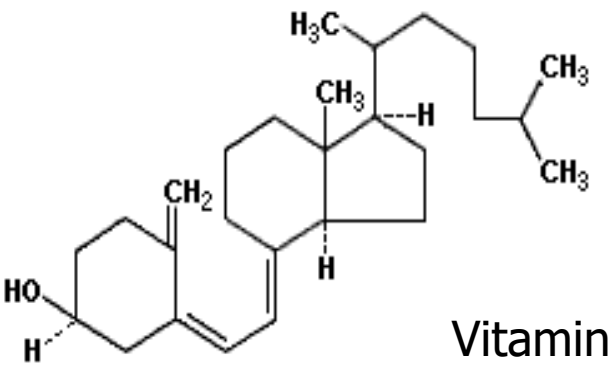


Sterols

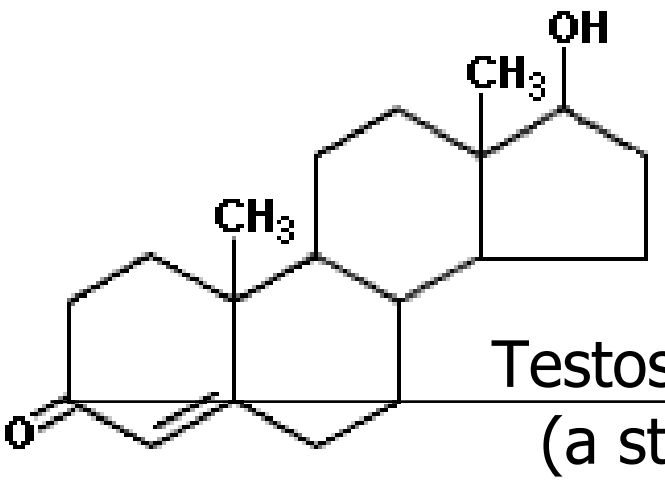
Common Sterol And Steroids



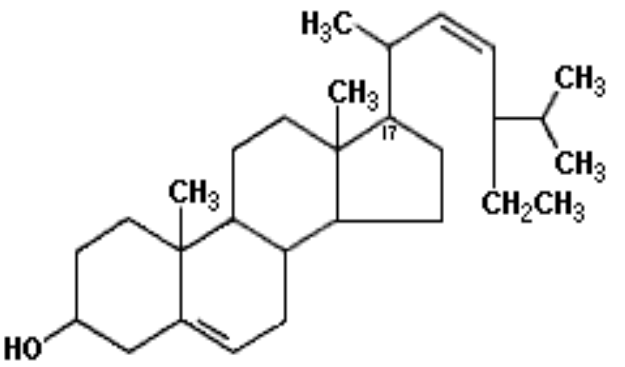
Cholesterol
(a sterol)



Vitamin D3
(cholecalciferol)



Testosterone
(a steroid hormone)



Stigmasterol
(a phytosterol)

- Sterols are chemically **complex, organic monohydric Alcohols.**

- **Sterols has cyclic ring structures**

- Sterols have **a parent ring**
- **Cyclo Pentano Perhydro Phenantherene** (CPPP) nucleus.

Examples Of Sterols

- **Cholesterol** (Animal Sterol)
- **7 Dehydrocholesterol**(Provitamin D)
- **Coprosterol** (Excretory form Cholesterol)
- **Ergosterol** (Plant Sterol)
- **Sitosterol** (Plant Sterol)

Cholesterol

Most abundant Sterol of Human body

Cholesterol

- Cholesterol is an **Animal Sterol** .
- Cholesterol means **Solid Alcohol** as it was **first obtained from gall stones** of bile.
- Cholesterol is excreted via bile hence **richly composed in bile ,Gall stones.**

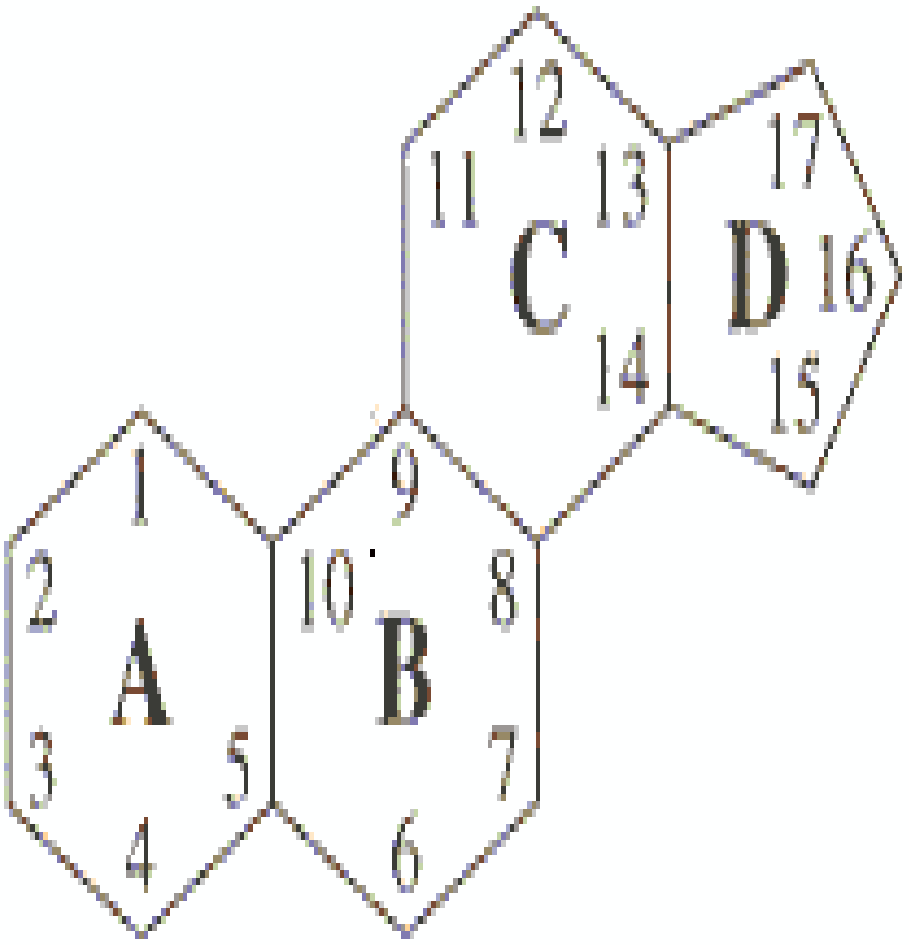
Cholesterol
Is A Derived Lipid

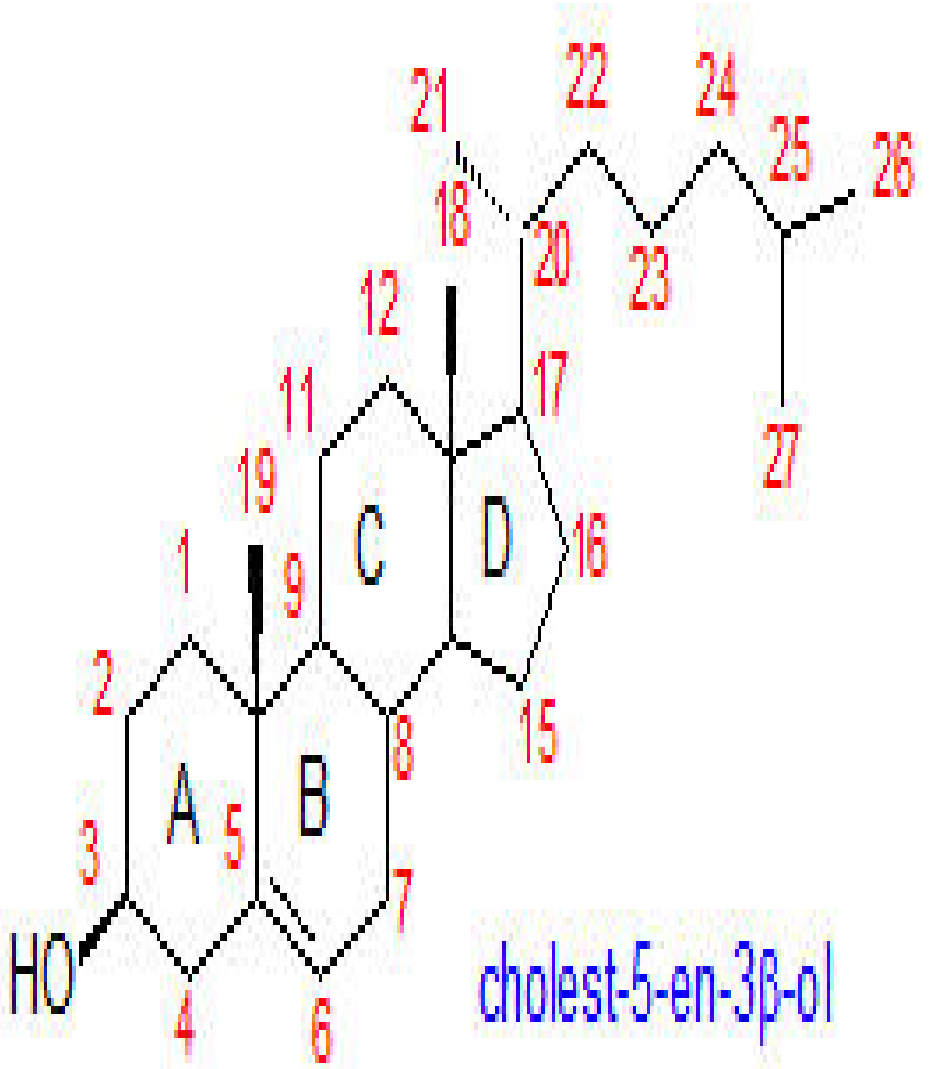
- Cholesterol is classified as **Derived Lipid.**

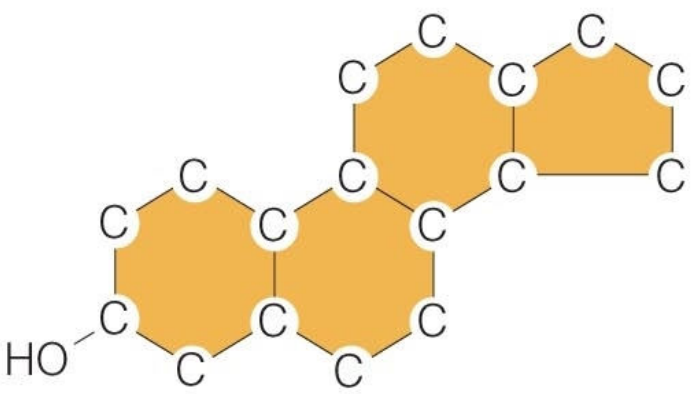
- It is **derived** from **hydrolysis of Cholesterol Ester** **(Human Body Wax).**

Chemical Structures Of Cholesterol and Cholesterol Ester

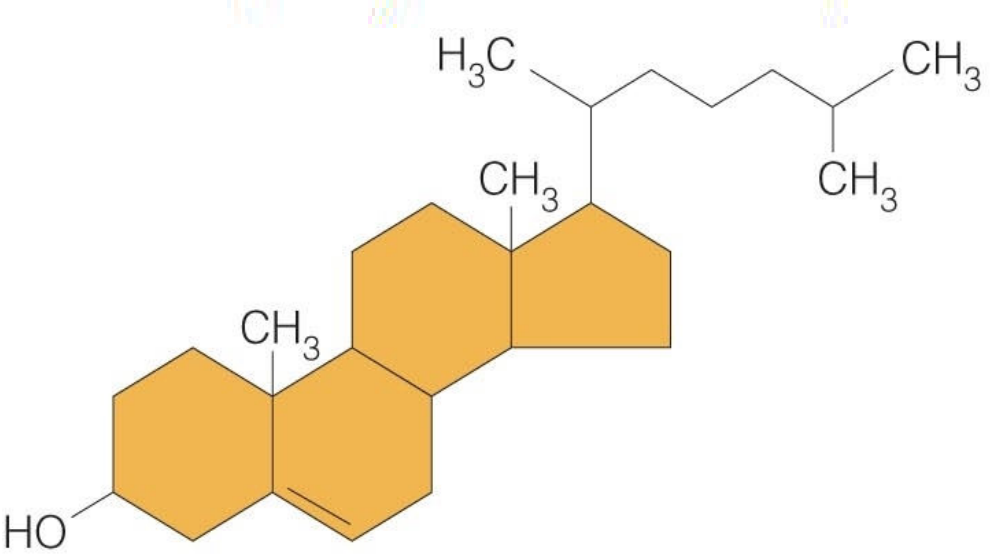
Pentahydrophenantrene (Sterane)



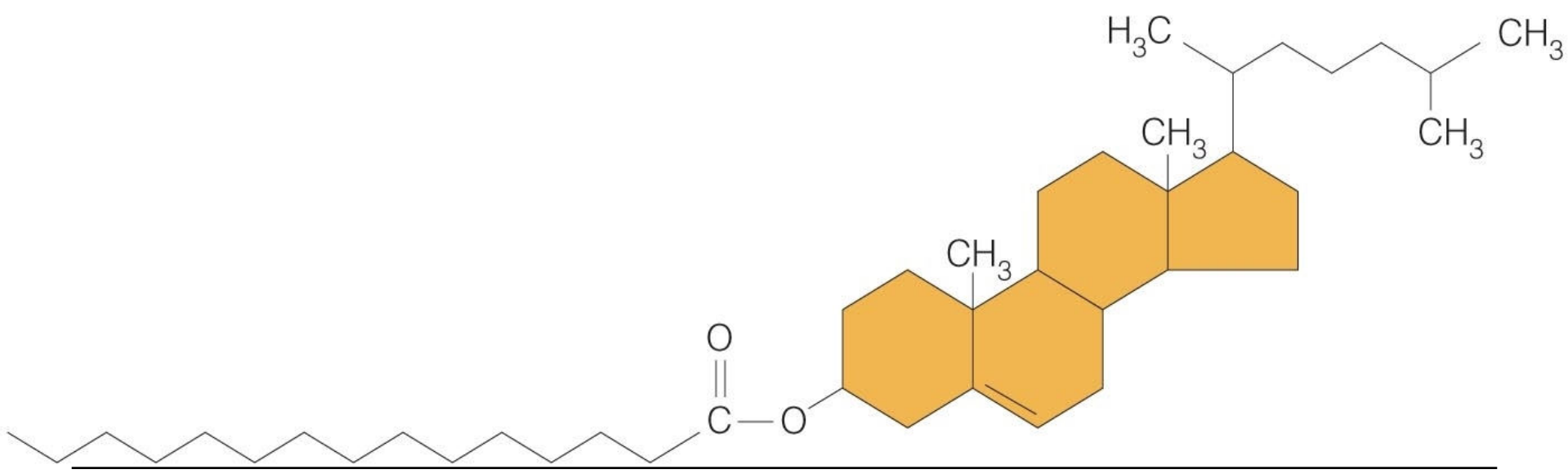




(a) Sterol ring structure



(b) Cholesterol



(c) Cholesterol ester

Structure Of Cholesterol

- Cholesterol is **complex, cyclic, unsaturated, monohydric Alcohol.**
- Molecular formula is **C27H45OH**
- Cholesterol has parent nucleus as **Cyclo Pentano Per hydro Phenantherene ring** system(CPPP).
- The structure of CPPP has **four fused cyclic rings** (A,B,C and D)

- Hexane ring **A,B,C** is a **Phenatrene** nucleus.

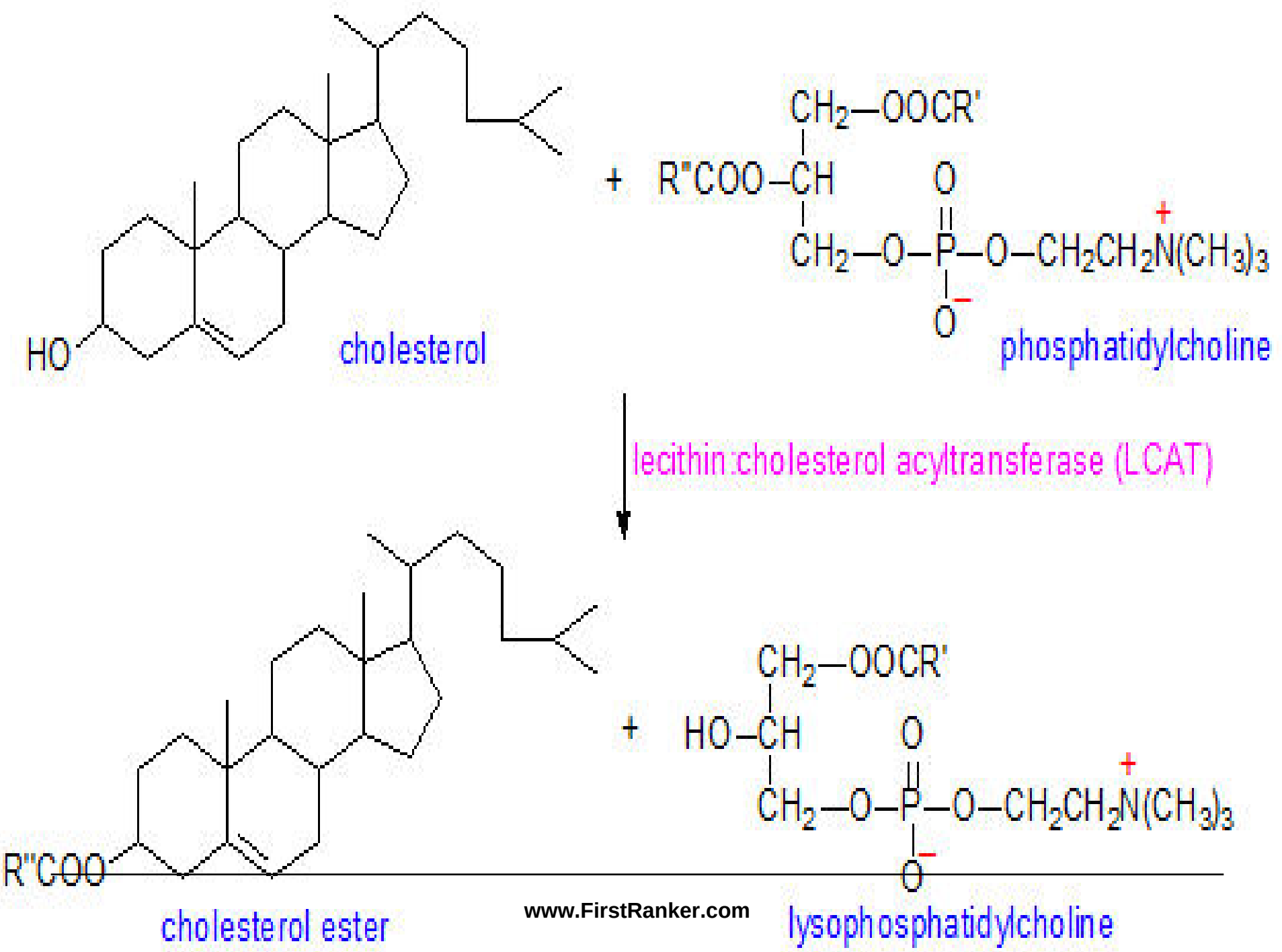
- **D** ring is **Cyclopentane** ring.

- **The Structure of Cholesterol Possess:**

1. **Hydroxyl group** (-OH) at C3.
2. **Double bond** between C5 and C6.
3. **5 Methyl** (-CH3) groups.
4. **8 Carbon side chain** linked to C17 of the structure.

Forms Of Cholesterol In Human Body

- **Cholesterol exists in two forms:**
  - **–Free Cholesterol - 30%**
    (Amphipathic form)
  - **–Cholesterol Ester - 70%**
    (Non polar form)

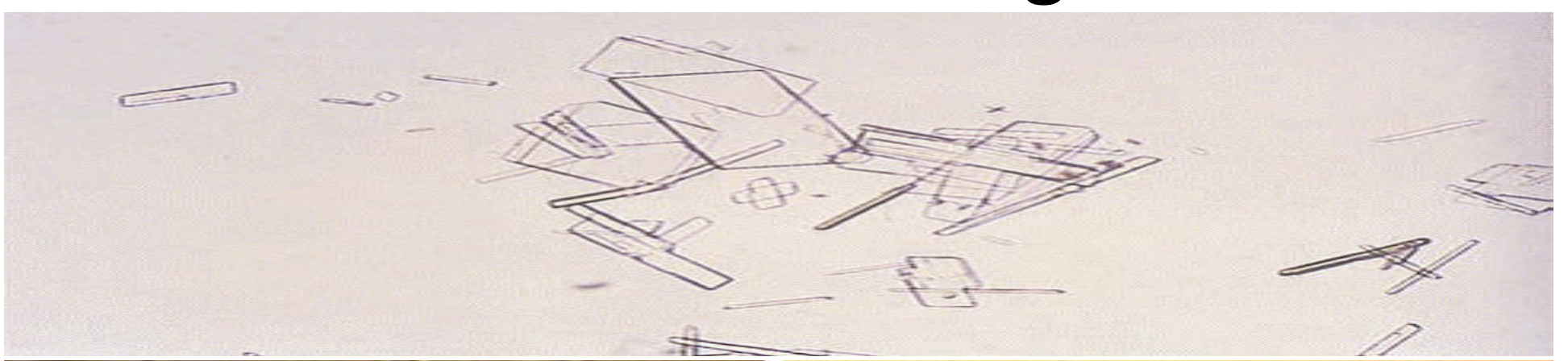


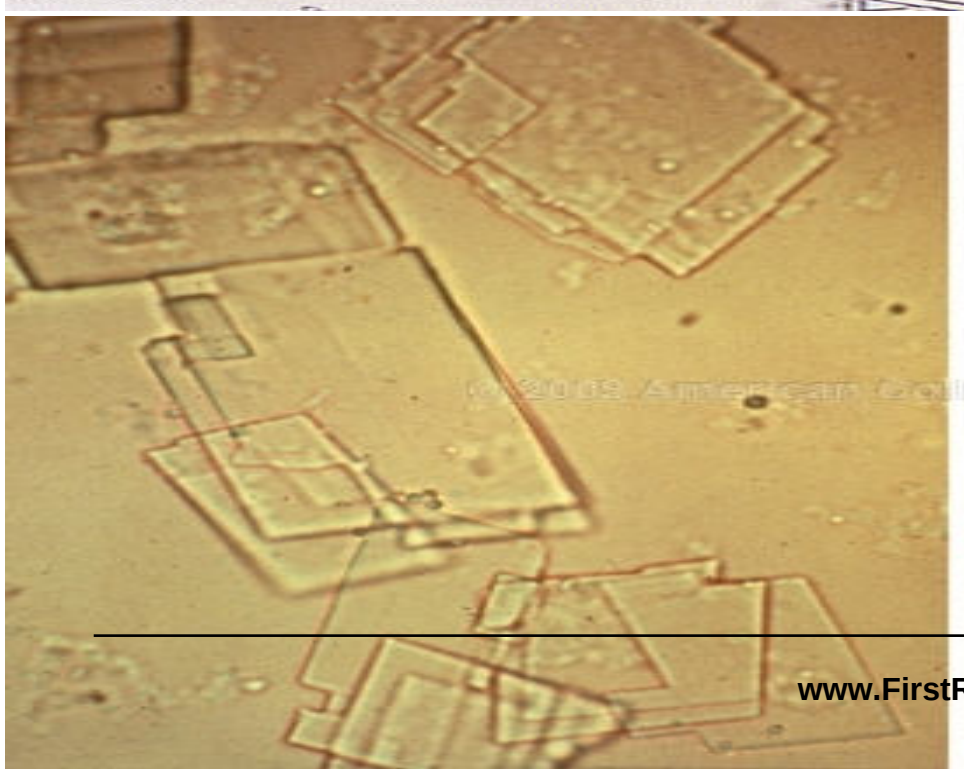
Properties Of Cholesterol

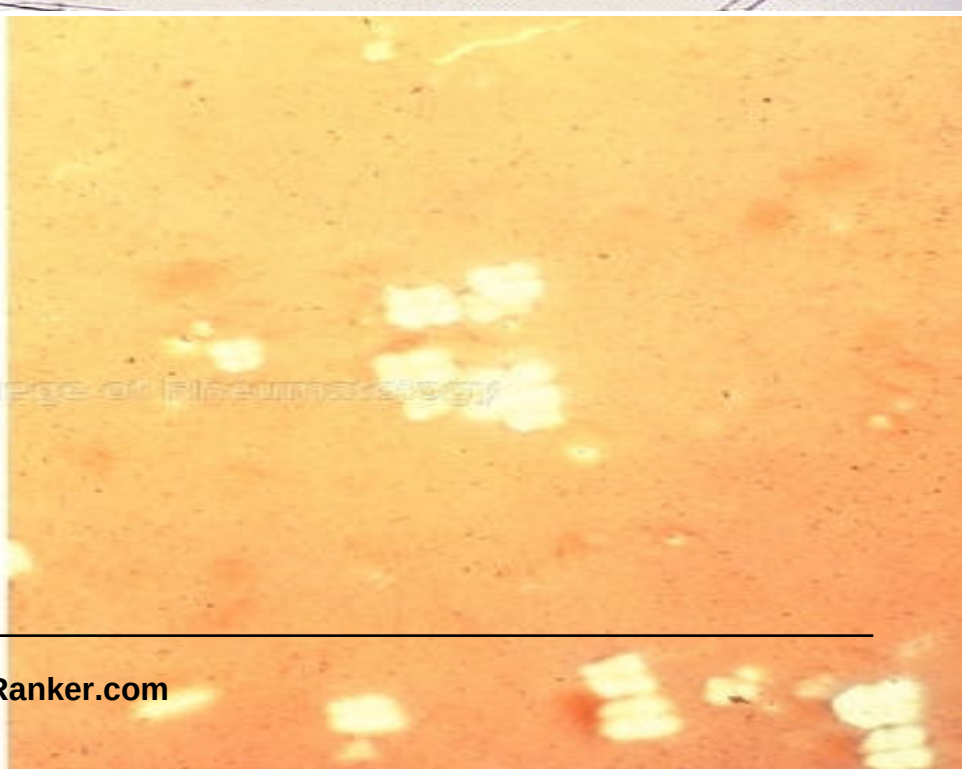
- Cholesterol is **white or pale yellowish, crystalline ,odorless compound.**

- **Insoluble in water and soluble in organic solvents** like **Ether and Chloroform.**

Crystals of Cholesterol Rhombic plates with Notched edges.







- **Qualitative Tests For Cholesterol detection are:**

–Liebermann Burchard Reaction

–Salkowski Reaction

–Zak’s Reaction

Sources Of Cholesterol To Human Body

- **Exogenous Sources of Cholesterol:**
  - **–Animal Origin Food Items**

- **Endogenous Source Of Cholesterol:**
  - –Obtained In **well fed condition from Excess Glucose**

Dietary Sources Of Cholesterol

- Cholesterol is exclusively present in **animal foods.**

- The dietary rich sources of Cholesterol **animal origin foods** like:
  - **Egg Yolk**
  - **Meat**
  - **Milk**
  - **Butter**
  - **Ghee**
  - **Cream**

- Remember **Cholesterol** is **absent in plant origin food items.**

Endogenous Source Of Cholesterol

- Cholesterol Biosynthesized in human body from **Free Excess Glucose** in **Liver.**

Transportation Of Cholesterol

- **Cholesterol in blood is transported by Lipoproteins:**
  - **Chylomicrons (Dietary origin)**
  - **LDL (From Hepatocytes to Extra hepatocytes)**
  - **HDL (From Extra hepatocytes to Hepatocytes)**

Occurrence and Distribution Of Cholesterol in the Body

- **70 %** of Cholesterol associated with **cellular components**

- **30 %** of Cholesterol is in the **Blood.**

- Cholesterol is richly present in **Nervous tissue Brain.**

- Other organs containing Cholesterol are:
  - **Liver**
  - **Adrenal Cortex**
  - **Gonads**
  - **Intestinal Mucosal cells**
  - **Skin**

Functions Of Cholesterol

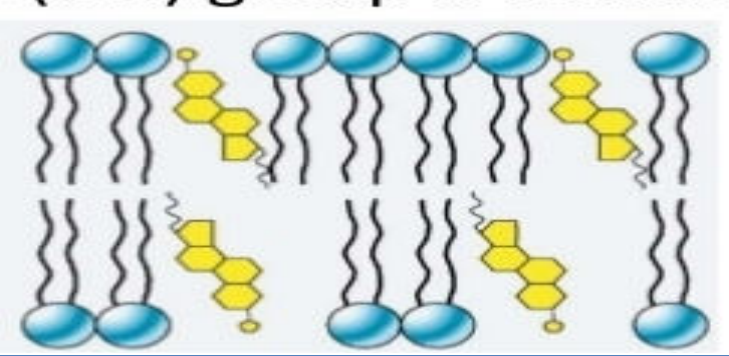
Depends Upon

Quality and Quantity

- Cholesterol is **constituent of biomembranes of cell**
- **It give structure, shape and fluidity to them.**

Cholesterol

- Embedded in membrane
- Helps stabilize and strengthen the cell membrane
- Important in cell metabolism
- Hydroxyl (OH) group is oriented to the outside



Effects on Membrane without Cholesterol	
In Cold Environment	**In Hot Environment**
Rigid/ Not Flexible	Too Flexible
Not Fluid	Very Fluid
May Get damage	**Not hold Shape**

- Cholesterol richly **present in nervous tissue and covers Myelin sheaths.**

- **Cholesterol help in nerve impulse conduction.**

- Cholesterol helps in nerve impulse transmission since:
  - **It has high dielectric constant.**
  - **It is a poor conductor of heat and electricity.**

Cholesterol Serves Precursor for Biosynthesis Of Many Steroids

Derivatives of Cholesterol

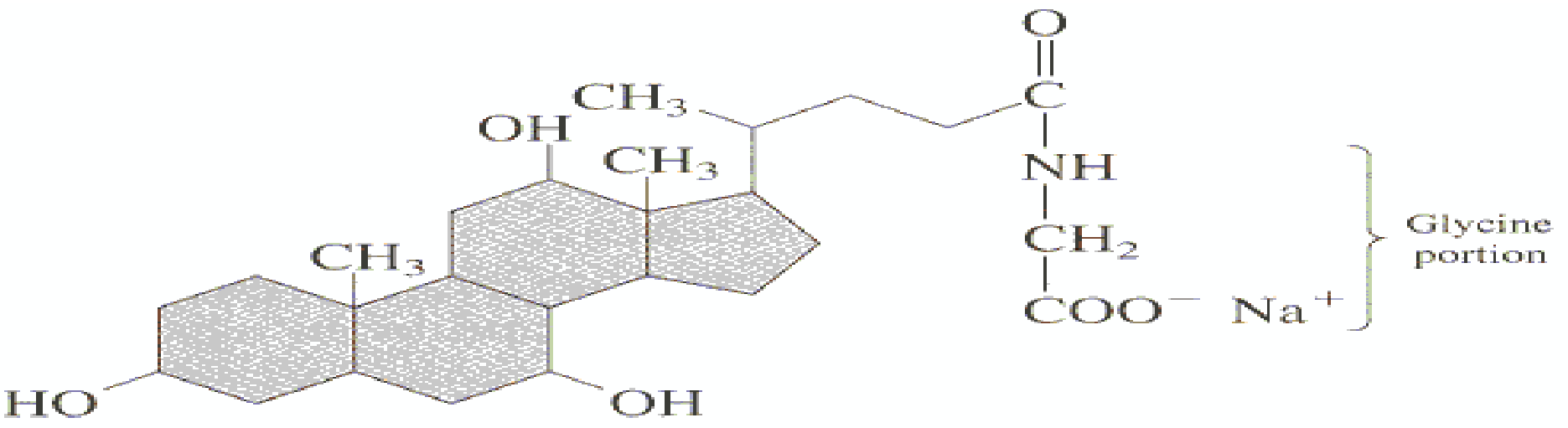
- Steroids are **derivatives of Sterols.**

- Chemical **Compounds obtained from Cholesterol** are termed as **Steroidal compounds.**

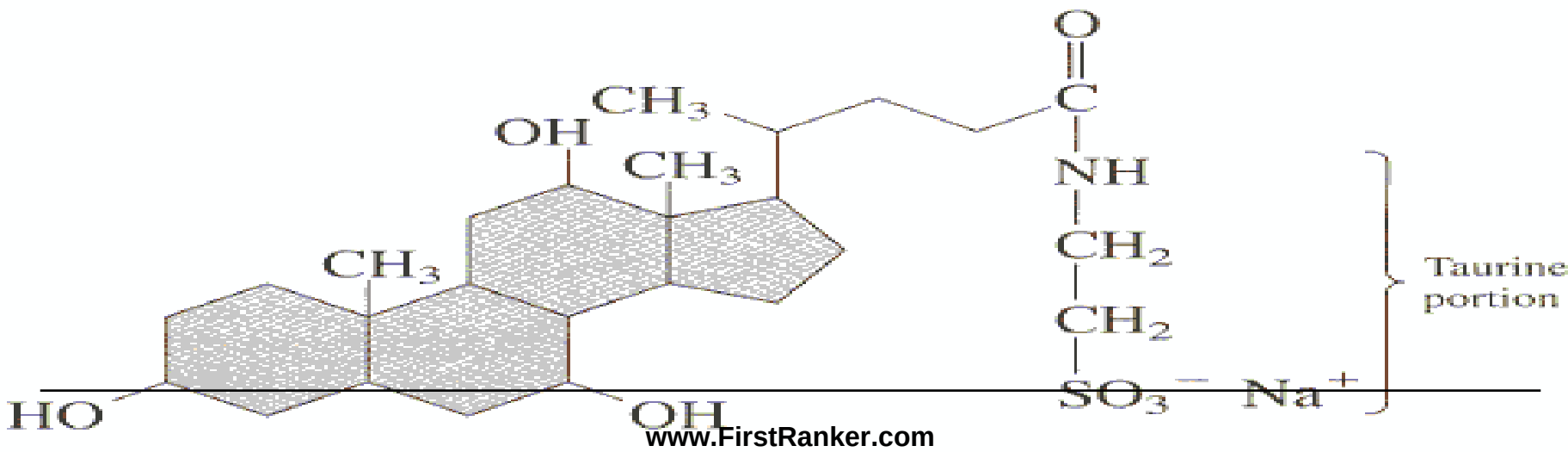
- **Derivatives of Cholesterol**

- **Vitamin D** (Cholecalciferol)
- **Bile acids** (Cholic and Chenodeoxycholic acid)
- **Bile Salts** are obtained from Bile acids.
- **Steroidal Hormones**
  - **ACTH**
  - **Mineralocorticoids**
  - **Glucocorticoids**
  - **Sex Hormones: Androgens, Progesterone, Estrogen and Testosterone**

Bile Acids and Bile Salts

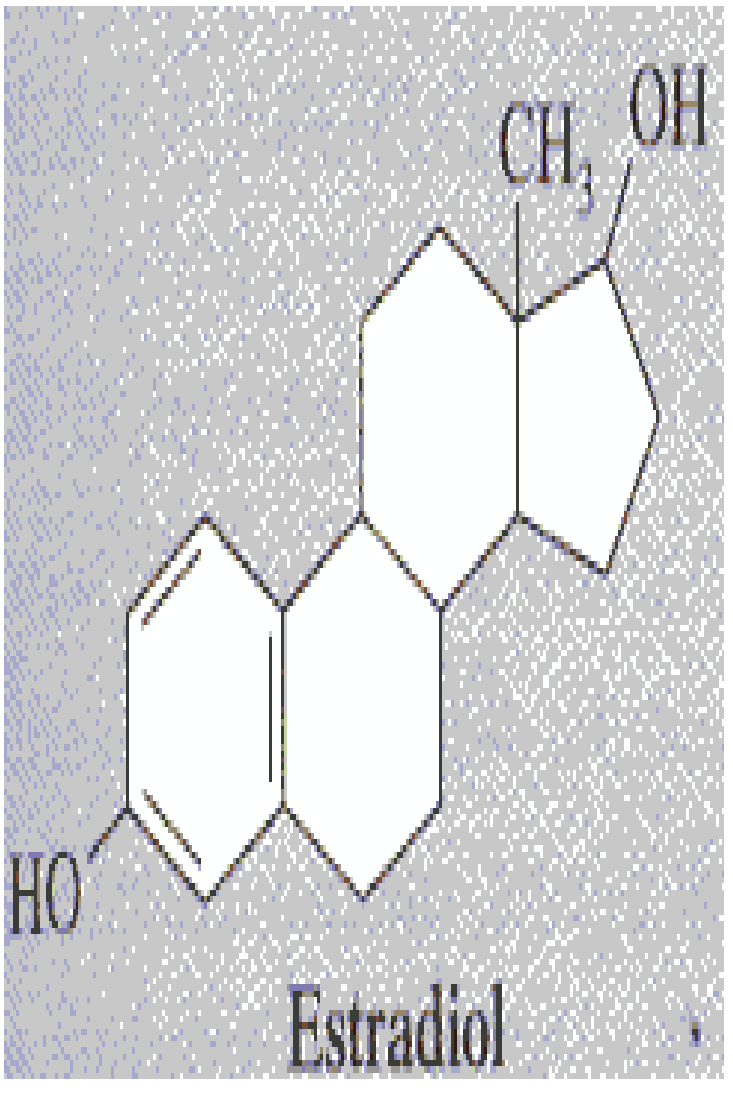


Sodium glycocholate

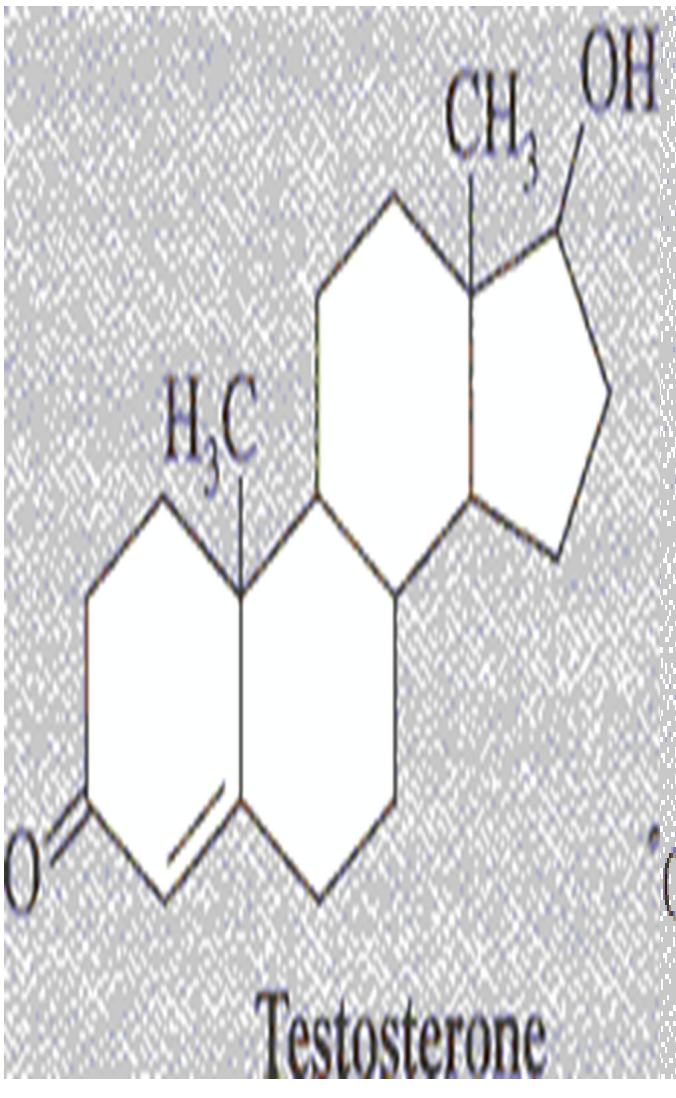


Sodium taurocholate

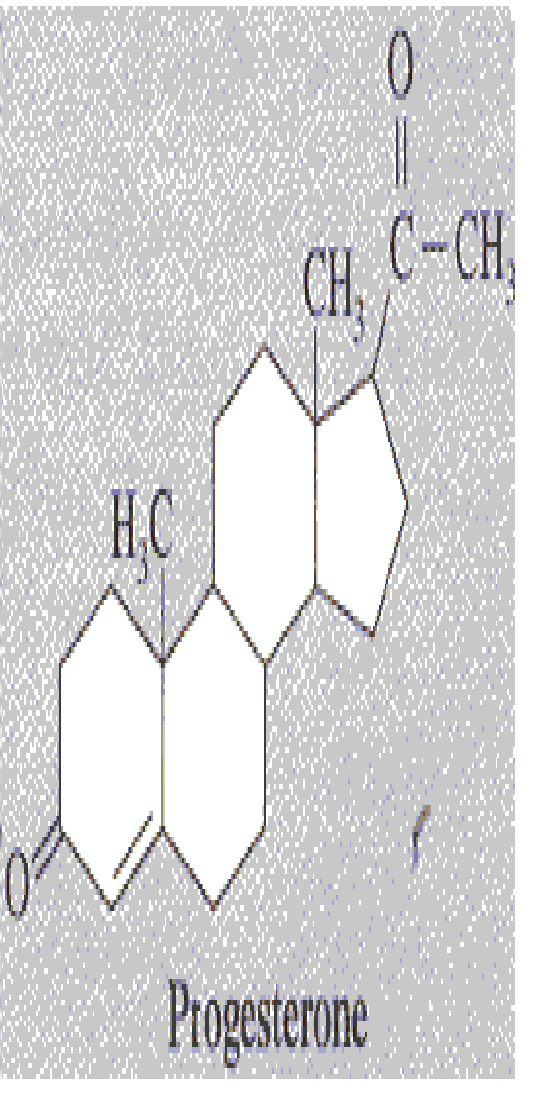
Steroids Hormones



Estradiol



Testosterone



Progesterone

Disorders Related To Cholesterol

- **Serum Total Cholesterol level** of a Healthy human body is **150-200 mg%**

Hypercholesterolemia

- **Causes for Hypercholesterolemia**

- **High intake** of dietary Cholesterol(animal origin) is a exogenous source of Cholesterol.

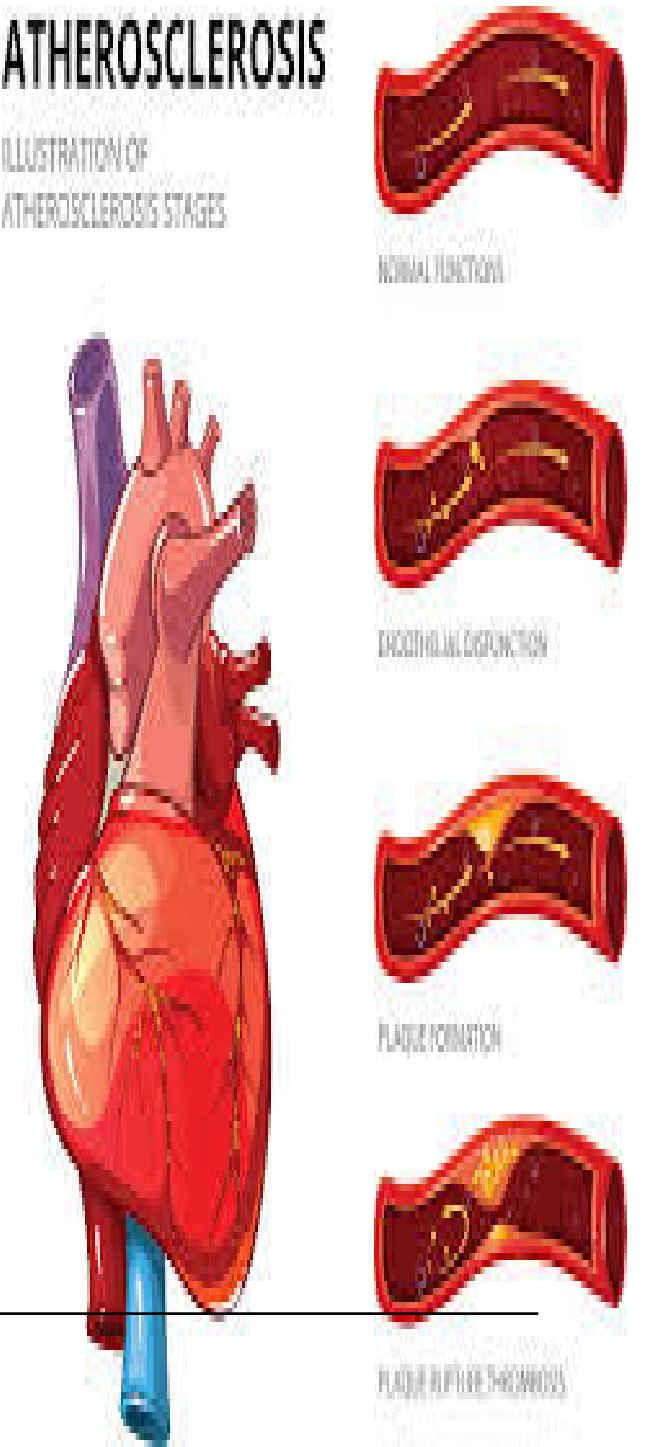
- **Elevated endogenous Cholesterol biosynthesis** when a very **rich Carbohydrates is ingested.**

- **Defect in Cholesterol transport by Lipoproteins** in ~~blood retains Cholesterol in blood~~.

Conditions Of Hypercholesterolemia

- Diabetes mellitus
- Obstructive Jaundice
- Nephrotic Syndrome
- Hypothyroidism

- **Hypercholesterolemia** leads to :
  - Deposits of **excess of Cholesterol** in **blood vessels.**
  - **Atherosclerosis** and atheroma /**plaque formation**.
  - Increased risk of **ischemia** and **Myocardial infarction and Stroke.**



–Cholesterol Summary

- Cholesterol is **exclusively found only in animals.**
- **Exogeneous** Cholesterol comes **from diet**
- **Endogeneous** Cholesterol is **biosynthesized** by the **Liver from Glucose product Acetyl-CoA.**
- Cholesterol is an important **component of biomembranes, steroidal hormones, bile acids and Vitamin D**