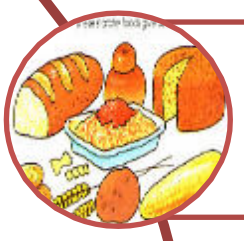
INDUCTION OF TOPIC

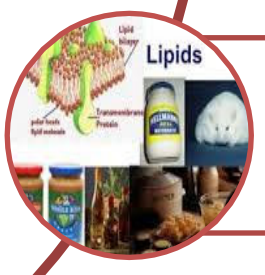
Chief Constituents Of Food
OR
Enumerate Macro Nutrients

Essential Food Nutrients



Carbohydrates

Proteins



Lipids

Body Constituents And Functional Biomolecules

Identify A Food Nutrient

Richly Associated

To Following Food Items

Ghee

Butter

Oil

Curds

Cheese

Milk


Chicken

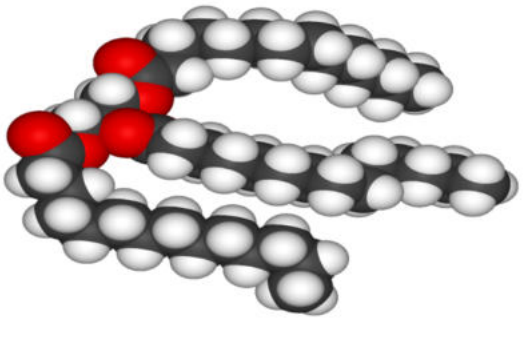

Fish


Eggs

Any Guesses Of Todays Topic???

LIPIDS

CHEMISTRY AND FUNCTIONS



SYNOPSIS/CONTENTS

- WHAT ARE LIPIDS?
- DEFINITION OF LIPIDS
- CLASSIFICATION OF LIPIDS
- STUDY Of BIOMEDICALLY IMPORTANT LIPIDS wrt:
  - STRUCTURE
  - DISTRIBUTION
  - FUNCTIONS
  - PROPERTIES
  - RELATED DISORDERS

INTRODUCTION

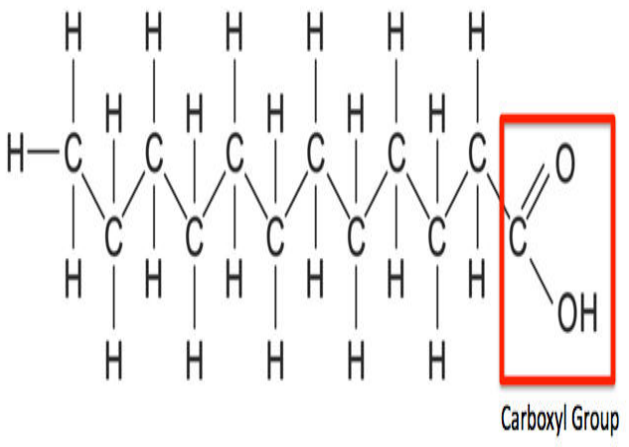
WHAT ARE LIPIDS?

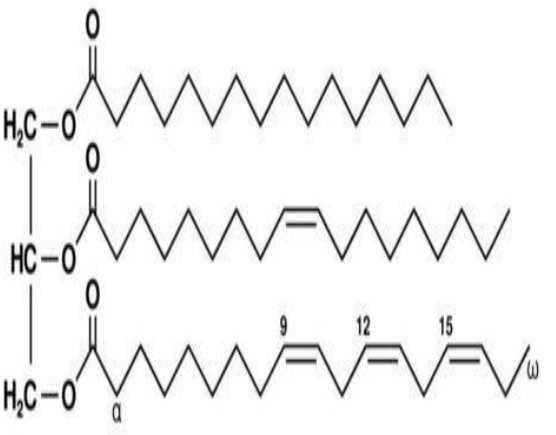
Pattern To Study Biomolecules

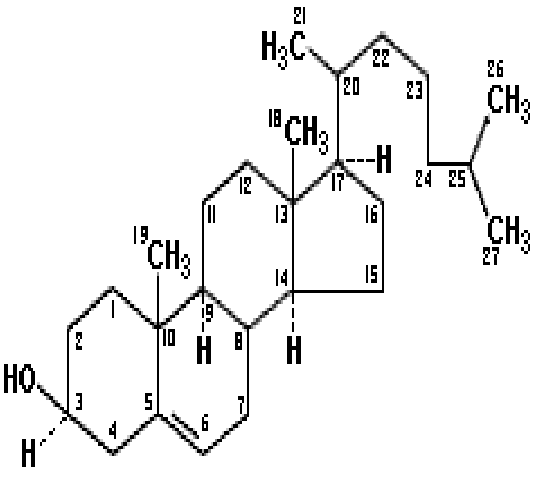
- Name of Biomolecule
- Class and Subclass
- Structural Features
- Sources
- Distribution in Body
- Functional aspects
- Interrelationships
- Derangements and Associated Disorders

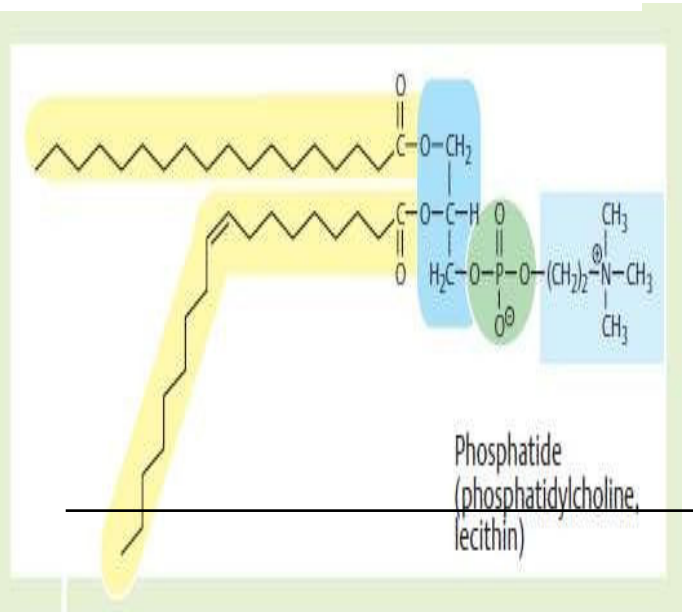
Look At Structural Forms Of Lipids

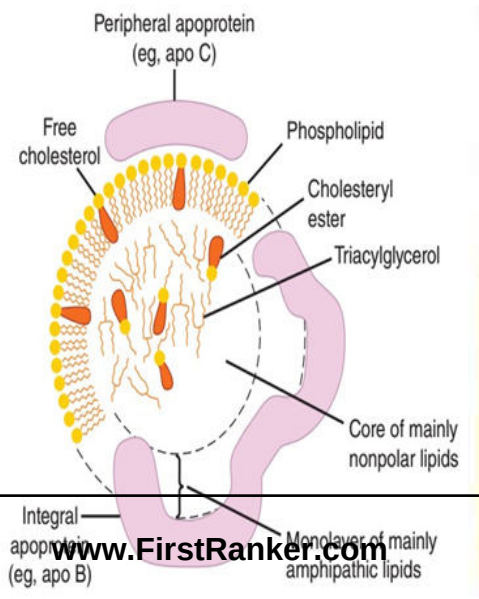
Depicts Its Features

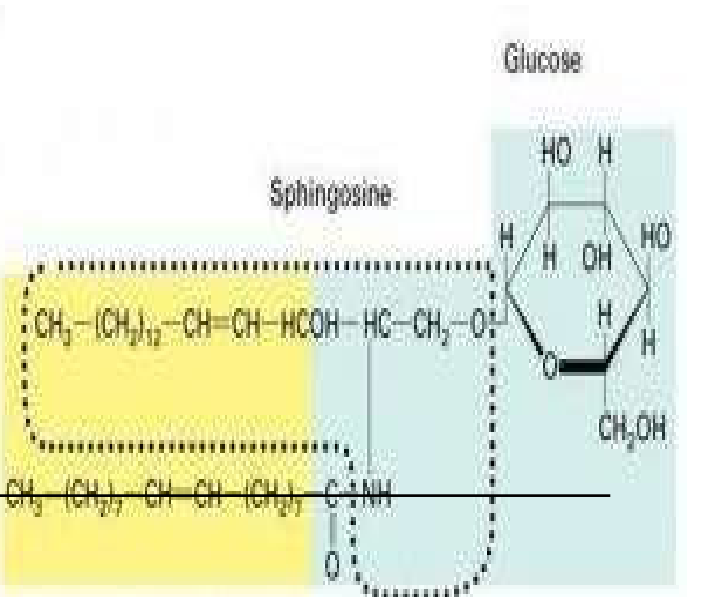












- **Lipids are :**

- **Organic Biomolecules**
- **Occurs** in **Plants and Animals**
- **Food Constituents/Nutrients**
- **Chemically Esters - has Ester Bonds(-COO)**
- **Heterogeneous**
- **Hydrophobic**
- **Secondary Source of Energy**
- **Structural Components of Biomembranes**
- **Signaling and Nerve Impulse Transduction**

Names Of Various Lipids Associated To Human Body

Biomedically Important Lipids

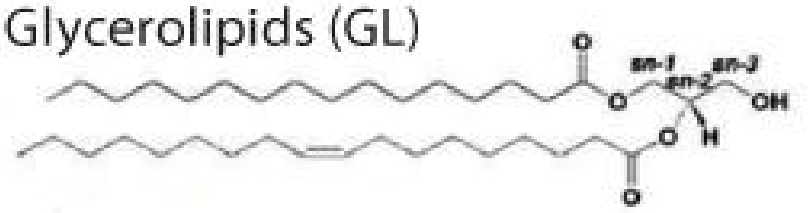
1. Fatty Acids (FAs)
2. Triacylglycerol (TAG)
3. Phospholipids (PL)
4. Lipoproteins (LP)
5. Glycolipids
6. Cholesterol (Free)Cholesterol-Ester(Esterifiec
7. Eicosanoids (PGs,PGI,TX,LT,LX,Resolvin)

Important Features Of Lipids

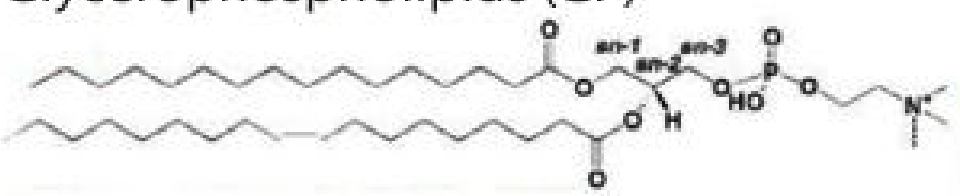
Heterogeneous Nature Of Lipids

Fatty Acids (FA)

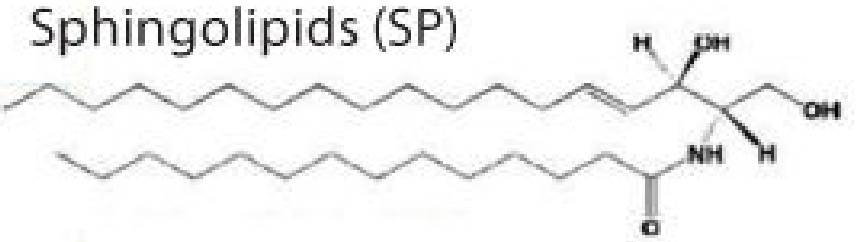
Glycerolipids (GL)



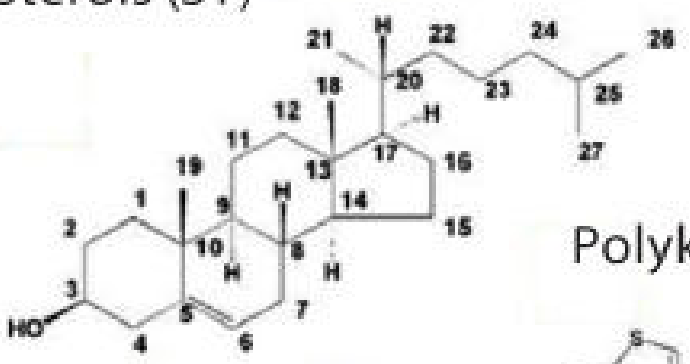
Glycerophospholipids (GP)



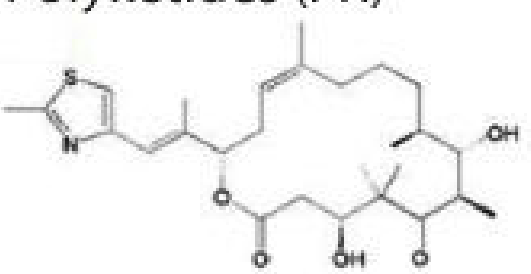
Sphingolipids (SP)



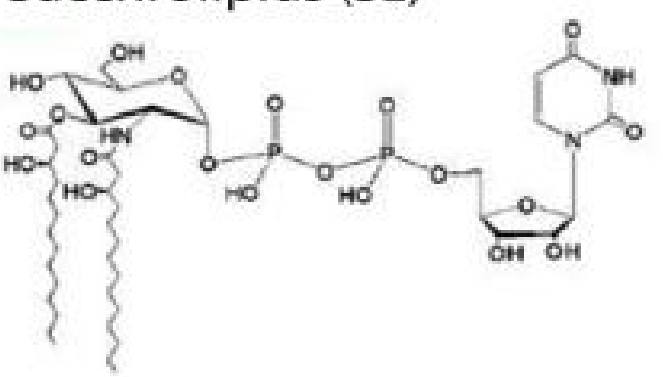
Sterols (ST)



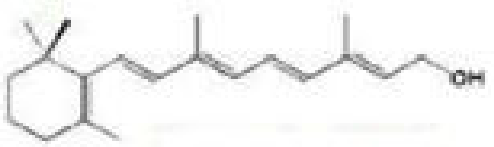
Polyketides (PK)



Sacchrolipids (SL)



Prenols (PR)



Heterogeneity Of Lipids

LIPIDS

Alter Lipids

Structure

Functions

Solubility Of Lipids

Solubility Of Lipids

Lipids are relatively Insoluble in Water/Polar Solvent

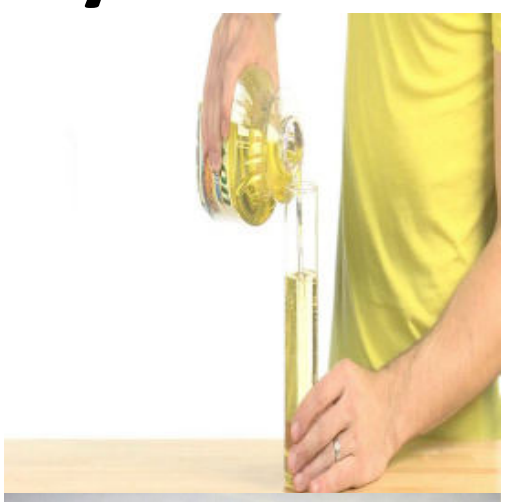
Since they have Uncharged/ **Non polar and Hydrophobic groups in their structures**

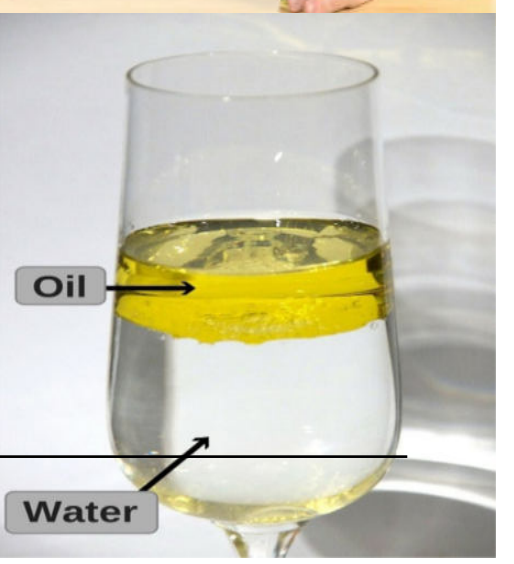
Lipids are soluble in Fat Solvents

- Lipids are readily soluble in
- Non polar Organic solvents /Fat Solvents
  - Acetone
  - Alcohol (Hot)
  - Benzene
  - Chloroform
  - Ether

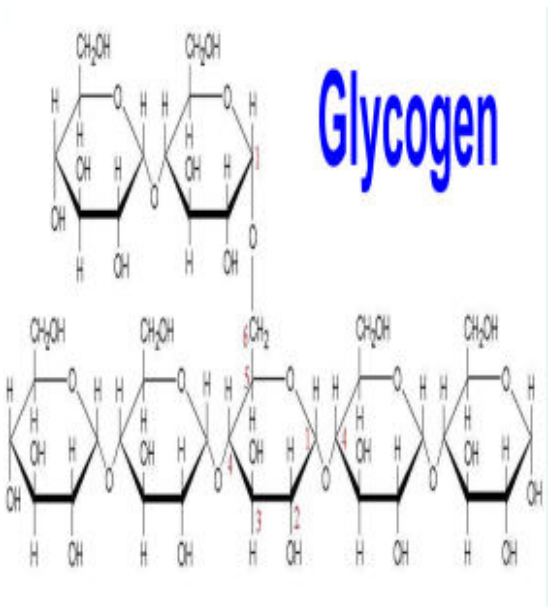
Size And Density Of Lipids

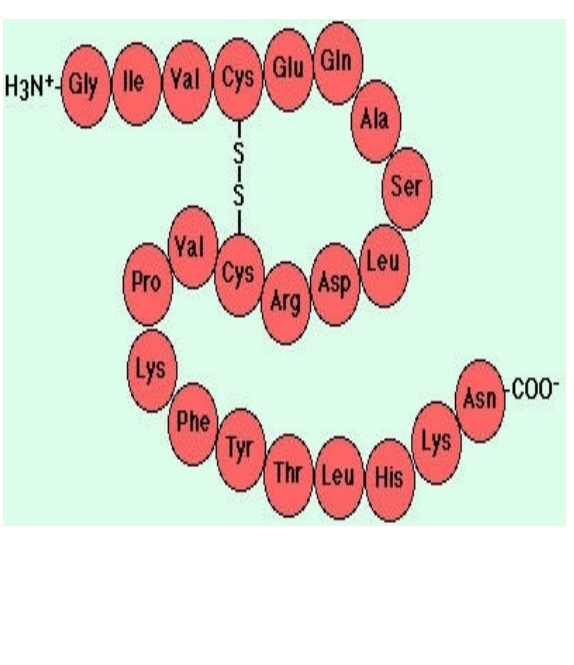
- Lipids are biomolecules relatively :
  - Smaller in size
  - Less dense
  - (Buoyancy- Float in Water)

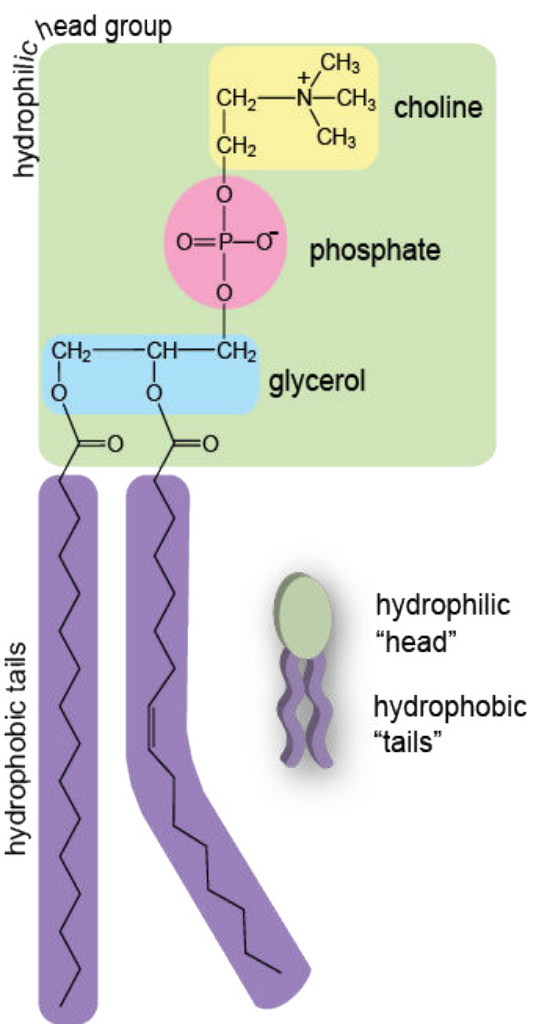




Complex Lipid structures are not Bio-Polymers





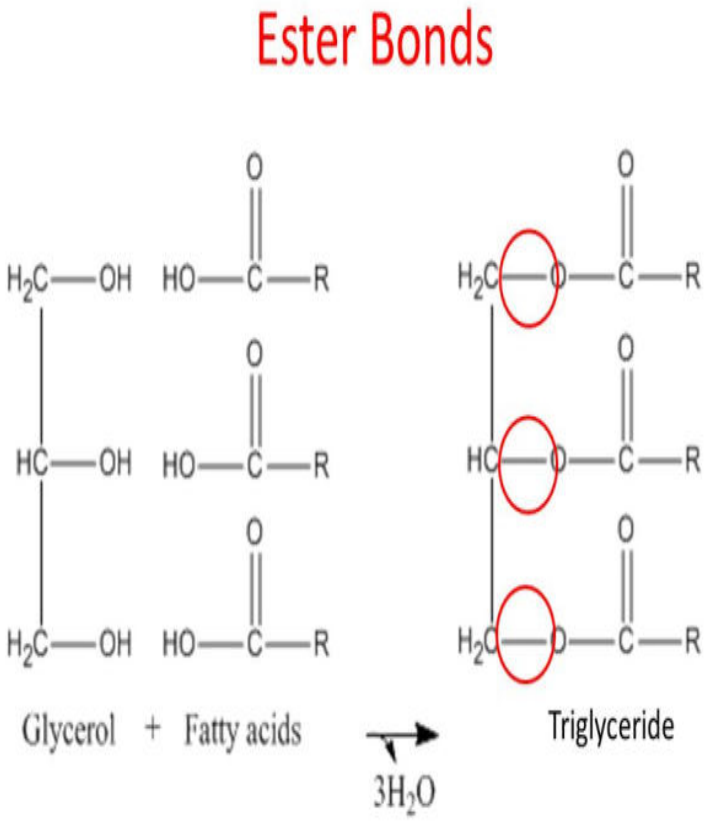


- Unlike Complex Carbohydrates and Proteins
- **Lipid structure contains no repeatedly linked Monomeric units**

Chemical Nature Of Lipids

Chemically Lipids are Esters

- **Most Lipids are Esters of Fatty acids(-COOH) with Alcohol (-OH)**



- **Lipids are relatively or potentially associated with Fatty acids.**

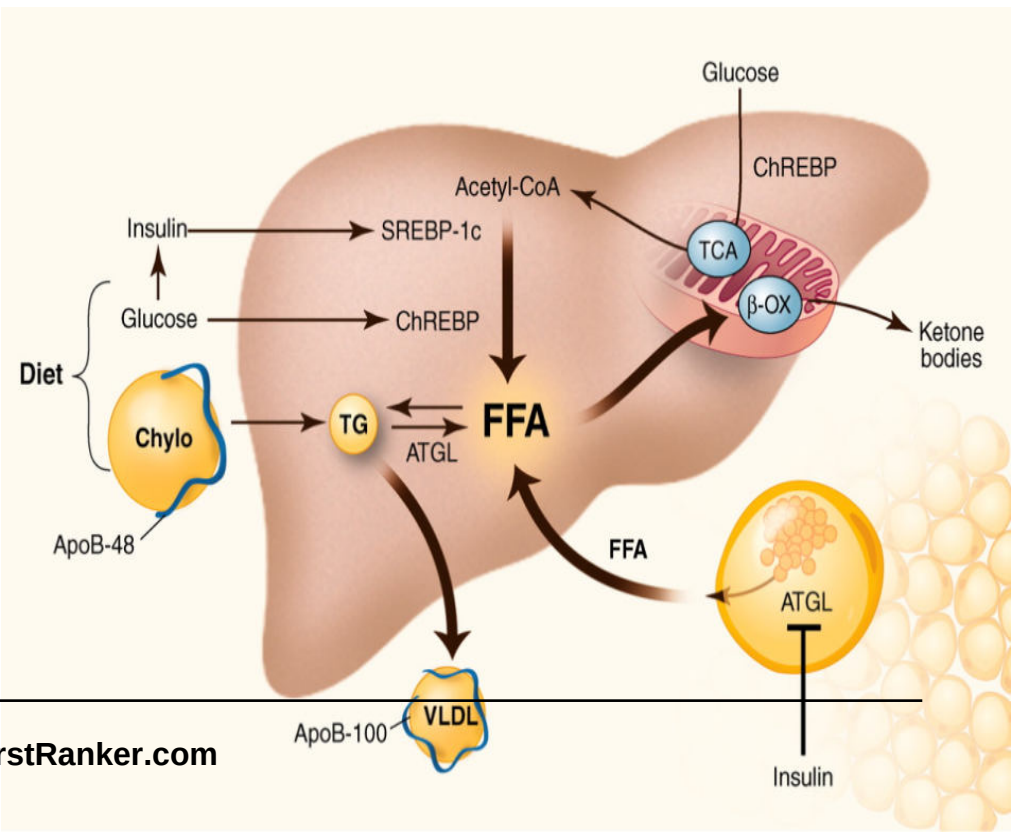
DEFINITION OF LIPIDS

Bloor's Definition Of Lipids

- Lipids are **Organic, Heterogeneous Hydrophobic Biomolecules**
- **Relatively insoluble in water** and **soluble in organic solvents.**
- Chemically **Esters of Fatty acids with Alcohol.**
- **Utilized by body to produce energy (ATP)**

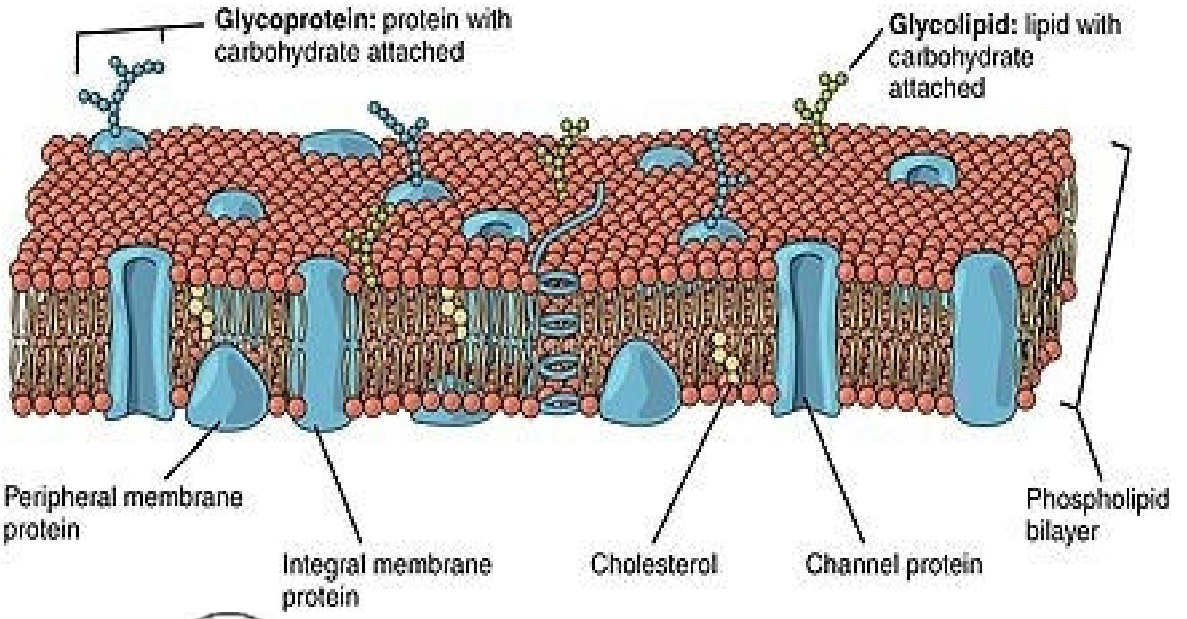
Sources Of Lipids To Human Body

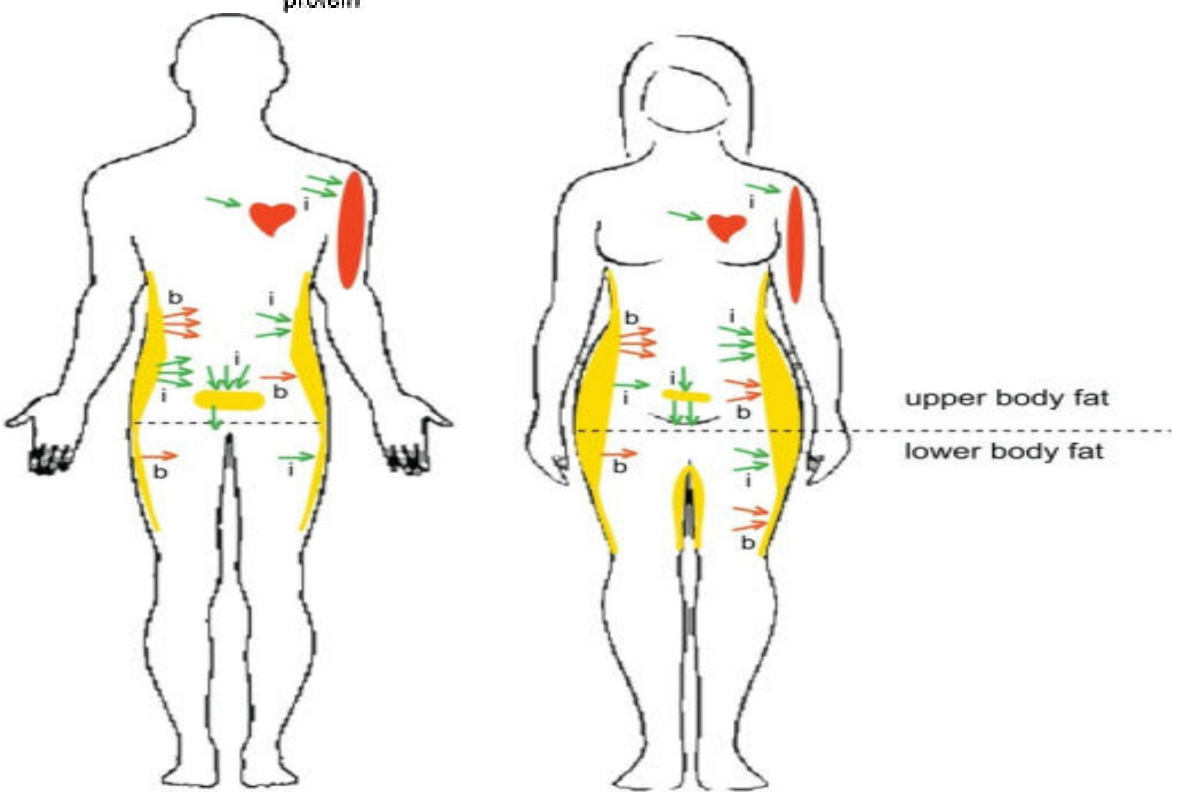
- **Exogenous Sources**
  - **Ingestion Dietary**
- **Endogenous Sources**
  - **Biosynthesis In Liver**
  - **Intestine**



Occurrence /Distribution Of Lipids In Human Body

- Bio Membranes
- Depot Fat
- Nervous System – Brain
- Subcutaneous Layer of Skin
- Padding of Internal Soft Organs





Biological Functions Of Lipids

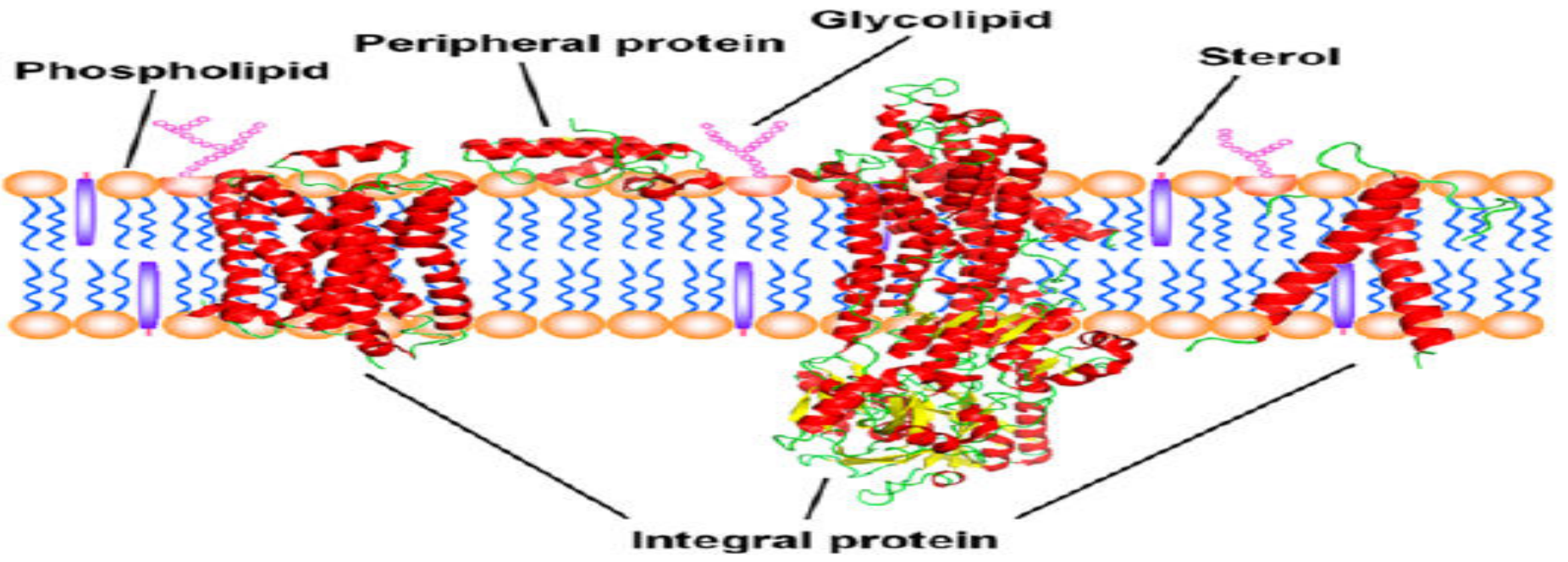
Calorific, Membrane Structural, Signaling

S.No	Lipid Form	Biochemical Role
1	**Triacylglycerol**	**Predominant Lipid form of Diet** **Calorific Value** **Reservoir of Energy** for long term **Insulator and Mechanical Shock absorber**
2	**Fatty acids**	**FAs Stored as TAG** **Oxidize to generate ATP** **Components of Phospholipids & Glycolipids**
3	**Phospholipids**	**Components of Biomembranes** Lung Surfactant Clotting Mechanism

S.No	Lipid Form	Biochemical Role
4	**Glycolipids**	Components of Biomembranes Neurons, Myelin Sheaths
5	**Cholesterol**	Components of Biomembranes Nerve Impulse conduction Precursors of Steroids
6	**Cholesterol Ester**	Transport ,Storage and excretory form of Cholesterol
7	**Lipoproteins**	Vehicles for transportation of various forms of Lipids through aqueous phase of blood and lymph

- Lipids of **dietary and Calorific value**
  - **Triacylglycerol**
  - **Fatty acids**

Structural Role Of Lipids
Lipids Associated To Biomembranes



1. **Phospholipid bilayer**
2. **Glycosphingolipids**
3. **Cholesterol**

Lipids
Superior Than
Carbohydrates

Lipids are Superior Than Carbohydrates

- **Lipids have Higher Calorific value** (9Kcal/gm)
- **High storage content** , can be stored in unlimited amount.
- They **provide energy source for longer duration**.

(During Marathon Races)

- Thus Lipids serve as **major reservoir of energy** for **long term use** in human beings.

Classification Of Lipids

With Examples of Biomedically Important Lipids

Lipids are Classified Into Three Main Classes

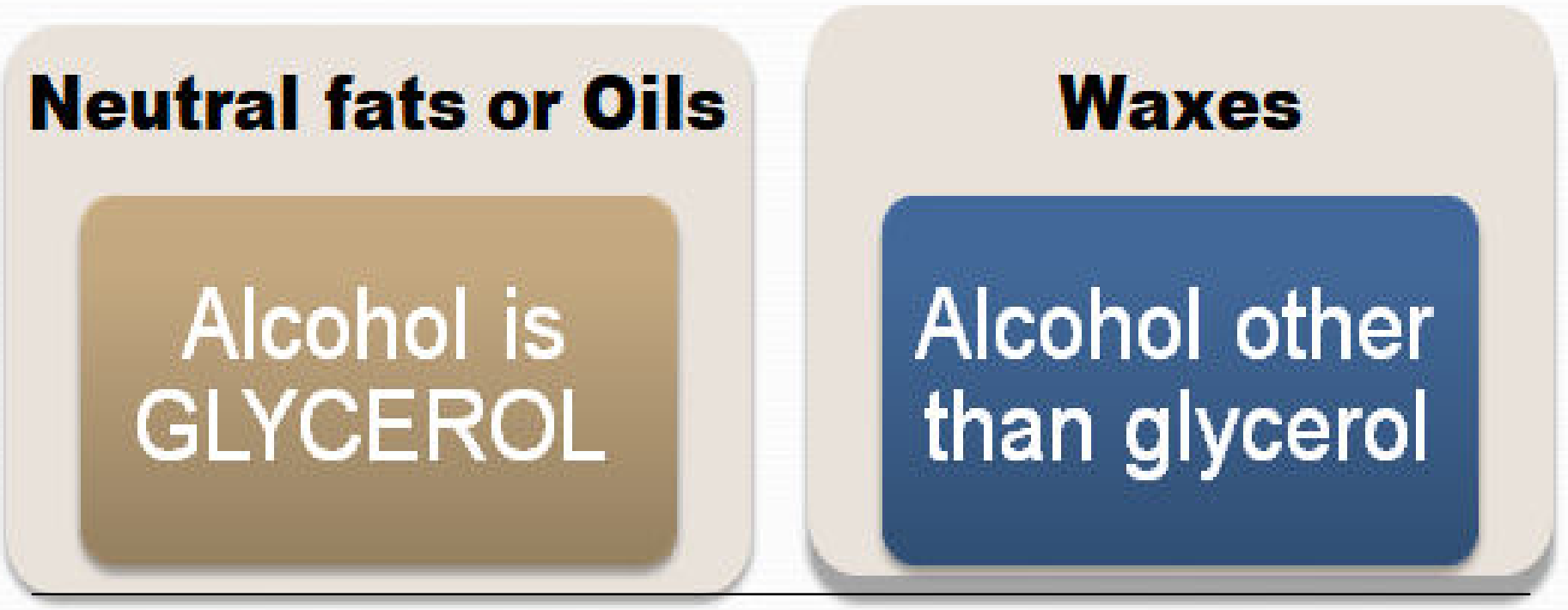
- **Three Main Classes of Lipids are:**

i. **Simple Lipids**
ii. **Compound /Complex Lipids**
iii. **Derived Lipids**

1. Simple Lipids/Neutral Lipids

- Chemically Simple Lipids are:
- **Esters of Fatty acids with an Alcohol**

Sub Classes Of Simple Lipids
Based On Alcohol



- **Depending upon the type of Alcohol :**

- **Simple Lipids are of two sub types:**
  - **Fats/Oils - Triacylglycerol**

  (Alcohol is Glycerol)
  - **Waxes**

  (Alcohol- Cholesterol/ Retinol)

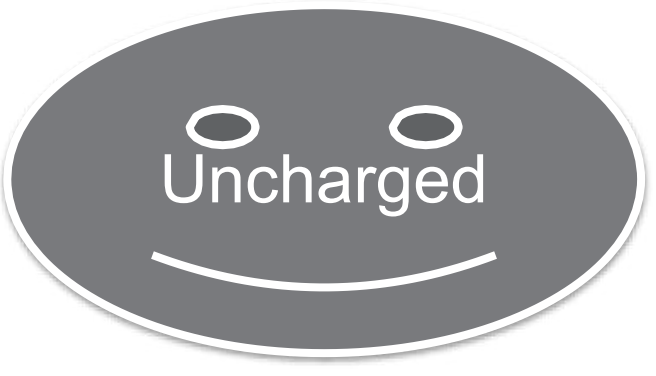
Chemical name of Fat /Oil

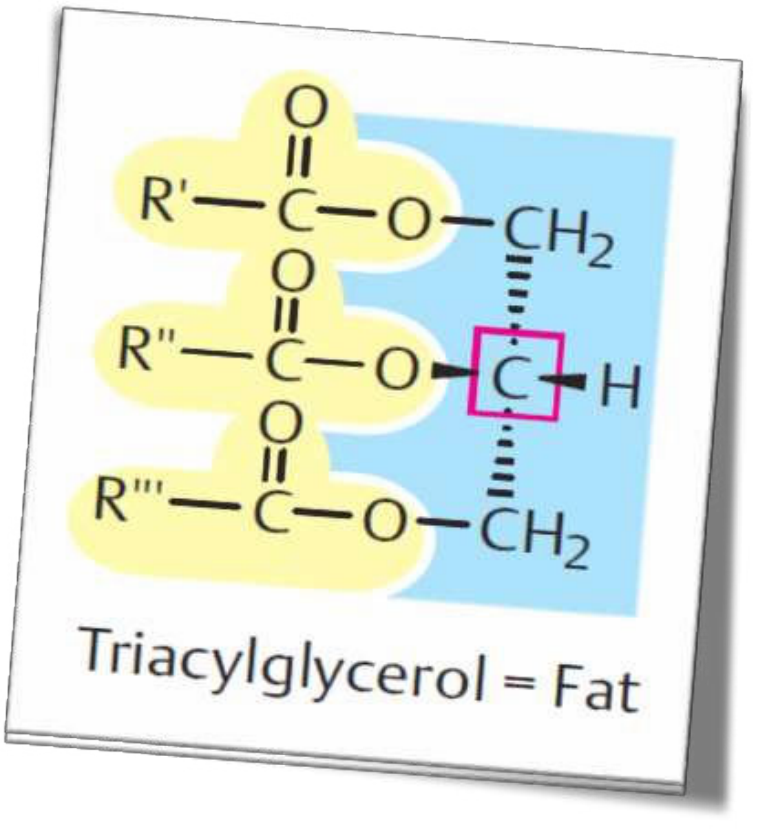
IS

Triacylglycerol (TAG)

TAG- Simple Lipid /Neutral Lipid/ FATS or OILS

Esters of FA with the alcohol GLYCEROL



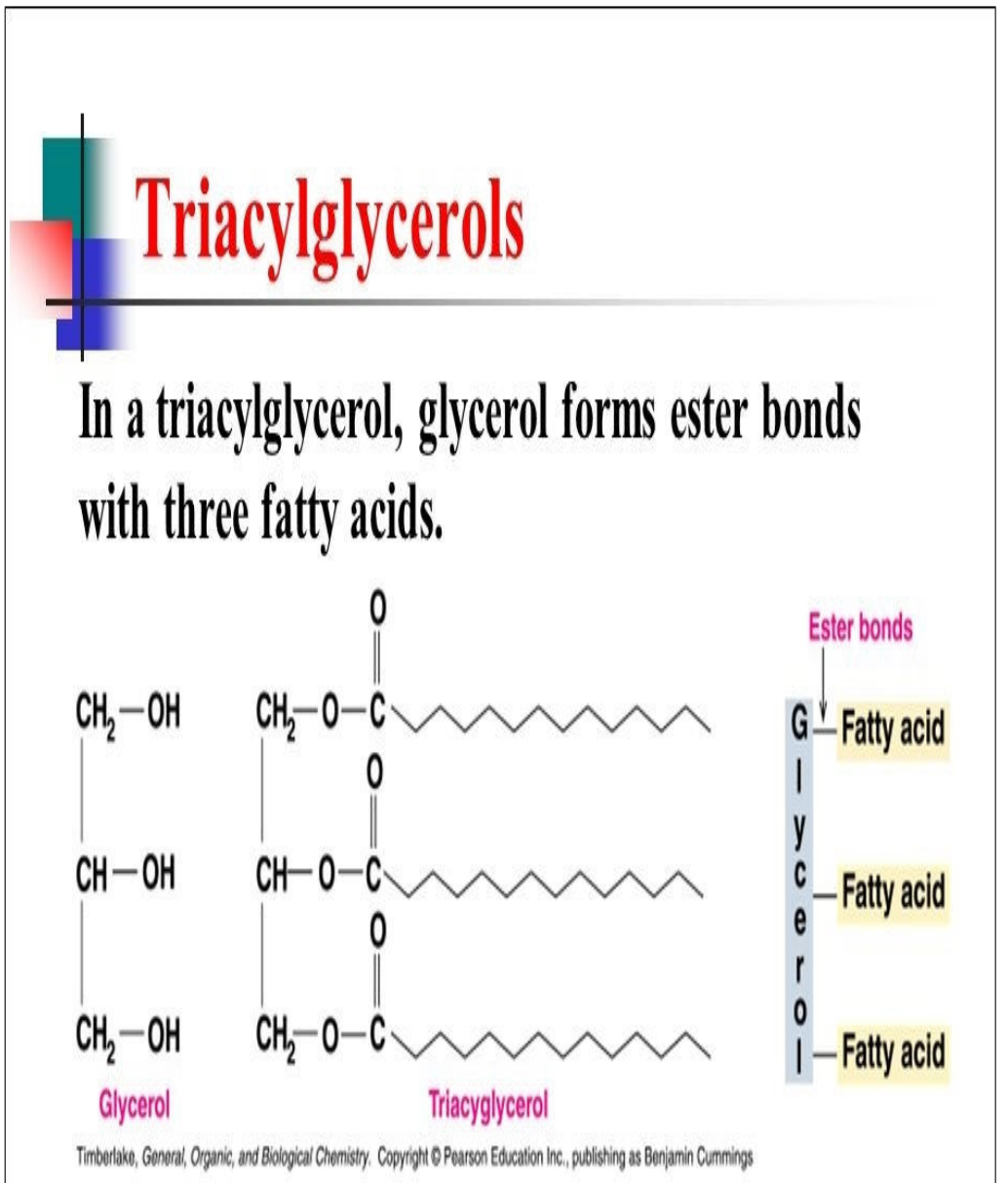


- **Fats/Oils/TAG**

- **Esters of Fatty acids** with **Glycerol**

  (Trihydric Alcohol)

- **Three Fatty acids linked to a Glycerol by ester bonds.**



- **Waxes :**

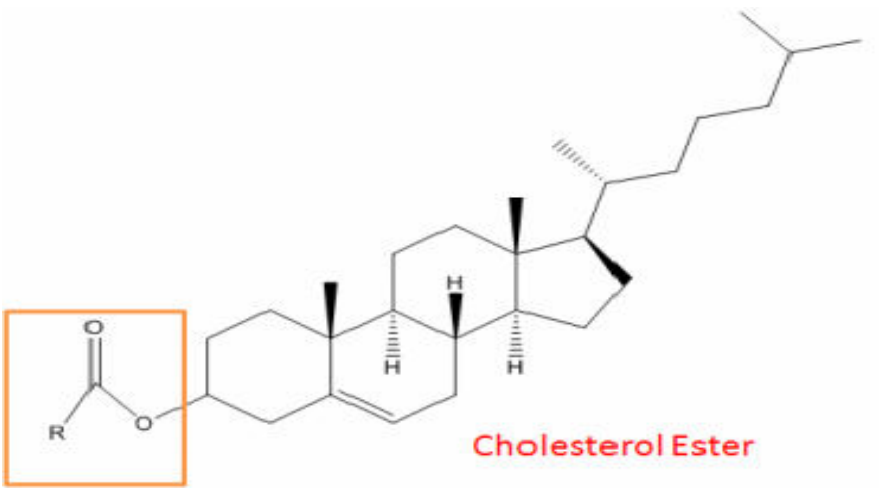
- Waxes are Simple Lipids

- Waxes are **chemically Esters of Fatty acids** with **higher complex, monohydric ,Alcohols**, other than Glycerol.

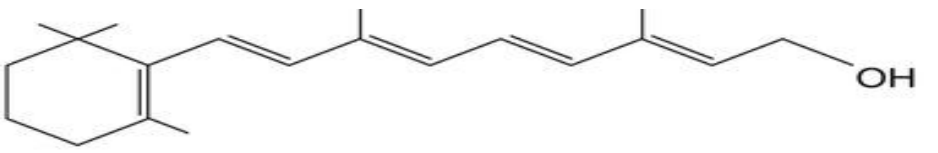
Examples Of Human Body Waxes :

- **Cholesterol Ester**

(Cholesteryl Palmitate)



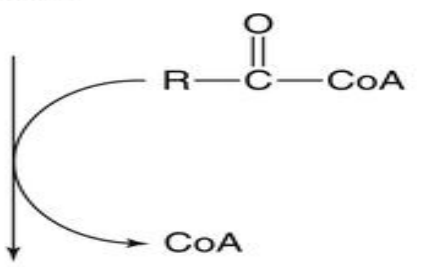
Cholesterol Ester

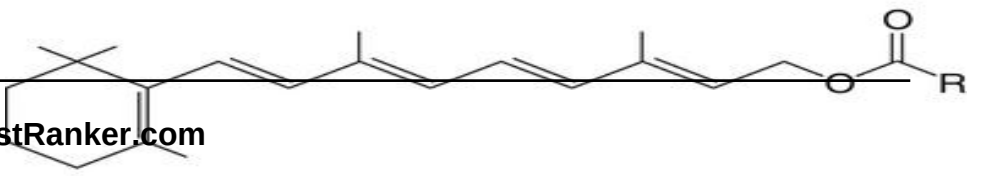


Retinol

- **Retinol Ester**

(Retinyl Palmitate)





Retinyl ester

Compound/Complex Lipids

- Compound Lipids is a class of Lipids

- Chemically composed of **Fatty acids** **Alcohol** and an **Additional group.**

Depending upon the Type of Additional group

Types of Compound Lipids are:

Three Main Compound Lipids

1. **Phospholipids**
2. **Glycolipids**
3. **Lipoproteins**

S. No	Type of Compound Lipids	Additional group Present
1	Phospholipids	Phosphoric acid and Nitrogen Base
2	Glycolipids	Carbohydrate moieties
3	Lipoproteins	Apoproteins

Types Of Phospholipids Based On Alcohol

»Glycerophospholipds

(Contains –Glycerol)

»Sphingophospholipids

(Contains –Sphingol)

Types Of Glycolipids/Glycosphingolipids

»Cerebrosides

»Gangliosides

»Globosides

»Sulfatides

- All Has Alcohol Sphingol/Sphingosine

Lipoproteins

Aggregation of Lipids and Apoproteins

- **Chylomicrons**
- **Very Low Density Lipoprotein (VLDL)**
- **Low Density Lipoprotein (LDL)**
- **High Density Lipoprotein (HDL)**

Derived Lipids

- Derived Lipids are **Hydrolytic products** of **Simple or Compound** Lipids **OR their derivatives**.

OR

- Hydrolytic products released from **Simple and Compound Lipids ,who** has **potency to form them.**

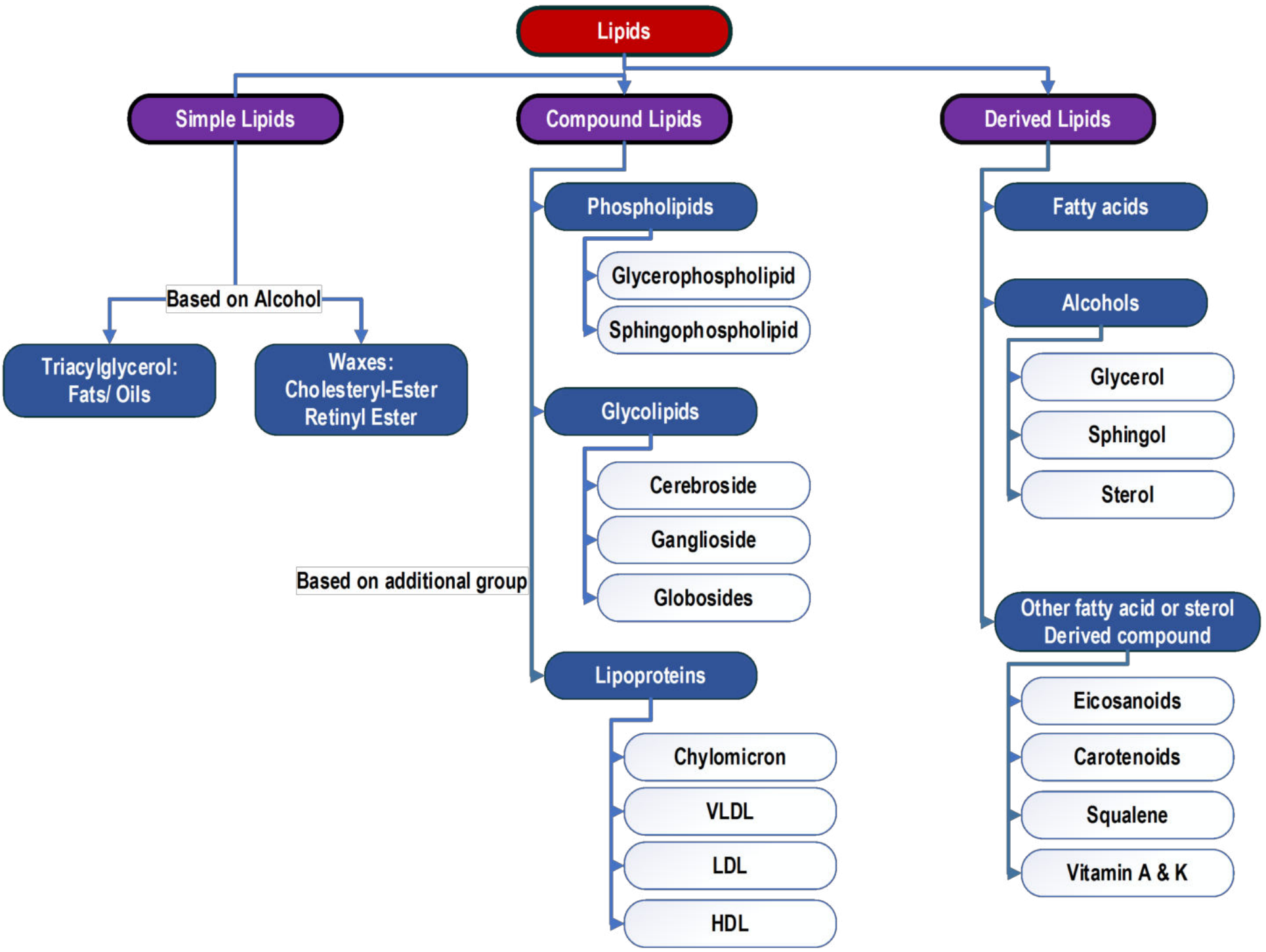
Examples of Derived Lipids:

Hydrolytic Products of Simple and Compound Lipids

- **Fatty Acids**
- **Alcohols:**
  - **Glycerol**
  - **Sphingol**
  - **Cholesterol**

Other Examples Of Derived Lipids

- **Lipid like compounds**
- **Derived from Fatty acids and Sterol/Cholesterol:**
  - **Eicosanoids** (Prostaglandins , Leukotrienes ,Thromboxanes)
  - **Steroidal Hormones:** Derived from Cholesterol
  - **Fat Soluble Vitamins** (A,D,E and K)
  - **Ketone Bodies** (Partial Oxidized Products of Fatty acids)



Bloor's Classification Of Lipids

- **Four Classes of Lipids By Bloor**

A. Simple Lipids

B. Complex/Compound Lipids

C. Derived Lipids

D. Miscellaneous Lipids

D.Miscellaneous Lipids

Substances with Lipid characters

- **Carotenoids: β-Carotenoid**
- **Squalene :**
- **Vitamin E and K**
- **Eicosanoids**

Types of Lipids Depending Upon Polarity

- **Neutral Lipids: (Non Polar Lipids)**

  (Contain No polar Groups/Charged groups)

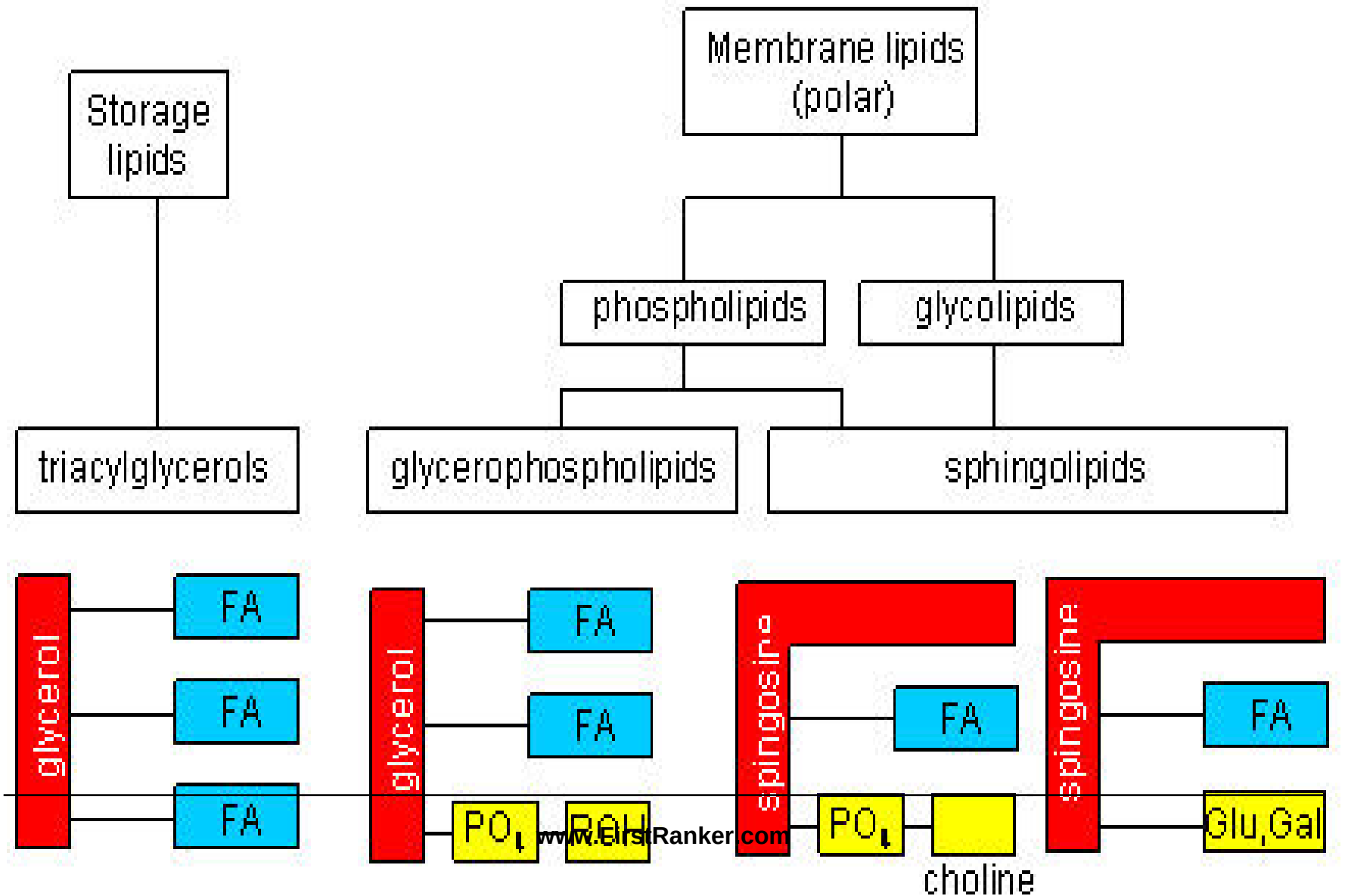
  - Triacylglycerol
  - Cholesterol Ester (Cholesterol Palmitate)

- **Amphipathic/Amphiphillic Lipids**:

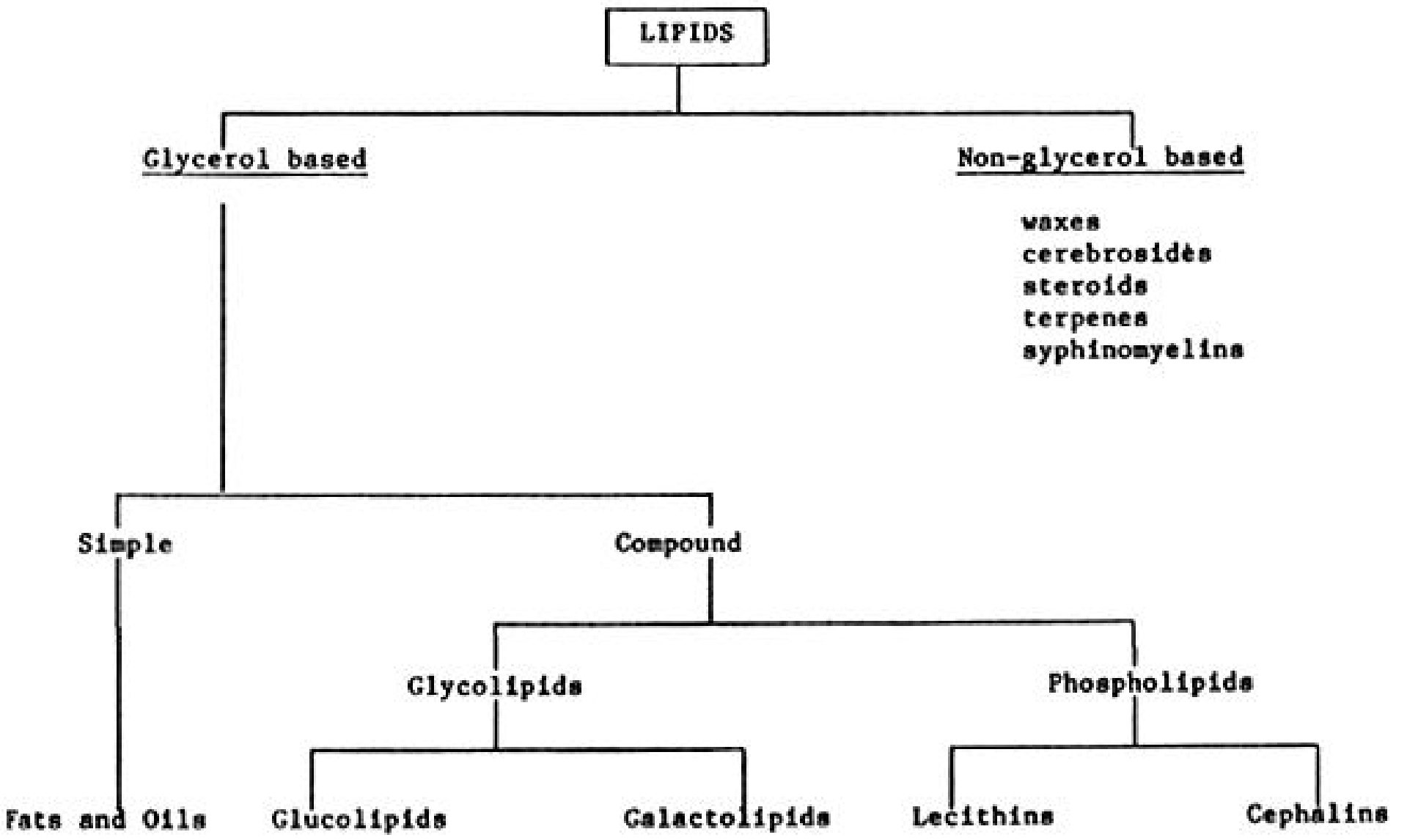
  (Contain both Polar and Non polar Groups)

  - Phospholipids
  - Cholesterol

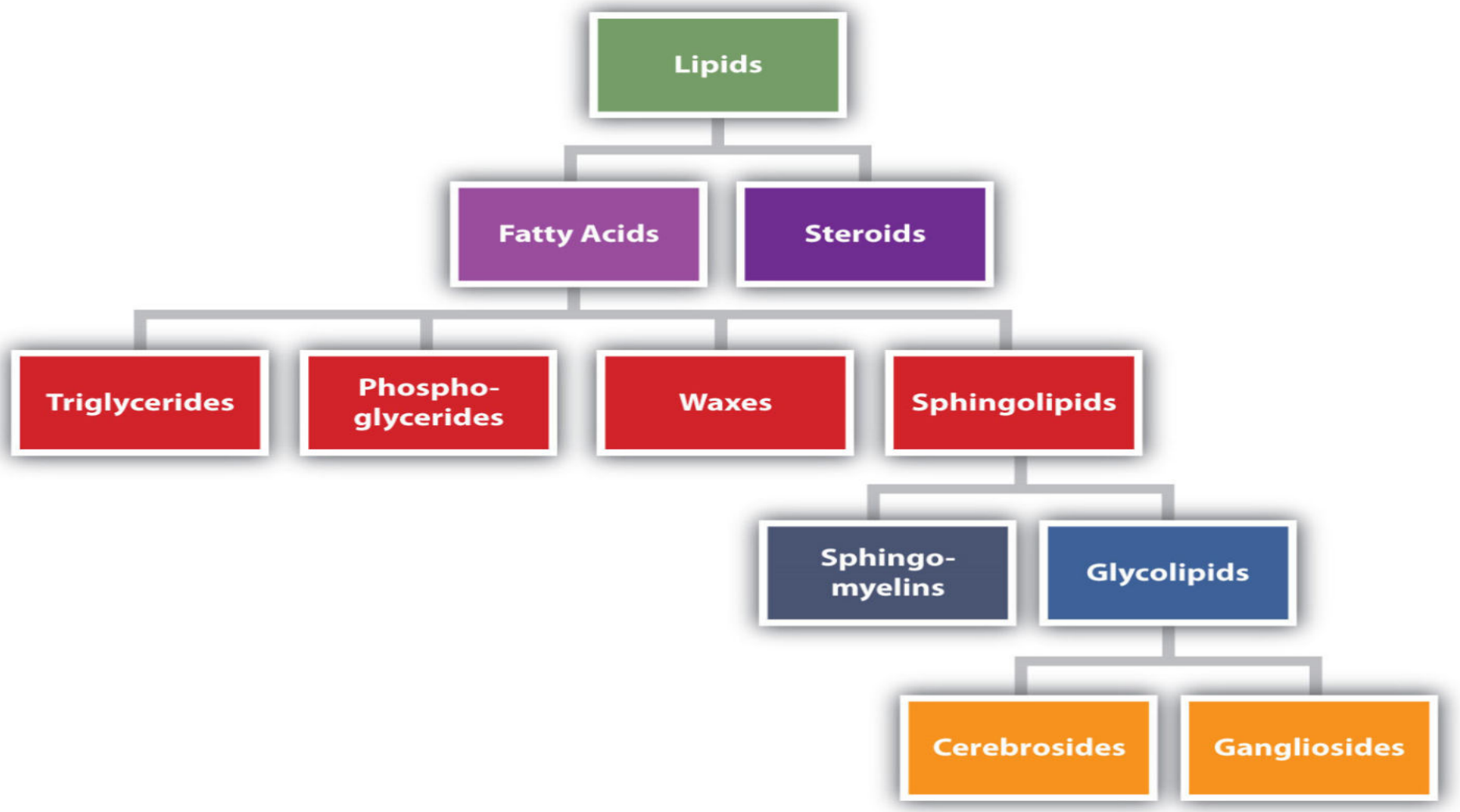
Types of Lipids Depending Upon Functions



Types Of Lipids Based On Alcohol



Types Of Lipids Based Upon the Main Components

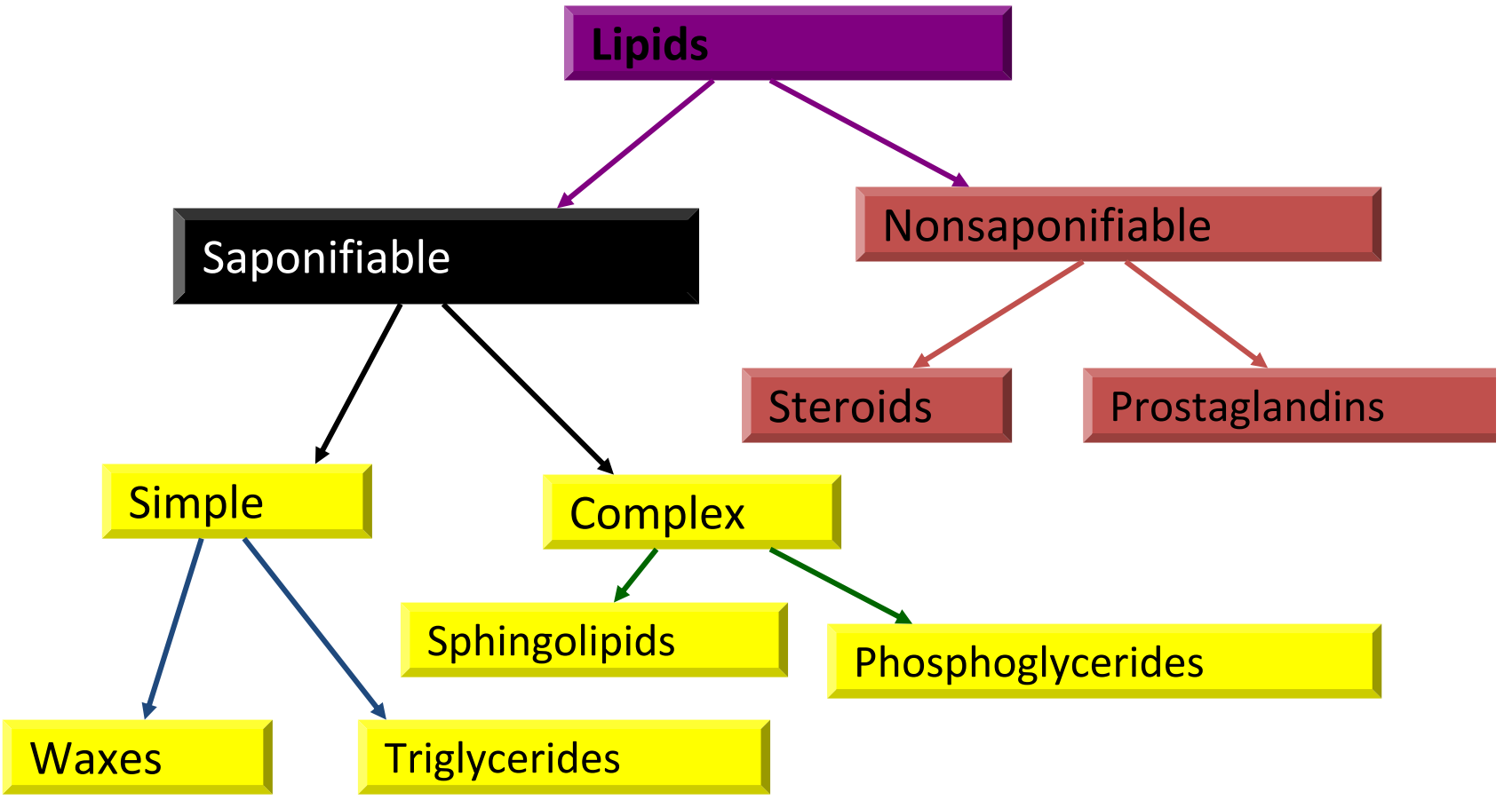


Types of Lipids Depending On Saponification Property

Saponifiable Lipids Undergo Alkaline Hydrolysis

- A **saponifiable lipid** is one who undergo Saponification reaction.
- **Saponification** is especially an **Alkaline hydrolysis of Ester bond of Fat or an Oil to form Soap.**
- In saponification an **Ester functional group** get **hydrolyzed** in presence of **Alkaline conditions (NaOH)** producing a **free alcohol and fatty acid salt (Soap)**

Lipid Based On Saponification



Study Of Various Classes Of Lipids