Name Of Eicosanoids

- **Eicosanoids** is a Generic term for the 20 Carbon related compounds like:

I. Prostaglandins (PGs)

II. Prostacyclins (PGI2)

III. Thromboxanes (TX)

IV. Leukotrienes (LT)

V. Lipoxins (LX)

VI. Resolvins

VII. Eoxins

Biosynthesis Of Eicosanoids

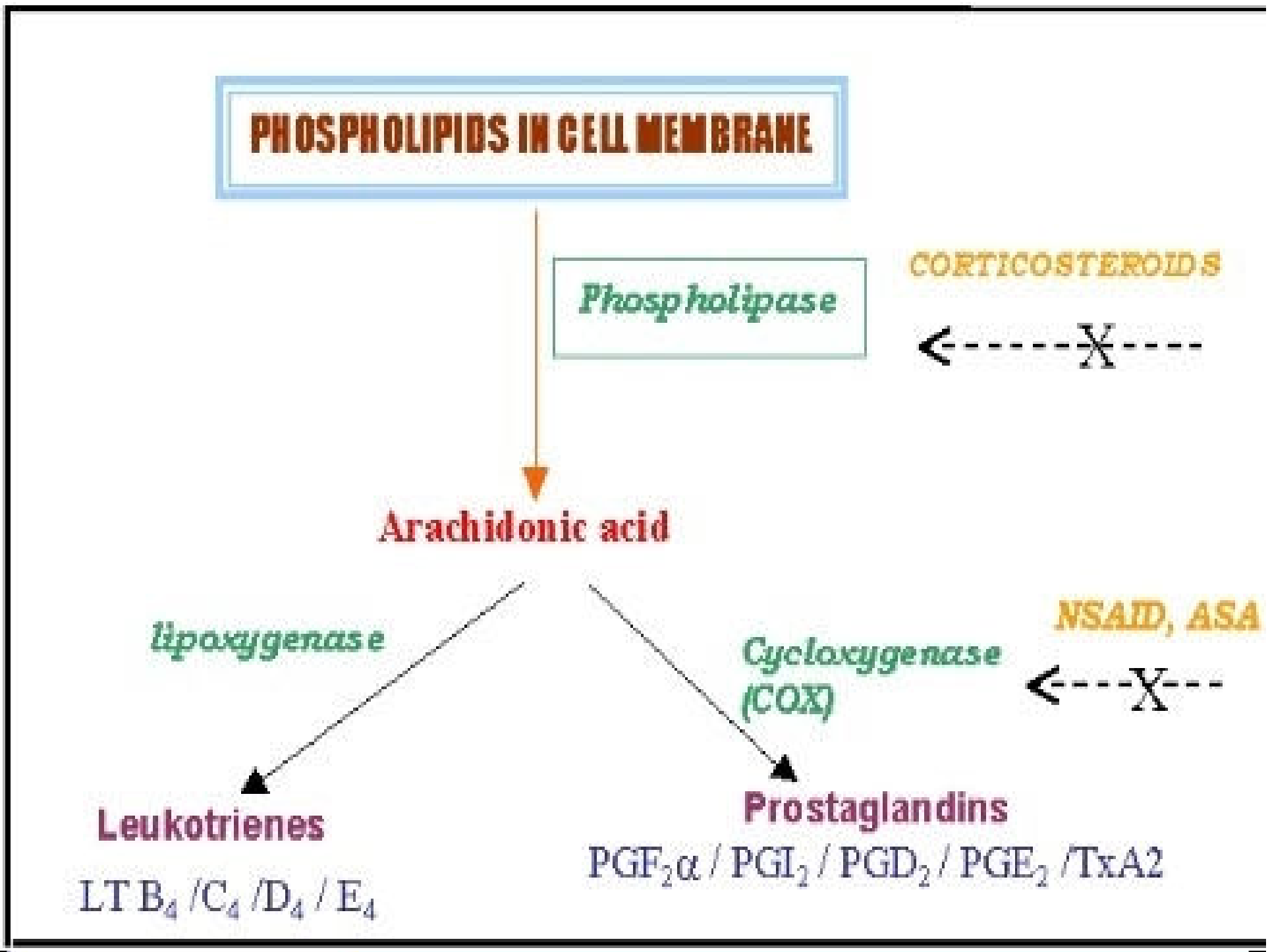
- **Eicosanoids** are **derivatives** of **Nutritional Essential Fatty acid/PUFAs**.

- **Eicosanoids** are biosynthesized in the body from **PUFAs**:

1. **Mostly from Arachidonic acid/Eicosatetraenoic acid (PUFA)/Omega 6 Fatty acid**

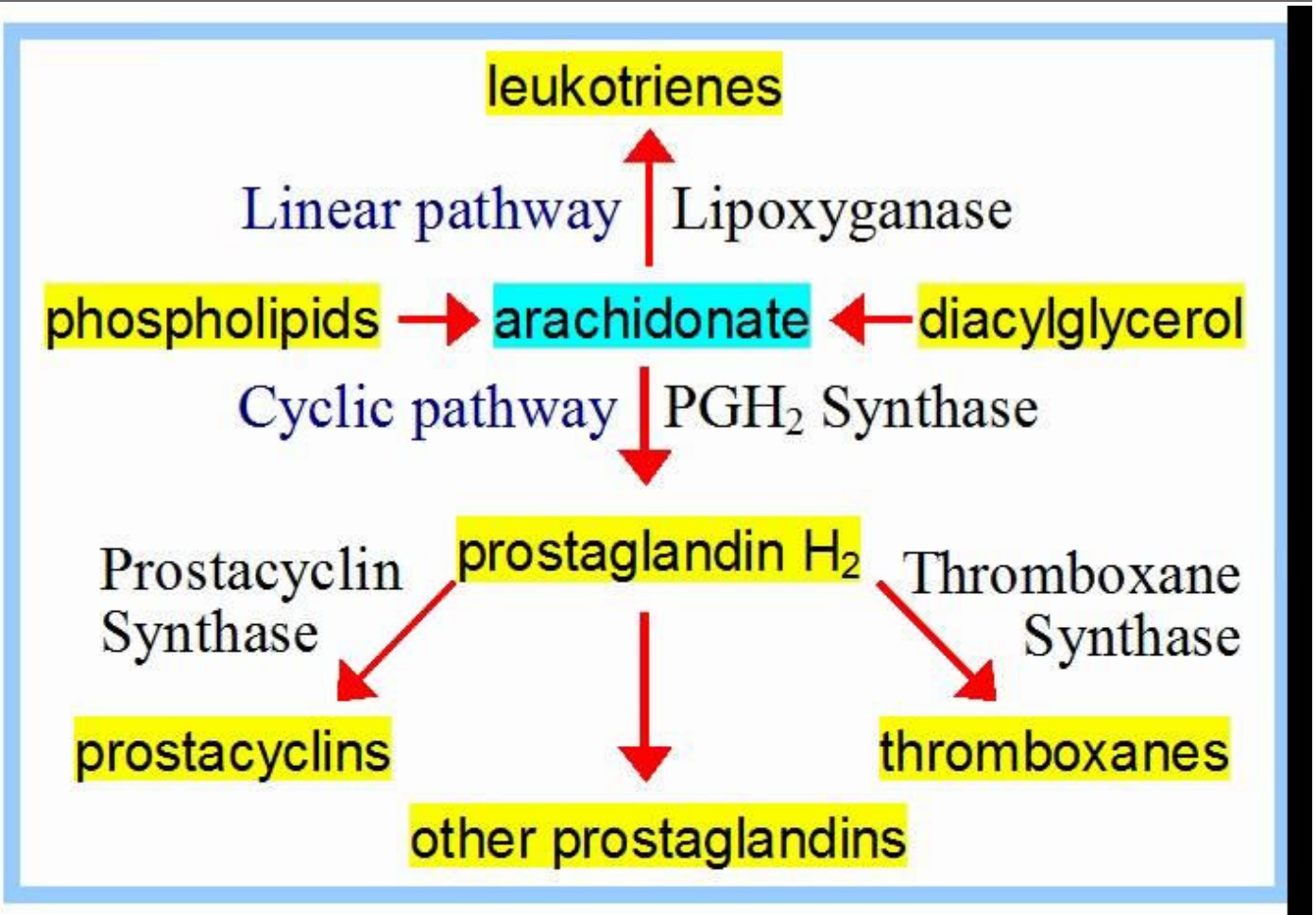
2. **Minorly from Timnodonic acid/Eicosapentaenoic /Omega 3 Fatty acid**

- **During Eicosanoid Biosynthesis Mostly**
- **Arachidonic acid** is released by **Phospholipids Viz: Lecithin/PIP3**
- **By Phospholipase A2 activity**



Two major pathways of eicosanoid metabolism.

Cyclic pathway:



Prostaglandin H_2 Synthase catalyzes the **committed step** in the "cyclic pathway" that leads to production of prostaglandins, prostacyclins, & thromboxanes.

~~Different cell types convert PGH_2 to different compounds.~~

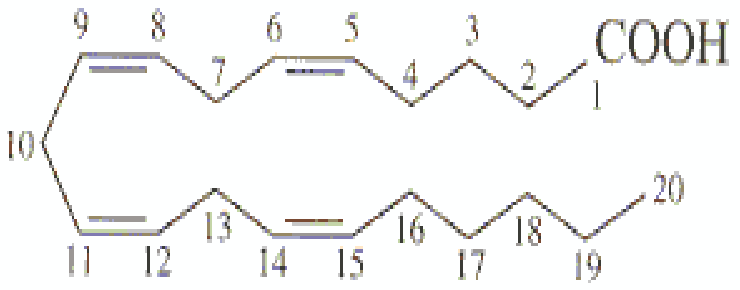
- **Eicosanoids** has **very short half life**
- **From seconds to few minutes**

Classification Of Eicosanoids

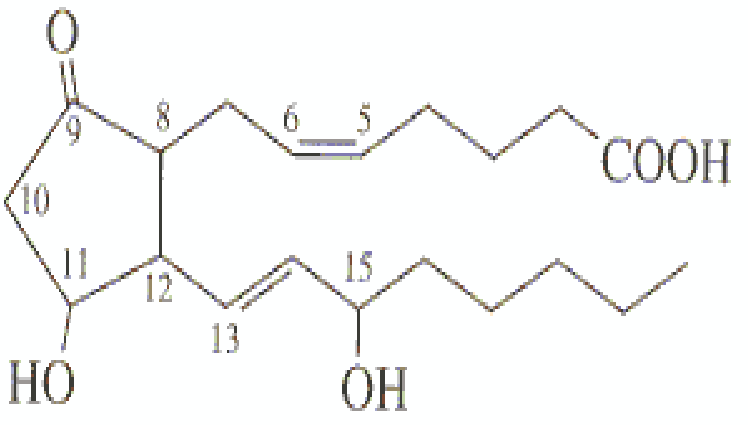
- **Prostanoids :** Obtained by **Cycloxygenase System** :
  - **Prostaglandin**
  - **Prostacyclins**
  - **Thromboxanes**

- **Leukotrienes** and **Lipoxins** are obtained by **Lipoxygenase System**

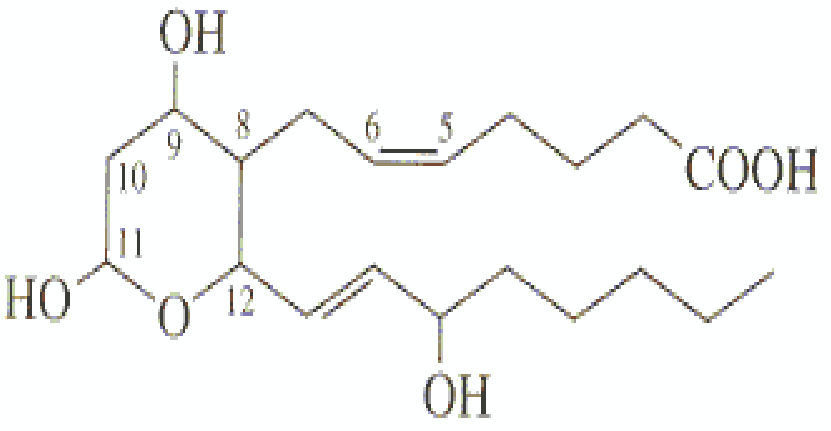
Prostaglandins are Derivative of Arachidonic acid



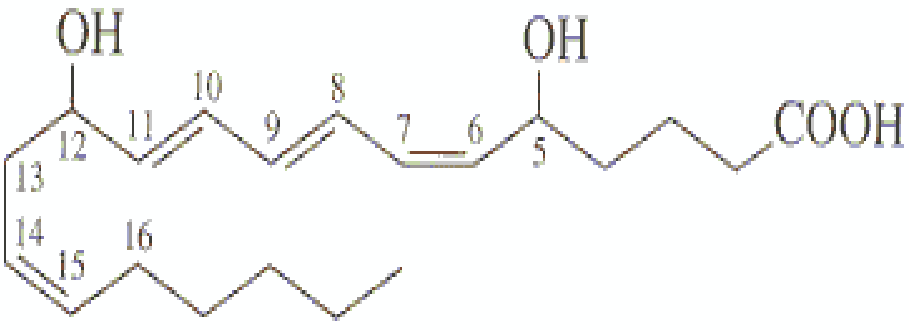
(a) Arachidonic acid



(b) Prostaglandin E_2



(c) Thromboxane B_2



(d) Leukotriene B_4

1. Prostaglandins (PGs)

- **Prostaglandins** are type of **Eicosanoids**.
- **PGs** also termed as **Prostanoids**
- Since they are obtained from parent compound **Prostanoic acid**

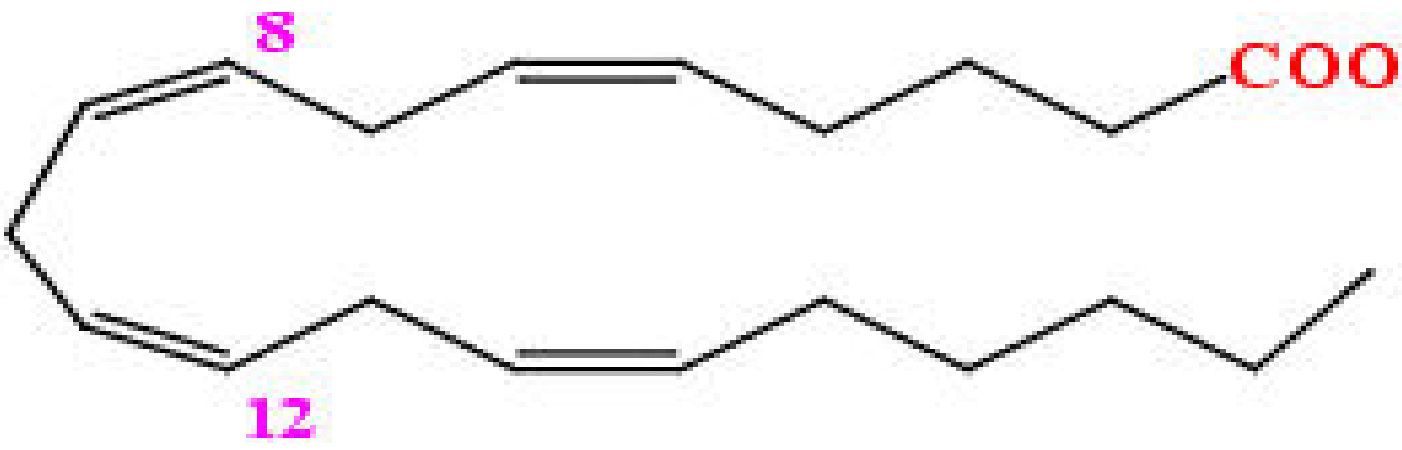
Biosynthesis Of Prostaglandins

- **Per day 1 mg** of **Prostaglandins are biosynthesized** in human body.

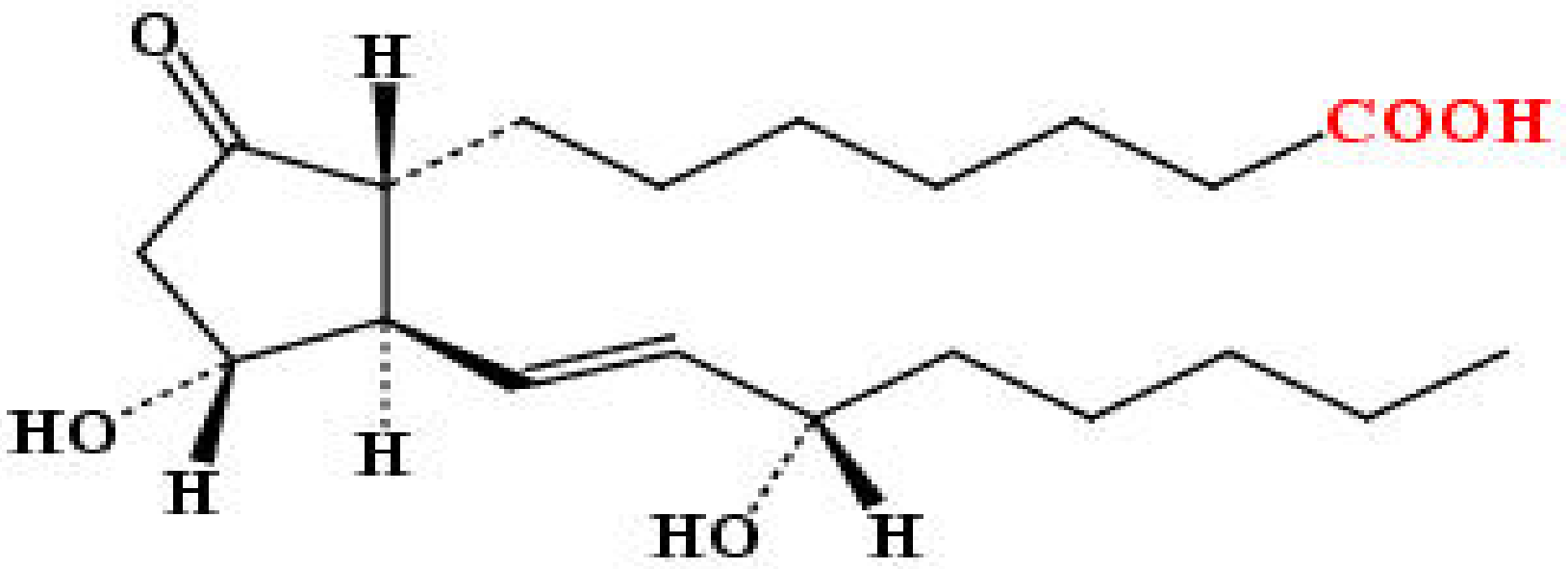
- Prostaglandins are derived from **Arachidonic acid** by **Cycloxygenase system**.

- **Phospholipid Lecithin** releases **Arachidonic acid**
- **Arachidonic acid** is used for **Prostanoic acid synthesis.**
- **Prostanoic acid** then **biosynthesizes Prostaglandin** in human body.

Structure and Types Of PGs



arachidonic acid

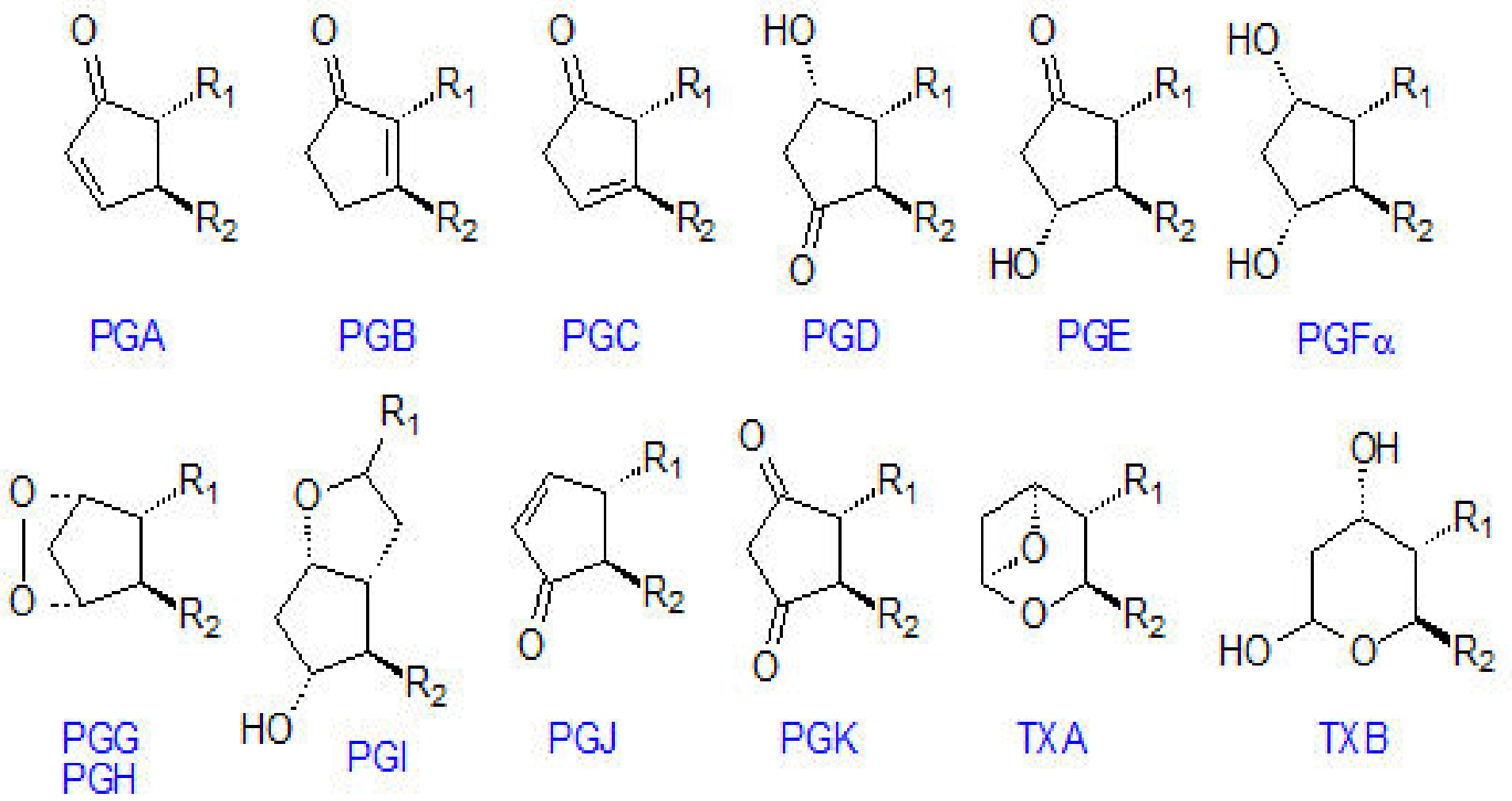


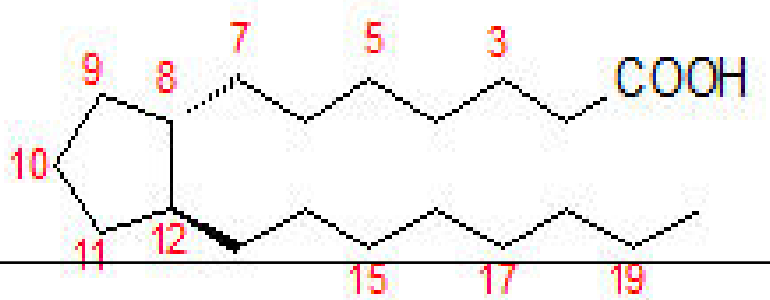
a prostaglandin

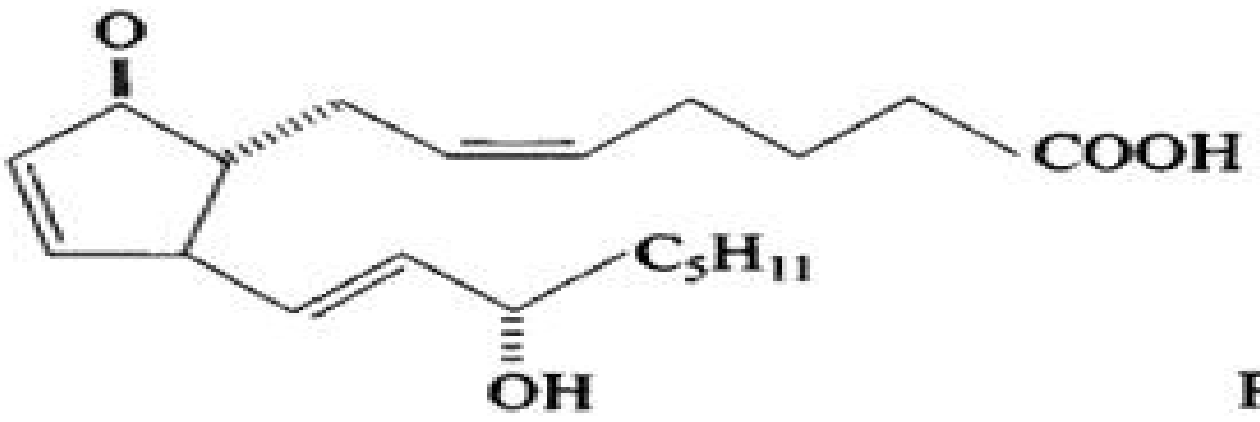
- Prostaglandin structure is complex and possess:
  - **Cyclopentane ring**
  - **Double bond**
  - **Carboxylic and Hydroxyl groups**

- **Prostaglandins** contains a
- **Cyclopentane ring** with **Hydroxyl groups** at **C11 and C15**

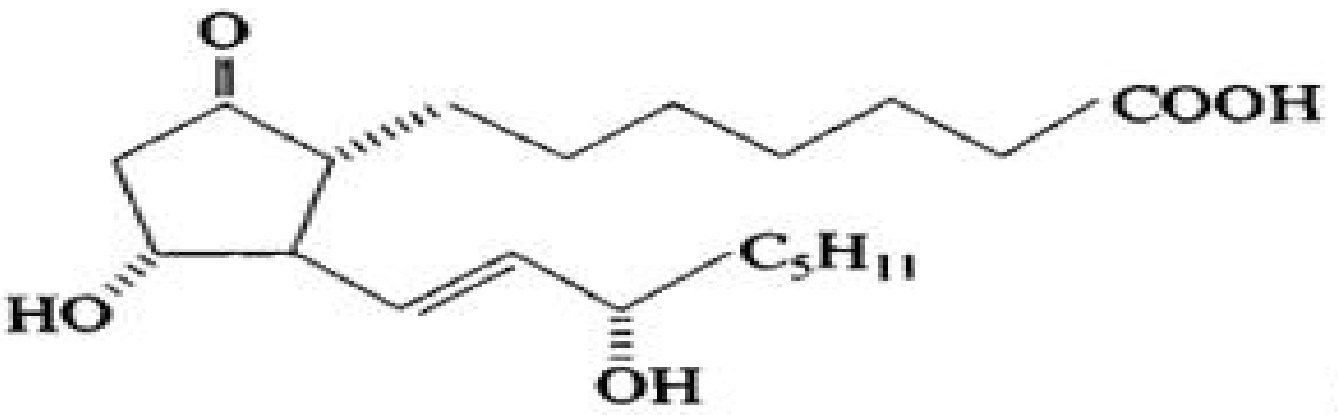
- **Prostaglandins (PG) are of following Types:**
  - **PG A**
  - **PG B**
  - **PG C**
  - **PG D**
  - **PG E**
  - **PG F**
  - **PG G**
  - **PG H**



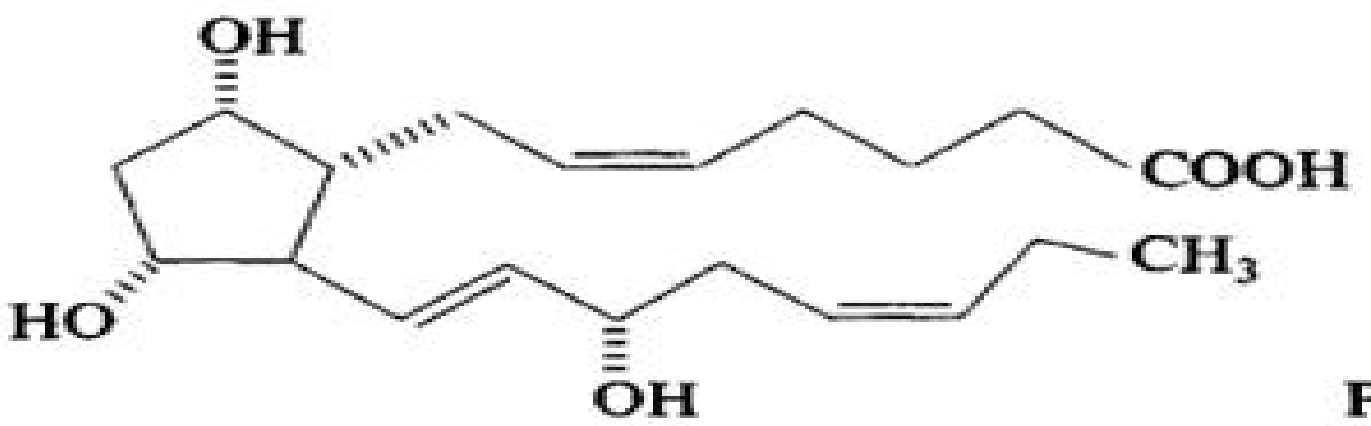




Prostaglandin A_2



Prostaglandin E_1



Prostaglandin $F_{3\alpha}$

Occurrence/Distribution Of PGs

Occurrence Of PGs

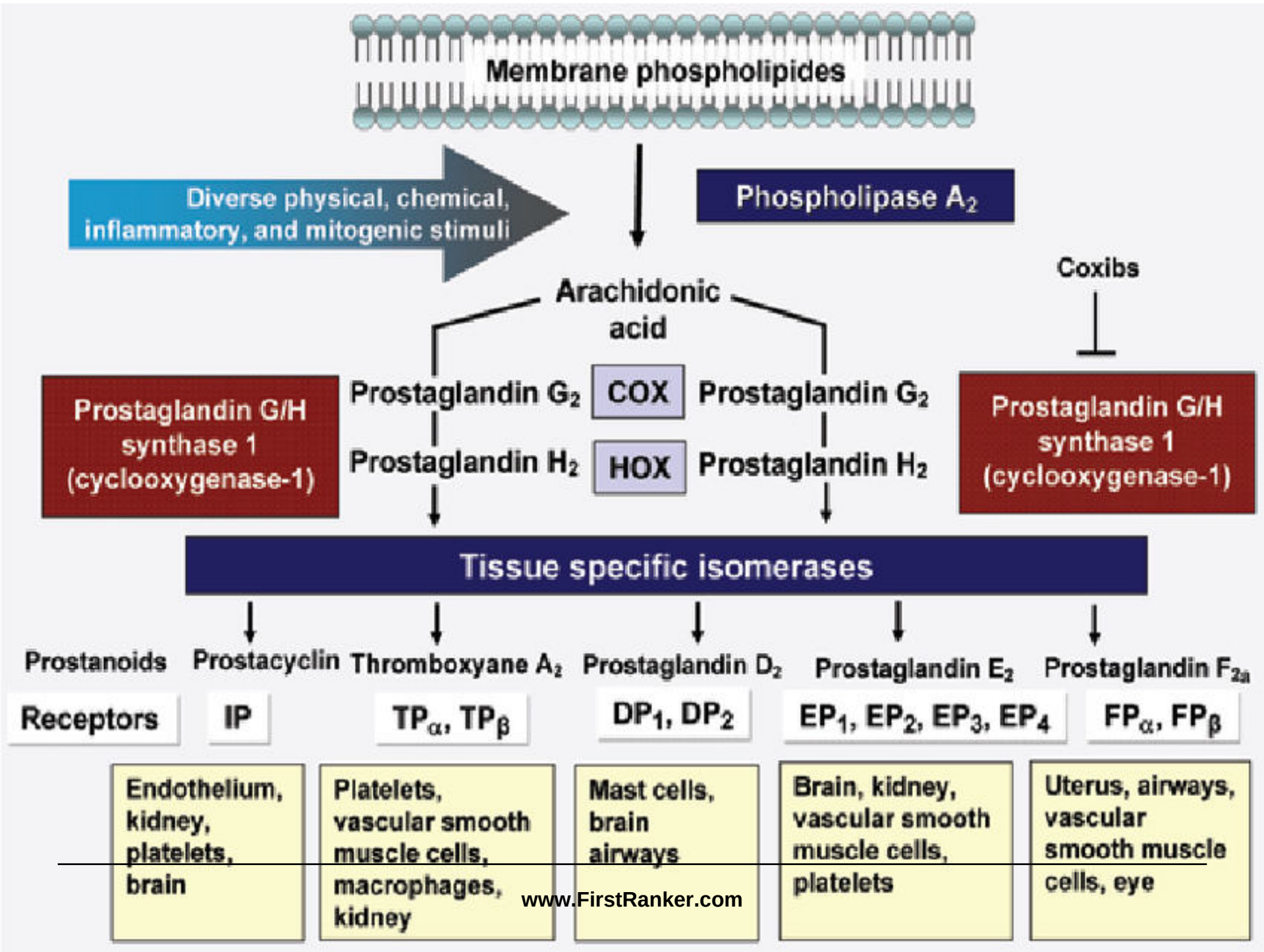
- Prostaglandin was **first seen** in **Prostatic secretion** and **Semen**.
- **Later** it was **found** that **Prostaglandins** are **ubiquitous**
- Present all over **in human body tissues.**

Functions OF Prostaglandins

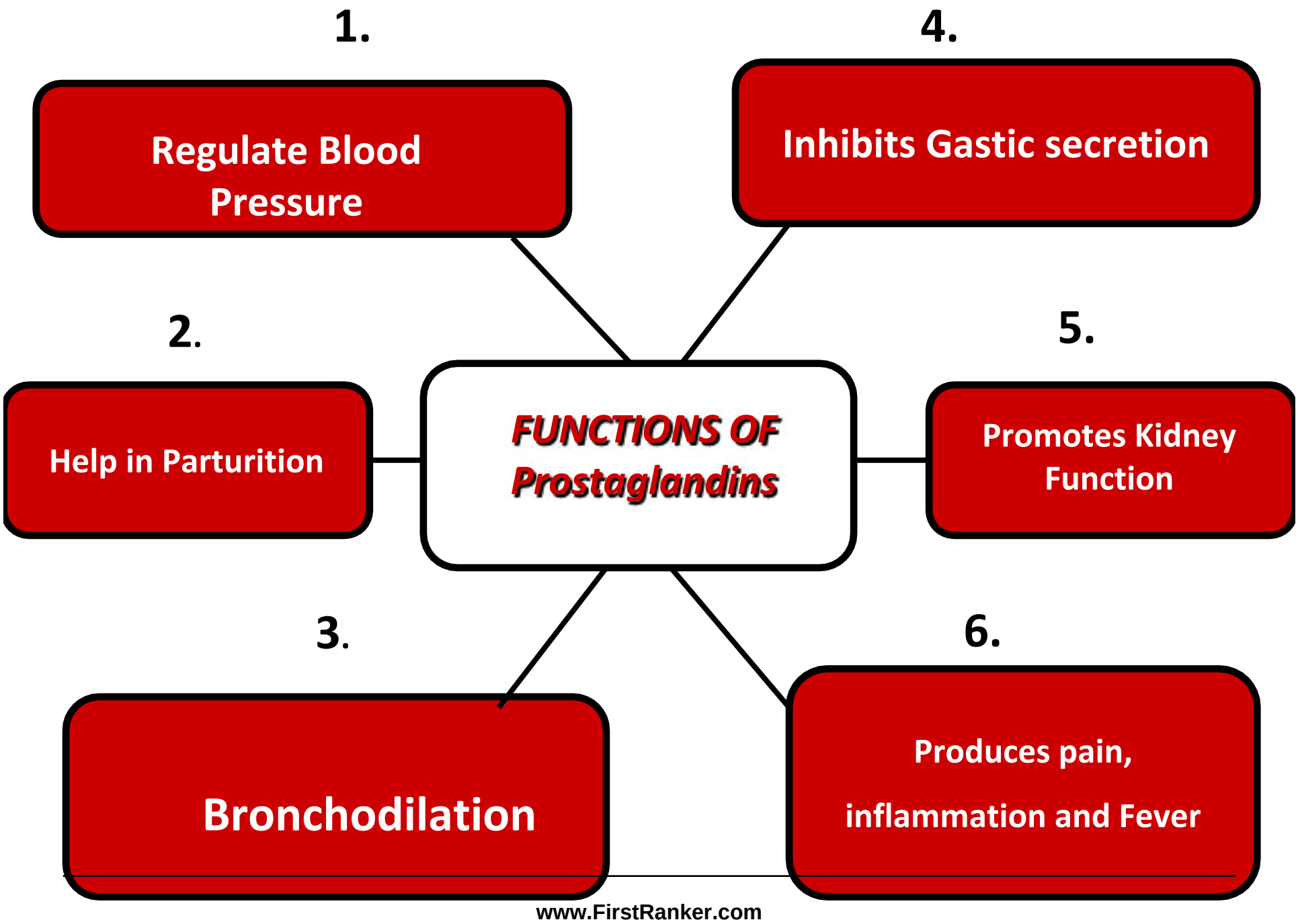
- **Prostaglandins serve as Cell Signaling Agents/Local Hormones with.**
  - **Paracrine in action (act on sites closely where they are produced/ neighboring cells).**
  - **Autocrine in action** that the **sites where they are produced.**

- **PGs exert their function through G-Protein linked membrane receptors.**

Prostaglandins have diverse functions on many tissues



- **Action of one PG** is **different in different tissues.**
- Sometimes PGs bring out **opposing action in same tissue.**



1.Role Of PGs In Blood Vessels

PGs Regulate Blood Pressure

- **PG A and PG E** are **Vasodilators.**
- **PGs lowers the blood pressure by:**
  - **Increasing blood flow** and
  - **Decreasing vascular resistance** in blood vessels.

- PGs are used **Therapeutically in treating Hypertension.**

Prostaglandin occur at Platelets

Inhibits Platelet Aggregation

and

Thrombus formation

2. PGs Has Role in Uterus At The Time Of Parturition

- PG naturally **increases uterine contraction of smooth muscles** which **induces** the **delivery of baby**.

- PGs can be **therapeutically used** as **Abortificients** during **Medical Termination of Pregnancies** (MTPs)
- PGs also arrests **postpartum hemorrhage**.

Prostanoids Therapeutic Uses

- **Uterine Stimulation**
- **Carboprost (15-methyl $PGF_{2\alpha}$)**
- Used by IM route for induction of abortion between 12^{th} -20^{th} gestational weeks
- Used at a dose of 250 µg every 1-3 hrs
- **Dinoprost ($PGF_{2\alpha}$)**
- Injection form for intra-amniotic administration
- Used to induce labour or abortion

3. Role Of Prostaglandins In Lungs

- PGs in Lungs serve as **Bronchodilators** and **Bronchoconstrictor** of Lungs.

  –**PG E-Bronchodilator**

  –**PG F- Bronchoconstrictor**

- **PG E is used in treatment of Bronchial Asthma.**

4. Role Of Prostaglandin In GIT

- Prostaglandin in stomach **increases its motility** and **inhibits gastric secretion of HCL**.

- PG is used in **treatment of gastric ulcers.**

5. Role Of Prostaglandins in Kidneys

- PGs in Kidneys **increases GFR** and **promotes urine formation** and **urine out put.**

- Thus helps in **removing waste out of the body**.

PGs Regulate Sleep and Wake Process

- **Use of PG D2 promotes Sleep**

6.Effect Of PGs on Metabolism

- PGs **Decreases Lipolysis** (breakdown of TAG).
- PGs **increases Glycogenesis**.
- PGs **promotes Steroidogenesis** (Biosynthesis of Steroid hormones)
- PGs **promotes mobilization of ionic Calcium** from bones.

Production of PGs Promote Fever , Pain , Nausea Vomiting and Inflammation

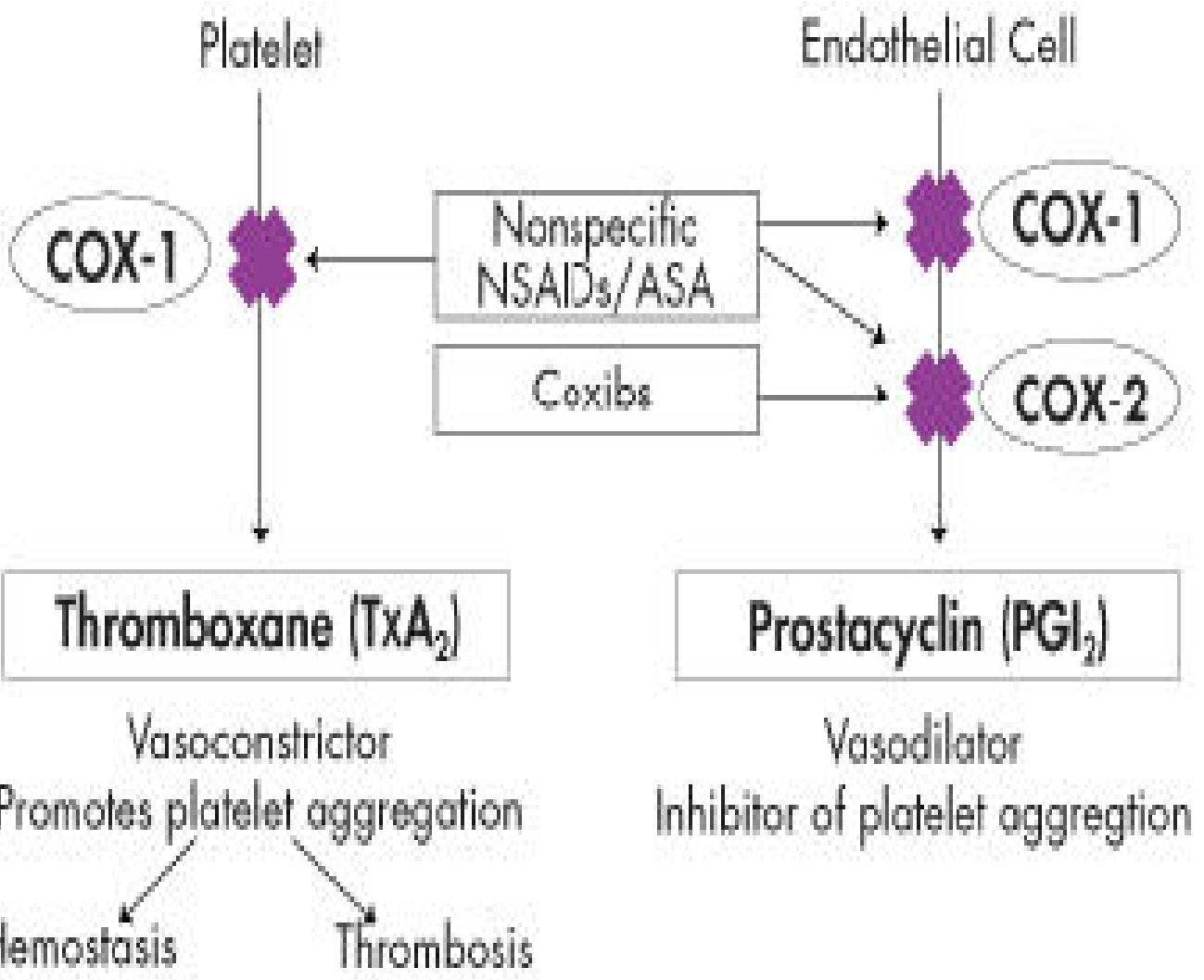
Role Of PGs In Immunity And Inflammation

- Prostaglandins are produced in more amounts at the time of :
  - **Fever**
  - **Pain**
  - **Nausea and Vomiting**
  - **Inflammation**
- ~~**Provide non specific immunity to body**~~

- PGs are more produced ir inflammatory disorders like **Rheumatoid Arthritis**

- Drugs like **NSAIDs Aspirin** used in **treating inflammatory disorders.**
- Inhibits the Enzyme of **Cycloxygenase system**
- **Which in turn inhibits** the **biosynthesis of Prostaglandins**.

FIGURE 7. Effects of NSAIDs on platelets and endothelium.



Drug	Preparation	Use
Dinoprostone	Vaginal tab/gel	Induction labour Mid term abortion
Dinoprost	Intra amniotic inj	Mid term abortion
Carboprost	IM, Intra amniotic inj	Mid term abortion Control of PPH
Gemeprost	Vaginal pessary	Cervical priming in early pregnancy
Alprostadil	IV infusion, IV inj Intra cavernosal inj	Maintenance of a patent ductus arteriosus in neonates Erectile dysfunction
Misoprostol Enoprostil	Oral	Abortion & Peptic ulcer Peptic ulcer
Epoprostenol	IV infusion	Pulmonary hypertension
Latanoprostol	Topical	Glaucoma
iloprost	IM	Dec. infact size, when given IM after MI

TABLE 7–1 Prostaglandins

Prostaglandin	Locations	Effects
D_2	Airways, brain, mast cells	• Bronchoconstriction
E_2	Brain, kidneys, vascular smooth muscle cells, platelets	• Bronchodilation • Gastroprotection • Increased activity of GI smooth muscle • Increased sensitivity to pain • Increased body temperature • Vasodilation
F_2	Airways, eyes, uterus, vascular smooth muscle	• Bronchoconstriction • Increased activity of GI smooth muscle • Increased uterine contraction (eg, menstrual cramps)
I_2 (Prostacyclin)	Brain, endothelium, kidneys, platelets	• Decreased platelet aggregation • Gastroprotection • Vasodilation
Thromboxane A_2	Kidneys, macrophages, platelets, vascular smooth muscle	• Increased platelet aggregation • Vasoconstriction

PHYSIOLOGICAL EFFECT

Inflammation

- PGs are natural mediators of inflammation
- PGE2 & PGE1 induce signs of inflammation- redness, heat (vasodilation), swelling, edema, etc

Pain & Fever

- Pyrogen stimulates PG synthesis & release of PGE2 in the Hypothalamus region of brain where temp is regulated.
- PGE2 can enhance the intensity & duration of pain caused by bradykinin & histamine.

Reproduction

- PGE2 and PGF2 have been used to induce parturition as well as to terminate pregnancy.
- Cytotec
- PGE series of PG may play a role in male infertility

PHYSIOLOGICAL EFFECTS

Peptic Ulcer

- Synthetic PGs have been useful in inhibiting gastric secretions in patients with gastric ulcers.

Regulation of Blood Pressure

- PGE, PGA & PGI2 being vasodilators lower the systemic arterial pressure; increase local blood flow.
- Might help in treating Hypertension

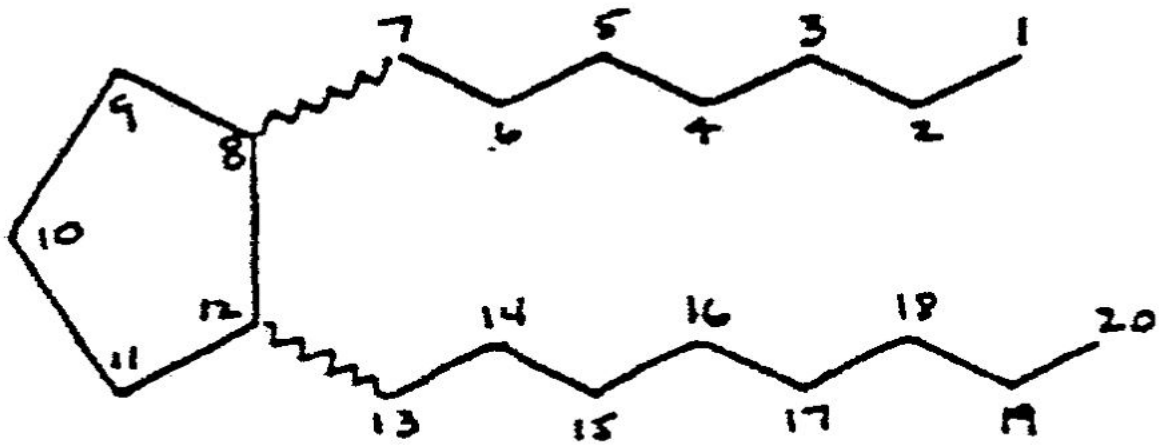
Ductus Arteriosus

- PGE2 maintains the patency of DA prior to birth.
- If DA remains open after birth COO inhibitor like indomethacin can be given
- Infants with congenital abnormalities are administered PG to maintain blood flow.

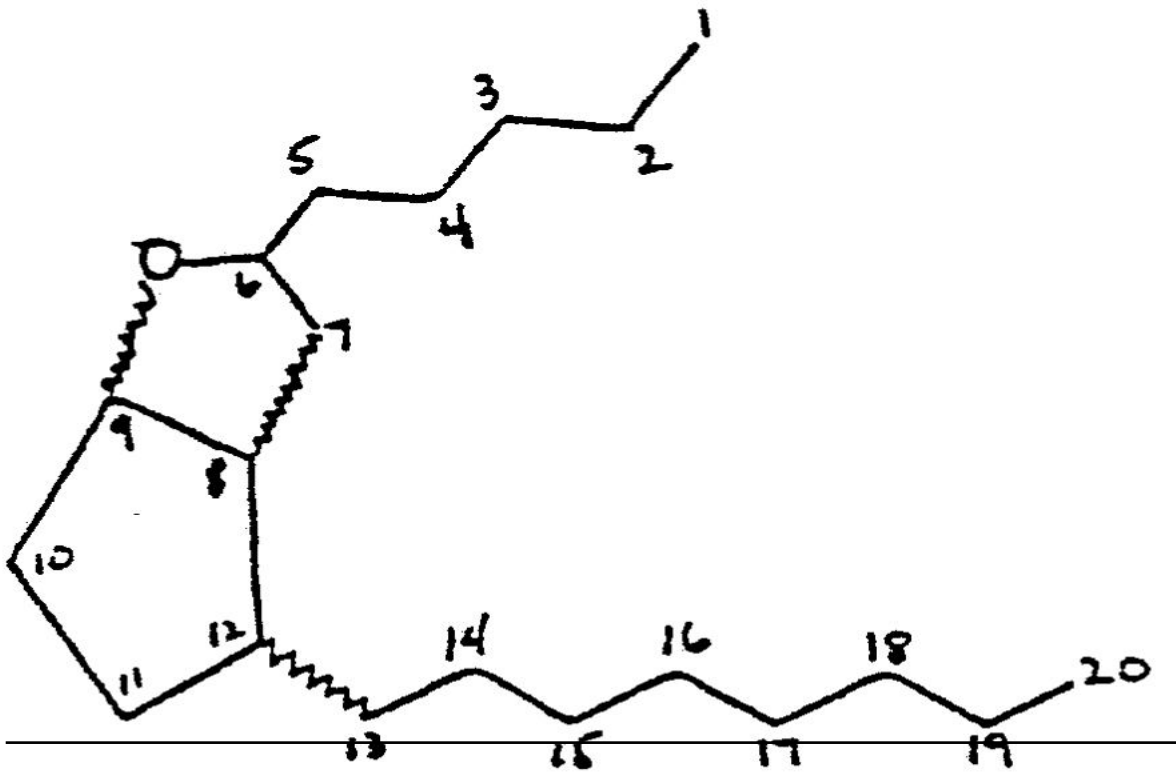
2. Prostacyclins (PGI_2)

Prostacyclins (PGI_2)

- Prostacyclins are type of **Eicosanoids/ Prostanoids.**
- Principally **formed in vascular endothelium**
- **They are Platelet Aggregation Inhibition Factors**
- Biosynthesized by enzyme **Prostacyclin Synthetase**.



Prostaglandin



Prostacyclin

Roles of Prostacyclins

- Prostacyclins are **Vasodilators.**
- Prostacyclins like Prostaglandins **inhibit platelet aggregation.**
- Prostacyclins **prevent Thrombus/clot formation**.

3. Thromboxanes (TX)

Thromboxanes (TX)

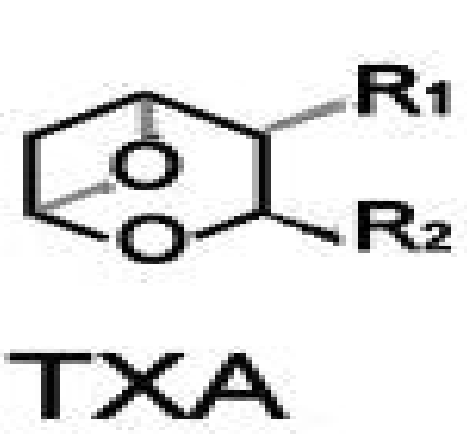
- **Thromboxanes** are also termed as **Platelet Aggregating Factor** (PAF).

- **Thromboxanes are Prostanoids** produced by **Thrombocytes** (platelets)

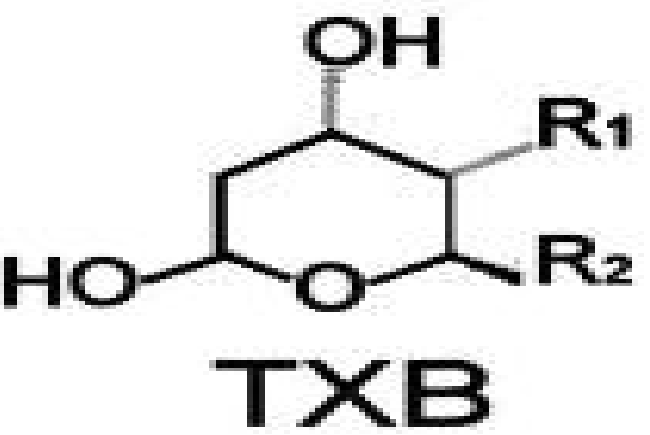
- By **Enzyme Thromboxy Synthase.**

Structure Of Thromboxanes

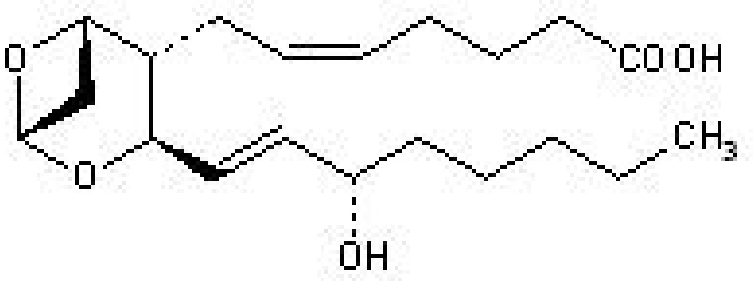
- Thromboxanes possess a **cyclic Ether** in their structures.



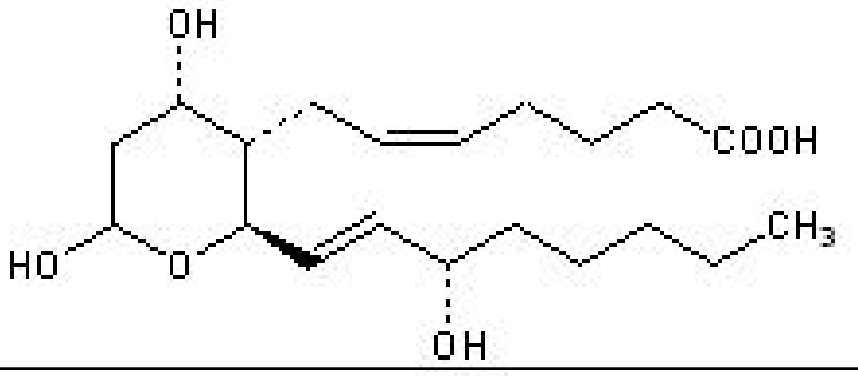
TXA



TXB



Thromboxane A_2



Thromboxane B_2

Types Of Thromboxanes

- **TX A and TX B** are types of Thromboxanes.
- **TXA2** is more prominent in human body.

Functions Of Thromboxanes

- Thromboxanes are **vasoconstrictors.**
- Thromboxanes **enhances platelet aggregation.**
- Thromboxanes **favors blood clot formation** during **blood coagulation**.

- **Thromboxanes** and **Prostacyclins** are **antagonistic to each other** balancing their activities.

- Increased **Thromboxane activity results in Thrombosis**.

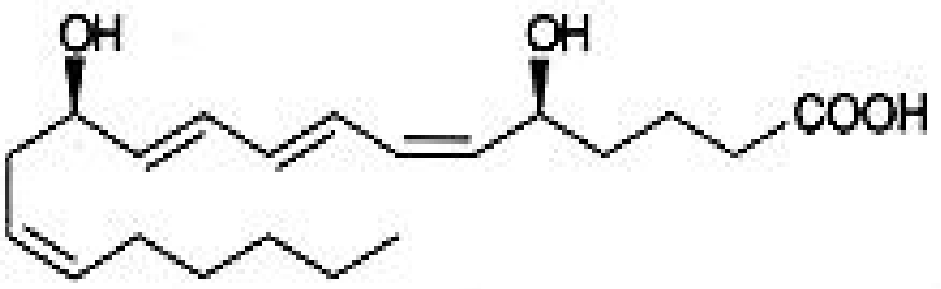
4. Leukotrienes

Leukotrienes

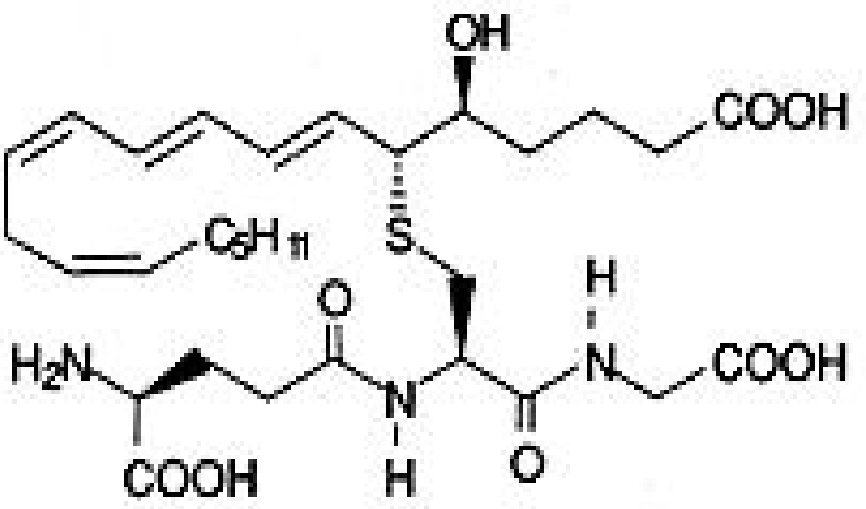
- Leukotrienes are **type of Eicosanoids**
- Biosynthesized through **Lipoxygenase system in Leukocytes.**

- **Leukotrienes** are a family of **Eicosanoid**
- **They are Inflammatory mediators produced in leukocytes.**

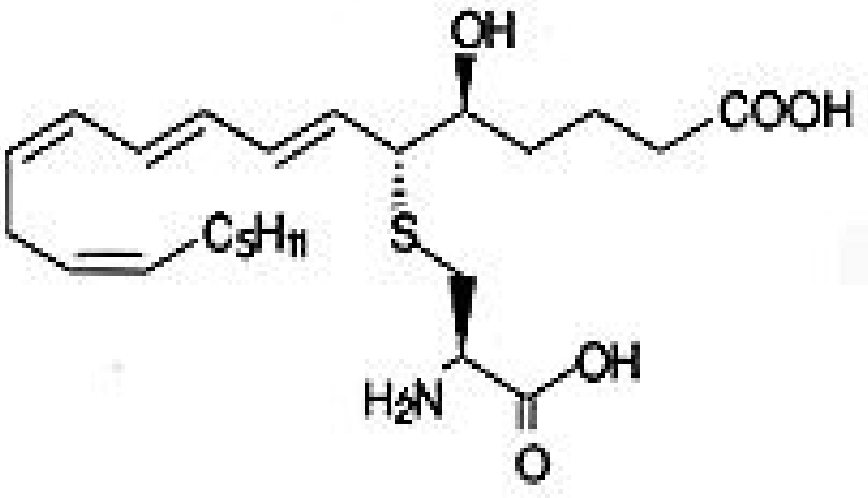
Structure And Types Of Leukotrienes



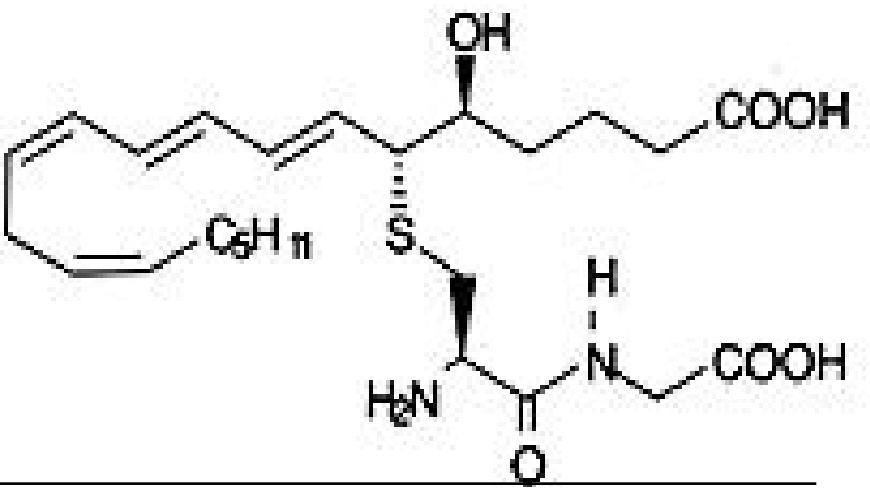
LEUKOTRIENE B_4



LEUKOTRIENE C_4



LEUKOTRIENE E_4



LEUKOTRIENE D_4

Leukotrienes Structure and Types

- **Leukotrines** are **Hydroxy derivatives** possessing **conjugated Trienes .**

- **Types of Leukotrienes:**

- **LTB4, LTC4, LTD4 and LTE4**

Occurrence Of Leukotrienes

- **Early discovery of Leukotrienes was in Leukocytes.**

- **Leukotrienes are also produced and present in.**
  - **Mast cells**
  - **Lung**
  - **Heart**
  - **Spleen**

Effect Of Leukotrienes

- Leukotrienes are biologically active **components of Slow Reacting Substances (SRS-A).**

- **SRS-A** are released during **Allergic reactions/Anaphylaxis.**

- **Leukotrienes** are **100-1000 times more potent** than **Histamine** during **allergic reactions.**

- **LTB_4** is a potent **chemotactic agent**.

(chemical substance which mediates movement of cells).

- Leukotrienes by action are:
  - **Bronchoconstrictors**
  - **Vasoconstrictors**

- **LTC_4, LTD_4 and LTE_4** are **Slow - Releasing Substance of anaphylaxis** (SRS - A) ,

- **SRS-A** causes fluid leakage from blood vessels to an inflamed area.

Levels Of Leukotrienes Increased In

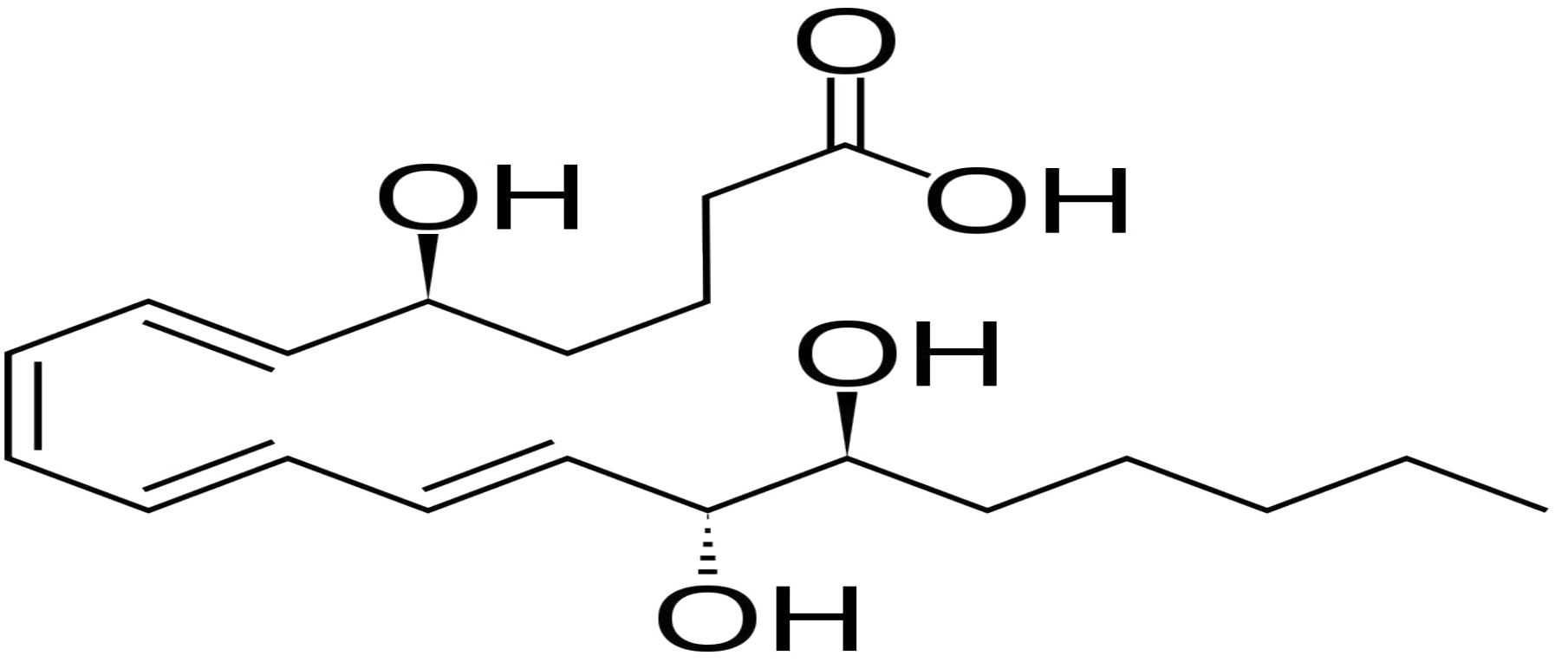
- **Allergies**
- **Allergic rhinitis**
- **Asthma**

(Tightening of airways, difficult to breathe)

- Overproduction of Leukotrienes causes **Anaphylactic shocks.**

- An **Antiasthmatic drug Prednisone inhibits Leukotriene biosynthesis.**

5.Lipoxins



Lipoxins

- **Lipoxins** are Eicosanoids produced in Leukocytes of human body.

Roles Of Lipoxins

Lipoxins are essential in **maintaining tissue homeostasis and resolve inflammation.**

- **Lipoxins are**:
  - Vasoactive/Vasodilators
  - Anti-inflammatory
  - Anti-proliferative
  - Pro-resolving
  - Immunoregulatory
  - Chemotactic substances

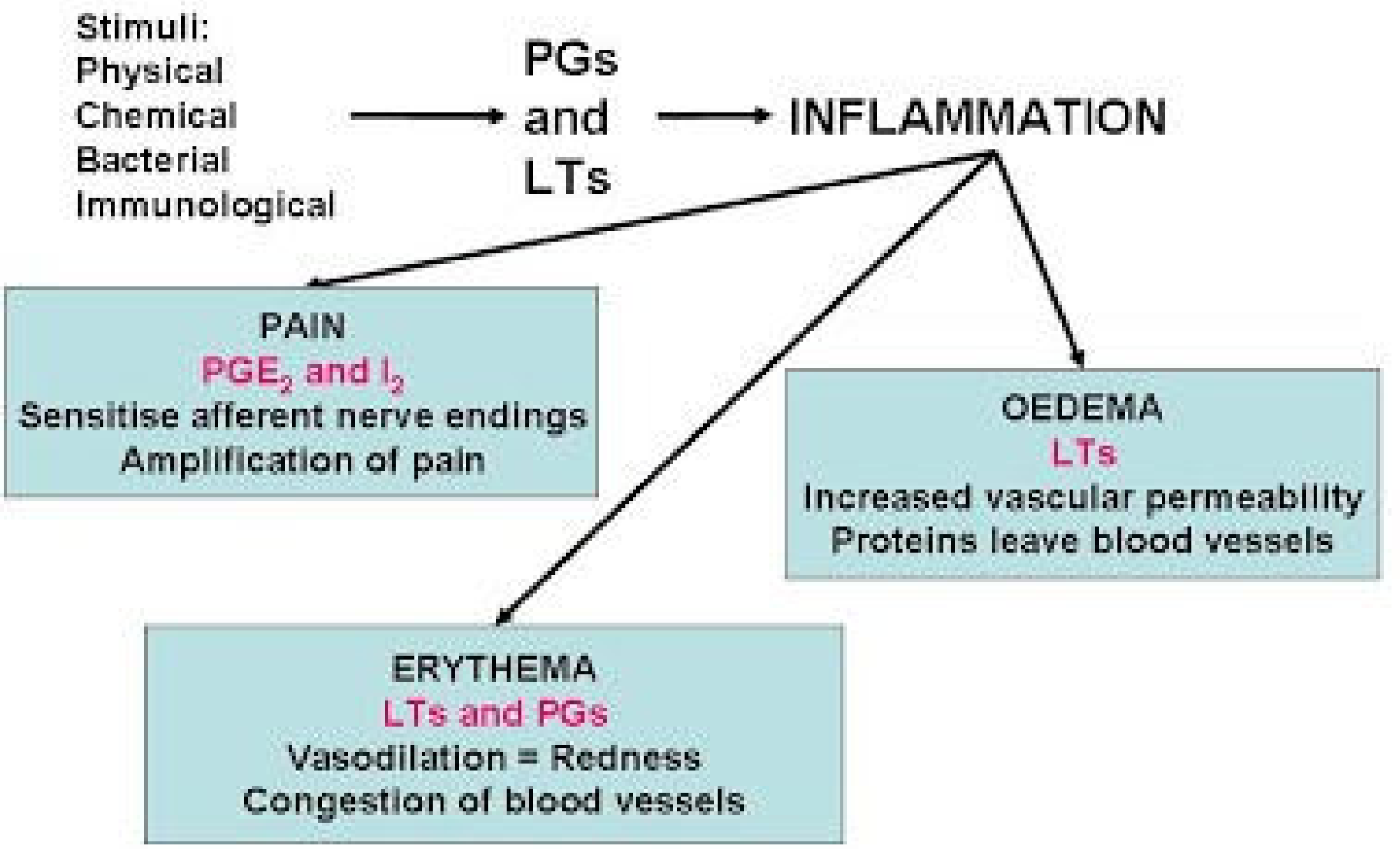
Omega 6 and Omega 3 Derived Eicosanoids Are Opposite in Action

- **Omega 6 Derived Eicosanoids**
- **Prostaglandins:**
  - Promotes Inflammation
- **Omega 3 Derived Eicosanoids**

Resolvins and Eoxins are:

- Anti inflammatory
- Anti allergy
- Anti hypertensive
- Anti cancer
- Anti atherosclerotic

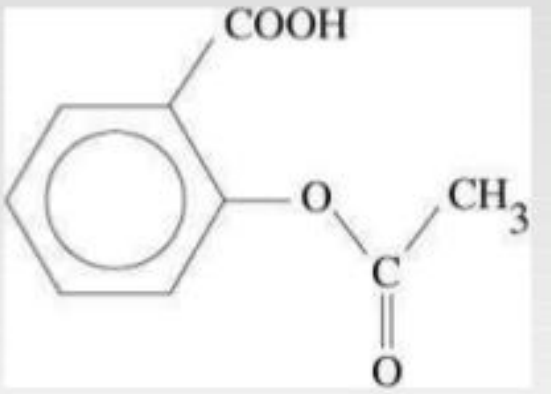
Effects of Eicosanoids



- Local pain and irritation
- Bronchospasm
- Gastrointestinal disturbances: nausea, vomiting, cramping, and diarrhea.

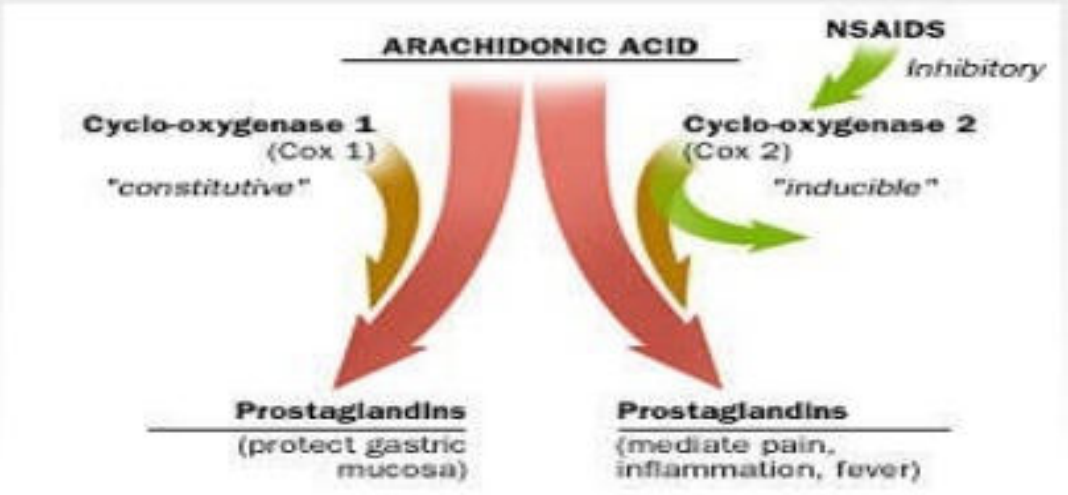
NSAID: ASPIRIN

- Acetyl salicylic acid (Aspirin) is an effective anti-platelet aggregator.
- It irreversibly acetylates the platelets COO system and inhibits it thus hampering in formation of Thromboxane A2
- At time same time it opposes the formation of PGI2 in the endothelial cells, which is a vasodilator.

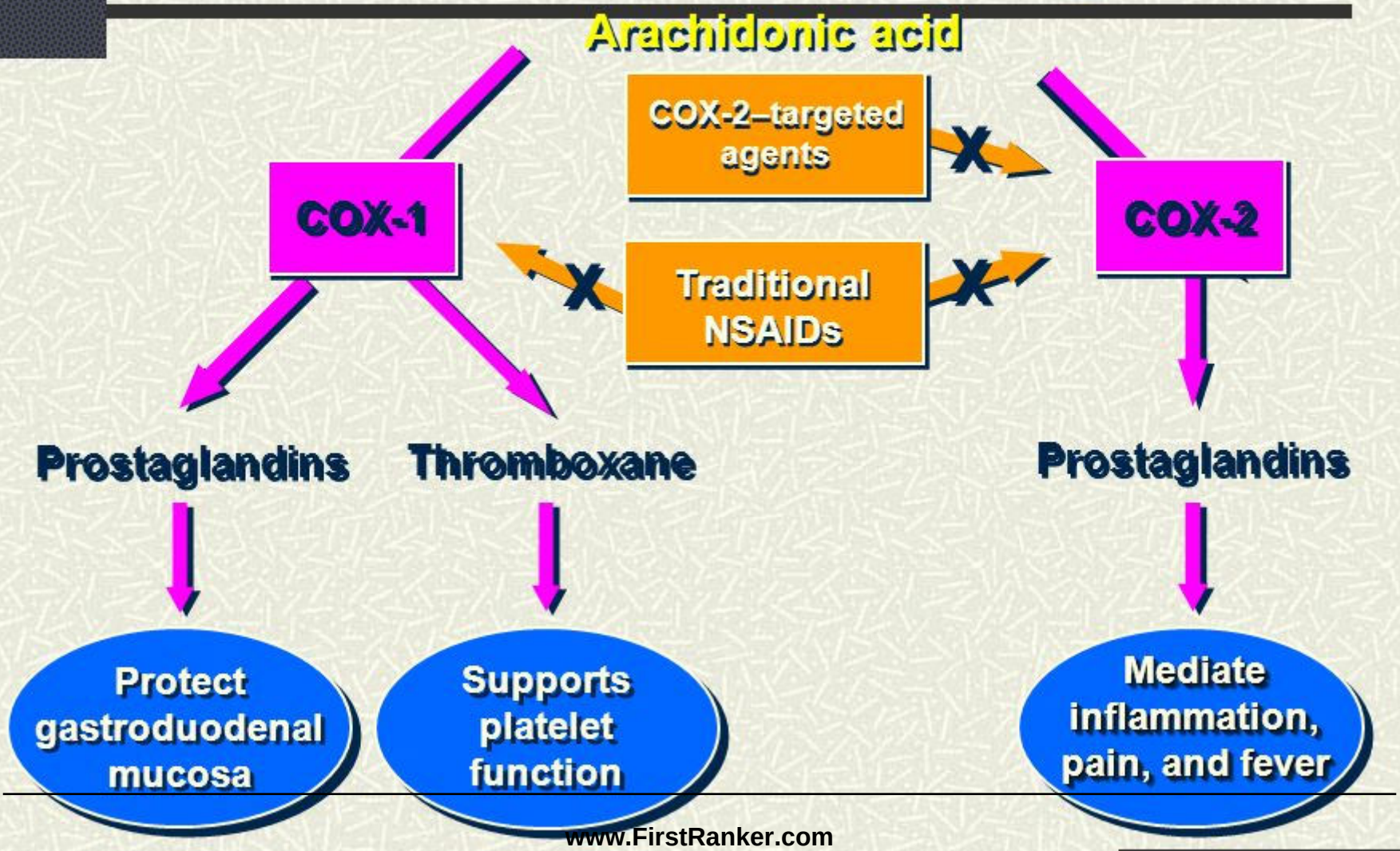


CLINICAL USES:

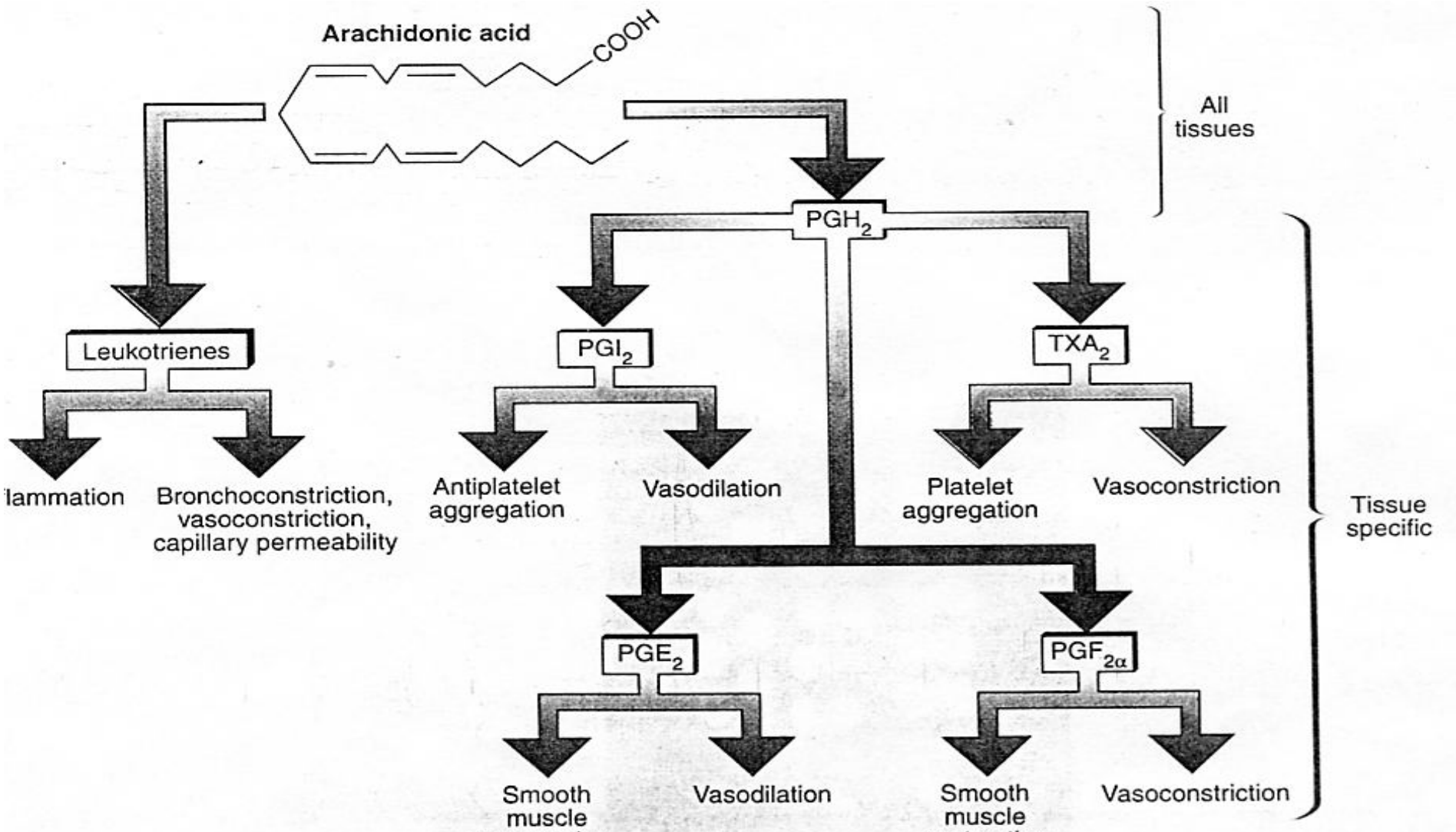
- Management of angina & MI
- Prevention of stroke & cerebral ischemic attacks

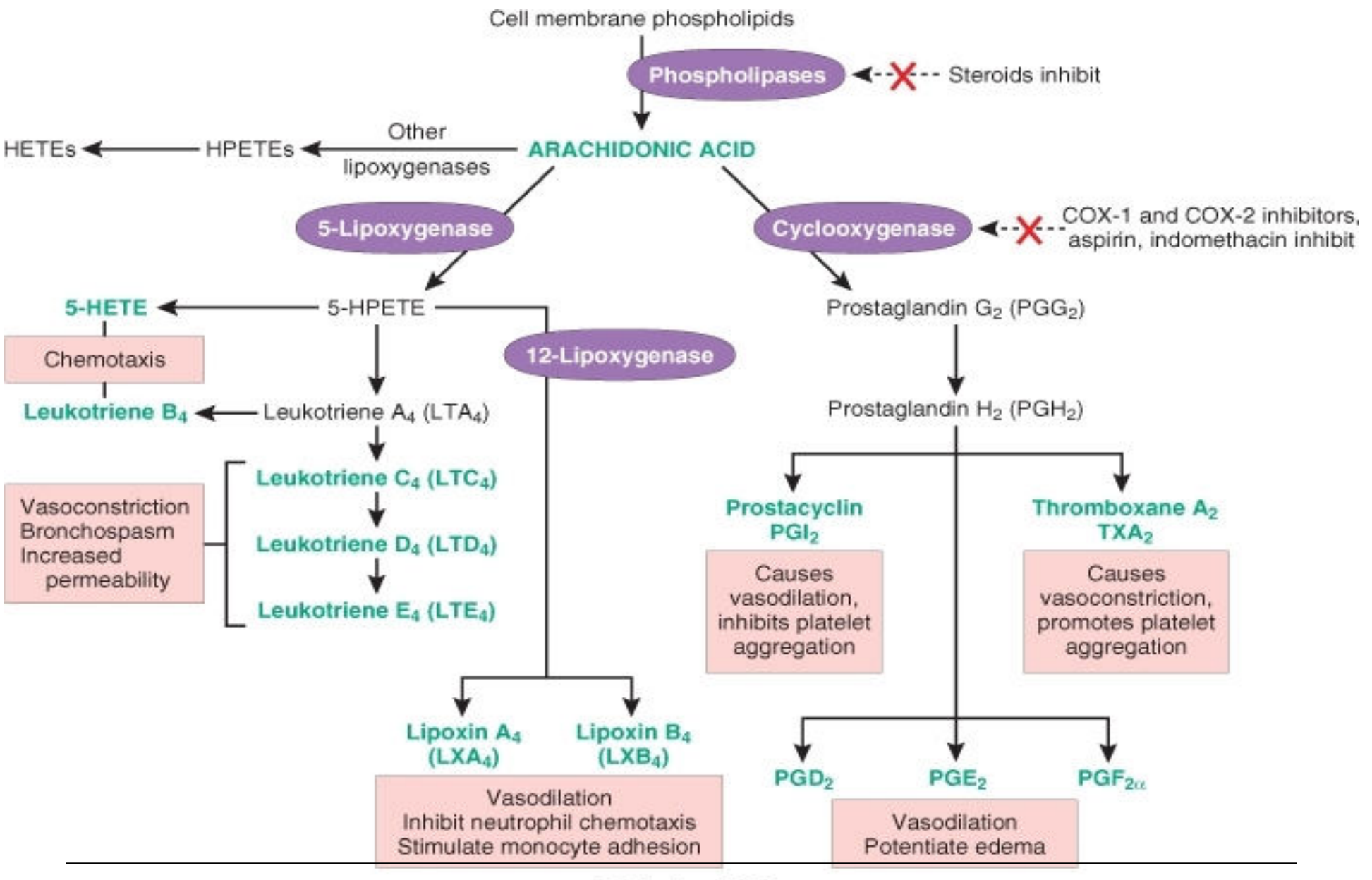


Mechanism of Action of Anti-inflammatory Agents



Biological Actions of Selected Eicosanoid Molecules





Amphipathic Lipids

Examples Of Amphipathic Body Lipids

- Phospholipids
- Glycolipids
- Free Fatty acids
- Free Cholesterol

Features Of Amphipathic Lipids

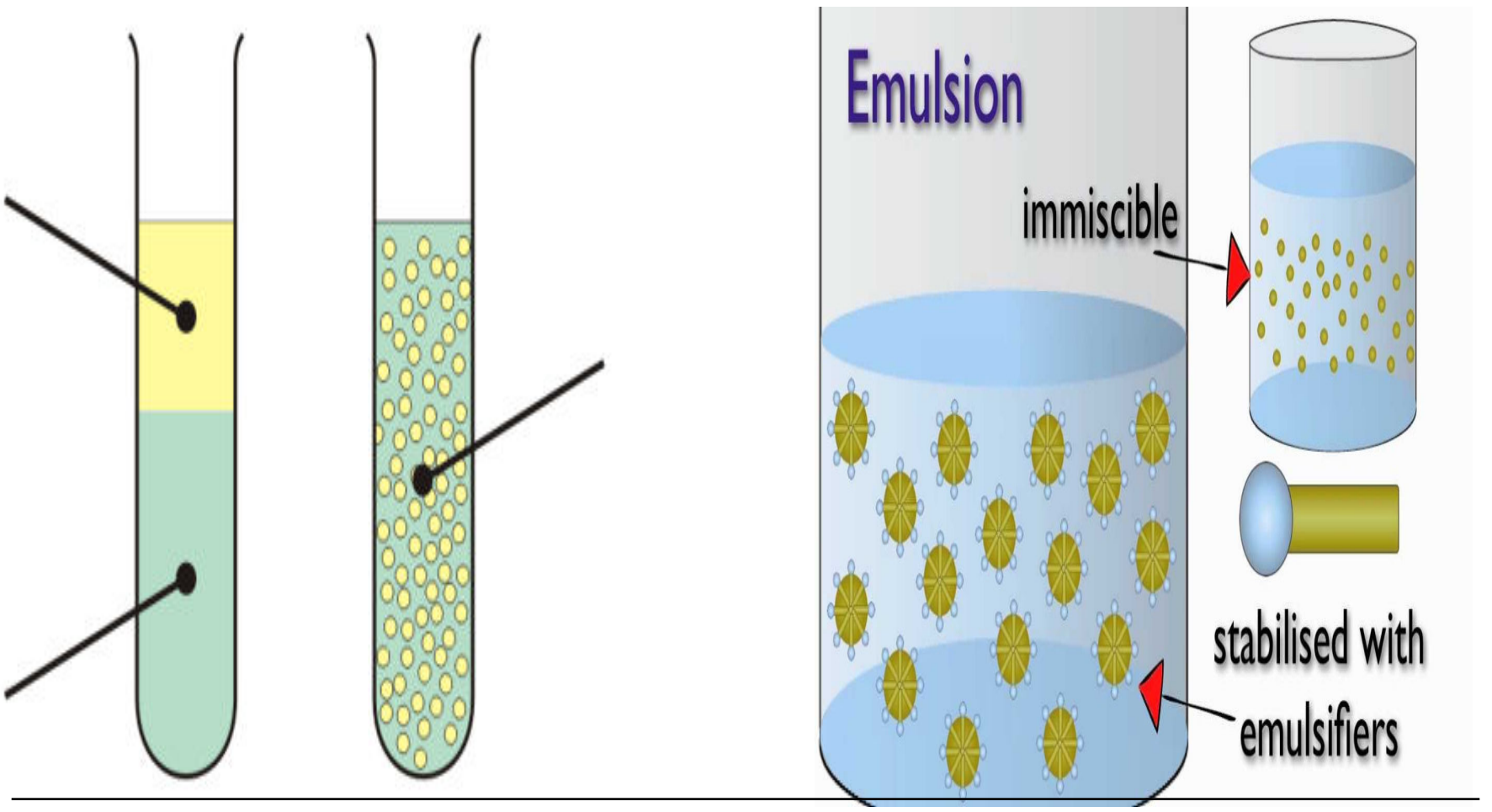
- Structure has both polar and non polar groups
- Partially soluble
- **Orientation of groups:**
  - –**Polar group directed** towards **water phase**
  - –**Non polar group directed** in **oil phase/away from water.**

Role Of Amphipathic Lipids

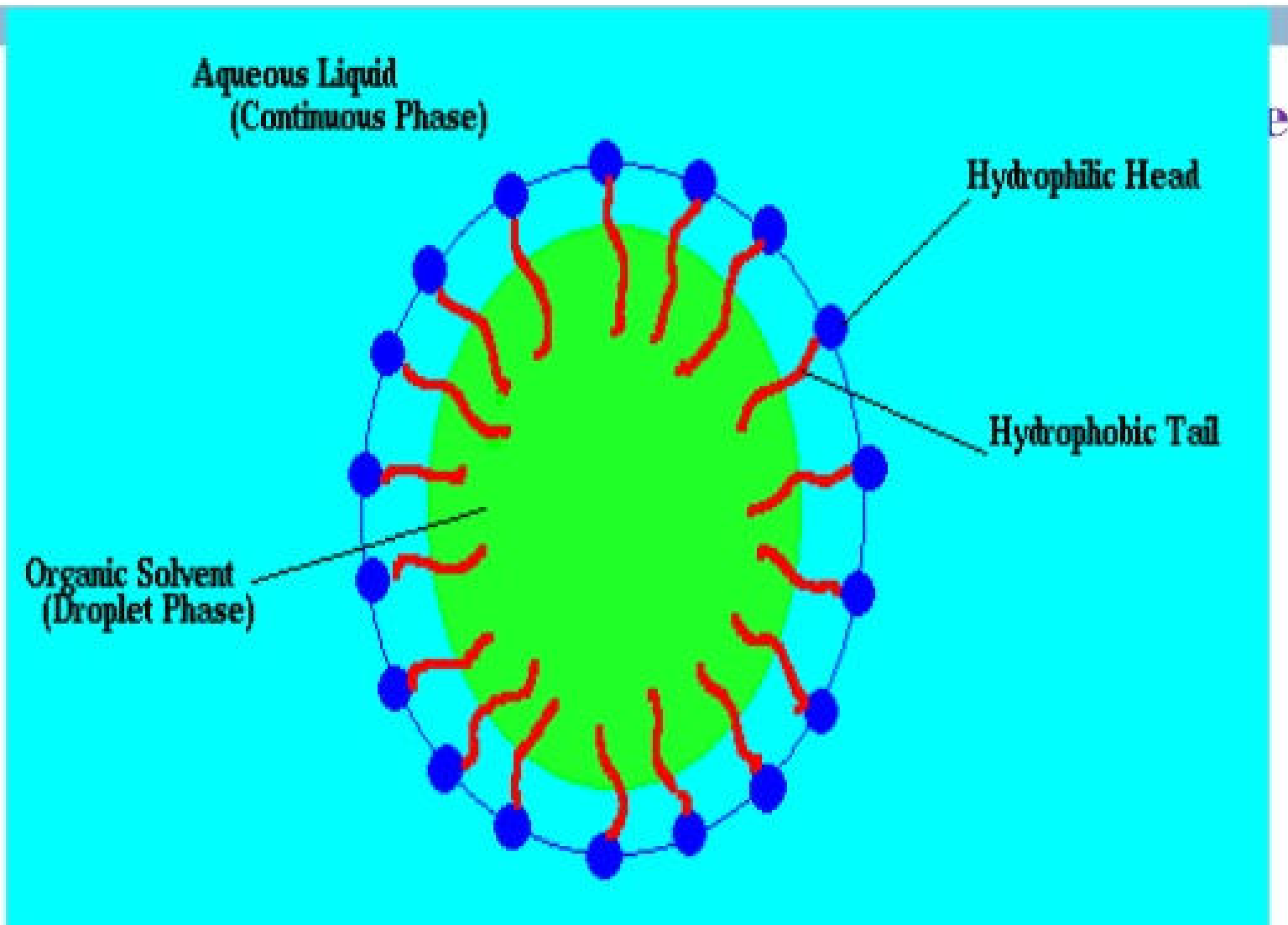
- **Amphipathic Lipids have following biological Significances in forming:**
  - **Biomembranes:**

  (Phospholipid bilayer, Glycolipids and Cholesterol)
  - **Emulsions:**
  - In intestine PL help in Lipids Digestion
  - **Micelles:**
  - In intestine help in Lipids Absorption
  - **Lipoproteins:**
  - For transport of nonpolar/neutral Lipids
  - **Liposomes:**
  - Agents for Drug /Gene carrier

Emulsions



Theory of emulsification



Emulsions

- **Emulsions** are small droplets of **oils miscible in aqueous phase**.
- **Emulsions** are usually formed by Nonpolar and Amphipathic Lipids along with Bile Salts in aqueous phase.

In Human GIT

- **Emulsions are formed as small, miscible dietary Lipid droplets** in aqueous phase of **intestinal juice in intestinal lumen**.

- **Emulsions** are formed during the process of **Emulsification in GIT.**

Requirements For Emulsification

- **Emulsifying agents :**
  - **Bile salts (Major)**
  - **Amphipathic Lipids** (Minor)
- **Mechanical force aids emulsification.**

- **Emulsifying agents reduces surface tension.**
- **Emulsifying agents** form a surface layer of **separating** main bulk of **nonpolar Lipids** from aqueous phase.

- **Emulsions** are **stabilized** by **detergent action** of **emulsifying agents.**

Emulsification Process

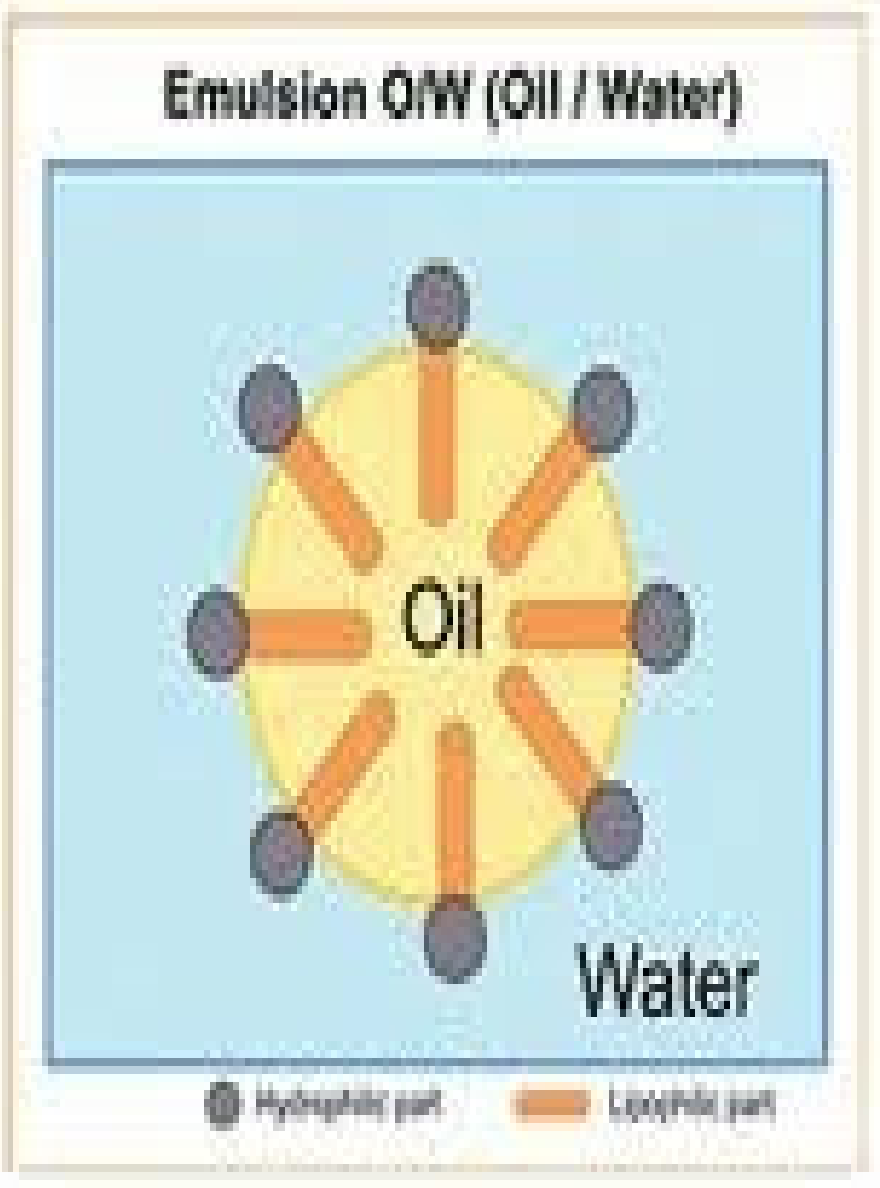
- **Emulsification** process takes place in an aqueous phase of **intestinal juice** **in** **intestinal lumen** and forms **Emulsions**.
- During Emulsification Hydrophobic or **nonpolar dietary Lipids (TAG)** are mixed **with** an **emulsifying agents:**
  - **Bile salts**
  - **Lecithin(Amphipathic Lipids)**

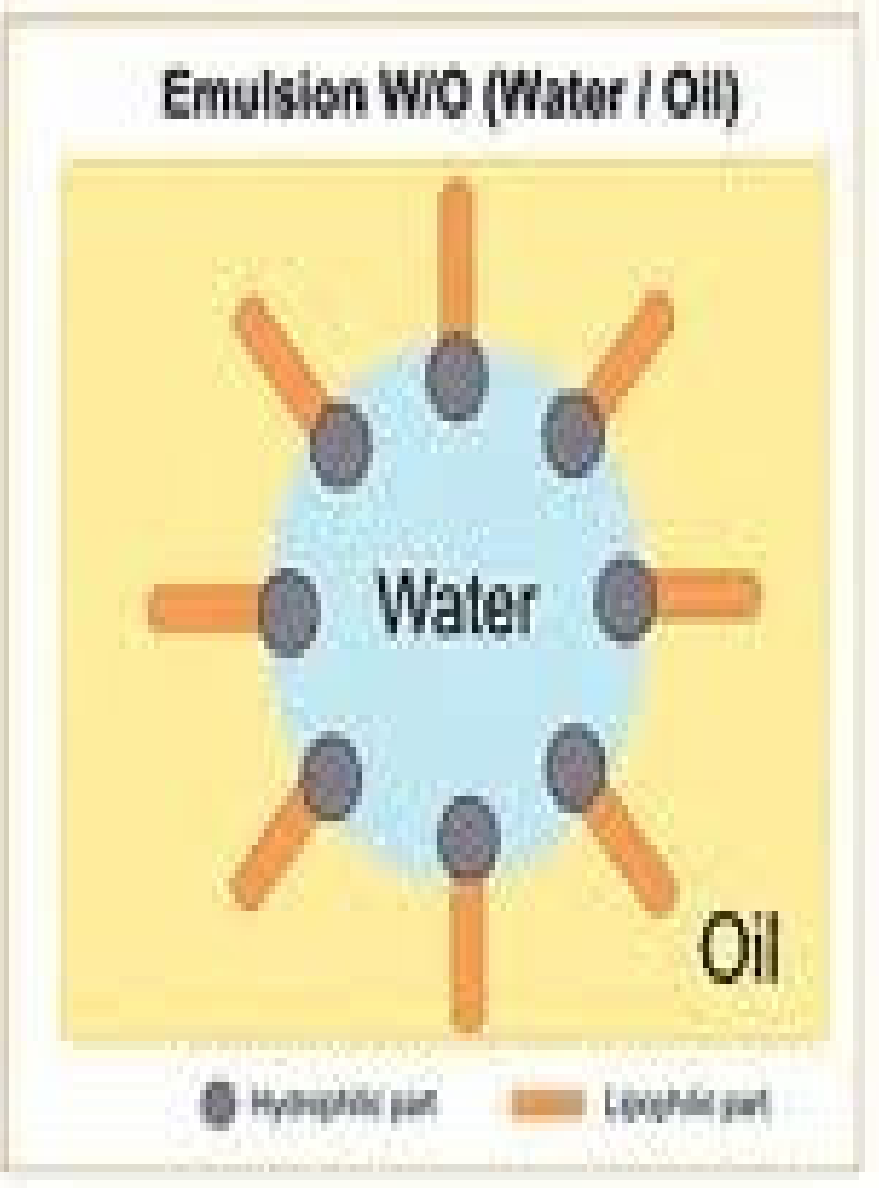
- **Mechanical force(provided by intestinal peristaltic movement) facilitates the process of Emulsification.**

Types Of Emulsions

I. Oil In Water

II. Water In Oil





Significance Of Emulsions

- Emulsions formed in the intestinal lumen **help in the digestion of dietary Lipids.**
- The **dietary large droplets of Fat/Oil** are transformed to **small ,miscible droplets** as **Emulsions.**

- **Emulsions** bring the dietary Lipids in **contact with Lipid digesting Enzymes** present in aqueous phase of **intestinal juice**.

Micelles

- Micelles have a **disc like shape** .
- Critical concentration of **Amphipathic Lipids** in aqueous medium form **Micelles(~200 nm)**.
- **Bile salts** help in forming **Mixed Micelles.**

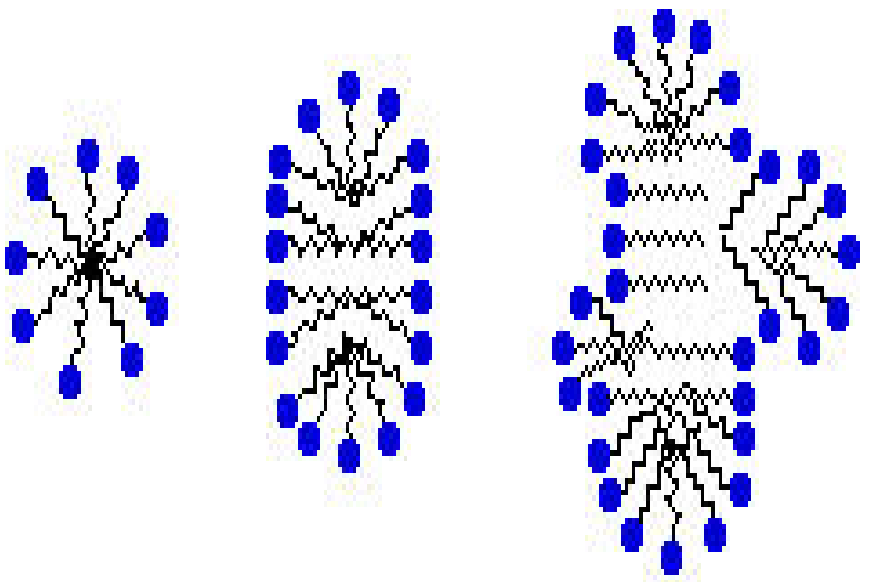
- **Mixed Micelles** are formed in Intestine **after digestion of Lipids.**
- By an aggregation of various forms of dietary digested Lipids with Bile salts.

- Aggregation of various **digestive end products** of dietary Lipids covered with a peripheral layer of **Bile salts** form **Mixed Micelles in intestinal lumen.**

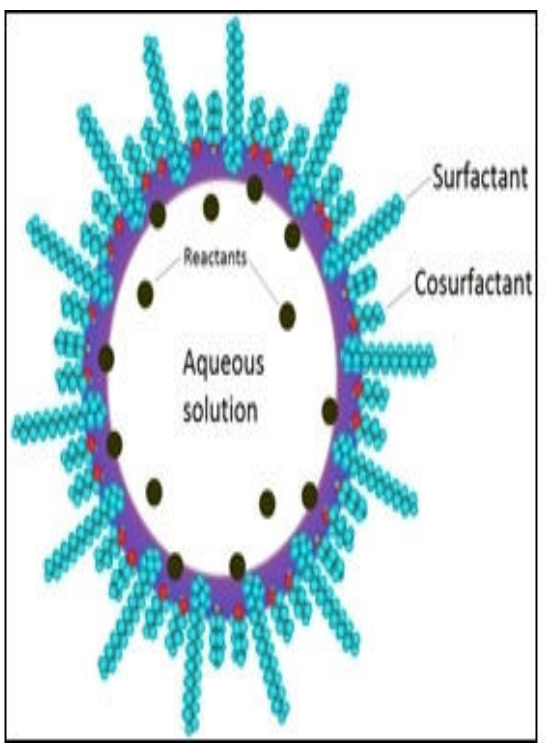
- Mixed Micelles contain the non polar Lipids in the interior portions and polar **Bile salts on the exterior**.

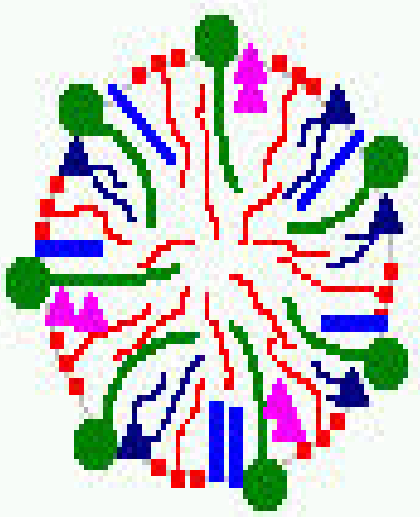
Significance Of Mixed Micelles

- **Mixed Micelles helps** in **absorption** of **dietary Lipids**
- **From intestinal** lumen into intestinal mucosal cells.



micelle assemblies of amphiphiles



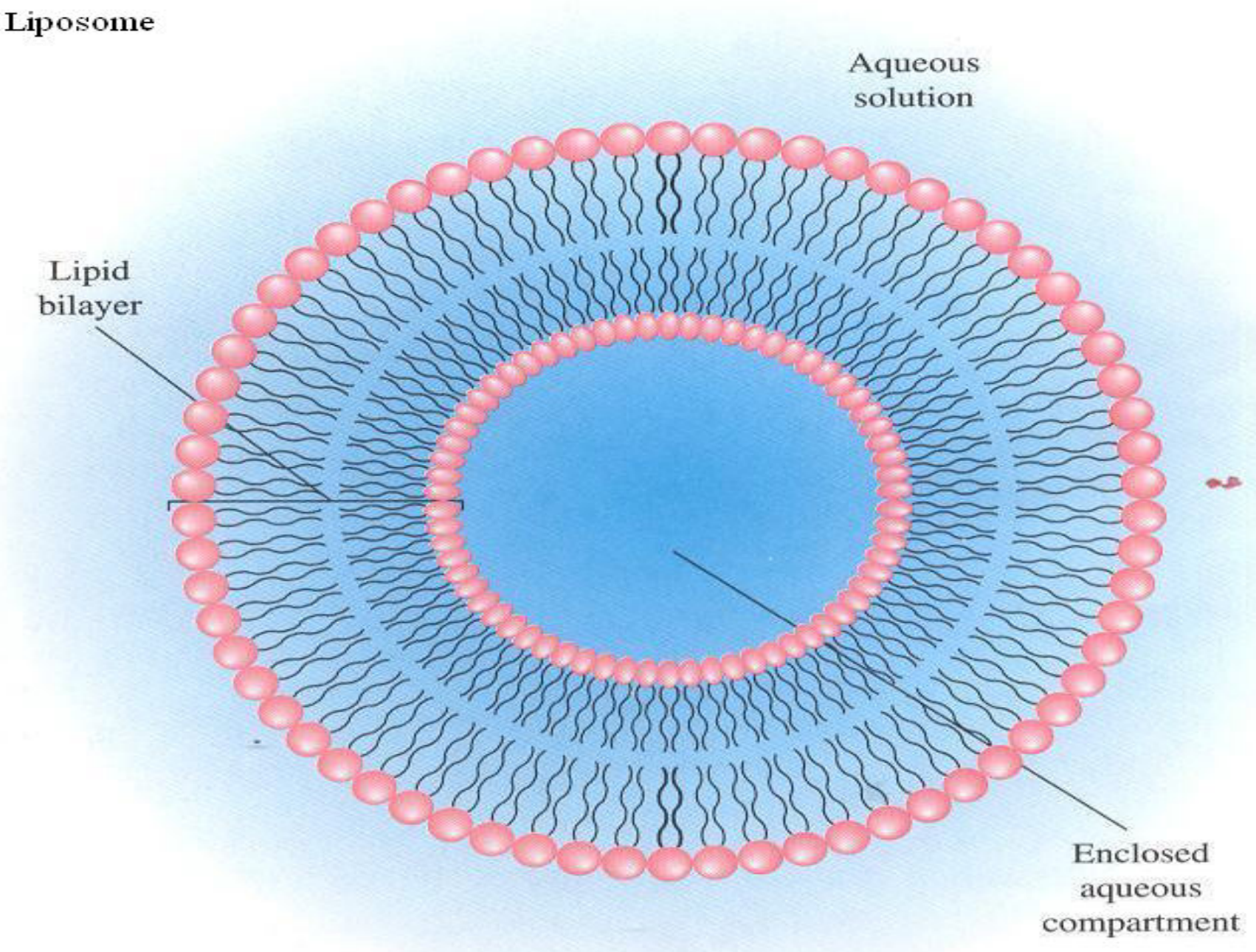


Bile salts
Monoglyceride
Fatty acids
Phospholipids
Cholesterol

Liposomes

- **Amphipathic Lipids** when **exposed** to **high frequency sound waves (Ultra Sonication)** in aqueous medium to agitate particles and **form Liposomes**.

- Liposomes can be prepared by **disrupting biological membranes by ultra sonication(>20 KHz)**

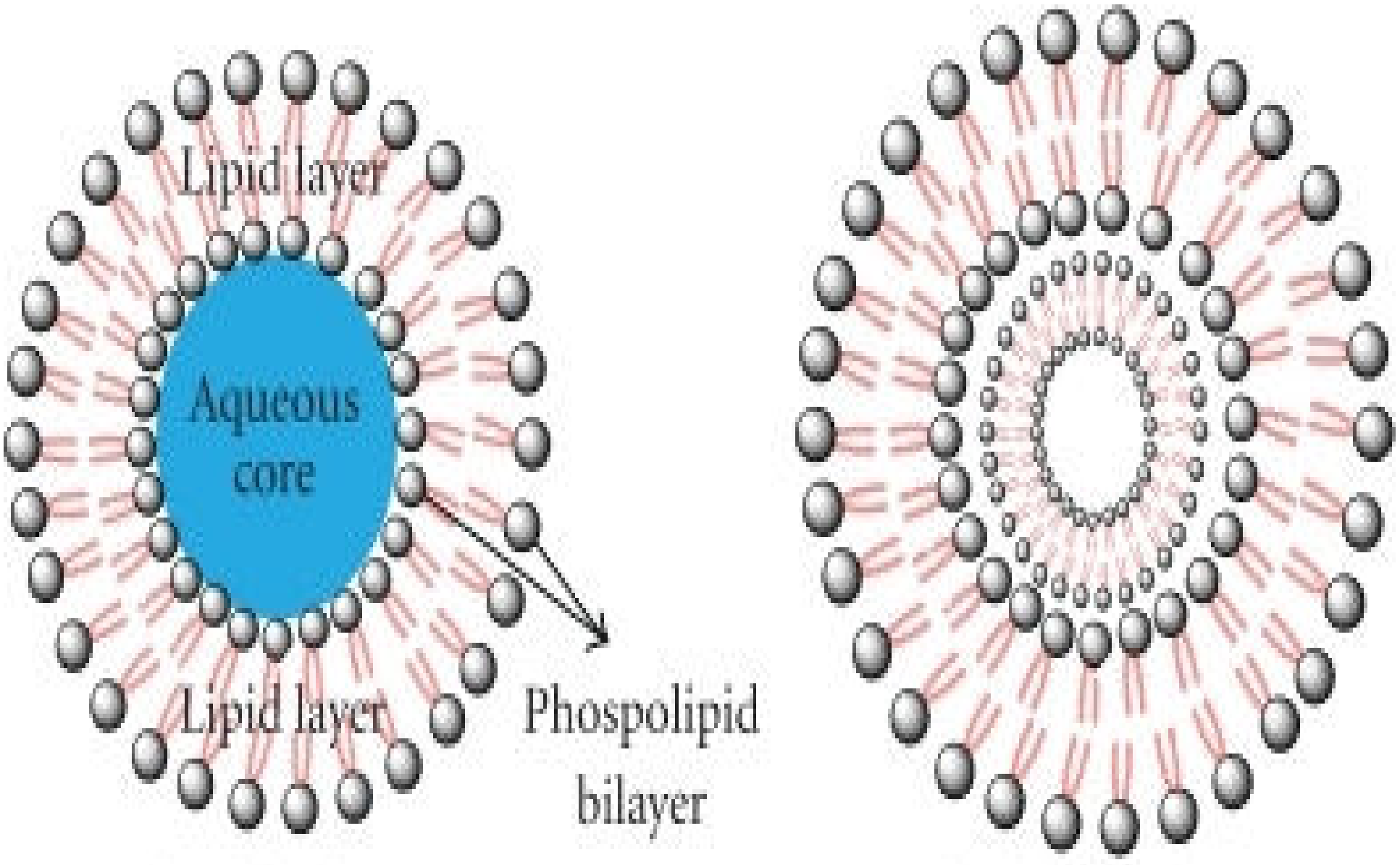


Structures Of Liposomes

- Liposomes are **composite structures made of largely phospholipids** and small amounts of other molecules
- Liposomes has **spheres of one/ many Lipid bilayers.**
- Liposomes contain **aqueous regions**(polar phase) and intermittently **lipid bilayer** (non polar phase).

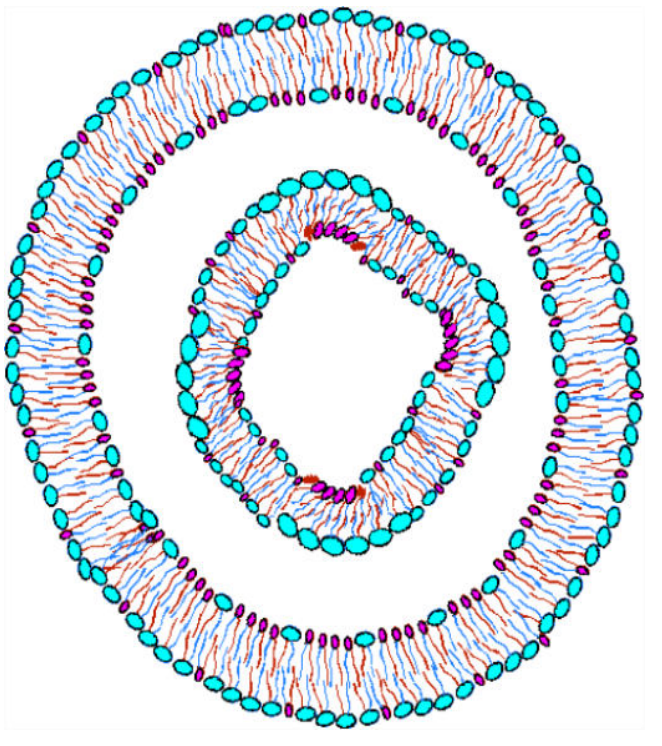
Types Of Liposomes

- **Unilamellar Liposome**
- **Multilamellar Liposome**



a)

b)

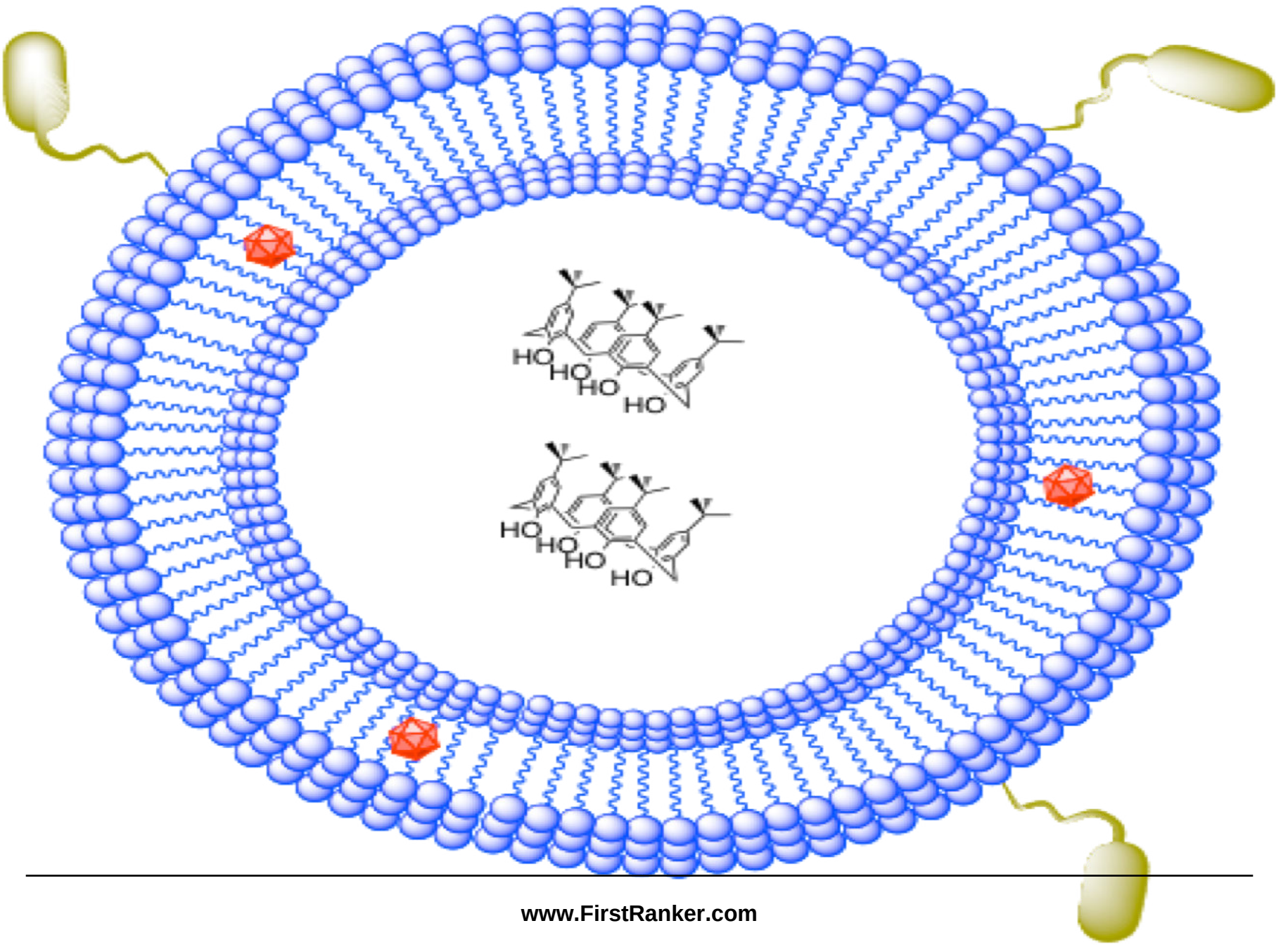


Applications Of Liposomes

- Liposomes are vehicles for **administration of drug through blood**, targeted to specific organs.
- Topical **transdermal delivery of drugs.**
- **Transfer of Gene** into **vascular cells**

- **Water insoluble drugs** are carried in **Hydrophobic region** of Liposome.

- **Water soluble drugs** are carried in **Hydrophilic region** of Liposomes.



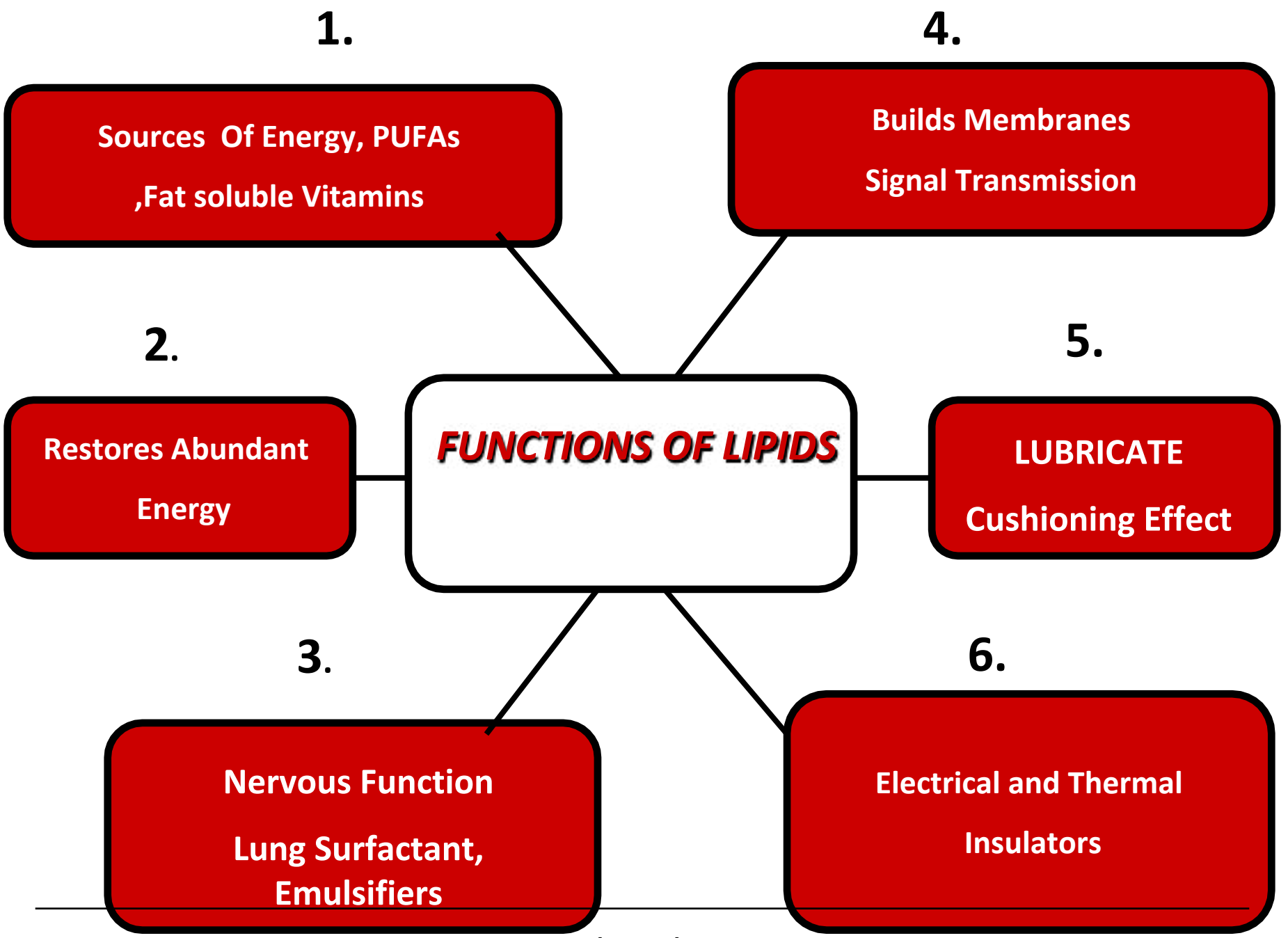
Biomedical Importances Of Body Lipids

Roles of 7 Biomedically Important Lipids

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

Body Lipids Functions

1. Secondary Source of Energy
2. Energy Storage Lipids- Long term use
3. Thermal and Electrical Insulators
4. Cushioning Effect and Shock absorber
5. Shape and Contour to body
6. Structural Lipids- Biomembrane components
7. Cell antigens, receptors, anchoring sites
8. Signal Transduction and Nerve Impulse conduction
9. Lung Surfactant helps in normal respiration
10. Emulsifiers helps in Lipid digestion and absorption
11. Transport Lipids
12. Metabolic regulatory Lipids



Lipoprotein & Phospholipids (cell wall & mitochondrion constituents)

Acts as fuel in the body

Insulating effect

Padding & protection of internal organs

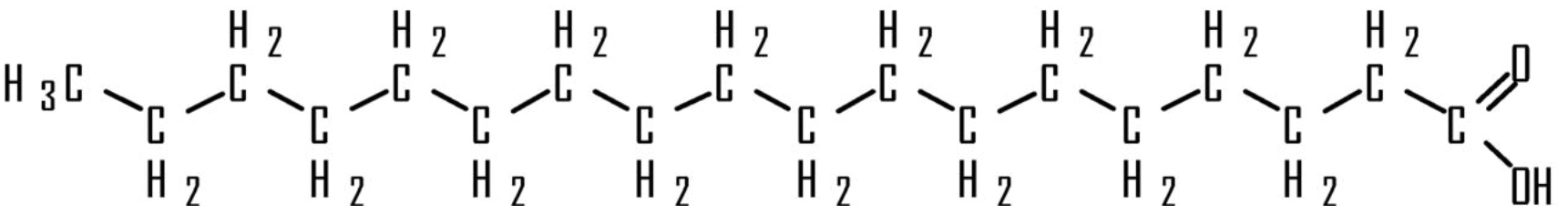
Vitamin A,D,E,K fat soluble vitamins

Building Materials (hormones)

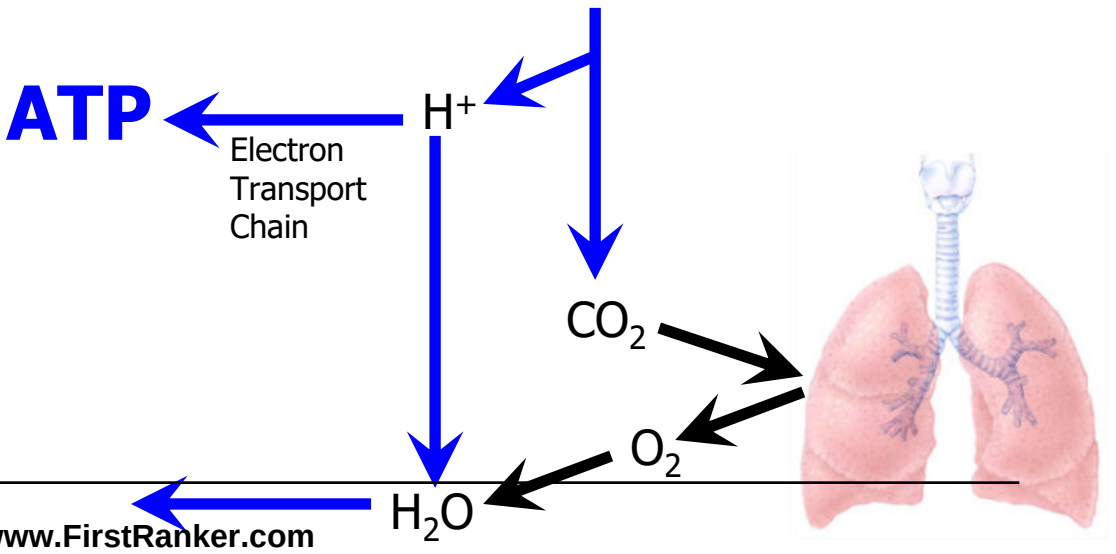
Supply essential fatty acids

Nervous system: Rich in lipids

Fatty acids of TAG is a Source of Energy



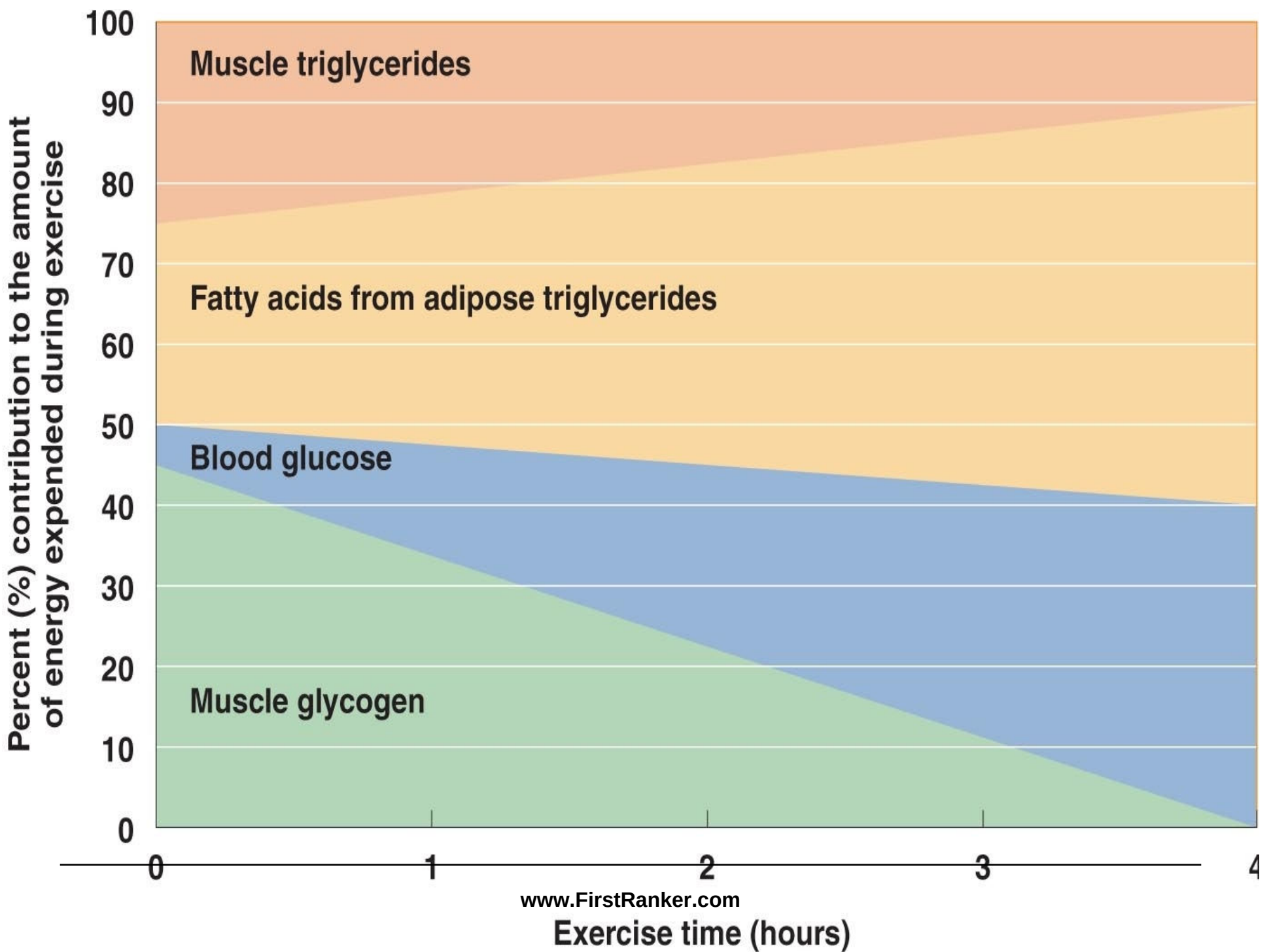
Energy-Containing Nutrients (C and H)



Good About Body Lipids

- Liberate **9 kcal per** gram of TAG.
- Major **fuel at rest**
- **Endurance Exercise**
- Source of :
  - **Essential fatty acids**
  - **Fat-soluble vitamins**

- **Regulates cell function**
- **Maintains membrane structure**
- **Improve nerve function**
- **Provides flavors and textures of foods**
- **Gives satiety value**



Disorders Associated To Lipids

- Obesity
- Atherosclerosis
- Respiratory Distress Syndrome
- Fatty Liver
- Hyperlipoproteinemias
- Hypolipoproteinemias
- Necrosis ,Oxidative damage of biomembranes due to Lipid peroxidation
- Lipid Storage Disorders

Common Lipids Associated Disorders

- **Obesity**
- **Metabolic Syndrome**
  - **Atherosclerosis**
  - **Coronary Heart Disease**
  - **Hypertension**
  - **Diabetes Mellitus**

Table I Lipid levels (mg/DL) in human beings with known heart disease

Test	Desirable	Borderline	Undesirabl
Total cholesterol	<200	200-240	>240
HDL cholesterol	>45	35-45	<35
Triglycerides	<200	200-400	>400
LDL cholesterol	<130	130-160	>160
Cholesterol/HDL	<4.5	4.5-7.5	>5.5
LDL/HDL	<3.0	3.5	>5.0

Lipid Storage Disorders
Inborn Errors Of Lipid Metabolism

- **Congenital Defects where deficient of Enzymes**
- Affects an **Abnormal accumulation of Lipid forms**
- In cells and tissues affecting there functionality.

S.No	Lipid Storage Disorder	Enzyme Defect and Abnormal Accumulation of
1	Niemann Picks Disease	**Sphingomyelinase** **Sphingomyelins**
2	Gaucher's Disease	**Beta Glucocerebrosidase** **Glucocerebrosides**
3	Krabbe's Disease	Beta Galactosidase **Galactocerebrosides**
4	Tay Sach's Disease	Hexoseaminidase-A **Gangliosides**
5	Farber's Disease	Ceramidase **Ceramides**

Human body Lipids	Associated Disorders	Biochemical Defects	Biochemical Alterations
Triacylglycerol	Obesity Metabolic syndrome fatty Liver	Excess deposition of TAG in Adipocytes and Liver	Hyperlipidaemias Hypertriglyceridemia Atheroma's
PUFA's	Phrynoderma	Deficiency of PUFA's	Hypolipoproteinemia
Cholesterol	Familial hypercholesterolemia	LDL receptor defects	Atherosclerosis Occlusions Tissue Infarcts
Phospholipid	Respiratory distress syndrome	Low lung surfactant	No reduction of surface tension of Alveoli
Lipoprotein	Hyperlipoproteinemias Tangier's disease	LPL defects LDL defect HDL defect	Atherosclerosis Occlusions Tissue Infarcts
Lipidosis OR Lipid storage disorders	a. Tay Sach's disease	Hexoseaminidase	Accumulation of Gangliosides
	b. Niemann pick's disease	Sphingomyelinase	Accumulation of sphingomyelin
	a. Gaucher's disease	Beta Glucocerebrosidase	Accumulation of Glucocerebrosides
	a. Krabbe's diease	Beta Galactosidase	Accumulation of Galactocerebrosides
	a. Farber's disease	Ceramidase	Accumulation of Ceramides

Questions

- **Long Answer Questions**

- **Define Lipids** (Bloor's Definition). Classify Lipids with suitable examples.

- Define **Fatty acids**. **Classify** them with different modes and suitable examples.

- What are **Compound lipids**? Describe Phospholipids wrt Chemistry,Types,Nature,SourcesDistribution,Functions and associated disorders of.
- What are **Sterols**? Describe the structure, dietary sources, properties & functions of Cholesterol.

- **Write Short Notes.**

- Biomedical importance of various forms of body Lipids
- Enlist various disorders associated to Lipid forms with biochemical defect and alterations.
- Essential fatty acids (PUFAs) & their role in the body.
- Triacylglycerol/Neutral Fats- Structure & Function.

- Rancidity- Causes & Prevention.
- Gycolipids/Cerebrosides/Gangliosides
- Lipoproteins- Chemistry, types & functions
- Eicosanoids/Prostaglandins

- Therapeutic uses of Prostaglandins
- Distinguish between Fats & Waxes
- Nomenclature & Isomerism of fatty acids
- Omega 3 fatty acids and their importance
- Amphipathic nature of lipids and their roles
- Distinguish between Fats & Oils
- Enumerate biomedical important lipids with their classes
- Properties of Fatty acids.

- Simple Lipids with their examples
- Enumerate Compound Lipids & one function of each
- Name Derived lipids & their functions
- Trans Fats and their harmful effects
- Tests to check the purity of fats & oils/Characteristic number of Fats

Revision Questions

- Define Lipids
- Number and Names of Lipid Classes
- Define Derived Lipids
- Examples of Derived Lipids
- Define Fatty acids
- What is Delta and Omega end of FAs
- What is Beta Carbon of a Fatty acid
- 6 Modes of Classification of Fatty acids

- Fatty acids with one double bond is:----------
- Name most predominant Fatty acid of human body-----
- Most easily metabolized fatty acids are :----------,_____- and _____
- Fatty acid with odd and even number carbon atoms are:
- PUFAs are Fatty acids with----------
- Name PUFAs of Omega 3 and 6 types
- Enumerate Lipidosis with enzyme defects

- Are Nutritionally Essential Fatty acids and PUFAs same
- Name branched Chain and Odd Number Fatty acids
- Name Cyclic and Hydroxy Fatty acids
- What are Cis and Trans Fatty acids
- Enlist Omega 3 Fatty acids and 3 Main Roles

- Criteria for Sub classification of Simple Lipids
- Define Simple lipids
- Examples/Subtypes of Simple Lipids
- What is a Class of Fat/Oil and its chemical name
- Define Waxes
- Name human body Wax

- Differences of Fats and Oils
- Differentiate between Cerebrosides and Gangliosides
- Occurrence and Role of TAG
- Definition of Compound Lipids
- Types of Compound lipids
- Sphingophospholipid Example

- Number and Names Of Glycerophospholipids
- Hormonal role of Phospholipds
- Chemical composition of Lung Surfactant
- Which Compound Lipid is classified under classes of Lipid and Protein?

- Enzyme defect in Niemann Picks Disease
- Red Spot Macula is noted in which all conditions
- In which disorder Ceramides get accumulated in joints
- Emulsions and Liposomes results due to which Lipid forms.
- On what criteria's TAG is selected as reservoir of energy for long term use
- Enumerate various Lipid Storage disorders with biochemical defect and abnormal accumulated Lipid form

- What value of L/S ratio shows lung maturity and immaturity?
- What are components of Lung Surfactant?
- What are roles of Lung surfactant?
- What form of energy source helps in endurance of exercises of body?
- Which Lipids are associated to biomembranes?
- What are applications of Amphipathic Lipids?
- What clinical conditions shows Hypercholesterolemia?
- Enzymes associated for Eicosanoids biosynthesis.
- Therapeutic roles of Prostaglandins

Thank You

Biochemistry Department