

## Glycerophospholipids membrane phospholipids (Glycerol backbone + 2FA + PO<sub>4</sub>—alcohol)

Types:

- 1) phosphatidic acid PA derived    2) Cardiolipin    3) ether phospholipids (Plasmalogens)

PA derived Glycerophospholipids	Head group (alcohol)	Synthesis location Smooth ER
<u>Phosphatidylethanolamine</u> (PE)	Ethanolamine 2 carbons (ethanol) + amino group	The head group is <b>activated</b> Synthesis steps: 1) phosphorylation of the head group by kinases. 2) transfer of CDP to head groups by transferase. 3) transfer of CDP-head to DAG forming PE or PC by phosphotransferase.
<u>Phosphatidylcholine</u> PC (lecithin)  <b>Function:</b> composes the structure of the surfactant DPPC. DPPC: dipalmitoylphosphatidylcholine	Choline 2 carbons + quaternary amine	
<u>Phosphatidylserine</u> (PS)	Serine 2 carbons + amino group + carboxyl group	The DAG backbone is <b>activated</b> • serine + CDP-DAG → PS
<u>Phosphatidylglycerol</u> (PG) *2 PG molecules react together to form cardiolipin: PG + activated PG (CDP-DAG) → cardiolipin	Glycerol	• CDP-DAG + G3P → PA 3-P • PA 3-P → phosphatidyl glycerol G3P: glycerol 3-phosphate PA 3-p: phosphatidylglycerol 3-phosphate
<u>Phosphatidylinositol</u> (PI) phosphatidyl inositol 4,5-bisphosphate <b>Structure:</b> stearic acid on C1 Arachidonic acid on C2 <b>Functions:</b> 1) arachidonic acid reservoir 2) precursor for signaling molecules IP3 & DAG in (G <sub>q</sub> -PLC pathway) 3) protein anchoring to plasma membranes ( e.g. GPI for lipoprotein lipase)	Myo-Inositol 4,5 bisphosphate Inositol (a sugar molecule) + 2 phosphates	• Inositol + CDP-DAG → Phosphatidyl inositol  *All synthetic rxns above release CMP is a byproduct.

- PC & PE are essential and primarily obtained from diet, they are very similar in structure, both can be synthesized by altering the structure of the head on PS. (this process takes place in the liver)  
PS  $\xrightarrow{\text{decarboxylation}}$  PE  $\xrightarrow{\text{methylation}}$  PC

- PA synthesis: (G3P+2FA)



- PA is the precursor for TAG & glycerophospholipids synthesis.

## Ether glycerophospholipids

- not synthesized in the ER
- has an alkyl group attached via either linkage on C1
- **Types:**
  - 1) Plasmalogens:**
    - a) Phosphatidyl ethanolamine (abundant in nerve tissue, has an unsaturated alkyl group on C1 and an acyl group with ester bonding on C2)
    - b) Phosphatidyl choline (abundant in heart muscles, quantitatively significant in mammals)

### 2) Platelet-activating factor (PAF)

Structure: saturated alkyl group on C1 & an Acetyl group on C2

Function: induces thrombosis and inflammation

## Surfactants

- prevent alveolar collapse (atelectasis) by decreasing surface tension & maintaining alveoli in their stretched form.
- Clinical application: RDS—respiratory distress syndrome  
premature infants lack mature lungs & surfactants  
Treatment: administration of glucocorticoids shortly before delivery to induce expression of specific genes to produce surfactants in premature babies.

## Degradation of Phospholipids by phospholipases

**Phospholipase A<sub>1</sub>** → removes FA on C1

**Phospholipase A<sub>2</sub>** → removes FA on C2 & releases arachidonic acid from PI

**Phospholipase C** → acts before the phosphate group releases IP3

**Phospholipase D** → acts after the phosphate group (releases inositol)

- **Phospholipase A<sub>2</sub>** is a zymogen activated by trypsin, present in snakes and bee venoms: damages glycerophospholipids which causes cell damage like RBCs damage resulting in excessive bleeding which explains why snakes are fatal.

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