# Quadrant II – Transcript and Related Materials

**Programme: Bachelor of Science (Second Year)**

**Subject: Zoology**

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**Paper Title: Animal Physiology & Biochemistry**

**Unit: 08- Lipids**

**Module Name: Structure and Significance of Phospholipids**

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**Introduction of Phospholipids:**

Lipids are molecules that include fats, waxes, and some vitamins, among others. A phospholipid is a type of lipid molecule that is the main component of the cell membrane. When many phospholipids line up, they form a double layer that is characteristic of all cell membranes.

**Structure of Phospholipids:**

They are abundant in all biological membranes. A phospholipid molecule is constructed from four components: fatty acids, a platform to which the fatty acids are attached, a phosphate, and an alcohol attached to the phosphate. The fatty acid components provide a hydrophobic barrier, whereas the remainder of the molecule has hydrophilic properties to enable interaction with the environment.

In phospholipids, two of the OH groups in glycerol are linked to fatty acids while the third OH group is linked to phosphoric acid. The phosphate group is negatively charged, making the head polar and hydrophilic, or “water loving.” The phosphate heads are thus attracted to the water molecules in their environment.

The lipid tails, on the other hand, are uncharged, nonpolar, and hydrophobic, or “water fearing.” A hydrophobic molecule repels and is repelled by water. Some lipid tails consist of saturated fatty acids and some contain unsaturated fatty acids. This combination adds to the fluidity of the tails that are constantly in motion.

Phospholipids are further divided into phosphoglycerides, phosphoinositides and phosphosphingosides.

**1. Phosphoglycerides:**

Glycerophospholipids, also called phosphoglycerides, are membrane lipids in which two fatty acids are attached in ester linkage to the first and second carbons of glycerol, and a highly polar or charged group is attached through a phosphodiester linkage to the third carbon.

All of them contain two nonpolar tails, each consisting of a long chain (usually C16 or C18) fatty acid. Usually one of the fatty acids is saturated and the other unsaturated. All phosphoglycerides have a negative charge on phosphoric group at pH 7. The following are the examples of phosphoglycerides.

**a) Phosphatidic acid:** It is important as an intermediate in the synthesis of triacylglycerols and phospholipids. Found in inner membrane of mitochondria and bacterial wall.

**b) Lecithins:** They are widely distributed in nature and present in animals glandular & nervous tissues. It is required for the normal transport & utilization as other lipids. In addition to glycerol & 2 moles of fatty acids, the lecithin also contains phosphoric acid and a nitrogen base choline at either the end or middle Carbon atom of glycerol unit.

**c) Cephalins:** Cephalins are closely associated with lecithins in animal tissues. These have also been identified from soybean oil. Similar in structure to the lecithins except that the choline is replaced by either ethanolamine or serine. Accordingly, two types of cephalins are recognized, phosphatidyl ethanolamine and phosphatidyl serine.

**d) Phosphatidyl Serine:** Consists of two fatty acids attached in ester linkage to the first and second carbon of glycerol and serine attached through a phosphodiester linkage to the third carbon of the glycerol. It plays a key role in cell cycle signaling, specifically in relation to apoptosis.

**e) Plasmalogens:** Plasmalogens constitute about 10% of the phospholipids of the brain and muscle. It resembles lecithins & cephalins but have one of the fatty acids replaced by unsaturated ether.

Since the nitrogen base can be choline, ethanolamine or serine 3 types of plasmalogens are accordingly distinguished, phosphatidal choline, phosphatidal ethanolamine & phosphatidal serine.

**2) Phosphosphingosides:**

It is found in nerve tissue and apparently lack in plants and the microorganisms. These differ from the other phospholipids in their lack of glycerol & the presence of another nitrogenous base, Sphingosine or a closely related dihydrosphingosine, besides choline, in place of glycerol.

**3) Phosphoinositides:**

Phosphoinositides have been found to occur in phospholipids of brain tissue and of soybeans and are of considerable importance because of their role in transport processes in cells. These are phospholipids where a cyclic hexahydroxy alcohol called inositol replaces base. The inositol is present as the stereoisomer, myo-inositol.

**Properties of phospholipid:**

They can form lipid bilayers because of their amphiphilic characteristic.

Cells and organelles are surrounded by water and they contain a watery cytoplasm, which causes the phospholipids to spontaneously arrange themselves in a double layer that is very stable.

Outside the cell, the hydrophilic heads face the water and their hydrophobic tails are directed inward. Inside the cell, the hydrophilic heads face the cytoplasm and their hydrophobic tails are directed outward.

**Significance of Phospholipids:**

1) Phospholipids join together to form phospholipid bilayers. This is the major component of the cell membrane.

2) Phospholipids help transfer biological signals across the cell membrane, they form a barrier between the cell and the exterior.

3) They participate in the transport of cholesterol and thus help in the removal of cholesterol from the body.

4) They participate in the absorption of fats from the intestine.

5) They are essential for the synthesis of different lipoproteins and thus participate in transport of lipids.

6) They prevent accumulation of fats in liver.

7) Cephalins are necessary for blood clotting.

8) Phospholipid that is both structural and functional is sphingomyelin, forms the insulation that protects nerves and facilitates the conduction of nerve impulses.