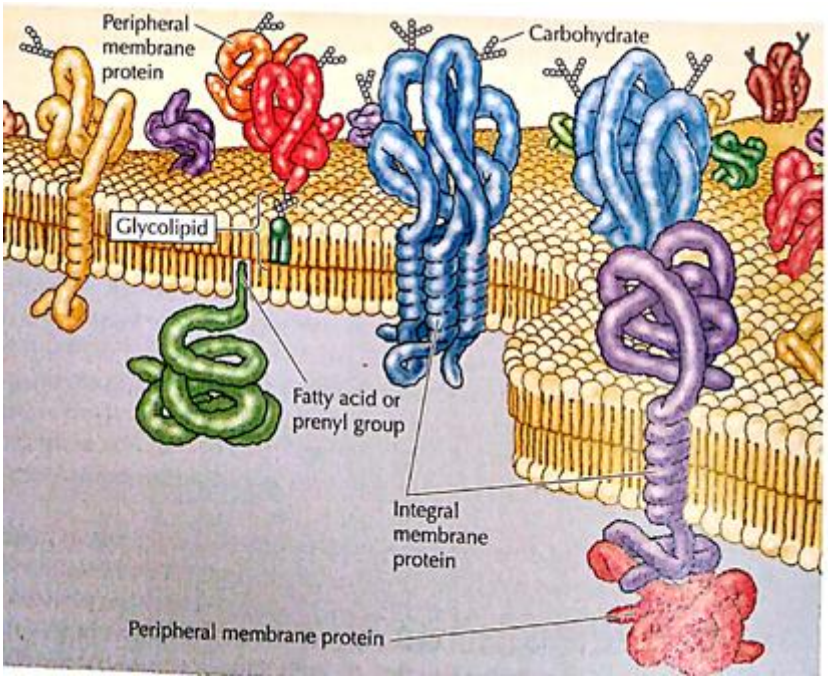

Biophysics and Cell Membrane

Lecture 2

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Lipids

Rules of lipids in the cell

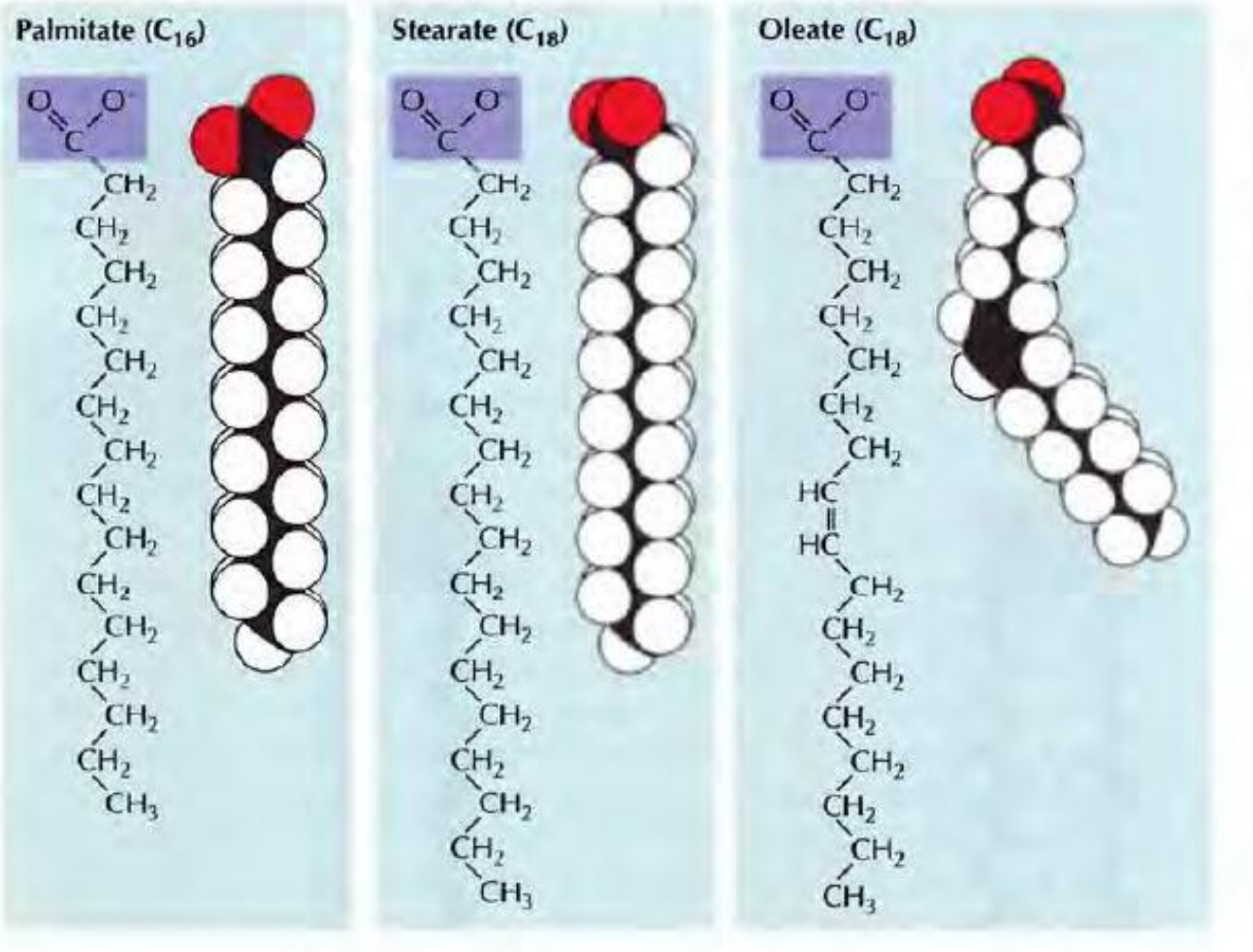
1	they provide an important form of energy storage
2	They are the major components of cell membranes
3	play important roles in cell signaling, both as steroid hormones (e.g., estrogen and testosterone) and as messenger molecules that convey signals from cell surface receptors to targets within the cell

Fatty acids

The simplest lipids are fatty acids, which consist of long hydrocarbon chains, most frequently containing 16 or 18 carbon atoms, with a carboxyl group (COO-) at one end.

Saturation

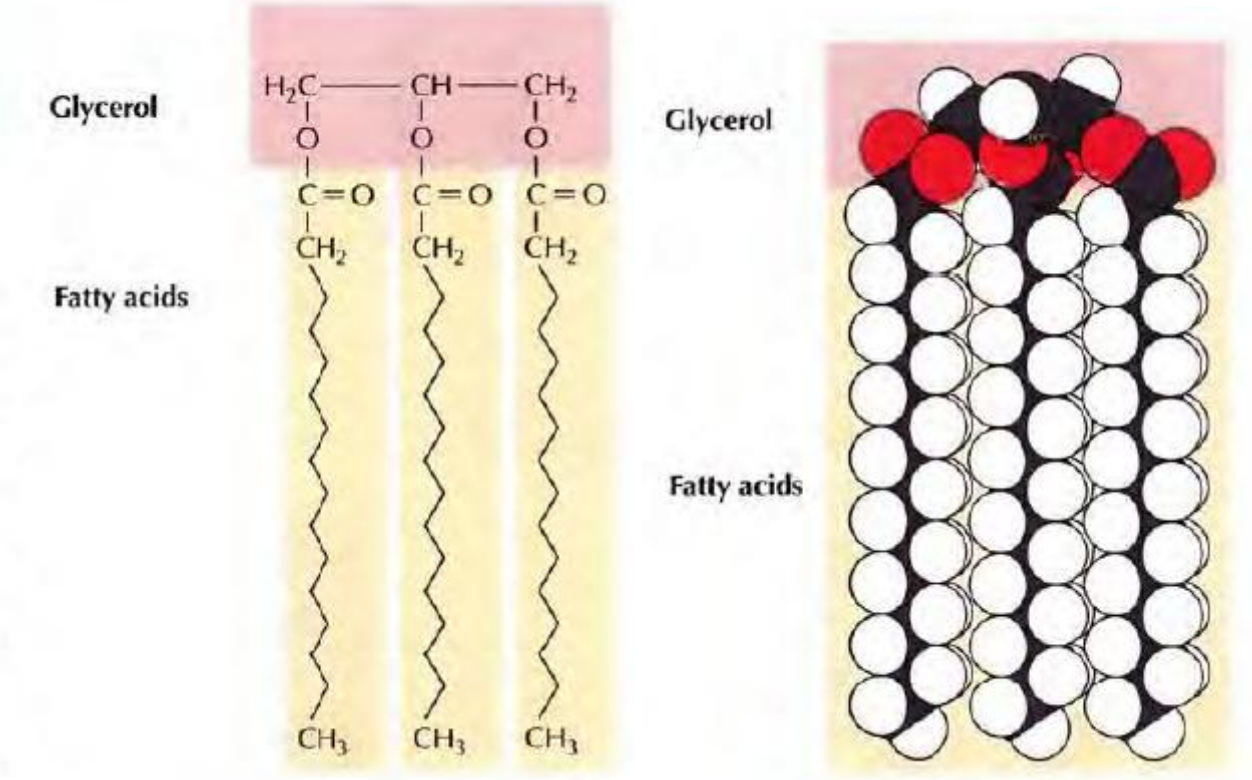
Unsaturated fatty acids contain one or more double bonds between carbon atoms;	saturated fatty acids all of the carbon atoms are bonded to the maximum number of hydrogen atoms



Nonpolar tail

The long hydrocarbon chains of fatty acids contain only **nonpolar C-H bonds**, which are unable to interact with water. The **hydrophobic** nature of these fatty acid chains is **responsible for much of the behavior of complex lipids, particularly in the formation of biological membranes.**

Triacylglycerols (Fats)



Structure

Fatty acids are stored in the form of triacylglycerols, or fats, which consist of three fatty acids linked to a glycerol molecule (Figure above).

Solubility

Triacylglycerols are insoluble in water and therefore accumulate as fat droplets in the cytoplasm.

For use of the cell

When required, they can be broken down for use in energy yielding reactions

Efficiency of energy storage

It is noteworthy that fats are a more efficient form of energy storage than carbohydrates, yielding more than

twice as much as energy per weight of material broken down. Fats therefore allow energy to be stored in less than half the body weight that would be required to store the same amount of energy in carbohydrates; a particularly important consideration for animals because of their mobility.

Phospholipids

Phospholipids, the principal components of cell membranes, consist of two fatty acids joined to a polar head group.

Glycerol phospholipids

In the glycerol phospholipids, the two fatty acids are bound to carbon atoms in glycerol, as in triacylglycerols. The third carbon of glycerol, however, is bound to a phosphate group, which is in turn frequently attached to another small polar molecule, such as choline, serine, inositol, or ethanolamine.

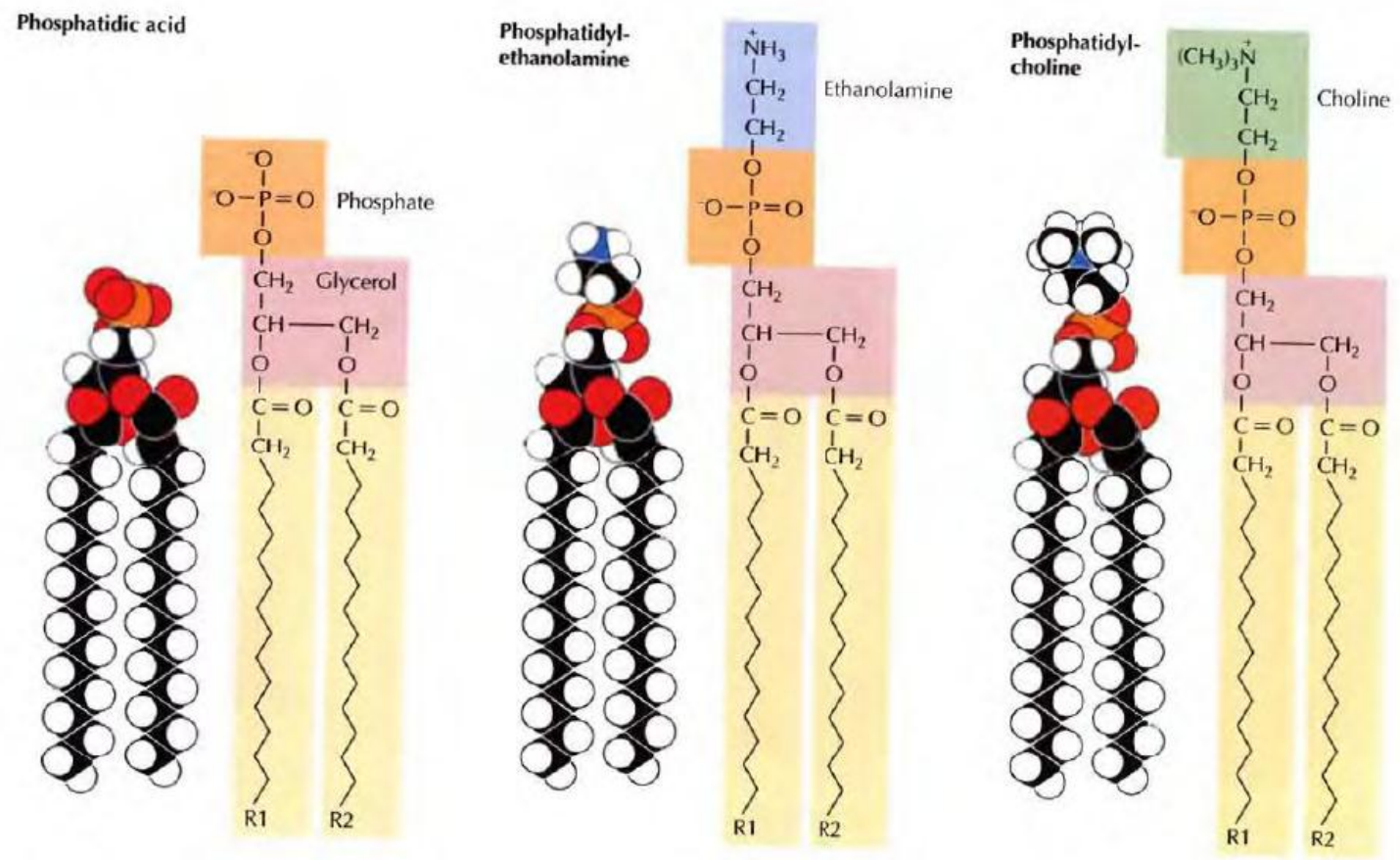
NonGlycerol phospholipids

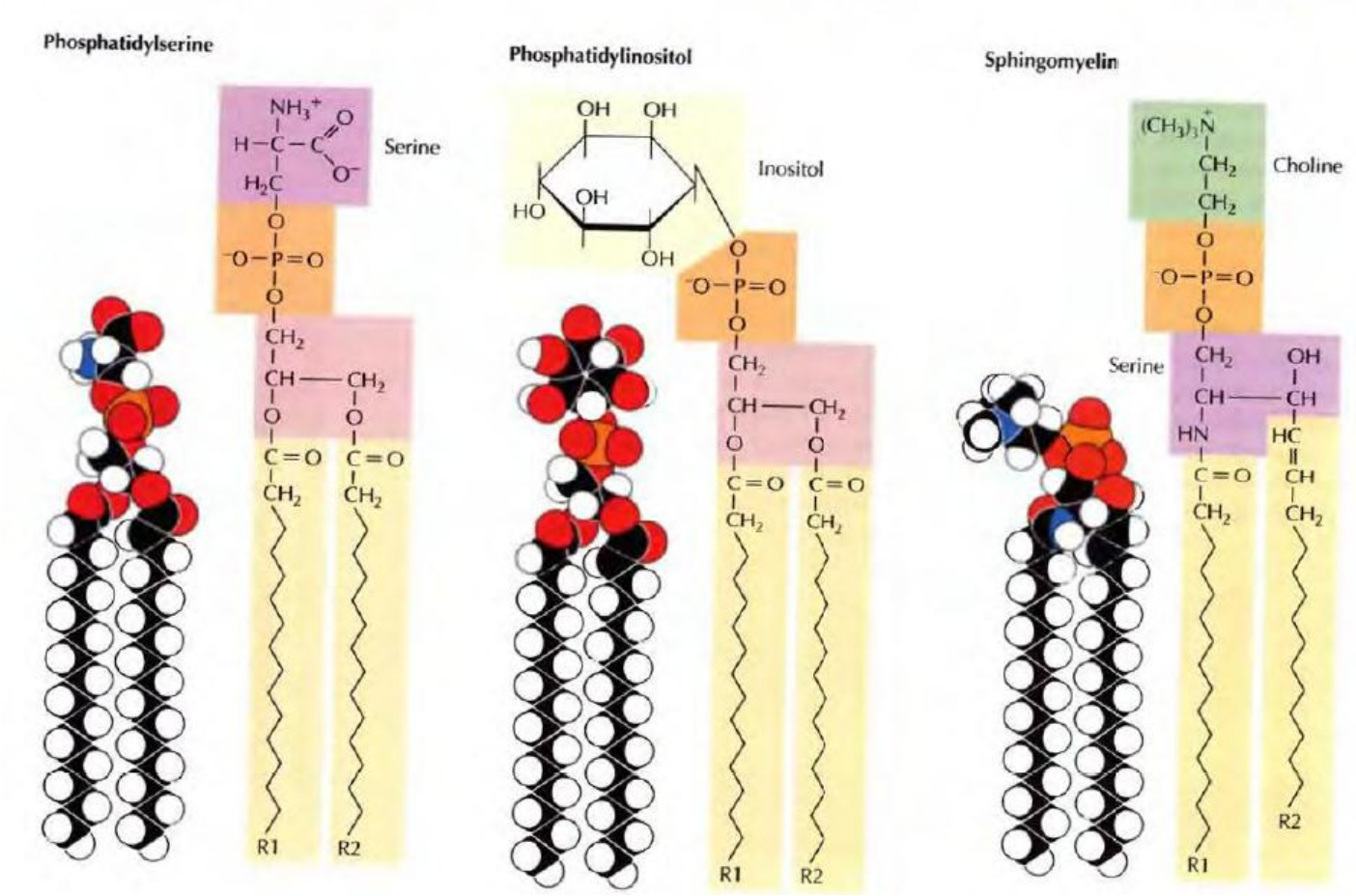
Sphingomyelin, the only nonglycerol phospholipid in cell membranes, contains two hydrocarbon chains linked to a polar head group formed from serine rather than from glycerol.

Head and tail (amphipathic)

All phospholipids have **hydrophobic tails**, consisting of the two hydrocarbon chains, and **hydrophilic head groups, consisting of the phosphate group and its polar attachments**. Consequently, **phospholipids are amphipathic molecules, part water-soluble and part water-insoluble**.

This property of phospholipids is the basis for the formation of biological membranes,





Glycolipids and cholesterol

In addition to phospholipids, many cell membranes contain glycolipids and cholesterol.

Glycolipids

They consist of two hydrocarbon chains linked to polar head groups that contain carbohydrates.

They are thus similar to the phospholipids in their general organization as amphipathic molecules.

Cholesterol,

Cholesterol, in contrast, consists of four hydrocarbon rings rather than linear hydrocarbon chains (Figure 2.9). The hydrocarbon rings are strongly hydrophobic,

but the hydroxyl (OH) group attached to one end of cholesterol is weakly hydrophilic, so cholesterol is also amphipathic.

Role of lipids (stores-drivers)

components of cell membranes, signaling molecules, both within and between cells.

The steroid hormones (such as estrogens and testosterone) are derivatives of cholesterol (see Figure 2.9). These hormones are a diverse group of chemical messengers, all of which contain four hydrocarbon rings to which distinct functional groups are attached. Derivatives of phospholipids also serve as messenger molecules within cells, acting to convey signals from cell surface receptors to intracellular targets that regulate a wide range of cellular processes, including cell proliferation, movement, survival, and differentiation

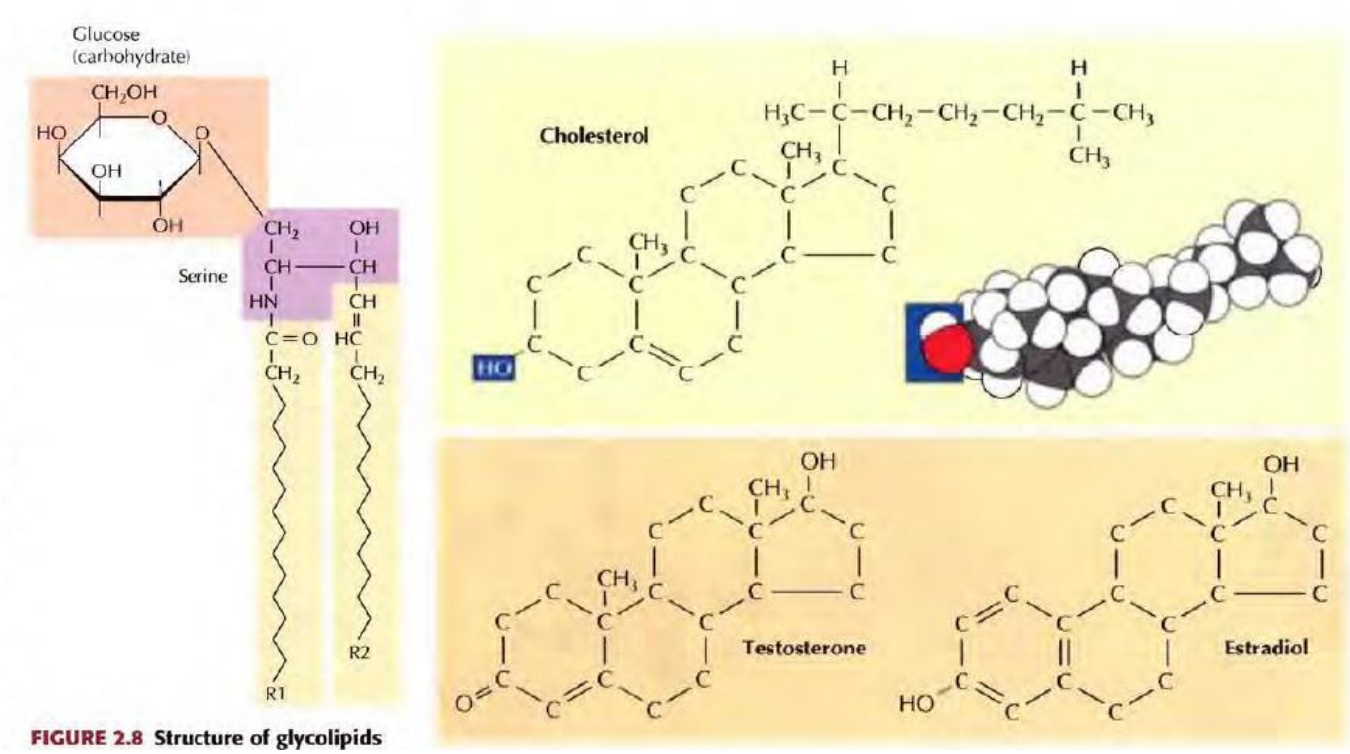


FIGURE 2.8 Structure of glycolipids

Complete:

1. ……. consist of long hydrocarbon chains, most frequently containing 16 or 18 carbon atoms, with a carboxyl group (COO-) at one end.
2. ……..fatty acids contain one or more double bonds between carbon atoms;
3. steroid hormones (such as …….. and ……) are derivatives of cholesterol
4. …….consist of two hydrocarbon chains linked to polar head groups that contain carbohydrates
5. …….consists of four hydrocarbon rings rather than linear hydrocarbon chains
6. ……..contains two hydrocarbon chains linked to a polar head group formed from serine
7. In the ……. phospholipids, the two fatty acids are bound to carbon atoms in glycerol, as in triacylglycerols. The third carbon of glycerol, however, is bound to a ……. group, which is in turn frequently attached to another small …… molecule, such as choline, serine, inositol, or ethanolamine.