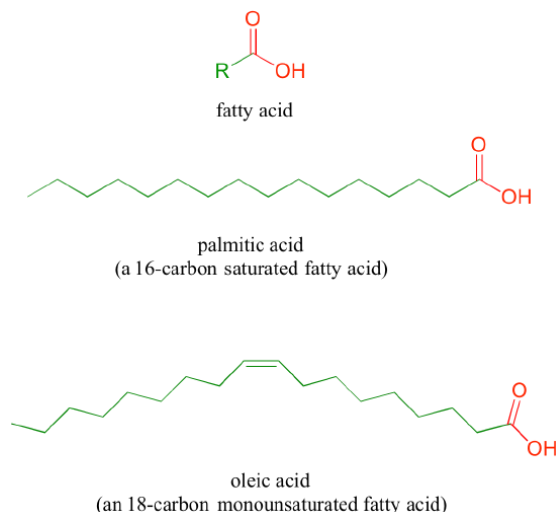
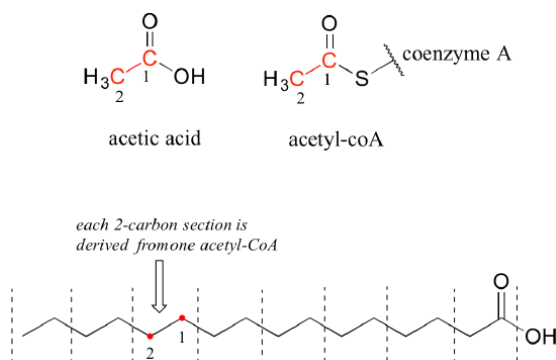


1.4.3: Introduction to Lipid Structure

Lipids are a class of biomolecules which includes fats, oils, waxes, and compounds such as cholesterol that are referred to as 'isoprenoids'. Fats, oils, and waxes all incorporate **fatty acids**, which are composed of hydrocarbon chains terminating in a carboxylic acid/carboxylate group (we will learn in Chapter 7 that carboxylic acids are predominantly in their anionic, carboxylate form in biological environments). Saturated fatty acids contain only alkane carbons (single bonds only), monounsaturated fatty acids contain a single double bond, and polyunsaturated fatty acids contain two or more double bonds. The double bonds in naturally occurring fatty acids are predominantly in the *cis* configuration.

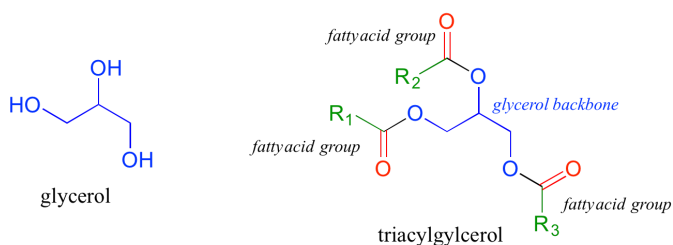


Fatty acids are synthesized in the body by a process in which the hydrocarbon chain is elongated two carbons at a time. Each two-carbon unit is derived from a metabolic intermediate called **acetyl-coA**, which is essentially an acetic acid (vinegar) molecule linked to a large 'carrier' molecule, called coenzyme A, by a thioester functional group. We will see much more of coenzyme A when we study the chemistry of thioesters in chapter 11.



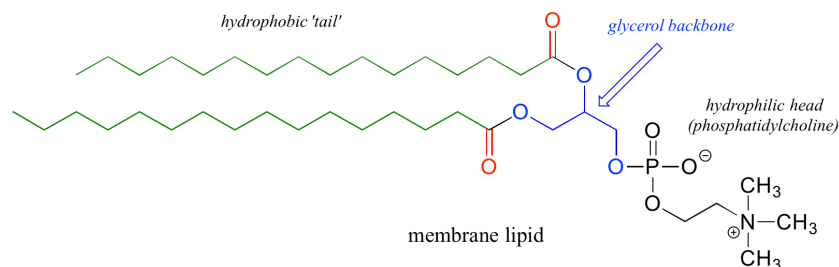
The breakdown of fatty acids in the body also occurs two carbons at a time, and the endpoint is again acetyl-coenzyme A. We will learn about the details of all of the reactions in these metabolic pathways at various places in this book. If you go on to take a biochemistry course, you will learn more about the big picture of fatty acid metabolism - how it is regulated, and how it fits together with other pathways of central metabolism.

Fats and oils are forms of **triacylglycerol**, a molecule composed of a glycerol backbone with three fatty acids linked by ester functional groups.



Solid fats (predominant in animals) are triacylglycerols with long (16-18 carbon) saturated fatty acids. Liquid oils (predominant in plants) have unsaturated fatty acids, sometimes with shorter hydrocarbon chains. In chapter 2 we will learn about how chain length and degree of unsaturation influences the physical properties of fats and oils.

Cell membranes are composed of **membrane lipids**, which are **diacylglycerols** linked to a hydrophilic '**head group**' on the third carbon of the glycerol backbone. The fatty acid chains can be of various lengths and degrees of saturation, and the two chains combined make up the hydrophobic 'tail' of each membrane lipid molecule.



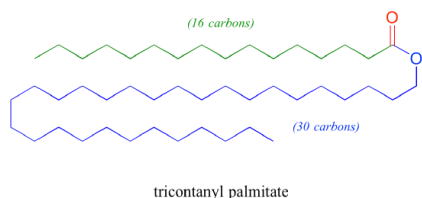
In chapter 2 we will see how these molecules come together to form a cell membrane.

Exercise 1.17

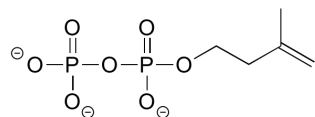
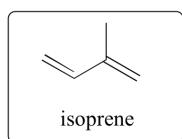
What functional group links the phosphatidylcholine 'head' group to glycerol in the membrane lipid structure shown above?

Solutions to exercises

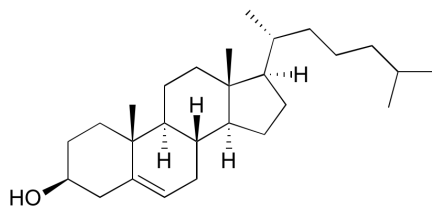
Waxes are composed of fatty acids linked to long chain alcohols through an ester group. Tricontanyl palmitate is a major component of beeswax, and is constituted of a 16-carbon fatty acid linked to a 30-carbon alcohol.



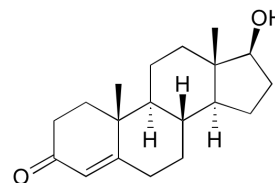
Isoprenoids, a broad class of lipids present in all forms of life, are based on a five-carbon, branched-chain building block called isoprene. In humans, cholesterol and hormones such as testosterone are examples of isoprenoid biomolecules. In plants, isoprenoids include the deeply colored compounds such as lycopene (the red in tomatoes) and carotenoids (the yellows and oranges in autumn leaves).



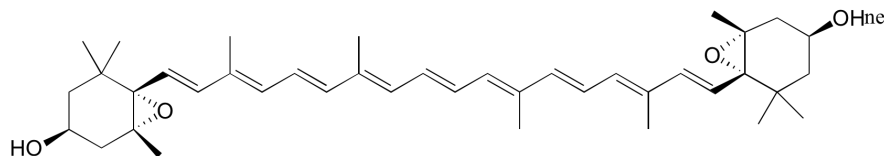
isopentenyl diphosphate



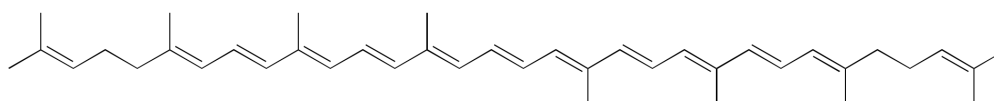
cholesterol



testosterone

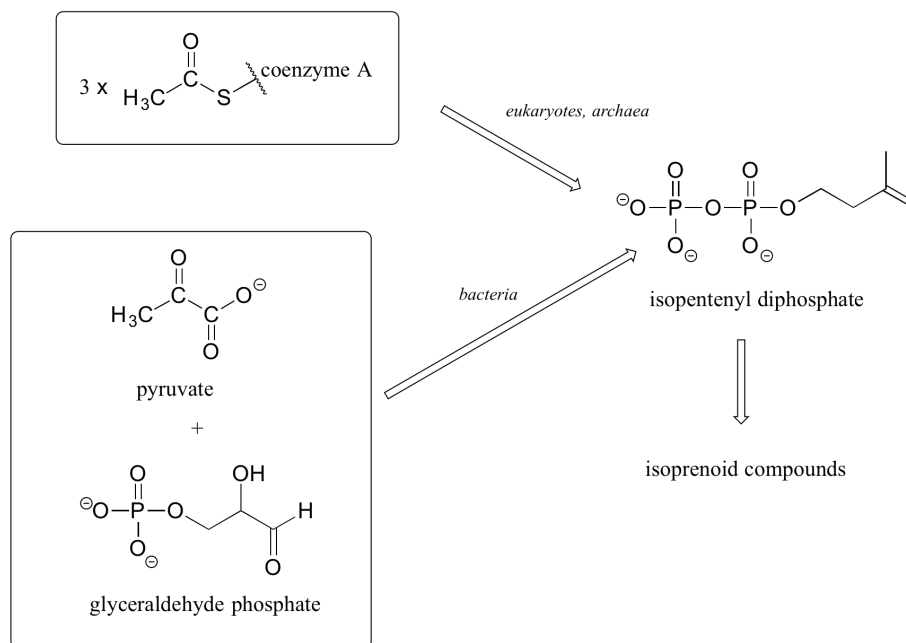


violaxanthin
(a carotenoid)



lycopene

In almost all eukaryotes, isopentenyl diphosphate (the building block molecule for all isoprenoid compounds) is synthesized from three acetyl-Coenzyme A molecules. Bacteria and the plastid organelles in plants have a different biosynthetic pathway to isopentenyl diphosphate, starting with pyruvate and glyceraldehyde phosphate.



Intro to carbohydrates⇒

Contributors and Attributions

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