

## Essential Fatty acids

Some polyunsaturated fatty acids cannot be synthesized by animals and are therefore to be supplied through food and they are called **essential fatty acids**. **Linoleic acid** and **linolenic acid** are the two fatty acids known to be essential for the complete nutrition of many species of animals. The third essential fatty acid **arachidonic acid** can be formed from linoleic acid in most mammals. Double bonds can be introduced at the  $\Delta^4$ ,  $\Delta^5$ ,  $\Delta^6$ ,  $\Delta^9$ , positions (counting from the carboxy 1 terminal) but never beyond the  $\Delta^9$ , position in animals. In contrast, plants are able to introduce additional double bonds at  $\Delta^{12}$ , and  $\Delta^{15}$  positions and can therefore synthesize the nutritionally essential fatty acids.

The nonessential monounsaturated fatty acids are synthesized from smaller saturated fatty acids by several tissues including the liver.

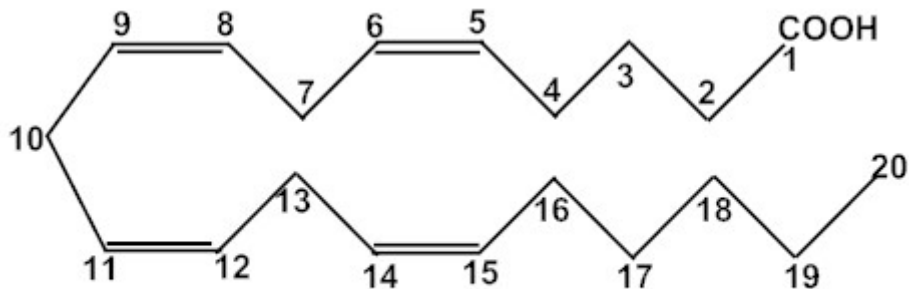


### Functions

The essential fatty acids in high concentrations, along with other lipids constitute the structural element of tissues. They are needed for the synthesis of eicosanoids which have important functions. The lipids of gonads also contain a high concentration of polyunsaturated fatty acids which suggest the importance in reproduction. They retard atherosclerosis being esterified and emulsified with cholesterol and are incorporated into lipoproteins for transport to the liver for further oxidation. They cure skin lesions. They effect prolongation of clotting time and increase the fibrinolytic activity.

## Eicosanoids

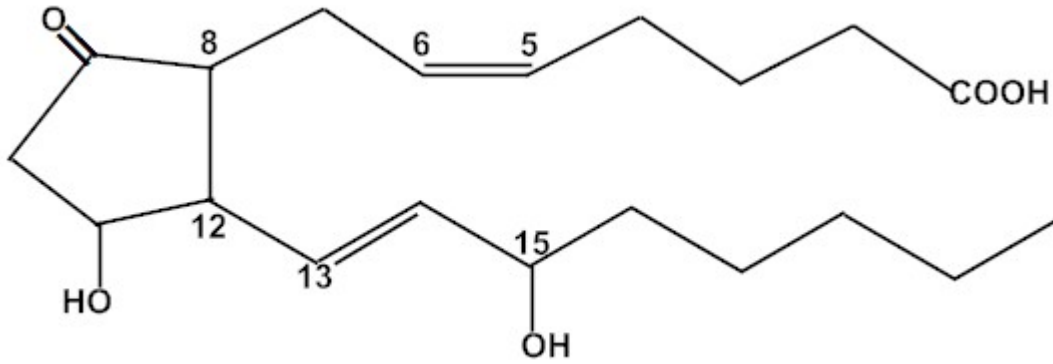
These compounds are derived from eicosapolyenoic fatty acids (20-carbon) comprise the prostaglandins, prostacyclins, leukotrienes and thromboxanes .



Arachidonic Acid

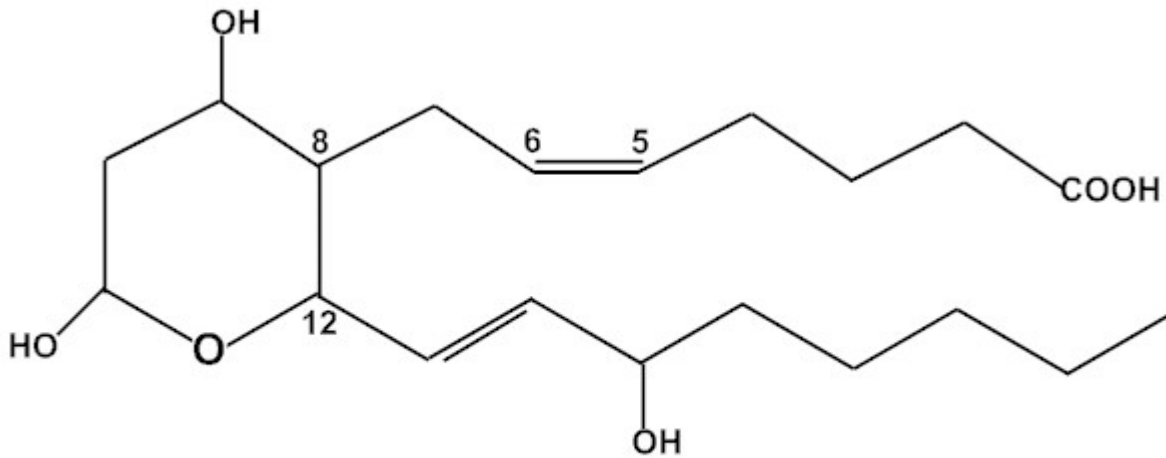
### Prostaglandin:

A Prostaglandin is a messenger lipid that is a C20-fatty acid derivative that contains a cyclopentane ring and oxygen-containing functional groups. [Prostaglandins](#) are involved in many regulatory functions, including raising body temperature, inhibiting the secretion of gastric juices, relaxing and contracting smooth muscle, directing water and electrolyte balance, intensifying pain, and enhancing inflammation responses.



Thromboxane:

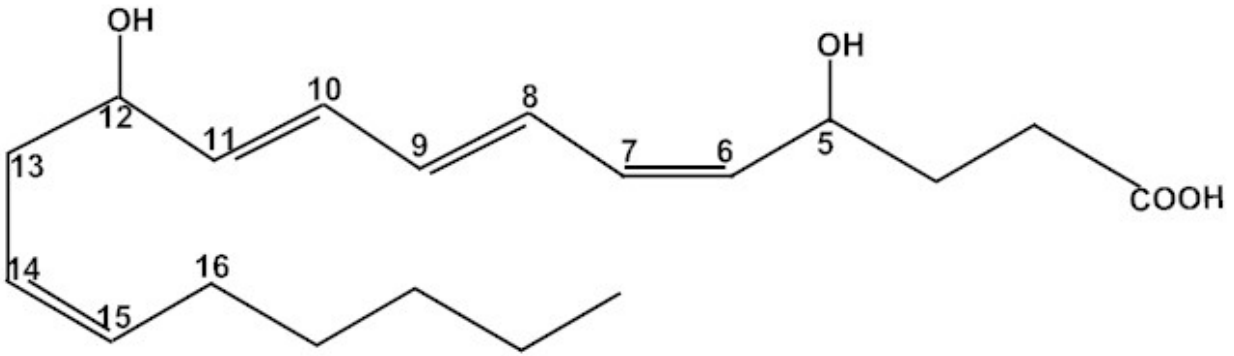
A thromboxane is a messenger lipid that is a C<sub>20</sub> fatty acid derivative that contains a cyclic ether ring and oxygen-containing functional groups. An important function of thromboxane is to promote the formation of blood clot and promote aggregation.



Thromboxane B<sub>2</sub>

Leukotrienes:

A leukotriene is a messenger lipid that is a C<sub>20</sub>-fatty acid derivative that contains three conjugated double bonds and hydroxy groups. Various inflammatory and hypersensitivity (allergy) responses are associated with elevated levels of leukotrienes.



**Prostaglandins:**

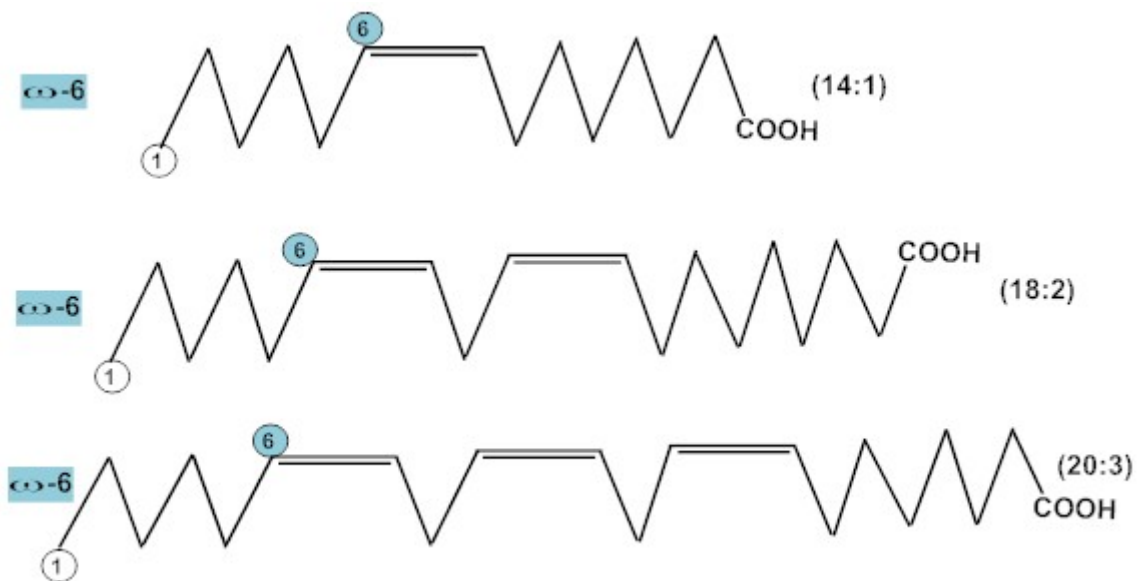
Prostaglandins are C<sub>20</sub> fatty acid derivative. They are important component of blood and are involved in prevention of blood clotting.

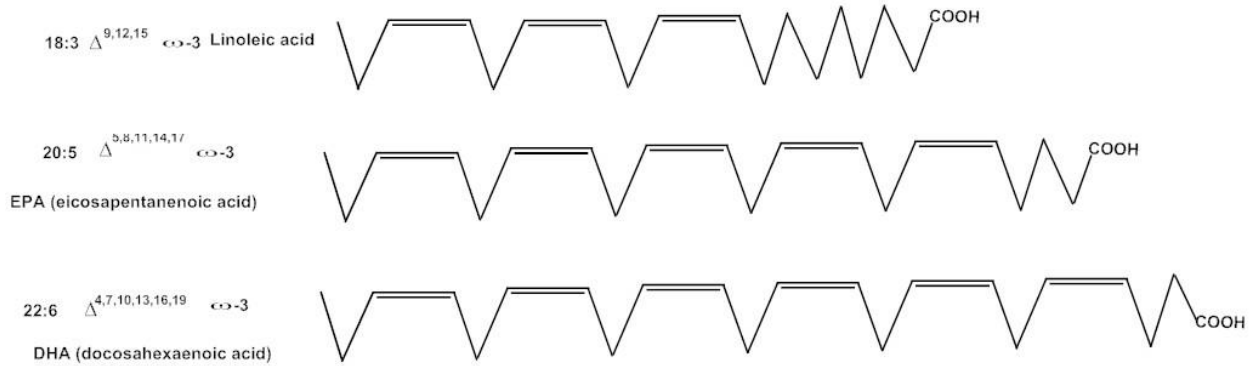
### Omega-3 ( $\omega$ 3) and omega-6 ( $\omega$ 6) fatty acids

**Omega-3 ( $\omega$ 3)** and **omega-6 ( $\omega$ 6)** fatty acids are unsaturated “Essential Fatty Acids” (EFAs) that need to be included in the diet because the human metabolism cannot synthesis them from other fatty acids.

Since these fatty acids are polyunsaturated, the terms n-3 PUFAs and n-6 PUFAs are applied to omega-3 and omega-6 fatty acids, respectively. These fatty acids use the Greek alphabet ( $\alpha, \beta, \gamma, \dots, \omega$ ) to identify the location of the double bonds. The “**alpha**” carbon is the carbon closest to the carboxyl group (carbon 2), and the “**omega**” is the last carbon of the chain because omega is the last letter of the Greek alphabet.

**Linoleic acid** is an **omega-6 fatty acid** because it has a double bond **six carbons away from the “omega” carbon**. **Alpha-linolenic acid** is an **omega-3 fatty acid** because it has a double bond **three carbons away from the “omega” carbon**





**Linoleic acid** plays an important role in lowering cholesterol levels.

**Arachidonic acid** is an omega-6 fatty acid. This type of terminology is sometimes applied to oleic acid which is an omega-9 fatty acid. In these simplified structural formulas all the double bonds have the [Cis configuration](#).

These two, linoleic acid (LA) and alpha linolenic acid (ALA), are widely distributed in plant oils.

In addition, fish oils contain the longer-chain omega-3 fatty acids **eicosapentaenoic acid (EPA)** and **docosahexaenoic acid (DHA)**. Other marine oils, such as those from whale, seal, porpoise etc. also contain significant amounts of docosapentaenoic acid (DPA), which is also an omega-3 fatty acid.

Although the body, to some extent, can convert ALA into these longer-chain omega-3 fatty acids, the omega-3 fatty acids found in marine oils help fulfill the requirement of essential fatty acids.

### Functions of omega 3 and omega 6 fatty acids

Omega 3 DHA (docosahexaenoic acid) and omega 6 AA (arachidonic acid) are both crucial to the optimal development of the brain and eyes. The importance of DHA and AA in infant nutrition is well established, and both substances are routinely added to infant formulas.

Excessive amounts of omega-6 polyunsaturated fatty acids and a very high omega-6/omega-3 ratio have been linked with pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory and autoimmune diseases.

The ratio of omega-6 to omega-3 in modern diets is approximately 15:1, whereas ratios of 2:1 to 4:1 have been associated with reduced mortality from cardiovascular disease, suppressed inflammation in patients with rheumatoid arthritis, and decreased risk of breast cancer.

Some researchers have suggested that there is not very strong evidence for the benefits of these ratios, and that it may be better to increase the consumption of omega-3 fatty acids rather than decrease the consumption of omega-6 fatty acids because a reduction of polyunsaturated fats in the diet would increase the incidence of cardiovascular disease.