**Chapter 17** **Fatty Acid Catabolism**

* The oxidation of long-chain fatty acids to acetyl-CoA is a central energy-yielding pathway in many organisms and tissues.
* In mammalian heart and liver, it provides as much as 80% of the energetic needs under all physiological circumstances.
* The electrons removed from fatty acids during oxidation pass through the respiratory chain, driving ATP synthesis.
* The acetyl-CoA produced from the fatty acids may be completely oxidized to CO2 in the citric acid cycle, resulting in further energy conservation.
* Triacylglycerols (also called triglycerides or neutral fats) are suitable as storage fuels.
* The long alkyl chains of fatty acids are essentially hydrocarbons and have an energy more than twice that for the same weight of carbohydrate or protein.

**17.1 Digestion, Mobilization and Transport of Fats**

* Cells can obtain fatty acid fuels from three sources:
* fats consumed in the diet,
* fats stored in cells as lipid droplets,
* fats synthesized in one organ for export to another.

**Dietary Fats Are Absorbed in the Small Intestine**

* Triacylgycerols (**Fig. 10-2)** are degraded to fatty acids and glycerols by intestinal lipases.



R-COOH

Fatty acid



**FIGURE 10-2** The mixed triacylglycerol shown here has three different fatty acids attached to the glycerol backbone.

* The fatty acids are packaged and delivered to muscle and adipose tissues by blood.
* In muscle, the fatty acids are oxidized for energy.
* In adipose tissue, they are reesterified for storage as triacylglycerols.
* The glycerols enter into the glycolytic pathway (**Fig. 17-4)**.





**Fatty Acids Are Activated and Transported into Mitochondria**

* The enzymes of fatty acid oxidation in animal cells are located in the mitochondrial matrix.
* The fatty acids with chain lengths of 12 or fewer carbons enter mitochondria without the help of membrane transporters.
* Those with 14 or more carbons cannot pass directly through the mitochondrial membranes and three enzymatic reactions are required to transport into mitochondria.
* The first reaction is catalyzed by **fatty acyl-CoA synthetase** present in the outer mitochondrial membrane. Fatty acyl–CoA esters are formed at the cytosolic side of the outer mitochondrial membrane **(Fig. 17-5)**.





Fatty acid + CoA + ATP fatty acyl-CoA + AMP + 2 Pi

* The second reaction is catalyzed by **carnitine acyltransferase 1.** Fatty acyl–carnitine is formed at the outer membrane or in the intermembrane space (**Fig. 17-6).**

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* The fatty acyl-carnitine enters the matrix by **acyl-carnitine/carnitine transporter** of the inner mitochondrial membrane (**Fig. 17-6)**.
* The third reaction is regeneration of fatty acyl-CoA by **carnitine acyltransferase 2** on the inner face of the inner mitochondrial membrane (**Fig. 17-6)**.
* Carnitine reenters the intermembrane space via the acyl-carnitine/carnitine transporter (**Fig. 17-6)**.