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BETA OXIDATION OF FATTY ACID

In [biochemistry](https://en.m.wikipedia.org/wiki/Biochemistry) and [metabolism](https://en.m.wikipedia.org/wiki/Metabolism), **beta-oxidation** is the [catabolic process](https://en.m.wikipedia.org/wiki/Catabolism) by which [fatty acid](https://en.m.wikipedia.org/wiki/Fatty_acid) molecules are broken down[[1]](https://en.m.wikipedia.org/wiki/Beta_oxidation#cite_note-1) in the cytosol in prokaryotes and in the [mitochondria](https://en.m.wikipedia.org/wiki/Mitochondria) in eukaryotes to generate [acetyl-CoA](https://en.m.wikipedia.org/wiki/Acetyl-CoA), which enters the [citric acid cycle](https://en.m.wikipedia.org/wiki/Citric_acid_cycle), and [NADH](https://en.m.wikipedia.org/wiki/NADH) and [FADH2](https://en.m.wikipedia.org/wiki/FADH2), which are co-enzymes used in the [electron transport chain](https://en.m.wikipedia.org/wiki/Electron_transport_chain). It is named as such because the [beta carbon](https://en.m.wikipedia.org/wiki/Alpha_and_beta_carbon) of the fatty acid undergoes oxidation to a [carbonyl](https://en.m.wikipedia.org/wiki/Carbonyl) group. Beta-oxidation is primarily facilitated by the [mitochondrial trifunctional protein](https://en.m.wikipedia.org/wiki/Mitochondrial_trifunctional_protein), an enzyme complex associated with the [inner mitochondrial membrane](https://en.m.wikipedia.org/wiki/Inner_mitochondrial_membrane), although [very long chain fatty acids](https://en.m.wikipedia.org/wiki/Very_long_chain_fatty_acid) are oxidized in [peroxisomes](https://en.m.wikipedia.org/wiki/Peroxisome).

The overall reaction for one cycle of beta oxidation is:

C*n*-acyl-CoA + FAD + NAD+
 + H
2O + CoA → C*n*-2-acyl-CoA + FADH
2 + NADH + H+
 + acetyl-CoA

## 3 STAGES OF BETA OXIDATION

Free fatty acids cannot penetrate any biological membrane due to their negative charge. Free fatty acids must cross the cell membrane through specific [transport proteins](https://en.m.wikipedia.org/wiki/Transport_proteins), such as the [SLC27](https://en.m.wikipedia.org/wiki/Solute_carrier_family) family fatty acid transport protein.[[2]](https://en.m.wikipedia.org/wiki/Beta_oxidation#cite_note-2)[[3]](https://en.m.wikipedia.org/wiki/Beta_oxidation#cite_note-3)[[*failed verification*](https://en.m.wikipedia.org/wiki/Wikipedia%3AVerifiability)] Once in the [cytosol](https://en.m.wikipedia.org/wiki/Cytosol), the following processes bring fatty acids into the mitochondrial matrix so that beta-oxidation can take place.

1. [Long-chain-fatty-acid—CoA ligase](https://en.m.wikipedia.org/wiki/Long-chain-fatty-acid%E2%80%94CoA_ligase) catalyzes the reaction between a fatty acid with [ATP](https://en.m.wikipedia.org/wiki/Adenosine_triphosphate) to give a fatty acyl adenylate, plus inorganic pyrophosphate, which then reacts with free [coenzyme A](https://en.m.wikipedia.org/wiki/Coenzyme_A) to give a fatty acyl-CoA ester and [AMP](https://en.m.wikipedia.org/wiki/Adenosine_monophosphate).
2. If the fatty acyl-CoA has a long chain, then the [carnitine shuttle](https://en.m.wikipedia.org/wiki/Carnitine#Carnitine_shuttle:_Activation_and_transportation_of_fatty_acids_into_the_mitochondria) must be utilized:
	1. Acyl-CoA is transferred to the hydroxyl group of carnitine by [carnitine palmitoyltransferase I](https://en.m.wikipedia.org/wiki/Carnitine_palmitoyltransferase_I), located on the cytosolic faces of the [outer](https://en.m.wikipedia.org/wiki/Outer_mitochondrial_membrane) and [inner mitochondrial membranes](https://en.m.wikipedia.org/wiki/Inner_mitochondrial_membrane).
	2. Acyl-carnitine is shuttled inside by a [carnitine-acylcarnitine translocase](https://en.m.wikipedia.org/wiki/Carnitine-acylcarnitine_translocase), as a carnitine is shuttled outside.
	3. Acyl-carnitine is converted back to acyl-CoA by [carnitine palmitoyltransferase II](https://en.m.wikipedia.org/wiki/Carnitine_palmitoyltransferase_II), located on the interior face of the [inner mitochondrial membrane](https://en.m.wikipedia.org/wiki/Inner_mitochondrial_membrane). The liberated carnitine is shuttled back to the cytosol, as an acyl-carnitine is shuttled into the matrix.
3. If the fatty acyl-CoA contains a short chain, these [short-chain fatty acids](https://en.m.wikipedia.org/wiki/Short-chain_fatty_acid) can simply diffuse through the inner mitochondrial membrane