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Beta oxidation is the catabolic process by which fatty acid molecules are broken down in the cytosol in prokaryotes and in the mitochondria in eukaryotes to generate Acetyl-CoA which enters the citric acid cycle and NADH and FADH2; which are coenzymes used in the electron transport chain. It is referred to as beta oxidation because the beta carbon of the fatty acid undergoes oxidation to a carbonyl group. 

Depending on the length, the Acyl-CoA chain will enter the mitochondria in one of two ways;

1. If the Acyl-CoA chain is short, it can freely diffuse through the mitochondrial membrane.
2. If the Acyl-CoA chain is long, it needs to be transported across the membrane by the carnitine shuttle. For this, the enzyme carnitine palmitoyltransferase 1(CPT1)-bound to the outer mitochondrial membrane-converts the acyl-CoA chain to acylcarnitine chain, which can be transported across the mitochondrial membrane by carnitine translocase(CAT). Once inside the mitochondria,CPT2-bound to the inner mitochondrial membrane-converts the acylcarnitine back to acyl-CoA. At this point, acyl-CoA is inside the mitochondria and can now undergo beta oxidation. If the acyl-CoA chain is too long to be processed in the mitochondria, it will be broken down by beta oxidation in the perixosomes. Beta oxidation in the peroxisomes yields H2O2 instead of FADH2 and NADH, producing heat as a result.

Beta oxidation occurs in four stages. Each stage is catalyzed by a distinct enzyme. Briefly, each cycle of this process begins with an acyl-CoA chain and ends with one acetyl-CoA, one FADH2, one NADH and water, and the acyl-CoA chain becomes two carbons shorter. The total energy yield per cycle is 17 ATP molecules. This cycle is repeated until two acetyl-CoA molecules are formed as opposed to one acyl-CoA and one acetyl-CoA. Thus, the four stages of beta oxidation are described below;

1. **DEHYDROGENATION:** In this stage, acyl-CoA is oxidized by the enzyme acyl CoA dehydrogenase. A double bond is formed between the second and third carbons of the acyl-CoA chain entering the beta oxidation cycle. This stage uses FAD and produces FADH2, which will enter the citric acid cycle and form ATP to be used as energy. 
2. **Hydration:** in this stage, the double bond between the second and third carbon of trans-enoyl –CoA is hydrated, forming the end product L-beta-hydroxyacyl CoA, which has a hydroxyl group in cabon two, in place of the double bond. This reaction is catalyzed by another enzyme called enoyl CoA hydratase. This stage requires water. 
3. **OXIDATION:** in this stage, the hydroxyl group in carbon two of L-beta-hydroxyacyl CoA is oxidized by NAD+ in a reaction that is catalyzed by 3-hydroxyacyl-CoA dehydrogenase. The end products are beta-ketoacyl CoA and NADH+H. NADH will the citric acid cycle and produce ATP that will be used as energy. 

Thus, the general reaction of one cycle of beta oxidation is:

Cn-acyl-CoA+FAD+NAD++H2O+CoA🡪Cn2-acyl-CoA+FADH2+NADH+H++acetyl-CoA