2

Metabolism

2.1 Glycolysis

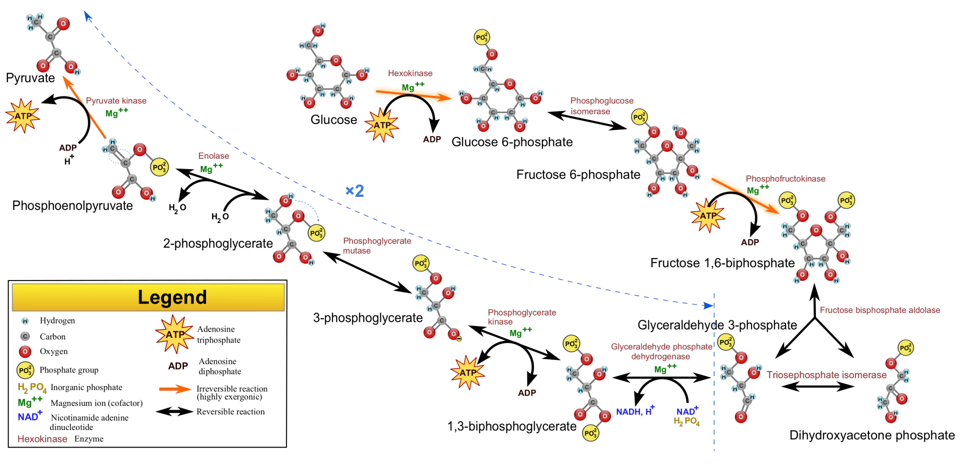

Figure 2.1 Glycolysis

2.2 The citric-acid cycle

Hundreds of different chemical reactions take place in a living cell. These reactions swap inputs and outputs and form a robust system that keeps the cell alive, enables it to adapt to its environment, and to divide when appropriate.

Some of these reactions are **cycles** in that they produce some of the molecules that they use. One of the most important cycles is the **citric-acid cycle**, also known as as the **tricarboxylic-acid cycle** (or **TCA** cycle) and as the **Krebs cycle**. Citric acid has three carboxylic-acid groups as in figure 2.2.

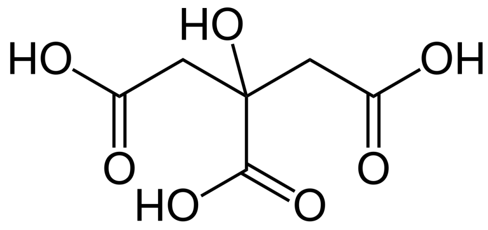

Figure 2.2 Citric acid. The unlabeled vertices are carbon atoms with as many hydrogens as needed to attach to the four bonds of each carbon atom. (Courtesy of Neurotiker via Wikimedia Commons)

It is a cycle because it consumes and regenerates citrate. The citric-acid cycle oxidizes acetate to make **NADH** which cells use to make ATP. The acetate comes in the form of **acetyl-CoA** from carbohydrates, fats, and proteins. The cycle adds a **hydride** ion H^- to NAD^+ thereby **reducing** it to the **reducing agent NADH** and **succinate** which the **oxidative phosphorylation** or **electron transport** pathway uses to make ATP. The TCA cycle also makes precursors of various amino acids and CO_2 as a waste product.

In eukaryotic cells, mitochondria perform the citric-acid cycle; in prokaryotic cells, the cycle occurs in the cytosol.

Acetyl-coA has three phosphate groups and one purine nucleotide. It ends in a sulfur atom which can bind to an acetyl group $COCH_3$.

$NADH^+$ is nicotinamide adenine dinucleotide, a derivative of vitamin B3 (niacin).

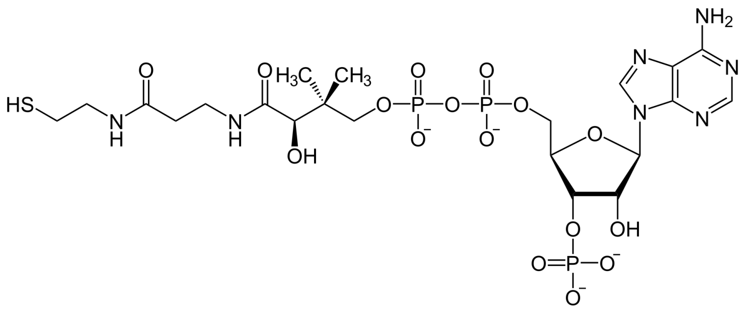

Figure 2.3 Coenzyme-A. An acetyl group $COCH_3$ binds to the sulfur atom at the far left. (Courtesy of Wikipedia)

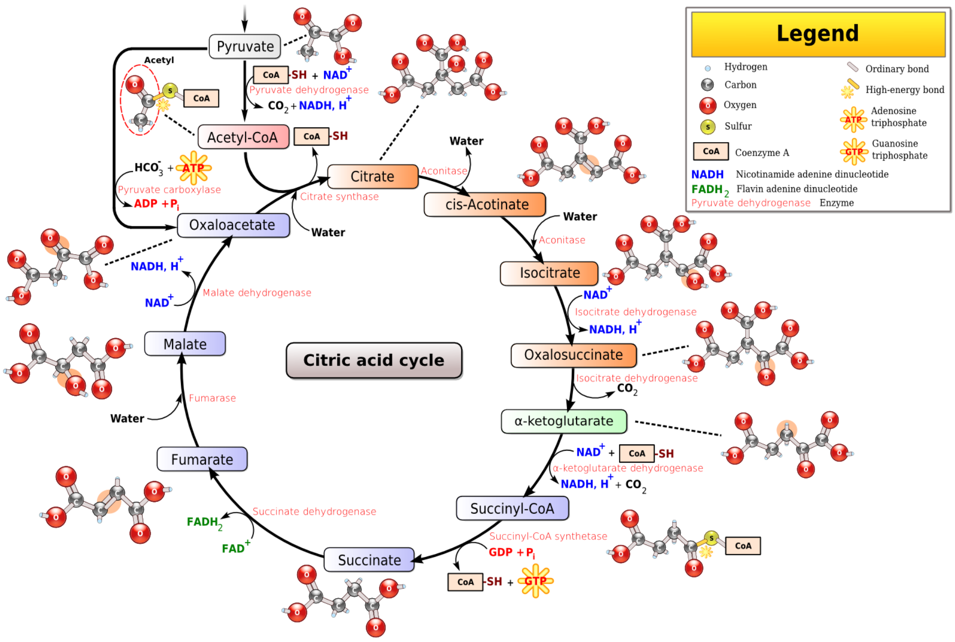

Figure 2.4 The citric-acid cycle. (Courtesy of Wikipedia)