

## The Krebs Cycle

The Krebs cycle, also known as the citric acid cycle or tricarboxylic acid (TCA) cycle, is a series of chemical reactions.

The cycle occurs in the mitochondria of cells and is central to cellular respiration. It follows glycolysis and the pyruvate decarboxylation.

Key steps in the Krebs cycle:

1. Acetyl-CoA combines with oxaloacetate to form citrate
2. Citrate is converted to isocitrate
3. Isocitrate is oxidized to  $\alpha$ -ketoglutarate, releasing CO<sub>2</sub>
4.  $\alpha$ -Ketoglutarate is converted to succinyl-CoA, releasing CO<sub>2</sub>
5. Succinyl-CoA is converted to succinate, generating GTP/ATP
6. Succinate is oxidized to fumarate
7. Fumarate is hydrated to malate
8. Malate is oxidized to oxaloacetate

The cycle produces:

- 3 NADH molecules (which generate ATP in the electron transport chain)
- 1 FADH<sub>2</sub> molecule (which generates ATP in the electron transport chain)
- 1 GTP molecule (equivalent to ATP)
- 2 CO<sub>2</sub> molecules

The Krebs cycle is regulated by several factors including the availability of substrates and the energy status of the cell.

## Glycolysis

Glycolysis is a metabolic pathway that converts glucose into pyruvate. It is the first stage of cellular respiration in all organisms.

The process involves a sequence of ten enzyme-catalyzed reactions that can be divided into two phases:

- The preparatory phase (energy investment phase)
- The payoff phase (energy generation phase)

In the preparatory phase, ATP is consumed to convert glucose into two molecules of glyceraldehyde-3-phosphate.

Key outcomes of glycolysis:

- 2 pyruvate molecules
- 2 ATP molecules (net gain)
- 2 NADH molecules
- 2 water molecules

Unlike the Krebs cycle, glycolysis occurs in the cytoplasm of cells and does not require oxygen. It is therefore a key anaerobic pathway.

Pyruvate, the end product of glycolysis, can undergo different fates depending on the organism and the availability of oxygen.

- In aerobic conditions, pyruvate enters the mitochondria and is converted to acetyl-CoA for the Krebs cycle
- In anaerobic conditions in animals, pyruvate is converted to lactate
- In anaerobic conditions in yeast and some bacteria, pyruvate is converted to ethanol and CO<sub>2</sub>