

CITRIC ACID CYCLE

Definition

The citric acid cycle also known as the Tricarboxylic acid cycle (TCA) cycle or the Krebs cycle is a series of chemical reactions for the oxidation of Acetyl CoA derived from carbohydrates, fats and proteins into carbon dioxide, water and chemical energy in the form of Adenosine Triphosphate (ATP).

Location

The citric acid cycle occurs in the matrix of the mitochondria in eukaryotic cells. It is the second stage of cellular respiration.

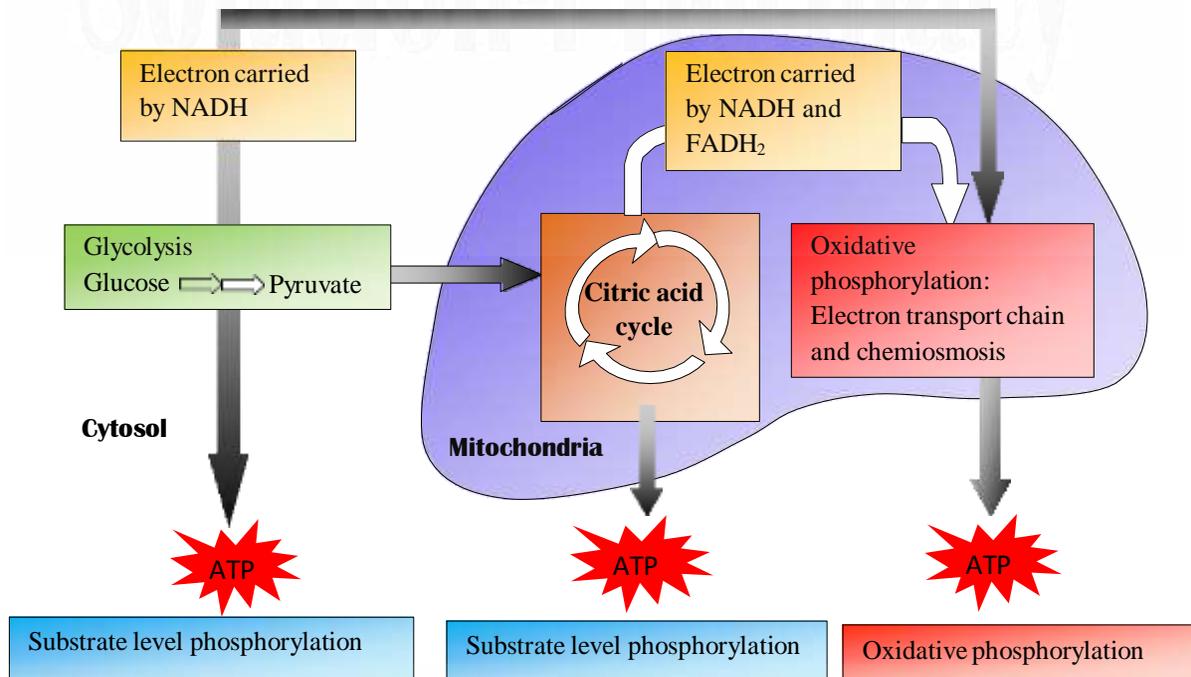
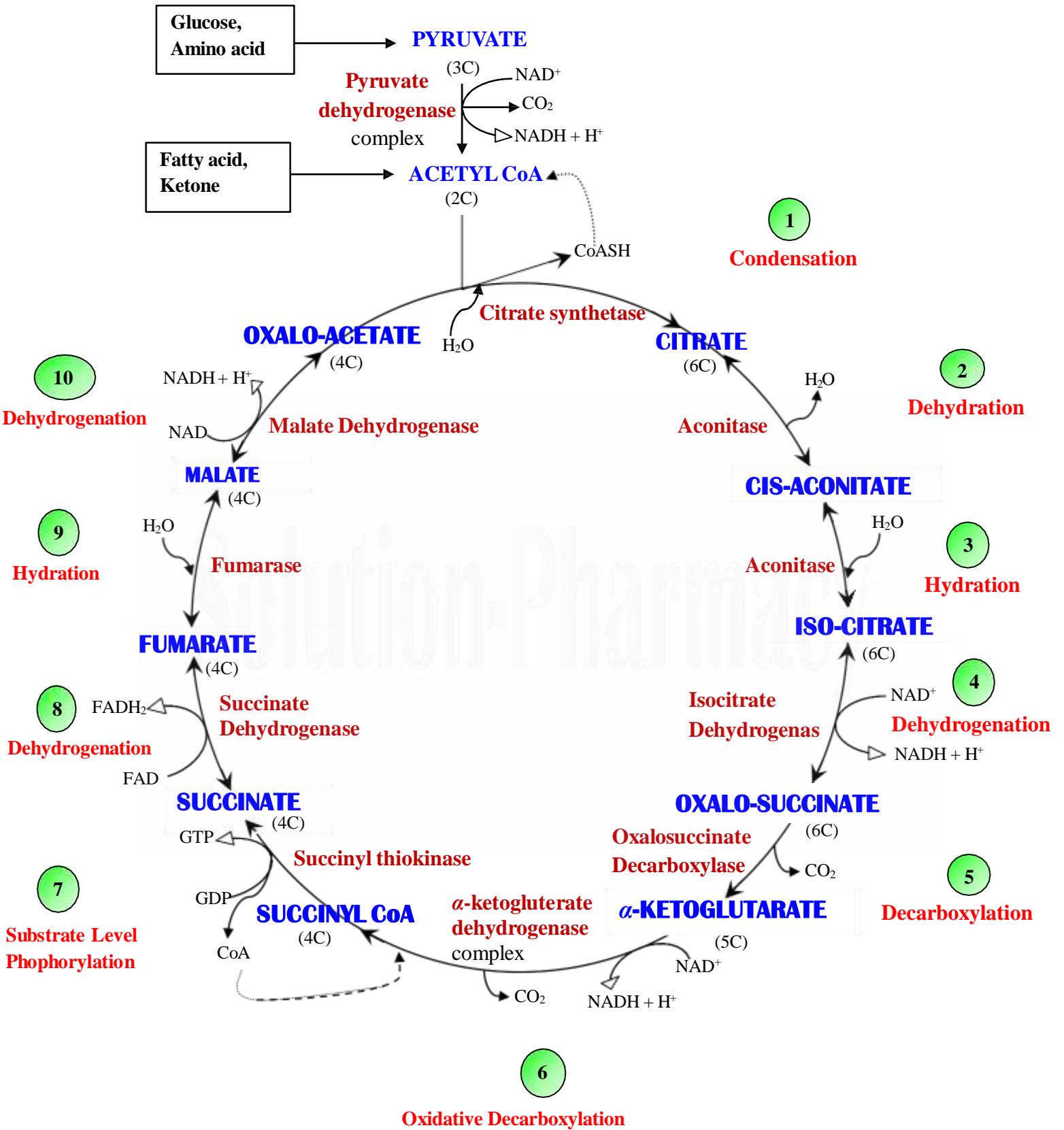


Figure 1: Cellular Respiration

Description

1. This cycle was discovered by British biochemist Hans Krebs hence it is also known as Krebs cycle also
2. It is also known as **Citric acid cycle** or **Tricarboxylic acid cycle** because the first product of Krebs cycle is **Citric acid (Citrate)**. It is called as tricarboxylic acid cycle because the citric acid contains three carboxyl groups.
3. After glycolysis, **Pyruvate enters mitochondria**. Here it undergoes a link reaction, losing a carbon atom (as carbon dioxide) and hydrogen (as reduced NAD). The resulting compound is **Acetyl CoA**. The actual Krebs cycle begins when acetyl -CoA enters into a reaction to form citric Acid. Its substrate Acetyl Co-A is connecting link between glycolysis and Krebs cycle. The oxalacetate acts as acceptor molecule. Although the citric acid cycle does not use oxygen directly, it works only when oxygen is present.

Reaction of Citric Acid Cycle



Energetic of TCA cycle

Step number	Reaction	Co-enzyme	ATP
4 & 5	Isocitrate \longrightarrow Oxalosuccinate	NADH	3
6	α - Keto glutarate \longrightarrow Succinyl CoA	NADH	3
7	Succinyl CoA \longrightarrow Succinate	GTP (ATP)	1
8	Succinate \longrightarrow Fumarate	FADH ₂	2
10	Malate \longrightarrow Oxalo acetate	NADH	3
Total			12

Significance of Citric acid cycle

- 1. Central metabolic/Common oxidative pathway:** Citric acid cycle is the common metabolic pathway **for oxidation of Carbohydrate, Lipid, and protein** because glucose, fatty acid and many amino acids are metabolized to acetyl CoA which is finally oxidized in the citric acid cycle.
- 2. Complete oxidation of Acetyl CoA to CO₂ and H₂O and release of energy.**
- 3. ATP generation:** The reducing equivalent in the form of hydrogen or electron in the cycle enters the respiratory chain, where large amount high energy phosphates (ATP) are generated by oxidative Phosphorylation.
- 4. The cycle provides precursors of certain amino acids**, as well as the reducing agent NADH that are used in numerous other biochemical reactions.
- 5. The citric acid cycle in amphibolic (dual) in nature** (both catabolic and anabolic). Involved in the glucose, fatty acid and amino acid synthesis.

Trick to remember TCA cycle

Total 10 steps and 10 molecules in cycle

Steps 1, 5, 6, 7 is irreversible steps

Oh **C**itric **A**cid **I**s **O**f (Course) **A** Silly **S**tupid **F**unny **M**olecule

I. A. M - **NADH**

Silly - **GTP**

Stupid - **FADH₂**

1. **O**h - **O**xaloacetate \longleftarrow H₂O
2. **C**itric - **C**itrate \longrightarrow H₂O
3. **A**cid - **C**is- **A**conitate \longleftarrow H₂O
4. **I**s - **I**so citrate \longrightarrow **NADH**
5. **O**f (Course) - **O**xalo- **S**uccinate \longrightarrow CO₂
6. **A** - **A**lpha Ketogluterate \longrightarrow **NADH**, CO₂
7. **S**illy - **S**uccinyl CoA \longrightarrow GTP
8. **S**tupid - **S**uccinate \longrightarrow **FADH₂**
9. **F**unny - **F**umarate \longleftarrow H₂O
10. **M**olecule - **M**alate \longrightarrow **NADH**