

Respiration in Plants

Respiration

- All living organisms require a continuous supply of energy for carrying out various life activities.
- Cellular respiration is the process of releasing energy from the breakdown of organic substances.
- The released energy is stored in the form of ATP.
- ATP is the energy currency of cell.
- The process of cellular respiration occurs in cytoplasm and mitochondria.
- It involves the consumption of oxygen and liberation of CO₂ and water.

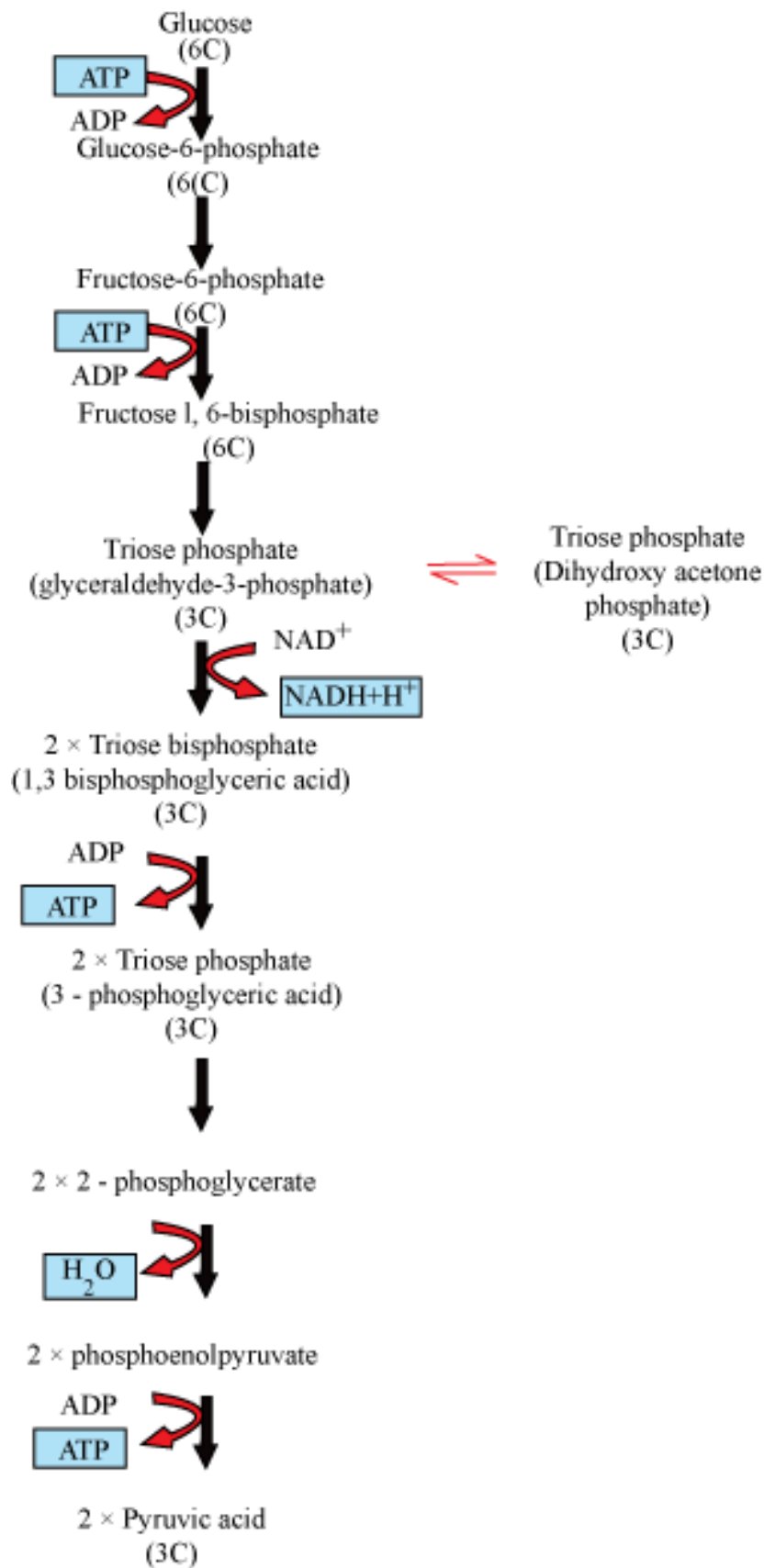


- **Respiratory substrate:** These are the compounds, which get oxidised during cellular respiration. Example: Carbohydrate, fats, proteins, etc.

Glycolysis

- It is a linear pathway that occurs in cell cytoplasm.
- It occurs in both aerobic and anaerobic respiration.
- It involves the partial breakdown of glucose into 2 molecules of pyruvic acid.
- In plants, as we know, sucrose is the end product of photosynthesis. Therefore, this sucrose is converted into glucose and fructose with the help of invertase enzyme.
- The process of glycolysis generates 2 NADH₂ and 2ATP molecules upon breakdown of one glucose molecule.

Steps of glycolysis

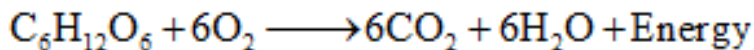


- The pyruvate, so produced, may undergo:
 - Lactic acid fermentation
 - Alcoholic fermentation

- Aerobic respiration (Krebs cycle)

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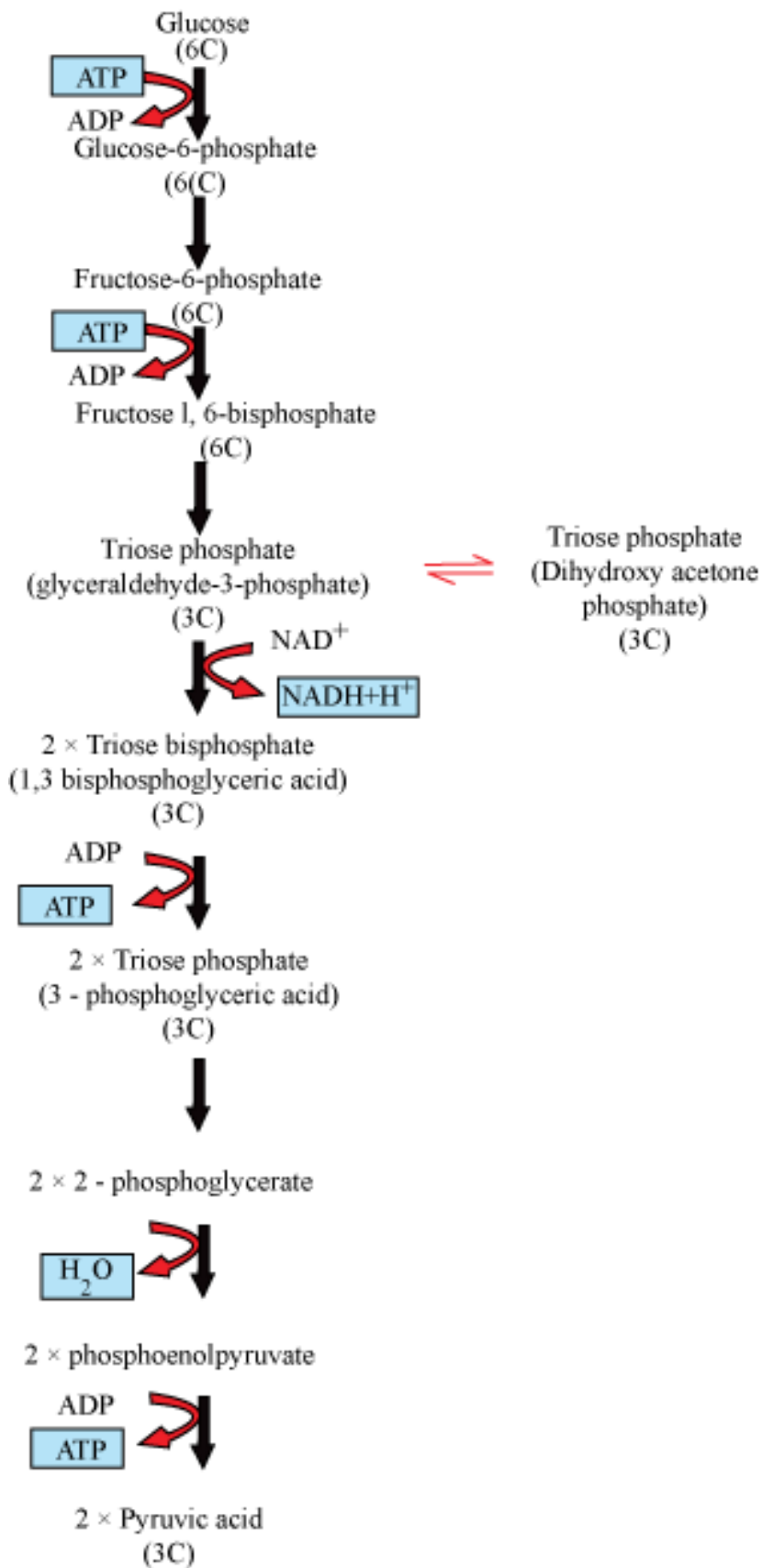


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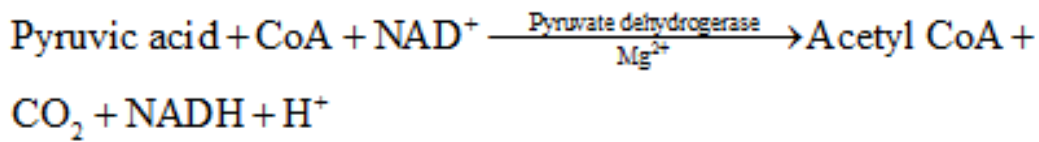


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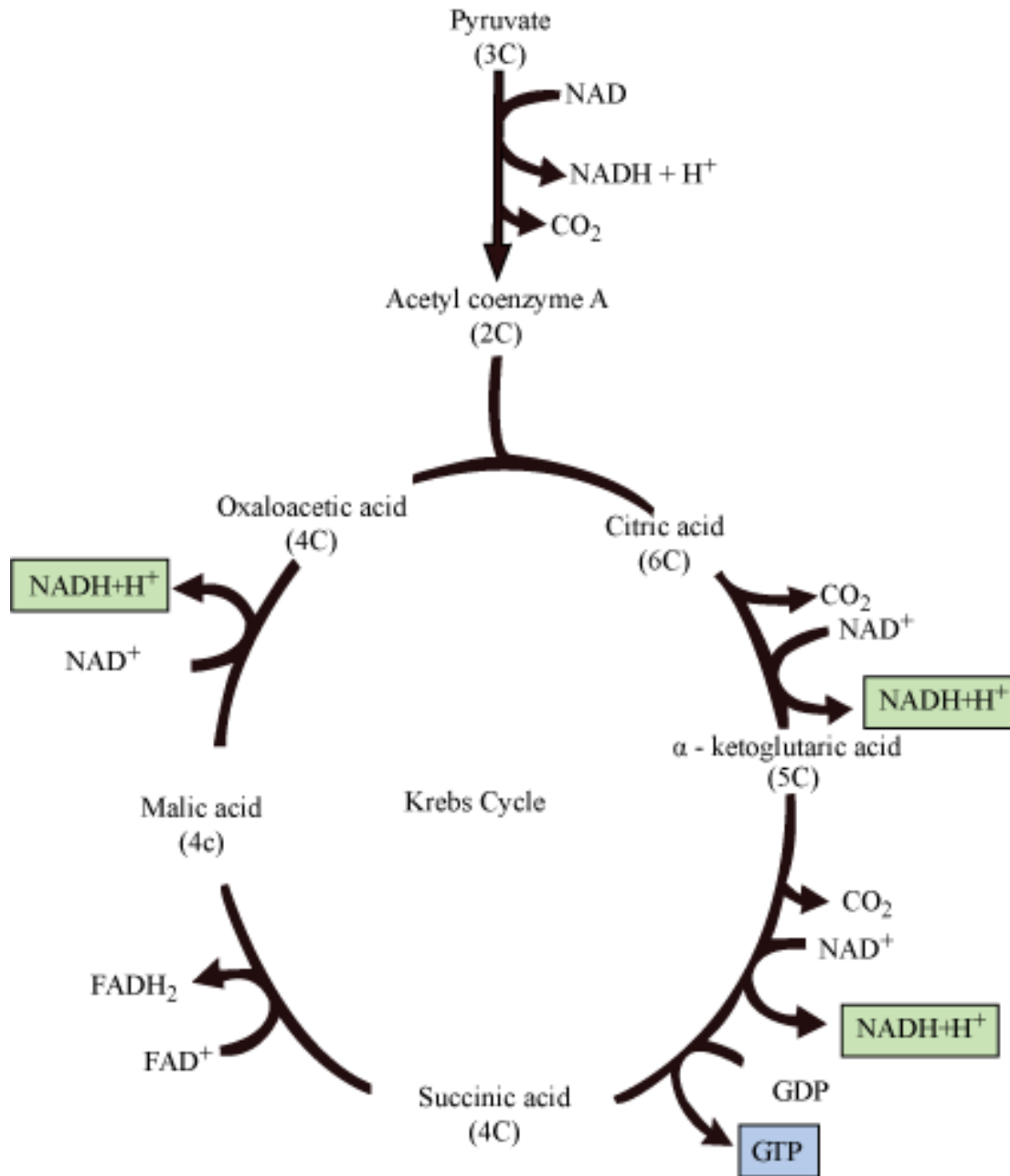
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Tricarboxylic Acid Cycle

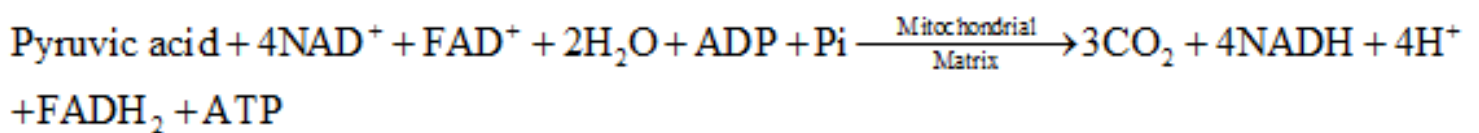
- **Aerobic respiration**
 - Pyruvate synthesised by the glycolytic catabolism in cytoplasm enters the mitochondrial matrix and undergoes oxidative decarboxylation.



- The acetyl CoA synthesized by **oxidative phosphorylation** then enters Krebs' cycle.
- **Krebs' cycle (Tricarboxylic acid)**
 - It is a cyclic process that occurs in mitochondrial matrix.



- The process of Krebs cycle produces 6NADH₂, 2FADH₂, and 2ATP molecules on the breakdown of two acetyl CoA molecules.



Electron Transport System and Oxidative Phosphorylation

- Electron Transport System

- By the end of citric acid cycle, glucose molecule is completely oxidised. But, the energy is not released unless NADH and FADH are completely oxidised through electron transport chain.
 - It occurs in mitochondrial matrix.
 - It is the process where electron passes from one carrier to another via complex I to IV.
- **Oxidative Phosphorylation** is the process in which electrons are transferred from electron donors to oxygen (electron acceptor).
 - The enzyme involved in oxidative phosphorylation is **ATP synthase**.
 - For every two protons passing through $F_0 - F_1$ complex, one molecule of ATP is synthesised.

Amphibiotic Pathway and Respiratory Quotient

- **Amphibiotic Pathway**
 - Respiratory pathway involves both anabolic and catabolic pathways. Hence, respiration is termed as amphibiotic pathway.
 - **Respiratory quotient**
- $$\text{Respiratory quotient (RQ)} = \frac{\text{Volume of CO}_2 \text{ evolved}}{\text{Volume of O}_2 \text{ consumed}}$$
- Respiratory quotient (RQ) depends on type of respiratory substrate used.
 - RQ when carbohydrates are used as substrate = 1
 - RQ when fats (Tripalmitin) are used as substrate = 0.7
 - RQ when proteins are used as substrate = 0.9