Respiration In Plants

Respiration is an energy releasing, enzymatically controlled catabolic process which involves a step-wise oxidative breakdown of food substance inside living cells.

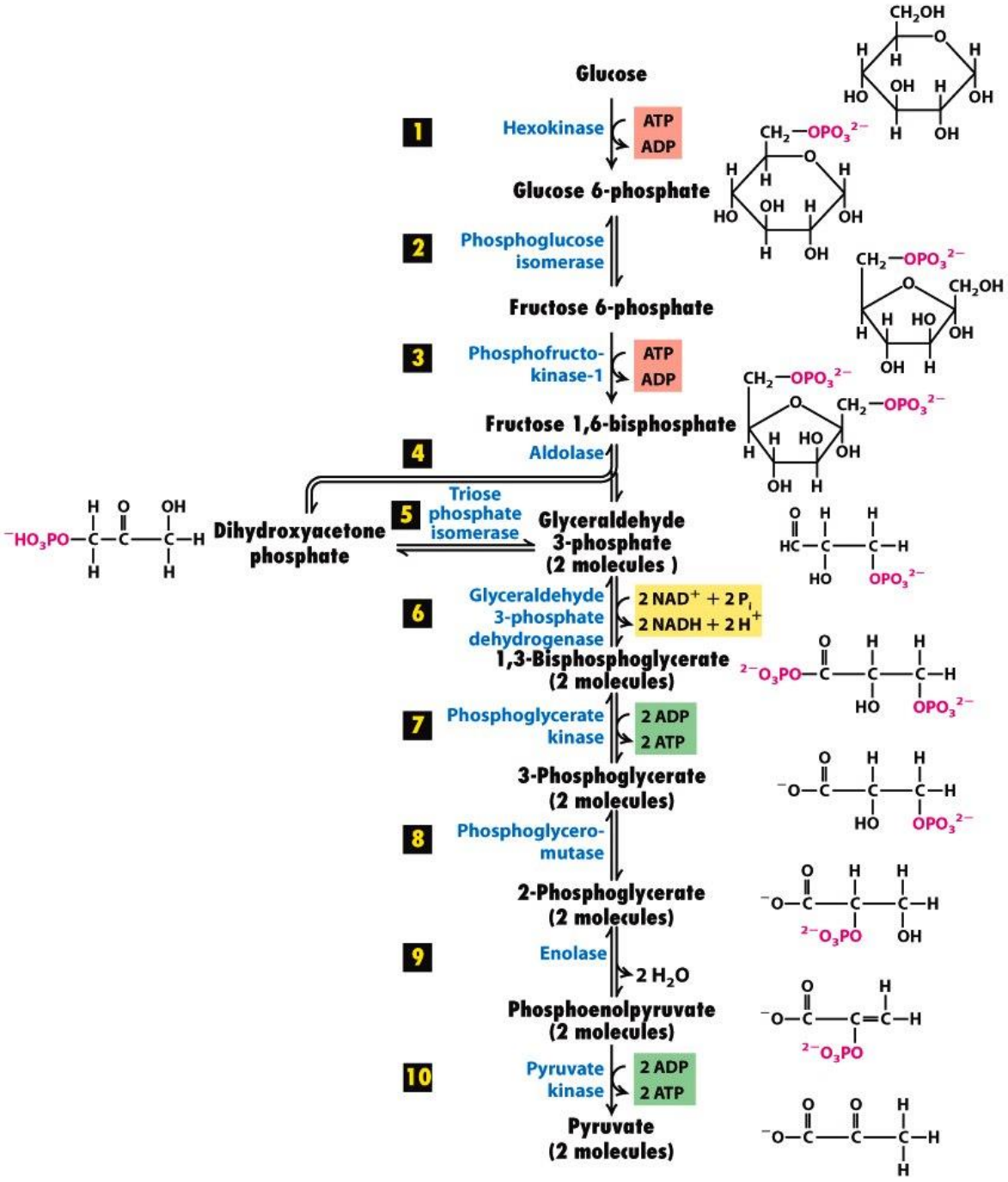
$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + Energy$$

- Living organism require energy for all activities like absorption, movement, reproduction or even breathing that is obtained from oxidation of food during respiration.
- **Cellular respiration** - mechanism of breaking down of food materials within the cell (cytoplasm & mitochondria) to release energy for ATP synthesis.
- Breaking down of C-C bond of complex compounds (food) through oxidation within the cells leading to release of energy is called **respiration.**
- **Respiratory substrates**- The compounds that get oxidized (Carbohydrates (Main Substrate) , Protein, Fats & organic acids)
- Energy released during oxidation is not used directly but utilized in synthesis of ATP, which is broken down when energy is required. Therefore, **ATP is called energy currency** of cells.
- Plants respire through Stomata & Lenticles and do not have any special respiratory organs because:
    1. Each part takes care of its own gas-exchange needs.
    2. No great demands for gas exchange.
    3. Living cell present near surface for diffusion. Parenchyma cells are loosely packed (for air).
    4. O2 released during photosynthesis fulfil the demand of respiration in plant.
- First cell on earth lived in O_2 lacked environment. Some were facultative anaerobes other were obligatory.
- Types of Respiration:
  1) Anaerobic Respiration: Incomplete breakdown of food (glucose) in absence of O_2 to release energy (2 ATP).
  2) Aerobic Respiration : Complete breakdown of food (Glucose) in presence of O_2 to release energy (38 ATP).

Glycolysis

A multistep metabolic pathway in all living organism to **partially breakdown glucose** with the help of enzyme in absence of O_2 .

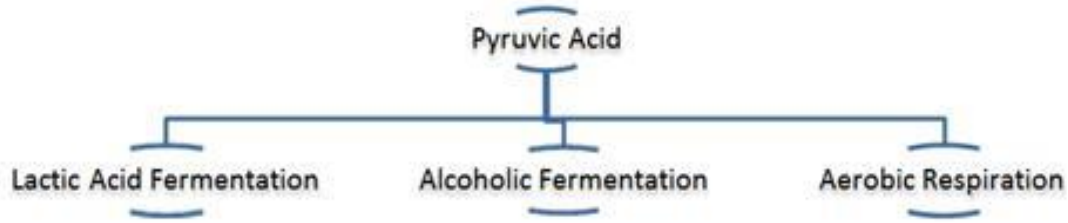
- Occur in cytoplasm, common for both Aerobic & Anaerobic respiration
- The scheme of glycolysis is given by Gustav **Embden,** Otto **Meyerhof**, and J. **Parnas** hence called as **EMP pathway**.
- Final products of glycolysis are two molecules of Pyruvic Acid, ATP and 2 $NADH+H^+$.
- In plants glucose is derived from sucrose or from storage carbohydrates. Sucrose is converted into glucose and fructose by enzyme *invertase*.
- Ten steps process-
    1. Phosphorylation of Glucose by ATP with the help of enzyme hexokinase to Glucose 6 phosphate.
    2. Isomerisation of glucose -6-phosphate to Fructose 6 phosphate using enzyme phosphoglucoisomerase.
    3. Phosphorylation of Fructose 6 phosphate to Fructose 1,6- bisphosphate using enzyme phosphofructokinase & ATP.
    4. Splitting of (6C) Fructose 1,6- bisphosphate into (3C) 3-phosphoglyceraldehyde (3-PGA) & Dihydroxyacetone (DHAP) using enzyme aldose. This reaction is reversible.
    5. Isomerization of Dihydroxyacetone Phosphate to Glyceraldehyde 3-phosphate by the enzyme phosphotriose isomerase. Hence two molecules of glyceraldehyde 3-phosphate are formed.
    6. Dehydrogenation of Glyceraldehyde-3-Phosphate to 1,3-bisphosphoglycerate by enzyme glyceraldehyde-3-phosphate dehydrogenase. Two NADH + H+ formed using two NAD+.
    7. Conversion of two molecules of 1,3-Bisphosphoglycerate to two molecules of 3-Phosphoglycerate using enzyme phosphoglycerate kinase. Two ATP are released.
    8. Inter-Molecular Shift of Phosphate Group using enzyme Phosphoglycerate mutase to form to 2-phospho glycerate. Mg2+ is essential for this reaction.
    9. Dehydration of 2-Phosphoglycerate using enzyme Enolase & Mg^{++}.
    10. Conversion of Phosphoenolpyruvate to Pyruvate using enzyme Pyruvate kinase. Two ATP are released.



Guru Ganesh Farmate Fal Dekar Ganga Bahate Param Pita Pujiyne Paate

Hasi Pal Pal Aati Thi Gauri Par Pyaar Ek Pachtawa hai.

Fate of pyruvate:



Lactic Acid Fermentation	Alcoholic Fermentation	Aerobic Respiration
• In Absence of Oxygen • Occur in Muscles • End Product is Lactic Acid • Total 2ATP produce	• In Absence of Oxygen • Occur in Organisms like Yeast • End Product is Ethanol & CO_2 • Total 2ATP produce	• In Presence of Oxygen • Occur in Mitochondria of Cell • End Product CO_2 & HO_2 • Total 38 ATP produce