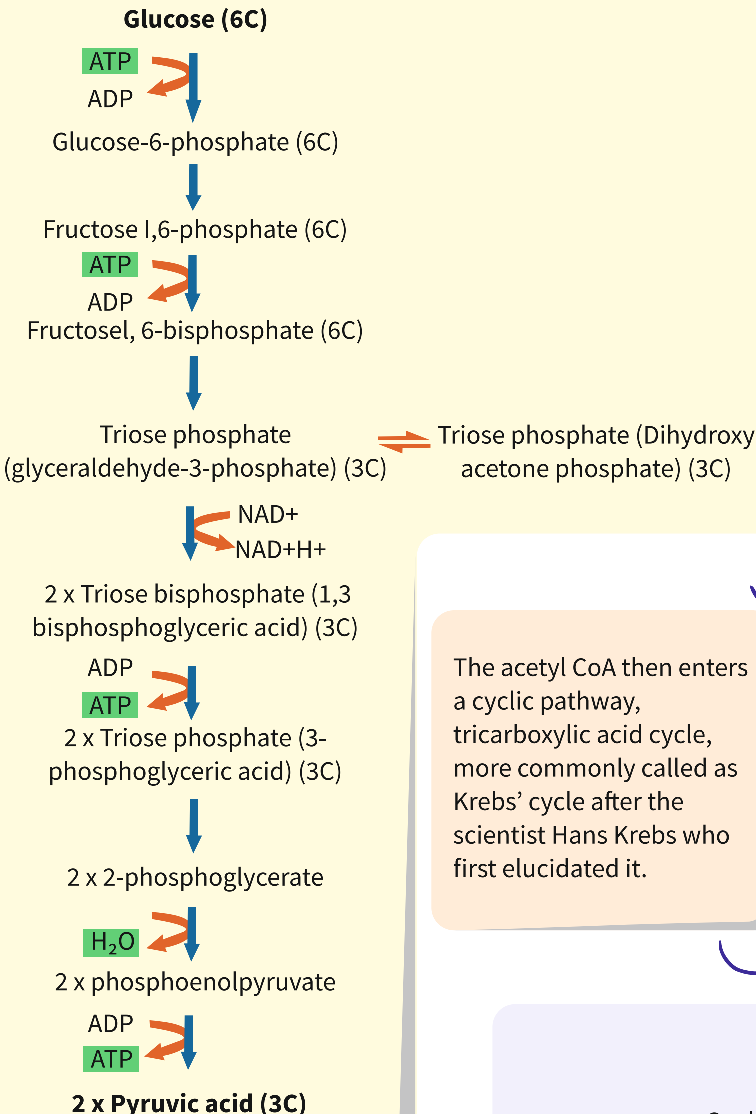
12. RESPIRATION IN PLANTS

Glycolysis

The term glycolysis has originated from the Greek words, glycos for sugar, and lysis for splitting. The scheme of glycolysis was given by Gustav Embden, Otto Meyerhof, and J. Parnas, and is often referred to as the EMP pathway. In anaerobic organisms, it is the only process in respiration. Glycolysis occurs in the cytoplasm of the cell and is present in all living organisms.



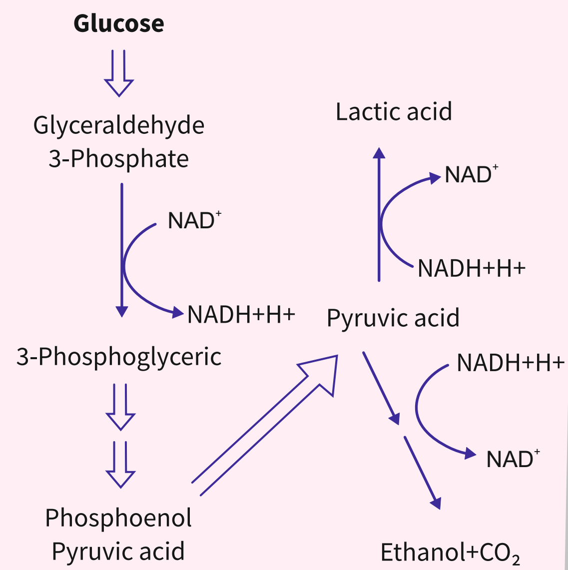
Anaerobic Respiration

Pyruvic acid

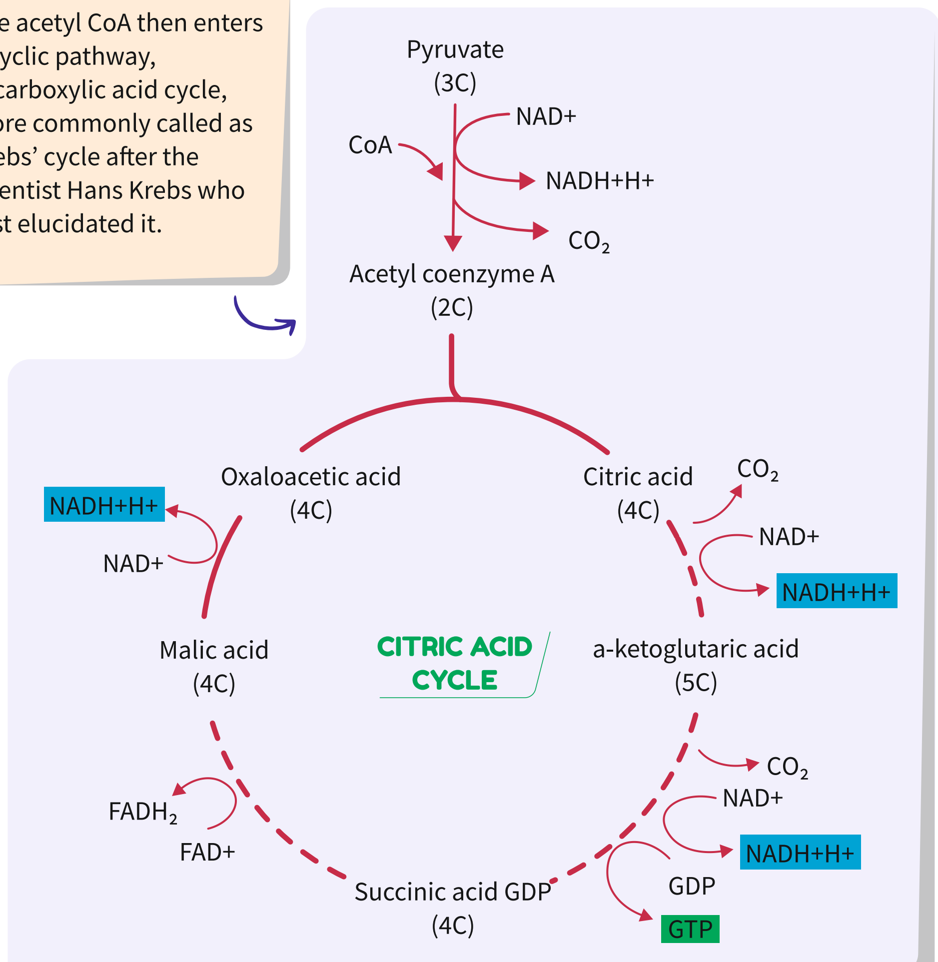
↓ in absence of O_2

Fermentation

[Incomplete oxidation of glucose under anaerobic condition]

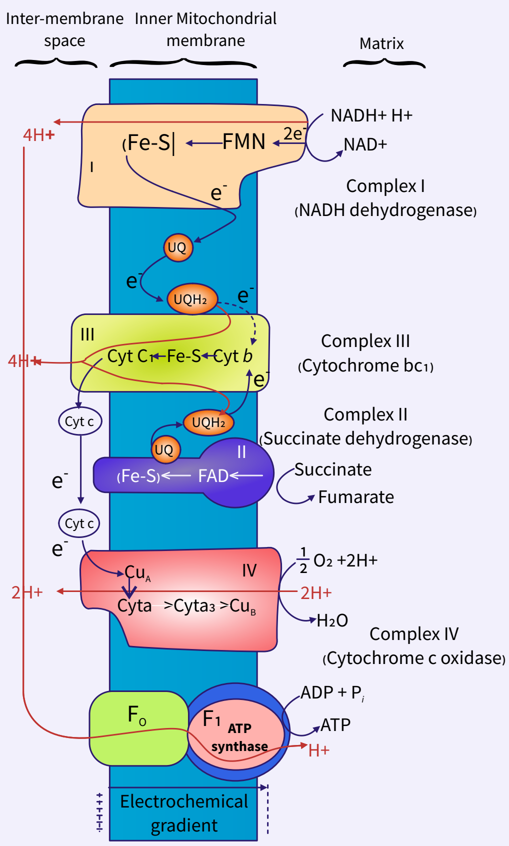


The acetyl CoA then enters a cyclic pathway, tricarboxylic acid cycle, more commonly called as Krebs' cycle after the scientist Hans Krebs who first elucidated it.



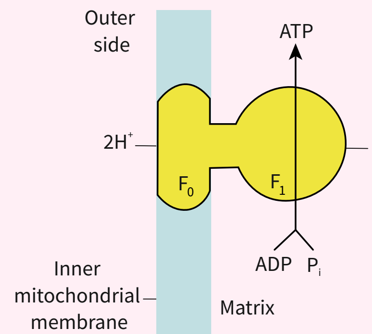
Inner mitochondrial membrane is the site of

ELECTRON TRANSPORT SYSTEM



Metabolic Pathway through which electron passes from one carrier to another. Oxidation of one molecule of NADH gives rise to 3 molecules of ATP, while that of one molecule of FADH2 produces 2 molecules of ATP. Although the aerobic process of respiration takes place only in the presence of oxygen, the role of oxygen is limited to the terminal stage of the process. Yet, the presence of oxygen is vital, since it drives the whole process by removing hydrogen from the system. Oxygen acts as the final hydrogen acceptor.

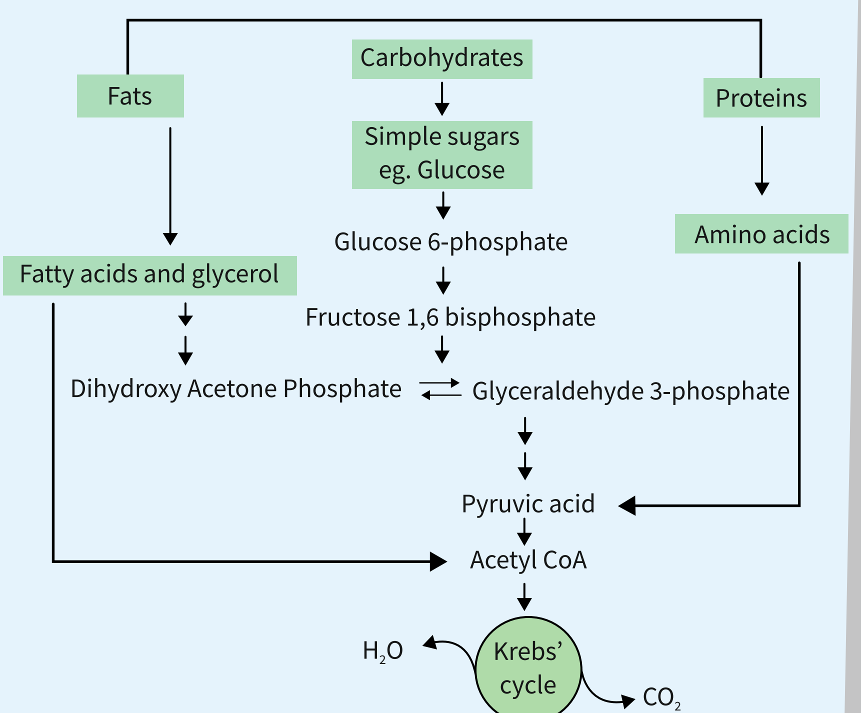
OXIDATIVE PHOSPHORYLATION



The energy released during the electron transport system is utilised in synthesising ATP with the help of ATP synthase (complex V). This complex consists of two major components, F_1 and F_0. The F_1 headpiece is a peripheral membrane protein complex and contains the site for synthesis of ATP from ADP and inorganic phosphate. F_0 is an integral membrane protein complex that forms the channel through which protons cross the inner membrane. The passage of protons through the channel is coupled to the catalytic site of the F_1 component for the production of ATP. For each ATP produced, 2H+ passes through F_0 from the intermembrane space to the matrix down the electrochemical proton gradient.

AMPHIBOLIC PATHWAY

Because the respiratory pathway is involved in both anabolism and catabolism, it would hence be better to consider the respiratory pathway as an amphibolic pathway rather than as a catabolic one.



Respiratory Quotient

$$RQ = \frac{\text{Volume of } CO_2 \text{ envolved}}{\text{Volume of } O_2 \text{ Consumed}}$$

- RQ for Carbohydrates $= \frac{6\ CO_2}{6\ O_2} = 1$
- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$
- RQ for fats is less than 1
- $\underbrace{2(C_6H_{12}O_6)}_{\text{Tripalmitin}} + 145O_2 \rightarrow 102CO_2 + 9H_2O + \text{Energy}$
- RQ for Proteins $= \frac{102\ CO_2}{145\ O_2} = 0.7$
- RQ for proteins is usually 0.9.

What is important to recognise in living organisms is respiratory substrates are often more than one; pure proteins or fats are never used as respiratory substrates.