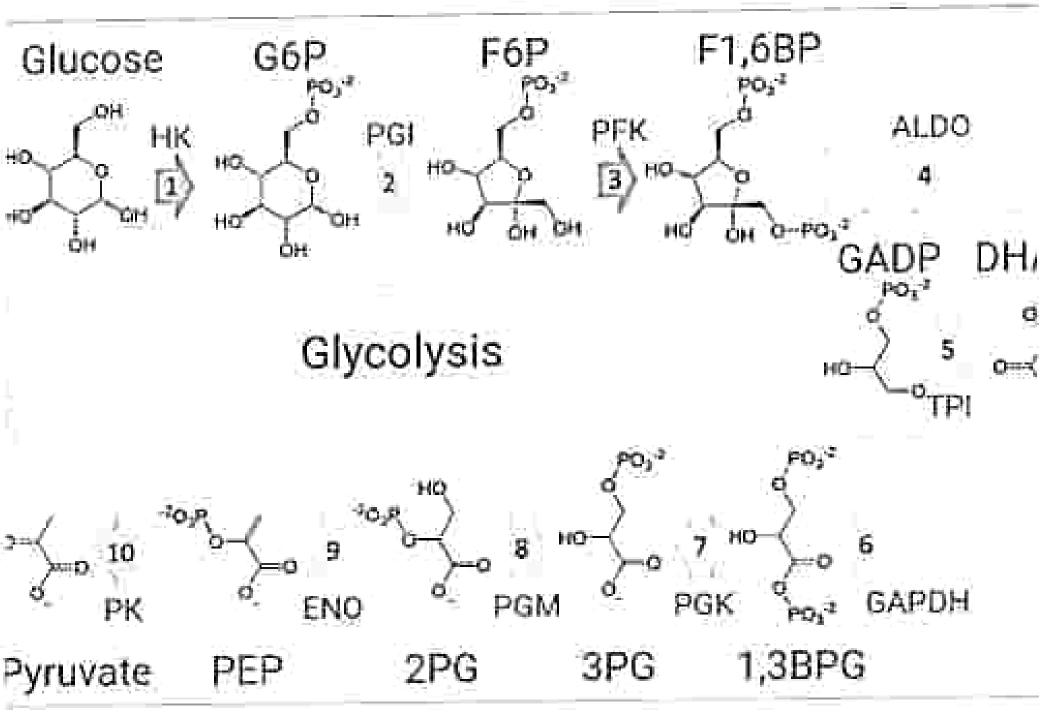
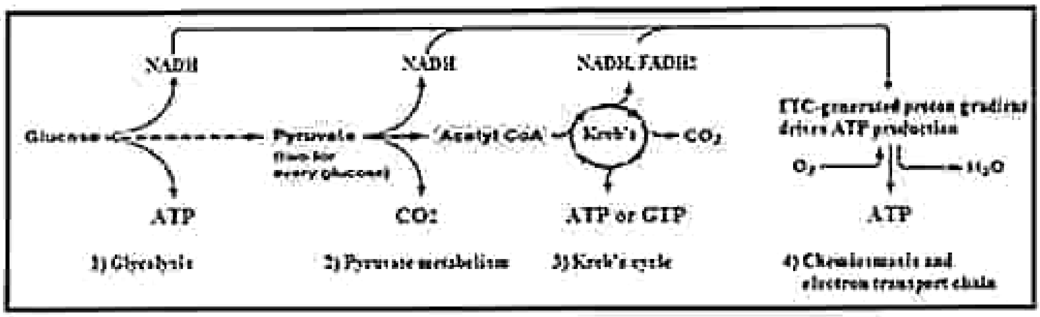
GLYCOLYSIS

Glycolysis (from *glycose*, an older term[1] for glucose + *-lysis* degradation) is the metabolic pathway that converts glucose $C_6H_{12}O_6$, into pyruvate, CH_3COCOO^- (pyruvic acid), and a hydrogen ion, H^+. The free energy released in this process is used to form the high-energy molecules ATP (adenosine triphosphate) and NADH (reduced nicotinamide adenine dinucleotide).[2][3][4] Glycolysis is a sequence of ten enzyme-catalyzed reactions. Most monosaccharides, such as fructose and galactose, can be converted to one of these intermediates. The intermediates may also be directly useful rather than just utilized as steps in the overall reaction. For example, the intermediate dihydroxyacetone phosphate (DHAP) is a source of the glycerol that combines with fatty acids to form fat.



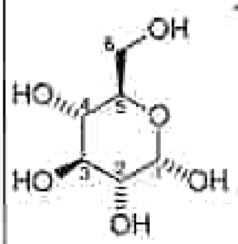
The metabolic pathway of glycolysis converts glucose to pyruvate by via a series of intermediate metabolites. Eac iemical modification is performed by a different enzyme. S and 3 consume ATP and steps 7 and 10 produce ATP. Sinc eps 6–10 occur twice per glucose molecule, this leads to a net oduction of ATP.



Summary of aerobic respiration

Glycolysis is an oxygen-independent metabolic pathway. The wide occurrence of glycolysis indicates that it is an ancient metabolic pathway.[5] Indeed, the reactions that constitute glycolysis and its parallel pathway, the pentose phosphate pathway, occur metal-catalyzed under the oxygen-free conditions of the Archean oceans, also in the absence of enzymes.[6]

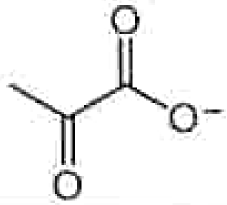
D-Glucose



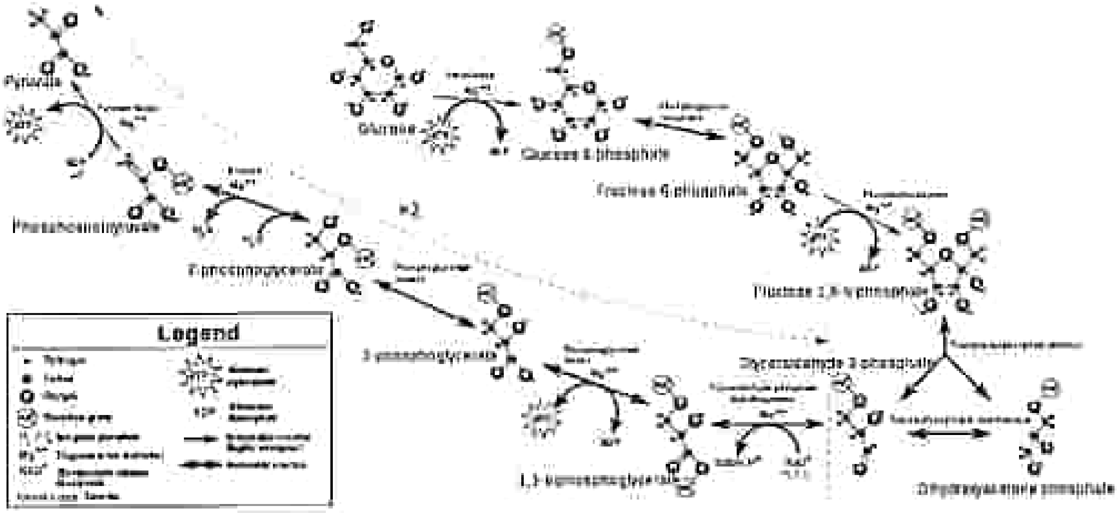
+ 2 [NAD]$^+$
+ 2 [ADP]
+ 2 [P]$_i$

2 × Pyruvate

2 ×



+ 2 [NADH]
+ 2 H$^+$
+ 2 [ATP]
+ 2 H_2O



Glycolysis pathway overview.

The use of symbols in this equation makes it appear unbalanced with respect to oxygen atoms, hydrogen atoms, and charges. Atom balance is maintained by the two phosphate (P_i) groups:[8]

- Each exists in the form of a hydrogen phosphate anion (HPO_4^{2-}), dissociating to contribute 2 H^+ overall
- Each liberates an oxygen atom when it binds to an adenosine diphosphate (ADP) molecule, contributing 2 O overall

Charges are balanced by the difference between ADP and ATP. In the cellular environment, all three hydroxyl groups of ADP dissociate into $-O^-$ and H^+, giving ADP^{3-}, and this ion tends to exist in an ionic bond with Mg^{2+}, giving $ADPMg^-$. ATP behaves identically except that it has four hydroxyl groups, giving $ATPMg^{2-}$. When these differences along with the true charges on the two phosphate groups are considered together, the net charges of −4 on each side are balanced.

For simple fermentations, the metabolism of one molecule of glucose to two molecules of pyruvate has a net yield of two molecules of ATP. Most cells will then carry out further reactions to "repay" the used NAD^+ and produce a final product of ethanol or lactic acid. Many bacteria use inorganic compounds as hydrogen acceptors to regenerate the NAD^+.

Cells performing aerobic respiration synthesize much more ATP, but not as part of glycolysis. These further aerobic reactions use pyruvate, and NADH + H^+ from glycolysis. Eukaryotic aerobic respiration produces approximately 34 additional molecules of ATP for each glucose molecule, however most of these are produced by a mechanism vastly different than the substrate-level phosphorylation in glycolysis.