Topic: Glycolysis
B.Sc. Botany (Sub.) II
Group: C

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Anaerobic respiration involves conversion of glucose to ethanol and CO_2 in alcoholic fermentation and the conversion of glucose to lactic acid in the muscles of anomals and certain lactic acid bacteria.

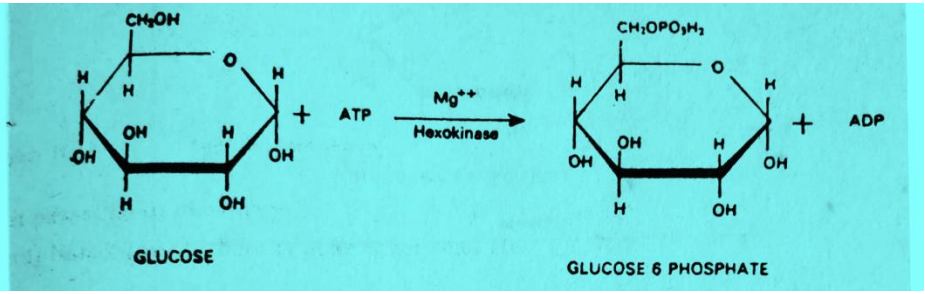
The processes does not require O_2. The glucose is first converted to pyruvic acid through Embden-Meyerhof-Parnas pathway (Glycolysis), which is then converted to ethyl alcohol or lactic acid depending upon the organisms in which it occurs. The complete pathway of anaerobic respiration occurs in the cytoplasm.

Oxidative breakdown of glucose in the cytoplasm of cell into two molecules of pyruvic acid along with formation of two molecules of $NADH_2$ and two molecules of ATP is known as Glycolysis.

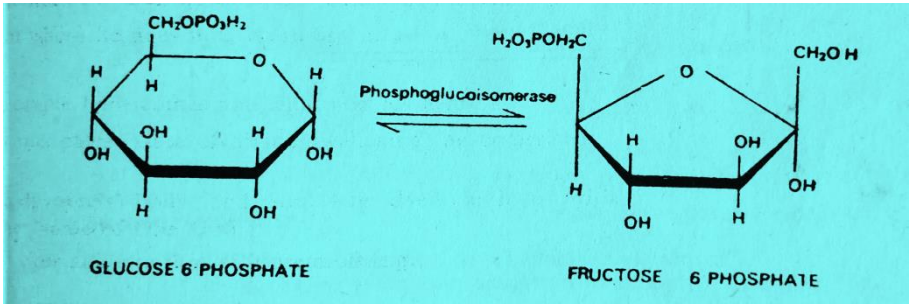
The various biochemical reactions of enzymes of glycolysis were discovered by Embden, Meyerhof and Parnas. Hence glycolysis is also known as EMP path.

The 10 individual reactions of the glycolytic pathway and the enzyme that catalyzes each step. The various steps involved in the pathway are -

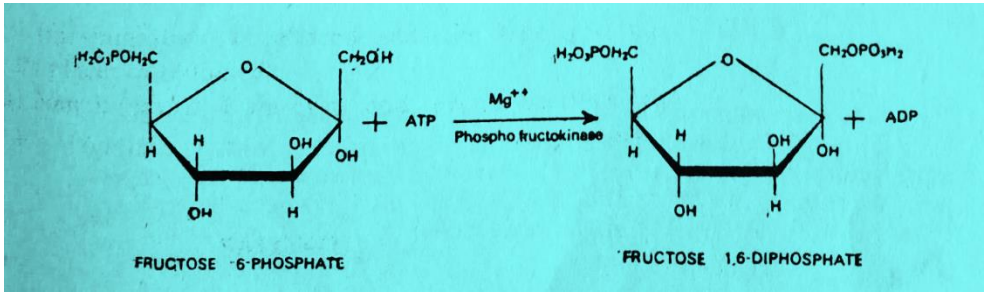
I. Glucose molecule is phosphorylated in presence of ATP to form glucose-6 phosphate. The reaction is catalyzed by enzyme *hexokinase* which requires a divalent MG^{++} as cofactor.



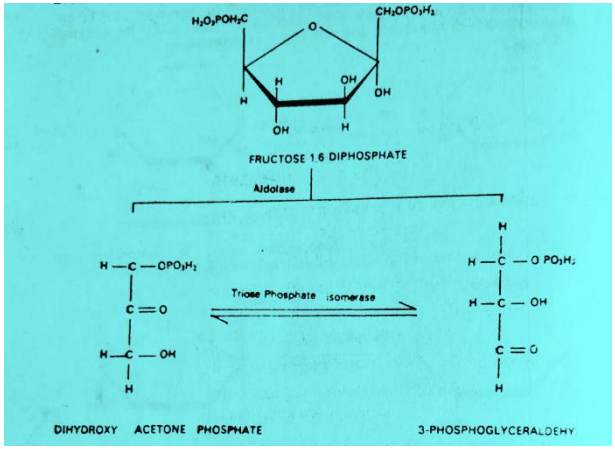
II. Glucose-6-phosphate is isomerized to fructose-6-phosphate in presence of enzyme *phosphogluco isomerase*.



III. Fructose-6-phosphate is then phosphorylated by ATP to form fructose-1,6-diphosphate in presence of enzyme *phosphofructokinase*.

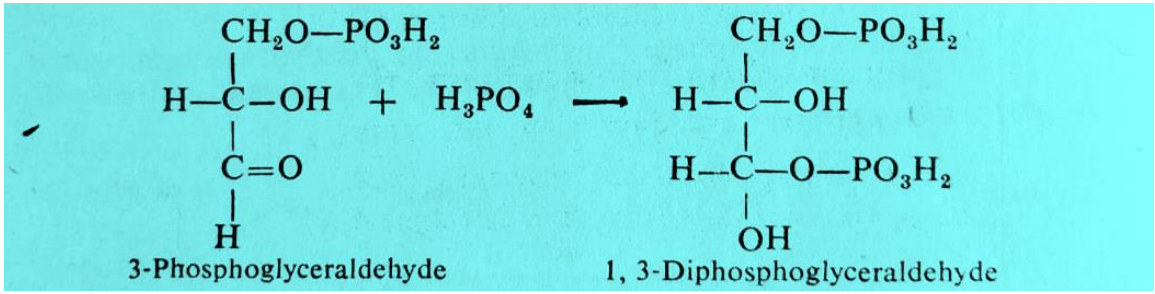


IV. Fructose-1,6-diphosphate is then cleaved to two triose phosphates; dihydroxy acetone

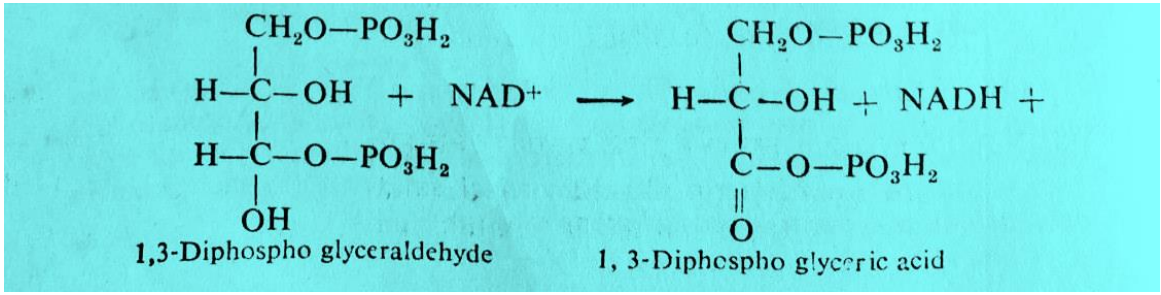


phosphate and 3-phosphoglyceraldehyde. The reaction is catalyzed by enzyme *aldolase*. The two trioses are isomeric and they may isomerise to each other in presence of enzyme *triosephosphate isomerase*.

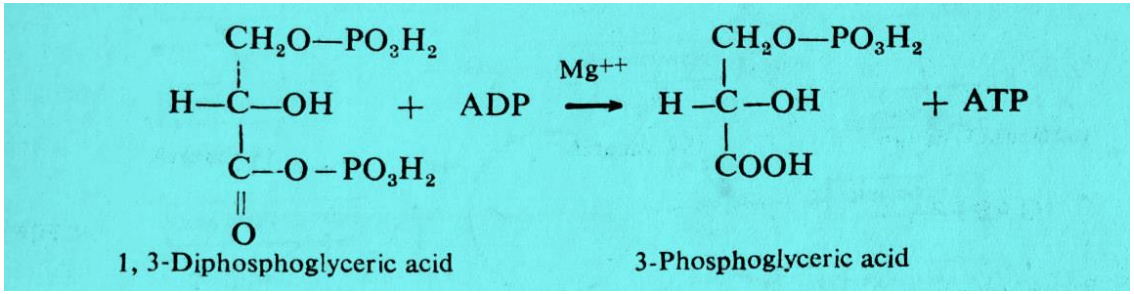
V. 3- Phosphoglyceraldehyde is converted to 1, 3-diphosphoglyceraldehyde in presence of inorganic phosphate (H_3PO_4).



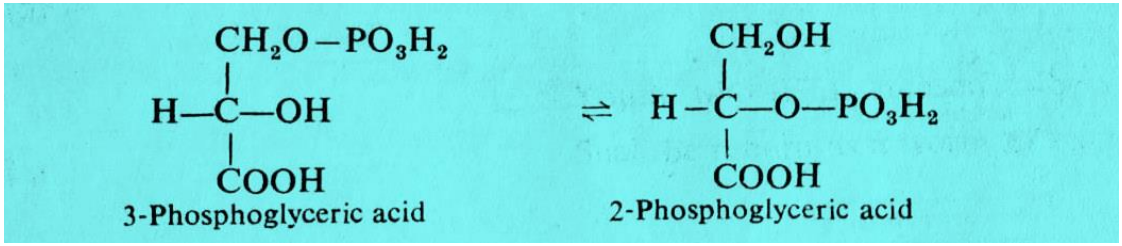
VI. 1,3-Diphosphoglyceraldehyde is oxidized to form 1, 3-diphophoglyceric acid in presence of enzyme *triosephosphate dehydrogena* and coenzyme NAD^+. The NAD^+ acts as hydrogen acceptor are reduced to $NADH^+ H^+$.



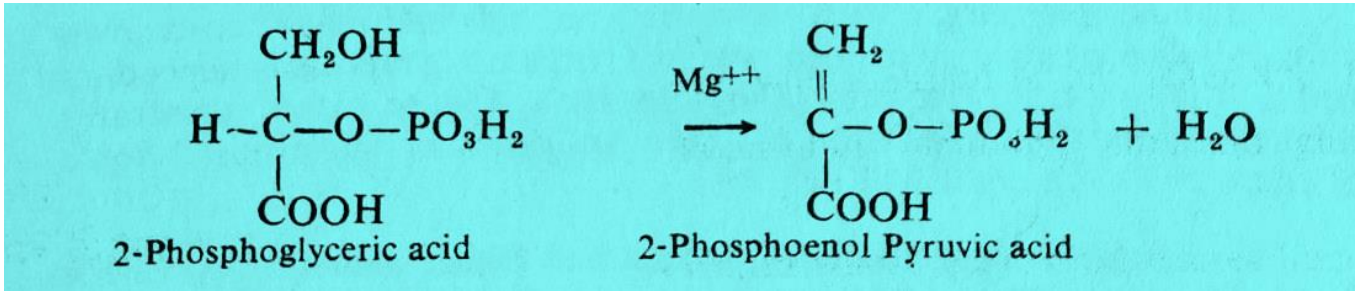
VII. 1,3-Diphosphoglyceric acid is then converted to 3-phosphoglyceric acid in presence of enzyme *phosphoglyceric transphosphorylase* (*phospho-glyceryl kinase*). One molecule of ADP is phosphorylated to ATP in the reaction.



VIII. 3-Phosphoglyceric acid is transformed to 2-phosphoglyceric acid in presence of enzyme-*phosphoglyceryl mutase.*

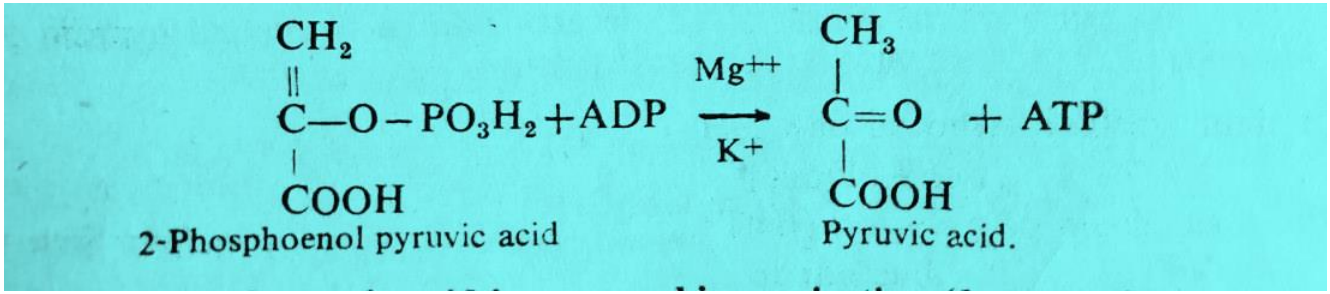


IX. The next reaction involves the dehydration of 2-phosphoglyceric acid to produce 2-phosphoenol pyruvic acid in presence of enzyme *enolase*.



2-Phosphoglyceric acid — 2-Phosphoenol Pyruvic acid

X. In the next step phosphate is transferred from 2-phosphoenol pyruvic acid to ADP to produce pyruvic acid and ATP in presence of enzyme- *pyruvate kinase*.



2-Phosphoenol pyruvic acid — Pyruvic acid.

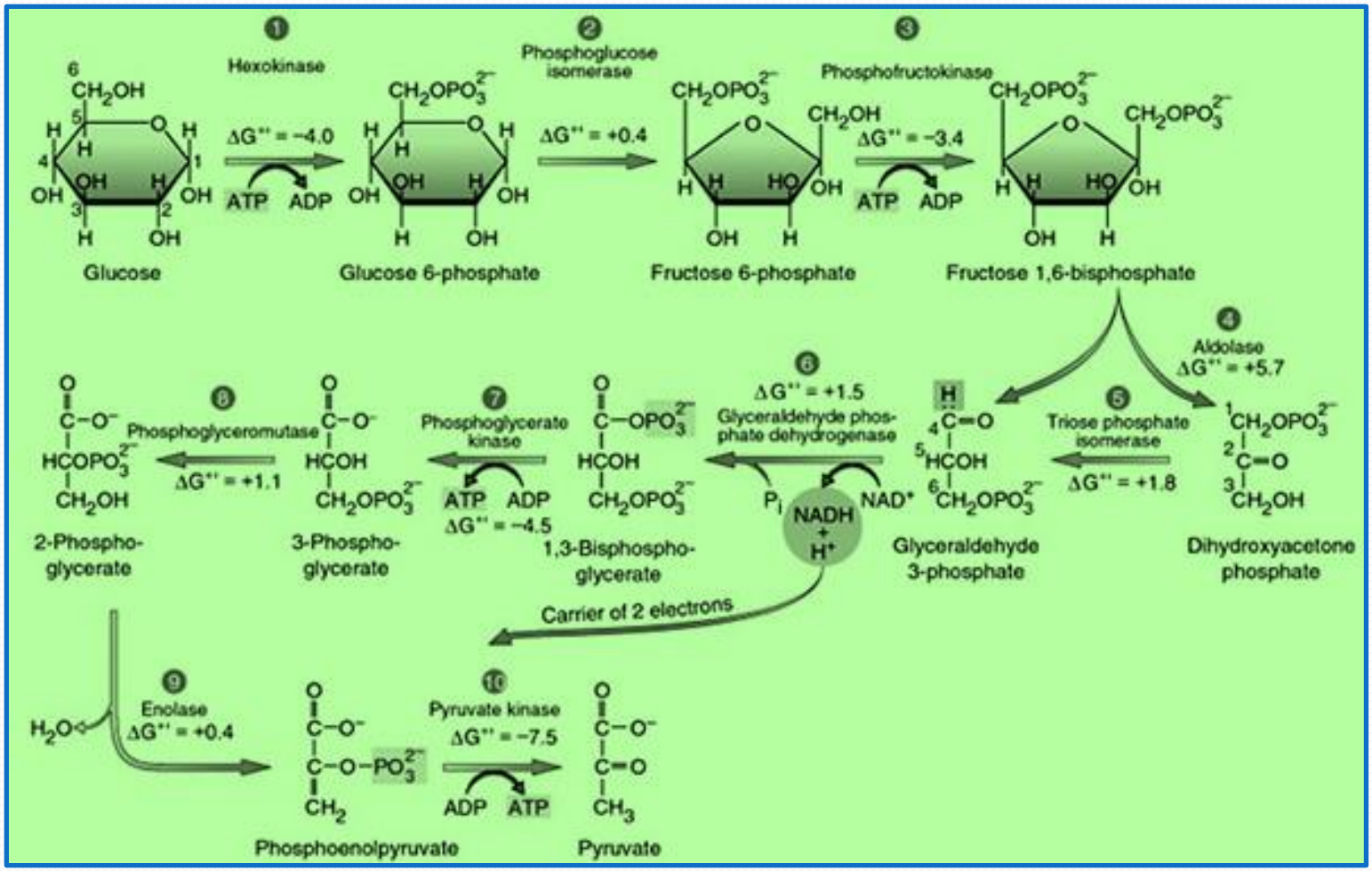


Fig. Glycolysis (EMP Pathway)

Conclusions

Glycolysis is the first pathway used in the breakdown of glucose to extract energy. It was probably one of the earliest metabolic pathways to evolve and is used by nearly all of the organisms on earth. Glycolysis consists of two parts: The first part prepares the six-carbon ring of glucose for cleavage into two three-carbon sugars. ATP is invested in the process during this half to energize the separation. The second half of glycolysis extracts ATP and high-energy electrons from hydrogen atoms and attaches them to NAD^+. Two ATP molecules are invested in the first half and four ATP molecules are formed by substrate phosphorylation during the second half. This produces a net gain of two ATP and two NADH molecules for the cell.