Fuelling reaction in heterotrophs

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Biochemistry of fuelling reaction in heterotrophs

Glycolysis –EMP pathway,

Glycolysis Glycos[G] = sugar,Lysis [G]=dissolution

- Glycolysis is the sequence of the 10 enzyme catalyzed reactions that converts glucose in to pyruvic acid with the simultaneous production of ATP.
- Glycolysis is the central pathway of glucose catabolism. Glycolysis is the first step in the breakdown of glucose to extract energy for cellular metabolism.
- It is also referred to as Embden-Meyerhof-Parnas or EMP pathway, in honor of the pioneer workers in the field.
- In aerobic microorganisms pyruvate formed as end product of glycolysis is oxidized acetyl coenzyme A ,latter it is completely oxidized to CO_2 and H_2O by citric acid cycle.
- In some microorganism it is fermented to lactic acid.

Two phases of glycolysis

Phase I: Preparatory phase

It is consist of Five steps .

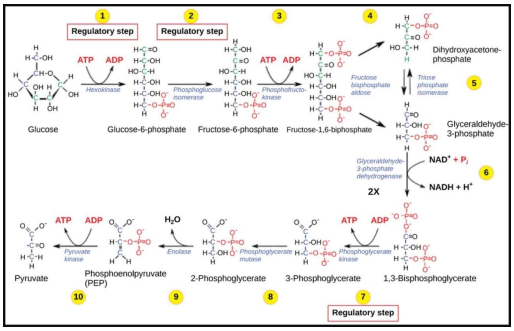
In these reactions, glucose is enzymatically phosphorylated by ATP to yield Fructose 1,6-diphosphate which is then split in to two moles of three carbon compounds glyceradehyde 3-phosphate.

Phase II: Pay off phase

Conversion of two moles of glyceradehyde 3-phosphate to two moles of pyruvate, coupled phosphoylation of 4 moles of ADP to ATP.

The following are the enzymes that catalyze different steps throughout the process of glycolysis:

1. Hexokinase
2. Phosphoglucoisomerase
3. Phosphofructokinase
4. Aldolase
5. Phosphotriose isomerase
6. Glyceraldehyde 3-phosphate dehydrogenase
7. Phosphoglycerate kinase
8. Phosphoglycerate mutase
9. Enolase
10. Pyruvate kinase



- **Step 1- Phosphorylation of glucose**

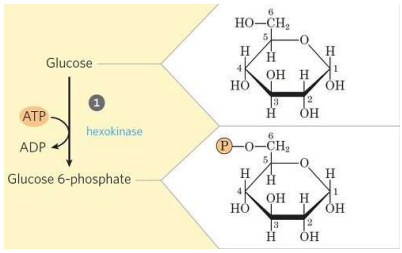


Image Source: Lehninger Principles of Biochemistry

- In the first step of glycolysis, the glucose is initiated or primed for the subsequent steps by phosphorylation at the C_6 carbon.
- The process involves the transfer of phosphate from the ATP to glucose forming Glucose-6-phosphate in the presence of the enzyme hexokinase and glucokinase (in animals and microbes).
- This step is also accompanied by considerable loss of energy as heat.
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- Step 2- Isomerization of Glucose-6-phosphate

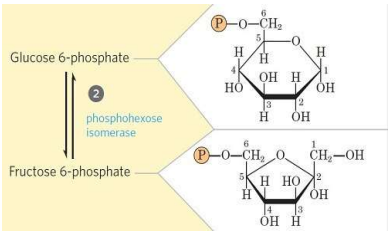
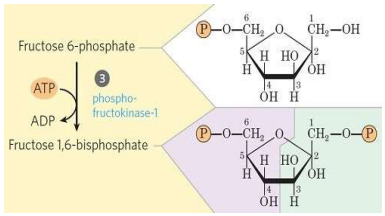


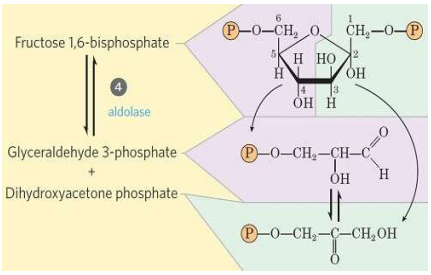
Image Source: Lehninger Principles of Biochemistry

- Glucose 6-phosphate is reversibly isomerized to fructose 6-phosphate by the enzyme phosphohexoisomerase/phosphoglucoisomerase.
- This reaction involves a shift of the carbonyl oxygen from C1 to C2, thus converting an aldose into a ketose

- Step 3- Phosphorylation of fructose-6-phosphate

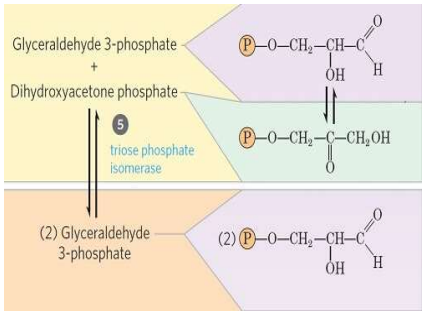


- Step 4- Cleavage of fructose 1, 6-diphosphate

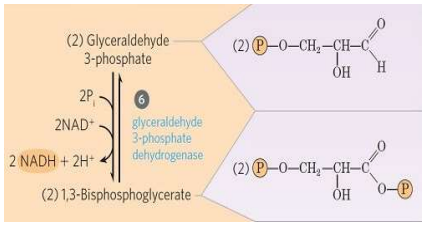


- Image Source: Lehninger Principles of Biochemistry

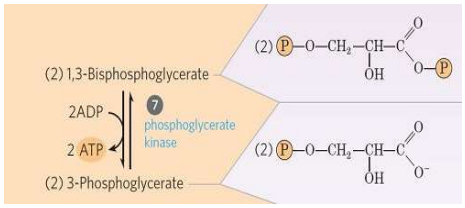
- Step 5- Isomerization of dihydroxyacetone phosphate



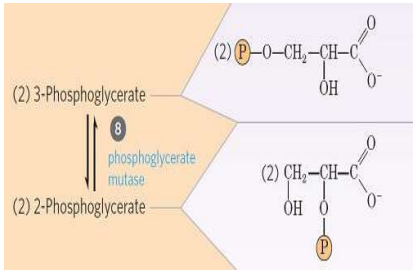
- Step 6- Oxidative Phosphorylation of Glyceraldehyde 3-phosphate



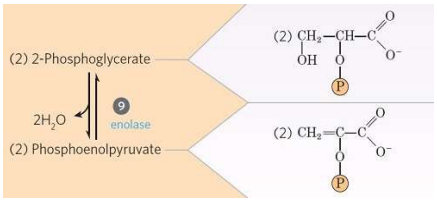
- Step 7- Transfer of phosphate from 1, 3-diphosphoglycerate to ADP



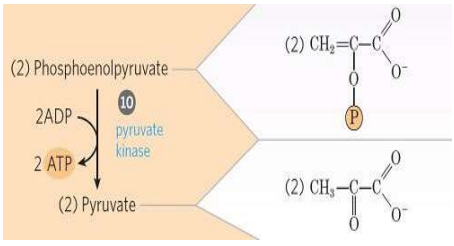
- Step 8- Isomerization of 3-phosphoglycerate



- Step 9- Dehydration 2-phosphoglycerate



- Step 10- Transfer of phosphate from phosphoenolpyruvate



- **Significanceof glycolysis**
  The primary function of glycolysis is to produce energy in the form of ATP.
- Similarly, glycolysis also produces pyruvate, which is then oxidized further to create more ATPs.

Energy gain

- A total of four moles of ATPs are formed in glycolysis.
- The net gain of ATP in glycolysis is 2 ATPs as two ATPs are utilized during the preparatory phase of glycolysis.

The overall reaction of glycolysis can be summarized as

$C_6H_{12}O_6$ +2NAD+2ADP+2Pi→$2CH_3COCOOH$+$2NADH_2$+2ATP