

Glycolysis

System Bioengineering

BME 322

BY

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Overview of Glycolysis

What is Glycolysis?

_Glycolysis is the series of reactions that extract energy from glucose by splitting it into two three carbon molecules called **pyruvates**. It is an ancient metabolic pathway that evolved long ago and is found in great majority of organisms alive today.

_In organisms that perform cellular respiration, glycolysis is usually the first stage of this process. However, glycolysis does not require oxygen.

_Glycolysis is comprised of ten steps and it takes place in the cytosol of a cell.

► Net reaction is: $C_6H_{12}O_6 + 2P + 2ADP + 2NAD^+ \rightarrow 2\text{Pyruvate} + 2ATP + 2NADH^+$

PHASES OF GLYCOLYSIS

There are two phases of glycolysis:

1. **Energy Requiring Phase:** In this phase, the starting molecule of glucose gets rearranged and two phosphate groups are attached to it. The phosphate group makes the fructose-1,2-biphosphate unstable, allowing it to split in half. The phosphate used here, comes from ATP so the three carbon sugars formed when the unstable sugar breaks down are different from each other.
2. **Energy Releasing Phase:** Here, each three carbon sugar is converted into another three carbon molecule, pyruvate through a series of reaction. In these reactions, 2ATP molecules and one ADH molecule are produced. This phase takes place twice.

NOTE: Each phase of glycolysis is catalysed by its own enzyme. Eg fructokinase

LEVELS OF GLYCOLYSIS

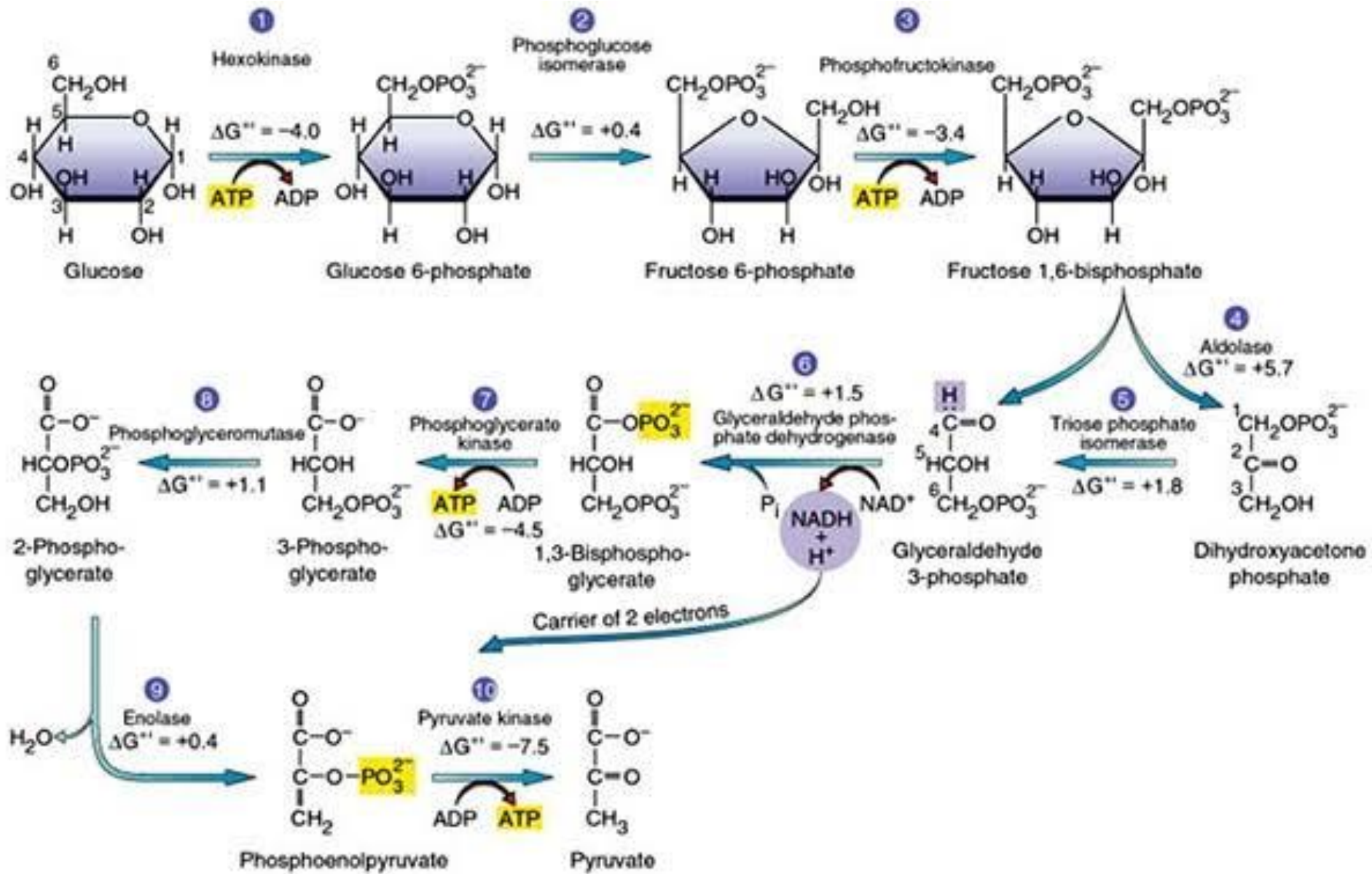
- ▶ There are basically ten steps involved with glycolysis and they include:
- ▶ STEP 1- A phosphate group is transferred from ATP to Glucose to make Glucose-6-phosphate. This is more reactive and it cannot move out of the cell membrane
- ▶ STEP 2 - Glucose -6- phosphate is converted to its isomer Fructose-6-phosphate
- ▶ STEP 3- Another phosphate group is transferred from ATP to fructose-6-phosphate making Fructose-1,6-bisphosphate. This step is catalysed by PFK
- ▶ STEP 4 - The fructose -1,6- bisphosphate is split into two three carbon sugar which are isomers of each other but only one can continue i.e glyceraldehyde-6-phosphate. DHAP-dihydroxyacetone phosphate.

CONTD

- ▶ STEP 5 - DHAP is converted to glyceraldehyde -6- phosphate
- ▶ STEP 6 - Two half reactions occur simultaneously, the glyceraldehyde - 6 - phosphate is oxidized and NAD^+ is reduced to NADH and H^+ and 1,3-bisphosphoglycerate is formed.
- ▶ STEP 7- 1,3-bisphosphoglycerate donates one phosphate to ADP making ATP and 3-phosphoglycerate
- ▶ STEP 8- 3- phosphoglycerate is converted to its isomer 2- phosphoglycerate
- ▶ STEP 9- 2- phosphoglycerate loses water and becomes phosphoenolpyruvate which is unstable
- ▶ STEP 10 - PEP donates a phosphate group to ADP making ATP and PYRUVATE

STAGES OF GLYCOLYSIS

- ▶ **STAGE ONE:** It is the investment stage. Here, two moles of ATP are consumed for each mole of glucose and it is converted to fructose-1,6-bisphosphate. Glucose is converted to an unstable form that can be easily cleaved.
- ▶ **STAGE TWO:** The fructose 1,6-bisphosphate is cleaved into two three-carbon units of glyceraldehyde-3-phosphate.
- ▶ **STAGE THREE:** The final stage of glycolysis is the generation of ATP from the phosphorylated three carbon metabolite the transfer of the phosphoryl group from the acyl phosphate of 1,3-bisphosphoglycerate to glucose. Phosphoglycerate kinase catalyses o ADP.



THE GLYCOLYTIC PATHWAY