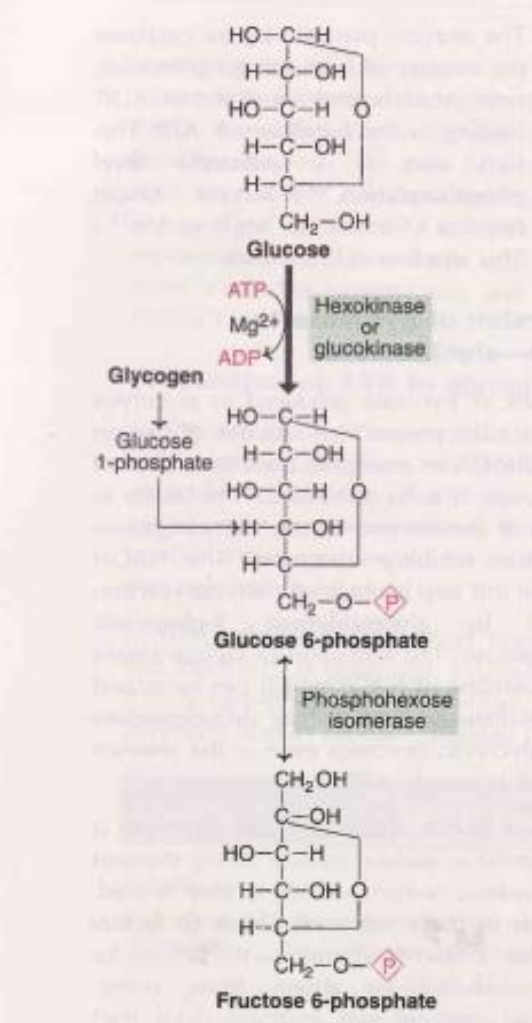
# BIOCHEMISTRY- BP203T

UNIT: 1 CARBHOHYDRATES

CLASS:2

## TOPIC: GLYCOLYSIS

**GLYCOLYSIS**



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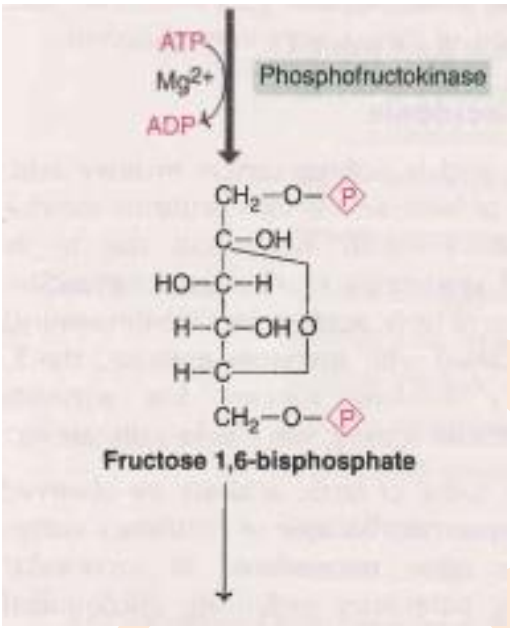
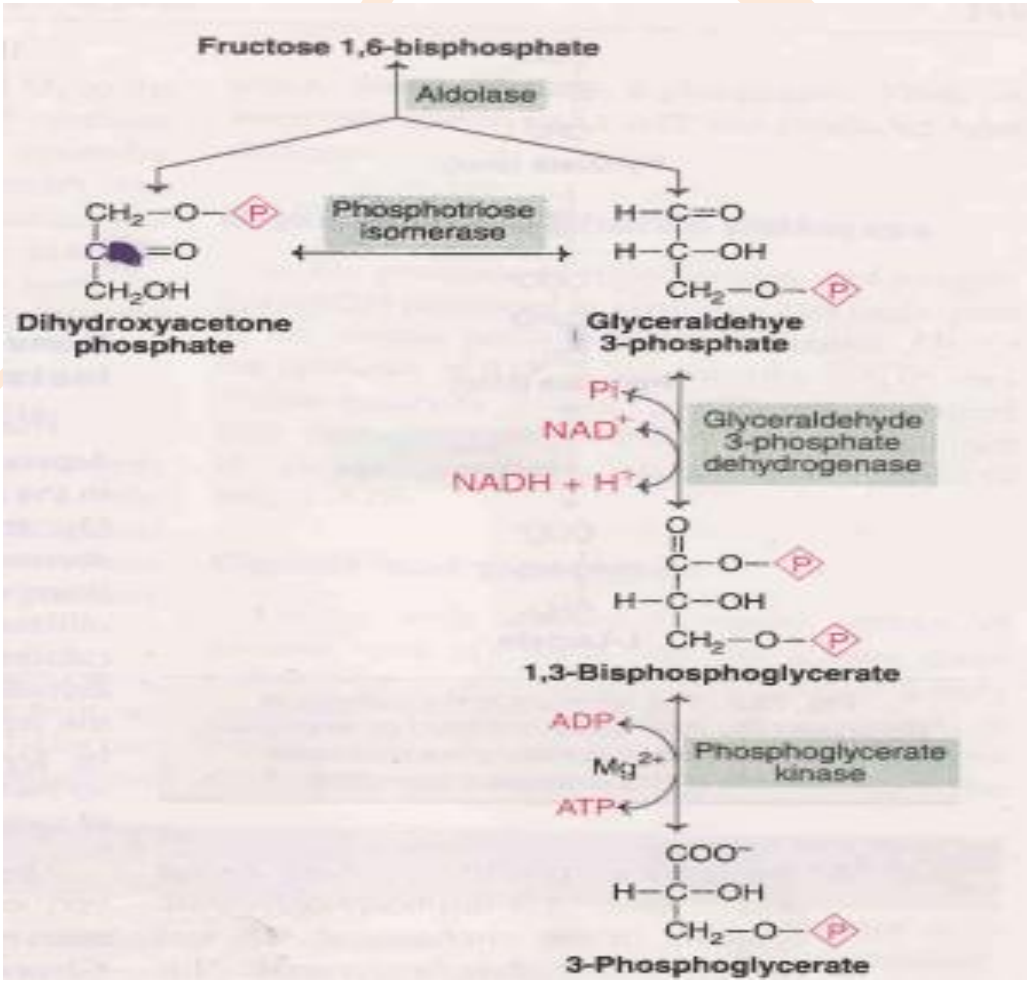
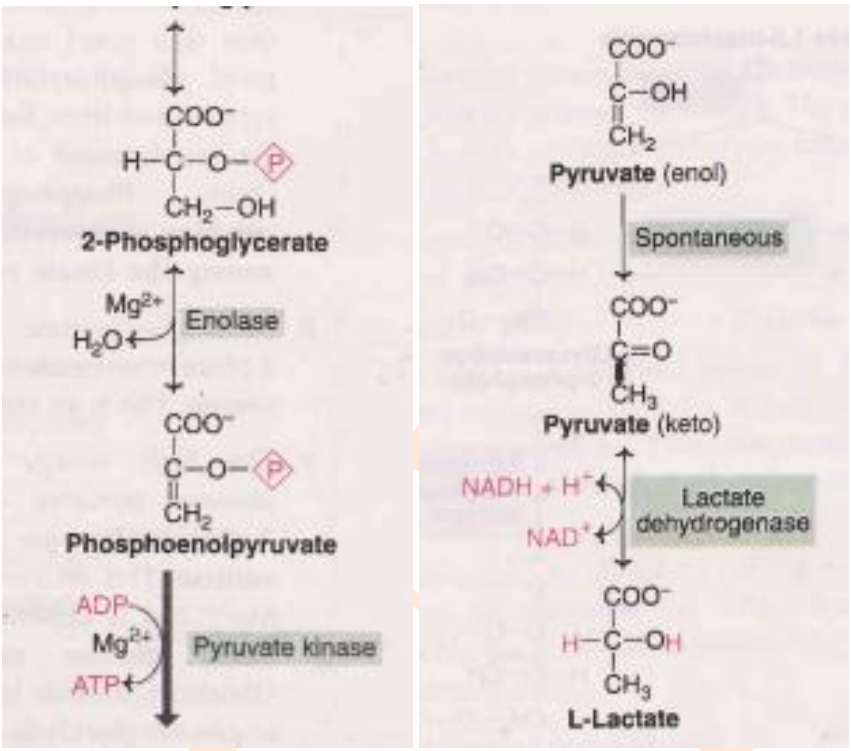

ATP
$Mg^{2+}$
ADP
Phosphofructokinase
Fructose 1,6-bisphosphate


Fructose 1,6-bisphosphate
Aldolase
Phosphotriose isomerase
Dihydroxyacetone phosphate
Glyceraldehye 3-phosphate
Pi
$NAD^+$
$NADH + H^+$
Glyceraldehyde 3-phosphate dehydrogenase
1,3-Bisphosphoglycerate
ADP
$Mg^{2+}$
ATP
Phosphoglycerate kinase
3-Phosphoglycerate




The pathway can be divided into three distinct phases:

A. Energy investment phase or priming stage

B. Splitting phase

C. Energy generation phase

I. Glucose is phosphorylated to glucose 6-phosphate by hexokinase or glucokinase (both are isoenzymes). This is an irreversible reaction, dependent on ATP and $Mg^{2+}$.

- The enzyme hexokinase is present in almost all the tissues. It catalyses the phosphorylation of various hexoses (fructose, mannose etc.), has low $K_m$ for substrates and is inhibited by glucose6-phosphate.
- Glucose-6-phosphate is impermeable to the cell membrane. It is a central molecule with a variety of metabolic fates- glycolysis, glycogenesis, gluconeogenesis and pentose phosphate pathway
- II. Glucose-6-phosphate undergoes isomerization to give fructose-6-phosphate in the presence of the enzyme phospho-hexose isomerase and $Mg^{2+}$.
- III. Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate by phosphofructokinase (PFK). This is an irreversible and regulatory step in glycolysis.

VI. Glyceraldehyde-3-phosphate dehydrogenase converts glyceraldehyde 3-phosphate to 1,3-bisphosphoglycerate.

- This step is important as it is involved in the formation of NADH + $H^+$ and a high-energy compound, 1,3-bisphosphoglycerate.
- In aerobic conditions, NADH passes through the electron transport chain and 6 ATP (2 x 3 ATP) are synthesized by oxidative phosphorylation.

VII. The enzyme phosphoglycerate kinase acts on 1,3-bisphosphoglycerate, resulting in the synthesis of ATP and the formation of 3-phosphoglycerate.

- This step is a good example of substrate-level phosphorylation, since ATP is synthesized from the substrate without the involvement of the electron transport chain.
- VIII. 3-Phosphoglycerate is converted to 2-phosphoglycerate by phosphoglycerate mutase. This is an isomerization reaction.
- IX. The high-energy compound phosphoenol pyruvate is generated from 2-phosphoglycerate by the enzyme
  enolase. This enzyme requires $Mg^{2+}$ or $Mn^{2+}$.
- X The enzyme pyruvate kinase catalyses the transfer of high-energy phosphate from phosphoenol pyruvate to ADP, leading to the formation of ATP. This step is also a substrate-level phosphorylation.

**Generation of ATP in glycolysis**

| *Pathway* | *Enzyme (method of ATP synthesis)* | *Number of ATP synthesized* |
|---|---|---|
| **Glycolysis** | Glyceraldehyde 3-phosphate dehydrogenase (2 NADH, ETC, oxidative phosphorylation) | 6* |
| | Phosphoglycerate kinase (substrate level phosphorylation) | 2 |
| | Pyruvate kinase (substrate level phosphorylation) | 2 |
| | Two ATP are consumed in the reactions catalysed by hexokinase and phosphofructokinase | -2 |
| | ***Net ATP synthesis in glycolysis in aerobic condition*** | ***8*** |