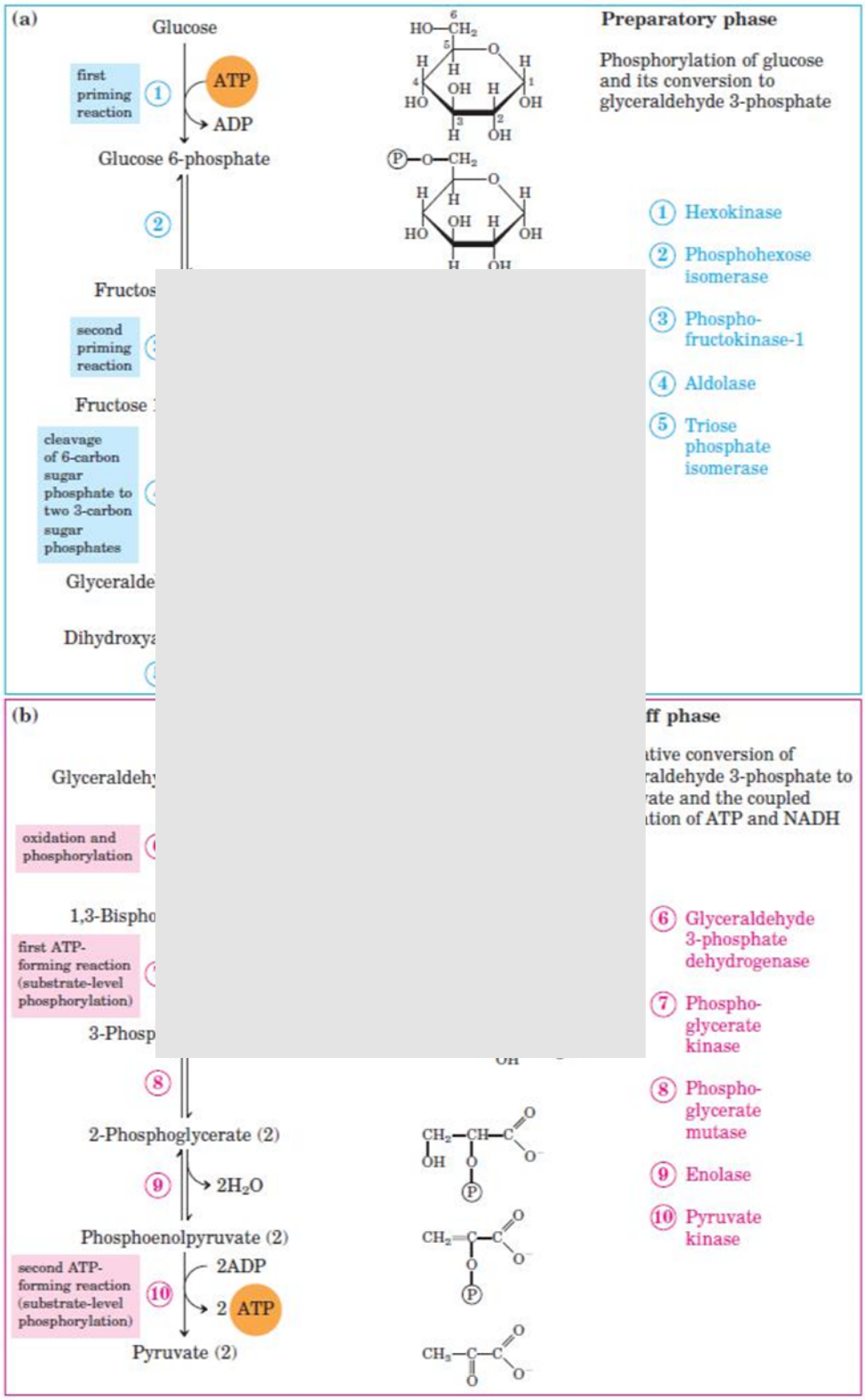
Glycolysis

Once glucose enters the cell, it is phosphorylated into Glucose-6-phosphate (G6P). The phosphorylation event is facilitated by the enzyme hexokinase, with concomitant conversion of ATP to ADP. This step causes the glucose molecule to become negatively charged, thus preventing it to diffuse out of the cell. As


(a)
Glucose
first priming reaction
1
ATP
ADP
Glucose 6-phosphate
2
Fructos
second priming reaction
Fructose
cleavage of 6-carbon sugar phosphate to two 3-carbon sugar phosphates
Glyceralde
Dihydroxya
Preparatory phase
Phosphorylation of glucose and its conversion to glyceraldehyde 3-phosphate
1 Hexokinase
2 Phosphohexose isomerase
3 Phospho-fructokinase-1
4 Aldolase
5 Triose phosphate isomerase
(b)
Glyceraldehy
oxidation and phosphorylation
1,3-Bispho
first ATP-forming reaction (substrate-level phosphorylation)
3-Phosp
8
2-Phosphoglycerate (2)
9
2H2O
Phosphoenolpyruvate (2)
second ATP-forming reaction (substrate-level phosphorylation)
10
2ADP
2 ATP
Pyruvate (2)
ff phase
ative conversion of raldehyde 3-phosphate to rate and the coupled ation of ATP and NADH
6 Glyceraldehyde 3-phosphate dehydrogenase
7 Phospho-glycerate kinase
8 Phospho-glycerate mutase
9 Enolase
10 Pyruvate kinase

the name of the enzyme suggests, it only rearranges the atoms of G6P to form Fructose-6-Phosphate (F6P) to expose the C1 for further phosphorylation. The G6P is then isomerized to form Fructose-6-phosphate with the use of phosphoglucose isomerase. Another enzyme called Phosphofructokinase (PFK) adds phosphate to the newly exposed C1 of fructose to form Fructose-1,6-bisphosphate (F-1,6-P). This process consumes a molecule of ATP and leads to increased instability of the molecule, as two bulky and negatively charged phosphate groups repel each other. F-1,6-P is then split to form two simpler sugars called Glyceraldehyde-3-phosphate (G-3-P) and dihydroxyacetone-3-phosphate (DHAP). Take note that these processes comprise the energy investment phase of glycolysis, in which ATP is consumed, whereas the next processes correspond to the energy-generation phase in which ATP is formed. Among the two sugars formed, only G-3-P can be used in successive steps, thus DHAP is converted to G-3-P through the enzyme triose phosphate isomerase (TPI). The two molecules of G-3-P will be used to form 1,3-Bisphosphoglycerate (1,3-BPG) through the action of glyceraldehyde phosphate dehydrogenase. This enzyme consumes two molecules of inorganic phosphates (Pi) and 2 molecules of NAD+. The phosphate group at the C1 of the 1,3-BPG is released to form ATP and 3-Phosphoglycerate (3-PG). As there are two molecules of 1,3-BPG that are used in the process, two molecules of ATP are

also produced hence, this step provides payoff for the first two ATPs spent during the energy investment phase. The next process involves transfer of the phosphate groups from the third to second carbon of 3-PG to form 2-phosphoglycerate (2-PG). The 2-PG serves as the substrate for the enzyme enolase, which removes

In summary, the glycolysis pathway that occurs in the cytosol requires 2 ATP molecules during the energy investment phase and produces four ATP molecules in the energy generation phase. This amount of ATP is insufficient to support our daily activities, thus the pyruvate must still be processed to form more ATP molecules.