Glycolysis: an analysis

Reaction & enzyme Steps 1-5 (Energy investment) Steps 6-10 (Energy payoff)	Δ G (kcal/mole)
1) Glucose + ATP → glucose-6-phosphate + ADP + P_i (hexokinase)	-4.0
2) Glucose-6-phosphate → fructose-6-phophate (phosphoglucoisomerase)	+0.4
3) Fructose-6-phosphate + ATP → fructose-1,6-biphosphate + ADP + P_i	-3.4
4 & 5) fructose-1,6-biphosphate → → 2 glyceraldehydes-3-phophate (2 PGAL) These combined steps make use of the enzymes aldolase and isomerase	+7.5
6) 2 PGAL + 2NAD+ + 2P_i → 2 (1,3 biphosphoglycerate) + 2 NADH + 2H+ This reaction involves a triose phosphate dehydrogenase.	+3.0
7) 2 (1,3 biphosphoglycerate) + 2 ADP + 2 P_i → 2 (3-phosphoglycerate) + 2 ATP made This reaction involves phosphoglycerokinase.	-9.0
8) 2 (3- phosphoglycerate) → 2 (2-phosphoglycerate) This reaction involves phosphoglyceromutase	+1.5
9) 2 (2- phosphoglycerate) → 2 phosphoenolpyruvate (PEP) + 2 H_2O This reaction involves enolase.	-0.4
10) 2 phosphoenolpyruvate + 2 ADP + 2 P_i → 2 pyruvate + 2 ATP made This reaction involves pyruvate kinase.	-15.0
Because each reaction is coupled with other reactions, glycolysis proceeds in a forward direction, producing 4 ATP and 2 NADH per glucose consumed. The overall process of glycolysis is highly exergonic and spontaneous in all cells.	Total Δ G = -19.4 kcal/mole