

Study Guide – Lehninger Principles 4th Edition

Chapter Fourteen

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Homework: 3,5,6,9,10,12,15. **14.1 Glycolysis.** Briefly put, you should know *everything* about Glycolysis. That means structures of all reactants and products, names of enzymes, cofactors for each reaction, and approximate ΔG° for reactions with standard free energy changes with absolute value greater than 16 kJ/mol. You should know the pathway itself (summarized in Fig 14-2) and the fates of pyruvate (Fig 14-3). You should know the mechanism of class I Aldolase (Fig 14-5 is more complex than it needs to be, mainly know Schiff Base forms between Lysine NH₂ and keto C=O). Also know the mechanism of G3PDH (Fig 14-7 is complex, mainly know that Cys –SH forms thioester with G3P).

14.2 Feeder Pathways for Glycolysis. Understand how glycogen can be broken down using glycogen phosphorylase, debranching enzyme, and phosphoglucomutase, yielding Glu-6-P. Glucose also comes from dietary starch, and amylose is hydrolyzed by amylase to yield free glucose. Disaccharides are hydrolyzed into monosaccharides. Know about *Lactose Intolerance*. Of the non-glucose monosaccharides, we will focus on galactose. Know how galactose is converted into glucose (Fig 14-11). A simple 4-epimerase would do the trick but typically hexoses require attachment of a UDP "handle" for such reactions. Lack of one of these enzymes produces *Galactosemia*, which can be very serious. The worst form is caused by lack of UMP-Transferase.

14.3 Fates of Pyruvate under Anaerobic Conditions: Fermentation. The simple anaerobic fate of pyruvate is conversion to lactate – note the ΔG° of this reaction. Yeast cells are eukaryotic and yeast anaerobic metabolism is different, resulting in ethanol. Understand the role of *Thiamine* in this and other reactions. Know the structure of the five membered ring of TPP. Carefully read Box 14-1 (alligators) and Box 14-2 (beer).

14.4 Gluconeogenesis. Gluconeogenesis is the pathway that synthesizes glucose. It makes use of all the reversible reactions of Glycolysis, run backwards. Fig 14-6 summarizes both pathways. The three irreversible reactions of Glycolysis are all Kinase reactions: Hexokinase, Phosphofructokinase, and Pyruvate Kinase (note that PG Kinase is reversible). Hexokinase and PFK-1 are reversed by simple "bypass" reactions, G6Pase and Fructose Bisphosphatase (p. 547). Know why G6Pase is "dangerous" and has to be compartmentalized. Pyruvate Kinase requires a more complicated "bypass" (Fig 14-17). Know the five membered rings of Biotin (Fig 14-18). Making glucose from 2 lactate requires 6~P, whereas Glycolysis from glucose to lactate affords a net gain of only 2~P. The Cori Cycle (Box 14-1) links liver Gluconeogenesis to muscle Glycolysis. Mutual regulation of the 2 pathways is discussed in more detail in the Glycogen chapter (15).

14.5 Pentose Phosphate Pathway of Glucose Oxidation. Know all details about the oxidative branch (Fig 14-21) and the non-oxidative branch (p. 552-3) of the PPP. Use the "Pentose Phosphate Worksheet" handout online. The goals of the PPP are production of NADPH and/or Ribose-5-P. Know about the effects of *G6PDH Deficiency* (Box 14-3). Understand Wernicke-Korsakoff Syndrome (554).