

BERG/STRYER VI STUDY GUIDE

CHAPTER 16 GLYCOLYSIS

1. Homework 1, 2, 7, 11-13, 16, 20. *Review main reaction types (Table 15.5 page 425).* Glycolysis is an anaerobic pathway, and very ancient. Parts of it are essentially universal. It takes place in the cytoplasm. You need to learn all intermediates with structures, all enzymes and all cofactors as shown in Fig. 16.2. Notice in that figure that 3 steps (all "kinase" reactions) are irreversible. Know which ones they are. In Table 16.1, know the approximate $\Delta G_o'$ for all reactions where the absolute value is 4 or greater.
2. Know the fates of pyruvate (Fig. 16.9) – anaerobic, to lactate; aerobic, to Acetyl CoA; yeast anaerobic, to CO₂ and ethanol. Understand how the anaerobic fates maintain redox balance. Two of the enzymes involved have the "Rossmann fold" for binding NAD⁺ just like G3PDH (Fig. 16.12). Know how galactose and fructose enter glycolysis, and understand the distinction between lactose intolerance and galactosemia. MECH: Know Lys Aldolase (not in book, but see Fig. 20.22) and G3PDH (440ff).
3. Understand how PFK controls the rate of glycolysis. Know that PFK2 produces the important positive allosteric modulator, F-2,6-BP. Be able to explain the curves in Fig 16.18. Understand how GLUT2 and GLUT4 interact with insulin – and see how this explains the problem in diabetes.

GLUCONEOGENESIS

4. First, notice that all of the structures in Fig 16.22 are exactly the same as the structures in 16.2 except for oxaloacetate (OAA), which is new. Then notice that the enzymes shown in blue are also the same. The red enzymes replace the irreversible steps in Fig 16.2. So in a real way, despite what every textbook says, gluconeogenesis *can* be thought of as a reversal of glycolysis, with some useful changes. Understanding this makes the pathway much easier to learn, especially if you already know glycolysis.
5. Making phosphoenolpyruvate (PEP) is difficult, and in eukaryotic cells requires a visit to the mitochondrial matrix. Pyruvate carboxylase uses biotin, ATP, and activating acetyl CoA to form OAA. This converts to malate and moves back to the cytoplasm, where it is re-oxidized to OAA. PEPCK converts it into PEP. The carboxyl that was added was added to pyruvate is now gone. This begins gluconeogenesis. At the end of the pathway we find Fructose biphosphatase and Glucose-6-phosphatase (G6Pase). Both of these enzyme activities must be tightly controlled. G6Pase is particularly dangerous (why?), and the enzyme is kept in the lumen of the endoplasmic reticulum (Fig 16.27).
6. Know the controls shown in Fig 16.28, and the Cori Cycle shown in Fig 16.33. Understand the final paragraph of the chapter – which four reactions are universal, and present both in glycolysis and gluconeogenesis?