

Study Guide – Lehninger Principles 5th Edition

Chapter Eighteen

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Homework: 1,3,4,5,6,9,11,17,19. **Introduction.** The amount of amino acid catabolism varies widely from species to species. Amino acids have to be broken down after 1) normal protein turnover, 2) a high protein meal or 3) in diabetes or starvation when the carbon is used for gluconeogenesis.

18.1 Metabolic Fates of Amino Groups. Amino acid catabolism involves removing nitrogen from the carbon chains, and then metabolizing the carbon. *Glutamate* and *glutamine* play an important role in this removal (Fig. 18-2). The removed nitrogen is simply excreted in *ammonotelic* organisms, and is excreted as a solid in *uricotelic* organisms. We are *ureotelic* and thus make urea. *Pyridoxal phosphate* (PLP) is very important in nitrogen metabolism, and you should be able to draw it (as in class) and understand mechanisms. See Fig 18-6 and online handout. In general most amino acids can transaminate, giving their nitrogens to α -KG and becoming α -keto-acids (Fig 18-4) with PLP as cofactor. Then glutamate DH can oxidatively remove the NH_3 (Fig 18-7). Thus α -KG can carry one nitrogen (as Glu) or two nitrogens (as Gln) (Fig 18-8). Know the reactions of *glutamine synthetase* and *L-glutaminase*. Why does the body respond to *metabolic acidosis* (low level *ketosis*) with enhanced glutamine metabolism? (p. 681) Know the enzymes in Box 18-1 (mentioned in "*Supersize Me*"). Know the glucose-alanine cycle (Fig 18-9). Know that ammonia is toxic (p. 681).

18.2 Nitrogen Excretion and the Urea Cycle. Know everything about the Urea Cycle, including structures, enzymes, and cofactors. Know how *carbamoyl phosphate* is produced. Understand the "*bicycle*" that links the urea cycle to the citric acid cycle (Fig 18-12). Know the reactions of *N-acetyl-glutamate synthetase* and that the product, N-acetyl glutamate, stimulates *CPS-I* (Fig 18-13). Understand that the "*urea bicycle*" reduces the overall cost of urea synthesis from 4 ~P to 1.5 ~P (p. 686). Know the "ten" essential amino acids taught in class (refer to Table 18-1) and know the treatments for urea cycle deficiencies (p. 686-7).

18.3 Pathways of Amino Acid Degradation. Understand the concept of *glucogenic* and *ketogenic* amino acids (Fig 18-15). All amino acids with 6 or more contiguous carbons are at least partly ketogenic. *One carbon metabolism* (689-692) is extremely important and should be studied carefully. Be able to recognize *THF* structures, see Fig 18-17 and online handouts. Know structure and synthesis of *SAM* (Fig 18-18). Homocysteine is bad (not in book). Be able to draw *biotin* and know that *B-12* or *cobalamin* is also a "one carbon cofactor."
Pyruvate Family: Know the lower four enzymes in Fig 18-19. **Acetyl CoA Family:** Know the first reaction in Fig 18-23 and the online handout about *epinephrine synthesis* (860). Understand *PKU* and *mixed function oxidases* (696-7). **α -Ketoglutarate Family:** Know reactions in Fig 18-26 except His pathway. **Succinyl CoA Family:** Know how Thr and homocysteine go to Succinyl CoA. **Branched Chain Family:** Understand that these are metabolized in muscle, adipose, etc. by enzymes that resemble fatty acid beta oxidation enzymes. Lack of DH Complex leads to *Maple Syrup Urine Disease*. Read Box 18-2. Know AsN and Asp go to OAA.