Introduction. We will skip much of this chapter but two long pathways are covered, Purine de novo (865) and Pyrimidine de novo (867). There are three main ways in which ammonia nitrogen is incorporated into organic compounds. 1) Glutamate DH (reductive), 2) Carbamoyl Phosphate Synthetase I (not II), and 3) Glutamine Synthetase. The first two were described in Chapter 18, but the third will be discussed below. Then, once the nitrogen is attached, there are three major modes of nitrogen transfer: 1) Transamination, 2) Aspartate donation, and 3) Glutamine donation. Again, the first two were described in Ch. 18 but the third will be discussed here.

22.1 Overview of Nitrogen Metabolism. We won’t be concerned with nitrogen fixation (833-6). The fact that Glutamate DH is reversible provides a ready pathway for incorporation of cellular NH3 into amino acids. Glutamine synthetase allows a second NH3 to be taken up. The reaction is simple but the allosteric feedback is rather complex in E. coli (Fig 22-6). Don’t worry about covalent modification of Gln Syn. (Fig 22-7) but do know the allosteric inhibitors. Once formed, glutamine serves as a ready donor of its R group nitrogen via glutamine amidotransferase enzymes. You don’t need to know the proposed mechanism of glutamine donation (Fig. 22-8).

22.2 Biosynthesis of Amino Acids. Students find this material intimidating. We are omitting most of it but retaining a few useful pathways. You should know the synthesis of proline (Fig 22-10), the synthesis of ser/gly (Fig 22-12), And know the conversion of ser to cys via cystathionine (Fig 22-14).

22.3 Molecules Derived from Amino Acids. Know that glycine is the starting material for heme group synthesis (but not the pathway) and know that bilirubin is a linear tetrapyrrole, and be able to sketch the structure (Fig. 22-25). Understand Box 22-1, about the disease porphyria. Know the pathway to epinephrine, mentioned already in Chapter 18 (Fig 22-29).

22.4 Biosynthesis and Degradation of Nucleotides. Start by learning the purine map (Fig 22-32). Then if you add in the sequence the de novo pathway is not difficult to master (Fig 22-23). Learn this “chant” – “N, Glycine, Formyl – N, cyclize, carboxyl – N, cleave, Formyl – Cyclize, N, cleave.” The phrase “N, cleave” represents aspartate donation, whereas a simple “N” represents glutamine donation. The “chant” gets you all the way to AMP. Understand the branching pathway and mutual regulation between AMP and GMP (Fig 22-34 and Fig 22-35). Also learn the de novo pathway for pyrimidines (Fig 22-36). Nucleotide reactions are specific for mono, di, or triphosphates. Conversion to 2’-deoxy occurs at the diphosphate level. The enzyme is ribonucleotide reductase or “RNR” (869-872). This ancient enzyme proves that protein came before DNA. Know the thymidylate synthase reaction (Fig 22-44 and Fig 22-49), dUMP → dTMP. Understand the purine salvage pathway and gout (875-6).