CHAPTER 5

1. HOMEWORK 1, 2, 4, 8, 13. Answers on p. C3. This chapter is designed to convey a basic idea of the working of DNA and RNA, the basic facts of protein synthesis. You should learn the definitions of transcription and translation (118) plus replication (DNA synthesis). DNA and RNA are polynucleotides. As with proteins, in order to understand the polymer, we have to look at the monomer. Here, the monomers are nucleotides. Each nucleotide has a "base", a sugar, and a phosphate. The chemical structures are shown on pages 119-120. Please learn to draw the structures of A, C, T, and G either alone or as part of a nucleotide. You should also understand the simplified "stick and P" diagrams shown in Fig. 5.7. These will be used throughout the semester. The top of the "stick" represents carbon one of the sugar, which is where the "base" attaches. The bottom of the stick is carbon 5, where the phosphate is linked by an ester bond.

2. The understanding of DNA took a quantum leap when Watson and Crick determined the structure of the DNA double helix in 1953. For the first time, it was clear how DNA could be precisely copied during cell replication. You should learn the properties of the double helix (122-3) and be able to draw AT or GC base pairs (p. 122). You should also understand that the two chains in the double helix are antiparallel, so that if one strand reads 5' ATG 3', the other will read 5' CAT 3' and not TAC. Meselson and Stahl confirmed Crick's speculation about how DNA replication works. It is a semi-conservative process, the two strands separate, and a new strand is "grown" to match each of the older strands. You should understand the experiment that proved this (p. 123-4). Understand the discussion about "melting" of double helical DNA (124-5). Know why the absorbance of DNA increases as it goes from ds (double stranded) to ss (single stranded). Know why poly-GC strands are harder to melt than poly-AT strands. DNA can be linear or circular – circular DNA is often supercoiled. RNA is usually single stranded, but pairs with itself.

3. Understand how DNA Polymerases work (Fig 5.21). Retroviruses (HIV, Herpes, Papilloma, etc.) have an RNA genome and need Reverse Transcriptase (Fig 5.23) to make DNA. Transcription is performed by RNA Polymerase, a protein which recognizes the "promoter sequence" on DNA and starts making RNA. See page 132 – "transcription start" in procaryotes has a –35 region and a Pribnow box in the DNA. "Transcription stop" can be a hairpin poly-U in the RNA. The three main kinds of RNA in cells are messenger, ribosomal, and transfer RNA (mRNA, rRNA, and tRNA). These convert nucleotide sequences into amino acid sequences. "Translation start" in procaryotes has a purine rich sequence (AGGAG) followed by AUG in the mRNA, and "translation stop" is a stop codon. The genetic code is nearly universal – we all run on the same "software."

4. Eukaryotic genes have introns and exons. Introns are "nonsense" interruptions and exons are the "message." Introns are transcribed and then removed from the resulting RNA. Prokaryotes generally lack introns, which appears to be a "streamlining" adaptation for reproductive speed. Introns appear to be ancient. Exons often encode protein domains, and exon shuffling can lead to rapid production of useful new proteins. See Fig 5.37, alternative splicing of exons can omit a domain and convert a membrane-bound protein to a free protein.