Cell Biology Exam #1 Study guide

Intro to Cells

What technological development and subsequent observations led to the birth of cell biology?
What is the cell theory?
What are the average sizes of prokaryotic and eukaryotic cells and organelles?
What are the resolution limits of the different types of microscopy?
Compare and contrast bright field light microscopy, differential interference contrast light microscopy, fluorescence microcopy, confocal fluorescence microscopy, transmission electron microscopy, and scanning electron microscopy.
What do images produced by the different types of microscopy look like? (Check out the relevant figures in your book).
What are the differences and similarities between prokaryotic and eukaryotic cells?
What are the main organelles and cell parts found in a eukaryotic cell?

Proteins I

Be familiar with the general structure of amino acids, peptide bonds and polypeptide chains (or proteins). While I don't expect you to memorize the amino acid side chains, I do expect you to be able to tell if they are nonpolar, acidic, basic, or uncharged polar if the structure is provided.
What are the four levels of structural organization of a protein and what characterizes each level?
What are covalent bonds (both polar and nonpolar)? What is a dipole?
What are the 4 types of non-covalent bonds/forces relevant to cells? Be able to describe them.
How do proteins fold?
What are □ helices and □ sheets? How are they formed?
What are a protein domains, chaperones, intrinsically disordered sequences, disulfide bonds, and protein families?
How do X-ray crystallography and nuclear magnetic resonance spectroscopy work?

Proteins II

What are binding sites, active sites, ligands, substrates, active sites, catalysts, and enzymes?
What does lysozyme do?
What do small molecules covalently attached to protein often do?
How does feedback inhibition work?
What is an allosteric protein?
What are some of the ways protein activity is modulated in a cell?
What do conformational changes have to do with protein activity?
What are kinases, phosphatases, and GTPases (GTP binding proteins)? How do these regulate protein activity?
What are antibodies and antigens?
How are antibodies used as molecular tags?

What is GFP and how is it used to track proteins in cells?

DNA and chromosomes

Be familiar with the general structure of nucleotides, phosphodiester bonds, and nucleic acids.
Compare and contrast: Purines vs pyrimidines, ribose vs deoxyribose, RNA vs DNA, heterochromatin vs euchromatin.
How are the following terms applied to the structure of double stranded DNA: hydrogen bonds, complementary base pairing, anti-parallel, and polarity. Ponder how complementary sequences are written with respect to polarity.
What are genomes, karyotypes, chromosomes, homologous chromosomes, and chromatin?
What three sequence elements are needed for chromosome replication and segregation?
What are the levels of chromatin organization and what proteins and interactions led to their formation?
What three ways can DNA binding proteins access nucleosome wrapped DNA?
What is the relationship between the amount of DNA condensation and the level of transcription?
What is X inactivation?
What are the main structural components of the nucleus?
What is a biochemical neighborhood? What happens in the nucleolus?

Central Dogma I

What is the central dogma?
What characteristics are unique to RNA?
What do polymerases do? Remember 5' to 3'.
What are the main steps in prokaryotic transcription? What is the role of the promoter (-10 and -35 sequences), sigma factor, RNA polymerase, and termination sequence?
How does prokaryotic and eukaryotic transcription differ?
What are the main steps in eukaryotic transcription? What are the roles of the promoter (TATA box), the general transcription factors (especially TFIID and TFIIH), RNA pol II, and the CTD of RNA pol II?
How are eukaryotic transcripts processed prior to exiting the nucleus? Why?
What is the role and composition of the spliceosome? What are snRNPs and snRNAs?
What is the advantage of alternative splicing?

Central Dogma II

What are codons, the genetic code, redundancy, and reading frames?
What are the important structural features of a tRNA? What is tRNA charging?
What is the enzyme responsible for tRNA charging? How is the charging checked within the enzyme?
What are ribosomes made of? What are the roles of the large and small subunit?
What are the E, P, and A sites?

What are the steps in translation including initiation, elongation, and termination?
What are the roles of the initiator tRNA, eIF2, EF-Tu, EF-G, release factors, and GTP hydrolysis in translation?
What is a polysome?
What do proteasomes, ubiquitin, and proteases have to do with protein degradation?

Gene Expression
What allows cells from the same organism to have different morphology and functions?
What is gene expression and how is it regulated?
What are transcriptional regulators (activators and repressors) and regulatory DNA sequences?
What types of chromatin modifying proteins can be recruited by transcriptional regulators?
What is combinatorial control?
How does a single transcriptional regulator control the expression of many genes?
What are three examples of cell memory?
What is epigenetic inheritance?