Study material.
This study guide covers material for the second exam: "Methods in molecular biology and the mechanics of replicating, repairing and copying genetic information," material from lectures 7-12 on the syllabus, Sept. 26 through Oct. 19.

Be able to define, discuss, and explain the following:

- molecular clone
- transformation
- F factor
- lysogen
- prophage
- PCR
- preimplantation genetic diagnosis
- RFLP
- microsatellite
- dideoxynucleotides
- coverage
- pseudogenes
- satellite DNA
- retrotransposons
- target site duplications
- homolog
- deamination
- direct repair
- topoisomerase II
- recA
- rho factor
- consensus sequence
- polycistronic
- operon
- helix-turn-helix motif
- core promoter
- general transcription factors
- radiation hybrid
- host
- transduction
- Hfr
- temperate bacteriophage
- complement (of DNA)
- cDNA
- polymorphism
- CAPs
- Cφ
- transformation
- conjugation
- temperate bacteriophage
- site-specific recombination
- complexity (of DNA)
- photolithography
- conjugation
- F'
- F''
- conjugation
- site-specific recombination
- DNA footprinting
- STR loci
- preimplantation genetic diagnosis
- polymorphism
- SNP
- microsatellite
- CODIS
- allele-specific primer
- RFLP
- cDNA
- polymorphism
- STR loci
- microsatellite
- CODIS
- allele-specific primer
- retrotransposons
- retrovirus-like transposable elements
- target site duplications
- Terminal inverted repeats
- homolog
- ortholog
- paralog
- deamination
- depurination
- thymine dimer
- direct repair
- mismatch repair
- AP endonuclease
- topoisomerase II
- base excision repair
- nucleotide excision repair
- recA
- recBCD
- Holliday junction
- rho factor
- sigma factor
- core polymerase
- consensus sequence
- RNA polymerases I, II, III and IV
- polycistronic
- monocistronic
- antitermination
- operon
- attenuation
- TBP
- helix-turn-helix motif
- recognition helix
- CTD
- core promoter
- enhancer
- silencer
- general transcription factors
- preinitiation complex
- zinc finger
- radiation hybrid
- YAC
- BAC
Review questions and suggested subjects for review.

Be sure that you understand the yeast two-hybrid assay for protein-protein interactions, both as a technique and as an illustration of principles behind transcriptional activation (see lecture 12).

1. Proteins with the helix-turn-helix motif interact with DNA using (pick one)
   a) hydrogen bonds between amino acids in an alpha helix and bases in the minor groove of DNA
   b) hydrogen bonds between amino acids in an beta sheet and bases in the minor groove of DNA
   c) hydrogen bonds between amino acids in an alpha helix and bases in the major groove of DNA
   d) hydrogen bonds between amino acids in an beta sheet and bases in the major groove of DNA
   e) covalent bonds between amino acids in an alpha helix and bases in the minor groove of DNA
   f) covalent bonds between amino acids in an beta sheet and bases in the minor groove of DNA
   g) covalent bonds between amino acids in an alpha helix and bases in the major groove of DNA
   h) covalent bonds between amino acids in an beta sheet and bases in the major groove of DNA

2. Transcription of a class II gene (a gene transcribed by RNA polymerase II) starts at a G 30 bp downstream of the first T in the TATA box. A deletion of 10 bp between the G and the TATA box would result in transcription starting where?

3. You have a cloned and sequenced a gene from the East Mongolian rabbit, a species without a known genetic map of any kind. How might you generate a map and place this gene on the map of the East Mongolian rabbit genome without performing any pedigree analyses and without using a microscope. What tools or resources would you need, and how would you proceed? This is a general question about map construction in non-model mammalian genomes.

4. Be able to distinguish between natural and artificial transformation of bacteria.

5. Be able to describe each of the following vectors for molecular cloning (advantages, disadvantages, host, approximate size range for inserts, etc..): plasmids, lambda phage, BAC and YAC.

6. Be able to define compare and contrast microsatellites and SNPs as markers in human genetics, including information about frequency and degree of polymorphism.

7. Be able to select primers appropriate for the construction of mutations using PCR-based approaches.

8. For each of the polymerases we've discussed (DNA polymerase, E. coli RNA polymerase, each of the eukaryotic RNA polymerases, primase, telomerase, reverse transcriptase) be able to state whether the product is DNA or RNA, whether the preferred template is DNA or RNA and whether the polymerase is primer-dependent).
Homework questions (please provide your answers on a separate sheet).

1. (1 point each, answer separately) Which RNA polymerase II general transcription factor(s)
   A - contains TBP and TAFs
   B - contains a protein subunit that also functions in transcription by RNA polymerases I and III
   C - binds polymerase off of DNA and joins the preinitiation complex together with polymerase
   D - phosphorylates the CTD of RNA polymerase II
   E – is/are part of the elongating transcription complex
   F - remains bound at the promoter after transcription initiation

2. (4 pts. - 1 each; check all that apply). AP endonuclease would be expected to act in which of the following repair events:
   a) Deamination of cytosine
   b) G:T mismatch
   c) double-strand break
   d) Depurination

3. (2 pts.) There are several examples of genetic events which result from double-strand breaks that
   are initiated by regulated endonuclease cleavage (as opposed to resulting from random DNA
   damage). Name two.

4. (2 pts.) Which technique for detecting protein DNA interaction (electrophoretic mobility shift
   assay or footprinting) requires that all (or nearly all) of the DNA present be bound by protein?
   Which technique generally involves an excess of DNA rather than protein?

5. (3 pts.) A species of bacteria has two chromosomes, A and B. A is 8 Mb. and B is 800 kb. The
   copy number of chromosome A is 2, meaning that on average, each cell has two of this
   chromosome. The copy number of chromosome B is 4, meaning that on average, each cell has four
   of this chromosome. You isolate DNA from the bacterium, shear the DNA to an average size of 10
   kb. and denature the DNA by heating. DNA on which chromosome will renature first, and by what
   factor (give me the ratio of the time it takes for each DNA to reach 50% double-stranded).

6. (3 points) Examine Figs. 9.20, 21.9 and 21.16. All of the genes shown are homologs. For each of
   the following pairs, state whether the term ortholog or paralog is most appropriate:
   a) human beta globin and human delta globin
   b) human beta globin and human myoglobin
   c) human beta globin and mouse myoglobin
   d) human beta globin and mouse beta globin
   e) human delta globin and mouse beta globin
   f) human beta globin and mouse alpha globin