

**MB 401 Exam II – Study Guide
Fall 2009**

Chapter Questions:

Chapter 5 – all

Chapter 7 – all

Chapter 8 – 1,2, 5, 6, 9, 11- 15, 17, 18, 19,

Exam Format:

Multiple Choice

Matching

Problems (such as Q. 9 in Chapter 7)

You should know and/or be able to answer the following:

Organization and Expression of Immunoglobulin Genes (Chapter 5)

1. What is an epitope? Define the term multivalent antigen. How does a linear epitope differ from a conformational epitope? Do antibodies bind their antigens via non-covalent or covalent bonding?
2. What is the difference between polyclonal antibodies and monoclonal antibodies? How is each produced?
3. Immunoglobulin Gene Rearrangement: understand the functions(s) of the following in the mechanism of DNA Rearrangement of the L and H chain:
 - a. RSS
 - b. 12/23 rule
 - c. heptamers & nonamers
 - d. signal joint
 - e. coding joint
 - f. V(D)J Recombinase
 - g. RAG1 & RAG2
 - h. TdT
 - i. Productive vs. non-productive gene rearrangements
4. Class Switching: Understand the function(s) of the following in the mechanism of class switching
 - a. Switch Regions
 - b. Switch Recombinase
 - c. AID
 - d. Alternate RNA splicing: when it occurs and what is produced
 - e. Poly-A sites 1-4
 - f. M1 & M2 exons
5. Describe the process responsible for expression of membrane-bound immunoglobulin vs. secreted antibody.
6. Explain how mature, naïve B cells co-express IgM and IgD.

6. What is isotype switching? What is the molecular mechanism of isotype switching?
7. What is affinity maturation? When & where in the B cell life cycle does this occur?
9. What is somatic hypermutation? When does this occur?

Complement System (Chapter 7)

1. a). Be able to Diagram and list all the steps of the Classical Complement Pathway the Alternate Pathway and MBL-lectin pathway (i.e. Figure 7-2 in your text)
 b). How are each of the 3 Complement pathways activated? At which step in the Complement pathway do the 3 pathways converge?
2. Know the function(s) of each of the following complement components:
 - C3a
 - C3b
 - C5a
 - C3 convertase (Alternate and Classical Pathways)
 - C5 convertase (Alternate and Classical Pathways)
 - C1q, C1r, C1s
 - MASP1 & MASP2
 - C3, B, D & properdin
 - C3 “tickover”
3. What is an anaphylatoxin? Which complement components are anaphylatoxins? Where in the complement pathway are they created?
4. **Regulation of the Complement System:** know the step of the complement pathway that each of the following affects:
 - a. C1Inh
 - b. C4bBP, MCP, CR1
 - c. Factor H
 - d. Factor I
 - e. DAF
 - f. S protein
 - g. HRF
5. Be familiar with the different types of Complement Deficiencies and the consequences of each of these deficiencies.
6. What is HANE? What is the cause? What are the consequences? Why?
7. What are the 5 biological functions of Complement? Which of the complement components are responsible for each of these functions?

The Major Histocompatibility Complex and Antigen Presentation (Chapter 8)

1. Describe in chronological order the steps of the endogenous antigen-processing pathway for intracellular, cytosolic pathogens (Class I Pathway). What would be the outcome if a mutant MHC Class I α chain could not associate with β 2-microglobulin? What would happen if the TAP transporter was lacking as a result of mutations?
2. Describe in chronological order the steps of the antigen-processing pathway for extracellular pathogens (Class II Pathway). What would be the outcome if the invariant chain were defective or missing? What would be the outcome if HLA-DM were not expressed?
3. What is cross-presentation? What is its significance?
4. What is the CD1 family? Compare & contrast CD1 family with MHC I and MHC II molecules.
5. How is diversity generated in the MHC? How is this different than the diversity generated in immunoglobulins? What's the role of polymorphism and polygeny in diversity in the MHC?
6. What's the genomic organization of MHC in mice? How is it different in mice vs. humans. What's the nomenclature for MHC genes in humans vs. mice? How many MHC Class I genes? MHC Class II genes? What proteins does MHC III region encode for? Is there diversity in the MHC III genes? Where is β 2 microglobulin encoded? Is there diversity in this protein?
7. What's a haplotype? Can you interpret a mouse MHC haplotype?
8. What is MHC restriction? What experiments demonstrate MHC restriction? What experiments demonstrated Class I and Class II restriction?
9. What is the cellular expression of MHC I vs. II? What is co-dominant expression? How many different types of class I genes could be expressed on the surface of a mammalian cell?

Short Answer Questions (20 pts each):

1. a). Explain how a vast number of immunoglobulins of different antigen specificities can be produced from the relatively small number of immunoglobulin genes present in the genome. Include the following terms in your explanation: somatic recombination, germline configuration, V, D, and J segments. (8 pts)
- b). What is the final arrangement of gene segments in the rearranged immunoglobulin heavy-chain gene V region and in what order do these gene segment rearrangements occur? (4 pts)
- c). How is additional diversity introduced into the variable region by the molecular mechanism of somatic recombination? Include the following terms in your answer: junctional diversity, P nucleotides, N nucleotides, terminal deoxynucleotidyl transferase (TdT). (6 pts)
- d). In what order do the heavy and light immunoglobulin loci rearrange? (2 pts)
2. a). Diagram the classical, lectin and alternative complement pathways. (8 pts)
- b). Indicate which steps of the complement system gives rise to inflammatory signals, opsonins and molecules that lyse bacteria directly. Which of these properties is most important? Explain your reasoning. (6 pts)
- c). Describe the regulation of the complement system. Briefly explain how each of these regulatory components function to harness the complement system to protect us rather than creating harm. (6 pts)
3. a). For an MHC Class I: (6 pts)
 - i). Describe the structure of an MHC class I molecule, identifying the different polypeptide chains and domains
 - ii). Which domains or parts of domains participate in antigen binding?
- b). For an MHC Class II molecule: (6 pts)
 - i). Describe the structure of an MHC class II molecule, identifying the different polypeptide chains and domains
 - ii). Which domains or parts of domains participate in antigen binding?
- c). What is the difference between MHC polygeny and MHC polymorphism? How does polygeny and polymorphism in the MHC genes influence the antigens a person's T cells can recognize? (4 pts)
- d). Describe the structure of the CD1 family. Discuss the cell types that recognize various CD1 genes. Discuss the kinds of ligand(s) that are presented by members of the CD1 family. (4 pts)