Micr-22 Final Exam Study Guide Revised Fall 2018

Test Preparation Suggestions

1. Our final exam is comprehensive, so it requires knowledge from the entire semester. This is only a guide to the recent material.
2. If you need more background to address the items below, look over all of the "Check Your Understanding" and Study Questions for the relevant chapters.
3. Be able to describe the meaning of major terms, with explanations appropriate for someone who has not taken this class.
4. Before our exam, be able to describe and explain the following structures and ideas, respectively.
5. Be able to place these topics in the broader context of microbiology. (For example: Why do we care about pili?)
6. Expect a few questions from our discussions in class. It is not possible to predict what issues may arise, but they are certainly worth reviewing.
7. Expect a few "challenge questions" which reach across multiple topics, and require your independent critical thinking. Some examples can be found at the end of textbook chapters. One strategy to prepare for these is to identify themes in the course.
8. Stick with it! I'm counting on you to come to me with your questions.

Terms used in these guides:
Recognize: Given a list, be able to identify.
Distinguish: Given a list, be able to describe differences.
Identify: Write the name.
Describe: Write a sentence.
Explain: Write a description of why particular things happen.

Be able to...

Biotechnology (Ch. 9)

1. label fig. 9.1 with the general parts, processes, and uses of recombinant DNA (rDNA).
2. describe the actions of restriction enzymes, in general.
3. interpret table 9.1.
4. describe four characteristics of useful cloning vectors.
5. explain the processes and uses of transformation, electroporation, protoplast fusion, gene guns, and microinjection.
6. describe how blue-white screening works (see fig. 9.11).
7. discuss each of these specific applications of rDNA (i.e. be able to describe what these are and how they each use rDNA technology):
   - therapeutic: (ex: insulin, subunit vaccines, DNA vaccines, human blood from pigs, spider silk from sheep, gene silencing).
   - agricultural: recombinant plants (Bt, Roundup Ready).
8. discuss safety and ethics issues of rDNA technology.

Mechanisms of Pathogenicity (Ch. 15)

9. describe the various pathways microorganisms can take to enter a host (mucous membranes, skin, parenteral route).
10. distinguish between ID50 and LD50.
11. given a list of ID50s for various pathogens, determine which pathogen is most concerning.
12. describe various methods bacteria use to evade host defenses (capsules, cell wall variants, enzymes, antigenic variation, cytoskeleton).
13. identify and distinguish among enzymes frequently used in penetration of host defenses (coagulases, kinases, hyaluronidase, collagenase, IgA proteases).
14. describe how bacteria damage host cells (namely, using host's nutrients, direct damage, and producing toxins).
15. differentiate between exotoxins and endotoxins.
16. describe mechanisms of action of: diphtheria toxin, botulinum toxin, tetanus toxin, vibrio enterotoxin, *Staphylococcus aureus* membrane-disrupting superantigens, and endotoxins (see table 15.2).
17. describe how viruses can evade defenses.
18. describe several cytopathic effects of viruses (such as stopping cell processes, lysosome release, inclusion bodies, syncytium formation, immunity reduction, chromosomal changes, loss of contact inhibition).
19. describe general pathogenic properties of these groups: fungi, protozoa, helminths, and algae.

Innate Immunity (Ch. 16)

20. identify the general elements and functions of the "first line of defense" (including physical, chemical, and normal microbiota).
21. identify major parts of the "second line of defense."
22. recognize names and functions of formed elements in blood (see table 16.1). For example, given a list of cell functions, be able to identify which are performed by white blood cells.
23. describe the general purpose and layout of the lymphatic system (see fig. 16.5, i.e. lymph nodes, and lymphatic capillaries and vessels).
24. describe the steps of phagocytosis (i.e., fig. 16.7).
25. describe how phagocytosis can be evaded.
26. describe the symptoms and purposes of inflammation.
27. describe the symptoms and purposes of fever.
28. explain the roles of antimicrobial substances: complement system, iron-binding proteins, and antimicrobial peptides. (What are they? How do they work?)

29. describe general outcomes of complement activation (see fig. 16.9).

Adaptive Immunity (Ch. 17)

30. distinguish between innate and adaptive immunity.
31. distinguish between humoral and cellular immunity.
32. describe the roles and actions of antigens, epitopes, and antibodies.
33. identify the variable and constant regions of antibodies.
34. discuss the implications of information from table 17.1:
    - how might their structures influence the effects of different classes of antibodies? (Note: not much is implied for IgA, IgD, or IgE)
    - half-life differences
    - placental transfer
35. explain the function of B cells.
36. explain how B cells are activated (i.e., be able to draw fig. 17.4).
37. recognize the value of T-independent antigens.
38. outline and describe five possible results of antigen-antibody binding (see fig. 17.7).
    - i.e.: agglutination, opsonization, neutralization, activation of complement, and ADCC.
    - when are each of these useful?
39. explain why humoral antibodies are not useful against intracellular pathogens, requiring instead the use of T cells.
40. describe the roles of helper, cytotoxic, and regulatory T cells.
41. describe the process of apoptosis, and why this is a useful process.
42. contrast immune responses after first and second exposures to the same antigen (see fig. 17.17).
43. distinguish among adaptive immunity types: active vs. passive, and natural vs. artificial, with examples of each combination (see fig. 17.18).

Applications of Immunology (Ch. 18)

44. read a vaccination schedule (e.g., table 18.3).
45. for the following types of vaccines, explain (1) what they are, (2) how they are produced, and (3) any specific benefits of their use:
    - live attenuated vaccines
    - inactivated killed vaccines
    - subunit vaccines
    - conjugated vaccines
    - nucleic acid (DNA) vaccines
46. describe these major challenges in the development of new vaccines: little money in it, growth environment, combinations, antigenic variation.
47. explain why adjuvants and preservatives are useful.
48. explain how people have sometimes been misled and thus scared of vaccines.
49. contrast the general safety risks of getting vaccinated with the risks of remaining unvaccinated.
50. describe the methods used to produce pure sources of antibodies (i.e., hybridomas, monoclonal antibodies).
51. describe the naming conventions (name endings) for chimeric monoclonal antibodies, humanized antibodies, and fully human antibodies.
52. explain how fluorescent-antibody techniques work.
53. explain how the direct and indirect ELISA work.

Immune Disorders (Ch. 19)

54. explain how cancers and the immune system are interrelated.
55. describe how immunotherapy may be useful to treat cancers.
56. connect the spread of HIV to themes from our discussion of emerging infectious diseases.
57. explain how HIV infects a CD4+ T cell, with the level of detail shown in fig. 19.13 (or as shown in class, including gp120, gp41, and CD4 receptors).
58. interpret figure 19.16, given a graph without labels (i.e., label the three phases across the top, explain how the T cell count and HIV count are connected, and explain why symptoms take so long to appear).
59. identify several means of transmitting HIV.
60. describe major methods of preventing HIV transmission, their benefits, and obstacles (namely, HIV vaccines and chemotherapy).

(Yes, we're ignoring reaction types III and IV, autoimmune diseases, reactions related to the HLA complex, and immunodeficiencies. Feel free to read up for fun!)

Bioterrorism

61. Be able to identify the characteristics of pathogens that make them likely to be used in biological weapons.

62. Be able to name several likely pathogens to be used in biological weapons.

63. Understand why medical professionals will be among the most likely people to detect a biological weapon attack.