STUDY GUIDE AND LEARNING OBJECTIVES
MICROBIOLOGY (Biology 2260)

In order to get the most out of the class and do well on your examinations, you should read each assigned chapter (preferable in advance), use the study outline at the end of each chapter (especially emphasizing those topics presented in lecture), and be able to:

CHAPTER 1 The Microbial World and You

1. Identify the importance of Koch’s postulates.
2. Identify the contributions to microbiology made by Pasteur, Hooke, van Leeuwenhoek, Lister, Ehrlich, Fleming, and Jenner.
3. Define bacteriology, mycology, parasitology, immunology, virology, and microbial genetics.
4. Recognize the system of scientific nomenclature that uses genus and specific epithet names.
5. Differentiate among the major groups of organisms studied in microbiology.

CHAPTER 2 Chemical Principles

1. Read and review chemistry as needed for subsequent chapters. This chapter should serve as a reference that you will be able to refer back to as we go along. Be able to apply chemical principles of chemical bonding, enzyme systems, and energy to biochemistry of microorganisms. Be able to differentiate between organic and inorganic molecule with a general idea of their structure and classification as related to further microbial metabolic principles.

CHAPTER 3 Observing Microorganisms Through a Microscope

1. List the units of measurements used for microorganisms.
2. Calculate total magnification and define resolution. Know the names of the lenses.
3. Identify a use for darkfield, phase-contrast, fluorescence, and electron microscopy, and compare each with brightfield illumination. Explain the principle behind each.
4. Compare simple, differential, and special stains. Give an example of the use of each one.
5. List the steps in preparing a Gram stain, and describe the appearance of gram-positive and gram-negative cells after each step.
6. Explain why each of the following is used: capsule stain, endospore stain, and flagellar stain.

CHAPTER 4 Functional Anatomy of Procaryotic and Eucaryotic Cells -

Note: Emphasis will be on bacterial (procaryotic) cells except as noted in the objectives

1. Compare and contrast the overall cell structure of procaryotes and eucaryotes.
2. Identify the three basic shapes and their variations of bacteria and correlate the name with the arrangement after division.
3. Describe the structure and function of the glycocalyx, flagella (types of), axial filaments, fimbriae, pili, and plasma membrane. Give a specific example of how these structures are important in bacteria.
4. Describe cilia and their role in eucaryotic cells.
5. Compare and contrast the cell walls of gram-positive, gram-negative, archaea, and mycoplasmas.
6. Explain how the chemistry of the bacterial cell wall relates to the gram stain.
7. Give an example of the importance of the cell wall chemistry in antibiotic resistance.
8. Identify the functions of the nuclear area, ribosomes, and inclusions.
9. Characterize the role of the plasmid and describe its function in antimicrobial resistance and biogenetic engineering. (See Chapters 8 & 9 for part of this answer)
10. Describe the function of endospores and describe how they allow the organisms to survive.
11. List the composition of the cell walls of plants, yeasts, fungi, and protozoa.

CHAPTER 5 Microbial Metabolism
Note: A long chapter, read it through, trying to see the big picture (not getting caught up in detail), and then be able to do the following:

1. Define metabolism, and describe the basic differences between anabolism and catabolism.
2. Characterize enzymes, their structure and function
3. Compare and contrast aerobic respiration, anaerobic respiration, and fermentation.
4. Describe the importance of ATP, and give examples of energy requiring activities of the cell.
5. Explain the overall function of metabolic pathways.
6. Describe the catabolism of glucose.
7. Define chemoheterotrophs.

CHAPTER 6 Microbial Growth

1. Classify microbes into the main groups on the basis of preferred temperature range.
2. Identify the group that is the most common cause of food spoilage and disease.
3. List the preferred pH range.
4. Explain the importance of osmotic pressure to bacteria.
5. List the chemical elements required for growth.
6. Match the oxygen requirements with the descriptive term. Example: obligate aerobe
7. Justify the use of each of the following: anaerobic techniques, living host cells, candle jars, selective and differential, enrichment media. Be able to state an example of the media.
8. Define bacterial growth, including binary fission.
9. Identify the phases of microbial growth curve, and describe the relation to generation time.

CHAPTER 7 The Control of Microbial Growth

1. Define the terms sterilization, disinfection, antisepsis, germicide, bacteriostasis, asepsis, degerming, sanitation, and pasteurization.
2. Describe the effects of microbial control agents on cellular structures.
3. Match the mechanism of action with the common methods used to control microbial growth.
4. Discuss the concern of bacterial spores in this process.
5. Match the methods of action with the common chemical disinfectants.
CHAPTER 8 Microbial Genetics
Note: This chapter will be evaluated with a take home exam.
1. Briefly explain the components of DNA, and explain its functional relationship to RNA and protein.
2. Explain DNA replication using these terms: replication fork, semiconservative replication, hydrogen bonds, DNA polymerase, and DNA ligase.
3. Explain the regulation of gene expression in bacteria using the operon model.
4. Classify mutations by type, and describe how mutations are prevented or repaired.
5. Define mutagen.
7. Define the functions of plasmids and transposons.
8. Relate the mechanisms for genetic change (mutation and recombination) to microbial evolution (natural selection).

CHAPTER 9 Biotechnology Tools and Techniques
Note: This chapter will be evaluated with a take home exam.
1. Define recombinant DNA.
2. Describe an overview of recombinant DNA procedures.
3. Identify the roles of a clone and a vector in genetic engineering.
4. Define restriction enzymes, and outline how they are used to make recombinant DNA.
5. Describe five ways genetic engineers get foreign DNA into a cell.
6. Describe how a gene library is made and the process used to create synthetic DNA.
7. Explain how each of the following is used to locate a clone; antibiotic-resistant genes, DNA probes, gene product.
8. List at least four applications of genetic engineering used in medicine.

CHAPTER 10 Classification of Microorganisms
1. Define taxonomy.
2. Define binomial as it relates to bacteria.
3. Explain taxonomic hierarchy and be able to order the correct sequence from most general to the most specific.
5. Describe how staining and biochemical tests are used to identify bacteria.

CHAPTER 11 Bacteria
Note: We will not follow the text closely in this chapter.
1. Recall characteristics and examples of organisms and their diseases as discussed in lecture.
CHAPTER 12 Fungi, Algae, Protozoa, and Multicellular Parasites

1. List the defining characteristics of the Kingdom Fungi.
2. Differentiate fungi from bacteria on a nutritional basis.
3. Differentiate between asexual and sexual reproduction.
4. Be able to identify representative asexual spores as pictured in the text.
5. Differentiate between the molds and yeast, and dimorphic fungi.
6. List the defining characteristics of the four divisions of fungi described in lecture and recognize the given examples.
7. Differentiate between systemic, subcutaneous, and cutaneous mycoses.
8. List the defining characteristics of protozoa.
9. Describe the outstanding characteristics of the six phyla of protozoa discussed in lecture and given examples.
10. Be able to identify representative amoeba and flagellates as pictured in the text.
11. Differentiate between an intermediate host and a definitive host.
12. Differentiate between dioecious and monoecious (hermaphroditic).
13. List the distinguishing characteristics of parasitic helminths.
14. List the characteristics of the three groups of parasitic helminths as discussed in lecture and recognize given examples.
15. Be able to identify the group to which a drawing of the general anatomy of each worm belongs.

CHAPTER 13 Viruses

1. List the general characteristics of a virus.
2. Describe the chemical and physical structure of both an enveloped and a nonenveloped virus.
3. Give an example of a common name for a virus. Explain how these names are derived.
4. Describe the common methods used for culture in the clinical laboratory for viruses that affect humans.
5. Discuss the lytic cycle in viral reproduction.
6. Discuss lysogeny.
7. Define oncogene.
8. Provide an example of a latent viral infection.
9. Differentiate between persistent (slow) viral infections and latent viral infections.
10. Discuss prions. Include what they are and diseases they are associated with.

CHAPTER 14 Principles of Disease and Epidemiology (Lecture on this chapter will be abbreviated since it is mostly learning some definitions). Read chapter and be able to:

1. Define pathology, etiology, infection, and disease.
2. Define normal microbiota (flora).
3. Compare commensalism and parasitism and give an example of each.
4. Compare and contrast normal flora with opportunistic microorganisms.
5. List Koch’s Postulates.
6. List seven probable reasons for emerging infectious diseases, and name one example for each reason.
7. Define reservoir of infection.
8. Explain three methods of disease transmission: contact, vehicle, and vector transmission.
9. Define nosocomial infections, and explain their importance.
10. Define compromised host.
11. Put the following in proper sequence, according to the pattern of disease: period of decline, period of convalescence, period of illness, prodromal period, incubation period.
12. Define epidemiology.
13. Define the following terms: morbidity, mortality, and notifiable (reportable) disease.

**CHAPTER 15 Microbial Mechanisms of Pathogenicity**

1. Differentiate between pathogenicity and virulence.
2. Identify the principle portals of entry.
3. Using examples given in lecture, explain how microbes adhere to host cells and list examples as given in lecture.
4. Explain how capsules and cell wall components contribute to pathogenicity.
5. Compare the effects of leukocidins, hemolysins, coagulases, hyaluronidase, and collagenase.
6. Contrast the nature and effects of exotoxins and endotoxins.
7. Recall a brief description of the mechanism of action of the diphtheria toxin, botulinum toxin, tetanus toxin, cholera toxin, staphylococcal toxin, and lipid A.
8. Describe the role of plasmids and lysogeny in pathogenicity. Explain bacteriophages.
9. Recall seven cytopathic effects of viruses as listed in lecture.
10. Discuss the pathogenic mechanisms of fungi listed in lecture.
11. Discuss the pathogenic properties and causes of symptoms for Plasmodium, Trypanosomes, Giardia, Wucheria bancrofti, and Clostridium as described in lecture.

**CHAPTER 16 Nonspecific Defenses of the Host**

1. Define resistance and susceptibility.
2. Define nonspecific resistance.
3. Describe the role of the skin and mucous membranes in nonspecific resistance.
4. List and differentiate between mechanical and chemical factors.
5. Define phagocytosis and phagocyte.
6. Classify phagocytic cells and describe the roles of granulocytes and monocyte.
7. Describe the role of lymphocytes and eosinophils.
8. Define differential white blood cell count.
9. List the signs and stages of inflammation.
10. Explain the mechanisms during the stage of inflammation called vasodilation.
11. Describe the cause of fever.
12. Describe three consequences of complement activation.
13. Discuss interferons in terms of the three types. Explain how they work to prevent infection with viruses.

**CHAPTER 17 Specific Defenses of the Host: The Immune Response**

1. Define innate resistance and immunity.
2. Contrast the four types of acquired immunity.
3. Differentiate between humoral (antibody-mediated) and cell-mediated immunity.
4. Define antigen, hapten, and antibody.
5. Explain the function of antibodies and describe their structural and chemical characteristics.
6. Name one function of each of the classes of antibodies.
7. Name the function of B cells.
8. Describe the clonal selection theory.
9. Explain how an antibody reacts with an antigen, and identify the consequences.
10. Distinguish between a primary and a secondary immune response.
11. Identify the function of cytokines and interleukins in cell-mediated immunity.
12. Be able to match the name of each of the following: Th cell, Tc cell, APC, MHC, and activated macrophage, with its function.
13. Compare and contrast cell-mediated and humoral immunity.

CHAPTER 18 Practical Applications of Immunology

1. Define vaccine. Differentiate between natural versus artificial, and, active versus passive immunity.
2. Define herd immunity.
3. Differentiate between the following, and provide an example of each: attenuated, inactivated, toxoid, and conjugated vaccines.
4. Discuss the value versus risks of vaccines.

CHAPTER 19 Disorders Associated with the Immune System

1. Differentiate among four types of hypersensitivity reactions.
2. Describe one example of each of the four types of hypersensitivity reactions.

CHAPTER 20 Antimicrobial Drugs

1. State the problem of chemotherapy for viral, fungal, protozoan, and helminthic infections versus bacteria.
2. Define broad spectrum antibiotic, bacteriostatic, and bactericidal.
3. List the five modes of action of antimicrobial drugs.
4. Explain why the commonly used antimicrobial drugs are specific for bacteria.
5. List the advantages of each of the following over penicillin: semisynthetic penicillins, cephalosporins, and vancomycin.
6. State the mode of action of penicillin and how the beta-lactamase producing organisms are able to evade the action of penicillin.
7. Explain why isoniazid (INH) is an antimycobacterial agent.
8. Recall that the following inhibits protein synthesis: aminoglycosides, tetracyclines, chloramphenicol, macrolides.
10. Describe how rifamycins and quinolones kill bacteria.
11. Describe how sulfonamides inhibit microbial growth.
12. Name and give examples from lecture of two of the following drugs: antifungal, antiviral, antiprotozoan, and antihelminthic.
13. Describe the mechanism of drug resistance.
For Chapters 21-26, you should read the chapters and be able to achieve the following objectives. Lectures can be followed using study outline at the end of each chapter. Use these, the summary charts for each chapter, and the objectives as your study guide for the final. (Note: The final includes Chapter 20). Due to the amount of material in this section, study early and often.

CHAPTER 21  Microbial Diseases of the Skin and Eyes

1. Briefly describe the structure of the skin and mucous membranes and how pathogens invade the skin.
2. Provide examples of normal skin flora.
3. Differentiate between staphylococci and streptococci, and recall skin infections caused by each: sty, furuncle (boil), impetigo, scalded skin syndrome, toxic shock syndrome, and erysipelas.
4. Describe skin, eye, and ear infections by Pseudomonas.
5. Differentiate between cutaneous (Dermatomycosis) and subcutaneous mycoses, and recall examples given in lecture of Tinea and Sporotrichosis.
6. Be able to match the name of the body with the Tinea infections.
7. Describe candidiasis and name the diseases caused by this organism.
8. List the causative agent and describe the epidemiology of acne, warts, smallpox, chickenpox, cold sores, measles (Rubeola), rubella, scabies, conjunctivitis, and trachoma.

CHAPTER 22  Microbial Diseases of the Nervous System

1. Define central nervous system and blood-brain barrier. Explain how the blood-brain barrier makes infections of the CNS hard to treat.
2. Differentiate between meningitis and encephalitis.
3. Discuss the epidemiology of meningitis caused by Hemophilus influenza, Streptococcus pneumoniae, Neisseria meningitidis, and Listeria monocytogenes.
4. Discuss the epidemiology and etiology of tetanus and leprosy.
5. State the causative agent, symptoms, suspect foods, and treatment for botulism.
6. List the virus and viral diseases of the nervous system discussed in lecture.
7. Identify the causative agent and describe the epidemiology for cryptococcosis and African trypanosomiasis. What test is used to detect Cryptococcus in the CNS.
8. List the characteristics of diseases caused by prions and name the disease of humans similar to scrapie.
9. List the characteristics of TSE diseases caused by prions and name the disease of humans similar to scrapie. Explain how is BSE related to human vCJD.

CHAPTER 23  Microbial Diseases of Cardiovascular and Lymphatic Systems

1. List the signs and symptoms of septicemia.
2. Describe the epidemiology and state the common agent of puerperal sepsis (child birth fever) and subacute bacterial endocarditis.
3. Name the cause and treatment of, and explain the preventative measures for, rheumatic fever.
4. Describe the epidemiology and list the causative agent of tularemia, brucellosis, anthrax, gas gangrene, and plague.
5. List the pathogens given in lecture that are transmitted by animal bites and scratches, which cause systemic disease.
6. List the diseases given in lecture transmitted by ticks.
7. Compare and contrast yellow fever, dengue, and dengue hemorrhagic fever.
8. List the emerging viral hemorrhagic fevers and describe the epidemiology and pathogenesis of CMV.
9. List the causative agents and describe the epidemiology for American trypanosomiasis (Chagas Disease), toxoplasmosis, and malaria.

CHAPTER 24 Microbial Diseases of the Respiratory System

1. Describe how microorganisms are prevented from entering the respiratory system.
2. Differentiate among pharyngitis, laryngitis, tonsillitis, and sinusitis.
3. List the causative agent and describe the epidemiology for streptococcal pharyngitis, scarlet fever, diphtheria, otitis media, and the common cold.
4. List the causative agent and prevention for pertussis and tuberculosis.
5. List and describe the causative agents of the pneumonia’s discussed in lecture.
6. List the causative agent and describe the epidemiology of coccidiodomycosis.

CHAPTER 25 Microbial Diseases of the Digestive System

1. Name the structures of the digestive system associated with food borne illness.
2. List examples of normal flora for each part of the gastrointestinal tract.
3. Describe the events that lead to dental caries and periodontal disease. Name the major organism involved.
4. List the causative agents, suspect foods, signs and symptoms (incubation times), describe the epidemiology of staphylococcal food poisoning, shigellosis, salmonellosis, typhoid fever, cholera, gastroenteritis, traveler’s diarrhea, and peptic ulcer disease.
5. Describe the diagnostic method for gastroenteritis caused by Campylobacter
6. Differentiate between gastrointestinal diseases as a result of a toxin and those due to the organism’s pathogenicity itself.
8. List the causative agents and symptoms of viral gastroenteritis as discussed in lecture.
9. Identify the causes of ergot poisoning and aflatoxin poisoning.
10. List the causative agents and describe the epidemiology for giardiasis, amoebic dysentery, cryptosporidiosis, and Cyclospora diarrheal infection.
11. List the causative agents and symptoms for tapeworms, pinworms, hookworms, ascariasis, and trichinosis.

CHAPTER 26 Microbial Diseases of the Urinary and Reproductive Systems

1. List the antimicrobial features of the urinary tract system.
2. Identify the portals of entry for microbes into the reproductive system.
3. Describe the normal microbiota of the upper urinary tract, the male urethra, and the female urethra and vagina.
4. Describe methods of transmission for urinary and reproductive system infections.
5. List the microorganisms that cause cystitis, pyelonephritis, and leptospirosis.
6. Describe the cause of glomerulonephritis.
7. List the etiologic agents and epidemiology for gonorrhea, PID, syphilis, NGU, vaginitis, lymphogranuloma venereum, chancroid, Gardnerella vaginosis, candidiasis, and trichomoniasis.
8. Discuss the epidemiology of genital herpes and warts.