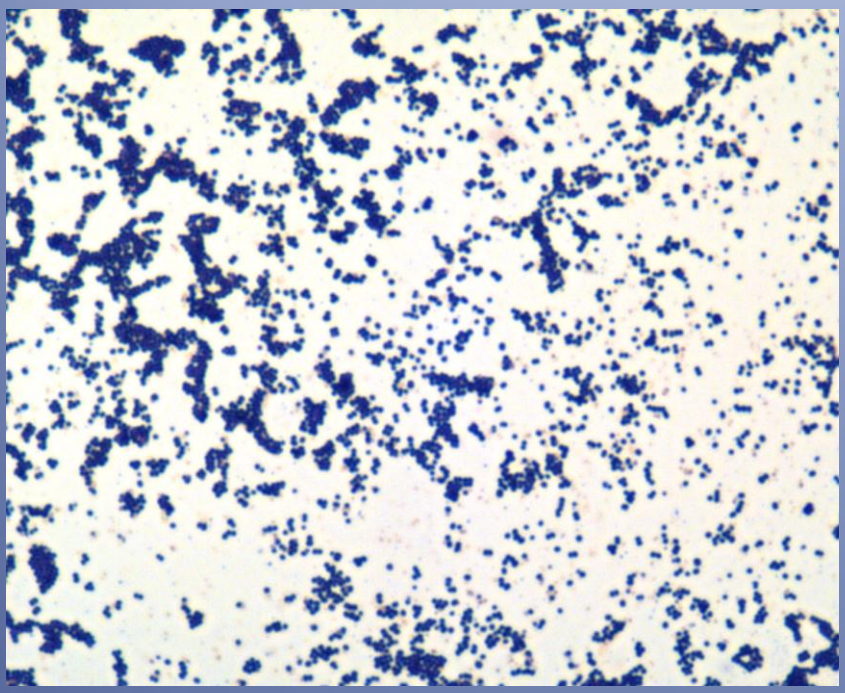

Medical Microbiology Core Competencies and Knowledge Objectives (OMS Years 1-4)

Pacific Northwest University of Health Sciences- College of Osteopathic Medicine

Infectious diseases will kill more people worldwide than any other single cause. The purpose of achieving these competencies and mastering these objectives is to empower medical students with a functional understanding of microbes, microbial-host interactions, and infectious disease etiologies needed for integration with other medical disciplines and competent clinical practice.

Prepared by Kimberly J. Taylor, Ph.D. – Spring 2013

MEDICAL MICROBIOLOGY CORE COMPETENCIES

NBOME and PNWU Competency Domain	Medical Microbiology Competency	Sample Topics/Objective Learning Objectives	Year(s) Achieved/Year(s) Refined
#1 Osteopathic Principles & Practice and Osteopathic Manipulative Treatment	The student will explain Osteopathic Philosophy in terms of whole and preventive care and lifestyle so as to increase avoidance of contracting an infectious disease.	Demonstrate basic medical microbiology knowledge supporting the appropriate application of osteopathic principles and OMT to clinical problems as well as health and wellness. Identify the relationship between organ structure/function and microbial colonization and infection. Describe how the human body's self-regulatory mechanisms affect treatment options.	Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4 Year 2/Years 3 and 4
#2 Osteopathic Patient Care	The student will demonstrate an awareness of patient feelings and attitudes toward the infectious disease process and prevention of these diseases.	Recognize the need for sensitive and effective communication regarding patient acquisition of an infectious disease. Demonstrate an understanding of cultural differences and backgrounds between individuals when considering informing a patient of the presence of an infectious disease.	Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4
#3 Medical Knowledge for Osteopathic Medical Practice	The student will be able to demonstrate basic science understanding of medical microbiology appropriate for competent medical care.	Apply basic clinical microbiology concepts to patient care. Evaluate assigned readings in various areas of microbiology.	Year 2/Years 3 and 4 Year 1/Years 2, 3, 4
#4 Practice-Based Learning and Improvement in Osteopathic Medicine	The student will be able to describe and apply evidence-based medicine.	Interpret electronic and hard-copy resources to gain the most current and up-to-date medical knowledge in microbiology. Identify the most important emerging infectious diseases from	Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4

		studying peer-reviewed basic and applied journal articles.	
#5 Interpersonal and Communication Skills in the Practice of Osteopathic Medicine	The student will be able to display communication skills useful in clinical practice The student will be able to identify team-based care as the optimal approach and is able to describe and appreciate the expertise of each team member, inclusive of the patient and the patient's family.	Demonstrate effective verbal and nonverbal communication skills needed to interact with patients and other healthcare professionals. Verbally discuss and communicate microbiological information in the lab with fellow students and professor.	Year 2/Years 3 and 4 Year 1/Years 2, 3, 4
#6 Professionalism in the Practice of Osteopathic Medicine	The student will be able to model the ethic or reciprocity with an emphasis on lifelong learning of self and others.	Discuss behavior-based communicable disease (e.g., STD's) with a patient in conjunction with dignity, respect, and confidentiality, while still promoting the community and patient's best interests. Demonstrate honesty, accountability, cultural awareness, respect, and compassion. Actively engage in self-directed learning activities that stimulate an attitude of lifelong learning.	Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4
#7 Systems-Based Practice in Osteopathic Medicine	The student will be able to display an understanding of the role of various healthcare personnel and delivery systems on patient care.	Describe the process of reporting a reportable disease. Explain the role of local and national agencies in the communication and epidemiological analysis of communicable diseases. Understand the role of local veterinarians in patient care, particularly in rural settings and with regard to infections associated with travel.	Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4 Year 1/Years 2, 3, 4

Knowledge Objectives in Medical Microbiology

I. BASIC BACTERIOLOGY

A. STRUCTURE AND FUNCTION OF BACTERIA

1. Compare and contrast prokaryotic and eukaryotic cells, particularly with respect to nuclear membranes, DNA structure, ribosomes, and cell walls.
2. Describe the morphology and arrangement of bacterial cells using acceptable scientific terms (cocci, bacilli, etc).
3. Explain the use of the Gram and acid-fast stains.
4. List some important gram-positive, gram-negative, and acid-fast bacteria and their morphology and arrangement.
5. Explain how the Gram stain works (why are gram + bacteria blue and gram - bacteria red?).
6. Describe the functions of the flagella.
7. State another name for flagella (H-antigen).
8. Describe the functions of pili/fimbriae.
9. Explain antigenic (phase) variation of pili or other cell surface proteins and describe its clinical significance.
10. Describe the structure bacterial capsules.
11. Describe the role of bacterial capsules in pathogenicity.
12. Describe the formation and importance of a baterial biofilms.
13. Compare and contrast the structure of Gram-positive and Gram-negative cell walls.
14. Describe the importance of peptidoglycan to bacteria.
15. Explain the importance of peptidoglycan as a target for some antibiotics.
16. Describe where teichoic acids are found and their importance.
17. Describe the components and functions of the outer membrane of Gram-negative bacteria.
18. Describe porins of Gram-negative bacteria and their importance.
19. Discuss the structure and biological activities of endotoxin.
20. Describe the type IV secretion system and its importance to pathogenicity.

21. Describe why mycoplasmas are unique among the bacteria.
22. Describe the structure and functions of cytoplasmic membranes in bacteria.
23. Explain the function of transpeptidase in bacteria.
24. Describe the major contents of bacterial cytoplasm.
25. Describe the structure and functions of endospores.
26. Name the two major genera of bacteria which produce endospores (*Clostridium, Bacillus*).
27. Describe the primary similarities and differences between the *Clostridium* and *Bacillus* genera (e.g., Gram reaction, oxygen requirements).
28. Describe the methods used to classify bacteria.
29. List some important Gram-positive, Gram-negative, and acid-fast bacteria and their morphology and arrangement.

B. NUTRITION AND GROWTH

1. Explain the function of siderophores.
2. Explain the term "fastidious" with respect to bacterial nutrition.
3. Describe the classification of bacteria based upon oxygen requirements.
4. List examples of bacteria exhibiting each of the oxygen requirement classifications.
5. Explain the term "halophile".
6. Explain the term "generation time" and the various factors that can affect it.
7. Describe the four growth phases of bacteria and explain the importance of each.
8. Describe the concept of quorum sensing and its importance.

C. MICROBIOLOGICAL TECHNIQUES

1. Describe how to perform a Gram stain, explaining the purpose of each manipulation/step or reagent.
2. Explain how the Gram stain works (i.e., why are Gram-positive bacteria blue/purple and Gram- negative bacteria red/pink?).
3. Differentiate between nonselective, selective, and differential media.

4. List common examples of each of the above types of media and examples of the microbes you would use each to grow/cultivate.

D. PHYSIOLOGY AND METABOLISM OF BACTERIA

1. Explain the following terms:

a. glycolysis

b. fermentation

c. aerobic respiration

d. anaerobic respiration

2. Using the terminology used to classify bacteria based upon oxygen requirements, list examples of bacterial species which typically perform the above metabolic processes.

3. Describe the amount (in general terms, not exact numbers) of energy (ATP) generated by each of the above metabolic processes.

4. Explain how the metabolic capabilities of bacteria can relate to pathogenicity.

E. MICROBIAL GENETICS

1. Describe the use of the terms "transcription" and "translation"

2. Define:

a. mutation

b. base substitution

c. frame-shift mutation

d. genotype

e. phenotype

3. Describe an operon and its regulation.

4. Describe transformation as it occurs in bacteria.

5. Define:

a. transfection

b. homologous recombination

c. nonhomologous recombination

d. donor

e. recipient

f. transformant

6. Describe conjugation as it typically occurs in Gram-negative bacteria when the donor is:

a. F^+

b. Hfr cell

c. F^-

7. Define:

a. male and female bacteria

b. f factor

c. plasmid

d. sex pili

e. Hfr cell

f. episome

8. Describe resistance transfer factors and discuss their significance to human medicine.

9. Describe the environmental pressures which favor the development of multiply antibiotic-resistant bacteria.

10. Describe pathogenicity islands.

11. Define "insertion sequence" and "transposon" and discuss their importance to bacterial gene expression.

12. Discuss selective pressures that can lead to antibiotic resistance.

13. Describe the essential features of bacterial viruses.

14. Define:

a. bacteriophage

b. capsid

c. capsomere

15. Describe, in words or by a sketch, the lytic cycle as it occurs in bacteriophage infected bacteria.

16. Define "lytic", "virulent", and "temperate" phages.

17. Describe the lysogenic cycle (lysogeny)

18. Define "prophage"

19. Define "lysogenic conversion" and discuss the clinical significance of these event.

20. Describe transduction as it occurs in bacteria.

F. ANTIBIOTIC SUSCEPTIBILITY TESTING

1. Discuss the basis on which antibiotics are selected.

2. Discuss the use of antibiotic susceptibility testing.

3. Define MIC and MBC.

G. ANTIBIOTICS

1. Define the following terms as they apply to antimicrobial agents:

a. broad-spectrum

b. narrow-spectrum

c. expanded-spectrum

2. For the following antimicrobial agents, discuss the primary mode of action, mechanisms of bacterial resistance, spectrum of activity, and any unique characteristics:

a. sulfonamides

b. trimethoprim

c. dapsone

d. daptomycin

e. isoniazid

f. ethambutol

g. pyrazinamide

h. beta-lactams (list examples)

i. cephalosporins (list examples; indicate differences in generations)

j. cephamycins

k. carbapenems (imipenem)

l. monobactams (aztreonam)

m. vancomycin

n. cycloserine

o. bacitracin

p. polymyxin

q. quinolones and fluoroquinolones (list examples)

r. rifampin

s. aminoglycosides (list examples)

t. tetracyclines

u. chloramphenicol

v. macrolides

w. lincosamides (clindamycin)

x. streptogramins and oxazolidinones

y. nitrofurans

z. metronidazole

3. Define bactericidal and bacteriostatic drugs.

4. Explain why cell wall and membrane active agents are usually bactericidal.

5. Explain why some antimicrobial agents (e.g., cell wall active) are most effective against rapidly growing cells while other agents (e.g., membrane active) are active against both rapidly growing and resting cells.

6. Explain the mechanisms of the following inherent resistances to antimicrobial agents:

a. mycoplasma resistance to cell wall active antibiotics

b. anaerobe resistance to aminoglycosides

c. aerobic resistance to metronidazole

d. Gram-negative resistance to vancomycin

H. PHYSICAL AND CHEMICAL AGENTS FOR CONTROL OF MICROBIAL GROWTH

1. Define:

a. antiseptic

b. aseptic

c. bactericidal

d. bacteriostatic

e. disinfectant

f. germicide

g. sepsis

h. sterilization

i. pyrogen-free

2. Describe the general effects chemical and physical agents have on membranes, proteins, and nucleic acids.

I. HOST-PARASITE/PATHOGEN RELATIONSHIPS

1. Explain Koch's Postulates.

2. Explain how pathogenic microbes can evade the non-specific first-line defenses of the body.

3. Describe the components of the non-specific second-line defenses of the body and their function as a barrier to disease.

4. Compare and contrast true pathogens and opportunistic pathogens.

5. Explain the difference between a toxigenic and an invasive pathogen.

6. Compare and contrast exotoxins and endotoxins.

7. Define superantigen.

8. List several infectious diseases mediated by superantigens.

9. Explain the biological activities of endotoxin and superantigens.

10. Describe AB toxin structure and function.

11. Explain the attributes of a microbe which can contribute to invasiveness.

12. Explain the roles played in health and disease by the body's normal flora.

13. List the major normal flora microbes and where they are found.

14. List the major normal flora microbes that are important opportunistic pathogens.

15. Describe where they are normally found and the disease associations.

16. Describe the major mechanisms of transmission of infectious disease.

17. Define the following:

a. bacteremia

b. carrier

c. communicable disease

d. endemic

e. endotoxin

f. enterotoxin

g. epidemic

h. exotoxin

i. fomite

j. infectious dose

k. latent infection

l. nosocomial infection

m. opportunistic pathogen

n. pandemic

o. pathogenicity

p. pyemia

q. pyogenic

r. septicemia

s. subclinical infection

t. superinfection

u. systemic

v. toxoid

w. virulence

x. zoonosis

y. pyrogenic

II. BASIC MYCOLOGY

A. PRINCIPLES

1. Compare the structure of fungal cells to other eukaryotic cells and to bacteria.

2. Compare and contrast yeasts, molds, and dimorphic fungi.

3. Define:

a. hyphae

b. septate

c. nonseptate

d. pseudohyphae

e. mycelium

f. rhizoids

g. conidia

h. zygospores

i. ascospores

j. ascus

k. basidiospores

l. conidia

m.arthroconidia

n. chlamydoconidia

o. blastospores

p. sporangiospores

q. macroconidia

r. microconidia

s. dimorphism

t. KOH preparation

u. Sabouraud's agar

B. FUNGAL CLASSIFICATION

1. Describe the classification of human mycoses.

2. List the major attributes of the following fungal phyla:

   a. Ascomycota

   b. Deuteromycota (fungi imperfecti)

   c. Zygomycota

   d. Basidiomycota

C. ANTIFUNGALS

1. Describe the mechanism of action and clinical use of:

   a. Nystatin

   b. Amphotericin B

   c. Itraconazole

   d. Fluconazole

   e. Ketoconazole

   f. Clotrimazole

   g. Miconazole

   h. Terbinafine

   i. Flucytosine

   j. Griseofulvin

   k. Tolnaftate

   l. Potassium iodide

III. BASIC PARASITOLOGY

A. PARASITE CLASSIFICATION

1. Describe parasite classification with regard to the following protozoa:
   a. Rhizopods (*Entamoeba*, etc.)

   b. Ciliates

   c. Flagellates (*Trypanosoma, Leishmania*, etc.)

   d. Sporozoa (*Plasmodium, Toxoplasma,* etc.)

2. Describe parasite classification with regard to the following helminths:

a. Nematodes (*Ascaris, Enterobius*, etc)

b. Cestodes (*Taenia, Echinococcus*, etc)

c. Trematodes (*Schistosoma, Clonorchis*, etc)

3. Define:

a. cyst

b. trophozoite

c. oocyst

d. schizogony

e. vector

f. intermediate host

g. definitive host

4. Draw and describe the life cycles for the following parasites:

a. *Taenia* spp.

b. *Trichuris trichiura*

c. *Trichinella spiralis*

d. *Schistosoma* spp.

e. *Giardia lamblia/intestinalis*

f. *Toxoplasma gondii*

g. *Enterobius vermicularis*

h. *Entamoeba* spp.

i. *Ancyclostoma, Necatur*

j. *Ascaris lumbricoides*

k. *Diphyllobothrium latum*

l. *Plasmodium* spp.

IV. BASIC VIROLOGY

A. BASICS

1. Compare a virus to a cell.

2. Define and discuss the following features of viruses:

   a. size

   b. shape

   c. nucleic acid

   d. capsid

   e. capsomere

   f. nucleocapsid

   g. capsid symmetry

   h. icosahedral

   i. helical

   j. envelope

3. Discuss virus classification schemes.

4. List the DNA virus families, including the following features:

   a. enveloped or naked

   b. DNA structure (ds, ss, linear, circular)

   c. site of replication (cytoplasm, nucleus)

   d. list medically important examples from each family

5. List the RNA virus families, including the following features:

   a. enveloped or nonenveloped

   b. RNA structure (ds, ss, linear, circular)

   c. positive-, negative-sense

   d. capsid symmetry

   e. replication site (cytoplasm, nucleus)

   f. list medically important examples from each family

6. Describe the following agents, including their replication cycle:

a. defective virus

b. pseudovirion

c. viroid

d. virion

7. Describe viral multiplication, including:

a. adsorption

b. hemagglutinin

c. entry

d. nonenveloped virus release

e. emveloped virus release

f. uncoating

g. site of replication

h. RNA viruses

i. DNA virus (pox)

j. Retroviruses

k. role of reverse transcriptase

l. Influenza virus

m. viral protein synthesis (structural versus regulatory protein synthesis)

n. assembly

o. lysis

p. budding

q. release

r. viral load

8. Define:

a. conditional mutants

b. recombination

c. reassortment

d. complementation

e. phenotypic mixing

9. Describe:

a. antigenic drift

b. antigenic shift

10. Describe how viruses are cultivated in the laboratory

11. Describe/define the following:

a. cell culture

b. one-step growth experiment

c. cytopathic effect

d. syncytia

e. plaque

f. hemagglutination assay

12. Describe the use of viruses in gene therapy

13. Explain and give examples of the following viral vaccines:

a. live

b. inactivated

c. recombinant

14. Discuss/define:

a. malignant transformation

b. oncogene

15. Define “prion”.

16. Draw and describe the pathophysiology of prion infection.

V. ESSENTIAL CONCEPTS IN INFECTIOUS PATHOGENESIS

A. ENCOUNTER WITH PATHOGEN

1. Define, in detail, endogenous (i.e., normal flora) versus exogenous sources of infection.

2. Explain how normal flora on skin or mucosal membranes can cause disease when introduced into deeper tissues.

3. Explain how exogenous infections are a result of encounters with organisms in the environment (e.g., food, water, air, inanimate objects, insect bites, other humans, animals)

4. List and discuss the following common mechanisms of microbial transmission:

   a. direct skin or mucosal contact
   b. inhalation

   c. ingestion

   d. vertical transmission

   e. vector –borne transmission

5. Discuss how anatomical sites exposed to the environment serve as portals of microbial entry. (i.e., nose, mouth, respiratory tract, alimentary tract, female genital tract, urinary tract and anus).

6. Discuss how entry may or may not involve the crossing of epithelial barrier (e.g., inhalation vs. the carrying of microorganisms into deeper tissues by macrophages, or insect bites).

B. INVASION AND DISSEMINATION

1. <u>Virulence Factors</u>: Adhesins/Colonization Factors

   a. Explain the significance of microbial adhesion as a component of the establishment of an infection.

   b. Explain which microbial surface structures can function as adhesins.

   c. Differentiate between bacterial fimbrial and afimbrial adhesins.

   d. Describe what structures act as adhesins for enveloped versus nonenveloped viruses.

   e. Identify the host cell surface components that can act as receptors.

   f. Discuss the function of neutralizing antibodies in preventing microbial attachment.

   g. Clarify how attachment helps microorganisms to remain at a particular location/evade innate defence mechanisms.

h. List some antimicrobial compounds and the targets that are used to interfere with attachment.

2. Virulence Factors: Invasins

a. Define the action of invasins.

b. Describe the factors responsible for invasiveness of *Shigella.*

c. Describe the role of secreted enzymes in invasiveness of bacteria.

3. Virulence Factors: Antiphagocytic Mechanisms

a. Describe the advantage of encapsulation for bacteria.

b. Name several organisms with anti-phagocytic capsules.

4. Virulence Factors: Cytotoxic Proteins

a. Define hemolysin and cytolysin and give an example of a toxin and its producing microorganism for each.

b. Explain the mechanisms of action for the pore-forming and phosphlipase cytolysins.

c. Discuss the Streptococcal hemolysins in terms of their mechanisms of action.

d. Explain how hemolysis patterns on blood agar can help with species differentiation and disease diagnosis.

e. List some hemolysins/cytolysins and their functions in terms of the damage seen with a particular infection.

C. MULTIPLICATION: **Intracellular versus Extracellular**

1. Discuss the advantages of intracellular growth from a microbial perspective.

2. Contrast mechanisms of bacterial entry into a phagocytic versus a non-phagocytic cell.

3. Identify bacteria that rearrange actin to enable their entry and identify the basic steps in the process.

4. Formulate a list of:
   a. Obligately intracellular bacteria

   b. Facultatively intracellular bacteria

5. Fully characterize each of the following intracellular survival mechanisms, giving specific microbial examples:

   a. escape from phagolysosome

   b. prevention of phagosome-lysosome fusion

   c. evasion/neutralisation of lysosomal contents

d. alteration of phagolysosomal environment

6. Describe the challenges facing an extracellular bacterium

7. List the adaptations/virulence factors utilised by extracellular bacteria to evade the host's antimicrobial defenses.

8. Identify the significance of intracellular growth when selecting an appropriate antimicrobial agent.

9. Describe the significance of intracellular growth when selecting an appropriate antimicrobial agent.

D. TISSUE TROPISM

1. Explain the significance of tissue tropism in helping to understand microbial pathogenesis.

2. List some bacterial, viral and fungal examples of microorganisms that are tropic for a particular tissue/cell type.

3. Identify the other factors, both host and microbial, that influence the colonization of a particular site by a microorganism.

4. Describe how the adhesin-receptor interaction determines the tissue tropism of a microorganism.

5. Hypothesise as to the significance of a microorganism being able to use more than one receptor-ligand combination.

E. OUTCOMES OF INFECTION: Colonization versus Disease

1. Define symbiosis, commensalism and parasitism.

2. Describe the benefits to the host of colonization by microorganisms.

3. Describe several sources of exogenous infection.

4. Name several factors that predispose to the development of disease when host encounters a microorganism.

F. MECHANISMS OF HOST CELL DAMAGE: Direct Damage from the Organism

1. Describe the benefits to the host of colonization by microorganisms.

2. Describe several sources of exogenous infection.
3. Name several factors that predispose to the development of disease when host encounters a microorganism.

4. Explain the genetic control of bacterial toxin production.

5. Explain the difference between exotoxins and endotoxins.

6. What determines the cell to which an exotoxin binds?

7. Name several enterotoxins and describe their mechanism of action.

8. Name two clostridial neurotoxins and describe their mechanism of action.

9. Name two cytotoxins that exert their effects via inhibition of protein synthesis.

10. Describe the effects of 3 types of toxins produced by Staphylococcus aureus.

11. Describe the effect of steptococcal pyrogenic exotoxin.

12. Explain the mechanism of action of pertussis toxin.

13. Explain the mechanism of action of tracheal cytotoxin in whooping cough

14. Name the organisms that produce Shiga toxin and explain its damaging effects.

15. Describe the differences between apoptosis and necrosis.

16. Define the source of endotoxins.

17. Explain the pathogenesis of septic shock produced by endotoxins.

18. Explain the infectious pathogenesis of disseminated intravascular coagulation.

19. What is the major mechanism of tissue damage of fungi?

20. What are the two morphologic growth patterns of fungi and which of them is advantageous for the organisms' invasion of host tissue?

21. What host cell surface molecule is a receptor for several bacteria and viruses?

22. Explain the process that occurs with bacterial invasion into host cells with the example of Shigella.

23. What process of cell death may be triggered on bacterial invasion of host cells?

24. Describe the mechanism of amebic enteric disease.
25. Describe the process by which a virus enters the host cell and brings out cell death in a lytic infection ("cytopathic effect").

26. Describe the changes in the host cell seen as a result of viral infection.

27. Explain occurrences in a virally infected cell that result in persistent or latent infection.

28. Describe the changes in a cell that is transformed by viral infection.

29. Which bacterial components are active in eliciting a host immune response?

30. Describe the elicitation of the cytokine response to microbial infection of the host.

31. Which type of immune response is involved in the development of lesions characteristic of *Mycobacterium tuberculosis*?

32. Differentiate between the immune responses in tuberculoid and lepromatous leprosy.

33. Describe the mechanism of damage to the host that may occur from virus-antibody immune complexes.

34. Describe the mechanism of damage to the host that may occur from the cell-mediated response to a virus.

35. Explain the damage that may occur with autoimmune sequelae of an infection.

36. For each of the bacterial virulence factors listed, describe how the factor facilitates evasion of the host immune response (innate and/or adaptive):

    a. Polysaccharide capsule
    b. Pili/fimbrae
    c. IgA protease
    d. Leukocidins
    e. Coagulase
    f. Protein A
    g. M protein
    h. Lipoteichoic acid

37. For each of the bacterial virulence factors listed, give specific examples of medically-important bacteria that possess the factor:

    a. Polysaccharide capsule
    b. Pili/fimbrae
    c. IgA protease
    d. Leukocidins
    e. Coagulase
    f. Protein A
    g. M protein
    h. Lipoteichoic acid

38. List several medically-important bacteria that are able to survive intracellularly and extracellularly, and explain how their ability to invade and survive inside cells helps them evade the host immune response.

39. Describe 3 different mechanisms used by some bacteria to evade the degradative enzymes inside phagocytic cells (polymorphonuclear cells, macrophages, or monocytes) and survive intracellularly.

40. Explain how bacteria in a biofilm are often more resistant to host immune responses.

41. Explain how antigenic variation facilitates evasion of the host immune response by microbial pathogens, and how this affects host and therapeutic/prophylactic mechanisms to prevent re-infection.

42. Describe how antigenic variation in the microbial structures listed below contribute to the pathogenesis of the organism:

    a. *Streptococcus pyogenes* M protein

b. *Neisseria gonorrhoeae* pilin protein
c. *Streptococcus pneumoniae* capsule
d. *Neisseria meningitidis* capsule
e. *Salmonella* O and H antigens
f. Influenza virus hemagglutinin and neuraminidase
g. Rhinovirus capsid protein
h. HIV envelope proteins
i. HCV envelope proteins

43. Explain how cytokine "decoy" receptors (or cytokine decoys) produced by some viruses enhance their virulence.

44. List several viruses that produce cytokine decoys and the host cytokines that are targeted.

45. Explain what "virokines" are and how they enhance the ability of some viruses to evade the host immune response.

46. Describe several mechanisms used by viruses to evade the anti-viral interferon response.

47. Explain how HIV- and CMV-mediated downregulation of MHC class I expression enhances their ability to evade the host immune response.

48. List several viruses that produce syncytia and how this mechanism of cell-to-cell spread enhances their ability to evade the host immune response.

49. Explain how HIV infection of T cells affects the host immune response to this virus and other infectious agents.

50. Explain what is meant by "immune privileged" sites in the body and list several viruses that exhibit a tropism for these sites.

51. Describe several mechanisms used by viruses to produce persistent infections.

52. Describe the mechanism by which herpesviruses produce a latent infection in their host and how this contributes to their ability to evade the host immune response.

53. Describe how "immune tolerance" is developed in neonates infected with hepatitis B virus, rubella virus, or CMV and the effects on the infant.

54. Compare and contrast the mechanisms of persistence for HBV and HIV.

55. Compare and contrast the mechanisms of persistence for HBV and HCV.

56. Explain why prion diseases do not induce a host immune response.

57. Explain how antigenic shift and antigenic drift contribute to the ability of influenza virus to evade the host immune response.

58. Explain how viral "quasispecies" are generated and how this contributes to the ability of some viruses to evade the host immune response.

G. TRANSMISSABILITY

1. Define and give examples of the following modes of transmission of infectious agents:

    a. Person-to-person
    b. Nosocomial/Hospital-acquired
    c. Endogenous infection
    d. Percutaneous/blood-associated
    e. Fomites
    f. Soil
    g. Vertical transmission
    h. Horizontal transmission
    i. Aerosols
    j. Food, water
    k. Zoonotic
    l. Sexual contact
    m. Fecal-oral

2. Describe structural features of viruses that often affect their stability in the environment and mode of transmission.

3. List the major sites of entry for infectious agents into the body and the barriers they must overcome at these sites to survive.

4. Describe conditions that enhance the transmission of infectious agents from person-to-person via non-sexual modes.

5. Define "reservoir" and "vector" in the context of zoonoses

6. Define self-limited infection.

7. Define chronic infection.

8. Describe the steps that occur in an acute, self-limiting infection with respect to the pathogen, pathogenesis, and host immune response.

9. List several infectious agents that cause acute, self-limiting infections in healthy, immunocompetent hosts.

10. List several infectious agents that cause acute, self-limiting infections in healthy, immunocompetent hosts, but can cause persistent infections immunocompromised hosts.

11. Compare and contrast the major characteristics of a chronic viral infection vs. a latent viral infection.

12. List several infectious agents that can produce chronic infections.

13. Describe the roles of humoral vs. cell-mediated immune responses in mediating clearance of different types of viruses.

14. Explain what is meant by the term "chronic carrier" and list examples of infectious

agents that can induce this state in human hosts.

15. List an example of a slow virus and explain how slow virus infections are defined.

VI. SYSTEMS-BASED DISEASES

A. UPPER RESPIRATORY TRACT INFECTIONS

1. Rhinitis

    a. Define rhinitis
    b. Name the two types of viruses that cause most cases of rhinitis
    c. Identify the characteristics of each virus
    d. Describe the attachment mechanisms of each virus
    e. Describe the means by which the viruses are spread
    f. Identify the major host defenses preventing infection by these viruses
    g. Identify treatment recommended for rhinitis

2. Pharyngitis

    a. Define pharyngitis
    b. Name the viruses that cause pharyngitis
    c. Identify the characteristics of each of these viruses
    d. Describe the means by which the viruses are spread.
    e. Identify sites other than the pharynx that may be associated with pharyngitis caused by some of these viruses
    f. Describe treatment for viral pharyngitis
    g. Name the most common cause of bacterial pharyngitis
    h. Identify the virulence factors of this species
    i. Describe the method of diagnosing bacterial pharyngitis
    j. Describe the normal reservoir of this species
    k. Identify the complications of infection by this species
    l. Describe the events that lead to the complications
    m. Identify the antibiotic(s) used to treat bacterial pharyngitis

3. Sinusitis

    a. Define sinusitis
    b. Name the three major bacterial causes of sinusitis
    c. Identify the characteristics of each of these bacteria
    d. Identify the virulence factors of these bacteria
    e. Describe the normal reservoir of the bacteria
    f. Identify the major host defenses that protect against infection by these bacteria
    g. Identify factors that predispose a patient to sinusitis
    h. Identify the major complication of sinusitis
    i. Identify the treatment recommended for sinusitis

4. Otitis media

    a. Define otitis media

b. Name the three major bacterial causes of otitis media
c. Identify the characteristics of each of these bacteria
d. Identify the virulence factors of these bacteria
e. Describe the normal reservoir of the bacteria
f. Identify the major host defenses that protect against infection by these bacteria
g. Identify factors that predispose a patient to otitis media
h. Identify the major complication of otitis media
i. Identify the treatment recommended for otitis media

B. LOWER RESPIRATORY TRACT INFECTIONS

1. Bronchitis

a. Define bronchitis
b. List the types of infectious agents that are involved in most cases of bronchitis
c. Identify the clinical presentation associated with each infectious agent
d. Identify the characteristics of each etiologic agent
e. Describe the attachment mechanisms of each etiologic agent
f. Describe the major virulence factors and mechanism of pathogenesis of each infectious agent
g. Describe the means by which the etiologic agents are spread
h. Identify the major host defenses preventing infection by these agents
i. Identify treatment recommended for rhinitis

2. Bronchiolitis

a. Define bronchiolitis
b. Name the viruses that cause bronchiolitis
c. Identify the characteristics of each of these viruses
d. Describe the major virulence factor(s) and mechanism(s) of pathogenesis of each virus
e. Describe the means by which the viruses are spread
f. Describe treatment for viral pharyngitis
g. Name the most common cause of bacterial bronchiolitis
h. Identify the clinical presentation associated with each bacterium
i. Describe the method of diagnosing bacterial bronchiolitis
j. Describe the major virulence factors and mechanism of pathogenesis of each infectious agent
k. Describe the normal reservoir of this species
l. Identify the complications of infection by this species
m. Describe the events that lead to the complications
n. Identify the antibiotic(s) used to treat bacterial bronchiolitis

3. Pneumonia

a. Define pneumonia
b. Differentiate between chronic and acute pneumonia
c. Name the major etiologic agents of pneumonia
d. Describe the normal reservoir of these etiologic agents
e. Identify the clinical presentation associated with each infectious agent
f. List pneumonia agents suggested by environmental history
g. Discuss the differential diagnosis of cavitary lesion on chest radiograph
h. Identify the characteristics of each etiologic agent
i. Describe the attachment mechanisms of each etiologic agent
j. Describe the major virulence factors and mechanism of pathogenesis of each infectious agent

k. Describe the means by which the etiologic agents are spread
l. Identify the major host defenses preventing infection by these agents
m. Identify factors that predispose a patient to pneumonia
n. Identify treatment recommended for pneumonia

C. CARDIAC INFECTIONS

1. Endocarditis

a. Name the organisms that commonly cause endocarditis.
b. Explain the epidemiologic factors (exposure, portal of entry) underlying specific etiologies in particular patients (i.e, Strep or Staph are common causes due to repeated transient exposure from the normal flora of the patient, for instance transient viridans Strep viremia associated with brushing teeth or dental work; Candida and other infectious agents associated with prosthetic valves or injection drug users; etc..)
c. Describe the "vegetative" lesions associated with endocarditis and explain how such lesions contribute to the diagnosis (persistently positive blood cultures, mass on valves by echocardiogram) and affect therapeutic options (choice of bacteriostatic versus bacteriacidal antibiotic therapy, etc..
d. Explain how laboratory procedures could distinguish between these various organisms.
e. What clinical sample would be used, what lab procedures, which selective & differential media, and which biochemical assays would be necessary to distinguish between these pathogens.
f. What are important virulence factors for these pathogens? How do these factors contribute to the virulence of the organisms?

2. Myocarditis

a. Name the most common infectious cause of myocarditis.
b. Describe the epidemiology and pathogenesis of coxsackievirus infections and explain why most coxsackievirus infections are subclinical.
c. What is the protective acquired immune response that prevents disease in most people infected with this virus and how does the timing of this immune response correlate with symptomatic versus nonsymptomatic infection?

3. Pericarditis

a. Name the most common infectious causes of pericarditis
b. Discuss the pathogenesis of pericarditis specifically with regard to the secretion of atrial natriuretic factor

D. GASTROINTESTINAL INFECTIONS

1. Gastroenteritis

a. Define diarrhea.
b. Differentiate gastroenteritis and enterocolitis
c. Name the most common cause of diarrhea in infants.
d. Describe the clinical findings in acute gastroenteritis.
e. Differentiate an invasive infection vs a toxin-mediated illness based on clinical findings.
f. Describe the two main modes for transmitting infectious agents that cause gastroenteritis and diarrhea.

g. Describe the pathogenesis of bacterial diarrhea.
h. Explain the mechanisms of damage from enterotoxins, cytotoxins, and invasive organisms.
i. Differentiate bacterial and viral causes of gastroenteritis based on clinical findings.
j. Decsribe the diagnostic techniques used to identify organisms causing gastroenteritis.
k. Describe the recommended treatment for gastroenteritis.

2. Hepatitis

a. Define hepatitis.
b. Define jaundice.
c. Describe the symptoms and laboratory findings in hepatitis.
d. Describe the mechanism of liver damage in hepatitis.
e. Name the potential long-term sequellae of hepatitis.
f. Name several external factor that greatly accelerate microbe-induced liver damage
g. What is the fatality rate of fulminant hepatitis?
h. For the following hepatotropic viruses describe the basic viral properties, principal routes of infection, global prevalence, potential to establish chronic infections, clinical symptoms, means of diagnosis including serologic markers, treatment options, and availability of vaccines.
i. Name several additional viruses that may target the liver.
j. Name 2 spirochetes that may target the liver.
k. Name 2 parasites that may target the liver

3. Other food/water-borne gastrointestinal infections

a. Typhoid fever
b. *Campylobacter jejuni*
c. Botulism
d. Infant botulism
e. *Staphylococcus aureus* (SEB)
f. *Helicobacter*

E. ***GENITOURINARY INFECTIONS***

1. Urinary Tract

a. Define cystitis
b. Define pyelonephritis
c. Distinguish acute from chronic pyelonephritis
d. List the most common causes of community-acquired v. nosocomial urinary tract infections (UTIs)
e. Explain the routes of transmission of agents of UTIs
f. Describe the primary virulence factors of bacterial agents of UTIs
g. Identify the major host defenses that protect against infection by these bacteria
h. Identify factors that predispose patients to UTIs
i. Explain the prevalence of bacterial UTIs in females
j. Describe diagnostic methods for bacterial UTIs
k. Identify the treatment recommended for bacterial UTIs
l. List viral and parasitic agents of UTIs

2. Genital Tract

- **Syphilis**

  a. Describe structural and cultural characteristics of Treponema pallidum
  b. Describe the epidemiology and pathogenesis of syphilis, including primary, secondary and tertiary manifestations of the disease
  c. Define congenital syphilis and describe its manifestations and prevention
  d. Define neurosyphilis and describe its manifestations
  e. Describe the mode of transmission of the disease
  f. Describe methods for the diagnosis of syphilis
  g. Explain the difference between non-specific and specific serological tests for syphilis and the pattern of the immune response vis-à-vis these tests in treated and untreated cases
  h. Identify antibiotics of choice in treating syphilis

- **Gonorrhea**

  a. Describe structural and cultural characteristics of Neisseria gonorrheae
  b. List the virulence factors associated with N. gonorrheae
  c. Describe modes of transmission of gonorrhea
  d. Describe the diagnosis and treatment of gonorrhea
  e. Distinguish between a diagnosis of gonococcal and non-gonococcal urethritis
  f. Describe disseminated gonococcal infections and distinguish them from gonococcal infections of the eyes and throat.
  g. Describe the mechanisms of acquired penicillin resistance and alternative drugs for treating resistant strains
  h. Explain the importance of phase and antigenic variation in pathogenesis of N. gonorrheae
  i. Appreciate that N. gonorrheae infections can lead to pelvic inflammatory disease in women

- **Non-gonococcal urethitis**

  a. List the causative agents of non-gonococcal urethritis
  b. Distinguish between a diagnosis of gonococcal and non-gonococcal urethritis
  c. Describe the life cycle and unique properties of Chlamydia trachomatis
  d. Describe structural and cultural characteristics of Ureaplasma urealyticum
  e. Describe structural and cultural characteristics of Mycoplasma genitalium
  f. Describe the diagnosis and treatment of non-gonococcal urethritis
  g. Appreciate that these bacteria can also cause pelvic inflammatory disease in women

- **Lymphogranuloma venereum**

  a. Describe the causative agent of lymphogranuloma venereum (LGV), Chlamydia trachomatis
  b. Describe the clinical progress and symptoms of LGV
  c. Explain the recent increase in LGV cases among travelers to Asia
  d. Describe the diagnosis and treatment of LGC

- **Chancroid (Soft Chancre)**

  a. Describe structural and cultural characteristics of Hemophilus ducreyi
  b. Describe the pathogenesis and symptoms of chancroid
  c. Describe the diagnosis and treatment of chancroid

d. Explain how symptoms of chancroid can be confused with those of primary syphilis, GV, GI, or genital herpes

- **Trichomoniasis**

a. Describe characteristics of the protozoan Trichomonas vaginalis
b. Describe symptoms associated with trichomoniasis
c. Describe the diagnosis and treatment of trichomoniasis

- **Bacterial Vaginosis**

a. List the four signs associated with non-specific vaginitis
b. Describe the organisms associated with bacterial vaginosis (BV)
c. Describe the diagnosis and treatment of BV

- **Vulvovaginal Candidiasis**

a. Describe the structural and cultural characteristics of Candida albicans
b. Explain how Candida can cause disease as a member of normal human flora
c. Describe the diagnosis and treatment of vulvovaginal candidiasis

- **Genital Herpes**

a. Describe the virion and genome structure of HSV-2
b. Describe the transmission and pathogenesis of HSV-2 infections
c. Discuss the concept of viral latency/reactivity and its significance with respect to genital herpes infections
d. Describe the current strategies for preventing and treating HSV-2 infections

- **Genital Warts**

a. Describe the virion and genome structure of Human Papillomavirus (HPV)
b. Describe the transmission and pathogenesis of HPV
c. Identify low and high risk strains of HPV and the pathogenesis of each.
d. Appreciate the association of cervical cancer with certain types of HPV infections
e. Describe methods for detection and treatment of HPV infections

- **Cytomegalic inclusion disease**

a. Describe the virion and structure of Human Cytomegalovirus (CMV)
b. Describe the epidemiology and pathogenesis of CMV
c. Appreciate that primary CMV infection in a healthy individual is clinically inapparent but in adults can lead to a mononucleosis syndrome
d. Appreciate that CMV causes the most common intrauterine viral infection and that cytomegalic inclusion disease in pregnant women can cause fetal death or damage to liver, spleen, blood-forming organs and nervous system

- **Other sexually transmitted diseases**

a. Appreciate that other organisms can be sexually transmitted without causing disease in the genital tract
b. Describe the genome, pathogenesis and transmission of Hepatitis B virus

c. Describe the transmission and life cycle of the Human immunodeficiency virus (HIV)

F. MUSCULOSKELETAL INFECTIONS

1. Myositis

a. Name the most common infectious cause of myositis
b. How does coagulase help *Staphylococcus aureus* evade host immunity?
c. What are other important virulence factors for this pathogen?
d. How do these factors contribute to the virulence of the organism?

2. Necrotizing fasciitis

a. Name the infectious causes of necrotizing fasciitis (Types 1-4).
b. Explain the pathogenesis of necrotizing fasciitis.
c. How do the pathogens' virulence factors contribute to the pathogenesis?
d. Why is surgery, even amputation, often necessary in the treatment of necrotizing fasciitis and antibiotic therapy alone inadequate?
e. Explain why gas gangrene is so infrequent despite the presence of relatively large amounts of the organism in human intestines and pervasive presence in soil.

3. Osteomyelitis

a. Name the most important infectious causes of osteomyelitis.
b. What are important virulence factors for these pathogens?
c. How do these factors contribute to the virulence of the organisms?
d. Describe the routes by which various microbes gain access to bone (hematogenous spread, trauma-wound, prosthetic device, etc..) and be aware that lesions are often polymicrobial.
e. Explain why surgical debridement and prolonged bacteriocidal antibiotic therapy are needed in chronic osteomyelitis.
f. Explain how laboratory procedures could distinguish between these various bacteria. What procedures, media & biochemical assays would be necessary to distiguish between these pathogens.
g. *Salmonella* (in Sickle cell disease patients)

4. Tetanus

a. Describe the characteristics of the Clostridium tetani organism.
b. How can tetanus be prevented?
c. Explain the important virulence factors for C. tetani?
d. How do these factors contribute to the pathogenesis of tetanus?

5. Skin and soft tissue infections

a. Define abscess, boil, carbuncle, furuncle, folliculitis, pyoderma (impetigo), erysipelas, cellulitis.
b. Define macule, papule, plaque, pustule, vesicle, bulla.
c. For the paired diseases and pathogens in the chart below:
    i. Describe the clinical case setting in which the disease would be found

ii. Describe the microbial pathogens known to cause the disease
iii. Describe the pertinent microbial structures related to virulence (virulence factors, including toxins).
iv. Describe the pertinent biochemical pathways related to pathogen virulence.
v. Describe the epidemiology of the disease
vi. Describe the etiology/ pathogenesis of disease
vii. Describe clinical aspects of the disease
viii. Describe the immune response to pathogens causing the disease
ix. Describe methods of diagnosis of the disease
x. Describe current therapy (and antibiotic resistance) for the disease
xi. Describe methods of prevention of the disease

Pathogen	**Disease**
Staphylococcus aureus	Scalded skin syndrome, carbuncle, furuncle, folliculitis, impetigo, wound infection, toxic shock syndrome
Streptococcus pyogenes (GAS)	Impetigo, erysipelas, cellulitis, necrotizing fasciitis, gas gangrene, scarlet fever, toxic shock syndrome
Clostridium perfringens	Gas gangrene
Clostridium tetani	Tetanus (local infection but systemic toxin)
Propionibacterium acnes	Acne
Mycobacterium leprae	Leprosy
Treponema pallidum	Syphilis
Treponema ssp.	Yaws, pinta
Borrelia burgdorferi	3 Lyme disease rash
Rickettsia rickettsii	3 Rocky Mountains spotted fever rash
Rickettsia prowazekii	Epidemic typhus
Rickettsia typhi	Endemic typhus
Erysipelothrix rhusiopathiae	Erysipeloid
Norcardia	Cutaneous nocardiosis
Superficial and cutaneous mycoses	
Malassezia furfur	Tinea versicolor
Microsporum, Trichophyton, Epidermophyton	Tinea corporis, Tinea pedis, Tinea cruris, Tinea nigra, Onychomycosis
Subcutaneous mycoses (introduced by trauma)	
Sporothrix schenckii	Sporotrichosis
Phialophora and *Cladosporum*	Chromomycosis
Petriellidium and *Madurella*	Mycetoma
Systemic mycoses with skin manifestations	
Coccidioides immitis	Coccidioidomycosis
Cryptococcus neoformans	Cryptococcosis
Blastomyces dermatitidi	Blastomycosis
Parasites	
Leishmania tropica	Cutaneous leishmaniasis
Leishmania braziliensis	Mucocutaneous leishmaniasis
Hookworms *(Ancylostoma and Necator)*	Cutaneous larva migrans
Onchocerca volvulus	Onchocerciasis

Viruses/disease	Presentation
Papilloma viruses	Warts
molluscum contagiosum	Fleshy papules
Herpes simplex, coxsackievirus	Vesicles
Measles, rubella, dengue, parvovirus B19	Maculopapular rash

G. INFECTIONS OF THE NERVOUS SYSTEM

1. Differentiate meningitis from encephalitis.
2. Name the 2 organisms that cause 80% of cases of bacterial meningitis beyond the neonatal period.
3. Name the common causes of bacterial meningitis in infants less than 1 month of age.
4. Describe host factors that may increase the risk for bacterial meningitis.
5. Describe the methods of acquisition of the organisms causing bacterial meningitis.
6. Define aseptic meningitis.
7. Describe the clinical signs and symptoms, pathogenesis, diagnostic techniques, and treatment options for bacterial, viral, and fungal meningitis and encephalitis.
8. Describe the pathophysiology of subacute sclerosing panencephalitis and progressive multifocal leukoencephalopathy.
9. Define prion disease.
10. Describe the course of Creutzfeldt-Jakob disease.
11. Describe the relationship of bovine spongiform encephalopathy to its associated human disease.

H. ZOONOSES

1. *Yersinia pestis*
2. *Pasteurella multocida*
3. *Francisella tularensis*
4. *Bartonella*
5. *Brucella*
6. Leptospirosis
7. Ehrlichiosis
8. Anaplasmosis
9. *Borrelia hermsii*
10. Rabies
11. Viral hemorhagic fever

I. OPPORTUNISTIC

1. *Enterobacter*
2. *Vibrio vulnificus*
3. *Aeromonas*
4. *Haemophilus influenzae* (non-typeable)
5. *Eikenella corrodens*
6. *Pseudomonas aeruginos*a
7. *Actinomyces*
8. *Bacteroides*
9. *Fusobacterium*
10. *Prevotella*
11. *Porphyromonas*

12. Peptostreptococcus

VII. MICROORGANISMS

A. The student should have familiarity with the following major pathogens with regard to their metabolic and identifying characteristics, virulence factors, disease(s) caused by them:

Campylobacter

Helicobacter

Chlamydia/Chlamydophila

Rickettsia

Clostridium

Enterobacteriaceae

Mycobacterium

Mycoplasma

Neisseria

Pseudomonas and Burkholderia

Staphylococci

Streptococcus

Treponema

Bacteroides

Bartonella

Haemophilus

Bordetella

Legionella

Vibrionaceae

Corynebacterium

Actinomyces

Fusobacterium

Leptospira

Borrelia

Yersinia

Pasteurella

Brucella

Moraxella

Listeria

Propionibacterium

Hepatitis viruses

Herpes viruses

Orthomyxovirus

Paramyxovirus

Retroviruses

Adenoviruses

Papillomaviruses

Picornaviruses

Reoviruses

Caliciviruses

Rhabdoviruses

Arboviruses

Arenaviruses

Filoviruses

Bunyaviruses

Parvoviruses

Poxviruses

Slow viruses

Prions

Pathogenic and Opportunistic Fungi

Malassezia furfur

Dermatophytes

Sporothrix schenckii

Blastomyces dermatitidis

Histoplasma capsulatum

Coccidioides posadasii

Coccidioides immitis

Paracoccidioides brasiliensis

Cryptococcus neoformans

Pneumocystis jiroveci

Penicillium marneffii

Candida albicans

Drug resistant *Candida* species

Aspergillus funigatus

Other aspergilli

Main features of agents of zygomycosis

Parasites

Entamoeba

Giardia

Trichomonas

Plasmodium

Toxoplasma

Cryptosporidium

Microsporidium

Cyclospora

Trypanosomes

Leishmania

Taenia solium

Taenia saginata

Echinococcus

Ascaris lumbricoides

Trichinella spp.

Enterobius vermicularis

Wuchereria bancrofti

Strongyloides stercoralis

Hookworm

Trichiuris

Schistosoma spp.

Agents causing visceral larva migrans and cutaneous larva migrans

IX. INFECTIOUS DISEASES

--For the infectious diseases listed below the student should know (when applicable, and in a degree of detail commensurate with the clinical significance of the organism):

1. General characteristics (staining, culture, metabolism, spore formation, motility, etc.)
2. Principles of laboratory identification with emphasis on distinguishing characterisitcs, including staining, culture, metabolism, spore formation, motility, physiologic tests, serological and genetic identification
3. Pathogenesis and major virulence factors
4. Epidemiological principles (colonization, reservoirs, mechanism of transmission age, ethnic, seasonal, and geographic distribution)
5. Major clinical presentations associated with the organism

6. Treatment (antimicrobials of choice and important alternatives, route of administration, prevalence of antibiotic resistance)

7. Prevention (sanitation, chemical and immunological prophylaxis)

A. UPPER RESPIRATORY ID MICROBES

1. *Adenovirus*
2. *Bordetella pertussis*
3. *Streptococcus pyogenes, Group A*
4. *Haernophilus influenzae*
5. Human Herpes viruses (EBV, CMV)
6. *Moraxella catarrhalis*
7. Rhinovirus
8. *Streptococcus pneumoniae*
9. *Mycoplasma* sp.
10. Paramyxovirus
11. Aspergillosis
12. *Borrelia* sp.
13. *Candida albicans*
14. *Chlamydophila pneumoniae*
15. Coronavirus
16. *Corynebacterium diphtheriae*
17. Echovirus
18. *Neisseria* sp.
19. Papillomavirus
20. *Staphylococcus aureus*
21. *Treponema pallidum*
22. Zygomycosis

B. LOWER RESPIRATORY INFECTIONS

1. Anaerobes
2. Influenza virus
3. *Klebsiella pneumoniae*
4. *Legionella pneumophila*
5. *Mycobacterium* sp.
6. *Mycoplasma pneumoniae*
7. RSV
8. Streptococcus pneumoniae
9. *Bacillus anthracis*
10. Adenovirus
11. *Chlamydophila* sp.
12. *Coccidioides immitis/C. posadasii*
13. Hantavirus
14. *Histoplasma capsulatum*
15. Other *Streptococcus* sp.
16. *Staphylococcus aureus*
17. *Ascaris lumbricoides* and other roundworms

18. *Aspergillus fumigatus*
19. *Blastomyces dermatitidis*
20. *Coxiella burnetti*
21. *Cryptococcus neoformans*
22. *Pneumocystis*
23. *Haemophilus influenzae*
24. Human Herpes viruses *(HSV, CMV, VZV)*
25. *Moraxella catarrhalis*
26. *Pseudomonas* spp. (and other opportunistic bacteria)

C. SEPTICEMIA

1. Aerobic Gram negative rods
2. *Neisseria* spp.
3. *Staphylococcus* spp.
4. *Streptococcus* spp.
5. *Streptococcus pneumoniae*
6. Anaerobic bacteria
7. *Candida albicans* and significance of other *Candida* species
8. *Listeria monocytogenes*

D. CNS INFECTIONS

1. Arboviruses
2. *Cryptococcus neoformans*
3. Enteroviruses
4. *Escherichia coli*
5. Herpes simplex viruses
6. *Listeria monocytogenes*
7. *Neisseria meningitidis*
8. Rabiesvirus
9. *Streptococcus* spp.
10. *Clostridium tetani*
11. *Haemophilus influenzae*
12. *Mycobacterium sp.*
13. *Toxoplasma gondii*
14. Amoebas
15. HIV
16. *Nocardia/Actinomyces*
17. Slow viruses and prions
18. *Staphylococcus* spp.
19. *Taenia solium*
20. *Treponema pallidum*

E. URINARY TRACT INFECTIONS

1. Aerobic Gram negative rods
2. *Staphylococcus* spp.

3. *Enterococcus* spp.
4. *Leptospira* spp.
5. Adenovirus
6. *Schistosoma haematobium*

F. SEXUALLY TRANSMITTED DISEASES

1. *Candida albicans*
2. *Chlamydia trachomatis*
3. *Gardnerella vaginalis* and related sp.
4. Herpes simplex virus
5. *Neisseria gonorrhoeae*
6. Papilloma virus
7. *Treponema pallidum*
8. *Trichomonas vaginalis*
9. *Haemophilus ducryeyi*
10. Molluscum contagiosum
11. Hepatitis virus B
12. Human Immunodeficiency Virus
13. *Mycoplasma* and *Ureaplasma sp.*

G. SKIN AND SOFT TISSUE INFECTIONS

1. Dermatophytes and *Candida*
2. *Malassezia furfur*
3. *Streptococcus* spp.
4. *Staphylococcus* spp.
5. *Actinomyces* spp.
6. *Bartonella henselii*
7. *Blastomyces dematiditis*
8. *Clostridium perfringens* and other anaerobes
9. Herpes simplex virus
10. Human Papilloma Virus
11. *Pseudomonas* spp.
12. Scabies, lice and other parasites
13. *Sporothrix schenkii*
14. Chromomycosis and mycetoma
15. *Haemophilus influenzae*
16. *Nocardia* sp.
17. *Propionobacterium acnes*

H. EXANTHEMATIC DISEASES

1. Measles virus
2. Parvoviruses
3. *Rickettsia* spp.
4. Varicella-Zoster virus
5. *Borrelia burgdorferi*
6. *Streptococcus pyogenes,* Group A
7. Herpes simplex viruses 1,2

8. HHV-6 and -7
9. Rubella
10. *Staphylococcus aureus*
11. *Candida albicans*
12. Enteroviruses
13. *Neisseria* spp.
14. *Salmonella typhi*
15. *Treponema pallidum*

I. GASTROENTERITIS AND FOOD POISONING

1. Caliciviruses (Norwalk-like virus)
2. *Campylobacter* spp.
3. Clostiridia (*C. difficile, C. botulinum, C. perfringens*)
4. *Escherichia coli* (7 diarrheagenic forms)
5. *Giardia intestinalis*
6. *Helicobacter pylori*
7. Rotavirus
8. *Salmonella* spp.
9. *Shigella* spp.
10. *Staphylococcus aureus*
11. *Bacillus cereus*
12. *Entamoeba histolytica*
13. Flat worms (*Taenia spp.*)
14. Roundworms *(Ascaris lumbricoides, Enterobius vermicularis, Necator* and *Ancylostoma* spp.*, Trinchinella spiralis, Trichiuris trichiura, Strongyloides stercoralis)*
15. *Vibrio* spp.
16. Hepatitis A
17. Trematodes (*Schistosoma mansoni)*

J. HEPATITIS

1. Hepatitis viruses (A to E)
2. Yellow fever virus
3. Cytomegalovirus
4. Epstein-Barr virus
5. *Schistosoma mansoni*
6. *Entamoeba*

K. CONGENITAL AND NEONATAL INFECTIONS

1. Cytomegalovirus
2. *Escherichia coli*
3. *Streptococcus agalactiae*, Group B
4. Hepatitis B virus
5. Herpes simplex virus 2
6. HIV
7. *Listeria monocytogenes*
8. Rubellavirus
9. *Toxoplasma gondii*
10. *Treponema pallidum*
11. Varicella zoster virus

12. *Chlamydia trachomatis*
13. *Neisseria gonorrhoeae*
14. Parvovirus B19

L. AIDS

K. NOSOCOMIAL AND OPPORTUNISTIC INFECTIONS

1. *Candida* spp.
2. *Clostridium difficile*
3. Gram negative aerobic rods
4. *Staphylococcus* spp.
5. *Aspergillus fumigatus*
6. *Bacteroides fragilis* and other anaerobes
7. *Cryptococcus neoformans*
8. *Enterococcus sp.*
9. Human Herpes viruses
10. *Malassezia furfur*
11. Diphteroids
12. *Pneumocystis*
13. Zygomycetes
14. *Klebsiella pneuomoniae*

L. EYE INFECTIONS

1. Adenoviruses
2. *Candida albicans*
3. *Chlamydia trachomatis*
4. Cytomegalovirus
5. Herpes simplex virus
6. *Neisseria gonorrhoeae*
7. *Toxoplasma gondii*
8. *Acanthamoeba* spp.
9. *Pseudomonas* spp.
10. *Haemophilus influenzae*
11. *Streptococcus pneumoniae*
12. *Moraxella catarrhalis*

M. ZOONOTIC INFECTIONS

1. *Borrelia burgdorferi*
2. *Campylobacter* spp.
3. Rhabdovirus
4. *Rickettsia* spp.
5. *Salmonella enteritidis*
6. Arboviruses
7. *Bartonella henselii*
8. *Ehrlichia chaffensis*
9. *Francisella tularensis*
10. *Listeria monocytogenes*
11. *Pasteurella multocida*
12. *Yersinia pestis*

13. Arenaviruses, Bunyaviruses, Filoviruses
14. *Plasmodium* spp.
15. Filariasis
16. Dermatophytes
17. *Vibrio vulnificus*

N. ANAEROBIC INFECTIONS

1. *Bacteroides fragilis*
2. *Clostridium* spp.
3. *Actinomyces israelii*
4. *Fusobacterium*

X. NEW AND EMERGING INFECTIOUS DISEASES

A. For the major pathogens involved in new and emerging Infectious Diseases students should be familiar and for each of them, in a degree of detail commensurate with the clinical significance of the organism:

1. General characteristics (staining, culture, metabolism, spore formation, motility, etc.)
2. Principles of laboratory identification, with emphasis on distinguishing characteristics, including staining, culture, metabolism, spore formation, motility, physiologic tests, serological and genetic identification
3. Pathogenesis and major virulence factors
4. Epidemiological principles (colonization, reservoirs, mechanism of transmission, age, ethnic, seasonal, and geographic distribution)
5. Major clinical presentations associated with the organism
6. Treatment (antimicrobials of choice and important alternatives, route of administration, prevalence of antibiotic resistance)
7. Prevention (sanitation, chemical and immunological prophylaxis).