



**BAKER COLLEGE**  
**STUDENT LEARNING OUTCOMES**

**BIO2410 Microbiology**  
**3 Credit Hours**

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**Student Learning Outcomes and Enabling Objectives**

1. Examine the important historical events which led to the development of the field of microbiology, including:
  - a. Pioneers and their contributions to microbiology.
  - b. Development of the microscope.
  - c. Application of the scientific method to the field microbiology.
  - d. The germ theory of disease.
  - e. Application of microbiology in medical settings.
2. Analyze the basic steps of the scientific method.
  - a. Identify the following steps in the scientific method: observation, question, hypothesis, testing of hypothesis, analysis, and conclusion.
  - b. Compare the level of support needed for hypotheses, theories, and laws.
  - c. Identify control and experimental groups.
  - d. Discuss these concepts and how they can be used in problem solving.
3. Differentiate between various methods of visualizing microscopic organisms, including:
  - a. Describe light microscopy.
  - b. Describe phase contrast microscopy.
  - c. Describe scanning and transmission electron microscopes.
4. Differentiate between the major biological macromolecules.
  - a. Describe carbohydrates (simple sugars, disaccharides, cellulose and starch).
  - b. Describe lipids (fats and phospholipids).
  - c. Describe proteins.
  - d. Describe nucleic acids (DNA and RNA).
5. Differentiate the structure and functions of the prokaryotic and eukaryotic cell.
  - a. Compare the structure and functions of the prokaryotic cell including fimbriae, flagella, cell wall, ribosomes, DNA, and endospores.
  - b. Discuss the basic structures of the eukaryotic cell including organelles.
  - c. Compare and contrast the prokaryotic and eukaryotic cell.
  - d. Discuss biofilms and the endosymbiotic theory.

6. Differentiate between the various staining and techniques used in microbiology. (this SLO was combined with #7 they should really be separate)
  - a. Describe Positive Stain.
  - b. Describe Negative Stain.
  - c. Describe Gram Stain.
  - d. Describe Acid Fast Stain.
  - e. Describe Endospore Stain.
7. Describe basic microbial techniques and how it is applied to bacterial identification.
  - a. Describe basic cell culture techniques.
  - b. Describe enriched, selective, and differential media.
  - c. Explain the importance of specimen collection and transport.
8. Evaluate the factors that influence microbial growth.
  - a. Explain the process of microbial growth in terms of an exponential growth curve.
  - b. Distinguish the important nutrients needed for microbial growth.
  - c. Describe the different environmental factors and explain how they affect microbial growth.
  - d. Discuss the range of ecological associations among microorganisms.
  - e. Discuss how resistance develops in microorganisms and the role of natural selection in this process.
  - f. Compare different methods of evaluating microbial growth.
9. Examine the multiple cellular mechanisms of energy metabolism.
  - a. Examine enzyme structure and function.
  - b. Relate the main points of bioenergetics and energy strategies in microorganisms.
  - c. Explain the process and importance of aerobic respiration
  - d. Compare and contrast the processes of aerobic and anaerobic respiration.
  - e. Explain the process and importance of anaerobic fermentation.
10. Examine the taxonomic relationship and the major infectious diseases caused by the organisms traditionally studied by microbiologists.
  - a. Review the binomial nomenclature, basic cell structure, growth requirements, and reproductive methods of the following organisms:
    - i. bacteria
    - ii. viruses
    - iii. fungi
    - iv. protozoan
    - v. multicellular parasites
11. Summarize basic genetic principles and analyze implications of genetic mutations, recombination, and genetic engineering.
  - a. Discuss the basic nature of genetic material and how it is replicated.
  - b. Explain how genetic material is used in a cell.
  - c. Explain the relationship between DNA and the structure of protein.
  - d. Outline the general reactions of protein synthesis.

- e. Compare and contrast protein synthesis in prokaryotic and eukaryotic microorganisms.
  - f. Define mutation and explain the cause and effect on cells.
  - g. Compare the different methods for bacterial recombination including transduction, transformation, conjugation, and transposons.
  - h. Discuss the use of restriction enzymes and vectors in the process of genetic transformation.
  - i. Describe the process of creating and uses of genetically modified organisms.
12. Identify the physical methods for prevention of microbial growth and describe their correct use and effectiveness.
- a. Discuss microbial control terminology including: sterilization, disinfection, degermenation, and antiseptis.
  - b. Discuss the mode of action and use of these physical agents: dry and moist heat including autoclaving, radiation, filtering.
13. Identify the chemical methods for prevention of microbial growth and describe their correct use and effectiveness.
- a. Discuss the mode of action and use of chemical agents including: alcohol, soaps, halogen compounds, phenols, hydrogen peroxide, formaldehyde, glutaraldehyde, heavy metals, dyes and acids.
  - b. Discuss factors that affect the germicidal activity of these control agents.
14. Identify the functional processes of basic antimicrobial agents and development of microbial resistance.
- a. Discuss the major modes of action of antimicrobial agents in controlling microbial growth and give examples of antimicrobials for each mode of action.
  - b. Explain how the appropriate antimicrobials are chosen for specific diseases including the Kirby-Bauer and MIC tests.
15. Analyze human and microbe interactions including the infection and disease processes.
- a. Define microflora and distinguish between pathogenic and normal flora.
  - b. Differentiate between the regions of the body that typically harbor microflora and those that are normally sterile
  - c. Describe the pathogenesis process including the portals of entry, attachment, and ways of establishment, virulence factors and portals of exit.
  - d. Differentiate the stages of infection, patterns of infection, and signs and symptoms of infection.
  - e. Differentiate between infection and disease.
  - f. Describe the reservoirs and transmission of infectious agents.
  - g. Discuss how deviations from the normal community can contribute to disease.
16. Analyze the types of nonspecific resistance related to immunity.
- a. Discuss physical and anatomical barriers to infection.
  - b. Discuss the chemical barriers to infection.

- c. Describe the organs of defense and immunity including the lymphatic and reticuloendothelial system and the role of white blood cells in immunity.
  - d. Describe the inflammatory response and stages of inflammation.
  - e. Analyze the importance of cytokines, phagocytosis, interferon, complement, and fever in the immune response.
17. Analyze the types of specific resistance related to adaptive immunity.
  - a. Compare and contrast between humoral (antibody) immunity and cell mediated immunity.
  - b. Discuss the importance and role of the different types of T cells and how they are activated.
  - c. Describe the development process of antibody mediated immunity including the process of clonal selection, role of plasma cells, and memory cells.
  - d. Describe antigen structure, functional categories, and roles in immunity.
  - e. Describe how antibodies function including opsonization, agglutination, complement, and neutralization.
18. Compare and contrast the four types of immunity to disease.
  - a. Differentiate between acquired and natural immunity and provide examples.
  - b. Differentiate between active and passive immunity and provide examples.
  - c. Discuss the role of vaccinations in public health and herd immunity.
19. Relate epidemiology to the study of microbiology.
  - a. Compare the prevalence and incidence of a disease.
  - b. Differentiate between sporadic, endemic, epidemic, and pandemic patterns of occurrence.
  - c. Discuss hospital acquired infections (HAI's or nosocomial infections) including common types of diseases and universal precautions.

## **Big Ideas and Essential Questions**

### **Big Ideas**

- History of microbiology
- Scientific Process
- Microscopy
- Prokaryotic and eukaryotic structure and function
- Cell staining and biochemical techniques
- Cell growth and metabolism
- Genetics and biotechnology
- Microorganism caused diseases
- Controlling microbial growth
- Human body responses
- Epidemiology

## Essential Questions

1. What is the history of microbiology?
  2. How does the scientific process work?
  3. How are microscopes used?
  4. What are the differences between prokaryotes and eukaryotes?
  5. How are samples prepared and stained?
  6. How do microorganisms create ATP?
  7. What is the source of genetic diversity in microbes?
  8. How do common microbes cause disease in humans?
  9. How are microbes controlled?
  10. How does the body respond to infection?
  11. What is epidemiology?
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These SLOs are not approved for experiential credit.

**Effective: Spring 2021**