



South Central College

# BIOL 270 Microbiology

## Common Course Outline

### Course Information

**Description** This course is an introduction to the general principles and methods used in the study of microorganisms. It includes a survey of prokaryotic and eukaryotic microorganisms emphasizing bacteria as well as viruses. Topics include microbial cell structure and function, metabolism, microbial genetics, and the role of microorganisms in disease, immunity, and other selected applied areas. Laboratory techniques include isolating, culturing, and identifying microorganisms. This course contains a three hour per week laboratory component. (Prerequisites: A grade of C or higher in BIOL115 OR BIOL225 OR BIOL220 AND CHEM108 OR CHEM110 OR CHEM120) (MNTC Goal Area 3)

**Total Credits** 4

**Total Hours** 96

### Types of Instruction

Instruction Type	Credits/Hours
Lecture	3/48
Lab	1/48

### Pre/Corequisites

Prerequisite A grade of C or higher in BIOL115 OR BIOL225 OR BIOL220 AND CHEM108 OR CHEM110 OR CHEM120

### Institutional Core Competencies

Communication - Students will be able to demonstrate appropriate and effective interactions with others to achieve their personal, academic, and professional objectives.

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

### Course Competencies

- Distinguish between the major classes of microorganisms based on their respective characteristics.**

**Linked Institutional Core Competencies**

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a

creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

#### **Linked External Standards**

Goal 3: Natural Sciences - To improve students' understanding of natural science principles and of the methods of scientific inquiry, i.e., the ways in which scientists investigate natural science phenomena. As a basis for lifelong learning, students need to know the vocabulary of science and to realize that while a set of principles has been developed through the work of previous scientists, ongoing scientific inquiry and new knowledge will bring changes in some of the ways scientists view the world. By studying the problems that engage today's scientists, students learn to appreciate the importance of science in their lives and to understand the value of a scientific perspective. Students should be encouraged to study both the biological and physical sciences.

#### **Learning Objectives**

Distinguish between bacteria, viruses, protozoa, algae, and fungi based on their structure and function.  
Recall the general properties of bacteria, viruses, protozoa, algae, and fungi.  
Compare and contrast the major categories of microbes.  
Identify which types of microbes are most medically relevant and provide examples of these organisms.  
Explain how microbes are assigned to different taxonomic groups.

### **2. Use the terminology of cell structure and function, cell reproduction, and microbial taxonomy.**

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3a - Demonstrate understanding of scientific theories.

#### **Learning Objectives**

Identify the components of Gram negative, Gram positive, and Acid fast cell walls.  
Compare and contrast the various types of bacterial cell wall including Gram positive, Gram negative, and Acid Fast cells.  
Identify the major internal cellular structures of a prokaryotic cell.  
Compare and contrast prokaryotes and eukaryotes in terms of cell structure and function.

### **3. Describe microbial metabolism.**

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#### **Learning Objectives**

Explain the key events of glycolysis.  
Explain the key events in the Krebs' cycle.  
Explain the key events of the Electron Transport Chain and Oxidative Phosphorylation.  
Compare and contrast the major energy producing pathways of a microbial cell.  
Compare and contrast aerobic and anaerobic respiration.  
Compare and contrast respiration and fermentation.

### **4. Explain microbial deoxyribonucleic acid (DNA) replication.**

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#### **Learning Objectives**

Explain the steps involved in DNA replication.

Describe the replication of DNA as a semiconservative process.

Distinguish the leading and lagging strands and how their synthesis differs.

### **5. Explain mutations including their potential causes, consequences, and uses.**

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#### **Learning Objectives**

Distinguish between the forms of point mutations.

Differentiate between a point and frameshift mutation.

Discuss properties of mutagens and materials within the category.

Describe the Ames test for testing for mutagenic properties of a chemical.

Describe light and dark repair of pyrimidine dimers.

### **6. Describe the process of protein synthesis in a prokaryotic cell.**

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#### **Learning Objectives**

Describe the process of transcription.

Describe the process of translation.

Explain the role of messenger, transfer, and ribosomal ribonucleic acid (RNA) in the process of translation.

Differentiate between the initiation, elongation, and termination stages of translation.

Use a DNA sequence to predict both the RNA and protein sequences.

Explain the use of operons for transcriptional control in prokaryotes.

Contrast the regulation of an inducible operon with that of a repressible operon, providing an example of each.

### **7. Evaluate microbial biotechnology and its applications including genetic engineering.**

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3c - Communicate their experimental findings, analyses, and interpretations both orally and in writing.

3d - Evaluate societal issues from a natural science perspective, ask questions about the evidence presented, and make informed judgments about science-related topics and policies.

#### **Learning Objectives**

Define biotechnology and genetic engineering.

Explain various applications of microbial biotechnology being used in contemporary society.

Evaluate genetic engineering from a natural science perspective and ask questions about evidence to determine the pros and cons of a specific example of genetic engineering.

## **8. Describe horizontal gene transfer in bacteria.**

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### **Learning Objectives**

Explain the process of transformation.

Explain the process of transduction.

Differentiate specialized and generalized transduction.

Explain the process of conjugation.

Contrast the major forms of horizontal gene transfer.

Compare the major forms of horizontal gene transfer.

## **9. Describe means of controlling microbial growth.**

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### **Learning Objectives**

Describe chemical means of microbial control in the environment.

Describe physical means of microbial control in the environment.

Describe methods of evaluating the effectiveness of a disinfectant or antiseptic including the phenol coefficient and the use-dilution test.

Describe means of controlling microbial growth within the body using antimicrobial drugs.

Describe methods of evaluating the effectiveness of an antimicrobial including the Kirby-Bauer test and the Minimum Inhibitory Concentration test.

## **10. Explain the modes of action of antimicrobial drugs including identifying the major types of antimicrobial drugs which work via each mode of action.**

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### **Learning Objectives**

Explain inhibition of cell wall synthesis.

Explain inhibition of protein synthesis.

Explain disruption of cell membrane.

Explain inhibition of metabolic pathways.

Explain inhibition of nucleic acid synthesis.

Identify groups of antibiotics which inhibit cell wall synthesis.

Identify groups of antibiotics which inhibit protein synthesis.

Identify groups of antibiotics which disrupt cell membrane function.  
Identify groups of antibiotics which act as antimetabolites.  
Identify groups of antibiotics which inhibit nucleic acid synthesis.

## **11. Explain processes related to microbial pathogenesis.**

### **Linked Institutional Core Competencies**

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### **Learning Objectives**

Summarize Koch's postulates and how they are used to determine the microbial cause of a disease.  
Distinguish between primary and opportunistic pathogens and identify specific examples of each.  
Explain how virulence factors contribute to signs and symptoms of infectious disease.  
Provide examples of virulence factors found in various types of microbes and the role they cause in disease.

## **12. Explain the basic principles of epidemiology.**

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### **Learning Objectives**

Define epidemiology.  
Distinguish between sporadic disease, epidemics, and pandemics.  
Relate portals of entry and exit to modes of disease transmission.  
Distinguish between modes of disease transmission.  
Differentiate between descriptive, analytical, and experimental epidemiologic studies.  
Distinguish between common-source outbreaks and propagated epidemics.  
Describe methods of disease control including isolation, quarantine, and vector control.  
Identify nosocomial infections and identify means to prevent and control nosocomial infections.

## **13. Explain the basic principles of immunology.**

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### **Learning Objectives**

Identify the types of cells involved in the immune system.  
Identify the role of the various cells involved in the immune system.  
Explain and provide examples of innate and adaptive immunity.  
Explain and provide examples of cell mediated and humoral immunity.  
Compare and contrast the various types of immunity.

**14. Explain the roles that components of the immune system play in preventing and occasionally causing disease.**

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**Learning Objectives**

Define and provide examples of Immediate/Type I Hypersensitivity.  
Define and provide examples of Cytotoxic/Type II Hypersensitivity.  
Define and provide examples of Immune Complex/Type III Hypersensitivity.  
Define and provide examples of Cell mediated/Delayed/Type IV Hypersensitivity.  
Define and provide examples of autoimmune disease.  
Explain how the immune system causes an autoimmune disorder.  
Describe examples of autoimmune disorders including lupus and rheumatoid arthritis.

**15. Describe the field of applied microbiology.**

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**Learning Objectives**

Describe how microbial metabolism can be manipulated for food production.  
Explain how food characteristics and the presence of microbes can lead to food spoilage.  
List several methods for preventing food spoilage.  
List commercial products produced by microorganisms.  
Explain how water for drinking and wastewater are treated to make them safe and usable.

**16. Identify infectious diseases including the causative agent and its characteristics, modes of transmission, signs and symptoms, as well as treatment of the disease.**

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**Learning Objectives**

Identify infectious diseases of the skin and eyes including wounds and bites.  
Identify urogenital and sexually transmitted diseases caused by microbes.  
Identify diseases of the respiratory tract caused by microbes.  
Identify diseases of the oral cavity caused by microbes.  
Identify diseases of the gastrointestinal tract caused by microbes.  
Identify cardiovascular, lymphatic, and systemic diseases caused by microbes.

Identify diseases of the nervous system caused by microbes.  
Integrate course themes as they relate to infectious diseases.

**17. Read, interpret, incorporate, and cite information and ideas from primary literature into writing.**

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3d - Evaluate societal issues from a natural science perspective, ask questions about the evidence presented, and make informed judgments about science-related topics and policies.

**Learning Objectives**

Demonstrate the ability to locate primary literature.

Interpret information presented in primary literature.

Appropriately cite primary literature sources both in-text and on a reference list.

**18. Demonstrate technical laboratory skills such as microscopy, bacterial cell staining, aseptic techniques, culturing, and isolation.**

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3b - Formulate and test hypotheses by performing laboratory, simulation, or field experiments in at least two of the natural science disciplines. One of these experimental components should develop, in greater depth, students' laboratory experience in the collection of data, its statistical and graphical analysis, and an appreciation of its sources of error and uncertainty.

**Learning Objectives**

Use a bright field microscope to view and interpret microbial slides.

Prepare microscope slides for microbiological examination.

Perform and interpret a Gram's Stain.

Perform and interpret an Endospore Stain.

Demonstrate proper use of aseptic techniques for the transfer and handling of microorganisms.

Demonstrate the streak plate technique for creation of a pure culture.

**19. Demonstrate proper handling of infectious and biohazardous waste in the laboratory setting.**

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**Learning Objectives**

Demonstrate the proper disposal of contaminated lab materials.  
Demonstrate the proper disposal of broken glassware.  
Demonstrate the proper clean up procedure upon finishing a laboratory exercise.

## **20. Apply staining and metabolic tests to characterize and identify unknown bacteria.**

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### **Learning Objectives**

Interpret a dichotomous key.

Perform the appropriate staining technique(s) to an unknown culture.

Identify and use appropriate microbiological media and test systems to identify the species of an unknown bacterial organism.

Write the results of the experiment in a laboratory report.

## **21. Enumerate the number of microbes in a sample.**

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### **Learning Objectives**

Determine the most appropriate means of enumerating the number of microbes based on the type of sample.

Choose and use the appropriate pipetting device.

Calculate the number of microbes based on plate counts and serial dilutions.

## **22. Evaluate the effectiveness of antimicrobials in the laboratory.**

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of its sources of error and uncertainty.

#### **Learning Objectives**

Describe the Kirby Bauer method of determining microbial sensitivities.

Perform a Kirby Bauer test.

Interpret zones of inhibition and determine the level of microbial sensitivity.

### **23. Formulate a hypothesis, and conduct and analyze an experiment with a model organism.**

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#### **Learning Objectives**

Formulate a hypothesis based on course content.

Design an experiment to test the hypothesis.

Conduct an experiment to test the hypothesis.

Analyze the results of the experiment to determine if the hypothesis is supported.

### **24. Organize, draft, edit, and revise formal scientific writing.**

#### **Linked Institutional Core Competencies**

Communication - Students will be able to demonstrate appropriate and effective interactions with others to achieve their personal, academic, and professional objectives.

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3c - Communicate their experimental findings, analyses, and interpretations both orally and in writing.

#### **Learning Objectives**

Identify common components of scientific writing.

Write a scientific laboratory report.

Revise scientific writing based on feedback.