**1. COURSE TITLE:** Microbiology

**2.** **COURSE NUMBER:** 2300 **CATALOG PREFIX:** BIOL

**3. PREREQUISITE:** BIOL 1102 or BIOL 1320 or BIOL 2206 or BIOL 1520

**4. COURSE TIME/LOCATION:**

**5. CREDIT HOURS:** 4 **LECTURE HOURS:** 3

 **LABORATORY HOURS:** 1 **LAB CONTACT HOURS:** 3

**6. FACULTY CONTACT INFORMATION: (per instructor on course syllabus)**

**7. COURSE DESCRIPTION:**

This course covers the morphology and physiology of microorganisms and selected human parasites. Topics covered include basic chemistry, cell structure and function, metabolism, genetics, biotechnology, growth and control of microbes, normal human microflora, mechanisms of disease production, transmission of infectious diseases, immune responses, and the action of specific pathogens in the production of human infectious disease. There is also a brief introduction to environmental microbiology and various career options in microbiology. This must be taken at the same time as the corequisite laboratory course in Microbiology. The Microbiology Lab course exposes students to biosafety and the practice of good aseptic technique in growing and identifying live bacteria.

**8. LEARNING OUTCOMES:**

At the completion of this course the student will be able to:

1. Recognize and describe basic cell structures and functions from a variety of microorganisms including viruses.

2. Identify and describe major metabolic pathways including the information flow in gene expression and potential sources and implications of genetic variation.

3. Recognize that microbes exist in diverse ecosystems and have essential roles in the maintenance of life and human health.

4. Recognize that evolution is important in classifying microbial organisms and impacts pathogenicity and other important characteristics of human health and disease.

5. Recognize ways to safely and effectively control microbial growth to break the epidemiological triangle and prevent Healthcare-Associated Infections (HAIs).

6. Apply scientific method and aseptic laboratory techniques to study microbes including a variety of identification methods.

**9. ADOPTED TEXTBOOK(S):**

*Microbiology with Diseases by Taxonomy*

6th edition, 2020, Pearson Education Inc.

Robert W. Bauman.

ISBN: 978-0-13-517483-8 (includes Inclusive Access E-text and Mastering Access).

ISBN for students not wanting Inclusive Access: 978-0-13-574760-5 (includes Mastering and E-text).

And:

 *Laboratory Experiments in Microbiology*

12th edition, 2019

Ted R. Johnson and Christine L. Case

Pearson Education, Inc.

ISBN: 978-0-13-464426-4 (includes Inclusive Access E-text and Mastering Access).

ISBN for students not wanting Inclusive Access: 978-0-13-460520-3 (includes Mastering and E-text).

**10. OTHER REQUIRED MATERIALS:**

The textbook listed above includes Modified Mastering Microbiology which is required for online homework and some exams.

Safety glasses of the type available from the Southern State Community College Bookstore must be purchased prior to the second lab session.

**11. GRADING\*\*\*:**

Grading will follow policy in college catalog.

 **A 90 – 100**

 **B 90 – 89**

 **C 70 – 79**

 **D 60 – 69**

 **F 0 – 59**

**12. GRADING PROCEDURES OR ASSESSMENTS (per instructor on course syllabus)**

**Grades will be based on:**

 Assignments 100 points 10%

 Lab Safety Quiz 25 points 2.5%

 Lab Reports 275 points 27.5%

 4 Exams (@ 100 points each, drop low score) 300 points 30%

 Unknowns Identification Project 100 points 10%

 Comprehensive Exam 200 points 20%

 Total 1000 points 100%

**13. COURSE METHODOLOGY: *(Course Syllabus – Individual Instructor Specific)***

This course will use lecture, discussion, power point and video presentations. Web based tutorials and learning exercises will be referenced and can be used at the discretion of the student. The course will include chapter assignments and review quizzes. Lecture exams will be used as appropriate to verify achievement of the course objectives and do determine grades.

Use of Artificial Intelligence (AI) will be determined by the instructor for each course activity. If the instructor does not specifically approve the use of AI for an activity then it should be assumed it is not approved. Please ask the instructor for clarification if there is a question about the use of AI for a specific course activity.

The instructor may modify any part of this course at his sole discretion.

The following may be used as Module Learning Outcomes (MLOs) for the course. These learning objectives are modified from the American Society of Microbiology (ASM) “Recommended Curriculum Guidelines for Undergraduate Microbiology Education” or its derivative “Microbiology in Nursing and Allied Health (MINAH) Undergraduate Curriculum Guidelines”.

1. Recognize the scientific achievements of key people and events important to the history and development of the various fields of modern microbiology.
2. Identify the steps of scientific method and critical thinking, and apply these processes to answering questions and solving problems.
3. Identify the sequence of steps in Koch’s postulates which can be used to identify the etiological agent of certain infectious diseases.
4. Identify the major parts of compound light microscopes, and recognize the major properties and techniques for improving observation with microscopes.
5. Recognize various staining techniques and biochemical test media that are useful for identifying bacterial pathogens.
6. Identify major cellular structures of prokaryotic and eukaryotic cells.
7. Recognize methods of aseptic technique for collecting and processing clinical samples, and its importance in protecting healthcare providers and patients.
8. Identify the basic metabolic processes involved in the catabolism and anabolism of carbohydrates, lipids, proteins, and nucleic acids.
9. Demonstrate an understanding that a microbe’s survival and growth in a given environment depends on its metabolic characteristics.
10. Recognize that most bacteria in nature live in biofilm communities that operate in specific ways.
11. Identify the mechanisms involved in gene expression as well as distinguishing characteristics among Bacteria, Archaea, Eukaryotes, and retroviruses.
12. Recognize the distinguishing characteristics of different modes of genetic recombination among prokaryotes and eukaryotes.
13. Recognize that mutations and horizontal gene transfer, operating within the immense variety of microenvironments, have provided conditions where natural selection could result in the evolution of a huge diversity of microorganisms.
14. Demonstrate an understanding that cell genomes can be manipulated to alter cell function including the production of pharmaceuticals.
15. Demonstrate an understanding that microbial growth is controlled using physical, chemical, mechanical, and biological means.
16. Identify the mechanism of action and spectrum of action of antimicrobial agents based on unique structures of target microbes.
17. Recognize that proper stewardship of antimicrobial drugs is essential to limiting the human impact on the environment that leads to antimicrobial resistance.
18. Demonstrate an understanding that pathogen virulence continuously evolves, and that mutations and recombination provide genetic variation that natural selection acts on to drive evolution.
19. Recognize the characteristics and classification of various bacteria and the limited applicability of the traditional definition of species.
20. Demonstrate an understanding that cells, organelles , and all major metabolic pathways, evolved from early prokaryotic cells.
21. Use phylogenetic trees to determine the evolutionary relatedness of organisms.
22. Recognize a list of characteristics that distinguish members of the domain Bacteria from members of the domain Archaea.
23. Recognize the characteristics and classification of various eukaryotes.
24. Recognize the characteristics and classification of various viruses.
25. Demonstrate an understanding that the synthesis of viral genetic material and proteins is dependent on host cells and the type of virus.
26. Compare and contrast the lytic and lysogenic replication cycles of viruses.
27. Demonstrate an understanding that microorganisms are ubiquitous and live in diverse and dynamic ecosystems, including the human body.
28. Compare and contrast the ecological terms: commensalism, mutualism, competition, microbial antagonism, and parasitism.
29. Recognize the impacts of microorganisms on human health and disease.
30. Identify pathogen virulence factors and their influence on pathogenesis, impact on treatment options, and clinical management of infectious disease.
31. Demonstrate an understanding of the causes and strategies to break the epidemiologic triangle and prevent nosocomial infections (Healthcare Associated Infections, HAIs).
32. Identify the methods used to determine vaccine safety and efficacy in preventing infectious disease.
33. Demonstrate an understanding of how various serologic and molecular techniques are used to diagnose infections and identify causative infectious agents.
34. Demonstrate an understanding that microbiology is central to the top three threats in healthcare: healthcare associated infections, antibiotic resistance, and emerging diseases.
35. Identify and discuss ethical issues in microbiology, especially with regard to vaccines and antimicrobial drug stewardship.
36. Identify the steps of the scientific method and critical thinking, and be able to develop useful questions, testable hypotheses, collect and analyze data, and draw conclusions from experimental lab results.
37. Demonstrate the ability to work effectively in groups, including use of effective labeling techniques and coordination needed to obtain correct results.
38. Recognize biosafety guidelines and practice safe laboratory practices.
39. Demonstrate an ability to use compound light microscopes to observe, characterize, and differentiate among various representative prokaryotes, eukaryotes, helminths, and other worms.
40. Use standard microbiological instruments and laboratory techniques to effectively perform aseptic transfers including slants, broths, and streak plates.
41. Improve the ability to use the metric system for measurement and reporting of experimental results.
42. Compare and contrast various sterilization and disinfection techniques and use selected approaches in the laboratory.
43. Recognize how staining enhances microscope resolution and perform basic microscopy staining techniques that allow differentiation of bacteria including Gram stain.
44. Demonstrate an ability to estimate the number of microbes in a sample using various techniques including pipetting and serial dilution.
45. Demonstrate an understanding of selective media and their use in isolating microorganisms and testing biochemical characteristics.
46. Demonstrate an ability to use standard laboratory equipment and techniques, including spectrophotometry to enumerate bacteria in broth culture and develop a microbial growth curve.
47. Perform and interpret disk-diffusion antimicrobial susceptibility tests and evaluate other methods of controlling microbial growth.
48. Use serologic techniques including ELISA to diagnose infections and identify causative infectious agents.
49. Demonstrate an ability to use appropriate microbiological media and test systems to isolate colonies and maintain pure cultures, including accurate recording of microscopic and macroscopic observations.
50. Demonstrate an understanding of the use of controls, including positive and negative controls, to interpret experimental results and provide quality control and quality assurance in laboratory activities.
51. Perform and use the results of biochemical tests, along with flow chart dichotomous keys, to identify unknown microorganisms.
52. Recognize and apply rules and behaviors of laboratory safety.
53. List and apply the steps of the scientific method.
54. Make measurements of length, volume, weight, pressure, and other common properties using the metric system and other appropriate scales including pH.
55. Properly use standard laboratory equipment including general lab ware, microscopes, thermocyclers, dissection tools, and other instruments and techniques.
56. Work collaboratively to perform and interpret experiments.
57. Collect and tabulate data, perform basic data analyses, and prepare and interpret graphs and charts to demonstrate quantitative and empirical reasoning.
58. Use critical thinking and problem-solving skills to perform and interpret experimental results.
59. Produce effective written, oral, and visual communication.

**14. COURSE OUTLINE: (per instructor on course syllabus)**

**Sample lecture outline:**

1. History of microbiology.
2. Biological chemistry.
3. Cell structure and function.
4. Microscopy and classification of organisms.
5. Microbial metabolism.
6. Microorganism nutrition and growth.
7. Microbial genetics.
8. Biotechnology.
9. Controlling microorganism growth outside the body.
10. Controlling microorganism growth inside the body.
11. Classification and standard growth curve of prokaryotes.
12. Classification and unique characteristics of eukaryotes.
13. Classification and replication of viruses.
14. Normal microbial flora, human health, and infectious disease.
15. Innate immunity.
16. Adaptive immunity.
17. Immunization and serologic testing.
18. Immune disorders.
19. Infectious diseases caused by bacteria, eukaryotic microbes, and viruses.

**Sample Course Calendar**

Week 1 History of microbiology.

Biological chemistry.

Week 2 Cell structure and function.

Microscopy and classification of organisms.

Week 3 Microbial metabolism.

Microorganism nutrition and growth.

Week 4 Microbial genetics.

Biotechnology.

Week 5 Controlling microorganism growth outside the body.

Controlling microorganism growth inside the body.

Week 6 Review week and Exam 1.

Classification and standard growth curve of prokaryotes.

Classification and unique characteristics of eukaryotes.

Week 7 Classification and replication of viruses.

Normal microbial flora, human health, infectious disease.

Week 8 Exam 2.

Innate immunity.

Week 9 Adaptive immunity

Adaptive immunity and Immunization.

Week 10 Immunization and serologic testing.

Immune disorders.

Week 11 Exam 3.

Infectious diseases caused by Gram positive bacteria.

Week 12 Infectious diseases caused by Gram negative bacteria.

Infectious diseases caused by other types of bacteria.

Week 13 Infectious diseases caused by fungi.

Infectious diseases caused by other eukaryotes.

Week 14 Infectious diseases caused by RNA viruses.

Infectious diseases caused by DNA viruses.

Week 15 Review and infectious diseases activity.

Week 16 Comprehensive Exam

**Sample lab outline:**

1. Lab Safety and Microbes in the Environment
2. Microscopy and Transfer of Bacteria
3. Cultivation of Bacteria and Staining Methods
4. Microbial Metabolism
5. Microbial Growth and the Environment
6. Microbial Genetics and Control
7. The Microbial World
8. Viruses and Epidemiology
9. Immunology
10. Serology Testing including ELISA
11. Bacteria of the Skin, Respiratory Tract, and Mouth
12. Bacteria of the Gastrointestinal and Genitourinary Tracts
13. Unknown Identification and Bergey's Manual
14. Identification of Unknowns
15. Presentation of Unknowns

 **SAMPLE** Course Calendar

 Week 1 Lab #1 – Lab Safety and Microbes in the Environment

 Week 2 Lab #2 – Microscopy and Handling Bacteria

 Week 3 Lab Safety Quiz

 Lab #3 – Cultivation of Bacteria and Staining Methods

 Week 4 Lab #4 – Microbial Metabolism and

Week 5 Lab #5 – Growth and the Environment

 Week 6 Lab #6 – Microbial Genetics and Control

 Week 7 Lab #7 – The Microbial World

 Week 8 Lab #8 – Viruses and Epidemiology

 Week 9 Lab #9 – Immunology

 Week 10 Lab #10 – Serology Testing including ELISA

 Week 11 Lab #11 – Bacteria of the Skin, Respiratory Tract, and Mouth

Week 12 Lab #12 – Bacteria of the Gastrointestinal and Genitourinary Tracts

 Week 13 Lab #13 – Unknown Identification and Bergey's Manual

 Week 14 Lab #14 – Identification of Unknowns

 Week 15 Lab #15 – Presentation of Unknowns

 Week 16 Comprehensive Exam

**15. SPECIFIC MANAGEMENT REQUIREMENTS\*\*\*:**

Final grade in this course will be determined by mastery of course material as assessed by quizzes, tests, exams, and other assignments.

The following will be learning objectives (MLOs) for the course. These learning objectives are directly from the American Society of Microbiology (ASM) “Recommended Curriculum Guidelines for Undergraduate Microbiology Education” or its derivative “Microbiology in Nursing and Allied Health (MINAH) Undergraduate Curriculum Guidelines”.

At the completion of this course the student will be exposed to the following:

Course Learning Outcome 1: Recognize and describe basic cell structures and functions from a variety of microorganisms including viruses.

1.1. The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).

1.2. Bacteria have unique cell structures that can be targets for antibiotics, immunity and phage infection.

1.3. Bacteria and Archaea have specialized structures (e.g., flagella, endospores, and pili) that often confer critical capabilities.

1.4. While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.

1.5. The replication cycles of viruses (lytic and lysogenic) differ among viruses and are determined by their unique structures and genomes

Course Learning Outcome 2: Identify and describe major metabolic pathways including the information flow in gene expression and potential sources and implications of genetic variation.

2.1. Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g., nitrogen fixation, methane production, anoxygenic photosynthesis).

2.2. The interactions of microorganisms among themselves and with their environment are determined by their metabolic abilities (e.g., quorum sensing, oxygen consumption, nitrogen transformations).

2.3. The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.

2.4. The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological means.

2.5. Genetic variations can impact microbial functions (e.g., in biofilm formation, pathogenicity and drug resistance).

2.6. Although the central dogma is universal in all cells, the processes of replication, transcription, and translation differ in Bacteria, Archaea, and Eukaryotes.

2.7. The regulation of gene expression is influenced by external and internal molecular cues and/or signals

2.8. The synthesis of viral genetic material and proteins is dependent on host cells.

2.9. Cell genomes can be manipulated to alter cell function.

Course Learning Outcome 3: Recognize that microbes exist in diverse ecosystems and have essential roles in the maintenance of life and human health.

3.1. Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.

3.2. Most bacteria in nature live in biofilm communities.

3.3. Microorganisms and their environment interact with and modify each other.

3.5. Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.

3.6. Microbes are essential for life as we know it and the processes that support life (e.g., in biogeochemical cycles and plant and/or animal microbiota).

3.7. Microorganisms provide essential models that give us fundamental knowledge about life processes.

3.8. Humans utilize and harness microorganisms and their products.

3.9. Because the true diversity of microbial life is largely unknown, its effects and potential benefits have not been fully explored.

Course Learning Outcome 4: Recognize that evolution is important in classifying microbial organisms and impacts pathogenicity and other important characteristics of human health and disease.

4.1. Cells, organelles (e.g., mitochondria and chloroplasts) and all major metabolic pathways evolved from early prokaryotic cells.

4.2. Mutations and horizontal gene transfer, with the immense variety of microenvironments, have selected for a huge diversity of microorganisms.

4.3. Human impact on the environment influences the evolution of microorganisms (e.g., emerging diseases and the selection of antibiotic resistance).

4.4. The traditional concept of species is not readily applicable to microbes due to asexual reproduction and the frequent occurrence of horizontal gene transfer.

4.5. The evolutionary relatedness of organisms is best reflected in phylogenetic trees.

4.6. Pathogens have diverse virulence factors that influence their pathogenesis and impact treatment options and clinical management.

4.7. Pathogens are continuously evolving and virulence is not a static property. Understanding mechanisms that impact pathogen evolution (i.e. vertical and horizontal genetic variation, mutations, recombination, etc.) is central to limiting pathogen evolution.

Course Learning Outcome 5: Recognize ways to safely and effectively control microbial growth to break the epidemiological triangle and prevent Healthcare-Associated Infections (HAIs).

5.1. Microbial growth is controlled using physical, chemical, mechanical, and biological means.

5.2. Antimicrobial compounds combat bacteria, fungi, helminths, protozoans, and viruses.

5.3. Vaccines are safe and effective methods to prevent disease.

5.4. Proper stewardship of antimicrobial drugs is essential to limit antimicrobial resistance.

5.5. Healthcare associated infections (HAIs, nosocomial) are costly and often have a poorer prognosis than community acquired infections.

5.6. Tracking and reducing the incidence of healthcare acquired infections is a collaborative effort that saves lives.

5.7. There are numerous strategies (i.e. quarantine, vector control, patient education) to break the epidemiological triangle and prevent disease transmission.

Course Learning Outcome 6: Apply scientific method and aseptic laboratory techniques to study microbes including a variety of identification methods.

6.1. Apply the process of science.

6.2. Use quantitative reasoning.

6.3. Communicate and collaborate with other disciplines

6.4. Understand the relationship between science and society

6.5. Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).

6.6. Use pure culture and selective techniques to enrich for and isolate microorganisms.

6.7. Use appropriate methods to identify microorganisms (media-based, molecular and serological).

6;.8. Estimate the number of microorganisms in a sample (using, for example, direct count, viable plate count, and spectrophotometric methods).

6.9. Use appropriate microbiological and molecular lab equipment and methods.

6.10. Practice safe microbiology, using appropriate protective and emergency procedures.

6.11. Document and report on experimental protocols, results and conclusions.

**16.** **FERPA:\***

Students need to understand that your work may be seen by others. Others may see your work when being distributed, during group project work, or if it is chosen for demonstration purposes. Students also need to know that there is a strong possibility that your work may be submitted to other entities for the purpose of plagiarism checks.

**17. ACCOMMODATIONS:**

Students requesting accommodations may contact Ryan Hall, Accessibility Coordinator at rhall21@sscc.edu or 937-393-3431, X 2604.

Students seeking a religious accommodation for absences permitted under Ohio’s Testing Your Faith Act must provide the instructor and the Academic Affairs office with written notice of the specific dates for which the student requires an accommodation and must do so no later than fourteen (14) days after the first day of instruction or fourteen (14) days before the dates of absence, whichever comes first. For more information about Religious Accommodations, contact Ryan Hall, Accessibility Coordinator at rhall21@sscc.edu or 937-393-3431 X 2604.

**18. OTHER INFORMATION\*\*\*:**