Revised: Fall 2016

Biology 205
Microbiology

COURSE OUTLINE

Prerequisites:

One year of college biology and one year of college chemistry or divisional approval; an ENG 111 placement recommendation, co-enrollment in ENF 3/ENG 111, or successful completion of all developmental English requirements.

Course Description:

Examines morphology, genetics, physiology, ecology, and control of microorganisms. Emphasizes application of microbiological techniques to selected fields. Focuses on human pathogens and the process of pathogenicity.

In this survey course, students explore the vast world of microbiology and the myriad ways microorganisms influence everyday life, with an emphasis on human health and disease. Initially, students study the history of microbiology and the classification and structure of microorganisms. After a basic introduction, students begin an in-depth look at microbial metabolism and genetics. The latest technologies are discussed, and the impact that genetics of the microbial organisms have on humans is emphasized. Following this unit, the students begin to explore the individual categories of microorganisms and individual representatives of each type of microbe are studied in detail. The course concludes with an overview of microbial control (with a focus on antibiotic resistance), epidemiology and the human immune system. Students learn how the human body remains healthy in the face of numerous microbial invaders, with the overall goal of improving their own personal health. Throughout the course, realistic examples from current events are presented and discussed in the context of the course material, and laboratory exercises are conducted to complement the lecture material.

Semester Credits: 4 **Lecture Hours: 3 Lab/Recitation Hours: 3**

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Course Outcomes

Following the completion of this course, the successful student will be able to:

- Describe the role of prokaryotes in the evolution of other cells and organelles.
- Give examples of the vast diversity metabolic of microorganisms and the factors that influence and generate this diversity, therefore affecting the evolution of these organisms
- Compare the basic anatomy and physiology of prokaryotic and eukaryotic cells
- Describe how microscopy has contributed to the understanding of these cell types
- Describe specialized structures that are specific to the prokaryotic cell
- Give examples of how prokaryotic cell structures may be targets for antimicrobial therapy
- Describe the replication cycles of viruses (lytic and lysogenic) and discuss how they differ, as determined by their unique structures and genomes.
- Describe how the replication cycle of various classes of viruses is dependent upon host cellular machinery
- Explain basic microbial metabolic pathways common in bacteria and archae
- Compare the relationship between the metabolic characteristics of a given organism and the environment in which it can survive and grow
- Describe physical, chemical, mechanical, and biological means of controlling microbial growth
- Describe the central processes of DNA replication, transcription and translation; and compare these processes in bacteria and eukaryotes
- Appreciate the importance of the genome in determining microbial function
- Give examples of how genetic variations can impact microbial processes
- Describe the following mechanisms of horizontal gene transfer: transformation, transduction, conjugation
- Compare the existence of microorganisms in a biofilm vs a planktonic culture and describe the more likely scenario in nature
- List neutral, beneficial and harmful ways in which microbes can interact with human hosts
- Describe the ways in which microorganism are essential to life on earth
- List how microorganisms are used to study eukaryotic life, and how microorganisms are used to produce products beneficial to humans
- Apply the scientific method to microbiology research
- Identify and discuss ethical issues in the field of microbiology

These goals squarely align with the American Society for Microbiology's Guidelines for undergraduate microbiology curriculum.

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Following completion of the laboratory component of this course, the successful student will be able to:

- Practice safe microbiology, using appropriate protective and emergency procedures.
- Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).
- Use pure culture and selective techniques to enrich for and isolate microorganisms.
- Use appropriate media based methods to identify microorganisms
- Estimate the number of microorganisms in a sample using viable plate count
- Use appropriate microbiological and molecular lab equipment and methods.
- Document and report on experimental protocols, results and conclusions

Required Materials:

Lab coat

Textbooks:

Microbiology: A Human Perspective. Nester, Anderson, Roberts 8th ed. McGraw Hill Publishing.

Hardback bundle ISBN: 9781259621871
Loose-leaf bundle ISBN: 9781259390586

Microbiology Laboratory Theory and Application – Brief Edition. Leboffe and Pierce 3rd ed. Morton Publishing Company. ISBN: 9781617314773

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Topical Description:

Topics	Chapter
I. Introduction to Microbiology	1
A. Types of Microorganisms	
1. Bacteria	
2. Fungi	
3. Viruses	
4. Protozoans	
5. Algae	
6. Archaea	
B. History of Microbiology	
1. Germ Theory of Disease vs. Spontaneous Generation	
2. Founders of Microbiology (Ex. Van Leeuwenhoek, Pasteur, Koch)	
II. Prokaryotic Cell Growth	4
III. Microscopy and Cell Structure	3
A. Light, Dark Field, and Electron Microscopy	3
B. Anatomy and Physiology of Prokaryotic and Eukaryotic Cells	3
1. Size, Shape, and Types	
2. Outer Structures; Flagella, Cilia, Capsules, and Pili	
3. Cell Wall	
4. Plasma Membrane (hypotonic, isotonic, and hypertonic solutions)	
5. Cell Organelles	
IV. Microbial Metabolism	6
A. The role of enzymes	
B. Central Metabolic Pathways	
a. Glycolysis	
b. Pentose Phosphate Pathways	
c. TCA cycle	
C. Respiration	
a. ETC	
b. ATP Synthase	

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D. Catabolism of non CHO macromolecules
E. Anabolic Pathways

V. Food Microbiology 31
A. Microbes in Food and Beverage Production
B. Food Spoilage
C. Foodborne illnesses

VI. From DNA to Protein 7
A. DNA Replication
B. Gene Expression
C. Regulation of gene Expression – the lac operon

VII. Microbial Genetics 8
A. Mutations
B. Transfer of Genetic Material
1. Transformation
2. Transduction
3. Conjugation
C. Mobile genetic Elements

VIII. Biotechnology and Recombinant DNA 9
A. Tools of Biotechnology
B. Applications
C. Techniques
1. DNA sequencing
2. Polymerase Chain Reaction
D. The ethics of Genetic Engineering

IX. Host Microbe Interactions 16
A. Principles and Causes of Infectious Disease
B. Mechanisms of Pathogenicity

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X. Microbial Diversity

A. Viruses, Viroids, and Prions 13

1. Structure and Classification
2. General Life Cycle of Bacterial and Animal Viruses
3. Cultivation in the Laboratory
4. Viruses and Cancer—Oncogenic Viruses
5. Infectious Protein and RNA.

B. Eukaryotes 12

1. Fungi
2. Protozoa
3. Helminthes

If time permits:

XI.. Principles of Epidemiology 19

A. Epidemiological Studies
B. Portals of entry and means of transmission
C. Surveillance
D. Trends in disease
E. Healthcare Associated Infections

XII. Control of Microorganisms

A. Physical Methods of Microbial Control 5

1. Heat
2. Filtration
3. Refrigeration
4. Radiation
5. Desiccation
6. Osmotic Pressure

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B. Chemical Methods of Microbial Control
   1. Antiseptics and Disinfectants
   2. Antibiotics and Their Modes of Action 20
      i. Selective toxicity
      ii. Mechanisms of action
      iii. Determining susceptibility
      iv. Antibiotic Resistance

IF TIME PERMITS:

XIII. Host Resistance

A. The Innate immune Response 14
   1. Intact Skin
   2. Inflammatory Response and Phagocytosis
   3. Fever
   4. Antimicrobial Substances (Lysozyme, Complement, Interferon)

B. The adaptive Immune Response 15
   1. Antigens and Antibodies
   2. Humoral and Cell-Mediate Immune Systems
   3. Active and Passive Immunity
   4. Immunological Memory
   5. Monoclonal Antibodies (if time permits)

C. Practical Applications of Immunology 19
   1. Immunizations
   2. Immunologic Testing

XIV. Emerging Diseases

XV. Sexually Transmitted Infections

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Laboratory Sessions

1. Use of the Compound Light Microscope and Dissecting Microscope
2. Bacteriological Media and Aseptic Techniques
3. Differential Staining (Gram Stain Technique)
4. Special Staining Techniques (Acid Fast Stains and Spore Stains)
5. Effects of Environmental Conditions on Growth (Aerobic vs. Anaerobic)
6. Bacterial enumeration by serial dilution and plate counting
7. Bacteriophage Infection of *E.coli* and/or phage discovery using *Bacillus* bacteria as hosts
8. DNA Technology
   May include PCR, DNA fingerprinting, transformation and/ or Microarray technology
9. Use of Disinfectants and U.V. Irradiation
10. Antibiotic Sensitivity Testing (Disc Diffusion Method)
11. Biochemical Testing and selective and differential media
12. Unknown Identification with multitest identification systems
13. Eukaryotic Microorganisms—Yeast, Molds, and Protozoans

    Slide identification
14. Immunology techniques, ex. ELISA

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Notes to Instructors

1. Departmental policy dictates that instructors do not allow students to keep tests.

2. A comprehensive final exam counting 15% - 20% of the total grade will be given at the end of the semester.

3. Syllabus should state what the course grade will be based on, such as tests, quizzes, a comprehensive final exam, and any other assignments made by the instructor.

4. The VWCC Biology Department uses a 10 point grading scale.

5. Comprehensive study of the listed topics is beyond the reasonable expectations of a 15-week Microbiology course. It is up to the discretion of the instructor to choose which topics are more detailed but each topic should be adequately covered.

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