

**I. CATALOG DESCRIPTION**

- A. Department Information:  
Division: Science & Math  
Department: Biology  
Course ID: BIOL 270  
Course Title: Microbiology  
Units: 5  
Lecture: 3 hours  
Lab: 6 hours  
Prerequisite: BIOL 250 or BIOL 260 or BIOL 261 or BIOL 201 or BIOL 102;  
and CHEM 101  
Departmental Advisory: Reading skills at the 12<sup>th</sup> grade level and ENGL 101  
entry level writing skills.
- B. Catalog Description:  
A formal introduction to the fundamental principles of microbiology and immunology. Attention is given to the morphology, control, metabolism and genetics of microorganisms. Emphasis is placed on the pathogenesis of and immunity to infectious diseases.
- C. Schedule Description:  
A formal introduction to the principles of microbiology and immunology. The pathogenesis of and immunity to infectious diseases is covered.

**II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One**

**III. EXPECTED OUTCOMES FOR STUDENTS:**

Upon successful completion of the course, the student should be able to do the following:

- A. recognize important contributors in the history of microbiology and immunology
- B. identify the five kingdoms of life
- C. compare and contrast structure and function of eukaryotic and prokaryotic cells and variation of each
- D. illustrate virus structure and explain how components function
- E. identify basic metabolic pathways in microbial metabolism
- F. formulate a microbial media and incubation plan to select and differentiate an organism from a mixed community
- G. design a logical therapy plan for treatment of infectious case scenarios and a plan for the prevention of infection or contamination
- H. diagram activities of DNA replication, recombination and translation
- I. identify the tools of the genetic engineer and applications
- J. construct a "basic" immune response to any given microbial antigen
- K. read and critically evaluate medical case scenarios on infectious disease
- L. apply the principles of microbiology to daily activities at work and at home
- M. write an organized scientific report to include data presentation and analysis
- N. apply characteristics of a bacterium toward its identification using Bergey's Manual
- O. produce and interpret a dichotomous flowchart
- P. develop data and evaluate its validity
- Q. use sterile techniques for preventing contamination
- R. demonstrate mastery in the use of a light microscope

**IV. CONTENT:**

- A. Lecture
1. historical figures are introduced throughout the course where subject warrants historical explanations
  2. classification
    - a) five kingdom vs. three domain systems
    - b) characteristics of each group
    - c) hierarchy of classification
    - d) classification criteria and methods of classification
  3. comparative analysis of prokaryotic and eukaryotic cell structures, structural functions and chemical composition; viral structure and chemical composition
  4. analysis and integration of catabolic and anabolic metabolic pathways of bacteria
    - a) aerobic respiration
    - b) anaerobic respiration
    - c) fermentation
    - d) Entner-Douderoff pathway
    - e) Pentose-phosphate pathway
    - f) Catabolic activity on proteins, lipids
    - g) Synthesis of proteins, lipids, N.A., complex sugars
  5. principles of microbial growth
    - a) laboratory requirements and considerations for maintenance of viral and bacterial cultures
    - b) bacterial and viral growth determinations
    - c) fungal, helminthes, protozoa growth considerations and replication patterns
    - d) bacteriophage replication to include both lytic and lysogenic phases
    - e) animal virus replication patterns
  6. control of microbes
    - a) physical methods of control
    - b) chemical methods of control
    - c) antimicrobials and their methods of action
  7. microbial genetics
    - a) the genetic code, genes, controls
    - b) DNA replication
    - c) protein synthesis
    - d) recombination
  8. recombinant DNA and biotechnology
    - a) tools and techniques of the genetic engineer
    - b) cloning
    - c) DNA sources
  9. host defenses
    - a) structure of organs of the immune system
    - b) cells host defenses
    - c) innate host defenses – chemical & physical barriers
    - d) the immune response
      - i. B and T lymphocytes and sub-populations
      - ii. antigen presenting cells
      - iii. molecular immunology
      - iv. immunogenetics
      - v. CMI & humoral immunity pathways
      - vi. Immune disorders

10. medical microbiology – viral, bacterial, helminthes, protozoa and fungal diseases
  - a) pathogenesis
  - b) epidemiological considerations
  - c) diagnostics
  - d) treatment and preventive measures
- B. Laboratory
  1. microscopy
    - a) function of the parts of the compound brightfield microscope
    - b) proper care of the microscope
    - c) proper focus technique
  2. survey of microorganisms – prepared slides and student slides of living material will be used to examine microorganism structure; packages of life cycles and discussion of disease processes complement the slide work on pathogenic organisms. This section of the lab provides practice with the use of the microscope and acclimates the student to observing for detail. Skill in microscope use prepares them for identifying the smallest of microorganisms visible by the compound microscope, the bacteria.
    - a) microscopic invertebrates, protozoa, fungi and bacteria microscopic morphology – drawing and labeling of various structures
    - b) classification systems – slide work is organized into the 5 kingdom system and outlined for students in handouts on each kingdom of microorganisms surveyed
    - c) parasitic life cycles – pathogenesis and diagnostics are discussed
  3. microscope slide techniques – each of the following techniques are applied and student prepared slides examined microscopically for various structures of bacteria
    - a) negative stain
    - b) smear preparation
    - c) simple, capsule, gram, acid fast, spore stain techniques
    - d) motility determinations
  4. culture techniques –introduction to specific laboratory equipment such as colony counters, micropipettors, spectrophotometers
    - a) pure culture techniques
    - b) anaerobe cultivation
    - c) bacterial population counts
    - d) media preparation
  5. control of microbial growth – Selected experiments will be written into a formal report where student will calculate, analyze and interpret the data from performed experiments and come to some conclusion on the effect of a mechanism of control of bacterial growth applicable to daily life; introduction to methods of testing and control used commercially.
    - a) temperature effects
    - b) pH effects
    - c) UV light effects
    - d) effects of disinfectants
    - e) effects of antiseptics
    - f) antimicrobial effects
    - g) oligodynamic action
    - h) effectiveness of hand washing
  6. identification of an unknown bacterium – An independent study where an unknown bacterium will be tested and the results compared to *Bergey's* to come to some conclusion as to its identification; a written report and lab journal entries will follow the conclusion of the independent study

- a) stocks
- b) morphological and cultural characteristic determinations
- c) biooxidation , hydrolysis and other miscellaneous testing
- d) *Bergey's Manual*
- e) Journal reporting, dichotomous flowchart production
7. microbiology of food and water
  - a) examination of environment water samples, MPN
  - b) bacterial counts of food
8. medical microbiology – Students will test themselves for carrier status of various species; class data will be used to derive carrier rate statistics; introduction of specialized media for selection of various pathogens.
  - a) synthetic epidemic
  - b) the *Staphylococci*
  - c) the *Streptococci*
  - d) gram negative pathogens
9. immunology applications in diagnostics – Introduction to specific equipment for electrophoresis, serological rotators and appropriate immunological reagents
  - a) agglutination tests, VDRL
  - b) precipitation reactions – gel and interface techniques
  - c) gel immunoelectrophoresis

**V. METHODS OF INSTRUCTION:**

A. Lecture:

1. Lecture complimented with audio visual materials in the form of video, video disk and computer generated animations
2. In class small group problem solving discussions
3. In class written assignments.
4. Individual consultations are available for questions specific to material and for study and exam taking skills.
5. Computer assignments utilizing a CD (in learning center) to clarify specific topics covered in lecture best illustrated by animation.

B. Laboratory:

1. Introductory lecture and demonstrations precede hands-on experiments performed by the students. Some experiments are arranged so students can work in pairs or larger teams and others are designed for students to work individually.
2. Individual assistance with technique is provided as the need arises.
3. Collection, analysis and discussion of class data follows completion of experiments.
4. Lab reports vary, including scientific drawings, objective questions, critical thinking essay questions, data analysis, mathematical calculations and graphing

**VI. TYPICAL ASSIGNMENTS:**

- A. Outline the catabolic pathway for the digestion of this (drawn) triglyceride. Detail the products of each step and derive an answer for the total amount of ATP's produced.
- B. An experiment required the inoculation of media to 8 different types of exposures. Class data is collected on the board for density (number of colonies) and diversity (number of types of colonies). Multiple sampling requires the averaging of data for each exposure type. Calculate averages and develop a table with the data illustrating the results for both density and diversity. Write a discussion to include your analysis of the data and draw conclusions.
- C. Draw and label the parts of the prokaryotic and eukaryotic cells. List the structures of each cell type and compare and contrast functions of each.

- D. Students are given a medical case scenario including signs and symptoms. Either individually or in small groups, students are to propose a presumptive diagnosis and steps to take for a definitive diagnosis, explaining their choices

**VII. EVALUATION(S):**

A. Method of Evaluation

1. Examination
2. Written assignments
3. Problem solving worksheets
4. Lab Reports
5. An unknown bacterium project and report in lab

Sample questions:

- a) *E. coli* growing in TSB gets its energy and carbon from peptones. Outline its pathway for metabolizing the peptones to make the cell wall.
- b) Which pattern of nutrition can use CO<sub>2</sub> and H<sub>2</sub> for energy?
- c) The binding of a cofactor to the allosteric site of a conjugated enzyme distorts the shape of the enzyme and blocks its function. True or False? Explain.
- d) Which group of microorganisms is most likely to spoil a freshwater trout preserved with salt? Explain.
- e) Using the data given (table of optical density matching temperatures of incubation), graph a curve representing the effect of temperature on the growth of this bacterium and identify its optimum temperature of growth.
- f) What is the concentration of a suspension made with 2 ml of a culture with the concentration of 2X 10<sup>6</sup> organisms/ml added to 4 ml of broth? Show your work.

B. Frequency of Evaluation

1. Five lab exams
2. Four lecture exams
3. Lab report sheets as experiments are completed – varies from semester to semester; ranges from approximately 23 to 28.
4. One Laboratory Unknown Project Report
5. Written lecture assignments vary from semester to semester; usually between 5 and 9 out of class assignments

**VIII. TYPICAL TEXT(S):**

Tortora, Gerard J., Berdell R. Funke, and Christine L. Case. Microbiology – An Introduction. 6<sup>th</sup> Edition. Menlo Park, California. Addison-Wesley-Longman, Inc. 1998.  
Lim, Daniel. Microbiology. 2<sup>nd</sup> Edition. Boston, Massachusetts. WCB/McGraw-Hill. 1998.

Talaro, Kathleen Park, and Arthur Talaro. Foundations in Microbiology. 3<sup>rd</sup> Edition. Boston, Massachusetts. WCB/McGraw-Hill. 1999.

Black, Jacquelyn. Microbiology - Principles and Explorations. 4<sup>th</sup> Edition. New York, New York. Wiley, 1999

Benson, Harold. Microbiological Applications. Short Version, 7<sup>th</sup> Edition. Boston, Massachusetts. WBC/Mcgraw-Hill. 1998.

Narrell, Stephen A. and Karen E. Messley. Microbiology – Laboratory Manual, Principles and Applications. Upper Saddle river, New Jersey. Prentice Hall. 1997

Recommended Texts:

Leboffe, Michael J. and Burton E. Pierce. A Photographic Atlas for the Microbiology Laboratory. 2<sup>nd</sup> Edition. Englewood, Colorado. 1999.

**IX. OTHER SUPPLIES REQUIRED OF STUDENTS:** lab coat; colored pencils; NCR paper; 3 ring binder; filler paper; dividers; black Sharpie (permanent ink marker.)