Lecture Contact Hours: 48-54; Homework Hours: 96-108;
Laboratory Contact Hours: 96-108; Homework Hours: 0;
Total Student Learning Hours: 240-270

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

BIOLOGY 152 – PARAMEDICAL MICROBIOLOGY

3 hours lecture, 6 hours laboratory, 5 units

Catalog Description
Introduction to the major groups of microorganisms and the diseases they cause. Emphasizes the concepts and techniques relevant to the student entering paramedical professions: identifying and handling bacteria, basic principles of immunology, medical microbiology and epidemiology. Principles of microbial physiology, genetics, growth and microbial control are discussed. This course satisfies the introductory microbiology requirement needed by students majoring in nursing and other paramedical fields leading to a B.S. or B.A. degree.

Prerequisite
"C" grade or higher or "Pass" in BIO 130 and 131, or equivalent

Recommended Preparation
"C" grade or higher or "Pass" in CHEM 102 or equivalent

Entrance Skills
Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:
1) Outline the methods and activities performed by scientists in solving problems in biology, and identify limitations to the types of questions that can be answered scientifically.
2) Distinguish among statements that describe a hypothesis, a theory or natural law.
3) Determine whether an entity is living based upon a description of its properties.
4) Classify an organism into the appropriate domain and kingdom based upon its characteristics and justify the reasons for placing it there.
5) Explain how the various components of matter can be organized into biological molecules.
6) Compare and contrast the structures, roles and interrelationships of biological molecules including nucleic acids, proteins, carbohydrates and lipids.
7) Given a single stranded DNA molecule, create the complementary strand of the double helix, transcribe one of the strands into RNA, and translate into a peptide.
8) Describe the relationship between structure and function in proteins and the implications of changes in structure on the operation of a cell.
9) Construct a model of a prokaryotic and a eukaryotic cell that includes the various sub-cellular structures and describes their inter-relationships and possible origins.
10) Demonstrate a model that describes the chemical composition and architecture of a cell membrane and predict the flow of molecules across the membrane based on osmolarity and opposite sides of the membrane.
11) Compare and contrast the characteristics of prokaryotic and eukaryotic cells.
12) Develop hypotheses, design experiments, organize and critically analyze data to show relationships and conclusions. Communicate results of investigations.
13) Determine the proper number of significant figures in a calculated number.
14) Determine the number of each type of subatomic particle in an atom from the periodic table.
15) Calculate concentrations of solutions.
16) Write chemical formulas for molecules using information in the periodic table.
17) Write balanced chemical equations for ordinary chemical processes.

Course Content

1) Lecture:
   a. History of microbiology
   b. Microscopy and staining
   c. Classification and survey of the microbial world
   d. Prokaryotic and eukaryotic cell structure
   e. Nature of viruses
   f. Nutrition and cultivation of microorganisms
   g. Physiology of microorganisms including respiration, fermentation, photosynthesis and biosynthesis
   h. Growth of microorganisms including nutrition, measurement and stages of growth and factors influencing growth
   i. Control of microorganisms including physical methods, chemical methods (disinfectant and antiseptics) and biochemical methods (antibiotics and chemotherapeutic agents)
   j. Introduction to microbial genetics and drug resistance
   k. Principles of epidemiology
   l. Factors of infection and virulence: invasiveness and toxigenicity
   m. Body defense mechanisms
   n. Innate immunity: mechanical, chemical, phagocytosis, and inflammation
   o. Adaptive immunity: the immunological response: antigens, antibodies, immunological-serological reactions, the immune response, hypersensitivity and immune diseases
   p. Infectious diseases of humans
   q. Bacteria of the skin, eye, ear, mouth, respiratory, gastrointestinal, urogenital, circulatory and nervous systems
   r. Fungal: superficial and systemic
   s. Parasitology: protozoan, flatworms, roundworms
   t. Basic virology
2) Laboratory: In addition to examining and illustrating many of the topics discussed in lecture, students will:
   a. Use and care for a compound, binocular microscope
   b. Perform and interpret basic bacterial stains
   c. Perform standard methods of aseptic technique, inoculation procedures, and isolation of pure cultures
   d. Perform and interpret a variety of biochemical/physiological tests used to identify bacterial species
   e. Employ standard dilution procedures and calculations to enumerate bacterial cultures
   f. Employ and interpret other standard microbiological laboratory procedures

Course Objectives

Students will be able to:

1) Discuss the impact of historical events on our knowledge and understanding of microbiology, the importance of microorganisms to humans, and the role of microorganisms in nature.
2) Explain how microbes (including viruses) are classified and the role of microbiology in public health and medicine.
3) Describe the structure and growth characteristics of prokaryotic cells, eukaryotic cells and viruses, and the impact of nutrition and environmental factors (temperature, pH, etc.) on their growth.
4) Explain the major physiological features of microorganisms including respiration, fermentation, photosynthesis and biosynthesis.
5) Describe the function and impacts of microorganisms on the human immune system, fundamental concepts of epidemiology, and mechanisms of microbial drug resistance in order to understand the relationships between microorganisms and human disease.
6) Describe the significance of the bacteria, fungi and parasites of the skin, eye, ear, mouth, respiratory, gastrointestinal, urogenital, circulatory and nervous systems in humans.

7) Describe the construction and appropriate application of a variety of microscopes including the binocular compound microscope, transmission electron microscope, and scanning electron microscope.
8) Demonstrate correct use and care of the compound binocular microscope.
9) Correctly prepare wet mount and hanging drop slides and identify common microscopic organisms including bacteria, protists and fungi.
10) Prepare, stain and correctly interpret bacterial smears including, at a minimum, simple stains such as methylene blue, gram stain, acid-fast stain, endospore stain.
11) Demonstrate correct use of aseptic techniques and safety practices in a microbiology laboratory.
12) Demonstrate the ability to solve problems related to medical microbiology through the ability to cultivate, isolate in pure culture, test, identify and quantify a variety of aerobic and anaerobic microorganisms of human medical significance.
13) Explain, perform, evaluate and interpret a variety of enzymatic tests used in microbial identification including amylase, catalase, lipase, cytochrome oxidase, cysteine desulfhydrase, urea hydrolysis, nitrate reduction and proteolysis of gelatin.
14) Perform and interpret tests for microbial fermentation of carbohydrates, IMViC tests and serological tests.
15) Explain and demonstrate correct utilization and interpretation of selective and differential media to distinguish between bacteria.
16) Explain the mechanism of action, evaluate and interpret the effects of a variety of disinfectants, antiseptics and antibiotics on microbial growth and survival.
17) Demonstrate the ability to correctly use and interpret results of a commercial multi-test system such as API 20E or Enterotube.

Methods of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Quizzes and exams that measure students' ability to recognize, explain and provide examples of the concepts, principles and techniques associated with microorganisms.
2) Technique demonstrations that measure students' ability to perform a variety of laboratory techniques including, but not limited to, preparation of stained specimens and isolation of pure cultures from a mixed population.
3) Independent and team laboratory projects that require students to formulate a strategy for testing, assessing and reporting data that utilizes skills and techniques learned in both the lecture and laboratory.
4) Laboratory reports that demonstrate research, writing and critical thinking skills.

Special Materials Required of Student

1) Laboratory coat, hip or knee length or long-sleeved smock
2) Microscope slides
3) Cover slips
4) Glass-marking pencil or pen (waterproof)
5) Lens paper, bibulous paper
6) Inoculating loop

Minimum Instructional Facilities

1) Smart classroom with overhead projector
2) Standard microbiology laboratory with preparation support facilities including autoclave and glassware washing facilities
3) Refrigerators, high and low temperature incubators and water baths
4) Bacterial stock culture transfer and storage facilities
5) Microbiological safety hood for work with pathogenic microorganisms

Method of Instruction
1) Lecture and discussion
2) Laboratory (individual and small groups)
3) Demonstration
4) Group discussion, interactive problem solving

Out-of-Class Assignments
1) Reading and written assignments that require students to identify and describe key microbiological concepts or solve problems
2) Research projects that require students to solve a microbiological scenario, locate relevant source material in the microbiological literature, and analyze the topic in a written or oral presentation

Texts and References
1) Required Lecture Text (representative examples):
   a. Tortora, Funke and Case. *Microbiology, An Introduction*. 14th edition. Pearson, 2024.
   b. Nester, Anderson, Roberts and Nester. *Microbiology, A Human Perspective*. 10th edition. McGraw Hill, 2022.
2) Required Laboratory Manual (representative example):
   a. Leboffe, Michael & Burton Pierce. *Microbiology Laboratory Theory & Application*. (Brief Edition) 3rd edition. Morton Publishing Company, 2016.
3) Supplemental: None

Student Learning Outcomes
Upon successful completion of this course, students will be able to:
1) Isolate, determine morphology and staining characteristics, and perform biochemical tests to identify to the level of Genus and species unknown bacterial isolates of medical significance.
2) Explain the major structural and physiological features of microorganisms and the manner in which these organisms are classified.
3) Research and present information regarding diseases caused by human pathogens.
4) Describe the key factors that impact the growth of microorganisms, and explain the mechanism of action, evaluate and interpret the effects of a variety of disinfectants, antiseptics and antibiotics and physical control methods on microbial growth and survival in a healthcare environment.
5) Describe the ways in which the human body fights off disease.