NOVA COLLEGE-WIDE COURSE CONTENT SUMMARY
BIO 150 – MICROBIOLOGY FOR HEALTH SCIENCES (4 CR.)

Course Description

Focuses on the general characteristics, cellular structure, and metabolism of microorganisms. Emphasizes microbial relationships with individual and community health. Includes impact of microbes on human health and disease, microbial pathogenicity, identifying and managing infectious diseases and controlling microbial growth, healthcare associated infections and epidemiology. Studies aseptic culturing techniques with hands-on experience in safe microbiology practices. Lecture 3 hours. Recitation and laboratory 3 hours. Total 6 hours per week.

General Course Purpose

Biology 150 serves as an introductory science course that exposes students majoring in Health Sciences to the existence and impact of microorganisms inside and outside the human body system on human health. The course has both lecture and laboratory components. Both these components will emphasize on giving a firm understanding to healthcare practitioners about the aseptic techniques that would assist in limiting the spread of infectious diseases.

Course Prerequisites/Corequisites

Prerequisite: BIO 101 or BIO 141

Course Objectives

Upon completion of this course, the student should be able to:

Scientific Literacy

- Evaluate different perspectives, opinions, and statements about biological issues in terms of their logic, content, scientific merit, and biases.

Quantitative reasoning

- Perform accurate calculations, interpret scientific data and graphs, and use results to support conclusions.
- Analyze data collected through experiments in lab. Present and discuss the findings and conclusions derived from data, with chart/spreadsheet and graphs.

Critical thinking

- Discriminate among degrees of credibility, accuracy, and reliability of inferences drawn from given data, determine whether certain conclusions or consequences are supported by the information provided and use problem solving skills.

Introduction to Microorganisms: History of Microbiology, Survey of various Prokaryotic and Eukaryotic and acellular microorganisms, Comparing cell organelles of prokaryotic Vs. eukaryotic cells, Foundations of biochemistry, and macromolecules

- Chart the timeline of the history of Microbiology and how it developed as a science.
- Identify key findings that led scientists to understand how microorganisms shape our planet, our health and society.
- Discuss common features of living things and describe microbes that are non-cellular.
- Differentiate between bacteria, archaea, and eukaryotes.
- Review biological chemistry and the building blocks of living things.
- Recognize the beneficial role of microbes in the food and biotechnology industry.
- Outline the principle concepts of microbial genetics and recombinant DNA technology
- Recognize the role and constitution of a healthy microbiome and the ubiquitous existence of microbes.
- Identify various beneficial, harmful and neutral interactions that human host have with microbes in nature.

Microscopy and Identification Techniques: Aseptic techniques, Microbiological culture media, Isolation techniques, Principles of microscopy, Staining techniques and Smear preparation and specimen observations under compound microscope

- Explore various types of microscopes and microscopy techniques
- Identify the importance and usage of aseptic techniques
- Discuss the growth of microbes in various selective and differential media
- Discuss various simple and differential staining techniques
- Identify various isolation techniques
- Recognize the clinical usage of staining techniques and growth media in identifying the unknown microorganisms from a patient's sample.
- Recognize the clinical usage of rapid test kits and molecular and serological methods

Microbial Metabolism, Nutrition and Growth: Structure and function of enzymes, Energy flow through the cell, Compare and contrast between aerobic respiration, anaerobic respiration and fermentation, Effect of various environmental factors and nutrients on microbial growth, Study of bacterial growth curve and its significance

- List various sources from which microbes obtain nutrients and energy.
- Differentiate between catabolism and anabolism
- State the role of enzymes in metabolism
- Differentiate between aerobic respiration, anaerobic respiration and fermentation metabolic pathways and relate these metabolic reactions to microbial identification tests (ex. Phenol red broth assay)
- Classify microorganisms based upon growth conditions
- Interpret bacterial growth curve phases and identify its usage in industrial microbiology as well as in clinical microbiology
- Classify microorganisms based upon growth conditions
- Draw a typical growth curve and describe its phases

Controlling Microbial Growth: Use of physical methods to control microbes, Use of chemical agents to control microbial growth, Survey of the major groups of chemotherapeutic antimicrobials: antibacterial, antifungal, antiprotozoan, antihelminthic, and antiviral drugs, Growing problem of antibiotic resistance

- List and discuss various physical and chemical means of microbial growth control
- Discuss role and mechanism of action of various antimicrobial drugs
- Identify clinical considerations in prescribing antimicrobials
- Discuss underlying molecular mechanisms behind antibiotic resistance.
- Identify how microbes receive resistance genes via horizontal gene transfer.
- Discuss various alternative treatment methods to overcome drug resistance.

Microbial pathogenicity and the role of microbes in infectious diseases, Epidemiology and Immunology: Human microbiome, Microbial pathogenicity, Charting the progress of infection in human host, Role of CDC and WHO Types of Epidemics, Types of immune responses and Immune system components

- Recognize the role of Koch's postulates in identifying the etiology of certain infectious diseases
- Define the human microbiome and its importance with regards to health and development.
- Discuss the stages of the course of an infection.
- Discuss epidemiology and types of Epidemics based on the transmission patterns of diseases in a community.
- List nationally notifiable diseases as defined by CDC.
- Chart a broad overview of non-specific and specific immunology.
- Discuss immunization plan followed by the Commonwealth of Virginia.
- Explain the use of vaccines in promoting herd immunity.
- Explore various infectious diseases caused by a variety of microbes like Gram-Positive bacteria, Gram-Negative bacteria, atypical bacteria, viruses, fungi, prions, helminths and protozoa.

- Provide the following for the most common diseases in human body systems caused by microorganisms
    - Causative organism
    - Occurrence
    - Reservoir
    - Mode of transmission
    - Incubation period
    - Period of communicability
    - Method of control including specific treatment

Lab skills and competencies

- Use aseptic technique in handling microorganisms
- Demonstrate the proper use of PPE and code of conduct for Biosafety Level-2.
- Apply standard microbiological techniques and scientific reasoning to the isolation, cultivation, and identification of microorganisms
- Perform physiological and biochemical tests and interpret the results
- Demonstrate the use of staining techniques and microscopy to view microorganisms
- Grow microbes in various selective and differential media.
- Proficiently use a compound light microscope
- Demonstrate the correct handling and labelling of media, and disposal of trash
- Draw conclusions from charts and graphs
- Communicate and collaborate with lab partners
- Document experimental results, protocols, conclusions

Major Topics to be Included

- Scientific Literacy
- Quantitative reasoning
- Critical thinking
- Introduction to Microorganisms: History of Microbiology, Survey of various Prokaryotic and Eukaryotic and acellular microorganisms, Comparing cell organelles of prokaryotic Vs. eukaryotic cells, Foundations of biochemistry, and macromolecules
- Microbial Genetics
- Microscopy and Identification Techniques: Aseptic techniques, Microbiological culture media, Isolation techniques, Principles of microscopy, Staining techniques and Smear preparation and specimen observations under compound microscope
- Microbial Metabolism, Nutrition and Growth: Structure and function of enzymes, Energy flow through the cell, Compare and contrast between aerobic respiration, anaerobic respiration and fermentation, Effect of various environmental factors and nutrients on microbial growth, Study of bacterial growth curve and its significance
- Controlling Microbial Growth: Use of physical methods to control microbes, Use of chemical agents to control microbial growth, Survey of the major groups of chemotherapeutic antimicrobials: antibacterial, antifungal, antiprotozoan, antihelminthic, and antiviral drugs, Growing problem of antibiotic resistance
- Microbial pathogenicity and the role of microbes in infectious diseases, Epidemiology and Immunology: Human microbiome, Microbial pathogenicity, Charting the progress of infection in human host, Role of CDC and WHO Types of Epidemics, Types of immune responses and Immune system components
- Microbial diseases of the skin, eyes, nervous system, cardiovascular system, lymphatic systems, respiratory system, digestive system, urinary system, reproductive system
- Lab skills and competencies