MCB 2000 & MCB 2000L

Microbiology with Lab

Course Description

MCB 2000	**Microbiology**	**(3) P**
MCB 2000L	**Microbiology Laboratory**	**(1) P**

This is a microbiology course intended for science, engineering, biotechnology and pre-professional majors. It includes the study of bacterial genetics, metabolism, industrial applications of microbiology, properties of selected organisms and their diseases, and an introduction to molecular biological techniques as they relate to microbiology. The course earns General Education credit under the Biological Sciences category for which successful students will demonstrate the skills necessary to understand and apply scientific concepts and reasoning, including the analysis and interpretation of various types of data.

Suggested Pre-requisite: BSC 2010 or its equivalent.
Co-requisite: MCB 2000L must be taken concomitant with MCB 2000.

Rationale

This course helps support the college mission of providing the highest quality post-secondary education, leading to the Associate of Arts and Associate of Science degrees, and further to a baccalaureate degree. Specifically, this course addresses students pursuing science, engineering, biotechnology and pre-professional programs of study. MCB 2000 will concentrate on bacterial genetics, metabolism and molecular biology. Ultimately, this course will help students develop a vocabulary sufficient for successful technical communication, laboratory skills which highlight conceptual relationships and connections, and analytical problem solving skills.

Impact Assessment

MCB 2000 is designed as a microbiology class for science majors. Success in the course is highly dependent on concepts delivered in BSC 2010 as the foundation provided by core biology is essential to understanding microbiology. This also allows students to spend time exploring subjects that relate to biotechnology and industrial microbiology, offering some insight into career opportunities in this field. The laboratory experience is intended to complement the lecture material, thus the lecture and lab courses must be taken together to gain the most from the experience.

General Education Learning Outcome

Understand scientific concepts and reasoning and analyze and interpret various types of data.

SF Scientific Reasoning Critical Attributes

- Deductive and inductive inferences,
- Controlling variables,
- Use of the scientific method (gather, analyze, and synthesize data relevant to a problem),
- Application of a model to a new situation,
- Interpretations based on fundamental theories,
- Interpretation of data in both tabular and graphical form, and
- Application of specialized knowledge to a different or larger context.

Broad Course Objectives

This course supports the departmental goal of providing a foundation in the sciences for students aspiring to science, engineering, biotechnology and pre-professional majors. As such, concepts relating microbiology to other science disciplines will be highlighted. Students will be expected to demonstrate proficiency in these concepts, in concepts related to microbiology, in collecting and analyzing data, and in the development of laboratory skills that are applicable to most disciplines in science today.

In order to achieve these objectives, the instructor will strive to:

1. extend students' ability to apply mathematics and math reasoning to microbiological situations;
2. enable students to develop their critical reasoning skills;
3. Include technology related skills in the assignments;
4. expand students' experience with characteristic properties and biochemical tests;
5. extend students' vocabulary of science concepts and terms;
6. illustrate the methodology of scientific inquiry;
7. provide perspective on the professional activities of science practitioners; and,
8. relate concepts in microbiology to other science disciplines.

Course Outline with Specific Objectives

The successful student should be able to master the skills and activities listed under each major topic heading.

1. Basic concepts of Microbiology
    a. Prokaryotes-classification
    b. Eukaryotes-Parasites and Fungi
    c. Growth and Reproduction
    d. Cell Structures and Arrangements
    e. Culture Media
    f. History
    g. Organic compounds of living organisms
    h. Microscopy
    i. Laboratory Safety

At the end of this section, the student will be able to:

- Classify organisms as prokaryotes and eukaryotes according to cell structures.
- Compare and contrast eukaryotes known to cause disease in various species.
- Compare types of microscopy according to the appearance of observed objects.
- Explain the bacterial growth curve for a typical bacterial population.
- Name classification schemes and use bacterial nomenclature appropriately.
- Identify notable figures in microbiology with their accomplishments.
- Identify functional groups in molecules that govern molecular behavior.
- Define parts of the bacterial cell with regards to chemical structure and function.
- Characterize the major organic molecules in living things (e.g. protein, lipids)
- Discuss the different types of chemical bonding possible in any given molecule.
- Recall the appropriate safety information (e.g. fire extinguishers, safety shower, and fire alarm locations) in the laboratory.
- Wear the appropriate personal protective equipment in the laboratory.
- Name the parts of the microscope and use the microscope effectively in the laboratory.

- Define incubation conditions for media components and discuss their relevance to maintaining cultures in the laboratory.
- Streak a media plate for isolation and obtain isolated colonies in the laboratory.
- Perform a gram stain and determine the gram reaction of an unknown organism in the laboratory.
- Classify bacteria according to shape and staining characteristics in the laboratory.
- Identify factors that can affect bacterial growth and predict their impact in the laboratory.

2. Metabolism
    a. Enzymes and chemical reactions
    b. Catabolism of glucose
    c. Respiration and glycolysis
    d. Krebs Cycle
    e. Anaerobic Metabolism

At the end of this section, the student will be able to:

- Discuss the role of enzymes in metabolism.
- Identify factors that regulate enzyme activity.
- Identify molecules that are potential energy sources.
- Compare and contrast autotrophs and heterotrophs in their use of energy.
- Discuss the importance of energy extraction from an environment.
- Identify the role of glycolysis and the Krebs Cycle in cellular respiration.
- Compare and contrast anabolism and catabolism.
- Differentiate anaerobic respiration and fermentation by their final electron acceptors.
- Define feedback inhibition and give examples.
- Identify the role of ATP in metabolism
- Compare and contrast metabolic pathways according to location, reactants and products.
- Perform biochemical tests in the laboratory and interpret the results.
- Use aseptic techniques in all inoculation procedures in the laboratory.

3. Bacterial Genetics/genomics
    a. Bacterial DNA
    b. DNA Replication
    c. Protein Synthesis
    d. Mutation
    e. Identifying mutants

At the end of this section the student will be able to:

- Compare and contrast prokaryotic and eukaryotic chromosomes
- Identify the molecules in bacterial replication.
- Identify the enzymes necessary for DNA synthesis to occur.
- Discuss how mutations occur and the mechanisms involved in correction.
- Understand the flow of genetic information within the bacterial cell.
- Discuss the role of plasmids in bacterial resistance to antibiotics.
- Discuss the importance of cell structures in bacterial conjugation.
- Discuss applications of genetic engineering in bacteria.
- Demonstrate transformation of recipient cells using antibiotic resistance plasmids in the laboratory.
- Perform polymerase chain reaction in the laboratory.

4. Virology
    a. Structure and function of viruses
    b. Viral Replication
    c. Gene therapy using viruses
    d. Viral Diseases
    e. Prions

At the end of this section the student will be able to:

- Identify the components and cellular structures of a virus.
- Identify the steps in viral replication.
- Compare and contrast viral replication for bacteriophages and animal viruses.
- Define the terms prophage and latency.
- Compare and contrast viral families according to DNA/RNA type and disease.
- Identify drugs used for treating viral infections and the mode of action.
- Discuss the evidence supporting a correlation between viruses and cancer.
- Identify the differences between prions and viruses.
- Discuss the use of viruses in gene therapy.
- Discuss techniques used to cultivate and detect bacteriophage and viruses in the laboratory.

5. Control of Microorganisms
    a. Disinfectants and Antiseptics
    b. Chemotherapeutic Agents
    c. Antibiotic Assays and Resistance
    d. Sterilization

At the end of this section, the student will be able to:

- Identify various chemicals as disinfectants or antiseptics.
- Discuss the role of time in the control of microorganisms.
- Identify the mode of action for several antibiotic classes.
- Discuss the mechanism of action for various chemotherapeutic agents
- Compare and contrast bactericidal and bacteriostatic chemotherapeutic agents.
- Perform antibiotic assays in the laboratory and identify bacterial resistance and susceptibility.
- Use the autoclave in the laboratory and explain how it works.

6. Infection and Disease
    a. Diseases of the Respiratory Tract
    b. Sexually Transmitted Diseases
    c. Disease associated with Food and Water
    d. Arthropod Mediated Diseases
    e. Miscellaneous Bacterial Disease
    f. The Immune System
    g. Serology

At the end of this section the student will be able to:

- Name bacterial organisms associated with diseases of the different body systems.
- Compare and contrast bacterial diseases of different body systems, noting mode of transmission, organs affected and typical treatment strategies.

- Discuss the differences between intoxications and infections and note the organisms associated with each.
- Define the terms antibody and antigen.
- Compare the primary and secondary immune responses.
- Perform techniques used to identify bacteria and describe how they work.
- Name the cell types and organs in the immune system.
- Identify immune system disorders.
- Discuss specimen collection and transport for different body systems.
- Name parasites/protozoa associated with diseases of the different body systems.
- Perform laboratory techniques used in the identification of clinically relevant microorganisms.
- Identify cells that are important to the immune system in the laboratory.

7. Microbiology and Industry
    h. Food Microbiology
    i. Environmental Microbiology
    j. Industrial Microbiology
    k. Molecular Biology/Biotechnology

At the end of this section, the student will be able to:

- Discuss techniques used to assure quality in foods.
- Discuss techniques used to ensure food safety.
- Name critical control points in food risk reduction.
- Discuss osmotic pressure, lyophilization, and radiation as techniques for food preservation.
- Identify three examples of biotechnology in food production.
- Discuss the conditions necessary for food spoilage and relate these conditions to the underlying chemistry.
- Name the cycle of elements in the environment that are influenced by microorganisms.
- Define biofilms and discuss their relevance in health care and in the environment.
- Identify the steps in sewage treatment and water purification.
- Discuss the use of microbial products in bioremediation.
- Discuss the use of microorganisms in genetic engineering.
- Name industry products made from microorganisms.
- Perform laboratory techniques used in water and food testing.

Evaluation

Student progress will be evaluated using 3-5 examinations, quizzes, and a comprehensive final. Exam questions will include short answer, multiple choice, and calculations. The laboratory portion of this course will be evaluated on the basis of adherence to safety procedures, the maintenance of a laboratory notebook, laboratory worksheets and reports. Students will take a laboratory midterm and final exam. In as much as the laboratory assignments require the students to demonstrate their scientific reasoning skills, the grade they earn in the laboratory portion of the course is also indicative of the extent to which they understand and are able to apply these skills (GELO assessment).

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