Madison College

20806273  University Medical Microbiology

Outline of Instruction

Course Information

Description  University Medical Microbiology addresses pathogenic and normal flora microbes (bacteria, fungi, parasites, and viruses), their structure and function, metabolism, nutrition, genetics, growth and their relationship to humans and the environment. This course examines human infectious disease including general diagnosis and treatment, transmission, host defense mechanisms, and processes used to control the growth and spread of infectious agents. This course includes an introduction to standard techniques and procedures used in the microbiology laboratory.

Instructional Level  Associate Degree

Total Credits  5.00

Total Hours  116.00

Target Population

This course is designed for Associated Degree and Technical Diploma students in Allied Health Programs requiring four credits of Microbiology. This includes students in the following Madison College health occupation areas: Dental Hygiene, Respiratory Care, Clinical Laboratory Technician, and Associate Degree Nursing and may include others as well. In addition, this course may apply to college-transfer students in programs/courses accepted by the University of Wisconsin system or other colleges and universities. Please verify transferability with other institutions.

Pre/Corequisites

Prerequisite  Completion of Anatomy & Physiology 1 20-806-207 or General Anatomy & Physiology 20-806-206 with a grade of C or better is strongly recommended.

Prerequisite  English 1 20-801-201 or Written Comm 10-801-195 or College Reading Strategies 10-808-101 or Minimum COMPASS Score: Reading 80.

Course Competencies

1. Explore the history and scope of the field of microbiology

   Assessment Strategies through a written product
   by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

   Criteria
Performance will be successful when:
written product includes a description of the range of organisms studied by microbiologists
written product includes relating historical events to the current understanding of microbiology
written product includes an evaluation of the relationship between humans and microbes
written product includes a summary of a current event article related to microbiology
written product includes correct writing conventions for binomial nomenclature
written product includes a description of class methods used for grouping organs emphasizing the five-kingdom approach
written product includes the role of microbes in nutrient cycling
written product includes associating laboratory tools and techniques of microbiology with their use in studying microorganism

Learning Objectives
List types of microorganisms
Summarize historical events that advanced understanding of microbes
Identify current events that relate to microbiology
Relate microbiological concepts to field of interest

2 Use safe laboratory practices

Assessment Strategies
skill demonstration in the laboratory

Criteria
Performance will be successful when:
you identify hazards and safety equipment in the microbiology lab
you wear personal protective equipment appropriate to the hazard
you never eat or drink in the laboratory
you routinely wash your hands before and after laboratory activities and at any time contamination is suspected
you disinfect lab surfaces and work areas before and after use
you use approved techniques for cleaning up spills
you report or correct unsafe conditions observed in the classroom
you report or correct unsafe conditions observed in the lab
you use Standard Precautions with blood and other body fluids
you abide by the requirements of the O.S.H.A. Blood-Borne Pathogens Standard
you use appropriate pipetting devices
you dispose of waste in assigned containers
you locate emergency equipment
you report all injuries and accidents to instructor
you follow lab protocols for responding to spills or emergencies
you follow the Good Laboratory Practices expectations of the college

Learning Objectives
Follow general lab safety guidelines
Demonstrate aseptic technique when handling bacteria

3 Perform microbiological laboratory procedures according to appropriate safety standards

Assessment Strategies
skill demonstration in the laboratory

Criteria
Performance will be successful when:
you prepare slides for microbiological examination
you prepare smears from cultures
you perform wet-mount and/or hanging-drop slide preparations
you perform Gram stains
you perform aseptic transfers
you obtain microbial samples for culture
you isolate colonies and/or plaques
you recognize pure and mixed cultures
you use biochemical test media or other means of organism identification
you accurately record observations and test results
you correctly use pipettes and pipetting devices
you spread diluted samples for counting
you estimate dilutions
you perform calculations associated with cultures for standard population count

Learning Objectives
Use laboratory equipment and supplies including innoculating loops, devices to sterilize loops, staining kits, and culture media
Inoculate bacterial cultures (broth and agar)
Obtain isolated colonies on plates streaked for isolation
Transfer cultures without contaminating media or work surfaces (aseptic transfer)
Dispose of contaminated materials according to instructions
Follow decontamination procedures in the event of a spill
Follow general lab safety guidelines

4 Use a bright-field microscope to examine microbial cells

Assessment Strategies
skill demonstration in the laboratory

Criteria

*Performance will be successful when:*
you identify parts of the microscope and their functions
you adjust microscope for optimal viewing
you focus on a prepared slide sample using the low, high, and oil immersion lenses
you explain why oil is used when using the oil immersion objective of the microscope
you calculate total magnification when given ocular and objective magnifications
you interpret microscopic observations
you demonstrate care and clean-up of microscopes
you contrast other types of microscopy with bright-field microscopy
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards

Learning Objectives
Examine slides to yield the best observations possible using bright field microscopy
Demonstrate proper care and cleaning of the microscope

5 Compare prokaryotic and eukaryotic cell structures and their functions

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

Criteria

*Performance will be successful when:*
written product or examination includes the identification of components of prokaryotic cells
written product or examination the identification of components of eukaryotic cells
written product or examination a description of the functions of cellular components
written product or examination includes contrasting cellular structure and functions of prokaryotic and eukaryotic cells
written product or examination includes contrasting the size and morphology of prokaryotic and eukaryotic cells
you use a bright-field microscope to examine microbial cells
you perform microbiological laboratory procedures and techniques according to appropriate safety standards
you use safe laboratory practices

Learning Objectives
Diagram a simple prokaryotic cell
Label components of a prokaryotic cell
Identify parts of a simple eukaryotic cell
List components that are common to all cells
Describe the function of cellular components
Describe the function of specialized structures including capsules, walls, flagella, pili, and cilia
Identify cells as prokaryotic or eukaryotic based on structure
Recognize which microbes are multicellular

6 Explain microbial growth requirements and key microbial metabolic processes

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams
to be scheduled by your instructor at various points throughout the course

Criteria
Performance will be successful when:
written product or examination includes a description of the phases of microbial growth
written product or examination includes an estimation of culture density
written product or examination includes a description of factors which affect microbial growth
written product or examination includes a description of microbial growth characteristics on various media including enriched, selective, and differential media
written product or examination includes a description of the role of enzymes in living organisms
written product or examination includes differentiating among organisms on the basis of their ability to metabolize different substances
written product or examination includes a definition the role and output of glycolysis, fermentation, aerobic and anaerobic respiration in organism metabolism
written product or examination includes a definition of aerobic, anaerobic, capnophilic, microaerophilic and facultatively anaerobic
you participate in the lab activities
you use a bright-field microscope to examine microbial cells
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards

Learning Objectives
Describe key reproductive events in bacteria, yeasts, fungi, viruses, and multicellular eukaryotic parasites
Relate binary fission to the reproductive potential of bacteria
Describe the phases of a bacterial growth curve
Relate clinical disease symptoms to a bacterial growth curve
Describe factors that affect microbial growth
Differentiate between microorganisms based on colonial morphology
Differentiate microorganisms based on growth patterns in various microbiological media (eg. alpha, beta, gamma reactions on blood agar)

7 Classify microorganisms based on differentiating characteristics

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams
to be scheduled by your instructor at various points throughout the course

Criteria
Performance will be successful when:
you perform differential stain techniques
you evaluate the results of differential stain techniques
you identify classified bacteria based on cell shape
you evaluate the growth of organisms on enriched, selective and differential media
you recognize environments necessary for growth
you describe the use of differential tests in identifying bacteria
you assign bacteria to taxonomic groups based on characteristics
written product or examination includes a comparison of prokaryotic and eukaryotic cell structures and their functions
written product or examination includes an explanation of microbial growth requirements and metabolic processes
you participate in the lab activities
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards
you use a bright-field microscope to examine microbial cells

Learning Objectives
Identify genus and species names of bacteria
List microbial characteristics that can be used in classification
Differentiate between prokaryotic and eukaryotic microbes based on cell characteristics
Classify bacteria based on cell shape
Perform simple and differential staining methods
Differentiate between simple and differential staining methods
Evaluate the results of differential stains
Describe the uses of differential and selective media
Interpret growth patterns of different strains on differential and selective media
Identify organisms in the lab using differential tests
Classify microbes using dichotomous keys

8 Explore the modern approaches to recombinant technologies and their implementation to diagnostics

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

Criteria

Performance will be successful when:
written product or examination includes an overview of principles at the basis of genetic engineering
written product or examination includes a description of basic methods of DNA analysis such as the principles of gene cloning, vectors, and Polymerase Chain Reaction (PCR)
written product or examination includes a description of real-time PCR technique and its role in routine microbial diagnostics
written product or examination includes an overview of basic steps in recombinant DNA technology and recombinant products
written product or examination includes a comparison of genetically modified bacteria and animals
written product or examination includes analysis of biosafety and bioethics of recombinant DNA research and development
you participate in the lab activities
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards

Learning Objectives
Assess the principles and tools of genetic engineering
Review the steps in gene cloning
Describe the principles of PCR and real-time PCR technology
Describe the practice DNA cloning procedure
Describe the products of genetic engineering and applications of Recombinant DNA technology
Assess bioethics and societal concerns of recombinant DNA projects

9 Assess the impact of microbial genetics on humans and the environment

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams
Criteria

*Performance will be successful when:*

- written product or examination includes an overview of the processes of DNA replication, transcription and translation
- written product or examination includes an overview of the regulation of gene expression and operon model
- written product or examination includes an overview of the processes of DNA replication, transcription and translation
- written product or examination includes differentiating among types of mutation and their impact
- written product or examination includes a description of how bacteria can acquire new genetic information
- written product or examination includes a description of the role of microbial genetics in biotechnology and diagnostics
- written product or examination includes an explanation of the impact of gene transfer on the spread of antibiotic resistance
- you participate in the lab activities
- you use safe laboratory practices
- you perform microbiological laboratory procedures and techniques according to appropriate safety standards

**Learning Objectives**

**Review the structure and function of DNA**

**Define genetics, genome, chromosome, gene, genetic code, genotype, phenotype, and genomics**

**Describe DNA replication**

**Assess the impact of gene transfer on microbial evolution**

**Describe regulation of gene expression**

**Assess the relative impact of different mutations on a hypothetical organism**

**Describe the structure and function of plasmids**

**Compare the processes of transformation and conjugation**

**Assess the impact of gene transfer on microbial evolution**

**Practically examine the transformation of genes**

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**10 Evaluate processes to control the growth of microbes in the body and in the environment**

**Assessment Strategies**

skill demonstration in the laboratory

through a written product

by accurately answering questions about the concepts that support this competency on one or more written exams

to be scheduled by your instructor at various points throughout the course

Criteria

*Performance will be successful when:*

- written product or examination includes differentiating between disinfection and sterilization
- written product or examination includes a comparison of methods of disinfection and sterilization
- written product or examination includes a description of modes of action of antibacterial agents
- written product or examination includes differentiating between broad-spectrum and narrow-spectrum agents
- written product or examination includes a description of mechanisms of antibiotic resistance
- written product or examination includes an identification of issues to consider in administering antimicrobial therapies
- written product or examination includes an interpretation of the results of susceptibility testing procedures
- you participate in the lab activities
- you use safe laboratory practices
- you perform microbiological laboratory procedures and techniques according to appropriate safety standards

**Learning Objectives**

**Compare disinfection and sterilization**

**Compare disinfectants, antiseptics, and antimicrobial therapies**

**Examine the effectiveness of common disinfectants**

**Compare the factors that affect the survival of endospore- and non-endospore-forming bacteria**

**Describe the mode of action of various antibacterial agents**

**Correlate the use of antimicrobial agents in treating disease with bacterial growth curves**

**Explain the significance of spectrum of activity**
Explain the significance of selective toxicity
Differentiate between microbial sensitivity or resistance to antimicrobial agents during antimicrobial sensitivity testing
Determine a microbe's MIC (minimum inhibitory concentration) or MBC (minimum bacterial concentration) to a particular antimicrobial agent
Describe the significance of antibiotic half-life, dosage interval, and duration of treatment in antimicrobial therapy
Examine mechanisms of antibiotic resistance

11 **Summarize pathogenic and non-pathogenic host-microbe interactions**

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

**Criteria**

*Performance will be successful when:*

- written product or examination includes an examination of symbiotic relationships between humans and microbes
- written product or examination includes an identification of mechanisms by which microbes cause disease
- written product or examination includes an identification of the stages of an infectious disease
- written product or examination includes an identification of the causes of nosocomial infections
- written product or examination includes a description of the methods of infection control in clinical settings
- written product or examination includes a description of the ubiquity of microorganisms
- written product or examination includes an examination of the role of opportunists in human disease
- you participate in the lab activities
- you use safe laboratory practices
- you perform microbiological laboratory procedures and techniques according to appropriate safety standards

**Learning Objectives**

- Identify the role of normal flora in a healthy individual
- Correlate a bacterial growth curve to the stages of infection
- Describe factors that contribute to a microbe's pathogenicity
- Determine conditions that contributed a microbe becoming an opportunistic pathogen
- Describe nosocomial infection as it relates to the transmission of microbes

12 **Analyze patterns of microbial disease transmission using principles of epidemiology**

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

**Criteria**

*Performance will be successful when:*

- written product or examination includes a comparison of communicable and noncommunicable diseases
- written product or examination includes an identification of possible reservoirs of infection
- written product or examination includes an examination of various modes of disease transmission
- written product or examination includes differentiating between endemic epidemic and pandemic conditions
- written product or examination includes an evaluation of the effect of herd immunity on disease transmission
- written product or examination includes a description of methods of controlling disease outbreaks
- written product or examination includes an exploration of new and re-emerging infectious disease agents
- you participate in the lab activities
- you perform microbiological laboratory procedures and techniques according to appropriate safety standards
- you use safe laboratory practices

**Learning Objectives**

- Differentiate between communicable and noncommunicable diseases
- Examine modes of disease transmission (direct, indirect, etc)
Examine sources of disease transmission (vectors, reservoirs, etc)
Describe herd immunity
Identify methods of controlling disease outbreaks
Interpret an epidemiology case study

13 Summarize host defense mechanisms

Assessment Strategies
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

Criteria

Performance will be successful when:
written product or examination includes distinguishing between specific and non-specific host defenses (including the inflammatory response)
written product or examination includes the identification of non-specific host defense mechanisms
written product or examination includes the identification of the processes of natural, artificial, passive, and active immunity
written product or examination includes a description of antibody-antigen interactions
written product or examination includes differentiating between humoral and cell-mediated immunity
written product or examination includes an explanation of the role of memory cells in lasting immunity

Learning Objectives
Describe non-specific host defenses
Describe specific host defenses
Differentiate between humoral and cell-mediated immunity
Differentiate between acquired, innate and temporary immunity
Summarize the process of acquiring immunity
Describe the role of memory cells in lasting immunity
Describe the role of other immune cells (helper T-cells, killer T-cells, suppressor T-cells, etc)

14 Evaluate immunopathology and immunological applications

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

Criteria

Performance will be successful when:
written product or examination includes a description of use of vaccines and immune globulins to confer specific immunity
written product or examination includes differentiating among the types of hypersensitivity
written product or examination includes an explanation of the health consequences of immune hypersensitivity
written product or examination includes a description of the consequences of immune system dysfunction
written product or examination includes an identification of immunological methods of diagnosing infectious disease
written product or examination includes correlating abnormal values on a complete blood count (CBC) to a probable infectious agent
written product or examination includes correlating abnormal values in a blood differential to a probable infectious agent
you participate in lab activities
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards

Learning Objectives
Describe the use of vaccines to confer specific immunity
Examine hematological results (CBC, differential) to identify infectious agents
Differentiates between sensitivity and specificity in immunological testing
Describe the application of acute and convalescent antibody titers in determining immune status
Summarize types of immune hypersensitivity
Examine the consequences of immune system dysfunction

15 Correlate select bacteria with human infectious disease

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams
to be scheduled by your instructor at various points throughout the course

Criteria
Performance will be successful when:
written product or examination includes a description of microbial characteristics for select organisms
written product or examination includes a description of disease signs and symptoms for select organisms
written product or examination includes a description of disease transmission, diagnosis, treatment, and prevention for select organisms
you participate in lab activities
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards

Learning Objectives
Differentiate bacterial pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human respiratory tract
Differentiate bacterial pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human gastrointestinal tract
Differentiate bacterial pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human urinary tract
Differentiate bacterial pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human reproductive tract
Differentiate bacterial pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human nervous system
Differentiate bacterial pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human skin wounds

16 Correlate select fungi and parasites with human infectious disease

Assessment Strategies
skill demonstration in the laboratory
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams
to be scheduled by your instructor at various points throughout the course

Criteria
Performance will be successful when:
written product or examination includes the definition of eukaryotic parasites
written product or examination includes a description of characteristics of select fungi
written product or examination includes a description of characteristics of select protists and helminths
written product or examination includes a description of disease signs and symptoms for select organisms
written product or examination includes a description of disease transmission, diagnosis, treatment, and prevention of select organisms
you participate in lab activities
you use safe laboratory practices
you perform microbiological laboratory procedures and techniques according to appropriate safety standards

Learning Objectives
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human respiratory tract
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human gastrointestinal tract
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human urinary tract
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human reproductive tract
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human nervous system
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human skin wounds
prevention in the human reproductive tract
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human nervous system
Differentiate fungal and parasitic pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human skin wounds

17 Correlate select viruses and prions with human infectious disease

Assessment Strategies
through a written product
by accurately answering questions about the concepts that support this competency on one or more written exams to be scheduled by your instructor at various points throughout the course

Criteria
Performance will be successful when:
written product or examination includes a description of viral morphology and the processes of viral replication
written product or examination includes an analysis of the impact of viruses on a host organism
written product or examination includes a description of disease signs and symptoms for select viruses
written product or examination includes a description of disease transmission, diagnosis, treatment and prevention for select viruses
written product or examination includes a description of prions and associated diseases

Learning Objectives
Distinguish between viruses and prions
Differentiate viral pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human respiratory tract
Differentiate viral pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human gastrointestinal tract
Differentiate viral pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human urinary tract
Differentiate viral pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human reproductive tract
Differentiate viral pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human nervous system
Differentiate viral pathogens by their disease symptoms, transmission, diagnosis, treatment and prevention in the human skin wounds