

# BIO 5100: Microbiology in Health and Disease

**Term:** Spring 2018

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## Course Information

**Catalog description:** (4 credits, 6 hours). For students preparing for Nursing, Physician's Assistant, and other allied health sciences only. This course examines the role of microbes as infectious agents responsible for a wide variety of diseases and medical conditions. Disease transmission, treatment, and prevent are considered. The laboratory focuses on the basic methods to cultivate, identify and control microbial growth. **This course does not satisfy the Biology major elective requirement.**

**Prerequisite:** Bio 1200

**Co-requisite:** Nursing students must be take Bio 5100 before or with Nursing 21. Nursing students who withdraw from Bio 51 cannot continue in NUR 2100

## Course Overview

- Major diseases caused by microorganisms are considered. These include: HIV opportunistic and nosocomial infections, tuberculosis, hepatitis, pneumonia, sexually transmitted diseases, and water and foodborne diseases.
- The course has direct application to medical surgical nursing.
- Universal precautions, asepsis, and control of microbial growth are emphasized.
- Immune responses to infections are discussed.
- Your knowledge of anatomy and physiology will be applied to understand the effects of microbial infections on various organs systems. If you are unsure of any of the anatomy and physiology principles being discussed, please review them or meet with your instructor.

## Course Goals for Student Outcomes

1. Apply the concept of asepsis and its applications to laboratory procedures, hospitals, & medical practices.
2. Employ basic principles of microbial anatomy and physiology to microbial virulence, pathogenicity, and disease establishment.
3. Identify the factors affecting microbial virulence and the responses by the host's defense mechanisms.
4. Determine properties of microorganisms through staining and biochemical testing that can be used for diagnostic microbial identification.



5. Recognize the signs and symptoms of particular disease and decisions involved in determining antibiotic therapy.

## Recommendations to Students

- Read assigned lecture and laboratory material before coming to class.
- Ask questions and meet your instructor during office hours to clarify any questions you may have.
- Attendance to class is essential. If you do miss class you are responsible for making up the missed work.
- Plan your work and study time. Read over or perhaps rewrite your notes after class. Read the text to supplement your notes. Discuss the material with your classmates. Form study groups.
- Best wishes for your success in the course. If you have any questions, please feel free to meet with your instructor.

## Access-Ability Services

Access-Ability Services (AAS) serves as a liaison and resource to the KCC community regarding disability issues, promotes equal access to all KCC programs and activities, and makes every reasonable effort to provide appropriate accommodations and assistance to students with disabilities. Please contact this office if you require such accommodations and assistance. Your instructor will be glad to make the accommodations you need, but you must have documentation from the Access-Ability office for any accommodations.

## Academic Integrity

Your instructor upholds the KCC policy on academic honesty (see Student Handbook online). There are consequences for cheating on exams or plagiarizing someone else's work (i.e., turning in work copied from another source). These include a reduced grade or zero, suspension, or dismissal. If you are not sure what constitutes academic dishonesty, please check with the instructor.

Plagiarism is the use of others' words and/or ideas without clearly acknowledging their source. As students, you are learning about other people's ideas in your course texts, your instructors' lectures, in-class discussions, and when doing your own research. When you incorporate those words and ideas into your own work, you need to give credit where it is due. Plagiarism, intentional or unintentional, is considered academic dishonesty and all instances can be reported to the Academic Judiciary. To avoid plagiarism, you give the original author credit whenever you use another person's ideas, opinions, drawings, or theories as well as any facts or any other pieces of information that are not common knowledge. Additionally, quotations of another person's actual spoken or written words, or a close paraphrasing of another person's spoken or written words, need to be referenced. Accurately citing all sources and putting direct quotations – of even a few key words – in quotation marks are required.



## Grade Computation

Lecture and laboratory are each 50% of the final grade.

### Lecture

Examinations	20%
Writing Assignment	10%
Final Examination	20%

Lowest Score of 3 will be dropped

### Laboratory

Examinations	10%
Clinical Unknowns	15%
Practicals	10%

Technique/classwork 5%

## Required Textbook, Laboratory Manual, and Other Materials

- This is a **Zero Textbook Cost** course.
- **Text:** Edited version of OpenStax. [Microbiology by Parker, Schneegurt, Tu, Forster and Lister](#) shared with you via Blackboard course site.
- **Lab manual:** Selected exercises of **Laboratory Exercises in Microbiology by Brancaccio-Taras** will be shared with you via Blackboard course site
- **Materials:** Knee length laboratory coat and safety goggles. These requirements conform to OSHA safety regulation and need to be worn at all times in the microbiology laboratory. You will not be able to remain in the laboratory without a lab coat or safety goggles. After each week's lab, the lab coat should be washed.

## BIO 51 Lecture Outline

All readings are found on our Blackboard site, under the "Lecture Reading Assignments" tab

### Week 1: Introduction and History of Microbiology

- Organisms studied in microbiology (prokaryotic and eukaryotic)
- The nature microbiological problems
- The history of microbiology
- **Reading Assignment-** The Invisible World- Week 1 Reading

### Week 2: Bacterial anatomy

- Bacterial shapes and arrangements
- Cell wall
- Cell membrane



- Glycocalyx
- Endospores
- Flagella
- Cytoplasmic inclusions
- Cytoplasmic structures/organelles
- **Reading Assignment-** Bacterial Structures- Week 2 Reading

### ***Week 3: Bacterial Genetic Transfer & Growth***

- 3 major modes of bacterial genetic transfer: transformation, conjugation, & transduction
- Significance of genetic transfer
- Bacterial cell division
- Bacterial growth curve
- **Reading Assignment-** Mechanisms of Microbial Genetics- Week 3 Reading & Microbial Growth-- Week 3 Reading

### ***Weeks 4: Microbial Metabolism***

- Aerobic respiration
- Anaerobic respiration
- Fermentation and types of fermentation
- Use of metabolic properties to identify microorganisms
- Industrial uses for microbial metabolism- food, antibiotic, and enzyme production Antibiotic therapy
- **Reading Assignment-** Microbial Metabolism- Week 4 Reading

### ***Weeks 5 & 6: Immunology***

- Normal flora, transient flora opportunistic microbes
- Pathogenicity, virulence, and factors that increase virulence (enzymes, toxins)
- Factors that affect the spread of disease
- Nonspecific immune responses
- Specific immune responses: humoral and cell mediated immunity
- Vaccines
- HIV/AIDS
- **Reading Assignments**
  - Microbial Mechanisms of Pathogenicity- Week 5 Reading
  - Disease and Epidemiology- Week 5 Reading
  - Innate Nonspecific Host Defenses- Week 6 Reading
  - Adaptive Specific Host Defenses- Week 6 Reading

### ***Weeks 7 & 8: Microbial Diseases of the Skin and Eyes***

- Bacterial diseases of the skin



- Acne, folliculitis, boils, furuncles, carbuncles, impetigo, cellulitis, & osteomyelitis
- Infections of burns and surgical wounds, gangrene
- Leprosy
- Viral Diseases of the Skin
- Warts
- Chicken pox and shingles
- Herpes (HSV I)
- Measles
- German measles (Rubella)
- Smallpox
- Fungal Diseases of the Skin
- Dermatophyte infection (Tinea infections)
- Candidiasis
- **Bacterial diseases of the Eyes**
- Conjunctivitis
- Atypical bacterial diseases of the Eyes
- Inclusion conjunctivitis
- Trachoma
- Viral Diseases of the Eyes
- Herpetic Keratitis
- **Reading Assignment-** Skin and Eye Infections- Week 7 & 8 Reading

### ***Weeks 8 & 9: Microbial Diseases of the Respiratory System***

- Bacterial diseases
- Group A streptococci, its complications (rheumatic fever, glomerulonephritis) & scarlet fever
- Diphtheria
- Otitis media
- Laryngitis, sinusitis & bronchitis
- Bacterial pneumonia
- Pertussis
- Tuberculosis
- Legionnaire's disease
- Atypical bacterial diseases
- Ornithosis
- Mycoplasmal pneumonia
- Viral diseases
- Common cold
- Influenza
- Viral pneumonia (Respiratory Syncytial Infection)
- Hanta virus pulmonary syndrome



- Fungal diseases
- Histoplasmosis
- Cryptococcosis
- Pneumocystis carinii pneumonia
- **Reading Assignment-** Skin and Eye Infections- Week 8 & 9 Reading

### ***Week 10: Microbial Diseases of the Cardiovascular & Lymphatic Systems***

- Bacterial diseases
- Bacteremia and septicemia
- Acute and subacute bacterial endocarditis
- Plague (pneumonic)
- Lyme disease
- Anthrax
- **Atypical bacterial diseases**
- Rocky mountain spotted fever
- Viral diseases
- Epstein Barr Virus: Infectious mononucleosis/ Burkitt's lymphoma
- Ebola virus hemorrhagic fever
- West Nile Fever
- Protozoan diseases
- Malaria
- Toxoplasmosis
- **Reading Assignment-** Circulatory and Lymphatic System Infections- Week 10 Reading

### ***Weeks 10 & 11: Microbial Diseases of the Nervous System***

- Bacterial diseases
- Meningitis
- Tetanus
- Botulism
- Viral diseases
- Polio
- Rabies
- Encephalitis
- West Nile Fever
- Cytomegalovirus infection
- Creutzfeldt-Jakob disease (CJD)
- Protozoan diseases
- Trypanosomiasis/ Chagas' Disease
- **Reading Assignment-** Nervous System Infections – Week 10 & 11 Reading



### ***Weeks 11 & 12: Microbial Diseases of the Digestive System***

- Bacterial diseases
- Dental caries
- Food poisonings
- Cholera
- Gastroenteritis
- Bacterial Dysentery
- Peptic Ulcers
- Fungal diseases
- Thrush
- Aflatoxin poisoning
- Ergot poisoning
- Viral diseases
- Mumps
- Hepatitis A-E
- Protozoan diseases
- Amebic dysentery
- Giardiasis
- Cryptosporidiosis
- Reading Assignment- Digestive System Infections – Week 11 & 12 Reading

### ***Week 12: Microbial Diseases of the Urinary/Reproductive Systems***

- Bacterial diseases
- Urinary tract infections
- Vaginitis
- Toxic Shock Syndrome
- Syphilis
- Gonorrhea
- **Atypical bacterial diseases**
- Nongonococcal urethritis
- Viral diseases
- Genital herpes
- Genital warts
- **Protozoan diseases**
- Trichomoniasis
- Fungal diseases
- Vaginitis
- Reading Assignment- Urogenital System Infections – Week 11 & 12 Reading



## Objectives

The objectives listed can be used as guidelines for studying each topic discussed in the course.

### ***Introduction and History of Microbiology***

1. Describe in one or two sentences the significance of the contributions
2. of the following scientists to the field of microbiology:
  - a. van Leewenhoek
  - b. Pasteur
  - c. Semmelweis
  - d. Lister
  - e. Koch
  - f. Ehrlich
  - g. Fleming.
3. Define spontaneous generation.
4. In a brief statement, describe the series of experiments disproving spontaneous generation.
5. List 3 major concerns regarding the spread and treatment of diseases caused by microorganisms.

### ***Bacterial Anatomy***

1. Draw and describe common bacterial shapes and their arrangements.
2. Describe the structure and function of the following:
  - a. cell wall
  - b. cell membrane
  - c. glycocalyx
  - d. endospores
  - e. flagella
  - f. inclusion bodies
3. For each of the structures mentioned in objective 2, describe how each is involved in disease processes.

### ***Genetic Transfer***

- Distinguish between transformation, transduction and conjugation.
- Explain the medical significance of the 3 modes of genetic transfer mentioned in objective 1.

### ***Growth and Factors Affecting Growth***

1. Draw and label the four phases of a typical bacterial growth curve.
2. Describe the phases of a typical bacterial growth curve.
3. List and describe four physical factors affecting microbial growth.
4. Explain why physical factors affecting growth can be used to demonstrate the human body is an excellent environment for growth of a variety of microorganisms.



### ***Microbial Metabolism***

- Define the following terms:
  - a. Fermentation
  - b. aerobic respiration
  - c. anaerobic respiration
- List the end products of
  - a. Glycolysis
  - b. Krebs cycle
  - c. electron transport/oxidative phosphorylation.
- Explain how proteins and lipids are metabolized to generate ATP.
- Explain the significance of microbial metabolism in the identification of microorganisms.
- List three organisms and their fermentation products used in food production.

### ***Immunology***

1. Distinguish between contamination, infection and disease.
2. Define each of the following terms: (a) normal flora; (b) transient flora & (c) opportunistic organisms.
3. Describe the stages and infectious disease establishment.
4. The list and describe the significance of three virulence factors.
5. List and describe the significance of five bacterial enzymes serving as virulence factors.
6. Distinguish between exotoxins and endotoxins.
7. Distinguish between nonspecific resistance and specific resistance.
8. Distinguish between portal of entry and portal of exit.
9. List and describe three examples of nonspecific resistance.
10. Describe the stages of inflammation.
11. Describe the classical and alternate pathway of the complement system.
12. Distinguish between humoral immunity and cell mediated immunity.
13. Distinguish between passive immunity and active immunity.
14. Distinguish between naturally acquired immunity and artificially acquired community.
15. Distinguish between an antibody and an antigen.
16. Describe in a series of steps antibody production.
17. Explain the immunological basis of vaccination against diseases such as smallpox.

### ***Microbial Diseases of the Skin and Eyes***

1. List and describe three examples of staphylococcal infections.
2. List and describe two eye infections caused by bacteria.
3. List two organisms found infecting skin burns.
4. List three major causes of wound infections.
5. Distinguish between superficial mycoses, subcutaneous mycoses, & cutaneous mycoses.
6. Distinguish between herpes simplex virus I (HSV I) & herpes simplex virus II (HSV II).



7. Describe the effects resulting from herpes simplex I and herpes simplex II infection.
8. Describe three childhood viral diseases including the name of the causative agent, signs & symptoms, treatment, & prevention.

### ***Microbial Diseases of the Respiratory System***

- List and describe three streptococcal infections.
- Describe three complications of streptococcal infections.
- Describe upper respiratory infections caused by *Haemophilus influenzae* & *Streptococcus pneumoniae*.
- Name of causative agent, transmission, signs and symptoms, and treatment of the following:
  - a. whooping cough
  - b. bacterial pneumonia
  - c. tuberculosis
  - d. Legionnaire's disease.
- Describe the effects resulting from rhinovirus infection.

### ***Microbial Diseases of the Cardiovascular and Lymphatic Systems***

1. Describe three bacterial systemic infections including the name of the causative agent, signs and symptoms, and treatment.
2. Distinguish between bacteremia and septicemia.
3. Distinguish between acute endocarditis and subacute endocarditis.
4. Describe the following diseases including the name of the causative agent, signs and symptoms, and treatment (if any):
  - a. Ebola virus
  - b. Hanta virus
  - c. West Nile virus.

### ***Microbial Diseases of the Nervous System***

1. Describe three bacterial nervous system infections including the name of the causative agent, signs and symptoms, and treatment.
2. List five effects of (a) botulism and (b) tetanus on the nervous system.
3. List three bacteria causing meningitis.
4. List three properties of parasitic protozoa.
5. Describe the mode of action of three drugs used to treat protozoan infections.
6. Describe the worldwide significance of malaria
7. Explain how toxoplasmosis can lead to congenital defects.
8. Describe the following diseases including the name of the causative agent, signs and symptoms, and treatment:
  - a. Rabies
  - b. Polio
  - c. encephalitis.



9. Distinguish between prions and viroid's.

### ***Microbial Diseases of the Digestive System***

1. List five bacteria that can cause gastrointestinal infections.
2. Distinguish between an intoxication and an infestation.
3. In a brief statement, describe the signs, symptoms and treatment of *Salmonella* gastroenteritis.
4. Distinguish between hepatitis A, hepatitis B, hepatitis C, hepatitis D, and hepatitis E with regard to incubation time, transmission, and groups at greatest risk of infection.

### ***Microbial Diseases of the Urinary/Reproductive Systems***

1. List three bacteria causing urinary tract infections.
2. List three reasons for urinary tract infections.
3. Define the term nongonococcal urethritis.
4. Describe the effects resulting from human papilloma virus infection.
5. Describe the progression of syphilis (primary, secondary, and tertiary)
6. Describe the signs/symptoms of gonorrhea.
7. Describe the effects of 2 sexually transmitted diseases on an unborn fetus.



# Biology 5100 Laboratory

## Recommendations to the student:

- Observe all safety precautions in the laboratory. They are for your protection.
- Each student is responsible for the proper safety and maintenance of their work area.
- Bench tops and microscopes must be properly cleaned before and after use.
- Microquat disinfectant is used on bench tops.
- Wear your laboratory coat at all times while in the microbiology laboratory.
- Read the laboratory exercises before class and the textbook pages corresponding to the laboratory activities.
- If you are unsure of any of the work you are required to perform during the lab, ask your instructor.
- If you spill any bacterial cultures or make a mistake you think might be a potential health hazard, inform your instructor.
- Wash your hands with betadine before, during and after lab work.



## Laboratory Outline

**Note:** Due to the live cultures and complicated media preparation required for each lab, labs cannot be made up if missed.

A **knee length lab coat** & safety goggles must be brought to each week's lab session. Lab coats and safety goggles cannot be left in the lab. It is recommended that you wash your lab coat after each lab.



Week	Activities
1	<p>Introduction, Safety Guidelines, Check-in – (Page v-vii)                      Culture Transfer Instruments Techniques &amp; Isolation &amp; Maintenance of Pure Cultures (Aseptic Technique only) – (Page 61, Exercise 10)</p> <p><b>Microbial morphology</b></p> <ul style="list-style-type: none"> <li>• Smear Preparation and Simple Staining – (Page 12, Exercise 2)</li> <li>• Gram Stain – (Page 25, Exercise 4)</li> <li>• Bright Field Light Microscope – (Page 3, Exercise 1)</li> </ul>
2	<p><b>Bacterial anatomy</b></p> <ul style="list-style-type: none"> <li>• Acid-fast Staining – (Page 32, Exercise 5)</li> <li>• Endospore Staining – (Page 43, Exercise 7)</li> <li>• Capsule Staining (Graham &amp; Evans procedure) – (Page 38, Exercise 6)</li> <li>• Bacterial Motility (demonstration) – (Page 49, Exercise 8)</li> <li>• The Effectiveness of Handwashing – (Page 131, Exercise 22)</li> </ul>
3	<p>Gram Stain Practical</p> <p><b>Microbial growth</b></p> <p>Environmental Factors Affecting Growth of Microorganisms: Temperature, pH, &amp; Osmotic Pressure – (Page 97, Exercise 15-17)</p> <p>Cultivation of Anaerobic Bacteria (Broth &amp; Plate cultures- demonstration) – (Page 110, Exercise 18)</p>
4	<p><b>Isolation and enumeration of microorganisms</b></p> <p>Spread Plate Technique – (Page 72, Exercise 11)</p> <p>Streak Plate Technique – (Page 70, Exercise 11)</p> <p>Determination of Bacterial Numbers – (Page 75, Exercise 12)</p> <p>Bacterial Count of a Food Product – (Page 327, Exercise 42)</p>
5	<p><b>Control of microbial growth</b></p> <p>Radiation (Ultraviolet Light) – (Page 126, Exercise 21)</p> <p>The Effects of Chemical Agents on Bacteria I: Disinfectants and Antiseptics – (Page 115, Exercise 19)</p> <p>The Effects of Chemical Agents on Bacteria II: Antimicrobial Agents (Kirby-Bauer method) – (Page 120, Exercise 20)</p>



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6	<p><b>Normal flora, host defenses, and throat unknown identification</b>                  Nonspecific Host Defenses: Lysozyme (demonstration) – <b>(Page 344, Exercise 44)</b>                  Isolation of Normal Microbiota from the Human Body (Nose, Throat, or Skin) – <b>(Page 289, Exercise 37)</b>                  Throat Culture Unknown Activity - Control and unknown specimens inoculated                  Proteins, Amino Acid &amp; Enzymes V: catalase activity – <b>(Page 170, Exercise 25)</b>                  Proteins, Amino Acid &amp; Enzymes VI: coagulase &amp; DNase activity – <b>(Page 167 and 169, Exercise 25)</b>                  Selective and Differential Media (blood &amp; mannitol salt agar only) – <b>(Page 87, Exercise 14)</b></p>
7	<p><b>Techniques to isolate and identify bacteria – (Page 167 and 169, Exercise 25)</b>                  Throat Culture Unknown Activity- Observe &amp; Record results – <b>(Page 87, Exercise 14)</b></p>
8	<p><b>Gastrointestinal tract unknown identification</b>                  Gastrointestinal (GI) Unknown Activity- Control &amp; Unknown specimens inoculated                  Carbohydrate Fermentatio – <b>(Page 139, Exercise 23)</b>                  The IMViC Tests                  Hydrogen Sulfide Production – <b>(Page 144-148 and 152-153, Exercise 23 and 24)</b>                  Motility – <b>(Page 159, Exercise 24)</b></p>
9	<p><b>Gastrointestinal tract unknown identification</b>                  GI Unknown Activity- Observe &amp; Record results</p> <ul style="list-style-type: none"> <li>• <b>(Page 139-142 and 144-148, Exercise 23)</b></li> <li>• <b>(Page 152-153 and 159-160, Exercise 24)</b></li> </ul>
10	<p><b>Urinary tract unknown identification</b>                  Urinary Tract (UT) Unknown Activity- Control and Unknown specimens inoculated                  Selective &amp; Differential Media (EMB &amp; MacConkey only) – <b>(Page 87, Exercise 14)</b>                  Tryptophan Hydrolysis – <b>(Page 152, Exercise 24)</b>                  Oxidase Test – <b>(Page 171, Exercise 25)</b>                  Urease Activity – <b>(Page 156, Exercise 24)</b>                  Phenylalanine Deamination – <b>(Page 153, Exercise 24)</b>                  Nitrate Reduction – <b>(Page 172, Exercise 25)</b></p>



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Week	Activities	Exercise # and Page
11	<b>Urinary Tract Unknown Identification</b> UT Unknown Activity- Observe & Record results <b>(Page 87, Exercise 14)</b> <b>(Page 152, 153 and 156, Exercise 24)</b> <b>(Page 171 and 172, Exercise 25)</b>	14 (page 87) 24 page 152; 153; 156 25 (page 171, 172)
12	Final Laboratory Practical* <sup>1</sup> Laboratory Check-Out**	

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<sup>1</sup> **The final laboratory practical cannot be made up if missed.** The point value for this practical (5%) will be deducted from your final grade. For check out, empty your drawer of all slides and media and place them in the discard bin. Clean empty drawer with Microquat. Once the drawer has been cleaned, reusable materials can be returned to the drawer. Material in the slide discard bowls is placed in the discard bin. All paper trash is placed in the proper receptacle. Lastly, wash the laboratory bench top with Microquat.

