Bio 241 – Principles of Microbiology

Community College of Philadelphia

Department of Biology

Departmental Syllabus, Objective, Laboratories, and Lecture Outline

Main Campus: Department of Biology Office
Room W2-7C
Department Head: Dr. Linda Powell
Spring and Fall Semester Hours: 9-5, M-F
Summer A and N Semester Hours: 9-5, M-R
Phone: 215-751-8432
Fax: 215-751-8937
Email: lpowell@ccp.edu

Departmental Website: http://faculty.ccp.edu/dept/biol/

Name ________________________________

Class Section: ________________________________

Instructor’s Name ________________________________

Office Number ________________________________Office Phone ________________________________

Office Hours ________________________________Email ________________________________
**Required Materials**


**Catalog Course Description**

BIOL 241 PRINCIPLES OF MICROBIOLOGY 3-2-4
Bacteria and viruses are studied. An emphasis is placed on the growth, metabolism, physiology and genetics of bacteria and viruses in lecture and laboratory experiences. Clinical aspects of selected microbes are discussed. Prerequisite: BIOL 106 or 107 or 109 or 123.

**Course Philosophy**

Principles of Microbiology is an upper level introductory science course. This course is often used to satisfy an applied science requirement for Allied Health students and/or as a transfer course to other colleges.

The purpose of microbiology is to provide students with an understanding of the classification, metabolism, and genetics of bacteria and viruses. Students will also experience the scientific process of investigation as it applies to the study of prokaryotic cells. In addition, the information that students are given is applied to the various aspects of medicine and biotechnology. Following the successful completion of this course, students will be prepared for further scientific study.

**Student Learning Outcomes**

By the end of the course, students will be able to…

1. **Understand the connection between the historical developments of microbiology and the application of technology to the treatment of disease.**
   - Identify the contributions of Leeuwenhoek, Jenner, Koch, and Pasteur in the early development of microbiology.
   - Define classification and list the major biological taxons in the modern system of classification.
   - Apply the rules for writing a scientific name.
   - Match specific pathogens to signs and symptoms associated with a disease.

2. **Explain how the morphology of a parasite and its host affects pathogenesis.**
   - Identify the major shapes of bacteria.
   - Describe the general characteristics of viruses.
   - Compare and contrast morphological characteristics of viruses to bacteria and other microbes.
   - Label bacteriophage

3. **Apply principles of microscopy and staining procedures to the identification of microorganisms.**
• Compute total magnification.
• Explain how modifications in the lens system of a compound microscope, affects the image of the specimen.
• List differences between light and electron microscopy.
• List differences between indirect and direct staining.

4. **Explain how the organization of macromolecules in the plasma membrane and various organelles of prokaryotic and eukaryotic cells relate to their function.**
   • Describe a phospholipid.
   • Distinguish between prokaryotic and eukaryotic cells.
   • Distinguish between the chemical composition of Gram negative and Gram positive bacteria.
   • State the function of the nucleus, mitochondria, lysosome, and ribosome.
   • List differences between indirect and direct staining.

5. **Describe how the availability of certain chemical agents and physical conditions contributes to microbial growth and survival.**
   • Describe adenosine triphosphate.
   • Describe the major differences between aerobic respiration, anaerobic respiration and fermentation.
   • Describe the role of electron carriers in a cell.
   • Describe how enzymes are characterized and named.
   • Differentiate between chemiosmosis and substrate level phosphorylation.
   • Summarize differences between the chemical and physical composition of special microbial growth media.
   • Predict the optimum temperature for a mesophile, thermophile, and a psychrophile.
   • Classify bacteria based on their oxygen requirements.

6. **Explain how the storage, transmission, regulation and modification of genetic information contribute to the continuity of microbial species.**
   • Define binary fission.
   • Explain how complementary bases pair up during RNA and DNA synthesis.
   • Differentiate between a frameshift mutation and a substitution mutation.

7. **Explain how the immune system and antimicrobial agents are involved in maintaining homeostasis during an internal or external threat to the body.**
   • Define sterilization.
   • Describe the mode of action of selected chemical and physical agents of sterilization.
   • Describe the mode of action of selected antibiotics.
   • Define pathogen.
   • Differentiate between an antigen and an antibody.
   • State the function of each type of white blood cell found in the human body.
   • State some differences between endotoxins and exotoxins.
   • Differentiate between various types of innate and adaptive immunity.
   • Evaluate the efficacy of selected antibiotics on the growth of Gram positive and Gram negative bacteria in the laboratory.
Resources

Library, Main Campus Mint Building, M1-12, 215-751-8383:
- Fall and Spring Semesters: Monday through Friday, 8 AM-10 PM, Saturday, 8:30 AM-5 PM
- Summer I and II Semesters: Monday through Thursday, 8 AM-10 PM

West Learning Lab, Main Campus West Building, W3-26, 215-751-8482:
- Call for appointments or schedules for one-to-one and/or group tutoring and workshops.

W3-45 Biology Open Lab, Main Campus West Building, 215-751-8809:
- Semester schedule to be posted and/or announced or call to make alternate arrangements.

Policy of Academic Dishonesty

All members of the college community are expected to obey public law and abide by college regulations. Students are expected to be well motivated and constructive in their pursuit of learning. Attendance of the College is a privilege, not a right. Students, through the act of registration, concede to the College, the right to dismiss any student at any time when it is deemed necessary in order to safeguard the College's ideals of scholarship and character, and to secure compliance with its regulations.

I. Academic Dishonesty

a. Cheating behaviors include, but are not limited to:
   i. examining or copying another student's answers during a test, exam, or practical exam
   ii. examining or copying another student's paper or lab report
   iii. bringing notes, etc. to class during testing (on a scrap of paper, cuffs, etc.)
   iv. using a dictionary or other source during testing
   v. asking someone for the answers to test questions
   vi. having another person take the test for you
   vii. stealing or having in your possession without permission, any materials, belonging to or generating from faculty, staff or students

b. Aiding another in committing an act of academic dishonesty includes, but is not limited to:
   i. willfully offering answers or information related to tests and examinations
   ii. doing another student's assignment (in or outside of the classroom)
   iii. taking a test for another student
   iv. failing to report knowledge of another student cheating

c. Plagiarism includes, but is not limited to:
   i. copying from any source without quotation marks and appropriate documentation
   ii. rewording an idea from a source but omitting documentation
   iii. having another write for you or copying another student's work
   iv. having another correct mistakes on your paper (suggested revisions are acceptable)

II. Faculty Rights

a. Sanctions available to faculty include, but are not limited to:

Edited January 12, 2016
i. requiring the student retake test or rewrite report
ii. drop the item in the calculation of the final grade or provide a substitute item in grading
iii. give the student a zero on the item
iv. drop the student's final grade by one letter
v. administratively withdraw the student from the course (if before the ninth week)
vi. give the student a failing grade in the course

III. Student Rights
a. Students may appeal decisions regarding final grades as per college policy. A copy of student rights and obligations are available in the student handbook that is available from the Office of Student Life (M2-37). Please note that the Biology department's Committee of Academic Review of Evaluation will NOT hear cases of alleged academic dishonesty.

Attendance and Withdrawal Policy

Students are expected to fulfill their academic obligation by attending all class and lab sessions, unless prevented from doing so by illness or other emergency. If a student misses the equivalent of two (2) weeks’ work without an acceptable excuse, the teacher may file an administrative withdraw to remove the student from class. Individual faculty members have the right to establish attendance regulations, which may include reduced grades for students who miss class and/or lab.

A student may withdraw from class without penalty up to the ninth week of the semester. It is advised that a student discuss any plans regarding withdraw from class with their teacher before taking action. Failure to attend classes does not constitute a course al withdraw and will result in the assignment of a failing grade. Students who withdraw due to illness or some other emergency, should petition the Vice President of Student Affairs for an Excused Withdraw.

Departmental Final Examination

Your instructor is required to administer a comprehensive final examination during the final week of the semester. The content has been determined by committee and can be found in the course outline which follows. This examination must count for at least 15% of your final grade.
Lecture Outline

I. Introduction to Microbiology
   A. The History of Microbiology [Chapter 1]
      i. The Discovery of Microorganisms
      ii. The Germ Theory of Disease - Koch's Postulates
      iii. Birth of Chemotherapy
      iv. Later Advances in the Study of Microbes
   B. Characterization, Classification and Identification of Microorganisms [Chapter 10]
      i. Major Characteristics of Microorganisms
      ii. Criteria for Classification
      iii. Taxonomy and Nomenclature
      iv. Methods of Classification and Identification

II. Laboratory Study of Microorganisms
   A. The Staining of Bacterial Cells [Chapter 3]
      i. Simple, Differential, and Special Stains
   B. The Cultivation of Bacteria [Chapter 6]
      i. Nutritional Classification (Autotrophic Vs. Heterotrophic)
         1. Media Types
         2. Defined
         3. Complex
         4. Selective
         5. Differential
      ii. Physical and Chemical Conditions Required For Growth
      iii. Pure Culture Methods
         1. Reproduction and Growth of Bacteria
         2. Growth Rate and Generation Time
      iv. Normal Growth Curve
      v. Measurement of Bacterial Growth

III. Survey of Bacteria and Viruses
   A. Bacteria (Prokaryotes) [Chapter 4]
      i. Morphology and Structural Components
         1. Bacterial Cytoplasm, Cell Membrane and Cell Wall
         2. Molecular Basis of Penicillin Antibacterial Activity
         3. The Glycocalyx
         4. Appendages - Flagella and Pili
         5. Inclusions
         6. Endospores
      ii. Major Groups of Bacteria
         1. Bacteria of Ecological, Industrial, and General Significance [Chapter 27 & 28]
         2. Bacteria of Medical Importance [Chapter 21-26]
         3. Representative Species of the Following Genera:
            a. Treponema

Edited January 12, 2016
b. Neisseria  
c. Bordetella  
d. Salmonella  
e. Hemophilus  
f. Staphylococcus  
g. Streptococcus  
h. Others: Optional, at the discretion of the professor, time permitting.

B. Viruses [Chapter 13]  
i. Morphology  
ii. Cultivation  
iii. Replication of Bacteriophages (Lytic Cycle/Lysogenic)  
iv. Replication of Animal Viruses  
v. Classification

C. Viruses of Medical Importance [Chapter 21-26]  
i. Influenza  
ii. Herpes  
iii. Hepatitis  
iv. Human Immune Deficiency Virus (HIV) - AIDS  
v. Molecular Basis of Antiviral Chemotherapeutic Agents  
vi. Viruses and Cancer  
vii. Others: Optional, at the discretion of the professor, time permitting

IV. Metabolism of Microorganisms [Chapter 5]  
A. Enzymes and Their Regulation  
i. Mechanisms of Enzyme Action  
ii. Conditions Affecting Enzyme Activity  
iii. Enzyme Inhibition as an Antimicrobial Therapy Agent

B. Energy Release (Catabolism)  
i. Energy - Characteristics and Measurement  
ii. Biological Oxidation (Dehydrogenation)  
1. An Energetics Oriented Description of Glycolysis and Citric Acid Cycle  
iii. Electron Transfer (Electron Transport  
iv. Chemiosmotic Theory  
v. Respiration (Aerobic) vs. Fermentation (Anaerobic)  
1. Relative Phosphorylative Efficiencies  
vi. Alternate Pathways for Fermentation

C. Energy Utilization (Anabolism)  
i. Use of Energy in Non-Biosynthetic Processes - Motility  
ii. Use of Energy for Biosynthesis of Organic Molecules  
1. General Description - Light Dependent vs. Light Independent Photosynthesis

V. Microbial Genetics [Chapter 8]  
A. Nucleic Acids  
i. DNA vs. RNA - A Comparison
ii. Nucleic Acid Biosynthesis - General Description

iii. Protein Synthesis
   1. Antibacterial Inhibition of Bacterial Translation

iv. Regulation and Expression of Gene Activity
   1. Operon Theory - Lactose Induction

B. Genetics of Bacteria
   i. Variability and Inheritance of Characteristics
   ii. Phenotypic vs. Genotypic Changes
   iii. Mutational Origin of Bacterial Resistance to Antibiotic Therapy
   iv. Bacterial Recombination
      1. Conjugation
      2. Transformation
      3. Transduction
      4. Plasmids and Transposons

VI. Biotechnology and DNA Technology [Chapter 9]
   A. The Isolation of a Gene
      i. The Production of Medically Important Proteins
   B. Formation of a Chimera
      i. Restriction Endonucleases
      ii. Ligation
   C. A Choice of Vectors
      i. Plasmids
      ii. Viruses
   D. Selection - Engineered Cells
      i. Selective Media – LB/Amp/X-gal

VII. Control of Microorganisms [Chapter 7]
   A. Fundamentals of Control
      i. Terminology
      ii. Pattern and Rate of Bacterial Death
      iii. Mode of Action of Antimicrobial Agents
   B. Control by Physical Agents
   C. Control by Chemical Agents

VIII. Antimicrobial Drugs [Chapter 20]

IX. Microorganisms and Disease Host Resistance to Infection
   A. Host-Microbe Interactions [Chapter 15]
      i. Mutualism and Commensalism
      ii. Pathogenicity
      iii. Microbial Virulence Factors
      iv. Factors Influencing Infection and Transmission of Communicable Diseases
   B. Host Resistance
      i. Natural Resistance and Non-Specific Defense Mechanisms [Chapter 16]
      ii. Specific Defense Mechanisms - Acquired Immunity [Chapter 17]
         1. Active vs. Passive Immunity
         2. Antigens and Antibodies

Edited January 12, 2016
a. Properties of Antigens
b. Functional Classification of Antibodies
c. Function of T and B Cells

X. Hypersensitivities (Immediate Type vs. Delayed Type) [Chapter 19]
XI. Representative and Relevant Diseases of Various Body Systems time permitting (selected from the referenced chapters by the professor) [Chapter 21-26]
# Biology 241 - Lab Schedule

<table>
<thead>
<tr>
<th>Session</th>
<th>Topic</th>
<th>Exercise (Page nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lab Safety, Microscopy Examination of Stained Cell Preparations (optional hand washing or environmental sampling)</td>
<td>Handouts, 1</td>
</tr>
<tr>
<td>2</td>
<td>Living Microorganisms (optional continue looking at slides or env. sampling)</td>
<td>2 (pp. 1-14)</td>
</tr>
<tr>
<td>3</td>
<td>Culture Transfer Techniques; Techniques for Isolation of Pure Cultures</td>
<td>3, 4, (pp. 15-23; 37-48; omit Part B (Isolation of pure cultures) of lab 4 on pp. 24-26)</td>
</tr>
<tr>
<td>4</td>
<td>Preparation of Bacterial Smears; Simple Staining; Negative Staining</td>
<td>7, 8, 9, (pp. 49-74)</td>
</tr>
<tr>
<td>5</td>
<td>Gram stain; Differential Staining for Visualization of Bacterial Cell Structures</td>
<td>10, 11</td>
</tr>
<tr>
<td>6</td>
<td>Use of Differential, Selective and Enriched Media; Carbohydrate Fermentation; Triple Sugar-Iron Agar Test; IMViC Test</td>
<td>12-15 (pp. 75-108)</td>
</tr>
<tr>
<td>7</td>
<td>Evaluating results of Ex. 12-15 (optional lab exam)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Use of Differential/Selective Media to ID Unknown Cultures</td>
<td>12-15 (pp. 75-108)</td>
</tr>
<tr>
<td>9</td>
<td>Evaluating Results of ID of Unknowns; AB resistance</td>
<td>12-15 (pp. 75-108)</td>
</tr>
<tr>
<td>10</td>
<td>Bacterial Transformation</td>
<td>17 (pp. 121-128)</td>
</tr>
<tr>
<td>11</td>
<td>Isolation of Bacterial Plasmids (or start transformations); Restriction Analysis (or start plasmid isolation—no gels)</td>
<td>18-19 (pp. 129-142)</td>
</tr>
<tr>
<td>12</td>
<td>Electrophoretic Separation of DNA (or combine with restriction analysis)</td>
<td>19 (pp. 142-148)</td>
</tr>
</tbody>
</table>