

Bergen Community College
Division of Mathematics, Science, and Technology
Department of Biology and Horticulture

Environmental Microbiology (BIO-224)
General Course Syllabus
Spring2016

Course Title:	BIO 224 Environmental Microbiology
Course Description:	This is a course concerning bacteria and other microorganisms and their role in the environment. Topics will include an introduction to the main groups of microorganisms and their physiology, soil microbiology, cycles of elements, aquatic microbiology, sewage treatment, bioremediation, and applied microbiology encompassing food microbiology, industrial microbiology, and biotechnology.
Prerequisites:	BIO 101 General Biology I, BIO 203 General Biology II
General Ed Course:	No
Course Credit:	4.0
Hours per week:	6.0: 3 hours lecture and 3 hours lab
Course Coordinator:	Luis Jimenez
Required Lecture Textbook:	Environmental Microbiology, 3 rd Edition, (Pepper, Gerba, Gentry), Academic Press. Philadelphia, Pennsylvania, ISBN: 978-0123946263
Supplementary Text: (Optional)	Brock Biology of Microorganisms, 13 th Edition, (Madigan, Martinko, Stahl, Clark), Benjamin Cummings Publishers, Upper Saddle River, New Jersey, ISBN: 978-0321649638.
Required Laboratory Manual:	Environmental Microbiology, A Laboratory Manual, 2 nd ed., (Pepper, Gerba, and Brendecke), Academic Press. Philadelphia, Pennsylvania, ISBN: 978-0125506564
Supplementary Manual: (Optional)	Microbiology Lab Manual, 2 nd ed., (Bablanian and Payne), Kendall-Hunt, ISBN: 978-0-7575-5789-7.
Laboratory Materials:	Students must wear protective eye wear and should purchase latex gloves and laboratory coats.

Student Learning Objectives:

The student will be able to:

1. Students will learn the major principles of environmental microbiology and the relationship of microbes to environmental processes and other living organisms. Assessment will be based upon performance on exam questions. Assessment can also be based on research papers/projects.
2. Students will demonstrate proper scientific procedure to identify various type of environmental microbes. Students will be evaluated by observation in the laboratory and analysis of unknown bacteria and projects. Assessment will also be based upon performance on exam question and laboratory projects.
3. Students will be able to explain the scientific basis for each technique used. Students will be required to answer exam questions designed to allow them to demonstrate their acquisition and retention of this knowledge.
4. Students will demonstrate proper scientific laboratory record keeping. Students will be evaluated by periodic notebook collection.
5. Students will learn to practice critical thinking skills and apply them to both material presented in lecture and the analysis of data generated in the laboratory. Students will be evaluated by observation in the laboratory and analysis of experimental results. Assessment will also be based upon performance on exam questions.
6. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
7. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Student Assessment Tools:

The above student learning objectives will be generally assessed or evaluated by instructors using a variety of **assessment instruments** including **lecture exams, laboratory exams, quizzes, laboratory reports, written reports, presentations, projects, etc.** The decisions concerning the type or types and number of instruments that are used in a specific section of the course will be left to the instructor of that section. This information, when given by the instructor should be recorded by the student in the **Student Assessment Section** of this document.

Course Content

Lecture Topics:

Chapter	Title	Text: Environmental Microbiology, 3 rd Edition,
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Week 1

Chapter 1	Introduction to Environmental Microbiology A. Environmental Microbiology as a Discipline. B. Microbial Influences on our Daily Lives.	
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Chapter 2	Microorganisms Found in the Environment A. Classification of Organisms. B. Prokaryotes. C. Eukaryotes. D. Viruses. E. Other Biological Entities.	
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Week 2

- Chapter 3 Bacterial Growth
- A. Growth in Pure Cultures in a Flask.
 - B. Continuous Cultures.
 - C. Growth in the Environment.

Week 3

- Chapter 4 Earth Environments
- A. Earth's Living Skin.
 - B. Physiochemical Characteristics of the Earth Environment.
 - C. Soil as a Microbial Environment.
 - D. Microorganisms in Surface Soils.
 - E. Distribution of Microorganisms in Soil.
 - F. Microorganisms in Subsurface Environments.

Week 4

- Chapter 5 Aeromicrobiology
- A. Aerosols.
 - B. Nature of Bioaerosols.
 - C. Aeromicrobiology Pathway.
 - D. Microbial Survival in the Air.
 - E. Extramural Aeromicrobiology.
 - F. Intramural Microbiology.

Week 5

- Chapter 6 Aquatic Environments
- A. Microbial Habitats in the Aquatic Environment.
 - B. Microbial Lifestyles in Aquatic Environments.
 - C. Marine Environments.
 - D. Freshwater Environments.
 - E. Other Notable Aquatic Environments.

Week 6

- Chapter 7 Extreme Environments
- A. Low Temperature Environments.
 - B. High Temperature Environments.
 - C. Desiccation and UV Stress.
 - D. Aphotic Environments Based on Chemolithoautotrophy.

Week 7

- Chapter 8 Environmental Sample Collection and Processing
- A. Soils and Sediments.
 - B. Water.
 - C. Air.
 - D. Detection of Microorganisms on Fomites.

- Chapter 9 Microscopic Techniques
- A. Visible Light Microscopy.
 - B. Fluorescence Microscopy.

C. Electron Microscopy.

Week 8

Chapter 10

Cultural Methods

- A. Extraction and Isolation Techniques.
- B. Plating Methods.
- C. Culture Media for Bacteria.
- D. Culture Methods for Algae and Cyanobacteria.
- E. Cell Culture-Based Methods for Viruses.

Chapter 11

Physiological Methods

- A. Measuring Microbial Activity in Pure Culture.
- B. Choosing the Appropriate Activity Measurement for Environmental Samples.
- C. Carbon Respiration.
- D. Incorporation of Radiolabeled Tracers into Cellular Macromolecules.
- E. Adenylate Energy Charge.
- F. Enzyme Assays.

Week 9

Chapter 12

Immunological Methods

- A. What is an Antibody?
- B. Immunoassays.
- C. Immunosensors.

Chapter 13

Nucleic Acid-Based Methods

- A. Structure and Complementarity of Nucleic Acids.
- B. Obtaining Microbial Nucleic Acids from the Environment.
- C. Hybridization-Based Assays.
- D. Amplification-Based Assays.
- E. DNA Fingerprinting.
- F. Recombinant DNA Techniques.
- G. Sequence Analysis.

Week 10

Chapter 16

Biogeochemical Cycling

- A. Carbon Cycle.
- B. Nitrogen Cycle.
- C. Sulfur Cycle.
- D. Iron Cycle.

Week 11

Chapter 17

Microorganisms and Organic Pollutants

- A. The Overall Process of Biodegradation.
- B. Contaminant Structure, Toxicity, and Biodegradability.
- C. Environmental Factors Affecting Biodegradation.
- D. Biodegradation of Organic Pollutants.
- E. Bioremediation.

Chapter 18

Microorganisms and Metal Pollutants

- A. Metals in the Environment.
- B. Metal Solubility, Bioavailability, and Speciation.
- C. Metal Effects on the Microbial Cell.

- D. Mechanisms of Microbial Metal Resistance and Detoxification.
- E. Microbial Metal Transformations.
- F. Microbial Approaches in the Remediation of Metal-Contaminated Environments.

Week 12 and 13

- Chapter 19 Microbial Diversity and Interactions in Natural Ecosystems
- A. Microbial Diversity in Natural Systems.
 - B. Microbial Interactions.
 - C. Microbial Diversity and Natural Products.

Week 14

- Chapter 23 Indicator Microorganisms
- A. Total Coliforms.
 - B. Fecal Coliforms and *Escherichia coli*.
 - C. Fecal *Enterococci*.
 - D. *Clostridium perfringens*.
 - E. *Bacteroides* and *Bifidobacterium*.
 - F. Heterotrophic Plate Count.
 - G. Bacteriophages.
- Chapters 25, 28 Municipal Wastewater Treatment, Drinking Water Treatment
- A. The Nature of Wastewater.
 - B. Conventional Wastewater Treatment.
 - C. Oxidation Pools.
 - D. Septic Tanks.
 - E. Wetlands Systems.
 - F. Sludge Processing.

- Week 15 - **FINAL EXAM**

Laboratory Schedule:**Week Title Text: Env. Micro., A Laboratory Manual, 2nd Ed.**

1	Introduction to the Lab, Aseptic Techniques, Cultural Characteristics Of Bacteria, Environmental Sampling
2	Microscopic Techniques Prep and Care of Stock Cultures
3	Cultural and Physiological Methods
4	Soil Microbiology
5	Air Microbiology
6	Water Microbiology
7	DNA Extraction
8	Amplification of Bacterial 16S rRNA Genes
9	Amplification of Functional Microbial Genes
10	Gel Electrophoresis
11	Sequencing of Bacterial 16S rRNA and Functional Genes
12	Composting and Thermophilic Bacteria
13	Bioremediation
14	Lab Project
15	Lab Final and Presentation

Student Assessment:	Lecture Examinations_____	_____%
	Laboratory Component_____	_____%
	Student Project/Report_____	_____%
	Class Participation	_____%
	Other	_____%
	Total	100%

If you have a medical condition or develop a medical condition during this semester, which prevents you from fulfilling the requirements of this course, you must notify your physician. You and your physician must decide whether or not it is appropriate for you to remain in this course. If the decision is to remain in this course, please obtain a letter from your physician indicating that your continued participation in this course is appropriate and present it to the Department Chair.

Faculty Addenda: As per individual faculty member

Lecture Attendance: As per instructor;

Lab Attendance: As per instructor;

Policy Concerning Late Assignments: As per instructor;

Policy Concerning Make-Up Testing: As per instructor;

Safety Information: As per instructor and assigned exercise;

College Policies:

Student Responsibility

Students will be held responsible for reading all pertinent information in college publications regarding withdrawals, course drops, college deadlines, and tuition refunds. Students are responsible for compliance with the rules and regulations as stated in college publications.

Absence of Instructor

Students are expected to wait twenty minutes for a faculty member to come to class. If at the end of twenty minutes, the faculty member does not come, the students should sign an attendance sheet, which indicates the course, date, and time. A student should deliver the attendance sheet to the divisional office (A304) if between 9:00 a.m. and 5:00 p.m. or to the Evening Office (C107) if before 9:00 a.m. or after 5:00 p.m. Students cannot be penalized by faculty for not waiting longer than twenty minutes.

Academic Dishonesty and Plagiarism

Bergen Community College is committed to academic integrity – the honest, fair and continuing pursuit of knowledge, free from fraud or deception. Students are responsible for their own work. Faculty and academic support services staff will take appropriate measures to discourage academic dishonesty. **Plagiarism** is a form of academic dishonesty and may be a violation of U.S. Copyright laws. Plagiarism is defined as the act of taking someone else's words, opinions, or ideas and claiming them as one's own.

Consequences of Violations Academic Integrity

A. Instructor's Sanctions for a Violation

The faculty member will determine the course of action to be followed. This may include:

- Assigning a failing grade on the assignment;
- Assigning a lower final course grade;
- Failing the student in the course
- Other penalties appropriate to the violation;

In all cases, the instructor shall notify the Vice President of Student Services of the violation and the penalty imposed. The student has the right to appeal the decision of the instructor to the appropriate department head.

B. Institutional Sanctions for Violations

When a violation of academic integrity has been reported regarding a student, the Vice President of Student Services may impose disciplinary penalties beyond those imposed by the course instructor, which may include suspension or dismissal from the College. The student shall have the right to a hearing before the Vice President of Student Services or a designated judicial affairs committee. Judicial procedures governing violations of academic integrity are contained in the student handbook.

Class Attendance

All students are expected to attend punctually every scheduled meeting of each course in which they are registered. Attendance and lateness policies and sanctions are to be determined by the instructor for each section of each course. These will be established in writing on the individual course outline. Attendance will be kept by the instructor for administrative and counseling purposes.

Eating and Drinking

Eating or drinking in classrooms, lecture rooms, laboratories, gymnasium, swimming pool, or passageways is forbidden. Covered beverages only are permitted in the library. Eating and drinking are permitted in cafeteria and vending areas only.

Learning Assistance

Henry and Edith Cerullo Learning Assistance Center

The Tutoring Center, English Language Resource Center, Math Walk-In Center and Writing Center are collectively known as the Henry and Edith Cerullo Learning Assistance Center. The Cerullo Learning Assistance Center is located in the Pitkin Education Building, in Room L-125. The telephone number is (201) 447-7489. The Learning Assistance Center, staffed with peer and professional tutors, offers free individual and group tutoring, supplemental instruction, and online tutoring for subjects offered at the College. The Center provides alternative approaches to problem solving and organizational skills. Tutors help clarify classroom lectures and textbooks and help students prepare for exams. These services build student self-confidence and reduce fear of failure. The Center is equipped with the latest technology and software, including tapes, books, review sheets, exercises and software.

Services for Students with Disabilities

Bergen Community College aims to create inclusive learning environments where all students have maximum opportunities for success. Any student who feels he or she may need an accommodation based on the impact of a disability should contact the Office of Specialized Services at 201-612-5269 or via email at ossinfo@bergen.edu for assistance.

Sidney Silverman Library

Main Building, Pitkin Education Center, L-wing, 2nd Floor.

Paramus Library Hours: (201) 447-7131 or visit <http://www.bergen.edu/library/calendar/gcal.htm>

Paramus Service Desk: (201) 447-7970

Meadowlands Location: 1280 Wall Street, Lyndhurst 2nd Floor

Meadowlands Library Hours: <http://www.bergen.edu/library/calendar/gcal.htm>

Meadowlands Service Desk: (201) 301-9692

www.bergen.edu/library

Testing Services

The Bergen Community College Office of Testing Services (OTS) is located in Room S-127. OTS serves the college community by identifying, developing, procuring, administering, processing, and/or evaluating examinations, which meet a variety of administrative and instructional needs. To contact the OTS, please call (201) 447-7202. The Office of Testing Services administers makeup tests as a service for students who, for compelling and exceptional reasons, have missed a scheduled classroom examination. Students must receive prior permission from and make arrangements with their course instructors to take these examinations, under specific conditions, in the Office of Testing Services, Room S-127.

WebAdvisor

WebAdvisor is a web interface that allows students to access information contained in Datatel's Colleague, the administrative database used by Bergen Community College. Students may use WebAdvisor to register for classes, to pay tuition and fees, to view their class schedules, to check grades, to check on progress toward degree requirements, etc. WebAdvisor accounts are available for all students enrolled in credit programs. New students are strongly encouraged to attend an in-person registration or advisement session before using a WebAdvisor account. Eligible students without WebAdvisor user names and passwords may access their WebAdvisor account by going to go.bergen.edu and selecting "I'm new to WebAdvisor." Then, follow the on-screen directions. Check the WebAdvisor FAQ for answers to common questions, such as how to reset your password. Students must have a valid e-mail address on file with the College to use WebAdvisor