

Prepared by the Department of Natural Science and Applied Technology

Date of Departmental Approval: September 29, 2014

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Effective: Fall 2014

1. **Title: BIO161 The Microbial World
BIO161L The Microbial World Laboratory**

2. **Course Description**

An introduction to microorganisms and the roles they play in our environment and our bodies, for non-science majors. The topics covered include the different types of microbes, their cell structure, function, ecology, physiology and genetics. An introduction will be given to applied microbiology including the fields of agricultural, food, industrial and medical microbiology and of microbial ecology. The laboratory component introduces basic skills of viewing, handling, isolating, growing, and identifying microorganisms. *This course satisfies a 4-credit science course with lab for the Mass Transfer Block of 34 General Education credits.*

3. **Student Learning Outcomes (Instructional Objectives, Intellectual skills)**

Upon completion of the course, the student is able to:

- Explain what microorganisms are, and list some of their basic characteristics, and how these are determined by their genome sequences.
- Describe the diversity of today's microorganisms; how they are classified, detected, and change over time.
- Describe how microorganisms grow and utilize nutrients from their environment.
- Explain microbial communities and the roles of microbes in various ecosystems, including possible effects of environmental changes.
- Describe the microorganisms present on and in our bodies, and how they affect our health, immunity and ability to defend ourselves against infection.
- Explain the ability of some microorganisms to cause disease; virulence factors, antibiotics resistance, and routes of transmission
- Describe the use of microorganisms in the production of food and pharmacological compounds, and how biotechnology plays a role in some of these applications.
- Explain the roles of microorganisms in generating bioenergy and in responding to pollution of our environment.
- Evaluate and explain microbe-related published data, including public health information (i.e. text, images, tables, graphs).
- Write a research paper on a microorganism of choice.
- Evaluate sources of information from authoritative websites and articles, based on knowledge acquired in the classroom.
- Examine and evaluate public data on microbes and their role in our environment and the health of humans.
- Synthesize a point of view, and present it to a peer
- Manipulate, summarize, interpret and present data in the form of graphs and charts
- Describe the importance of microorganisms in human health and the basis of public health including microbial pathogens, their transmission and ability to cause disease.
- Describe the effect of pollution and climate changes on microorganisms in our environment.
- Describe the meaning of biotechnology and give examples of how microorganisms are genetically altered for production of foods, medicines, bioenergy.
- Describe the many roles microbes play in human health; as essential functional components of our bodies yet potentially causing disease that can be transmitted. How social and behavioral factors and pollution affect the growth and dissemination of microbes.
- Discuss the diversity of functions that are carried out by microbes and how their use in industrial applications (bioremediation, bioenergy, pharmacology, and food production) are affecting our lives.

- Explain how microbes may play a role in the future, as emerging infectious diseases, as ‘factories of needed compounds’, as environmental indicators.
- Examine and evaluate published microbe-related data in the form of spreadsheets, graphs and charts.
- Evaluate (consensus) sources of information from authoritative web sites and articles.
- Manipulate, summarize, interpret, and present data, in the form of graphs and charts, to arrive at meaningful conclusions.
- Identify reliable sources of information available online, specifically governmental and public health authority resources, upload/download files, and view multimedia online.
- Manipulate, summarize, interpret, and present data using appropriate software to arrive at meaningful conclusions.

4. Credits: 4 credits

5. Satisfies General Education Requirement: Yes Natural or Physical Science

6. Prerequisite(s): ENL101, MAT035

7. Semester(s) Offered: Fall and Spring

8. Suggested Guidelines for Evaluation:

Evaluation will be based on written exams, quizzes, research paper, a lecture final exam, and a lab exam.

9. General Topical Outline of the Course:

- I. What are microorganisms
 - a. Major groups of microorganisms and their characteristics
 - b. Review of macromolecules (nucleic acids, proteins, polysaccharides, lipids) and their functions
 - c. Differences between eukaryotic and prokaryotic microorganisms
 - d. The genome as the blueprint for cell function
- II. Diversity of microorganisms
 - a. Evolutionary relationships between organisms
 - b. Classification of organisms using nucleic acids
 - c. The species concept
 - d. Detection of microorganisms by microscopy, nucleic acids, functions)
- III. Nutrition and growth of microorganisms
 - a. Nutrition and growth requirements
 - b. Growth properties, and spore formation
 - c. Microbial metabolism
- IV. Microbial ecology
 - a. Microbial communities (biofilms)
 - b. Role of microorganisms in ecosystems
 - c. Detection of environmental microbes
 - d. Detection of microbial function in the environment
- V. The human body as a microbial habitat
 - a. The human microbiome
 - b. The microbiome and human health
 - c. Personalized medicine
- VI. The human body's response to microbes
 - a. Types of immune cells
 - b. Innate and adaptive immune responses
 - c. Vaccinations
- VII. Microbes and disease
 - a. Microbial virulence factors
 - b. Transmission routes of pathogens
 - c. Identification of infectious agents
 - d. Antibiotic resistance and its implications
- VIII. Public health

- a. Role of the Centers for Disease Control
- b. Monitoring disease outbreaks
- c. Historically important and current outbreaks
- IX. Industrial applications
 - a. Biotechnology and microorganisms
 - b. Food microbiology
 - c. Pharmaceutical applications
 - d. Agricultural applications
- X. Microbes and the environment
 - a. Bioenergy
 - b. Algal blooms
 - c. Microbial bioremediation
 - d. Environmental microbiomes

Lab experiments:

1. Hay infusion: Microscopic examination of microbes in an environmental sample.
2. Winogradsky column: Collect sediment sample from environment, set up column, and monitor changes over several weeks.
3. Simple stain and Gram stain of microorganisms
4. Microbiology of potatoes: Inoculate pond water on a potato slice, monitor growth under different conditions.
5. Soil microbiology: Grow organisms from moist or dry soil samples, observe the different types of microbes.
6. Bacterial growth and effect of selected compounds: Growth enumeration (virtual experiment), factors that affect growth (pH, temperature, etc)
7. Metabolic diversity of microorganisms: Differentiate bacteria based on fermentation characteristics.
8. Algal blooms: WHOI monitoring virtual experiment.
9. Fungi, lichens: Slide observation.
10. Food microbiology: How to make yogurt, and ferment fruit juice.