Virginia Western Community College
BIO 205
General Microbiology

Prerequisites

One semester of college biology and one year of college chemistry or divisional approval; an ENG 111 placement recommendation, co-enrollment in ENF 3/ENG 111, or successful completion of all developmental English requirements.

Course Description

Examines morphology, genetics, physiology, ecology, and control of microorganisms. Emphasizes application of microbiological techniques to selected fields. Focuses on human pathogens and the process of pathogenicity.

In this survey course, students explore the vast world of microbiology and the myriad ways microorganisms influence everyday life, with an emphasis on human health and disease. Initially, students study the history of microbiology and the classification and structure of microorganisms. After a basic introduction which outlines some of the major discoveries in the field of microbiology, students begin an in-depth look at microbial metabolism and genetics. The latest technologies are discussed, and the impact that genetics of the microbial organisms have on humans is emphasized. Students will also begin to explore the individual categories of microorganisms and individual representatives of each type of microbe. The course concludes with an overview of microbial control (with a focus on antibiotic resistance), epidemiology and the human immune system. Students learn how the human body remains healthy in the face of numerous microbial invaders, with the overall goal of improving their own personal health. Throughout the course, realistic examples from current events are presented and discussed in the context of the course material, and laboratory exercises are conducted to complement the lecture material.

Semester Credits: 4 **Lecture Hours: 3** **Laboratory Hours: 3**

Required Materials

Textbook:
Microbiology: The Human Experience, Foster, Aliabadi, & Slonczewski. ISBN 978-0-393-93826-5 (E book), ISBN 978-0-393-97858-2 (Paperback), Norton Publishing Company (Access code for online content required)
Software:
Virtual Unknown Microbiology (Vumie); Intuitive Systems https://vumicro.com

Other Required Materials:
Lab Coat, Goggles

Course Outcomes

At the completion of this course, the student should be able to:

- Practice safe microbiology culture techniques, using appropriate protective and emergency procedures.
- Properly prepare and view specimens for examination using bright field microscopy
- Use pure culture and selective techniques to enrich for and isolate microorganisms.
- Use appropriate media-based and biochemical methods to identify microorganisms
- Use molecular techniques to identify microorganisms
- Estimate the number of microorganisms in a sample using viable plate count
- Determine antibiotic susceptibility of various microorganisms
- Use appropriate microbiological and molecular lab equipment and methods.
- Document and report on experimental protocols, results and conclusions

Topical Description:

1. History of Microbiology:
    a. Germ theory vs spontaneous generation
    b. Founders of microbiology: Koch, Pasteur, Semmelweis, van Leeuwenhoek, Nightengale
2. Types of microbes:
    a. Viruses, prions, viroids
    b. Bacteria, eukaryotes (archaea, algae, protists, etc)
3. Prokaryotic growth
    a. Growth curves
    b. Factors influencing growth: pH, temperature, nutrients, oxygen
    c. Aerotolerance of microorganisms
4. Microscopy:
    a. Light vs EM
    b. Staining techniques: Gram, spore, acid fast, fluorescent, flagellar
5. Prokaryotic cell biology:
    a. Size, shape, growth habits of prokaryotes
    b. Chemical composition and molecular structure of Gram negative, Gram positive, Mycobacterial cell wall
    c. Composition and function of plasma membrane
    d. Outer structures: flagella, pili, capsules, etc
    e. Inner structures: endospores, storage granules, etc
6. Microbial metabolism
    a. Role of enzymes
    b. Central metabolic pathways:
        i. Glycolysis
        ii. TCA cycle
        iii. Pentose phosphate pathway
        iv. Oxidative phosphorylation and electron transport chain
    c. Fermentation pathways
7. Food Microbiology
    a. Use of microbes in food and beverage production

   b. Food spoilage
   c. Foodborne illnesses
8. Microbial gene expression
   a. DNA replicatiron
   b. Transcription
   c. Translation
   d. Regulation of gene expression- operons
9. Microbial genetics
   a. Horizontal gene transfer:
      i. Transformation
      ii. Transduction
      iii. Conjugation
   b. Mobile genetic elements
   c. Mutations
10. Biotechnology
   a. Tools of biotechnology: gel electrophoresis, DNA sequencing, restriction enzymes, polymerase chain reaction
   b. Applications
11. Host-Microbe interactions
   a. Establishing infection
   b. Immune system avoidance
   c. Microbial toxins- mechanism of action
      i. Exotoxins
      ii. Endotoxins
12. Non-living microbes: Viruses, viroids and prions
   a. Structure and classification
      i. Bacteriophages
      ii. Animal viruses
   b. Replicative cycles of different types of viruses
      i. DNA
      ii. RNA
      iii. Retroviruses
   c. Viruses and cancer- oncogenic viruses
   d. Overview of selected viral diseases
13. Eukaryotic microbes
   a. Fungi: classification
      i. Overview of select fungal diseases
   b. Protozoans: life cycles, overview of select diseases
   c. Helminths: life cycles, overview of select diseases
14. Control of Microbial Growth
   a. Microbial control: heat, filtration, refrigeration, radiation, etc
   b. Antibiotics:
      i. Selective toxicity and dosing
      ii. Determination of microbial susceptibility
      iii. Mechanisms of action
      iv. Antibiotic resistance: mechanisms

15. Innate Immune System:

   a. Skin and mucous membranes; other physical barriers
   b. Inflammation and phagocytosis
   c. Fever
   d. Antimicrobial substances: lysozyme, complement, interferons
16. Adaptive Immune System
   a. Antigens and antibodies
   b. Humoral vs cell mediated immunity
   c. Immune memory
   d. Cell types
   e. Applications of immunity: vaccinations

Laboratory Topics

- Use of the Compound Light Microscope
- Aseptic Culture Techniques
- Differential staining (Gram stain)
- Special staining techniques (acid fast stains and spore stains)
- Effects of environmental conditions on growth (aerobic vs. anaerobic)
- Bacterial enumeration by serial dilution and plate counting
- Bacterial Transformation
- DNA technology: DNA isolation, PCR, gel electrophoresis, DNA sequence analysis
- Use of disinfectants and U.V. Irradiation
- Antibiotic Sensitivity Testing (Disc Diffusion Method)
- Biochemical Testing and Selective and Differential Media
- Unknown identification with multi-test identification systems
- Eukaryotic Microorganisms – Yeast, Molds, and Protozoans (Slide identification)
- Immunology Techniques (Ex. ELISA)

Notes to Instructors

1. Departmental policy dictates that instructors do not allow students to keep tests.
2. A comprehensive final exam counting 15%-20% of the total grade will be given at the end of the semester.
3. The syllabus should state what the course grade will be based on, such as tests, quizzes, a comprehensive final exam, and any other assignments made by the instructor.
4. The VWCC Biology Department uses a 10-point grading scale.
5. Comprehensive study of the listed topics is beyond the reasonable expectations of a 15-week Biology 101 course. It is up to the discretion of the instructor to choose which topics are more detailed but each topic should be adequately covered.