Course Acronym:	MICR
Course Number:	33
Descriptive Title:	General Microbiology
Division:	Natural Sciences
Department:	Microbiology
Course Disciplines:	Biological Sciences
Catalog Description:	This course is a study of microbial anatomy and physiology, classification, microbes in water, air, soil, food, sewage, and medical aspects of microbiology. It also includes the study of fundamental techniques in the growth, culture, and identification of microorganisms. Laboratory experiments are performed by students to reinforce principles of microbiology discussed in lecture. This course is designed for students planning to pursue careers in the health sciences or other life sciences.
Prerequisite:	Biology 10 or Biology 10H or Anatomy 30 or Anatomy 32 or Anatomy and Physiology 34A or Physiology 31 or Biology 75 or Biology 76 AND Chemistry 4 or Chemistry 4H or Chemistry 20 or Chemistry 1A or Chemistry 21A with a minimum grade of C in prerequisite or equivalent
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	6
Outside Study Hours:	6
Total Course Hours:	162
Course Units:	5
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	
Transfer UC:	Yes

Effective Date:	
General Education: ECC	Area 1 - Natural Sciences
Term:	
Other:	
CSU GE:	Area B2 - Physical Universe and its Life Forms: Life Science, Area B3 - Physical Universe and its Life Forms: Laborator Activity
Term:	
Other:	
IGETC:	Area 5B - Biological Science, Area 5C - course that incorporate a laboratory
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Language** Students will be able to use language appropriate to microbiological studies and the health sciences **SLO #2 Instruments** Students will demonstrate the use of instruments to gather data. **SLO #3 Microbes** Student will be able to identify microbes and explain their roles in health and disease.
Course Objectives:	1. Describe the basic structure and functional characteristics of microorganisms and determine how they exist in their particular ecological niche. 2. Demonstrate the understanding and the ability to successfully practice aseptic techniques in the microbiology laboratory. 3. Provide details of and perform various staining techniques and biochemical tests used to identify bacteria in the laboratory. 4. Identify the measures and describe the procedures used to control microorganisms. This includes those that are personally carried out to halt the spread of infection and disease in the health care setting. 5. Explain the basic elements of the human immune system and how it functions to protect us from disease. 6. Compare and contrast different human diseases, including those that are food-borne, air-borne, arthropod-borne and those transmitted by sexual contact. 7. Discuss the roles microorganisms play in all aspects of human life and provide basic descriptions of what roles they play in many facets of biology including recombinant DNA research, genetic engineering, and biotechnological applications.
Major Topics:	**I. Introduction to Microbiology (3 hours, lecture)** A. History of Microbiology B. Introduction to the Scientific Process **II. Microscopy (3 hours, lecture)**

A. Microscope Parts
B. Microscope Functioning
C. Types of Microscopy

III. Chemistry and Biomolecules (3 hours, lecture)

A. Atoms, Elements, and Molecules
B. Chemical Bonds and pH
C. Structure and Function of Organic Macromolecules

IV. Cells (6 hours, lecture)

A. Cell Structures and Functions
B. Membrane Transport

V. Taxonomy and Classification (1 hour, lecture)

VI. Microbial Diversity (11 hours, lecture)

A. Bacteria
    1. Growth Curve
    2. Physical, Chemical and Mechanical Control Methods
B. Viruses
    1. Characteristics and Classification
    2. Replication

C. Fungi
    1. Cell Structures
    2. Reproduction
D. Protozoans and Parasitic Helminths
    1. Cell Structures
    2. Reproduction

VII. Epidemiology (3 hours, lecture)

A. Concepts of Infectious Disease
B. Pathogenesis
C. Modes of Transmission
D. Epidemiology Terminology

VIII. Metabolism (6 hours, lecture)

A. Energy Processing
B. Enzymes
C. Oxidation-Reduction Reactions
D. Role of Adenosine Triphosphate (ATP)
E. Aerobic Respiration
F. Anaerobic Respiration
G. Fermentation

IX. Molecular Biology (4 hours, lecture)

A. DNA Replication
B. Transcription
C. Translation

X. Microbial Genetics (3 hours, lecture)

A. Mutations (for example, Antibiotic Resistance)
B. Bacterial Recombination
    1. Transformation
    2. Transduction
    3. Conjugation
    4. Transposition

XI. Immunology (5 hours, lecture)

A. Innate Immunity
    1. Mechanical and Chemical Defenses
    2. White Blood Cells
    3. Phagocytosis
    4. Inflammation
B. Adaptive Immunity
    1. Cell Mediated Immunity
C.
    1.
        a. T Lymphocytes
    2. Acquired Humoral Immunity
        a. B Lymphocytes and Plasma Cells
        b. Antigens and Antibodies
    3. Vaccination

XII. Microbial Ecology and Industrial Microbiology (1 hour, lecture)

A. Roles of Microbes in Nutrient Recycling
B. Carbon, Oxygen, and Nitrogen Cycles

XIII. Biotechnology (5 hours, lecture)

A. DNA Techniques
B. Applications

XIV. LABORATORY TOPICS:

Select 13 or more experiments/exercises, including all starred required ones. The starred laboratories must be completed during the semester. **(108 hours, lab)**

A. Lab Safety*

B. Aseptic Transfers and Streak Plating*

C. Microscope Use*

D. Staining Procedures*

1. Simple Stains
2. Negative Stains
3. Gram Stain
4. Acid Fast Stain
5. Capsule Stain
6. Spore Stain
7. Flagellar Stain

E. Environmental Factors Effecting Growth*

1. Temperature
2. pH
3. Osmotic Pressure
4. Oxygen Requirements

F. Methods of Controlling Growth*

1. Antibiotics
2. Ultraviolet Radiation

G. Enumeration of Bacteria- Standard Plate Count*

H. Plaque Assay

I. Microorganisms

1. Fungi
2. Protozoans
3. Algae
4. Cyanobacteria

J. Biochemical Tests*

1. IMViC (Indole, Methyl Red, Voges Proskauer & Citrate)
2. Carbohydrate Fermentation
3. Catalase
4. Oxidase
5. Nitrate Reduction
6. Hydrogen Sulfide Production
7. Hydrolytic Reactions

K. Examination of Water

L. Blood Analysis

M. Lab Projects

1. Staining Unknown
2. Biochemical Unknown* (16 out of 108 hours)

	N. Scientific Method & Experimental Design O. Bacterial Transformation
Total Lecture Hours:	54
Total Laboratory Hours:	108
Total Hours:	162
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	In the space provided, calculate the number of ATP molecules and final end- products produced from one molecule of glucose utilized by Escherichia coli, during aerobic respiration
Critical Thinking Assignment 1:	In the space provided, explain the following case study question: An infant was admitted to the hospital experiencing the following symptoms: problematic swallowing, excessive drooling, the inability to move, and difficulty breathing. What laboratory tests would you order? Explain why. What type of treatment would you prescribe? Discuss which types of microorganisms could be causing this medical problem.
Critical Thinking Assignment 2:	In the space provided, explain the following case study question: An adult female with a gunshot wound to her abdomen was admitted to the hospital. What possible bacterial infections might she acquire from her wound and what types of antibiotics would she be given for preventative treatment?
Other Evaluation Methods:	Completion, Essay Exams, Homework Problems, Laboratory Reports, Matching Items, Multiple Choice, Objective Exam, Quizzes, Reading Reports, True/False, Written Homework, Presentation, Scientific Literacy Assignment
Instructional Methods:	Discussion, Lab, Lecture
If other:	
Work Outside of Class:	Answer questions, Problem solving activity, Required reading, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Textbooks:	Tortora, Funke, and Case. *Microbiology, An Introduction*, 13th ed. Benjamin Cummings, 2019. Brown, Alfred and Smith, Heidi. *Benson's Microbiological Applications Laboratory Manual*, 15th ed. McGraw-Hill, 2022.
Alternative Textbooks:	**Digital Text (OER Text)-** Parker, Schneegurt, Tu, Lister, and Forster. Microbiology. Openstax, 2021. https://openstax.org/books/microbiology/pages/1-introduction. Creative Commons Attribution License v4.0. Parks. *An Interactive Guide to Microbiology*, 1st ed. Great River Learning, 2020.
Required Supplementary Readings:	
Other Required Materials:	Colored pencils

	Laboratory notebook Sharpie pen
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Biology-10 or Biology-10H or Anatomy-30 or Anatomy-32 or Anatomy and Physiology-34A or Biology 75 or Biology 76 or Physiology-31 AND Chemistry-4 or Chemistry-4H or Chemistry-20 or Chemistry-1A or Chemistry-21A or
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Chemistry: Write symbols for chemical elements and know their meanings.** CHEM 20 - Use chemical terminology to name inorganic chemical compounds, formulas and reactions and classify types of chemical reactions. Perform stoichiometric calculations involving chemical reactions. CHEM 1A - The student will be more proficient in a. the use of scientific terminology. b. the naming and writing of chemical formulas for inorganic compounds: binary nonmetal compounds, salts, acids and bases. c. writing and classifying chemical equations for elementary chemical reactions. d. performing stoichiometric calculations involving chemical reactions. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4H - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 21A - Use the language of general chemistry (vocabulary, nomenclature, formulas and equations) to describe chemical systems and changes (physical and chemical) they undergo. **Have basic understanding of different reactions.** CHEM 20 - Use chemical terminology to name inorganic chemical compounds, formulas and reactions and classify types of chemical reactions. Perform stoichiometric calculations involving chemical reactions. CHEM 1A - The student will be more proficient in a. the use of scientific terminology. b. the naming and writing of chemical formulas for inorganic compounds: binary nonmetal compounds, salts, acids and bases.

c. writing and classifying chemical equations for elementary chemical reactions.
d. performing stoichiometric calculations involving chemical reactions.

CHEM 21A - Identify different types of chemical reactions (combination, decomposition, double and single replacement, and combustion). Predict products and write balanced chemical equations representing these reactions.

CHEM 4 - Differentiate between five reaction types: combination, decomposition, single replacement, double replacement, and complete oxidation. Given a set of reactants, diagnose the reaction type and predict the products.

CHEM 4H - Differentiate between five reactions types: combination, decomposition, single replacement, double replacement, and complete oxidation. Given a set of reactants, diagnose the reaction type and predict the products.

Have knowledge of pH.

CHEM 20 - Compare and contrast Arrhenius and Bronsted-Lowry acid theories. Write acid-base reactions and determine the pH of aqueous solutions. Demonstrate an understanding of how a buffer works.

CHEM 1A - Acids and bases: The student will

a. compare and contrast acid-base theories
b. predict acid strengths based on structure.
c. write and classify acid-base reactions.

CHEM 21A - Solve introductory level quantitative problems applied to chemical systems by using dimensional analysis and algebra. These problems include unit conversions, stoichiometry, gas laws, solution concentrations, and pH..

CHEM 4H - Solve problems and express answers in scientific and decimal notation with correct units and significant figures. Use logarithms to convert among pH, pOH, [H+], and [OH-].

CHEM 4 - Solve problems and express answers in scientific and decimal notation with correct units and significant figures. Use logarithms to convert among pH, pOH, [H+], and [OH-].

Have basic understanding of different types of bonds.

CHEM 1A - Structure: The student will

a. provide a historical picture of the development of atomic theory.
b. be able to state the fundamentals of quantum theory; assign quantum numbers and construct orbital diagrams.
c. predict and explain periodic trends of elements in terms of electronic configurations.
d. describe and illustrate the structure and bonding of molecules by constructing Lewis structures, sketching and labeling the molecular geometries of a molecule, describing the hybridization of the atoms involved, and determining polarity.
e. predict and explain properties of molecules in terms of structure and bonding.

f. predict and explain properties of conductors, semiconductors and insulators in terms of structure and bonding.

CHEM 20 - Use atomic theories to interpret the structure of an atom. Predict and explain periodic trends based on atomic structure and the periodic table. Describe and illustrate the structure and bonding for molecules using Lewis structures, molecular geometry and polarity.

CHEM 4H - Compare and contrast ionic and covalent compounds. Evaluate bonding based on the chemical formula, and then correlate compound properties with the structure and types of bonding present.

CHEM 4 - Compare and contrast ionic and covalent compounds. Evaluate bonding based on the chemical formula, and then correlate compound properties with the structure and types of bonding present.

CHEM 21A - Explain the difference between ionic and covalent bonding and write Lewis structures for molecules and polyatomic ions.

Biology: Demonstrate the proper use of the microscope.

ANAT 30 - Demonstrate proper use of the microscope.

ANAT 32 - Demonstrate the proper use of the microscope and identify specimens.

APHY 34A - Demonstrate mastery of the microscope and be able to identify the cellular structures and tissues for all the systems covered.

BIOL 10H - Describe the anatomy of cells and relate cellular structures to their functions.

BIOL 10 - Describe the anatomy of cells and relate cellular structures to their functions.

BIOL 75 - Select proper techniques including aseptic technique, proficiency using the Brightfield microscope, appropriate culture methodologies, and solution preparation including serial dilutions.

Have knowledge of homeostatic pathways.

BIOL 10H - Describe the biochemical pathways involved in photosynthesis and cellular respiration.

BIOL 10 - Describe the biochemical pathways involved in photosynthesis and cellular respiration.

PHYO 31 - Compare and contrast the methods whereby the body maintains homeostasis.

APHY 34A - Explain how the systems work together as a whole, and methods whereby the body maintains homeostasis.

ANAT 30 - Demonstrate an understanding of the physiology of each system and how each system interacts to maintain homeostasis.

	Have basic understanding of cellular structures and their functions. APHY 34A - Demonstrate mastery of the microscope and be able to identify the cellular structures and tissues for all the systems covered. ANAT 30 - Identify cellular structures, organelles and tissue types for all human systems. ANAT 32 - Identify cellular structures, organelles, and tissue types for all human organ systems. BIOL 10 - Describe the anatomy of cells and relate cellular structures to their functions. BIOL 10H - Describe the anatomy of cells and relate cellular structures to their functions. BIOL 76 - Compare and contrast the morphological differences between prokaryotic and eukaryotic cells. Diagram the distribution and function of organelles found in eukaryotic cells. **Have basic understanding of cellular reproduction.** ANAT 30 - Identify all major anatomical structures for each major system, including integumentary, skeletal, muscular, nervous, special senses, endocrine, digestive, cardiovascular, respiratory, urinary and reproductive systems. ANAT 32 - Identify the major anatomical structures for the major organ systems of the human body including integumentary, musculoskeletal, nervous, endocrine, digestive, circulatory, respiratory, urinary, and reproductive systems. BIOL 10 - Identify and describe the phases of mitosis and meiosis. BIOL 10H -Identify and describe the phases of mitosis and meiosis. **Discuss the roles microorganisms play in all aspects of human life and provide basic descriptions of what roles they play in many facets of biology including recombinant DNA research, genetic engineering, and biotechnological applications.** BIOL 75 - Evaluate the steps of the typical ELISA diagnostic test. BIOL 76 - Assess the environmental impacts of biotechnology.
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	

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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	G. E. Thompson
Date:	01/01/1971
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Thanh-Thuy Bui
Date:	02/11/2016
Last Board Approval Date:	12/19/2022