Course Syllabus

BIOL 2421 MICROBIOLOGY

Catalog Description: Lecture hours = 3, Lab hours = 3

For science majors. This course deals with the study of the morphology, physiology, genetics and taxonomy of both pathogenic and nonpathogenic microorganisms. Examination of public health concerns disease pathology and immunology is included. The isolation and identification of unknowns using correct laboratory techniques is required.

Prerequisites: TSIP reading completed and one semester credit from BIOL 1411, 1413, 2401, 2402, CHEM 1405, 1407, 1411 or 1412.

Semester Credit Hours: 4
Lecture Hours per Week: 3
Contact Hours per Semester: 96
State Approval Code: 2605035103

Course Subject/Catalog Number: BIOL 2421
Course Title: Microbiology

Course Curriculum: State Criteria (those marked with an X reflect the state-mandated competencies taught in this course) *(double-click on the box and choose 'checked' or 'not-checked')*

Basic Intellectual Competencies in the Core Curriculum

- ☒ Reading
- ☒ Writing
- ☒ Speaking
- ☒ Listening
- ☒ Critical thinking
- ☒ Computer literacy

Perspectives in the Core Curriculum

- ☒ Establish broad and multiple perspectives on the individual in relationship to the larger society and world in which he/she lives, and to understand the responsibilities of living in a culturally and ethnically diversified world.
- ☒ Stimulate a capacity to discuss and reflect upon individual, political, economic, and social aspects of life in order to understand ways in which to be a responsible member of society.
- ☒ Recognize the importance of maintaining health and wellness.
- ☒ Develop a capacity to use knowledge of how technology and science affect their lives.
- ☒ Develop personal values for ethical behavior.

☒ Develop the ability to make aesthetic judgments.

☒ Use logical reasoning in problem solving.

☒ Integrate knowledge and understand the interrelationships of the scholarly disciplines.

Core Components and Related Exemplary Educational Objectives

Natural Sciences
The objective of the study of a natural sciences component of a core curriculum is to enable the student to understand, construct, and evaluate relationships in the natural sciences, and to enable the student to understand the bases for building and testing theories.

☒ To understand and apply method and appropriate technology to the study of natural sciences.

☒ To recognize scientific and quantitative methods and the differences between these approaches and other methods of inquiry and to communicate findings, analyses, and interpretation both orally and in writing.

☒ To identify and recognize the differences among competing scientific theories.

☒ To demonstrate knowledge of the major issues and problems facing modern science, including issues that touch upon ethics, values, and public policies.

☒ To demonstrate knowledge of the interdependence of science and technology and their influence on, and contribution to, modern culture.

Instructional Goals and Purposes:

The purpose of this course is to familiarize the student with the concepts, principles and theories of science and provide an opportunity to experience and appreciate the processes and methodology of science.

General Course Objectives:

Upon the completion of this course, the student should gain an understanding of the following general course objectives:

-demonstrate an understanding of the fundamental concepts and principles related to microbiology.
-identify the role of microorganisms in the environment and as they relate to human health.
-identify the importance of scientific research in the development of new technologies associated with the disciplines of microbiology.
-demonstrate fundamental laboratory skills as related to microbiology procedures.
-evaluate, analyze and draw conclusions from science-based literature and/or experimental data concerning microbiology topics.

Specific Course Objectives:

Upon the successful completion of this course, the student should have an understanding of the following specific course objectives:

-differentiate between prokaryotic and eukaryotic cell structure and function.
-identify specific bacteria based on morphological and biochemical characteristics.
-identify the causative agent of disease, pathogenicity abilities, symptoms, diagnosis, prevention and treatment of selected bacterial, fungal, protozoan and parasitic worm infections.
-identify the major components and principles associated with innate and specific immunity.
-identify major metabolic pathways or processes associated with microorganisms.
-identify basic requirements for microbial nutrition and growth.
-discuss the principles associated with microbial genetics.

-identify methods used to control microorganisms in the environment and the chemical control of microorganisms in the human body.
-identify major characteristics and classification strategies for prokaryotic and eukaryotic organisms.
-discuss the general characteristics of viruses and identify the causative agent, mechanism of transmission, symptoms, prevention and treatment of selected viral diseases.
-identify the importance of immunization and immune testing.
-identify the importance of microbes in food microbiology, industrial microbiology and environmental microbiology.

Course Content:

The students are required to comprehend the following course content. (from Bauman, Robert. Microbiology (2nd Edition). 2007. Pearson Benjamin Cummings, San Francisco, California).

UNIT 1: HISTORY, CHEMISTRY, PROKARYOTES and APPLIED/ENVIRONMENTAL MICROBIOLOGY

HISTORY

-describe the world-changing scientific contributions of Leeuwenhoek.
-define microbes in the words of Leeuwenhoek and as we know them today.
-list six groups of microorganisms.
-explain why protozoa, algae, and non-microbial parasitic worms are studied in microbiology.
-differentiate between prokaryotic and eukaryotic organisms.
-list and answer four questions that propelled research into what is called "the Golden Age of Microbiology."
-identify the scientists who argued in favor of spontaneous generation.
-compare and contrast the investigations of Redi, Needham, Spallanzani, and Pasteur concerning spontaneous generation.
-list four steps in the scientific method of investigation.
-discuss the significance of Pasteur's fermentation experiments to our world today.
-explain why Pasteur is known as the Father of Microbiology.
-identify the scientist whose experiments led to the field of biochemistry and the study of metabolism.
-list at least seven contributions made by Koch to the field of microbiology.
-list the four steps that must be taken to prove the cause of an infectious disease.
-describe the contribution of Gram to the field of microbiology.
-identify four health care practitioners who did pioneering research in the areas of public health microbiology and epidemiology.
-name two scientists whose work with vaccines began the field of immunology.
-describe the quest for a "magic bullet."
-identify the field of microbiology that studies the role of microorganisms in the environment.
-name the fastest growing scientific disciplines in microbiology today.

CHEMISTRY

-define matter, atom, and element and explain how they are related to one another.
-draw and label an atom showing the parts of the nucleus and orbiting electrons.
-list at least four ways that radioactive isotopes are useful.
-explain the configuration of electrons in a stable atom.
-contrast molecules and compounds.
-contrast nonpolar covalent, polar covalent, and ionic bonds.
-explain the relationship between electronegativity and the polarity of a covalent bond.
-define ionization using the terms cation and anion.
-describe hydrogen bonds and discuss their importance in living organisms.
-describe three general types of chemical reactions found in living things.
-give an example of a synthesis chemical reaction that involves formation of a water molecule.
-give an example of a decomposition reaction that involves breaking the bonds of a water molecule.
-contrast endothermic and exothermic chemical reactions.
-compare exchange reactions to synthesis and decomposition reactions.

-describe five qualities of water that make it vital to life.
-contrast acids, bases and salts, and explain the role of buffers.
-define a “functional group” as it relates to organic chemistry.
-describe the structure of a triglyceride molecule and compare it to that of a phospholipid.
-distinguish between saturated, unsaturated, and polyunsaturated fatty acids.
-discuss the roles of carbohydrates in living systems.
-describe five general functions of proteins in organisms.
-sketch and label four levels of protein structure.
-describe the basic structure of a nucleotide.
-compare and contrast DNA and RNA.
-contrast the structure and function of ATP, ADP, and AMP.

PROKARYOTES
-describe the four major processes of living cells.
-compare and contrast prokaryotic and eukaryotic cells.
-describe composition, function, and importance to human health of glycocalyces.
-distinguish between capsules and slime layers.
-discuss the structure and function of prokaryotic flagella.
-list and describe four prokaryotic flagellar arrangements.
-compare and contrast the structure and function of fimbriae and pili.
-contrast fimbriae and pili with flagella.
-compare and contrast the cell walls of Gram-positive and Gram-negative prokaryotes in terms of structure and Gram staining.
-describe the clinical implications of the structure of the Gram-negative cell wall.
-compare and contrast the cell walls of acid-fast bacteria with typical Gram-positive cell walls.
-contrast types of archaeal cell walls with one another and with bacterial cell walls.
-diagram a phospholipid bilayer and explain its significance in reference to a cytoplasmic membrane.
-explain the “fluid mosaic” model of membrane structure.
-describe the functions of the cytoplasmic membrane as they relate to permeability.
-compare and contrast the passive and active processes by which materials cross the cytoplasmic membrane.
-define osmosis and distinguish among isotonic, hypertonic, and hypotonic solutions.
-describe prokaryotic cytoplasm and its basic contents.
-define inclusion and give two examples.
-describe the formation and function of bacterial endospores.
-describe the structure and function of ribosomes and the cytoskeleton.
-identify six basic shapes of prokaryotes.
-list three common types of reproduction in prokaryotes.
-describe snapping division as a type of binary fission.
-draw and label five arrangements of prokaryotes.
-describe the formation and function of bacterial endospores.
-explain the general purpose of Bergey’s Manual of Systematic Bacteriology.
-discuss the veracity and limitations of any taxonomic scheme.
-identify the common features of microbes in the domain Archaea.
-compare and contrast the two kinds of extremophiles discussed in this section.
-list at least four significant roles played by methanogens in the environment.
-describe the unique features of chlamydias and spirochetes.

APPLIED MICROBIOLOGY
-describe how microbial metabolism can be manipulated for food production.
-describe how food characteristics and the presence of microorganisms in food can lead to food spoilage.
-list several methods for the preventing food spoilage.
-discuss the basic types of illnesses caused by food spoilage or food contamination and describe how they can be avoided.
-list some of the various commercial products produced by microorganisms.
-explain how water and wastewater are treated to make them safe and usable.
-describe the process of bioremediation.

-define the terms used to describe microbial relationships within the environment.
-explain the influence of competition, antagonism, and cooperation on microbial survival.
-describe the role of genetically manipulated microorganisms in industrial and agricultural processes and the basics of industrial-scale fermentation.
-identify the criteria used to assess microorganisms for potential use as biological weapons.
-list the characteristics of agents deemed of significant risk for use as biological agents against humans, animals, and plants.
-describe several microbial illnesses that can be acquired from terrestrial and aquatic environments.
-describe several measures that can be taken to limit the potential for bioterrorist attack.
-discuss how recombinant DNA technology could be used to produce modified biological agents.

UNIT 2: INFECTION, EPIDEMIOLOGY & MICROBE/HUMAN INTERACTION /PATHOGENIC BACTERIA

INFECTION, EPIDEMIOLOGY & MICROBE/HUMAN INTERACTION

-distinguish among the types of symbiosis and list them in order from most beneficial to most harmful to the host.
-describe the relationship between the terms: *parasite*, *host*, and *pathogen*.
-describe the normal microbiota, including resident and transient members.
-explain three conditions that create opportunities for normal microbiota to cause disease.
-describe the relationship between contamination and infection.
-identify and describe the portals through which pathogens invade the body.
-list the types of adhesion factors and the roles they play in infection.
-explain how a biofilm may facilitate contamination and infection.
-compare and contrast infection, disease, morbidity, pathogenicity, and virulence.
-contrast symptoms, signs, and syndromes.
-define etiology.
-list Koch's postulates, explain their function, and describe their limitations.
-explain how microbial extracellular enzymes, toxins, adhesion factors and antiphagocytic factors affect virulence.
-list and describe the five stages of the disease process.
-describe three types of reservoirs of infection in humans.
-describe the basis for each of the various classification schemes of infectious disease.
-distinguish among acute, subacute, chronic and latent diseases.
-distinguish among communicable, contagious and noncommunicable infectious diseases.
-define epidemiology.
-contrast between incidence and prevalence.
-differentiate between the terms endemic, sporadic, epidemic, and pandemic.
-explain three approaches used by epidemiologists to study diseases in populations.
-describe three types of nosocomial infections and how they may be prevented.
-list five ways public health agencies work to limit the spread of diseases.

GRAM POSITIVE PATHOGENIC BACTERIA

-contrast *Staphylococcus aureus* with *Staphylococcus epidermis* in terms of virulence in humans.
-discuss the structural and enzymatic features and toxins of *Staphylococcus* that enable it to be pathogenic.
-describe the symptoms and preventions of staphylococcal food poisoning.
-list and describe six pyogenic lesions caused by *Staphylococcus aureus*.
-discuss five systemic and potentially fatal diseases caused by *Staphylococcus*.
-describe how staphylococcal species are distinguished from one another during diagnosis.
-discuss briefly the history of staphylococcal resistance to antimicrobial drugs
-describe the classification of streptococcal strains.
-describe seven diseases caused by *Streptococcus pyogenes* and the treatments available.
-describe two structures in *Streptococcus pyogenes* that allow this organism to survive against the body's defenses.
-identify four enzymes and three toxins that facilitate the spread of *Streptococcus pyogenes* in the body.
-identify the conditions under which Group A streptococci cause disease.
-identify the normal sites of viridans streptococci in the human body and list three serious diseases they cause.
-describe how the structure of *Streptococcus pneumoniae* affects its pathogenicity.

-describe the route of *Streptococcus pneumoniae* through the body, describing the chemical and physical properties that allow it to cause pneumonia.
-discuss the diagnosis, treatment, and prevention of pneumococcal diseases.
-list three methods of transmission of anthrax.
-list and describe three clinical manifestations of *Bacillus anthracis* infections.
-identify the diagnosis, treatment, and prevention of anthrax.
-characterize the four major species of *Clostridium*.
-identify the mechanisms accounting for the pathogenesis of Clostridium *perfringens* infections.
-describe diagnosis, treatment, and prevention of *Clostridium perfringens* infections.
-discuss the role of antimicrobial drugs in the development of gastrointestinal diseases of *Clostridium difficile*.
-discuss the diagnosis, treatment, and prevention of *Clostridium difficile* infections.
-contrast three manifestations of botulism.
-describe the use of mice in diagnosis of botulism poisoning.
-describe three treatments of botulism and describe how to prevent it.
-describe the epidemiology of tetanus.
-list treatment and preventative measures against *Clostridium tetani* infections.
-explain the structures of *Listeria monocytogenes* that account for its pathogenicity.
-discuss the signs and symptoms, diagnosis, treatment, and prevention of listeriosis.
-characterize the arrangement of *Corynebacterium* cells.
-describe the transmission of *Corynebacterium diphtheriae* and the effect of diphtheria toxin.
-discuss the diagnosis, treatment, and prevention of diphtheria.
-characterize mycobacteria in terms of endospore formation, cell wall composition, growth rate, and resistance to antimicrobial drugs.
-identify two effects of cord factor of *Mycobacterium tuberculosis*.
-describe the transmission of *Mycobacterium tuberculosis* and its subsequent action within the human body.
-discuss diagnosis, treatment, and prevention of tuberculosis.
-describe the significance of the tuberculin test.
-compare and contrast tuberculoid leprosy with lepromatous leprosy.
-discuss the diagnosis, treatment, and prevention of leprosy.
-identify the most common species of *Propionibacterium* involved in human infection.
-explain the role of *Propionibacterium acnes* in the formation of acne.

GRAM NEGATIVE PATHOGENIC BACTERIA

-list three structural features of *Neisseria* that contribute to its pathogenicity.
-compare and contrast the symptoms of gonorrhea in men and women.
-discuss the difficulties researchers face in developing an effective vaccine against *Neisseria gonorrhoeae*.
-describe how meningococci survive and thrive in humans.
-discuss the epidemiology of meningococcal diseases.
-discuss how members of the family *Enterobacteriaceae* are distinguished in the laboratory.
-list six virulence factors found in the family *Enterobacteriaceae*.
-describe the diagnosis, treatment, and prevention of diseases of enteric bacteria.
-describe the pathogenesis and diseases of *Escherichia coli* O157:H7.
-describe the diseases caused by truly pathogenic enteric bacteria.
-contrast salmonellosis and shigellosis.
-describe the life cycle of *Yersinia pestis* and contrast bubonic and pneumonic plague.
-describe five virulence factors of *Bordetella pertussis.*
-identify the four phases of pertussis.
-explain why *Legionella pneumophila* was unknown before 1976.
-describe the symptoms and treatment of Legionnaires disease.
-differentiate between coliform and non-coliform opportunists.
-describe the diseases caused by non-coliform opportunistic enteric bacteria.
-describe two pathogenic genera of the family *Pasteurellaceae*.
-identify and describe three diseases caused by species of *Haemophilus*.
-contrast the ubiquitous nature of pseudomonads with the infections they actually cause.
-describe *Pseudomonas aeruginosa* as an opportunistic pathogen of burn victims and cystic fibrosis patients.
-list practical measures that can be taken to prevent infection by *Francisella tularensis.*

-explain how *Coxiella burnetii* survives desiccation to cause Q fever.
-describe the mode of transmission of Q fever.

MYCOPLASMAS, RICKETTSIAS, CHLAMYDIAS, SPIROCHETES and VIBRIOS
-list four characteristics of all mycoplasmas.
-explain why mycoplasmas have been classified with both Gram-negative and Gram-positive organisms.
-compare and contrast mycoplasmas and viruses.
-discuss the damage done to respiratory epithelial cells by *Mycoplasma pneumoniae*.
-list the types of cells in the human body that are most affected by *Chlamydia*.
-explain how non-sexually active children may become infected with *C. trachomatis*.
-describe the cause and symptoms of lymphogranuloma venereum.
-discuss the prevention of chlamydial infections.
-describe the diseases caused by *Chlamydia psittaci.*
-describe the morphology and locomotion of spirochetes.
-describe the disease caused by *Treponema pallidum*.
-describe the four phases of untreated syphilis and the treatment for each.
-describe the diseases caused by non-venereal species of *Treponema.*
-describe Lyme disease, its vector, and its causative agent.
-discuss the life cycle of the *Ixodes* tick as it relates to Lyme disease.
-describe the two types of relapsing fever, including their causes and vectors.
-contrast *Vibrio* with enteric bacteria in terms of their flagella and biochemical properties.
-describe the action of cholera toxin in causing cholera.
-name two species of *Vibrio* and describe the resulting diseases.
-discuss the major change in medical opinion of the cause of peptic ulcers.
-describe the effect of *Helicobacter pylori* of the lining of the human stomach.
-list three species of *Rickettsia* that are responsible for human infections.
-identify the vectors of *R. rickettsia*, *R. typhi*, and *R. prowazekii.*
-describe the rash and petechiae of Rocky Mountain spotted fever (RMSF).
-describe the life cycle of *Chlamydia*, including the two cellular forms.
-discuss the term "energy parasite" as it relates to *Chlamydia.*
-describe three diseases associated with *Chlamydia pneumoniae*.

UNIT 3: EUKARYOTES, PATHOGENIC FUNGI, PROTOZOA AND HELMINTHS

EUKARYOTIC CELLS
-identify non-membranous and membranous organelles.
-describe the composition, function and importance of eukaryotic glycocalyces.
-compare and contrast prokaryotic and eukaryotic cell walls and cell membranes.
-contrast exocytosis and endocytosis.
-describe the role of pseudopods in eukaryotic cells.
-compare and contrast the structure and function of prokaryotic and eukaryotic flagella.
-describe the structure and function of cilia.
-compare and contrast eukaryotic cilia and flagella.
-describe the structure and function of ribosomes, cytoskeletons, and centrioles.
-compare and contrast the ribosomes of prokaryotes and eukaryotes.
-list and describe the three filaments of the eukaryotic cytoskeleton.
-discuss the function of each of the membranous organelles: nucleus, ER, Golgi apparatus, lysosome, peroxisome, vesicle, vacuole, mitochondrion, and chloroplast.
-label the structures associated with each of the membranous organelles.
-describe the endosymbiotic theory of the origin of mitochondria, chloroplasts and eukaryotic cells.
-list evidence for and against the endosymbiotic theory.

EUKARYOTES
-state four reasons why eukaryotic reproduction is more complex than prokaryotic reproduction.
-describe the phases of mitosis mentioning chromosomes, chromatids, centromeres, and spindle.

-contrast meiosis with mitosis mentioning homologous chromosomes, tetrads, and crossing over.
-distinguish among nuclear division, cytokinesis, and schizogony.
-list several problems involved in the classification of protists.
-list three characteristics shared by all protozoa.
-cite at least three characteristics that distinguish fungi from other groups of eukaryotes.
-list five ways in which fungi are beneficial.
-distinguish among septate hyphae, aseptate hyphae, and mycelium.
-describe asexual reproduction in fungi.
-list three basic types of asexual spores found in molds.
-compare and contrast the three divisions of fungi in terms of their sexual spore formation.
-describe deuteromycetes and explain why this group no longer constitutes a formal taxon.
-list several beneficial roles or functions of lichens.
-describe the distinguishing characteristic of algae.
-describe the alternation of generations in algae.
-list four groups of algae and give distinguishing characteristics of each.
-list several economic benefits derived from algae.
-list four ways in which water molds differ from true fungi.
-explain why microbiologists study large organisms such as parasitic worms.
-discuss the inclusion of vectors in a study of microbiology.

PARASITIC FUNGI
-summarize the complexities of identifying, treating, and preventing fungal infections.
-state the most significant mode of transmission for mycoses.
-compare and contrast true fungal pathogens with opportunistic fungi.
-identify factors that predispose people to experiencing opportunistic fungal infections.
-describe three primary clinical manifestations of mycoses.
-discuss why the diagnosis of opportunistic fungal infections can be difficult.
-discuss the advantages and disadvantages of fungicidal and fungistatic medications.
-compare and contrast the endemic areas for the four genera of pathogenic fungi that cause systemic mycoses.
-compare the clinical appearance of the diseases resulting from each of the four pathogenic fungi.
-identify the laboratory techniques used to distinguish among the four pathogenic fungi.
-discuss the difficulties in diagnosing opportunistic fungal infections.
-explain how candidiasis can develop from a localized infection to a systemic mycosis.
-discuss the characteristics of *Cryptococcus* that contribute to the severity of cryptococcoses in immunocompromised patients.
-list the characteristics of *Pneumocystis* that distinguish it from other fungal opportunists.
-identify several emerging fungal pathogens seen among AIDS patients.
-identify the three factors contributing to the emergence of new fungal pathogens.
-compare and contrast mycotoxins, mushroom toxins, and fungal allergies.
-define mycotoxin and identify the most common group.
-describe fungal allergens and identify the types of hypersensitivity reactions they produce.

PARASITIC PROTOZOANS AND HELMINTHS
-describe the epidemiology of the more important protozoan parasites.
-describe the characteristics of *Balantidium coli.*
-compare and contrast three amoebae that cause human disease.
-contrast the life cycles of *Trypanosoma brucei* and *Trypanosoma cruzi.*
-describe the life cycle of *Leishmania* and the clinical forms of leishmaniasis.
-compare *Giardia* infections to those caused by *Entamoeba* and *Balantidium.*
-identify the risk factors and preventative measures for *Trichomonas vaginalis* infection.
-describe the life cycle of *Plasmodium* and relate malarial symptoms to stages in the life cycle.
-describe the clinical manifestations of *Toxoplasma gondii* infections.
-describe the general morphological and physiological features of parasitic worms.
-describe the common features of the life cycles of tapeworms that infect humans.
-list the predominant modes of infection for *Taenia* and suggest preventative measures.
-explain how the life cycles of blood flukes differ from those of other flukes.

-discuss the life cycles and disease manifestations outcomes of *Schistosoma* and *Fasciola*.
-describe the common characteristics of roundworms.
-compare and contrast the three most common roundworm infections of humans.
-discuss the life cycle of filarial nematodes and contrast it with the life cycles of intestinal nematodes.
-list the principal arthropod vectors and give one example of a pathogen transmitted by each.

UNIT 4: METABOLISM, VIRAL PARTICLES AND VIRAL DISEASE

METABOLISM

-distinguish among metabolism, anabolism, and catabolism.
-contrast reduction and oxidation reactions.
-compare and contrast the three types of ATP phosphorylation.
-draw a table listing the six basic types of enzymes, their activities, and an example of each.
-describe the components of a holoenzyme, and contrast protein and RNA enzymes.
-define activation energy, enzyme, apoenzyme, cofactor, coenzyme, active site, and substrate, and describe their roles in enzyme activity.
-describe how temperature, pH, substrate concentration, and competitive and noncompetitive inhibition affect enzyme activity.
-in general terms, describe the three stages of aerobic glucose catabolism (glycolysis, the Krebs cycle, and the electron transport chain), including their substrates, products, and net energy production.
-compare the pentose phosphate pathway with glycolysis in terms of energy production and products.
-discuss the roles of acetyl-CoA, the Krebs cycle, and electron transport in carbohydrate catabolism.
-contrast electron transport in aerobic and anaerobic respiration.
-identify four classes of carriers in electron transport chains.
-describe the role of chemiosmosis in oxidative phosphorylation of ATP.
-describe fermentation and contrast it with respiration.
-identify three useful end-products of fermentation, and explain how fermentation reactions are used in the identification of bacteria.
-discuss the use of biochemical tests for metabolic enzymes and products in the identification of bacteria.
-explain how lipids are catabolized for energy and metabolite production.
-explain how proteins are catabolized for energy and metabolite production.
-define photosynthesis.
-compare and contrast the basic chemicals and structures involved in photosynthesis in prokaryotes and eukaryotes.
-contrast the light-dependent and light-independent reactions of photosynthesis.
-describe the reactants and products of the Calvin-Benson cycle.
-define amphibolic reaction.
-describe interrelationships between catabolism and anabolism in terms of ATP and substrates.
-discuss regulation of metabolic activity.

VIRAL PARTICLES

-discuss viral genomes in terms of dsDNA, ssDNA, ssRNA, dsRNA, and number of segments of nucleic acid.
-explain how viruses are specific for their host cells.
-compare and contrast viruses of fungi, plants, animals, and bacteria.
-discuss the structure and function of the viral capsid.
-discuss the origin, structure, and function of the viral envelope.
-list the characteristics by which viruses are classified.
-sketch and describe the five stages of the typical lytic replication cycle of bacteriophages.
-compare and contrast the lysogenic replication cycle of viruses with the lytic cycle and with latency.
-explain the differences between bacteriophage replication and animal viral replication.
-compare and contrast the replication and synthesis of DNA, -RNA, and +RNA viruses.
-compare and contrast the release of viral particles by lysis and budding.
-define neoplasia, cancer, tumor, benign, malignant, and metastasis.
-explain in simple terms how a cell may become cancerous, with special reference to the role of viruses.
-define and describe viroids.
-compare and contrast viroids and viruses.

-define and describe prions, including their replication process.
-compare and contrast prions and viruses.
-list four diseases caused by prions.

VIRAL DISEASES (DNA)
-list two diseases caused by poxviruses and discuss their etiology, signs, and symptoms.
-discuss the historical importance of poxvirus in terms of immunization, epidemics, and eradication.
-describe the progression of disease in poxvirus infection.
-describe the diseases caused by herpes simplex types 1 and 2, including their signs, symptoms, treatment, and prevention.
-list conditions that may reactivate latent herpesviruses.
-compare and contrast chickenpox in children with shingles in adults.
-describe the diseases associated with Epstein-Barr virus.
-describe the epidemiology of cytomegalovirus infection.
-describe the diseases caused by HHV-6 and HHV-8.
-describe four kinds of warts associated with papillomavirus infection.
-describe the etiology, treatment, and prevention of genital warts.
-list and describe two diseases caused by polyomavirus infection in humans.
-discuss the diseases, including epidemiology, of adenoviruses.
-describe the epidemiology, treatment and prevention of hepatitis B
-describe the epidemiology, treatment, and prevention of hepatic cancer.
-describe the epidemiology of erythema infectiosum.

VIRAL DISEASES (RNA)
-discuss treatment of the common cold.
-describe the effects of polioviruses on humans.
-describe the symptoms of hepatitis A.
-describe the contribution of Jonas Salk and Albert Sabin toward the elimination of polio.
-describe arboviruses.
-define zoonoses.
-contrast the two types of dengue fever.
-discuss the symptoms and the prevention of yellow fever.
-describe the togaviruses that produce skin lesions.
-compare and contrast the six types of hepatitis.
-describe the structure and diseases of coronavirus.
-discuss the symptoms of severe acute respiratory syndrome (SARS).
-differentiate between a disease and a syndrome using AIDS as an example.
-describe the virions responsible for AIDS.
-describe the relationship between T-helper cells and the course of AIDS.
-describe how oncogenic viruses, such as retroviruses, induce cancer.
-list four preventative measures that could be used to prevent AIDS.
-define syncytia and explain their relationship to paramyxoviruses.
-describe the symptoms and prevention of rubeola and SSPE.
-compare the effects of RSV infection in infants and adults.
-describe the effects, treatment, and prevention of rabies.
-describe the effect of filoviruses on the human body.
-describe the purposes of hemagglutinin and neuramidase in the influenzavirus replication cycle.
-contrast hantaviruses with the other bunyaviruses.
-identify the distinguishing characteristics of arenaviruses.
-discuss disease prevention from viruses in *Orthomyxoviridae*, *Bunyaviridae*, and *Arenaviridae*.
-discuss the meaning of the name “reovirus.”
-describe the effect of a rotavirus infection.
-discuss the disease most commonly caused by a coltivirus.

UNIT 5: GENETICS, DISINFECTION AND ANTIBIOTIC THERAPY

GENETICS

-compare and contrast the genomes of prokaryotes and eukaryotes.
-describe the structure of DNA and discuss how it facilitates the ability of DNA to act as genetic material.
-describe the structure and function of plasmids.
-compare and contrast prokaryotic and eukaryotic chromosomes.
-describe the replication of DNA as a semiconservative process.
-compare and contrast the synthesis of leading and lagging strands in DNA replication.
-explain how the genotype of an organism determines its phenotype.
-describe the central dogma of genetics and explain the roles of DNA and RNA in polypeptide synthesis.
-describe three steps in RNA transcription mentioning DNA, RNA polymerase, promoter, and terminator.
-describe the genetic code in general and identify the relationship between codons and amino acids.
-describe the translation of polypeptides, identifying the roles of the three types of RNA.
-explain the operon model of transcriptional control in prokaryotes.
-contrast the regulation of an inducible operon with that of a repressible operon.
-define mutation; define and describe three types of point mutations.
-list three effects of mutations.
-discuss how different types of radiation cause mutations in a genome.
-describe three kinds of chemical mutagens and their effects.
-contrast the positive and negative selection techniques for isolating mutants.
-describe the Ames test and discuss its use in discovering carcinogens.
-define genetic recombination.
-compare and contrast crossing over, transformation, transduction, and conjugation.
-contrast vertical gene transfer with horizontal gene transfer.
-describe the structures and actions of simple and complex transposons.
-define biotechnology and recombinant DNA technology.
-list several examples of useful products made possible by biotechnology.
-identify the three main goals of recombinant DNA technology.
-explain the function and use of reverse transcriptase in synthesizing cDNA.
-describe three uses of synthetic nucleic acids.
-explain the source and names of restriction enzymes.
-describe the importance and action of restriction enzymes.
-define a vector in terms of genetic manipulation.
-describe the purpose and application of the polymerase chain reaction.
-describe the process and use of gel electrophoresis, particularly as it is used in a Southern blot.
-list and explain three artificial techniques for introducing DNA into cells.
-describe genome mapping and genomics and explain their usefulness.
-describe six potential medical applications of recombinant DNA technology.
-define gene therapy.
-identify five agricultural applications of recombinant DNA technology.
-discuss the pros and cons concerning the safety and ethics of recombinant DNA technology.

DISINFECTION

-contrast antisepsis, disinfection, and sterilization and describe their practical uses.
-contrast the terms degerming, sanitization, and pasteurization.
-compare the effects of “static” versus “cidal” control agents on microbial growth.
-identify three groups of resistant microbes and explain why they are resistant to many antimicrobial agents.
-discuss the advantages and disadvantages of using moist heat in an autoclave versus dry heat in an oven for sterilization.
-explain the importance of pasteurization and describe three different pasteurization methods.
-name two factors that could affect the choice of using chemical versus a physical control method.
-discuss environmental conditions that can affect the effectiveness of antimicrobial agents.
-draw and label a bacterial growth curve.
-describe what occurs at each phase of a population’s growth.
-compare and contrast four methods that are used to measure the effectiveness of disinfectants.
-describe how antimicrobial agents act against cell boundaries, proteins, and nucleic acids.
-describe five physical methods of microbial control.

-describe the use and importance of refrigeration and freezing in limiting microbial growth.
-compare and contrast desiccation and lyophilization.
-discuss the use of hypertonic solutions in microbial control.
-differentiate between ionizing and nonionizing radiation as they relate to microbial control.
-compare and contrast the major types of antimicrobial chemicals and discuss their action(s) and use.

ANTIBIOTICS
-explain how semisynthetic and synthetic antimicrobials differ from antibiotics.
-explain the principle of selective toxicity.
-list six mechanisms by which antimicrobial drugs affect the growth of pathogens.
-describe the actions and give examples of drugs that affect the cell walls, protein synthesis, cell membranes, metabolic pathways and nucleic acid synthesis of bacteria.
-distinguish between narrow-spectrum and broad-spectrum drugs in terms of targets and side effects.
-compare and contrast Kirby-Bauer, MIC, and MBC tests.
-discuss the advantages and disadvantages of the different routes of administration of antimicrobial drugs.
-identify three main categories of side effects of antimicrobial therapy.
-list factors to consider in selecting an antimicrobial control method.
-describe how populations of resistant microbes can arise.
-describe the relationship between R-plasmids and resistant cells.
-list five ways by which microorganisms can be resistant to antimicrobial drugs.
-define cross resistance and distinguish it from multiple resistance.
-describe four ways that development of resistance can be retarded.

UNIT 6: IMMUNITY, EPIDEMIOLOGY AND MICROBE/HUMAN INTERACTIONS

IMMUNOLOGY
-list and briefly describe the three lines of defense in the human body.
-explain the phrase non-specific lines of defense.
-identify the physical and chemical factors that enable skin to prevent the entrance of pathogens.
-identify the locations of mucous membranes in the body.
-explain how mucous membranes protect the body both physically and chemically.
-define normal microbiota and explain how they help provide protection against disease.
-contrast the first and second lines of defense against disease.
-discuss the components of blood and their functions in the body's defense.
-explain how macrophages are named.
-name and describe the five phases of phagocytosis.
-describe the complement system, including its classical and alternate pathways.
-explain the roles of interferons and defensins in innate immunity.
-discuss the process and benefits of inflammation.
-explain the benefits of fever in fighting infection.
-identify the characteristics of effective antigens.
-describe the characteristics of B lymphocytes.
-describe the basic structure of an antibody (immunoglobulin) molecule.
-contrast the structure and function of the five classes of immunoglobulins.
-describe five functions of antibodies.
-describe the importance of the thymus to the development of T lymphocytes.
-describe the basic characteristics of T lymphocytes.
-compare and contrast three types of T cells.
-describe five types of cytokines.
-describe apoptosis and explain its role in lymphocyte editing by clonal deletion.
-describe the two classes of major histocompatibility complex (MHC) proteins with regard to their location and function.
-explain the roles of macrophages, dendritic cells, and MHC molecules in antigen processing and presentation.
-describe the formation and functions of plasma cells and memory B cells.
-describe the steps and effect of clonal selection.
-contrast primary and memory immune responses.

-describe a cell-mediated immune response.
-compare and contrast the two pathways of cytotoxic T-cell action.
-describe the establishment of memory T cells.
-explain the process and significance of the regulation of cell-mediated immunity.
-contrast active versus passive acquired immunity and naturally acquired versus artificially acquired immunity.
-discuss the history of vaccination from the 12th through the 21st centuries.
-describe the advantages and disadvantages of the three types of vaccines.
-describe three methods by which techniques of molecular biology can be used to develop improved vaccines.
-delineate the risks and benefits of routine vaccination in healthy populations.
-compare the advantages and disadvantages of active immunization versus passive immunization.
-in general terms, compare and contrast precipitation, agglutination, neutralization, complement fixation, tagged antibody, immunofiltration, and immunochromatography immune tests.
-define serology.
-list three tests using labeled antibodies or antigens as part of their procedures.
-compare and contrast direct and indirect fluorescent antibody tests and identify at least three uses for these tests.
-compare and contrast the purposes, benefits, and methods of ELISA and western blot tests.

LABORATORY OBJECTIVES

-identify specific guidelines concerning laboratory safety.
-identify the parts of the microscope; indicate the function of each of the microscope parts.
-indicate proper use of the microscope, including technique for oil immersion.
-identify proper procedure for making and observing a wet mount.
-differentiate on the basis of size, shape, arrangement and motility between different bacterial species utilizing a hanging drop slide.
-identify the purpose and principles of negative, simple, Gram, capsule, acid-fast and endospore staining and understand the correct technique in utilizing these stains.
-identify the importance of having a thin smear and heat fixation in the staining procedures.
-identify the purpose of the different medias utilized in the laboratory.
-differentiate between agar deeps, slants, pours and plates; identify the importance of agar.
-describe how various media, supplies and equipment can be sterilized.
-utilize aseptic technique to remove and transfer bacteria for subculturing; demonstrate proper aseptic technique utilizing pipettes, inoculating loops and inoculating needles.
-identify the importance of streak plates, spread plates and pour plates and demonstrate correct technique while performing these procedures.
-determine quantitatively from a food or water sample the number of viable cells in a bacterial culture by the standard plate count technique.
-examine the effects of oxygen requirements, pH, temperature, osmotic pressures, chemical preservatives, UV radiation, antibiotics, disinfectants and spices on bacterial growth.
-differentiate between obligate aerobes, facultative anaerobes, obligate anaerobes, aerotolerant anaerobes and microaerophiles.
-define the three cardinal temperatures; compare psychrophilic, mesophilic, thermophilic and thermoduric organisms.
-identify the importance of placing a buffer into a bacterial media; compare acidophilic, neutrophilic and alkalinophilic organisms.
-define osmotic pressure and explain how it affects a bacterial cell.
-compare isotonic, hypertonic and hypotonic solutions.
-identify the mode of action of ultraviolet radiation.
-differentiate between microbicidal and microbistatic.
-utilize the Kirby-Bauer agar diffusion technique to determine antibiotic sensitivity.
-identify the importance of biochemical testing in the determination of a bacterial unknown.
-perform biochemical tests that include carbohydrate fermentation, starch hydrolysis, lipid hydrolysis, hydrogen sulfide production, motility, casein hydrolysis, gelatin hydrolysis, phenylalanine deamination, catalase production, oxidase production, urea hydrolysis, lysine decarboxylation and the IMViC tests; indicate the principles concerning each of these tests.
-utilize Bergey's Manual to correctly identify two unknown bacterial strains.
-isolate genomic DNA from a bacterial cell.

Methods of Instruction/Course Format/Delivery:

The faculty may select from (but are not limited to) the following list of instructional methods:

-lecture
-classroom discussions
-television (video)
-internet (WebCT)
-online learning center (textbook publisher)
-software
-demonstrations
-reading assignments

Assessment:

The faculty may assess the student's knowledge and abilities by utilizing in-class and out-of-class activities. The faculty may choose from (but are not limited by) the following list of assessment tools:

-examinations
-quizzes
-homework/written assignments
-internet
-attendance
-discussions/classroom participation
-library assignments
-internet assignments
-readings
-research papers
-individual projects

Course Grade:

Final course grades are determined by the following scale:

100 – 90	A
89 – 80	B
79 – 70	C
69 – 60	D
59 or below	F

Texts, Materials, and Supplies:

Bauman, Robert. Microbiology (2nd Edition). 2007. Pearson Benjamin Cummings, San Francisco, California.

Harley, John. Laboratory Exercises in Microbiology (7th Edition). 2008. McGraw-Hill, New York, New York.

Other:

- For current texts and materials, use the following link to access bookstore listings: http://www.panola.edu/collegestore.htm
- For testing services, use the following link: http://www.panola.edu/instruction/dl/testing.htm

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