Montgomery County Community College
BIO 120
Concepts of Biology
4-3-3

COURSE DESCRIPTION:
A terminal lab-science for non-science majors who desire only one-semester of Biology. Topics include a discussion of the fundamentals and contemporary issues regarding biological chemistry, cell biology, genetics and the different forms of life. The material is discussed in the context of the principles of evolution and the biology of ecosystems. This course does not satisfy the prerequisites for BIO 131. This course is subject to a course fee. Refer to http://mc3.edu/adm-fin-aid/paying/tuition/course-fees for current rates.

REQUISITES:
Previous Course Requirements
None

Concurrent Course Requirements
None

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Evaluate role of science in western and world society.	Lectures Class Discussions Field Trips Class Presentations	Laboratory Exercises and Reports Quizzes and Exams Essays
2. Explain the parts of an experiment, formulate hypotheses, make predictions, interpret data, make conclusions and judge the merit of a theory.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays
3. Analyze evolution as the predominant unifying theme in biology, and its role in understanding the history of life on Earth and important ecological interactions.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
4. Explain the relationship of atoms, ions, molecules within the living and nonliving universe.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays
5. Relate the principle parts of a cell to organism function.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays
6. Analyze the basic processes of all cells and living organisms.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Quizzes and Exams Laboratory Exercises and Reports
7. Apply the principles of transmission genetics to basic genetics problems.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams
8. Explain the relationship between gene, protein and phenotype, and the roles of proteins and nucleic acids in cell and organism functioning.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays
9. Apply the scientific method and critical thinking skills to biological and scientific problems.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays Class Discussions
10. Explain the important chemical and biotic influences in maintaining a stable biosphere.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays
11. Explain the important influences on human and non-human population dynamics.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Laboratory Exercises and Reports Quizzes and Exams Essays

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
12. Support opinions concerning contemporary biological and human sustainability issues utilizing relevant resources.	Lectures Class Discussions Field Trips Class Presentations Laboratory Activities	Quizzes and Exams Class Discussions Essays or Other Projects
13. Demonstrate the ability to set up and utilize basic laboratory equipment, including microscopy, and carry out basic experiments.	Field Trips Laboratory Activities	Laboratory Exercises and Reports

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria*.

SEQUENCE OF TOPICS:

UNIFYING THEMES AND TOPICS

I. The Scientific Method
   - A. Science vs. “faith”
   - B. Experimentation
     1. forming hypotheses and making predictions
     2. testing the prediction (experiment); controls
     3. conclusions, theories, biological principles or laws
     4. facts
     5. correlation studies, animal testing

II. The Business of Science
   - A. Roles of government: National Institutes of Health (NIH), National Science Foundation (NSF), etc.
   - B. The funding process
   - C. Relationship between science funding and college/university function
   - D. Applied science and the corporate role

III. Introduction to Biology
   - A. Characteristics of life
   - B. Levels of organization
   - C. Taxonomy and classification: artificial and phylogenetic concepts

IV. Evolution & Natural Selection
- A. The development of evolutionary thought: Darwin and Wallace
- B. The basis of natural selection: surplus of offspring, heritable variation, survival of the fittest
- C. The role of genetics and environment
- D. Evidence that supports evolution: importance and examples of each
  1. fossil record
  2. biogeography
  3. comparative anatomy/embryology
  4. comparative molecular genetics and biochemistry

BIOLOGICAL CHEMISTRY & ENERGY

I. Basic Chemistry
- A. Atomic structure according to the Bohr Model:
  1. neutrons
  2. protons
  3. electrons and orbitals
- B. Atomic mass and atomic number
- C. Definition of isotope and radioactivity and the importance of isotopes in biological research and medicine
- D. Chemical bonds: description and importance of each, with examples
  1. ionic
  2. non-polar
  3. polar
  4. hydrogen
- E. Molecules and compounds
- F. Water
- G. Acids, bases, pH and buffers

  Possible Lab: Chemical model building, pH measurement of environmental water, household substances, etc.

II. Biological Chemistry
- A. Macromolecules: a basic understanding of each
  1. Carbohydrates: complex, simple, downplay nomenclature
  2. Lipids: including saturated, unsaturated, steroids, phospholipids
  3. Proteins: importance, downplay levels of structure
  4 Nucleic acids
     a. energy molecule (ATP)
     b. genetic material (DNA, RNA)
- B. Dehydration synthesis and hydrolysis
- C. Relevance of the above to nutrition
  1. analysis of food labels; e.g., fat content, etc.
  2. vitamins

  Lab: Biological Chemistry, simplified version of what is now done; perhaps use chemstrip tests, focus on food nutrition or screen for diabetes?

III. Energy
  A. Chemical Reactions
  B. Catalysts; including enzymes
  C. Importance of oxidation and reduction
  D. Metabolic pathways; define here; expand with cells
    1. photosynthesis
      a. overall reaction
      b. importance as the major pathway where carbon dioxide is reduced
    2. cellular respiration
      a. overall reaction
      b. importance as the major process where complex carbon compounds are oxidized

ORGANISMAL BIOLOGY (including timeline history of life on Earth)

I. Archaea Groups and Importance
II. Eubacteria Diversity, and Roles in Ecosystems
III. Endosymbiotic Theory for Origin of Eukaryotes, Relationship to O_2 in Atmosphere
IV. Diversity of Protists
V. Basic Plant Structure and Evolutionary History
  A. Alternation of Generations
  B. Bryophytes (e.g., mosses), Seedless vascular plants (e.g., ferns), Gymnosperms (e.g., conifers), and Angiosperms. Evolutionary innovations that each represents.
VI. Basic Animal Structure and Evolutionary History
  A. Evolutionary embryology of ectoderm, endoderm, and mesoderm
  B. Brief introduction to various invertebrate phyla
  C. Brief evolutionary history of Chordates

ECOSYSTEMS and ECOLOGY

I. Components of Ecosystems
II. Energy Cycling
III. Nutrient Cycling
  A. carbon cycle
  B. nitrogen cycle
  C. phosphorous cycle
  D. water cycle
IV. Water and Air Pollution Issues (Eutrophication, Climate Change Theory, Acid Deposition, Ozone, etc.)
V. Population Ecology and Dynamics, Community Relations
  A. population growth rates, factors influencing biotic potential
  B. carrying capacity and resource restrictions, intraspecific competition
  C. roles of predators and disease
  D. role of interspecific competition
VI. Species Extinctions and Biodiversity

CELL BIOLOGY

I. Cell Theory
II. Why Cells are Small (e.g., surface area to volume relationships)
III. Microscopy
    A. basic operation and use of the light microscope
    B. importance of the electron microscope
        Lab: Use of compound and dissecting microscope
IV. Prokaryotic Cells: Basic Structure
V. Eukaryotic cells: A Basic Understanding of Cell Structure and Function
    A. Organelles: plants vs. animals; discuss distinguishing features of each
    B. Nucleus
    C. Endomembrane system
    D. Cytoskeleton and movement
    E. Extracellular matrix and cell junctions
    F. Energy organelles
        1. structure and basic function of chloroplasts
        2. structure and basic function of mitochondria
        Lab: Comparative microscopic view of prokaryotic and eukaryotic cells
VI. Membranes
    A. Membrane structure
    B. Movement of molecules across membranes; for each, discuss the importance to human health and organisms
        1. diffusion: define and apply to oxygen and carbon dioxide transport in humans
        2. osmosis: define and apply to hypertension, polyuria in diabetics
        3. protein assisted transport: passive and active
        4. endocytosis and exocytosis
        Lab: Osmosis in a model cell, tonicity effects on plant and animal cells
VII. Origin of Life Theories (Biogenesis and Abiogenesis)
    A. “Big bang” cosmology and the “primordial soup”
    B. The first cells: life in a membrane

CELL REPRODUCTION & CLASSICAL GENETICS

I. Cell Reproduction
    A. Prokaryotic chromosomes and binary fission
    B. Structure of eukaryotic chromosomes
    C. Eukaryotic cell cycle
    D. Mechanism and importance of mitosis and cytokinesis
II. Sexual Reproduction
    A. Mechanism of meiosis
    B. Evolutionary importance of recombination & independent assortment
    C. Formation of gametes and fertilization

III. Classical Genetics
- A. Mendel
- B. Laws of segregation and monohybrid inheritance
  1. autosomal recessive diseases
  2. autosomal dominant diseases
- C. Independent assortment and dihybrid inheritance
- D. Complexities of Mendelian inheritance—incomplete dominance, sex-linked genes, codominance, pleiotropy, polygenic inheritance, etc.
- E. Genetics and sex determination
- F. Following inheritance from generation to generation: pedigrees

MOLECULAR GENETICS

I. Molecular Nature of the Gene
- A. DNA structure; de-emphasize details of chemistry and historical aspects of discovery
  1. double stranded/double helix
  2. complementary base pairing
- B. DNA replication, role of DNA polymerase
- C. Gene structure
- D. Transcription, role of RNA polymerase
- E. Genetic code
  1. triplet codons
  2. use of the genetic code table
- F. Protein synthesis: de-emphasize mechanism; e.g., subunits, stages, etc.
  1. roles of ribosomes and tRNA
- G. Gene/chromosomal mutations
  1. point mutations and relation to disease; e.g., Sickle Cell
  2. Chromosome mutations, including Trisomies
- H. Concepts of gene expression, simple control concepts, DNA packaging
- I. Cancer, oncogenes

II. Genetic Engineering
- A. The process of cloning genes; details such as cDNA cloning, library screening need not be addressed
  1. how scientists use naturally-occurring enzymes to cut and splice DNA
  2. getting the DNA into the host, transformation, transduction
     Lab: transformation of *E. coli* with plasmid DNA
- B. Biotechnology, current and future
  1. diseases
  2. genetic testing
  3. DNA fingerprints
  4. gene therapy
  5. human genome project
  6. current topics, etc.
- C. Ethical Concerns

SURVEY OF ORGANISMS

Goal: A basic understanding of each taxon with lab analysis of one or two representative organisms

I. Viruses; This Could Be Integrated with the Cell Biology Section
- A. characteristics
- B. the “non-living” issue
- C. basic lytic life cycle
- D. HIV

Possible Lab: phage infection of *E. coli*

II. Kingdom Prokaryotae (Monera)
- A. structure
- B. importance to ecosystem
  1. photosynthetic bacteria
  2. decomposers
  3. symbionts: N_2 fixation

Lab: identification and observation of cyanobacteria, culture and staining of bacteria

III. Kingdom Protista
- A. diversity:
  1. characteristics of amoeboid protests, ciliates, flagellates, etc.
  2. photosynthetic protests: the green algae
- B. importance to ecosystems

Lab: observation of *Paramecium, Amoebae, Spirogyra*

IV. Kingdom Fungi
- A. characteristics of the main groups
- B. brief description of a lichen
- C. life cycle of a representative group: *Basidiomycete* (mushroom)
- D. importance to ecosystems

Lab: dissection of a mushroom, *Zygomycetes cross*

V. Kingdom Plantae
- A. characteristics of the main representative groups
  1. bryophytes
  2. ferns
  3. gymnosperms
  4. angiosperms
- B. life cycle of a flowering plant
- C. importance to the ecosystem

Lab: Flower dissection

VI. Kingdom Animalia
- A. Invertebrates: characteristics, structure and ecological role of each of the main groups; decrease the depth of discussion of evolutionary origins
  1. sponges
  2. cnidarians
  3. nematodes; de-emphasize parasites
  4. mollusks
  5. annelids
  6. arthropods

Possible Lab: life cycle of *Drosophila*

B. Vertebrates:
   1. Define chordate and vertebrate
   2. Characteristics of
      A. fishes: focus on *Osteichthyes*
      B. amphibians: the frog
      C. reptiles
      D. birds
      E. mammals

      Lab: dissection of a rat and identification of the major organs

LEARNING MATERIALS:
Campbell, Reece & Simon. (2010). *Essential Biology* (3rd ed.). Benjamin Cummings.

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by:	Christopher J. Harendza, Ph.D. Assistant Professor of Biology	Date: 11/18/1998
Revised by:	Christopher J. Harendza, Ph.D.	Date: 10/26/2004
VPAA/Provost Compliance Verification:	Dr. John C. Flynn, Jr.	Date: 10/30/2004
Revised by:	Jerry Coleman	Date: 4/20/2013
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 4/22/2013
Revised by:	Debbie Dalrymple	Date: 6/27/2016
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 6/27/2016
Revised by:	Debbie Dalrymple	Date: 12/18/2017
VPAA/Provost or designee Compliance Verification:		Date: 12/18/2017

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.