Montgomery County Community College
BIO 151
Principles of Biology I
4-3-3

COURSE DESCRIPTION:
An introduction to the study of life as it applies to all organisms. Primary emphasis is given to biological chemistry, energy & metabolism, cell structure & function, cell reproduction and the classical and molecular aspects of genetics. Laboratory requires hands on experiments related to the course content. 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
- CHE 121 General Chemistry - Inorganic, CHE 131 Chemistry for Technology I, or CHE 151 Principles of Chemistry I with a minimum grade of "C" within the last five (5) years
- BIO 121 General Biology I with a minimum grade of "C" within the last five (5) years

Concurrent Course Requirements
None

COURSE COMMENTS
- High School Chemistry taken within the last five years, with a minimum grade of "C" is accepted in place of CHE 121
- A passing grade on the MCCC Biology Placement Tes may be substituted for BIO 121
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LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Apply the scientific method.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
2. Describe the characteristics that all organisms have in common.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
3. Explain the relationship between the principles of biological chemistry and an organism's metabolism.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
4. Explain or analyze how the basic structure of cells, membranes and organelles impact the ability for them to function individually as well as in an integrated fashion.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
5. Explain or analyze the processes of cellular reproduction as it applies to the production of both vegetative and reproductive cells.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
6. Apply the principles of cell metabolism to enzymatic activity, energy, photosynthesis and cellular respiration	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
7. Explain the relationship between classical hereditary mechanisms and the structure and function of organisms.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
8. Apply knowledge of the basic process involved in the central dogma of biology to the mechanisms in prokaryotes and eukaryotes.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
9. Apply all of the above to higher order applications and analysis, where applicable.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
<u>Laboratory</u> 10. Use the binocular microscope to identify cellular features.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
11. Set up various laboratory apparatuses, as described in the list of laboratory section, collect data and draw conclusions.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
12. Perform biological assays, as described in the list of laboratories.	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
13. Apply knowledge of scientific method to laboratory experiments	Lectures Class Discussions Comprehension of Current Articles, Reviews or Primary Literature in Biology Laboratory Activities	Quizzes Exams Homework
14. Support opinions concerning contemporary biological issues utilizing relevant resources.	Lectures Class Discussions Field Trips Class Presentations	Laboratory Exercises and Reports Quizzes and Exams Essays

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[1]:

I. Introduction to Biology
   - A. Characteristics of life
   - B. Introduction to taxonomy / phylogeny
   - C. Scientific method
   - D. Evolution and adaptation
   - E. Biological organization
   - F. Interrelationships of organisms: introduction to energy & trophic levels

II. Introductory Chemistry
   - A. Composition of matter
   - B. Atomic structure
   - C. Molecules and compounds
   - D. Chemical Bonding
     1. Polar and nonpolar covalent bonding
     2. Ionic bonding
     3. Hydrogen bonding
   - E. Oxidation and Reduction
   - F. Acids and Bases; including relative strengths and the pH scale
   - G. Inorganic and organic compounds
   - H. Water: characteristics and importance

III. Organic Chemistry
   - A. Importance of characteristics of carbon
   - B. Complexity of Structure
   - C. Condensation / dehydration synthesis and hydrolysis / digestion reactions
     1. Examples
     2. Role of enzymes
     3. Relationship to genetic control
   - D. Functional groups
   - E. Monomers, dimers, oligomers & polymers as they relate to macromolecules; recognition of structures, as appropriate
   - F. Carbohydrates
     1. Elemental and molecular composition
     2. Types of carbohydrates
        - a. monosaccharides, disaccharides, oligosaccharides and polysaccharides
        - b. structure and importance of examples given
   - G. Lipids
     1. Elemental and molecular composition
     2. Types of lipids
        - a. fatty acids, triglyerides, phospholipids, steroids and eicosinoids
        - b. structure and importance of examples given
   - H. Proteins
     1. Elemental and molecular composition
     2. Classes of amino acids (polar, non-polar, ionic)

[1] Presented at or above the depth of the current textbook

3. Primary, secondary, tertiary and quarternary structure
4. Types of proteins
    a. structural proteins, globular, transport, etc.
    b. structure and importance of examples given

I. Nucleotides
1. Elemental and molecular composition
2. Energy and signaling nucleotides
    a. ATP, GTP, cyclic AMP
    b. structure and importance of examples given
3. Types of nucleotides that function in polymers
    a. DNA, RNA
    b. introduction to structure and function

IV. Cell Structure
A. Cell Types, Structure and Function
1. Prokaryote – brief intro to Bacteria & Archaea
2. Eukaryote
B. Common Characteristics
C. Membrane Structure and Function
1. Fluid mosaic model
2. Types of lipids, proteins
3. Experiments involved in deduction of the model
D. Cytoplasmic Structures
1.. Examples, structure & functions
2. Interrelationships / systems biology of cells
E. Endomembrane System
1. Structure & functions
2. Secretory pathway; including signal peptides
F. The nucleus
1. Nuclear membrane, pores
2. Nucleoplasm, nucleolus, chromatin
G. Energy organelles
1. Mitochondria
2. Chloroplasts
3. Endosymbiotic theory

V. Transport in cells
A. Membrane Structure and Function
B. Diffusion
1. Kinetic energy, equilibrium, concentration gradients
2. Applications
C. Osmosis
1. Definition, importance
2. Tonicity; applications and cells
D. Facilitated Diffusion
E. Active Transport
F. Endocytosis: Phagocytosis, Pinocytosis & Receptor Mediated
G. Exocytosis

H. Intercellular Junctions: tight junctions, desmosomes, etc.

VI. Energy & Enzymes
- A. Definition and Laws of Thermodynamics
- B. Exergonic/Endergonic Reactions
- C. ATP – function, ATP / ADP Cycle
- D. Enzymes
  1. Structure, active site
  2. Mechanism: induced fit, kinetics, V_{Max}, etc.
  3. Factors affecting enzyme activity
  4. Allosteric regulation
  5. Introduction to ribozymes

VII. Photosynthesis
- A. Defined
- B. Importance to Plant
- C. Importance to All Organisms
- D. Structure
  1. Leaf
  2. Plastids
  3. Pigments / types and roles, absorbance spectra
  4. Electromagnetic spectrum
- E. Light Dependent Reactions
  1. Photolysis
  2. Photophosphorylation
  3. NADP reduction
  4. Chemiosmotic gradient
  5. Electron transport
  6. Comparison of cyclic and non-cyclic reactions
  7. Coupling with light independent reactions
- F. Light Independent Reactions
  1. Calvin cycle
  2. Products
  3. Coupling with light reactions
- G. Problems and adaptations with photosynthesis.
  1. Photorespiration
  2. C4 pathway: main reactions, spatial separation, types of plants
  3. CAM pathway: main reactions, temporal separation, types of plants

VIII. Cellular Respiration
- A. Anaerobic
  1. Defined
  2. Phases of glycolysis: activation, cleavage, oxidation, substrate level phosphorylation
  3. Efficiency
  4. Allosteric regulation
- B. Aerobic
  1. Defined
  2. Pyruvate oxidation / transition reaction

3. Krebs / Citrate Cycle – types of reactions, e.g. decarboxylation, dehydrogenation, etc.
4. Electron transport system: principle, role of O_2, chemiosmosis
5. Efficiency and yields

C. Intermediary metabolism
1. Lipid anabolism and catabolism; beta oxidation, etc.
2. Amino acid anabolism and catabolism

IX. Cell Division & Chromosomes

A. Chromosome structure; compare prokaryotes and eukaryotes
1. Histones, nucleosomes, etc.
2. Centromeres & telomeres: function and importance

B. Gross chromosomal mutations

C Cell Cycle
1. Events of all phases; significance of G_o
2. Regulation: main checkpoints and main role of cyclins, cdks, etc.

D. Binary fission in prokaryotes and energy organelles

E. Mitosis
1. All phases and events
2. Cytokinesis – differences in plants and animals
3. Differentiation

F. Meiosis
1. Meiosis I & II – phases: crossing over, independent assortment
2. Cytokinesis

X. Molecular Genetics

A. DNA
1. Structure
2. Replication; include major factors, helicase, etc.
3. Differences in prokaryotes and eukaryotes

B. Gene structure; promoters, coding regions, terminators; differences in prokaryotes and eukaryotes

C. Transcription and processing
1. RNA polymerase, transcription factors
2. Post-transcriptional modification; intron splicing (process and importance), polyadenylation

D. Translation
1. Types of RNA and their roles
2. Ribosomes

E. Regulation of gene expression in prokaryotes
1. Lac operon; history, introduction to the genetics
2. Negative control: Induction and repression
3. Positive control: role of cAMP

F. Regulation of gene expression eukaryotes
1. Transcriptional control
3. Post transcriptional control: alternative splicing, etc.
4. Translation control
5. Chromatin remodeling

G. DNA Mutations
1. Types and their importance; point mutation – silent, nonsense, missense; frameshift

XI. Classical Genetics
A. Mendel
1. Experimentation and Principles of inheritance
2. Law of segregation
3. Law of independent assortment
B. Crosses
1. Probability
2. Monohybrid
3. Dihybrid
4. Sex linkage
5. Autosomal linkage
C. Genetic linkage mapping
D. Polygenic Inheritance
E. Epistasis

XII. Recombinant DNA and Genomics
A. Restriction Enzymes
B. Standard Cloning Techniques
C. Polymerase Chain Reaction
D. Applications of recombinant DNA and genomics
1. Biotechnology
2. Transgenic Organisms
3. Genetic screening / DNA diagnostics
4. DNA sequencing and genomics

GENERAL WET LABORATORY TOPICS[2]

I. Identification and quantitation of macromolecules –spectrophotometry and construction of standard curves with MS Excel
II. Detection of enzymes and factors influencing enzyme activity
III. Microscopy & examination of prokaryotic and eukaryotic cells
IV. Culture and examination of bacteria
V. Osmosis & diffusion in cells and model organisms
VI. Quantitation of anaerobic and aerobic respiration
VII. Photosynthesis – chlorophyll analysis and measurement of light independent reactions
VIII. Isolation of DNA
IX. Transformation of bacteria with plasmid DNA
X. DNA electrophoresis and mock DNA fingerprinting

LEARNING MATERIALS:

[2] Note there may be slight variation

Textbook:
Campbell Biology, 10th Edition, 2011, Reece, et.al. Benjamin Cummings Publishing.

Lab Manual:

Individual Laboratory Outlines will be distributed electronically or in class

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:	R. Wayne Habermehl Professor of Biological Sciences	Date: 6/1/1998
Revised by:	Christopher J. Harendza, Ph.D. Associate Professor and Coordinator of Biology	Date: 10/22/2004
Revised by:	Christopher J. Harendza, Ph.D. Interim Dean STEM & Professor of Biology	Date: 7/22/2012
Revised by:	Christopher Harendza, Ph.D.	Date: 10/30/2012
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 5/23/2013
Revised by:	Christopher Harendza, Ph.D.	Date: 3/14/2016
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 3/15/2016
Revised by:	Debbie Dalrymple .	Date: 06/27/2016
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 06/27/2016
Revised by:	Wendy Zoll-Fillgrove and Debbie Dalrymple	Date: 1/27/2018
VPAA/Provost or designee Compliance Verification:		Date: 1/30/2018

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.