Virginia Western Community College
BIO 173
Biology for Biotechnology

Prerequisites

Successful completion of MTE 1, 2, 3, 4, and 5; and a placement recommendation for ENG 111, co-enrollment in ENF 3/ENG 111, or successful completion of all developmental English requirements.

Course Description

Introduces the student to biological concepts essential to the understanding of biotechnology. Focuses on the structural organization, function, and chemical nature of the cell. Studies cellular processes such as membrane transport, information, processing, reproduction and heredity. Emphasizes laboratory methods of biotechnology.

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

Required Materials

Textbooks:
How Life Works, Clark and Pazdernik. 2nd edition. Macmillian. ISBN: 9781464126093
Virginia Western Community College Biology 173 Lab Manual: Biology for Biotechnology. Summer 2016

Course Outcomes

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

- Describe the main themes in the study of life
- Explain the chemistry of life, including basic structure and properties of biological macromolecules
- Describe the structures within and surrounding the cell, giving their function
- Explain the cellular processes of cell respiration and photosynthesis
- Explain the processes of mitosis and meiosis
- Describe Mendel's laws and their variations
- Discuss some of the phenomena explained by the chromosomal basis of inheritance
- Describe the discovery and the key properties of DNA
- Explain how a gene may ultimately produce a protein
- Explain the principles of cell communication
- Identify and describe key methods used in biotechnology

Topical Description

Chapter 1: Life

- The Scientific Method
- Chemical and Physical Principles
- The Cell
- Evolution

Chapter 2: The Molecules of Life

- Properties of Atoms
- Molecules and Chemical Bonds
- Water: The Medium of Life
- Carbon: Life's Chemical Backbone

Chapter 3: Nucleic Acids and Transcription

- Major Biological Functions of DNA
- Chemical Composition and Structure of DNA
- Retrieval of Genetic Information Stored in DNA: Transcription
- Fate of the RNA Primary Transcript

Chapter 4: Translation and Protein Structure

- Molecular Structure of Proteins
- Translation: How Proteins are Synthesized
- Protein Evolution and the Origin of New Proteins

Chapter 5: Organizing Principles

- Structure of Cell Membranes
- The Plasma Membrane and Cell Wall
- The Internal Organization of Cells
- Endomembrane System
- Mitochondria and Chloroplasts

Chapter 6: Making Life Work

- An Overview of Metabolism
- Kinetic and Potential Energy
- The Laws of Thermodynamics
- Chemical Reactions
- Enzymes and the Rate of Reactions

Chapter 7: Cellular Respiration

- Glycolysis
- Pyruvate Oxidation
- The Citric Acid Cycle
- The Electron Transport Chain and Oxidative Phosphorylation
- Anaerobic Metabolism
- Metabolic Integration

Chapter 8: Photosynthesis
- Photosynthesis: An Overview
- The Calvin Cycle
- Capturing Sunlight into Chemical Forms
- Challenges to Photosynthetic Efficiency

Chapter 9: Cell Signaling
- Principles of Cell Communication
- Cell Signaling Over Long and Short Distances
- Cell-Surface and Intracellular Receptors
- G Protein-Coupled Receptors
- Receptor Kinases

Chapter 10: Cell and Tissue Architecture
- The Cytoskeleton
- Cell Junctions
- The Extracellular Matris

Chapter 11: Cell Division
- Cell Division
- Mitotic Cell Division
- Meiotic Cell Division
- Regulation of the Cell Cycle

Chapter 12: DNA Replication and Manipulation
- DNA Replication
- Replication of Chromosomes
- Isolation, Identification, and Sequencing of DNA Fragments
- Genetic Engineering

Chapter 13: Genomes
- Genome Sequencing
- Gene Number, Genome Size, and Organismal Complexity
- Organization of Genomes
- Viruses and Viral Genomes

Chapter 14: Mutation and DNA Repair
- Small-Scale Mutations
- Chromosomal Mutations
- DNA Damage and Repair

Chapter 15: Genetic Variation
- Genotype and Phenotype
- Genetic Variation and Individual Uniqueness
- Genomewide Studies in Genetic Variation

- Genetic Variation in Chromosomes

Chapter 16: Mendelian Inheritance

- Early Theories of Inheritance
- Foundations of Mendelian Genetics
- Segregation of Genes
- Independent Assortment
- Patterns of Inheritance

Chapter 17: Inheritance of Sex Chromosomes. Linked Genes, and Organelles

- The X and Y Sex Chromosomes
- X-Lined Genes
- Genetic Linkage and Recombination
- Y-Linked Genes
- Inheritance of Mitochondrial and Chloroplast DNA

Chapter 18: Genetic and Environmental Basis of Complex Traits

- Heredity and the Environment
- Twin Studies
- Complex Traits in Health and Disease

Chapter 19: Genetic and Epigenetic Regulation

- Chromatin to Messenger RNA in Eukaryotes
- Messenger RNA to Phenotype in Eukaryotes
- Transcriptional Regulation in Prokaryotes

Suggested Laboratory Topics

- Scientific Method
- Metric System, Lab Measurements, and Pipetting
- Microscopy
- Cell Structure-Bacteria, protists, plant, and animal
- Macromolecules
- Diffusion and Osmosis
- Enzymes
- Plant Genetics
- DNA Isolation and PCR
- Gel Electrophoresis
- Bioinformatics
- Additional DNA technology (Microarray, etc.)
- Photosynthesis/Chromatography

Notes to Instructors

1. Departmental policy dictates that instructors do not allow students to keep tests.
2. A comprehensive final practical will be given at the end of the semester.
3. The syllabus should state what the course grade will be based on, such as tests, quizzes, a comprehensive final exam, and any other assignments made by the instructor.
4. The VWCC Biology Department uses a 10-point grading scale.
5. Comprehensive study of the listed topics is beyond the reasonable expectations of a 15-week Biology 173 course. It is up to the discretion of the instructor to choose which topics are more detailed but each topic should be adequately covered.