

MIDDLESEX COUNTY COLLEGE  
EDISON, NEW JERSEY

Course Title: **Biology I**

Catalog #: **Bio-117**

Class Hours: 3

Laboratory Hours: 3

Credit Hours: 4

Department Chair \_\_\_\_\_ Division Dean \_\_\_\_\_ Date 2007-2008

Prerequisites: Appropriate score on the College's Placement Test or MAT 013 and one year of high school laboratory science or BIO 010 or CHM 010.

**Textbooks for the Course:**

<b><u>Author</u></b>	<b><u>Title</u></b>	<b><u>Publisher</u></b>	<b><u>Copyright</u></b>
<b>C. Starr &amp; R. Taggart</b>	<b>Biology: The Unity and Diversity of Life 11th Edition</b>	<b>Thompson Brooks Cole</b>	<b>2006</b>
<b>Mader, Sylvia</b>	<b>Inquiry Into Life 12th Edition</b>	<b>W. C. Brown</b>	<b>2008</b>

**Catalog Description:**

A general course involving a study of the physical and chemical properties of living material, cell organelles, transport, cell division, energy transformations in photosynthesis and cellular respiration, plant and animal tissues, the classification of organisms and genetics.

**Course Goals:**

1. To prepare students for critical understanding of the basic concepts of biology.
2. To help students understand the relationships of biology to other areas of study.
3. To emphasize the effects of biology on modern society.
4. To stimulate the students curiosity to continue to investigate scientific advances that occur and appreciate how these advances affect their lives.
5. To provide students with the scientific literacy necessary for responsible participation in society.

## **Objectives**

1. Understand the biological theories that explain the origin of life.
2. Learn the relationship of inorganic and organic compounds to organisms.
3. Learn the important life processes of cellular structures, movement of materials across membranes, photosynthesis, cellular respiration, mitosis and meiosis, tissue structure, and classification of plants and animals.
4. Understand the general principles of genetics.
5. Apply knowledge to specific exercises in laboratory with emphasis on interpretation of data.
6. Learn correct laboratory techniques and proper use of microscopes and other equipment.
7. Utilize the scientific method in the lecture and laboratory to analyze data.
8. Understand the historical value of science and recognize the changeability of ideas (e.g., DNA, cell membrane theory, genetics).
9. Recognize the ethical and moral perspectives of Biology as related to such topics as ecology, genetic engineering, abortion, etc.
10. Learn to accept conflicting scientific theories and to evaluate the validity of these theories.

## COURSE OUTLINE

### I. Introduction

- A. History of Biology
  - 1. Science vs. non-science
- B. Branches of Biology
- C. Qualities of Living Organisms
  - 1. structure
  - 2. metabolism
  - 3. irritability
  - 4. adaptation
  - 5. homeostasis
  - 6. reproduction
  - 7. heritability-evolution
- D. Levels of Organization
  - 1. subatomic particles
  - 2. atoms
  - 3. compounds
  - 4. organelles
  - 5. cells (minimum structural unit of life)
  - 6. tissues
  - 7. organs
  - 8. organ systems
  - 9. organisms
  - 10. population
  - 11. community
  - 12. ecosystem
  - 13. biosphere
- D. The Scientific Method
  - 1. components
    - a. hypothesis
    - b. background information
    - c. experimental design
      - 1) control group
      - 2) experimental group
    - d. results/conclusions
    - e. theories(?)/laws(?)
  - 2. applications of the scientific method

### II. Chemistry

- A. Basic Chemistry- Inorganic Principles
  - 1. atoms

2. element
3. compound
4. molecule
5. states of matter
  - a. liquid
  - b. solid
  - c. gas
  
6. states of matter in organisms
  - a. solutions (simple, saturated, supersaturated)
  - b. suspensions (colloids)
  - c. mixtures

B. Atomic Structure

1. nucleus
  - a. protons
  - b. neutrons
3. electrons
4. atomic number
5. atomic weight
6. isotopes

C. Bond formation

1. ionic bonds
  - a. electron charge transfer
  - b. electrolytes
2. covalent bonds
  - a. electron charge sharing
  - b. non-electrolytes
  - c. non-polar covalent bonds (e.g. CO<sub>2</sub>, O<sub>2</sub>)
  - d. polar covalent bonds
    - 1) ammonia
    - 2) water
      - a) solvent properties
      - b) specific heat
      - c) surface tension
      - d) heat of vaporization
      - e) capillarity
  - d. hydrogen bonding
3. energetics of reactions (brief)
  - a. reaction coefficients (brief meaning of chemical equation)
  - b. hydrolysis
  - c. dehydration synthesis
  - d. transfer
  - e. oxidation - reduction
4. pH (acids, bases, and salts)

D. Organic Molecules

1. Definition of Organic
2. Carbohydrates
  - a. Role of organic compounds (e.g., fuel, storage, building blocks)
  - b. monosaccharides
    - 1) trioses (PGA, PGAL)
    - 2) pentoses (ribose, deoxyribose)
    - 3) hexoses
      - a) glucose - structure, polymer formation
      - b) isomers
      - c) polymerization
  - c. disaccharides
    - 1) sucrose
    - 2) maltose
    - 3) lactose
  - d polysaccharides
    - 1) starch
    - 2) glycogen
    - 3) cellulose
    - 4) chitin
3. Proteins
  - a. roles (structural, functional, etc.)
  - b. structure
    - 1) amino acids (types, basic structure and source)
    - 2) peptide bond formation
    - 3) protein shape
      - a) primary structure
      - b) secondary structure
      - c) tertiary structure
      - d) quaternary structure
    - 4) enzymes
      - a) role
      - b) reaction mechanics
    - 5) examples (enzymes, collagen, hair, keratin)
4. Lipids
  - a. role (membrane, fuel storage)
  - b. structure
    - 1) glycerol
    - 2) fatty acids
    - 3) triglycerides
    - 4) phospholipids
  - c. fat soluble vitamins
  - d. steroids
5. Nucleotides and Nucleic Acids
  - a. role (genes, chromosomes, protein synthesis)
  - b. types
    - 1) DNA

- 2) RNA
- c. brief mention of other substances (NAD, FAD)

### III. Cells and Tissues

#### A. Ultrastructure - organelles

##### 1. Membrane

- a. phospholipids
- b. proteins
- c. pores
- d. function
  - 1) passive transport
    - a) diffusion - Brownian movement
    - b) osmosis - hypotonic, hypertonic, isotonic
    - c) filtration
    - d) facilitated diffusion
  - 2) active transport
    - a) Na-K pump
    - b) phagocytosis
    - c) pinocytosis

##### 2. Cell contents

- a. nucleus
  - 1). nuclear envelope
    - a) pores
    - b) double layer membrane
    - c) continuous with other cytoplasmic organelles
  - 2). contents
    - a) chromosomes
    - b) nucleolus
    - c) RNA

##### b. role of the nucleus

- 1) control of protein synthesis
- 2) mitosis - meiosis

##### c. cytoplasm

###### 1) Endoplasmic Reticulum

- a) structure
- b) membranes - channels, sacs
- c) ribosomes - RER
- d) smooth endoplasmic reticulum (SER)
  - i. role - protein synthesis and export

###### 2) Golgi Complex

- a) structure
- b) membranous sacs and channels
- c) secretion vesicles
- d) role - packaging and transporting zymogens or other materials;  
lysosome formation

- 3) Mitochondrion
  - a) structure
    - i. double membrane
    - ii. cristae - folds - surface area
    - iii. enzymes and electron transport of particles
  - b) role - utilization of fuel - food molecules - ATP synthesis
- 4) Vacuoles
  - a) structure
  - b) types
    - i. contractile - (*Paramecium*, *Amoeba*)
    - ii. storage - (plant cells)
    - iii. food - (animal cells)
- 5) Lysosome
  - a) structure
  - b) role
- 6) Centrosome
  - a) structure
  - b) role
- 7) Plastids
  - a) types
  - b) structure
  - c) role
- 8) Cilia and Flagella
  - a) structure
  - b) role
- 9) Cytoskeleton
  - a) microfilaments
  - b) microtubules
10. Cell inclusions

#### IV. Cells and Tissue Types

##### A. Animal Tissue Types, Organs and Systems

1. epithelial tissues
2. muscle tissues
3. connective tissue
4. nerve tissue
5. organs/systems - give examples

## B. Plant Tissue Types

1. meristematic tissue
2. permanent tissues
  - a. parenchyma
  - b. sclerenchyma
  - c. collenchyma
  - d. epidermis
    - 1) cuticle
    - 2) cork
  - e. conductive
    - 1) xylem
    - 2) phloem

## V. Cell Reproduction

### A. Mitosis and Cytokinesis

1. Stages of mitosis
  - a. cell cycle
  - b. chromosomes
  - c. chromatids
2. Differences between plant and animal mitosis

### B. Meiosis

1. Stages of meiosis
2. Importance of meiosis
  - a. haploid
  - b. diploid

## VI. Genetics and Heredity

### A. Mendelian Genetics

1. Mendel's classical experiments - historical perspectives
2. Mendel's Laws
  - a. segregation
  - b. independent assortment

### B. General Principles and Problem Solving

1. allele
2. dominant - recessive
3. blending
4. multiple alleles
5. homologous chromosomes
6. polygenes
7. linkage
8. sex-determination
9. crossing-over
10. mutation

11. non-disjunction
  12. environmental influences on heredity
  13. sex determination and linkage
- C. Molecular Genetics (Post-Mendelian)
1. DNA structure
  2. concept of the gene
  3. gene function - protein synthesis
    - a. triplet code - codon
    - b. mRNA - structure and function
    - c. ribosomes - function
      - 1) rRNA
      - 2) tRNA
- D. Biotechnology
1. gene products
  2. social implications
  3. future uses

## VII. Energy

- A. Photosynthesis
1. leaf structure
  2. chloroplasts
  3. chlorophyll - energy trapping
  4. NADP - electron carrier
  5. ATP - energy currency
  6. the light dependent reactions
  7. Calvin Cycle (dark independent reactions)
- B. Cellular Respiration
1. glycolysis
  2. Krebs Cycle
  3. electron transfer system- chemiosis
  4. fermentation
  5. pathways other than glucose (brief discussion)

## VIII. Diversity of Life - Taxonomy (Selected Groups to be Covered in Lab)

- A. Classification systems
1. basis for system - historical developments
  2. criteria utilized for classification
  3. nomenclature (hierarchy)
- B. The Five Kingdoms
1. Monera
    - a. bacteria
    - b. blue-green alga
  2. Protoctista
    - a. Chrysophyta

- b. Pyrrophyta
- c. Euglenophyta
- d. Protozoa
- 3. Plantae
  - a. Chlorophyta
  - b. Rhodophyta
  - c. Phaeophyta
  - d. Bryophyta
  - e. Tracheophyta
- 4. Fungi
  - a. Myxomycetes
  - b. Zygomycetes
  - c. Ascomycetes
  - d. Basidiomycetes
- 5. Lichens
  - a. Porifera
  - b. Cnidaria
  - c. Platyhelminthes
  - d. Aschelminthes
  - e. Annelida
  - f. Mollusca
  - g. Arthropoda
  - h. Echinodermata
  - i. Chordata