MIDDLESEX COUNTY COLLEGE
EDISON, NEW JERSEY

Course Title: **Biology for Lab Technology I** Catalog #: **BIO 119**

Credits: **4** Contact Hours: **6** Lecture Hours: **3** Lab Hours: **3**

Department Chair: _____ Division Dean: _____ Date: 2007 - 2008

Prerequisite(s): **Appropriate score on the College's placement test or MAT 013 and one year high school laboratory science or BIO 010 or CHM 010**

Corequisite(s): **none**

Textbooks for Course :

Author	Title	Publisher	Copyright
Starr and Taggart	**The Unity and Diversity of Life 11th Edition**	**Thomson–Brooks/Cole**	**2006**
Seidman and Moore	**Basic Laboratory Methods for Biotechnology**	**Prentice Hall**	**2000**
Perry and Morton	**Photo Atlas for Biology**	**Wadsworth**	**1996**
Jones and Barlett	**Official Laboratory Research Notebook**		**1998**

Catalog Course Description:

This course is a general study of cell biology including chemistry, organelles, membranes, cell division, energy transformations, and genetics. Plant and animal tissues and classification of living things are also introduced. The labs focus on the skills required for lab technicians such as preparation and calculation of solutions, proper documentation and safety considerations. Emphasis is on the care and use of basic laboratory instruments, such as microscopes, balances and spectrophotometers.

Objectives of the Course: Behavioral

Through hands-on exercises (lab performance and lab practicals) and written homework assignments, tests, quizzes and lab reports, the student will be able to:

Demonstrate an understanding of the scientific method
Describe and identify inorganic and organic compounds common to all life
Explain major life processes including transport of materials through membranes, energy transformations
Summarize the cell cycle and the processes of mitosis and meiosis
Analyze and solve problems related to the transmission of genetic traits
Describe and explain the structure and function of cellular organelles

Identify and describe the major classifications of living things
Demonstrate proficiency using the compound light microscope, stereomicroscope and spectrophotometer
Implement appropriate safety regulations and guidelines when working in the lab
Practice proper procedures for cleaning glassware, preparing solutions, weighing and measuring
Demonstrate time management and observational skills in the lab
Demonstrate communication skills including maintaining laboratory notebook, listening skills, reading and comprehending written documentation
Calculate metric conversions, concentration of solutions, dilutions, pH

COURSE OUTLINE - LECTURE

I. Introduction (2 lectures)
- A. History of Biology
  - 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
- E. The Scientific Method
  1. Components
     a. Hypothesis
     b. Background information
     c. Experimental design
        1) Control group
        2) Experimental group
     d. Results/conclusions
     e. Theories
  2. Applications of the scientific method

II. Chemistry (5 lectures)

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
2. Electrons
3. Atomic number
4. Atomic weight
5. 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_2, O_2)
    d. Polar covalent bonds
        1) Ammonia
        2) Water
            a) Solvent properties
            b) Specific heat
            c) Surface tension
            d) Heat of vaporization
            e) Capillarity
    e. 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 (4 lectures)

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

3). Role of the nucleus

a) Control of protein synthesis

b) Mitosis - meiosis

b. Cytoplasm

1) Endoplasm Reticulum

a) Structure

b) Membranes - channels, sacs

c) Ribosome's - RER

d) Smooth endoplasm reticule (SER)

2) Golgi Complex

a) Structure

b) Membranous sacs and channels

c) Secretion vesicles

d) Role - packaging and transporting 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, Amoebae)
        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 (1 lecture)
- 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 (2 lectures)
- 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 (5 lectures)

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 (4 lectures)

A. Photosynthesis
   1. Leaf structure
   2. Chloroplasts
   3. Chlorophyll - energy trapping
   4. NADP - electron carrier
   5. ATP - energy currency
   6. Light dependent reactions
   7. Calvin Cycle (dark independent reactions)

B. Cellular Respiration
    1. Glycolysis
    2. Krebs Cycle
    3. Electron transfer system- Chemiosmosis
    4. Fermentation
    5. Pathways other than glucose (brief discussion)

VIII. Diversity of Life - Taxonomy (2 lectures)
A. Classification systems
    1. Basis for system - historical developments
    2. Criteria utilized for classification
    3. Nomenclature (hierarchy)
B. Classification Schemes
    1. Five Kingdoms
        a. Monera
            1) Bacteria
            2) Cyanobacteria
        b. Protista
            1) Chrysophyta
            2) Pyrrophyta
            3) Euglenophyta
            4) Protozoa
        c. Plantae
            1) Chlorophyta
            2) Rhodophyta
            3) Phaeophyta
            4) Bryophyta
            5) Tracheophyta
        d. Fungi
            1) Myxomycetes
            2) Zygomycetes
            3) Ascomycetes
            4) Basidiomycetes
            5) Lichens
        e. Animalia (Metozoa)
            1) Porifera
            2) Cnidaria
            3) Platyhelminthes
            4) Aschelminthes
            5) Annelida
            6) Mollusca
            7) Arthropoda
            8) Echinodermata
            9) Chordata

2. Six Kingdoms
    a. Eubacteria
    b. Archaebacteria
    c. Protista
    d. Fungi
    e. Plantae
    f. Animalia
3. Three Domains
    a. Eubacteria
    b. Archaebacteria
    c. Eukaryotes

COURSE OUTLINE – LAB

WEEK	TOPIC
1	Introduction to the Biology Lab • Appropriate lab behavior • Following Standard Operating Procedures (SOPs) & documentation • Appropriate attire • Safety features in lab and safety practices • Becoming familiar with the lab equipment and reagents
2	Metrics Lab #1 • Metric units of measure • Metric conversions • Equipment for measuring weight, length, volume, temperature • Proper use, cleaning, care and storing equipment
3	Metrics Lab #2 • Proper techniques for making solutions • Accuracy and precision in making solutions • Micropipetting
4	Chemistry of the Cell • Qualitative and quantitative tests for reducing sugars (Benedict's Reagent), lipids (Sudan III) and proteins (Bicinchoninic Acid) • Qualitative test for starch (Iodine test)
5	Microscope and Cells • Parts and use of microscope • Cleaning, care and storage of microscopes • Sample preparation • Calculating total magnification and size of specimen using ocular micrometer
6	Solutions and pH • Various kinds of solutions (%m/v, %v/v, molar, etc) • Stock solutions • Making dilutions

- Prepare solutions for next week's lab
- pH and buffers
- Measuring pH with indicators, pH paper and pH meters

7 Diffusion and Osmosis
- Diffusion of gases
- Diffusion through semisolid
- Diffusion through dialysis membranes
- Osmosis of water through dialysis membranes
- Osmosis in living cells

8 Preparation for Photosynthesis and Enzyme Labs
- Prepare spinach extract, chromatography solvent, starch solution, buffers
- Introduction to spectroscopy

9 Separation of Photosynthetic Pigments
- Paper chromatography

Enzymes
- Effect of concentration and pH on amylase activity

10 Fermentation

11 The Mystery of the Crooked Cell
- Genetics of sickle cell anemia
- Microscopic observation of cells
- Case studies
- Electrophoresis of normal and sickle cell hemoglobin

12 Preparation for DNA Electrophoresis Lab
- Preparation of TBE buffer
- Preparation of agarose gels
- Set up λ digests
- Practice loading gels

13 DNA electrophoresis
- Electrophoresis of λ digests (prepared in last week's lab)
- Graphing migration of size standards and determining size of DNA fragments

14 Lab Practical