

STATUS: A

COMMON COURSE NUMBER: BSC 1810

COURSE TITLE: Biology Principles for Teachers I

CREDIT HOURS: 3

CONTACT HOURS BREAKDOWN:

Lecture/Discussion 48

Lab

Other

Contact Hours/Week 3

CATALOG COURSE DESCRIPTION:

Prerequisite: None

Corequisite: None

This course is designed for middle and high school science teachers. It covers the basic principles of biology including molecular biology, cell structure and function, and genetics. Lectures will include hands-on activities and demonstrations. This is the first of a two-course sequence. This course will not satisfy the General Education Requirements for the A.A. degree.

General Education Requirements - Associate of Arts Degree, meets Area(s):

General Education Requirements - Associate in Science Degree, meets Area(s):

UNIT TITLES:

1. Unifying Concepts in Biology and Introductory Lab Techniques
2. Chemical Foundations for Cells
3. Carbon Compounds in Cells
4. Cell Structure and Function
5. Membrane Structure and Function
6. Introduction to Metabolism
7. Energy-Acquiring Pathways
8. Energy-Releasing Pathways
9. Cell Reproduction
10. Patterns of Inheritance

LAST REVIEW Academic Year 2004-2005 NEXT REVIEW Academic Year 2009-2010

I. Course Overview:

Upon successful completion of this course, the students should be able to demonstrate an understanding of principles of biology focusing on those elements common to the fundamental structure, nature, and activities of all living organisms.

II. Units:

Unit 1. Unifying Concepts in Biology and Introductory Lab Techniques

General Outcome:

1.0 The students should be able to demonstrate an understanding of evolution, the scientific method, the basic life processes, laboratory safety, and microscopic techniques.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 1.1 Explain four concepts that unify all life.
- 1.2 Distinguish between deductive and inductive reasoning.
- 1.3 List the five steps of the scientific method and apply to an example investigation.
- 1.4 Distinguish between natural (phylogenetic) and artificial classification systems.
- 1.5 List seven major divisions of the Linnean system of classification in descending order from highest classification to lowest classification.
- 1.6 Describe the binomial system of nomenclature.
- 1.7 Classify man from kingdom to species using the Linnean system.
- 1.8 Explain the basic concepts of Lamarck's theory of acquired characteristics.
- 1.9 Recount the history behind Darwin and Wallace's theory of evolution by natural selection.

- 1.10 List the five basic tenets of Darwin's theory of evolution as expressed in On the Origin of Species by Means of Natural Selection.
- 1.11 List the five kingdoms of organisms; describe the general characteristics of each, and recognize a representative example of each.
- 1.12 List safety procedures in the biology lab.
- 1.13 Locate lab safety features such as fire extinguishes, fire alarm, first aid kit, eye wash, fire shower, chemical disposal kits, broken glassware container, and fire exits.
- 1.14 Demonstrate proper use of the light microscope and stereo microscope.
- 1.15 Compare and contrast the light and stereo microscopes.
- 1.16 Demonstrate proper technique in preparing and viewing a stained wet mount of cheek cells.
- 1.17 Measure the size of one cheek cell in micrometers (μm).
- 1.18 Identify and give the function of the parts of the light microscope.

Unit 2. Chemical Foundations for Cells

General Outcome:

2.0 The students should be able to demonstrate an understanding of the chemical basis of cellular functions.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 2.1 Distinguish among matter, elements, compounds, and mixtures.
- 2.2 Define an atom and list the major particles and their characteristics.
- 2.3 Distinguish between atomic number and atomic mass.
- 2.4 Distinguish between an isotope and an ion.
- 2.5 Calculate the atomic mass if given the number of protons and neutrons, or give the number of neutrons if given the atomic number and the atomic mass.
- 2.6 Relate the location of electrons relative to the nucleus and discuss their role in bonding.
- 2.7 Name three types of bonding and distinguish among each.
- 2.8 Distinguish between polar and nonpolar covalent bonds.
- 2.9 Explain characteristic differences between acids and bases and define the pH scale.
- 2.10 Relate how a buffer works.
- 2.11 Describe the importance of hydrogen bonding in water.
- 2.12 Define solute and solvent.
- 2.13 Produce a neutral solution given an acid and base, and provide evidence and explanation of neutralization.
- 2.14 Determine the pH of several substances by using pH paper.

Unit 3. Carbon Compounds in Cells

General Outcome:

3.0 The students should be able to list and describe important organic compounds and their roles in biological systems.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 3.1 Draw the structural formulas of several common functional groups.
- 3.2 Explain dehydration synthesis and hydrolysis reactions.
- 3.3 Describe the structure and composition of basic carbohydrates.
- 3.4 Differentiate monosaccharides, disaccharides, and polysaccharides.
- 3.5 List some common mono, di, and polysaccharides and recognize their structures.
- 3.6 Identify the building blocks of triglycerides.
- 3.7 List several types of lipids, i.e., steroids, phospholipids, glycolipids.
- 3.8 Explain the basic components of an amino acid.
- 3.9 Draw the structural formula of a generalized amino acid.
- 3.10 Describe the differences in primary, secondary, tertiary, and quaternary structure of proteins, name the type of bonding involved in each, and relate these structures to protein function.
- 3.11 Explain protein denaturation.
- 3.12 Describe the building blocks of DNA and RNA.
- 3.13 Distinguish three differences between DNA and RNA.
- 3.14 Identify an unknown amino acid from a chromatogram.
- 3.15 Explain how paper chromatography works and why the technique is useful in identifying proteins.

- 3.16 Identify various reducing sugars using the Benedict's Test.
- 3.17 Prepare a wet mount of potato or other appropriate cells stained with iodine and identify the cell wall and starch granules.
- 3.18 Build a dipeptide using molecular models.

Unit 4. Cell Structure and Function

General Outcome:

4.0 The students should be able to discuss the complexities of prokaryotic and eukaryotic animal and plant cells.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 4.1 Describe the contributions of Hooke, Schwann, and Schleiden to the cell theory.
- 4.2 Name the three basic parts of a "typical" cell and the function of each.
- 4.3 Compare and contrast characteristics of eukaryotic and prokaryotic cells.
- 4.4 Compare and contrast characteristics of plant and animal cells.
- 4.5 Give the characteristics and functions for major cell organelles.
- 4.6 Describe the importance of cell homeostasis.
- 4.7 Locate various forms of prokaryotic cells found in samples provided.
- 4.8 Measure and compare the size of cheek and bacterial cells.
- 4.9 Describe taxis in Paramecium.
- 4.10 Identify and state the function of the nuclei found in Paramecium.
- 4.11 Demonstrate and explain digestion in Paramecium.

Unit 5. Membrane Structure and Function

General Outcome:

5.0 The students should be able to describe the importance of cell membranes in regulation of cell activities.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 5.1 Describe the fluid mosaic model of the cell membrane.
- 5.2 Distinguish between passive and active transport.
- 5.3 Describe osmosis, diffusion, facilitated diffusion, active transport, exocytosis, and endocytosis.
- 5.4 Identify and explain Brownian movement.
- 5.5 Explain and demonstrate evidence of osmotic pressure.
- 5.6 Explain and demonstrate evidence of the movement of molecules of various sizes through a dialysis membrane.
- 5.7 Explain the effects of hypotonic and hypertonic solutions on plant and animal cells.
- 5.8 Provide physical evidence of the occurrence of plasmolysis in plant cells.
- 5.9 Explain the effect of heat on membrane function.

Unit 6. Introduction to Metabolism

General Outcome:

6.0 The students should be able to relate how cells trap, store and utilize energy.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 6.1 Explain the first and second laws of thermodynamics.
- 6.2 Define metabolism and explain how anabolic and catabolic reactions play a part.
- 6.3 Discuss activation energy.
- 6.4 Describe enzyme structure.
- 6.5 Discuss the induced-fit hypothesis.
- 6.6 Describe the effects of pH and temperature on enzyme activity.
- 6.7 State two types of energy transfers in cells.
- 6.8 Describe the components and use of ATP.
- 6.9 Demonstrate the effects of denaturation on enzyme activity.
- 6.10 Identify the source of enzyme, products, substrate, and type of reaction in appropriate lab experiments.

Unit 7. Energy-Acquiring Pathways

General Outcome:

7.0 The students should be able to demonstrate an understanding of the major energy acquiring pathways in living systems.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 7.1 Distinguish between heterotrophic and autotrophic organisms.
- 7.2 Describe light-dependent and light-independent reactions of photosynthesis.
- 7.3 Identify the sources of hydrogen and oxygen in photosynthesis.
- 7.4 Describe chloroplast structure and function.
- 7.5 Describe the electromagnetic spectrum and its importance in photosynthesis.
- 7.6 Describe the two light gathering units of photosynthesis and the basic events that occur in each system.
- 7.7 Explain the mechanism of ATP production by chemiosmosis.
- 7.8 Explain various ways autotrophs use the intermediates and products of photosynthesis.
- 7.9 Distinguish between C3 and C4 metabolism.
- 7.10 Identify the components of photosynthetic pigments on a chromatogram.
- 7.11 Describe starch production as a function of light exposure.

Unit 8. Energy-Releasing Pathways

General Outcome:

8.0 The students should be able to demonstrate an understanding of cellular respiration.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 8.1 Explain phosphorylation and oxidation-reduction reactions.
- 8.2 Detail glycolysis, the Krebs' cycle and electron transport.
- 8.3 Contrast aerobic and anaerobic respiration.
- 8.4 Distinguish between lactate fermentation and alcoholic fermentation.
- 8.5 Compare and contrast photosynthesis and cellular respiration.
- 8.6 Demonstrate the use of homogenization and centrifugation in separation of cellular organelles.
- 8.7 Describe the use of chemical tests such as the tetrazolium test to detect the occurrence of cellular respiration.

Unit 9. Cell Reproduction

General Outcome:

9.0 The students should be able to demonstrate an understanding of all types of cell division.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 9.1 Describe chromosome structure.
- 9.2 Distinguish among prokaryotic fission, mitosis, and meiosis.
- 9.3 Define haploid, diploid, and polyploid.
- 9.4 Describe the events of the cell cycle including the phases of mitosis and cytokinesis in plant and animal cells.
- 9.5 Describe the events of meiosis in plants and animals.
- 9.6 Detail gametogenesis in higher plants and animals.
- 9.7 Compare and contrast meiosis and mitosis.
- 9.8 Identify the phases of mitosis on prepared slides.

Unit 10. Patterns of Inheritance

General Outcome:

10.0 The students should be able to explain the basic laws of inheritance and predict genetic outcomes.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 10.1 Describe the contributions of Gregor Mendel to genetics.
- 10.2 Analyze a monohybrid and dihybrid cross.
- 10.3 Discuss the significance of a test cross.
- 10.4 Define and describe selected genetic terms such as locus, homozygous, heterozygous, dominant trait, recessive trait, genotype, phenotype, probability, Punnett Square, incomplete dominance, complete dominance and polygenic inheritance.
- 10.5 Explain Mendel's principles of segregation and independent assortment in terms of meiotic events.
- 10.6 Define multiple alleles as exemplified by the human ABO blood types.
- 10.7 Interpret a pedigree chart.
- 10.8 Demonstrate principles of probability using coins or dice.
- 10.9 Demonstrate the ratio which results from a dihybrid cross.
- 10.10 Calculate expected results in monohybrid and dihybrid crosses.
- 10.11 Determine possible genotypes in their families for selected genetic characteristics.