

Introductory Biology

This document is designed to facilitate the transfer of general education credit for undergraduate, non-majors' biology lecture courses among institutions in the State of Missouri.

All biology lecture courses designed for non-science majors should help students:

1. Develop an understanding of how science is conducted.
2. Develop an understanding of basic biological concepts necessary for biological literacy.
3. Apply higher-level thinking to biology concepts, with emphasis placed on those skills and content needed by educated citizens.
4. Explore biological issues of concern to the public, forming a foundation for life-long learning on scientific issues.

It is expected that faculty teaching an introductory biology course for non-majors will address each of the eight concepts described below. Various approaches are appropriate for teaching each concept. *This document provides suggested objectives, but it is not required that every objective be achieved for every concept.*

These competencies are not designed to limit the topics in college biology to these eight concepts, but is rather a foundation upon which other topics may be added at the instructor's discretion.

Some aspects of this document were taken either directly or indirectly from the following sources:

- Summary of Group Goals for Introductory Biology from the Missouri Alignment Project: Life Sciences Discipline Workgroup, as summarized by Deborah Allen.
- MIT Hierarchical Introductory Biology Concept Framework (<http://web.mit.edu/bioedgroup/HBCF/CBE-Summer2004.html>)
- Quality in Undergraduate Education – Standards for a Non-Majors Biology Course (<http://www2.gsu.edu/~wwwque/standards/biology/biologynonmajors.html>)

1) Biology is a scientific discipline based on observations and experiments.

Objectives to support this concept may include:

- a) Judge the validity of science found in popular media based on the source, methodology used to investigate the science, and the conclusions drawn from the results.
- b) Read and discuss scientific material written for the educated lay reader.
- c) Explain that scientific knowledge is cumulative and subject to changes in interpretation based on new evidence.

2) At the molecular level, biology is based on interactions of three-dimensional molecules and life processes are the result of regulated chemical reactions.

Objectives to support this concept may include:

- a) Explain why each of the four major categories of organic molecules (carbohydrates, lipids, nucleic acids, proteins) is required for living systems.
- b) Recognize that the metabolism of living things is a series of chemical reactions that transfers energy and atoms between molecules.
- c) Apply an understanding of a molecule's 3-dimensional shape to molecule function (e.g. tertiary protein structure to enzyme function).

3) The cell is the basic unit of life.

Objectives to support this concept may include:

- a) Determine if an object is living or non-living, prokaryotic or eukaryotic, plant cell or animal cell based on identifying characteristics.
- b) Explain how different parts of the cell contribute to characteristics common to all living things.
- c) Interpret the statement, "Cells arise from other cells," using cellular reproduction as evidence.

4) The structure of DNA guides its own replication, the production of proteins, and the transmission of information to future generations.

Objectives to support this concept may include:

- a) Describe how the structure of DNA makes it possible for identical copies to be made when cells replicate.
- b) Draw and/or explain the relationship between DNA molecules, chromosomes, genes, alleles and genomes.
- c) Explain that genes are segments of DNA with information for making a protein and that the sequence of bases in that DNA segment dictates the sequence of amino acids in the protein.
- d) Apply an understanding of gene expression to explain why most somatic cells in an individual have the same genetic information, but are structurally and functionally different.
- e) Integrate an understanding of genes and protein synthesis to explain why a mutation can change the resulting protein.
- f) Explain that versions of genes (alleles) are sources of variation in a population and the source of inheritable genetic diseases.
- g) Relate gene expression and phenotype.

5) The physiology of multicellular organisms involves interactions among different levels of organization.

Objectives to support this concept may include:

- a) Describe the relationship between the following levels of organization: molecule, organelle, cell, tissue, organ, organ system, and organism.

- b) Explain how changing a fundamental physiological process at the molecular level will impact the other levels in the organizational hierarchy (e.g., cystic fibrosis, photosynthesis, etc.)
- c) Define and give examples of homeostasis.
- d) Explain how physiological development is controlled by carefully synchronized chemical signals.

6) Organisms interact with each other and the environment.

Objectives to support this concept may include:

- a) Give examples of the interdependency of biotic and abiotic components of ecosystems (e.g. nutrient cycling, energy flow, etc.).
- b) Describe the impact of human activity on the environment and how this impact may drive biological change, loss of habitat, and/or species extinction.
- c) Describe a) how human activities contribute to the greenhouse effect, b) the consequences of global climate change, and c) strategies for mitigating these effects.
- d) Explain the relationship between the following levels of organization: organism, population, communities, ecosystems and biosphere.

7) The Theory of Evolution is the central unifying theme of biology.

Objectives to support this concept may include:

- a) Recognize that the Theory of Evolution explains both the universal characteristics of organisms as well as the diversity of life on Earth.
- b) Explain the importance of variation in a population.
- c) Identify sources of genetic variation (e.g., mutation, genetic recombination during meiosis, and sexual reproduction).
- d) Define evolution as a change in allele frequency.
- e) Explain and give examples of natural selection as the primary mechanism of evolution.
- f) Explain how various tools (e.g., fossil record, radiometric dating, gene modification, comparative morphology, etc.) are used to determine the relationships among species.
- g) Interpret the relationships among organisms in a phylogenetic tree.

8) Biology and society impact each other.

Objectives to support this concept may include:

- a) Explain how science and technology impact society, as well as how scientists are influenced by the political, social, economic and cultural influences of the time.
- b) Demonstrate a basic understanding of common biotechnology tools (e.g., Recombinant DNA Technology, restriction enzymes, DNA Fingerprinting, Somatic Cell Nuclear Transfer) and explain how the use of these tools has influenced social, cultural, or political issues.
- c) Examine both sides of conflicting opinions on bioethical issues.