

BIOLOGY I: COURSE OVERVIEW

The academic standards for High School Biology I establish the content knowledge and skills for Tennessee students in order to prepare them for the rigorous levels of higher education and future job markets. The course provides students with a wealth of experiences for both science practices and content knowledge needed in an ever changing world. The academic standards for Biology I are research-based, supported by the National Research Council's *Framework for K-12 Science Education*, and establish the core ideas and practices of science and engineering that will prepare students to use scientific thinking to examine and evaluate knowledge encountered throughout their lives.

The major disciplinary core ideas utilized for Biology I include:

Biology I (BIO1)
Life Sciences (LS)
From Molecules to Organisms: Structure and Process <ul style="list-style-type: none">• Central Dogma• Feedback mechanisms• Homeostasis• Cellular differentiation and coordinated functions• Photosynthesis• Organic molecules• Aerobic respiration and alternative glucose metabolism• Cellular respiration• Interpretation of input(s) in behavior
Ecosystems: Interactions, Energy, and Dynamics <ul style="list-style-type: none">• Population dynamics• Energy transfer• Disturbances• Resilience• Biodiversity and ecosystem stability• Group behavior and species survival and reproductive success
Heredity: Inheritance and Variation of Traits <ul style="list-style-type: none">• Eukaryotic cell cycle• Sexual reproduction• Phenotype determining factors• Sources of genetic variation
Biological Change: Unity and Diversity <ul style="list-style-type: none">• Evidence of common ancestry and biological evolution• Differential success• Natural selection• Adaptation in populations• Evolutionary processes

Although science is a body of knowledge consisting of theories that explain data, science is also a set of practices that use analysis and argumentation to establish, extend, and refine knowledge. The science and engineering practices are used as a means to learn science by doing science. These practices are not intended to be a sequence of steps nor are they intended to be taught as a separate, introductory unit for the course. By combining content knowledge with skill, students discover how scientific knowledge is acquired and applied to solve problems or advance scientific knowledge further. In addition, there are seven crosscutting concepts that are fundamental to the nature of science and thus stretch across all science disciplines. The Biology I standards have been constructed by explicitly integrating practices and crosscutting concepts, iteratively and in combination, within each core idea to provide students with a well-rounded education in science.

Special attention is given to science literacy through the use of the science and engineering practices. Students are required to gather information from reliable sources to construct evidenced-based arguments. Finally, STEM integration is supported both as a stand-alone disciplinary core idea as well as integrated into the life science core ideas. By the end of high school, it is expected that all students should be able to demonstrate the skills and content knowledge emphasized in the following standards.

BIOLOGY I: ACADEMIC STANDARDS

BIO1.LS1: From Molecules to Organisms: Structures and Processes

- 1) Construct an explanation based on evidence that the essential functions of life are primarily carried out through the work of proteins that are coded for by genes in DNA, as described by the Central Dogma (i.e., transcription, translation).
- 2) Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- 3) Use a model to describe how differentiation in a multicellular organism creates specialized cells that perform diverse functions to work together to meet the needs of the entire organism, including human development
- 4) Create, or use, a model to describe how the process of photosynthesis converts light energy into the stored chemical energy of bonds created by converting CO₂ and H₂O into sugar and other organic molecules.
- 5) Construct an explanation based on evidence that matter taken into an organism can be broken down and recombined to make macromolecules necessary for life functions.
- 6) Create, or use, a model to describe how cellular respiration transforms stored chemical energy of food resulting in a net transfer of energy. Compare aerobic respiration to alternative processes of glucose metabolism.
- 7) Construct an explanation from evidence to explain how the integrated functions of the brain in complex animals results in successful interpretation of input and generation of behaviors in response to those inputs.

BIO1.LS2: Ecosystems: Interactions, Energy, and Dynamics

- 1) Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- 2) Create, or use, a mathematical model to describe the transfer of energy from one trophic level to another. Explain how the inefficiency of energy transfer between trophic levels affects the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight and inorganic compounds from the environment.
- 3) Obtain, evaluate, and communicate information based on evidence to describe how the impact

of varying levels of disturbance is related to the resilience of an ecosystem.

- 4) Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- 5) Analyze data about the role of group behavior on individual and species' chances to survive and reproduce.

BIO1.LS3: Heredity: Inheritance and Variation of Traits

- 1) Engage in an argument from evidence that the process of cellular division (mitosis) creates diploid daughter cells that are genetically identical to the diploid parent cells.
- 2) Engage in an argument from evidence that the process of meiosis exists to create genetic variation in a population from the creation of new combinations of genetic material in each of the haploid gametes.
- 3) Ask questions to clarify that variation of traits arises from differences in genes (alleles) and how cells regulate gene expression.
- 4) Construct an explanation based on evidence that genetic variations may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during meiosis, (b) mutations that occur during replication, and/or (c) mutations caused by environmental factors. Evidence should include that mutations that occur in gametes can be passed to offspring.

BIO1.LS4: Biological Change: Unity and Diversity

- 1) Analyze and interpret scientific data that common ancestry and biological evolution are supported by multiple lines of empirical evidence (e.g. DNA sequences, amino acid sequences, anatomical structures, the fossil record, biogeography, or order of appearance of structures during embryological development).
- 2) Apply concepts of statistics (i.e. probability) to support explanations that organisms in a population with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- 3) Analyze and interpret data that natural selection is influenced by (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the

environment.

- 4) Construct an explanation based on evidence for how natural selection leads to adaptation in populations.
- 5) Obtain, evaluate, and communicate information about how changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.