

# **Biology**

## **Overview**

The biology standards provide students with a basic knowledge of living organisms and the interaction of these organisms with the natural world. The standards establish the scientific inquiry skills and core content for all biology courses in DoDEA schools. Biology courses should serve as the foundation for higher-level science courses and should give students the science skills necessary for life science–related technical careers.

Teachers, schools, and districts should use these standards to make decisions concerning the structure and content of Biology 1 and Applied Biology 1 and 2. Educators must also determine how all biology courses in their schools, as well as individual classes, may go beyond the standards. These decisions will involve choices regarding additional content, activities, and learning strategies and will depend on the objectives of the particular courses. All biology courses must include inquiry-based instruction, allowing students to engage in problem solving, decision making, critical thinking, and applied learning.

All biology courses are laboratory courses (minimum of 30 percent hands-on investigation). Biology laboratories will need to be stocked with all of the materials and apparatuses necessary to complete investigations.

# High School Core Science Standards

## Biology

### Scientific Inquiry

The skills of scientific inquiry, including knowledge and use of tools, are not taught as separate skills in science, but are embedded throughout because these process skills are fundamental to all science instruction and content. A table of the PK–12 of scientific inquiry standards and Indicators: is provided in appendix A.

**Standard: Ba:** **The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.**

- Indicators: Ba.1:** Generate hypotheses based on credible, accurate, and relevant sources of scientific information.
- Ba.2:** Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.
- Ba.3:** Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.
- Ba.4:** Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations.
- Ba.5:** Organize and interpret the data from a controlled scientific investigation by using mathematics, graphs, models, and/or technology.
- Ba.6:** Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.
- Ba.7:** Evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).
- Ba.8:** Compare the processes of scientific investigation and technological design.
- Ba.9:** Use appropriate safety procedures when conducting investigations.

**Standard: Bb:** **The student will demonstrate an understanding of the structure and function of cells and their organelles.**

- Indicators: Bb.1:** Recall the three major tenets of cell theory (all living things are composed of one or more cells; cells are the basic units of structure and function in living things; and all presently existing cells arose from previously existing cells).
- Bb.2:** Summarize the structures and functions of organelles found

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in a eukaryotic cell (including the nucleus, mitochondria, chloroplasts, lysosomes, vacuoles, ribosomes, endoplasmic reticulum [ER], Golgi apparatus, cilia, flagella, cell membrane, nuclear membrane, cell wall, and cytoplasm).

- Bb.3:** Compare the structures and organelles of prokaryotic and eukaryotic cells.
- Bb.4:** Explain the process of cell differentiation as the basis for the hierarchical organization of organisms (including cells, tissues, organs, and organ systems).
- Bb.5:** Explain how active, passive, and facilitated transport serve to maintain the homeostasis of the cell.
- Bb.6:** Summarize the characteristics of the cell cycle: interphase (called G1, S, G2); the phases of mitosis (called prophase, metaphase, anaphase, and telophase); and plant and animal cytokinesis.
- Bb.7:** Summarize how cell regulation controls and coordinates cell growth and division and allows cells to respond to the environment, and recognize the consequences of uncontrolled cell division.
- Bb.8:** Explain the factors that affect the rates of biochemical reactions (including pH, temperature, and the role of enzymes as catalysts).

**Standard:**    **Bc:**    **The student will demonstrate an understanding of the flow of energy within and between living systems.**

- Indicators:**
- Bc.1:** Summarize the overall process by which photosynthesis converts solar energy into chemical energy and interpret the chemical equation for the process.
  - Bc.2:** Summarize the basic aerobic and anaerobic processes of cellular respiration and interpret the chemical equation for cellular respiration.
  - Bc.3:** Recognize the overall structure of adenosine triphosphate (ATP)—namely, adenine, the sugar ribose, and three phosphate groups—and summarize its function (including the ATP-ADP [adenosine diphosphate] cycle).
  - Bc.4:** Summarize how the structures of organic molecules (including proteins, carbohydrates, and fats) are related to their relative caloric values.
  - Bc.5:** Summarize the functions of proteins, carbohydrates, and fats in the human body.
  - Bc.6:** Illustrate the flow of energy through ecosystems (including food chains, food webs, energy pyramids, number

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pyramids, and biomass pyramids).

**Standard:** **Bd:** **The student will demonstrate an understanding of the molecular basis of heredity.**

**Indicators:** **Bd.1:** Compare DNA and RNA in terms of structure, nucleotides, and base pairs.

**Bd.2:** Summarize the relationship among DNA, genes, and chromosomes.

**Bd.3:** Explain how DNA functions as the code of life and the blueprint for proteins.

**Bd.4:** Summarize the basic processes involved in protein synthesis (including transcription and translation).

**Bd.5:** Summarize the characteristics of the phases of meiosis I and II.

**Bd.6:** Predict inherited traits by using the principles of Mendelian genetics (including segregation, independent assortment, and dominance).

**Bd.7:** Summarize the chromosome theory of inheritance and relate that theory to Gregor Mendel's principles of genetics.

**Bd.8:** Compare the consequences of mutations in body cells with those in gametes.

**Bd.9:** Exemplify ways that introduce new genetic characteristics into an organism or a population by applying the principles of modern genetics.

**Standard:** **Be:** **The student will demonstrate an understanding of biological evolution and the diversity of life.**

**Indicators:** **Be.1:** Summarize the process of natural selection.

**Be.2:** Explain how genetic processes result in the continuity of life-forms over time.

**Be.3:** Explain how diversity within a species increases the chances of its survival.

**Be.4:** Explain how genetic variability and environmental factors lead to biological evolution.

**Be.5:** Exemplify scientific evidence in the fields of anatomy, embryology, biochemistry, and paleontology that underlies the theory of biological evolution.

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**Be.6:** Summarize ways that scientists use data from a variety of sources to investigate and critically analyze aspects of evolutionary theory.

**Be.7:** Use a phylogenetic tree to identify the evolutionary relationships among different groups of organisms.

**Standard Bf:** **The student will demonstrate an understanding of the interrelationships among organisms and the biotic and abiotic indicators of their environments.**

**Indicators: Bf.1:** Explain how the interrelationships among organisms (including predation, competition, parasitism, mutualism, and commensalism) generate stability within ecosystems.

**Bf.2:** Explain how populations are affected by limiting factors (including density-dependent, density-independent, abiotic, and biotic factors).

**Bf.3:** Illustrate the processes of succession in ecosystems.

**Bf.4:** Exemplify the role of organisms in the geochemical cycles (including the cycles of carbon, nitrogen, and water).

**Bf.5:** Explain how ecosystems maintain themselves through naturally occurring processes (including maintaining the quality of the atmosphere, generating soils, controlling the hydrologic cycle, disposing of wastes, and recycling nutrients).

**Bf.6:** Explain how human activities (including population growth, technology, and consumption of resources) affect the physical and chemical cycles and processes of Earth.