

Marine Biology

Overview

The marine biology standards provide students with a basic system knowledge of living organisms and the interaction of these organisms with the marine environment. The standards establish the scientific inquiry skills and core content for all marine biology courses in DoDEA schools. Marine Biology courses should be built on the foundation of other science courses and should give students the science skills necessary for marine specific life science–related technical careers.

Educators must determine how marine biology fits into biology courses offered in their schools, as well as other individual classes, that 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. Marine biology like all biology courses must include inquiry-based instruction, allowing students to engage in problem solving, decision making, critical thinking, and applied learning.

Marine Biology is a laboratory courses (minimum of 30 percent hands-on investigation). Laboratories will need to be stocked with all of the materials and apparatuses necessary to complete investigations.

High School Core Science Standards Marine 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:	Ma:	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:	Ma.1:	Generate hypotheses based on credible, accurate, and relevant sources of scientific information.
	Ma.2:	Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.
	Ma.3:	Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.
	Ma.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.
	Ma.5:	Organize and interpret the data from a controlled scientific investigation by using mathematics, graphs, models, and/or technology.
	Ma.6:	Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.
	Ma.7:	Evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).
	Ma.8:	Compare the processes of scientific investigation and technological design.
	Ma.9:	Use appropriate safety procedures when conducting investigations.
Standard:	Mb:	The student will describe the behavior of organisms and hypothesizes the relationship to nervous and endocrine systems and various external stimuli.
Indicators:	Mb.1:	Provides examples of organisms using sense organs to monitor their environment and react to stimuli in ways that maximize their fitness.
	Mb.2:	Compares and contrasts the ways motile and non-motile organisms respond to external stimuli.
	Mb.3:	Compares and contrasts innate and learned responses to stimuli (e.g., prey choice, predator avoidance and deterrence, social behavior).
Standard:	Mc:	Relates the theory of biological evolution to geologic time and addresses speciation, biodiversity, natural selection, and biological classification.
Indicators:	Mc.1:	Describes the scope of biological diversity in the marine environment and relationships among major groups of marine organisms .

High School Core Science Standards

Marine Biology

- Mc.2:** Explains the relationship between organisms living in unpredictable environments and the evolution of characteristics that are flexible enough to accommodate uncertainty and change.
- Mc.3:** Distinguishes adaptation from acclimation .
- Mc.4:** Explains why organisms in similar environments converge in form and function.
- Mc.5:** Analyzes life history patterns (e.g., lifespan, age of reproduction, iteroparous vs. semelparous reproduction) in terms of trade-offs in the allocation of limited resources, in a way that optimizes the fitness of the organism.
- Mc.6:** Analyzes dispersal (e.g., migration, larval transport) in terms of risks (e.g., extinction), rewards (e.g., escaping predators and parasites), and the unpredictability of many environments.
- Mc.7:** Explains why, although diversity has traditionally been defined at the species level, distinctions that are broader (e.g., community, ecosystem) and narrower (e.g., within-species) may be necessary for some conservation-related purposes.
- Mc.8:** Explains that some traits that reduce an individual’s chance of survival spread through and are maintained in a population because of advantages those traits confer in reproductive success.
- Mc.9:** Recognizes that some heritable characteristics can persist in a population due to chance alone.

Standard: **Md:** **Analyzes ecology as interrelationships of biotic and abiotic factors and explains the transfer of matter and energy within ecosystems.**

- Indicators:** **Md.1:** Provides examples of how human activities can alter marine ecosystems in ways that affect humans (e.g., by introducing new species, adding nutrients to coastal waters, over-harvesting food species).
- Md.2:** Explains why ecosystems tend to recover from a disturbance in stages that eventually result in a system similar to the original one (e.g., by referring to larval supply, life-history characteristics of organisms, and positive and negative interactions between organisms).
- Md.3:** Explains why distinct communities can persist in very similar environments (e.g., by referring to succession, trophic cascades, and alternative stable states).
- Md.4:** Hypothesizes about how marine ecosystems may change due to climate changes and due to the appearance of one or more new species as a result of migration or transport by humans.
- Md.5:** Explains why small populations are at increased risk of extinction.
- Md.6:** Justifies recommendations for marine protected areas (e.g., based on source-sink dynamics, analysis of life history characteristics, and human use).
- Md.7:** Analyzes the factors that limit the amount of life a given environment can support (e.g., energy, oxygen, minerals, rate of nutrient cycling).

High School Core Science Standards Marine Biology

- Md.8:** Analyzes the ways in which the physical environment (e.g., currents, tides, waves, weather) influences the structure of marine communities.
- Md.9:** Compares and contrasts the environmental factors that hold in check different populations of organisms within a given community (e.g., referring to density-dependent vs. density-independent regulation; interactions between disturbance, predation, competition, and larval supply; and different forms of competition).
- Md.10:** Describes potential effects of size-selective predation on populations, community structure, and ecosystem function.
- Md.11:** Models simple predator-prey and competitive interactions (e.g., using the Lotka-Volterra models).
- Md.12:** Provides examples of ecological factors that can allow greater diversity within a community (e.g., facilitation, microhabitats, keystone species, disturbance, prey-switching).
- Md.13:** Explains the role of foundation species in structuring communities.