

Marine Science

UNIT I: Life in the Marine Environment

Goal 1. The student will demonstrate the ability to explain the scope and methodology of marine science and the role that scientific investigations play in the search for scientific understanding of the sea.

Objectives - The student will be able to:

- a. Describe the scope and methodology of marine science.
- b. Explain safe and humane laboratory practices.
- c. Use current communication technology to interact with the global scientific community.
- d. Discuss a scientific approach to problem solving.
- e. Apply the basic units and tools of scientific measurement.
- f. Develop an experimental procedure.

Goal 2. The student will demonstrate the ability to apply the basic principles of biology to marine organisms.

Objectives - The student will be able to:

- a. Describe biologically important processes for life in the sea.
- b. Explain the challenges of life in the sea.
- c. Explain how the biological classification system is used to classify marine organisms.

Goal 3. The student will demonstrate the ability to classify the marine prokaryotes, protists, fungi, and plants.

Objectives - The student will be able to:

- a. Compare prokaryotic and eukaryotic cells.
- b. Explain the classification scheme for marine prokaryotes, protists, fungi, and plants.
- c. Identify the morphological characteristics of marine prokaryotes, protists, fungi, and plants.
- d. Relate the diversity of habitats to the role marine plants in the marine environment.
- e. Discuss the ecological importance of marine algae and plants.

Goal 4. The student will demonstrate the ability to classify the major invertebrate phyla of marine animals.

Objectives - The student will be able to:

- a. Explain the classification scheme for marine invertebrates.
- b. Describe adaptations associated with each invertebrate group.
- c. Diagram and explain the anatomy of selected members of invertebrate groups.
- d. Explain the modes of reproduction and reproductive strategies used by marine invertebrates.

Goal 5. The student will demonstrate the ability to describe and classify the major marine fish.

Objectives - The student will be able to:

- a. Summarize the major groups of marine fish.
- b. Explain important morphological features, distributions, and adaptations of marine fish.
- c. Diagram and explain the anatomy of selected fish (i.e., sharks and bony fish).
- d. Explain the modes of reproduction and reproductive strategies used by marine fish.

Goal 6. The student will demonstrate the ability to summarize the characteristics of other marine vertebrates and describe the adaptations of each group.

Objectives - The student will be able to:

- a. Describe the major characteristics and give specific examples of the marine tetrapods.
- b. Explain the major characteristics of the marine reptiles and birds.
- c. Describe the major characteristics of the marine mammals.
- d. List the types of reptiles and birds that are found in the marine environment.
- e. Relate the special adaptations that reptiles have for living in the sea.
- f. Recognize the special adaptations that seabirds have for an oceanic life.
- g. Identify the basic characteristics and behaviors of the cetaceans.
- h. Compare the adaptations of pinnipeds and other marine mammals.
- i. Identify the unique diving response features of marine mammals.
- j. Explain the modes of reproduction and reproductive strategies used by other marine vertebrates.

UNIT II: Fundamentals of Oceanography

Goal 1. The student will demonstrate the ability to describe the geology of the ocean basins and explain the relationships among geologic history, structure of the ocean basins, and the geological characteristics of various marine environments.

Objectives - The student will be able to:

- a. Identify and label the major oceans on a world map.
- b. Discriminate among the structures of the ocean floor (mid-ocean ridges, seamounts, subduction zones, abyssal plains, and trenches).
- c. Relate the theories of continental drift and plate tectonics to the evolution of the ocean basins.
- d. Describe the evolution of today's ocean basins.
- e. Identify the three major types of plate boundaries and explain the consequences of these interactions.

Goal 2. The student will demonstrate the ability to describe the physical and chemical properties of seawater.

Objectives - The student will be able to:

- a. Discuss the basic physical properties of a sample of seawater (i.e., temperature, salinity, transparency, density, and pressure).
- b. Explain the ability of water to act as a solvent of solids and gases.
- c. Describe the basic chemical composition of seawater.
- d. Discuss the sources of variations in the ocean's salinity.
- e. Create seawater for an aquarium.
- f. Explain the major biogeochemical cycles that relate to the marine environment (carbon, nitrogen, water).

Goal 3. The student will demonstrate the ability to explain the physical factors that affect waves, tides, and currents.

Objectives - The student will be able to:

- a. Identify the properties and types of ocean waves.
- b. Explain how the Coriolis effect and wind patterns create ocean currents.
- c. Describe how the gravitational pull from the Earth, Moon, and Sun create tides.
- d. Describe how and why an El Nino event occurs and explain its effects.

Goal 4. The student will demonstrate the ability to access and process information from readings, investigations, and/or oral communications.

Objectives - The student will be able to:

- a. Read a technical selection and interpret it appropriately.
- b. Use relationships discovered in the lab to explain phenomena observed outside the laboratory.

UNIT III: Marine Ecology

Goal 1. The student will demonstrate the ability to summarize the basic principles of marine ecology.

Objectives - The student will be able to:

- a. Trace the flow of energy and nutrients within the marine environment.
- b. Give examples of how marine species interact.
- c. Diagram and label a profile of the ocean basins illustrating the major zones.

Goal 2. The student will demonstrate the ability to explain how intertidal organisms meet the physical demands of their environment.

Objectives - The student will be able to:

- a. Explain the effects of exposure on marine organisms at low tide.
- b. Explain the distribution of wave energy along the shore and its effects on marine organisms.

- c. Describe vertical zonation.
- d. Explain oxygen availability, feeding strategies, mobility, and zonation in soft bottom intertidal communities.

Goal 3. The student will demonstrate the ability to explain the dynamics of estuarine systems, using the Chesapeake Bay as an example.

Objectives - The student will be able to:

- a. Discuss the origins and classification of estuaries.
- b. Outline the unique physical and chemical characteristics of estuaries.
- c. Explain how organisms are adapted to estuarine environments.
- d. Describe the distribution of life within the four major habitats: open water, mud flats, salt marshes, and mangrove forests.
- e. Relate food webs to estuarine environments.

Goal 4. The student will demonstrate the ability to explain the most significant physical factors that influence subtidal communities.

Objectives - The student will be able to:

- a. Discuss the physical characteristics of the subtidal environment.
- b. Compare soft-bottom and hard-bottom communities.
- c. Identify the location of the world's kelp beds.
- d. Discuss the importance of kelp beds in the marine ecosystem.

Goal 5. The student will demonstrate the ability to explain the dynamic interactions of the coral reef ecosystem.

Objectives - The student will be able to:

- a. Discuss the various organisms that build reef environments.
- b. Explain the conditions necessary for reef growth.
- c. Explain why the world reef ecosystems are located where they are.
- d. List each type of coral reef and describe it.
- e. Explain the formation of atolls.
- f. Explain the food webs associated with coral reef environments.

Goal 6. The student will demonstrate the ability to explain the dynamic properties of the epipelagic, near-surface marine ecosystem.

Objectives - The student will be able to:

- a. Describe the organisms of the epipelagic ecosystem.
- b. Identify the adaptations of organisms in the epipelagic ecosystem.
- c. Explain the epipelagic food webs.
- d. Explain why the most productive epipelagic ecosystems are located where they are.
- e. Explain the occurrence of upwelling currents and their relationship to El Nino.
- f. Recognize the importance of upwelling currents to the ecology of fisheries.

Goal 7. The student will demonstrate the ability to explain the basic characteristics of mesopelagic and deep ocean ecosystems.

Objectives - The student will be able to:

- a. Explain the adaptations of midwater organisms.
- b. Explain the physical and chemical variations that occur with an increasing depth of water in the marine environment.
- c. Explain the adaptations of marine organisms to increasing water depth.
- d. Describe the deep ocean floor environment.
- e. Relate the importance of seafloor hydrothermal vents to life cycles on the seafloor.

UNIT IV: Humans and the Sea

Goal 1. The student will demonstrate the ability to explain how humans use resources from the marine environment.

Objectives - The student will be able to:

- a. Identify the various types of food items provided by marine environment.
- b. Discuss the factors that determine how selected countries depend on the marine environment for food.
- c. List the major marine food species and their global location.
- d. Explain the economic importance of marine algae, plants, and fish.
- e. Explain the concept of over-fishing and the effect it has on global economics.
- f. List the role of aquaculture in meeting the world's marine food needs.
- g. List and describe the nonliving resources from the oceans.

Goal 2. The student will demonstrate the ability to explain the impact of humans on the marine environment.

Objectives - The student will be able to:

- a. List the effects of pollution on the marine environment (e.g., oil, sewage, synthetic chemicals, heavy metals, thermal, solid and radioactive waste).
- b. List and discuss the species that are threatened and endangered.
- c. List and explain the impact of alien species on various marine environments.
- d. List and describe attempts that are being pursued to enhance and conserve various marine environments.