Marine Environments

There are different marine life zones, and four major types of marine environments, each having different communities of organisms that characteristic them. Sandy beach and rocky coast environments are described and compared and the various communities found within estuary environments are described, i.e., salt marsh, mud flat, and mangrove.

Outcomes:

Students will be able to ...
1. Identify the major marine life zones.
2. Visualize the zones geographically.
3. Name the four major types of marine environments and describe the characteristics of the sandy and rocky environments.

Background:

The ocean contains several different life zones, each one characterized by particular communities of plants and animals that are adapted to live in those environments.

1. Supratidal zone: an area of the upper beach that gets a fine mist of salt spray from the crashing waves. Has beach plants, including grasses, shrubs, and trees.
2. Intertidal zone: the turbulent area between high tide and low tide, where clams, barnacles, mussels, worms, and seaweeds live. A long line of seaweed called the strandline marks the high tide on beaches.
3. Subtidal zone: the area below the intertidal zone. This zone includes the surf zone, an area of wave turbulence. Fish, crabs, sea stars, and sea urchins are typical inhabitants of this zone.
4. Neritic zone: lies above the continental shelf, the shallow part of the seafloor that surrounds the continents. It is the main area of commercial fishing.
5. Oceanic zone: extends beyond the neritic zone and includes most of the open ocean. Together, the neritic and oceanic zones make up the largest marine life zone, i.e., the pelagic zone. The upper part (or photic zone), which most light penetrates to about 100 meters, contains more life (due to photosynthesis by algae) than does the vast area below it (i.e., aphotic zone), which remains in darkness.
6. Benthic zone: includes the entire ocean floor, from the intertidal zone to the ocean basin. Organisms that live on the seafloor are called benthos. Benthic organisms often show unique adaptations to conditions on the ocean floor.

Activity Part 1: Major life zones in the ocean and along the coast.

Show students a world map and ask them to describe the parts of the ocean that they think contain the most life and the least life.
**Development**

1. A life zone is a region that contains specific organisms that interact with one another and with their environment. The surroundings of a living thing are called its environment. Write out the aim: What are the major life zones in the ocean and along the coast?

2. Draw a profile of the coast and ocean, going from the supratidal zone to the oceanic zone.

3. Imagine walking from the upper part of a sandy beach down to the sea, and then kayaking out to sea for a short distance. What major marine life zones would you pass through? Write down the zones provided in the teacher's background after identifying them on the diagram.

4. Have students write in their notebooks or nature journals a brief description of each life zone discussed in the lesson and one thing they find fascinating or interesting about it.

Now ask students to visualize that world map used in the beginning to a cross-sectional view of one of the oceans. Emphasize it’s perhaps more accurate to consider life zones in this way than from the top, or merely by comparing oceans.

![Cross Section of Ocean Life Zones.](image)

**References & Resources**

Visit the following links for cross-sections, maps and other interactive displays.


**Activity Part 2: The sandy beach environment.**

Lead students through a process that describes the sandy beach environment and identifies the life zones of a sandy beach. Then discuss interactions between organisms and the environment.

1. Describe the characteristics of a sandy beach (or shore).

2. Why is the in the surf zone water white? Explain. When waves crash on a beach, air mixes with the water, producing white foam. The region where waves crash on a beach is called the surf zone. The surf zone is a characteristic feature of a sandy beach.

2. The sandy beach environment contains loose, unstable sediment (i.e., sand), which is easily moved about by wind and water. Beaches that are characterized by large surf (i.e., breaking waves) are those that face the open ocean. The surf zone is not a fixed zone. It moves with the tide as it advances and retreats up and down the slope of the beach.

3. What kinds of organisms are found on a sandy beach? Note the distinct life zones on a sandy beach, in which groups of organisms are found. On the upper beach, e.g., there is a zone of beach plants that includes trees, shrubs, and grasses. The roots of these plants hold the sand in place, preventing its erosion by wind and water, and forming small hills called dunes. The trees occupy the highest elevation in the dunes, followed by shrubs growing along the slopes, and then beach grasses at the lowest part of this (upper supratidal) zone.

4. How are marine animals adapted to life in the surf zone? Organize the class into groups of three to four students. Have the students find information on the following organisms: mole crab, blue claw crab, and silverside fish.
   - Mole crab (Emertia): has smooth jellybean shape that helps it swim through sand and water; avoids wave impact by digging into the sand with its paddle-like appendages; feeds on microscopic organisms by sticking its feathery appendages up into the water.
   - Lady crab (Ovalipes): swims and digs into the sand by means of its paddle-like appendages; hides from predators by burrowing in the sand, leaving just its eye-stalks exposed.
   - Silverside fish (Menidia): small fish that swims in schools in the well-oxygenated waters of the surf zone; feeds on invertebrates and crab eggs; are preyed upon by larger fish such as the striped bass (Morone).

**Summary**

Ask a student leader from each group to read aloud the information obtained by their group. Ask another student to write a brief summary about each animal on the board. Have students copy the completed information into their note-books.
Activity Part 3: Marine life found on a rocky coast.

Let’s investigate zonation on the rocky coast, compare and contrast a rocky coast with a sandy beach and identify typical rocky coast marine organisms.

Show students some beach sand; then show students a rock that has barnacles or other marine organisms attached to it. Ask students: In which environment are more organisms found—a sandy beach or rocky shore?

Development
1. Shores made of solid rock, called rocky coasts, provide stable substrates on which organisms can attach. The irregular topography of the rocky coast, with its coves, crevices, and tunnels, also provides hiding places for marine life. Examine the map
of our bioregion’s coastline and identify which parts are rocky and which are sandy.

2. What kinds of marine life are found on a rocky coast? Note that characteristic organisms inhabit distinct bands, or life zones, along the coast. These bands of different communities in an environment make up a feature known as zonation. From the distance, these zones have a layered appearance when the tide is low.

3. The rocky coast zones are divided into the upper intertidal, the mid-intertidal, and the lower intertidal zones. Organize into groups and have students do research to find information on the following rocky coast life zones: upper, mid-intertidal, and lower intertidal. The following information should be covered:

- **Intertidal zone**: is above the high-tide mark, receives wave splash; blue-green bacteria and algae grow on the moist rocks; when algae die, they stain the rocks black; periwinkle snails and limpets graze on the algae.
- **Mid-intertidal zone**: is inhabited by barnacles, mussels, and seaweeds; barnacles attach to the rocks by means of a natural glue; mussels produce sticky byssal threads that adhere to the rocks; rockweeds adhere to rocks by means of a holdfast attachment; at high tide, barnacles filter feed on plankton; at low tide, barnacles close their shells to avoid drying out.
- **Lower intertidal**: is dominated by seaweeds; at low tide, spaces between the rocks retain water, forming small living communities (of algae, invertebrates, small fish), called tide pools. When the tide is in, sea stars, sea urchin, and fish invade this zone to feed.

**Summary**

Have a student read aloud the information their group has obtained. Ask another student to write a brief summary about each life zone on the board, or if in smaller groups, do so in a nature journal.

*See cross section on next page.*
**Activity Part 4: The estuary as a vital marine environment.**

Since our focus in this unit is only on sandy and rocky shores, part four and five are only provided so that all four environments are presented. You may wish to cover them with your group, or simply name the others while focusing on the first two and marine zones.
Development

1. The area along the shoreline where a river enters the ocean forms an environment called the estuary. In the estuary, freshwater from the river mixes with salt water from the ocean, forming what is called brackish water.

2. Why is the estuary such a vital marine environment? Sketch a diagram of an estuary. Estuaries provide varied habits for marine life. Many estuaries have large offshore sandbars called barrier beaches. The barrier beach separates the ocean from the bay, creating natural sanctuaries for communities of aquatic (and terrestrial) animals. Visit the Coal Oil Point website to view photos of the Devereux Slough estuary to see an example of one such barrier beach.

3. What kinds of biological communities are found in the estuary? Organize the class into groups of three to four students. Have the students research information on three kinds of estuary (and shore) communities: salt marsh, mud flat, and mangrove swamp. The following information should be covered:

- Salt marsh: also called wetlands; its dominant species are the marsh grasses; the tall marsh grass Phragmites, with its brown tassels, grows in the upper supratidal zone; tough cordgrasses (Spartina) grow in the shallow waters and provide a haven for marine invertebrates and fish; when cordgrass dies, it forms dead matter, or detritus, which supplies nutrients for plankton; the plankton are the basis of marine food chains, many of which originate in the salt marsh.

- Mud flat: is like the graveyard of the estuary; the sand is dark and contains organic debris carried in by the incoming tides; decomposers are abundant; bacteria decompose the wastes and turn them into the foul-smelling compound hydrogen sulfide (H2S); invertebrates such as the mud snail (Ilyanassa) scavenge for food; inhabitants include a variety of worms and clams that burrow in the muddy sand, such as the clam worm (Nereis), the razor clam (Ensis), and the soft-shell clam (Mya); various shorebirds prey on these invertebrates.

- Mangrove swamp: the dominant species is the mangrove tree (Rhizophora), which grows in tropical regions (like Florida); a thick growth of mangrove trees lines the shores of bays and inlets, forming a mangrove community; the trees have arching prop roots, which anchor the trees and provide a haven for a variety of marine animals; inhabitants include the crown conch (a marine snail) and the mangrove snapper (a marine fish). Mangrove swamps protect the shoreline from erosion, and act like giant sponges, absorbing the impact of tropical storms.

References & Resources

Marine Bio website:
**Activity Part 5: Coral Reefs.**

There are probably at least a dozen (readily visible) different species of living things found on a small patch of reef. As such the coral reef considered to be an underwater oasis: it contains a fantastic assortment of marine life in what otherwise would be an area of low biodiversity. Coral reefs are found in tropical and subtropical regions (between 30 degrees north and 30 degrees south latitude). Warm, clear, sunlit, shallow ocean waters are necessary to promote the growth of coral reefs. Together, the hard corals and soft corals on a reef provide a varied habitat for marine life.

Some of the marine organisms that inhabit a reef are listed below. Emphasis in this unit is on the first three activities but if you would like do all of these, organize the class into groups, with each researching one of these typical reef organisms: staghorn coral, spotted trunkfish, schooling reef fish, queen angelfish, butterfly fish and reef sharks.

- **Staghorn coral:** is a type of hard coral; named for its familiar shape; thin membrane covers and protects hard coral’s surface; although made up of hard coral, the reef is very fragile, and pieces can break off easily.
- **Spotted trunkfish:** depends on camouflage to avoid being detected by predators; lives at the bottom of the reef, where it is difficult to spot against the background of coral and speckled sand.
- **Schooling reef fish:** such as the grunt, gain protection against predators by swimming together in a group, or school, of their own species. There is security in numbers; the chances of any fish being caught by a predator are reduced because of the large number in the school.
- **Queen angelfish:** colorful, its yellow and black colors stand out in sharp contrast to the background colors of the reef; the strong difference between its own body colors, called color contrast, enables fish of the same species to find one another in the maze of tunnels and crevices of the reef.
- **Butterfly fish:** uses color to confuse predators; has two fake eyespots at the base of its caudal tail, which tricks predators into thinking that the back of the fish is its front; spots, bars, and stripes, which obscure the outline of a fish are called disruptive coloration.
- **Reef sharks:** large, predatory fish that patrol an area of the reef to protect its resources from competitors; such behavior by an organism in defending its home area is called territoriality.