Unit 16: Marine Mammals

Unit Focus

This unit provides students with an overview of the basic characteristics of cetaceans, pinnipeds, sirenians, and other marine mammals. Students will learn about the adaptations these mammals have acquired for life in the ocean and about the unique diving responses of marine mammals.

Student Goals

1. Classify marine mammals as cetaceans, pinnipeds, or sirenians and note other marine mammals.
2. Explain the importance of bradycardia for diving marine mammals.
3. Describe the feeding methods of cetaceans, pinnipeds, sirenians, and other marine mammals.
4. Describe the difference in feeding methods between toothed and baleen whales.

Vocabulary

Study the vocabulary words and definitions below.

baleen whales ..... whales without teeth but with rows of whalebone plates that act as a sieve for feeding
Example: blue whale

blowhole ..... opening located on the top of the head of whales and dolphins, used for obtaining oxygen

blubber ..... the fat of marine animals, which is used to keep the animal warm

echolocation ..... use of sounds to locate objects

endangered ..... in danger of extinction due to natural or manmade factors

flippers ..... front limbs of dolphins, other whales, and seals; used for balancing and steering

fluke ..... tail fin of whales, including dolphins

melon ..... fatty area on the forehead of whales, including dolphins, that controls the reception of pulses and echolocation

moratorium ..... a legal ban; a legally authorized period of delay

toothed whales ..... whales which have teeth
Examples: sperm whale, dolphin

Introduction: Marine Mammals—Back to the Sea

All mammals share certain traits. They breathe air, nurse their young, have backbones, body hair, and are warm-blooded. Marine mammals, however, evolved from being land-based animals to living totally or partially in aquatic (water) environments. The legs of land-based mammals have been replaced by **flippers** in most marine mammals.

Marine mammals have developed streamlined bodies for swimming, and layers of body fat to provide insulation.

Marine mammals have developed streamlined bodies for swimming, spongy bones for buoyancy, and layers of body fat (**blubber**) to provide insulation against low temperatures. They have also developed adaptations to help them see, breathe, and navigate in aquatic environments. One important difference distinguishes marine mammals from fish and other fully-developed aquatic organisms: Marine mammals are dependent on the oxygen in the atmosphere to breathe. To breathe, these mammals must surface for air. Other marine mammals such as polar bears, walruses, sea otters, and seals go ashore to breed and raise their young, returning to the ocean only to feed.

Many marine mammals such as whales, dolphins, and manatees never leave the water during their lifetime. They bear and nurse their young in the water. When the young mature, they breed, rest, and feed in the water.

All marine mammals share many similarities including their physical structures and aquatic habitat. Each, however, is adapted to its own special lifestyle and environment. For example, marine mammals that live in cold areas or deep water have developed layers of blubber for insulation, whereas marine mammals that live in warmer waters, such as the manatee, have not.

Marine mammals that are predators or carnivores, such as the polar bear and killer whale, have developed speed, strength, and sharp teeth or claws to

Classification of Marine Mammals

Cetaceans	Pinnipeds	Sirenians	Other Marine Mammals
toothed whales baleen whales roqual whales right whales gray whales dolphins porpoises	fur seals sea lions walruses true seals	manatees dugongs Steller's sea cow	sea otters (member of weasel family) polar bears (member of bear family)

catch and kill prey. Marine mammals that are herbivores do not have the physical structures of their carnivorous relatives; instead they have grinding molars to break down plants.

Polar Bears: Living on the Ice

polar bear

The marine mammal that is most adapted to land is the polar bear, a member of the bear family (*Ursidae*). The polar bear lives on *ice floes* (pieces of floating ice) and on the shore in the north polar region. It has thick fur and a thick layer of blubber to keep out the arctic cold. The thick fur and blubber also help the polar bear to retain body heat.

The polar bear is mainly a solitary animal and is adapted for living on the land. However, the polar bear occasionally will swim in the arctic waters to catch a seal. Seals are the favorite food of the polar bears. Polar bears are not fast swimmers. They usually catch their prey by stalking seals relaxing in the sun or when seals pop up through holes in the ice.

Sea Otters: Tool Users

sea otters

Sea otters are the smallest marine mammals. They are closely related to the smaller river otters found in freshwater streams and are members of the weasel family (*Mustelidae*). Sea otters are commonly found in the giant kelp beds along the rocky California coast. They are carnivorous and can eat many different types of ocean creatures including sea urchins, shellfish, and other marine invertebrates.

Sea otters spend much of their time in the oceans diving for food. They must eat constantly to survive. Sea otters are one of the few marine mammals to use "tools" to get their food. For example, when a sea otter eats an abalone, a type of shellfish with a hard exterior shell, its shell must be cracked open. Many sea otters do this while floating on their backs. They place the abalone shell on their stomachs and use a rock to whack the abalone shell until it opens.

Bradycardia: Surviving Long Periods without Oxygen

In order to live, all mammals must breathe and our hearts must pump blood throughout our bodies. These processes carry oxygen to our tissues and remove the waste, carbon dioxide. Any interruption of breathing or circulation threatens our life. Not *all* of the tissues of an animal need to be continuously supplied with fresh oxygen. Most parts of the human body can, and often do, survive *asphyxia* (too little oxygen). The kidney can survive without circulation for a similar period. And a transplanted cornea can survive for many hours. The heart and brain, however, are extremely sensitive to asphyxia. Suffocation and heart failure kill a human within a few minutes, and the brain may suffer irreversible damage if its circulation ceases for more than five minutes.

Time of Breath Hold and Depth of Dive

Marine Mammal	Maximum Breath Hold (minutes)	Depth (meters)
sea otter	4-5	55
porpoise	6	305
dolphin	8	650
killer whale	10	30-60
manatee	20	10-16
sea lion	30	168
true seal	73	575
sperm whale	90	2,200

Marine mammals often dive and remain underwater for periods far longer than five minutes. So how do marine mammals avoid these problems during their very long dives? The simplest explanation would be that diving animals have a large capacity for storing oxygen. But examinations of marine mammals have found that their lungs are not unusually large. Scientists have found, however, that every animal studied exhibits *bradycardia*: a slowing of the heartbeat when the animal is submerged. In addition to slowing down their heartbeat when they dive, marine mammals also close down circulation to many of their body parts while maintaining circulation to the heart and brain. Typically, during a dive, their bodies greatly reduce the blood supply to their muscles, intestines, and parts of their lower bodies.

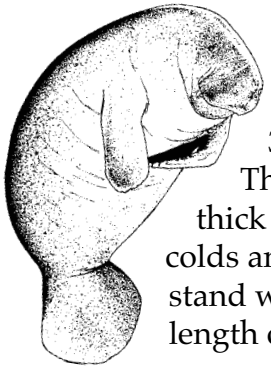
Manatees: The Gentle Giant

Courtesy of Pat Rose and Save the Manatee Club

The West Indian manatee, a large, gray-brown aquatic mammal, is known for its gentle nature. The manatee population in the United States is concentrated primarily in Florida. During the winter months in Florida the manatees come to the springfed coastal areas to feed and keep warm. In Florida, manatees can be found in the St. Johns, Suwannee, Crystal, Homasassa, Manatee, Indian, and Wakulla rivers, as well as Blue Springs and other waters and bays along the coast. Little is known about the manatee's ocean migration during the summer.

Anatomy

Manatees look like a gray blimp with a small head and a square snout (nose) with upper lip. The manatee's split lip lets it move each lip separately while tearing off bits of plants to eat. They have an endless supply of molars known as *marching molars*. The molars form in the rear, with six to seven on each side of the jaw and move forward. As older molars in front become worn, they fall out and are replaced by new teeth in the back. The molars are worn down by what the manatee eats—abrasive plants that are often mixed with sand.



The average manatee is about 10 feet long and weighs about 800-1,200 pounds. Large manatees have been known to exceed lengths of 13 feet and weigh over 3,500 pounds. Females are generally larger than males. The manatee's skin is about two inches thick—not quite thick enough to keep out cold. Consequently, manatees catch colds and pneumonia very easily. Manatees seem unable to stand water temperatures below 65 degrees Fahrenheit for any length of time and often die when severe cold spells occur.

The front limbs of manatees are paddle-shaped flippers. Manatees do not have hind limbs but have a fan-shaped tail. They nave no external ears and have very small eyes.

Feeding Habits

Manatees are herbivores, feeding on submerged, emergent, and floating plants. They feed mainly at night but will sometimes graze during the day. On average, manatees return to the surface every three to four minutes. However, manatees can stay underwater for up to 20 minutes. Some of their favorite foods include turtle grass, widgeon grass, and shoal grass—all of which are marine vegetation. Manatees also have favorite freshwater plants such as water hyacinths and water lettuce. Manatees eat about 10 to 15 percent of their body weight daily. Therefore, a 1,000 pound manatee would eat between 100 to 150 pounds a day.

Terminology, Longevity, and the Law

Manatees live a maximum of 50 to 60 years. They belong to the class Mammalia and the order *Sirenia*. Manatees have become **endangered** because poachers once killed them for their meat and skin. Manatees are also killed by motorboats, cold water, and red tides. Many of the manatee's coastal feeding areas are in danger of destruction by dredging, runoff, and herbicide spraying. This coastal destruction is reducing the manatee populations and threatening its survival. It has been estimated that the manatee population in Florida today is about 3,280.

Federal and State Protection Laws	
Marine Mammal Protection Act of 1972	Provides protection for manatee and other marine mammals; includes restrictions on products derived from these animals. Penalty - one year in prison and/or fine up to $50,000
Endangered Species Act of 1973	States that it is illegal to kill, hunt, collect, harass, harm, pursue, shoot, trap, wound, or capture a member of an endangered species. Penalty - one year in prison and/or fine up to $50,000
Florida Manatee Sanctuary Act of 1978	Established all of Florida as a sanctuary for manatees. Slow and idle speed zones may be established in Florida waterways to protect these animals from boat injuries. Penalty - 60 days in prison and/or fine of $500

State and federal laws have been passed to protect manatees. The Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972 are federal laws which protect manatees. The Florida Manatee Sanctuary Act of 1978 is a state law in Florida.

Seals and Sea Lions: Escaping Extinction

Seals and sea lions inhabit a broad range of climates from the tropics to the polar seas. Seals and sea lions are not common to the Florida coasts and waters but are common along the California coasts and in polar areas. They spend much of their time out of water on rocky beaches, ice floes, and caves. They migrate long distances and then band together in large groups to breed. Human hunters, in search of the valuable fur and oil of the seal and sea lion, nearly hunted them to extinction. Under protection of some national governments, the seal and sea lion have survived. Seals and sea lion pups engage in mock battles, jousting chest to chest, weaving their necks, and nipping and barking. This playful behavior helps males prepare for battles they will engage in as adults. Victorious bulls will mate with females to produce strong offspring.

Seals spend much of their time on rocky beaches.

Anatomy

All four limbs of the seal and sea lion have developed into *flippers*. Sea lions rotate their hind flippers under their bodies so they can "gallop" along on all four flippers. Seals "hump" along, undulating their bodies like caterpillars and pushing with their front flippers. Seals have a more streamlined body than sea lions and are able to swim like fish. Both sea lion and seals have a thick layer of *blubber* between their skin and muscles. This layer of blubber helps them to withstand the cold polar waters. The blubber can also be used for a source of reserve energy, buoyancy, and padding.

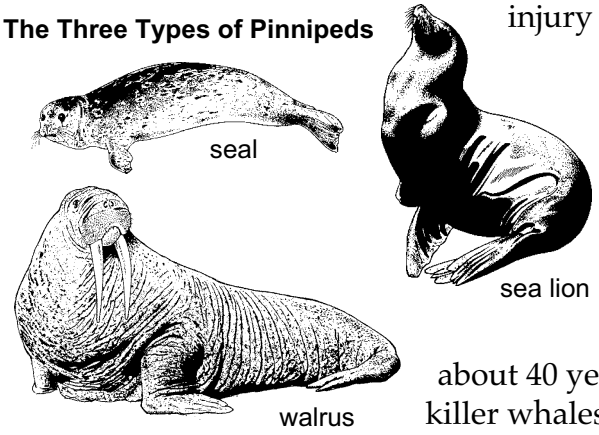
Seals and sea lions have large eyes with thick, curved lenses, making them nearsighted on land but able to see well underwater. These mammals also have good hearing.

Seals have no ear flaps but only ear holes, which adds to their streamlined bodies. Sea lions have small ear flaps, similar to those of land mammals. The nose of seals and sea lions is on the front of their snout and not on the top of the head.

Feeding Habits

The diet of seals and sea lions consists of fish and squid. Their teeth are adapted for grasping and tearing, not chewing. Sea lions practice tossing and catching pebbles in their mouths. This skill helps them to catch fish and swallow them head first, avoiding injury from spines and scales.

The Three Types of Pinnipeds



Longevity and Terminology

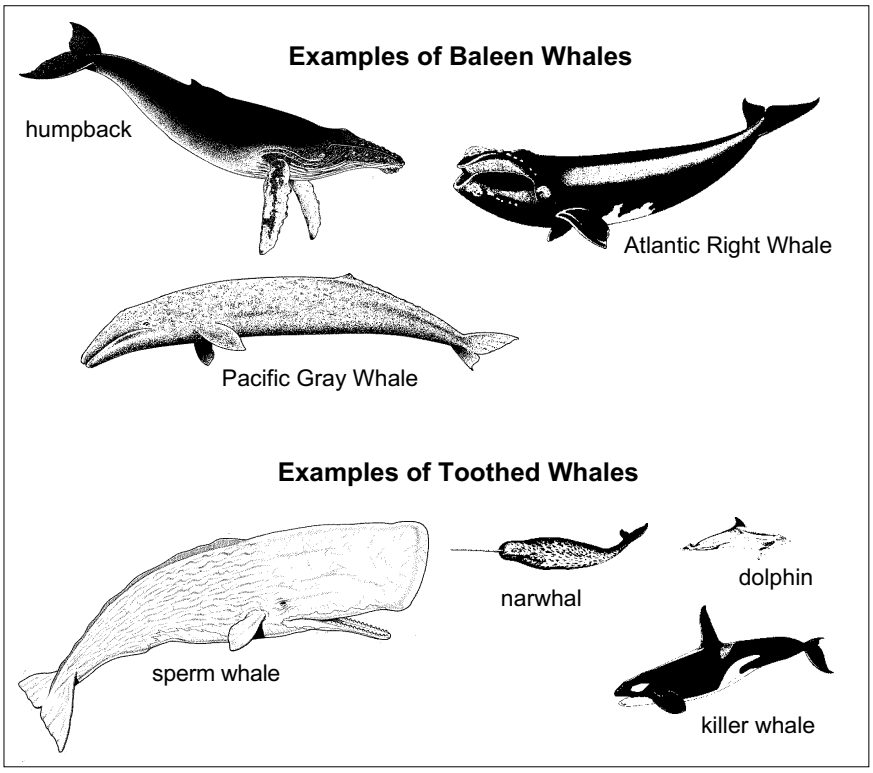
Seals and sea lions belong in the class Mammalia and the suborder *Pinnipedia*. Pinnipedia means "flipper footed." Pinnipeds live for about 40 years. Their enemies include man, killer whales, and polar bears.

Whales: Baleen and Toothed

Whales belong to the class Mammalia and the order *Cetacea*. Whales are divided into two groups—whales that have teeth and whales that do not have teeth. Whales that do not have teeth are called **baleen whales**. Instead of teeth, they have a row of whalebone plates attached to their mouths that function like a sieve. During the summer, baleen whales travel to polar regions to feed on the abundant, small shrimp-like organisms called krill. During the other seasons, baleen whales roam the oceans feeding on krill and plankton. The largest baleen whale, the blue whale, may gather three tons of krill a day! The blue whale is the largest animal to have ever lived and may be longer than any dinosaur. Baleen whales are very gentle, slow-moving animals. They do not chase their food but cruise through the open ocean waters water with their mouths open, allowing the baleen plates to collect the krill and plankton like a sieve.

Toothed whales are whales that have small teeth to help them catch fish and other small marine animals for food. The sperm whale is the largest toothed whale, growing to 60 feet in length. The head of the sperm whale is squarish in shape and contains an abundance of oil. Hunters once hunted the sperm whale to near extinction for the oil supply in its head. The well-known fictional sperm whale Moby Dick was hunted by the peg-legged Captain Ahab in Herman Melville's novel *Moby Dick*.

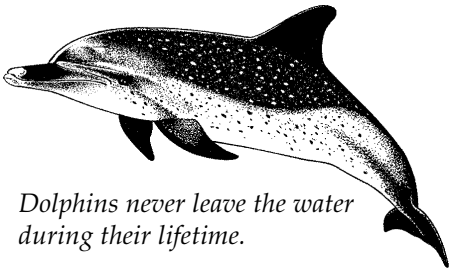
Toothed whales have very good hearing and produce high frequency clicking noises to communicate with other members of their group or pod. Toothed whales also use clicking noises to find prey and to judge distances and speed. Killer whales, another toothed whale, are black and white in color and feed mainly on fish, seals, sea lions, sharks, squid, and penguins. Killer whales are not known to feed on humans.



Dolphins: The Gentle and Social Creatures of the Sea

Dolphins are toothed whales found in all oceans and in some rivers and lakes around the world. They are also common to Florida waters. They exhibit highly intelligent behavior.

Dolphin Anatomy

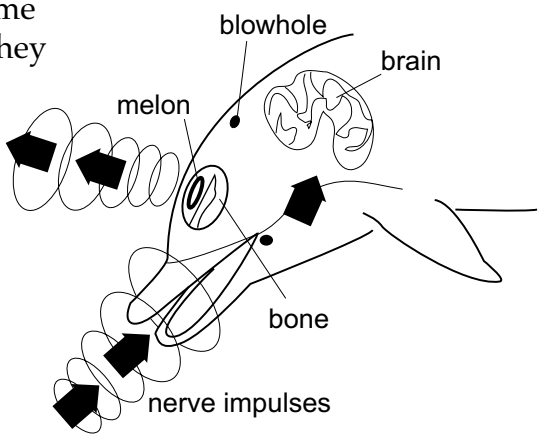


Dolphins never leave the water during their lifetime.

Because dolphins do not have sweat glands, they must rely on the water to act as a cooling system for their bodies. Consequently, when dolphins are stranded or beached out of water, their body heat will cause them to die. Although dolphins have no ears, they have a very keen sense of hearing. They depend mostly on **echolocation** to detect objects or prey. They have no sense of smell, even though they have a single opening called a **blowhole** located on the top of the head. The blowhole is connected to the dolphin's lungs. The dolphin's mouth does not connect to the lungs but leads directly to the stomach.

Dolphins have a **fluke**, or tail fin, which propels them through the water. They use their front limbs, or flippers, for balancing and steering. Dolphins also have a small fin on the back—the dorsal fin.

Echolocation: Using Sound to See



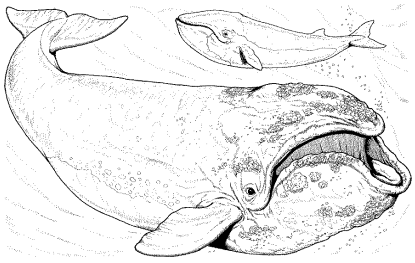
Dolphins use echolocation to become familar with their surroundings. They produce sounds such as whistles, squawks, and clicks through the **melon**, a fatty area on their forehead. The melon contains fat tissue which can change in shape, allowing the dolphin to control the sound emitted. They emit these echolocation sounds in pulses to focus on surrounding objects. They emit lower frequencies to get a general picture of their surroundings. To focus in on a specific object they've found, they use higher frequencies. These sound pulses bounce off objects, and dolphins then "feel" the rebounding sound through their lower jaw. The vibration is then transmitted from the lower jaw to the brain. Echolocation enables dolphins to find food such as fish, octopus, and squid—which they swallow whole, usually head first. A dolphin's echolocation is so exact that dolphins can find half a vitamin pill on the bottom of a pool while blindfolded.

Terminology, Longevity, and the Law

Dolphins belong to the class Mammalia and the order *Cetacea*. The longevity or life span of the dolphin varies between species. The Atlantic bottle-nosed dolphin can reach an age of 25 years or more. Dolphins are protected by the Marine Mammal Protection Act of 1972 (see page 380). The act protects dolphins from being molested by anyone in the United States and provides a **moratorium**, or ban, on capturing and importing marine mammals and marine mammal products.

Summary

Marine mammals share certain traits with land-based mammals. Both breathe air, nurse young, have backbones, grow body hair, and are warm-blooded. Marine mammals, however, have adapted to their aquatic environments. They have developed flippers and buoyancy to swim, and *blubber* for warmth.



To survive lengthy dives, marine mammals are capable of *bradycardia*: a slowing of the heart action when the animal is submerged. This trait enables them to remain underwater far longer than a land-based mammal could on the same volume of air.

Notable marine mammals include manatees, dolphins, seals and sea lions, and whales. Manatees are gentle giants that look like gray blimps. In the United States, they are concentrated primarily in Florida. Poachers and motorboats have endangered the manatee and created the need for its protection under law. Seals and sea lions have also been hunted to near extinction. Their valuable fur and oil have made them attractive prey for hunters.

Whales, the largest of the marine mammals, are divided into two groups: those with teeth and those without teeth. *Toothed whales* use their teeth to catch fish and other small marine animals for food. Dolphins—also toothed whales—use *echolocation* to map their surroundings. They emit whistles, squawks, and clicks, and then *read* these sounds as they bounce off surrounding objects. The largest toothed whale—the sperm whale can grow to 60 feet in length. Those whales without teeth, *baleen whales*, swim the ocean with their mouths open, as they collect krill and plankton with their rows of whalebone plates acting like a sieve.