
Unit V. Lesson I. Marine Mammals

Lesson Objectives

- Students will be able to identify the different classes of marine mammals
- Students will learn how all the marine mammals are related in a taxonomic tree
- Students will be able to understand how a stranding is life threatening to animals

Vocabulary words: mammals, cetacean, pinniped, baleen, benthic invertebrates

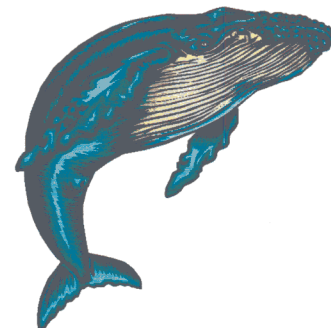
What is a Marine Mammal?

Marine mammals are specialized animals highly adapted to life in the water. They are mammals, which mean they breathe air, are warm blooded, and give birth to live young. To be considered a marine mammal, the mammal must depend on a **marine environment** for part if not all of its life. Some well-known marine mammals are dolphins, **cetaceans**, and sea lions, **pinnipeds**; however, polar bears and sea otters are also marine mammals.

In order to survive in the ocean, marine mammals must overcome certain challenges to their environment. They must maintain their body temperature (close to 98.4° F for dolphins) in waters close to freezing. They swim long distances searching for food and they must be able to dive in order to get food from deep water. They also are specially adapted to obtain fresh water from their food. Whales have specialized kidneys (similar to those in camels) that are very efficient at preserving freshwater in

the body. Marine mammals get almost all their freshwater from food.

A **blubber** layer is often used to keep marine mammals warm. This layer of fatty tissue can be found just under the skin of a marine mammal. Blubber layers also serve as a way for marine mammals to store energy. In order to maintain their blubber layer marine mammals must eat. Their search for food requires that they be efficient swimmers and good divers. The body of a marine mammal is very streamlined with little to no hair. This reduces the resistance the animal encounters when it swims through the water. Deep diving abilities can be found in both **pinnipeds** and **cetaceans**. While most marine mammals have the ability to dive to depths of around 200 m, a few species go to extremes. Two of the deepest diving animals on the planet



are the sperm whale and elephant seal. Both species can dive over 2000m and remain submerged for extended periods of time. Sperm

Long and deep dives might be a method to avoid predators. While most accept that elephant seals also **forage** on their long dives, some researchers suggest that deep diving in elephant seals is also a form of predator avoidance. This is based on the assumption that large sharks, particularly great white sharks, are the major predators on elephant seals. The evidence given to support this hypothesis includes the short surface interval between dives, evidence that elephant seals may actually sleep while diving, and the observation that most shark attacks occur near the surface.

One diving adaptation found in most animals is a decrease in **metabolic rate**, noted as a drop in body temperature and heart rate. This reduces the body's need for oxygen. (Although not a marine mammal, studies indicate that the marine iguana can stop its heart for an hour!). Marine mammals are no exception. They also show a drop in body temperature and heart rate when diving. The suggestion that elephant seals sleep while they dive was originally proposed as a way to further reduce their metabolic need for oxygen.

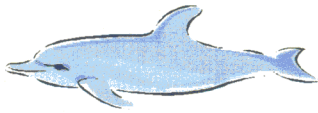
Another important adaptation that increases the dive times for marine

whales can stay submerged for 1-2 hours! Sperm whales prey on giant squid in the deep waters.

mammals is the ability to shunt oxygen away from unimportant areas of the body to the brain and other vital organs. One adaptation in cetaceans that enhances their diving is their rib cage. The ribs end in a series of pieces that can flex inward and rapidly compress the chest cavity, moving air out of the lungs and into the blood stream. Marine mammals also have 2 oxygen binding proteins, **myoglobin** and **hemoglobin**, in order to more effectively bind oxygen. The circulatory system of marine mammals is especially well developed. A **countercurrent exchange** system of veins and arteries helps to preserve body temperature during deep dives. The well developed circulatory system aids in quickly replenishing oxygen in deprived tissues once the animal returns to the surface.

Marine mammals thrive in many parts of the world. They inhabit tropical, subtropical, and polar regions. There are so many species of marine mammals that it would be impossible to write about all of them here. The following two sections will look more closely at 2 major groups of marine mammals: the cetaceans and pinnipeds.

Cetaceans



Cetacean is another word for a whale, dolphin, or porpoise. The animals in this order live their entire life at sea, from the moment they are born. This makes whales highly adapted when it comes to living the aquatic environment. When people talk about whales, they usually think of large whales like the humpback whale or the blue whale.

Mysticete whales consist of 3 different groups, the right whales, the grey whales (only one species), and the rorqual whales. Among these whales are the largest animals on earth. The blue whale can reach lengths of over 100 feet! Despite their size, these mammals feed on plankton. These whales feed using **baleen** instead of teeth. Baleen is a defining characteristic of all mysticete whales. They use their baleen to filter the water, gathering zooplankton, like copepods the same way you drain water off pasta noodles using a colander. Baleen whales spend their summers in highly productive areas near north or south pole. Because nutrient rich deep water is upwelled at the poles, many species of plankton grow in large numbers making it easier for the whales to find the food they need. Mysticetes also produce sound. Most people think of dolphins when they think of a whale making noises but baleen whales make them, too. However, many of the vocalizations made by

mysticetes are too low for humans to hear. New evidence suggests that many species of whale can use the sound channel in the ocean to transmit their long wavelength vocalizations across the ocean basins.

The other group of whales is the **odontocetes**. This diverse suborder contains the sperm whale, as well as some of the smallest whales on the planets. Dolphins and porpoises are also odontocete whales, they just happen to be smaller. While this group is characterized by having teeth instead of baleen, they are also well known for their ability to **echolocate**. Echolocation is a biological form of sonar produced by many odontocetes. The animal creates sound by passing air through its nasal passages. The sound is focused by fatty tissue in the melon, the "forehead" of the whale. By listening to the echoes produced when sound bounces off objects in the water, odontocetes are able to learn information about the size and shape of an object as well as where the object is in the water column.

Cetaceans are different from **pinnipeds** in many respects. Whales don't have hindflippers to use when they swim. Instead they have



powerful flukes which move up and down in the water. Also, whales do not breathe through their mouth or

nose the way pinnipeds do. They breathe through a blowhole at the top of their head.

Pinnipeds

Pinnipeds include seals, sea lions, and walruses. These diverse animals inhabit most of the world's oceans, with each species specialized for its habitat. One of the most common questions asked

about pinnipeds is how to tell them apart. The following table adapted from Marianne Riedman's book *The Pinnipeds: Seals, Sea Lions and Walruses* gives a good summary.

Seals Phocids	Sea Lions Otarids	Walruses Odobenids
no external ears	visible external ears	no external ears
hindflippers are covered with fur, they cannot be turned forward under the body	hindflippers are hairless, they can be turned forward under the body and used for movement on land	hindflippers are hairless, they can be turned forward under the body and used for movement on land
variable sexual dimorphism	pronounced sexual dimorphism	pronounced sexual dimorphism
found mainly in marine environments but also in freshwater and estuarine areas	live in marine environments, occasionally go up freshwater rivers	live only in marine habitats
mothers nurse their young for a short time, from 4 days to several weeks	mothers nurse their young for a relatively long period of time, from several months to 2 years	mothers nurse their young for a long time, 2 or more years

There are many differences between the different pinniped groups. While all pinnipeds are **carnivores**, diet varies between species. Walruses generally feed on **benthic invertebrates**. Harbor seals eat fish, squid, and krill while the leopard seal eats birds, other pinnipeds, krill, and fish. They occupy a high position in the food web and have few natural enemies. Other than man, the only threats to pinnipeds are large sharks, killer whales, polar bears, and some fellow pinnipeds.

Pinnipeds differ from cetaceans in that they can leave the water. As a matter of fact, they depend on land for reproduction. Because each species is adapted to its environment, the amount of time spent on land varies. Some animals leave the water for only a month while some males may stay out of the water for more than 3 months while guarding a harem!

How are They All Related?

What follows is a basic outline of the different groups of cetaceans and pinnipeds. Included are a few examples of the species in each group.

Cetaceans

Order Cetacea

Suborder Mysticeti (Baleen Whales)

Family Balaenidae (Right Whales, 3 species)

Northern Right Whale *Eubalena glacialis*

Family Eschrichtiidae (Grey Whales, 1 species)

Grey Whale *Eschrichtius robustus*

Family Balaenopteridae (Rorqual Whales, 6 species)

Blue Whale *Balaenoptera musculus*

Humpback Whale *Megaptera novaeangliae*

Suborder Odontoceti (Toothed Whales)

Family Physeteridae (Sperm Whales, 3 species)

Sperm Whale *Physeter macrocephalus*

Pygmy Sperm Whale *Kogia breviceps*

Dwarf Sperm Whale *Kogia simus*

Family Ziphiidae (Beaked and Bottlenosed Whales, ~18 species)

Cuvier's Beaked Whale *Ziphius cavoristros*

Southern Bottlenose whale *Hyperoodon planifrons*

Family Monodontidae (2 species)

Narwal *Monodon monoceros*

Beluga whale *Delphinapterus leucas*

Family Platanistidae (Freshwater dolphins, 5 species)

Ganges River dolphin *Platanista gangetica*

Amazon River dolphin *Inia geoffrensis*

Family Delphinidae (Dolphins, ~32 species)

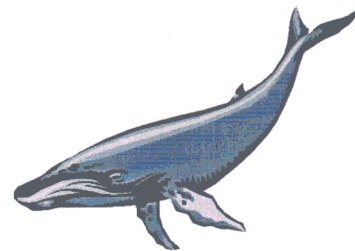
Bottlenose dolphin *Tursiops truncatus*

Killer Whale *Orcinus orca*

Family Phocoenidae (Porpoises, 6 species)

Harbor porpoise *Phocoena phocoena*

Vaquita *Phocoena sinus*



Pinnipeds

Order Pinnipedia

Family Phocidae (Seals)

Subfamily Monachinae (Southern seals, 8 species)

Hawaiian monk seal *Monachus schauinslandi*

Northern elephant seal *Mirounga angustirostris*

Subfamily Phocinae (Northern seals, 10 species)

Harbor seal *Phoca vitulina*

Bearded seal *Erignathus barbatus*

Superfamily Otarioidae

Family Otariidae

Subfamily Otariinae (Sea Lions, 5 species)

California Sea Lion *Zalophus californianus*

Stellar sea lion *Eumetopias jubatus*

Subfamily Arctocephalinae (Fur seals, 9 species)

Northern fur seal *Callorhinus ursinus*

Galapagos fur seal *Arctocephalus galapagoensis*

Family Odobenidae (1 species)

Walrus *Odobenus rosmarus*

Marine Mammal Strandings

People have been interested in injured marine mammals for a long time. In the United States, marine mammals are protected under the Marine Mammal Protection Act. The federal agency in charge of enforcing that act is the **National Marine Fisheries Service (NMFS)**. In order to learn more about marine mammals and to help animals that come ashore, the NMFS created the marine mammal-stranding network. The network consists of scientists, veterinarians, marine aquariums, and public individuals that volunteer their time to help animals in distress. In addition, they perform **necropsies**, an animal autopsy, on animals that have died. Most people who work with stranded animals volunteer their time. A local veterinarian usually donates medical services and a local marine rescue

group funded by private donations pays for medical supplies and food.

A stranded animal is an animal that cannot survive in its current state. Usually, this refers to an abandoned pinniped pup or a whale washed up on a beach. However, it can also refer to a manatee that has been hit by a boat or a humpback whale that has fishing gear wrapped around its mouth. These animals cannot survive in these circumstances. The species of animals that strand depend on what part of the country it is and the species that inhabit the local waters. Florida and Texas stranding networks respond to a large number of bottlenose dolphin strandings each year while California stranding groups rescue a lot of pinnipeds.

What Happens when an Animal is Found?

The first person to know about a stranding is usually a member of the general public. A person who finds a stranded animal on the beach should notify the police or directly call the local marine mammal stranding team. The stranding team will send out volunteers to assess the situation and see what can be done. If a single animal has stranded, such as a lone elephant seal, the team will usually take the animal back to a care facility. A stranded animal has very little chance for survival. Some estimate only 1 in every 1000 animals will survive, even fewer can be released back to its natural habitat. However, each rescue group works around the clock to give each animal the best care possible.

Sometimes, many animals strand at the same time, this is called a **mass**

stranding. There may be more than 50 animals on the beach at the same time. In this case, stranding groups usually try to take as many sick ones as possible back to their care facility. It is usually not possible to save all the animals involved in a mass stranding.

Remember that a stranded marine mammal is sick. It needs proper medical attention **IMMEDIATELY.** Notify the local stranding network, or local police force. They will send the stranding team. Even if a mass stranding is encountered, the decision to refloat an animal should be made by a veterinarian.

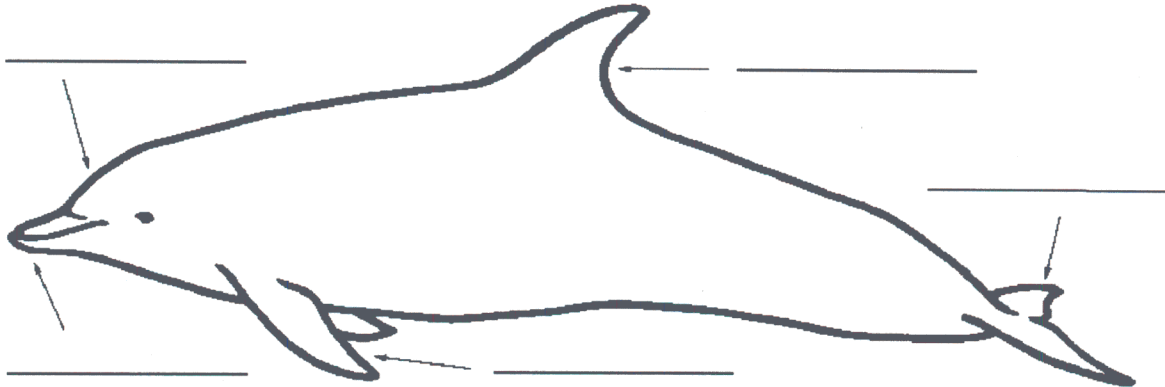


Lesson V. Activity I. Matching Activity

Learning the genus and species of different marine mammals takes a long time. Very few people know all of them. Just for fun, see how many of these you can match.

Common Name	Genus and Species
Bottlenose dolphin	Tursiops truncatus
Humpback whale	Megaptera noveangliae
Walrus	Odobenus rosmarus
Harbor seal	Orcinus orca
Killer whale	Zalophus californianus
California sea lion	Phoca vitulina
Galapagos fur seal	Arctocephalus galapagoensis
Ganges river dolphin	Platanista gangetica
Beluga whale	Platanista gangetica
Bearded seal	Erignathus barbatus

Activity II. Dolphin Identification

**Background:**

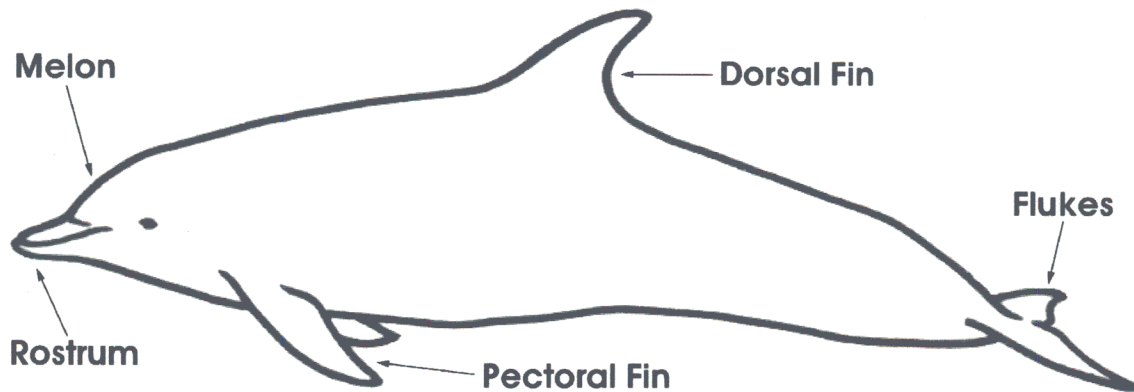
Whales spend their entire lives in the ocean. As a result you will see certain adaptations in whales that you don't see in many other animals. Here we will look at a sketch of the bottlenose dolphin to illustrate some of these changes.

Dolphins have a **rostrum**. The rostrum is at the front of the face. After the rostrum we find the melon. The **melon** looks like the forehead of the whale. It contains fatty tissue used to focus sound during echolocation. Not all whales have a melon. Next we find the **dorsal fin**, located on the animal's back. While not all whales have a pronounced dorsal fin, it does stabilize animals as they swim through the water as well as play a role in regulating body temperature. On the bottom half of the animal are the **pectoral fins**. These flippers have bones similar to the human hand. They are generally used for steering in the water. Finally, we reach the tail. Scientists refer to the tail as the **flukes**. The flukes are shaped like the wing of an airplane. The whale moves the fluke up and down when they swim.

Activity:

Fill in blanks with the bolded vocabulary words listed in the Background section.

Activity II. Teacher's Answer Key to Dolphin Identification

**Background:**

Whales spend their entire lives in the ocean. As a result you will see certain adaptations in whales that you don't see in many other animals. Here we will look at a sketch of the bottlenose dolphin to illustrate some of these changes.

Dolphins have a **rostrum**. The rostrum is at the front of the face. After the rostrum we find the melon. The **melon** looks like the forehead of the whale. It contains fatty tissue used to focus sound during echolocation. Not all whales have a melon. Next we find the **dorsal fin**, located on the animal's back. While not all whales have a pronounced dorsal fin, it does stabilize animals as they swim through the water as well as play a role in regulating body temperature. On the bottom half of the animal are the **pectoral fins**. These flippers have bones similar to the human hand. They are generally used for steering in the water. Finally, we reach the tail. Scientists refer to the tail as the **flukes**. The flukes are shaped like the wing of an airplane. The whale moves the fluke up and down when they swim.

Activity:

Fill in blanks with the bolded vocabulary words listed in the Background section.

Activity III. Track a Whale

This lesson is one that will need to be completed with the use of the internet. It is a great web-learning lesson, as well as re-inforces geography, map reading, elementary remote sensing and problem solving.

Whale migrations are a long and busy journey for the marine mammals. Visit <http://athena.wednet.edu/curric/oceans/whales/index.html> to follow the grey whales. This website is exciting in that it provides links to ocean color maps in the winter and the spring, while explaining why marine mammals are found where they are.

Click on Migrations Task Card, and use while visiting the ocean color and sea surface maps.

Resources

Books:

The Pinnipeds: Seals, Sea Lions, and Walruses. 1990. Marianne Reidman, 1990. University of California Press.

A great book to learn about pinnipeds.

Marine Mammals Ashore: A Field Guide for Strandings by Joseph R. Geraci and Valerie J. Lounsbury

Published by some very respected researchers, this guide gives scientists and the general public a good idea of what to do during a stranding.

Focuses on animals from all over the United States.

The Bottlenose Dolphin. 1990. eds. Stephen Leatherwood and Randall R. Reeves. Academic Press

This book brings together all the current information we have about this species. It may be advanced for a 6th grade class to read but it is full of wonderful information.

World Wide Web Sites

Sea World
<http://www.seaworld.org/>

A lot of good information on marine mammals and well as activities for teachers

The Society for Marine Mammalogy
<http://pegasus.ucf.edu/smm/>

It has a wonderful guide for students interested in marine mammalogy as a career

National Marine Mammal Laboratory
<http://nmml.afsc.noaa.gov/>

National Marine Fisheries Service's web site for marine mammal information

The Marine Mammal Center
<http://www.tmmc.org/>

A California based marine mammal rescue group.

Texas Marine Mammal Stranding Network
<http://www.tmmsn.org/>

A good web site to learn about strandings

Clearwater Marine Aquarium
<http://www.cmaquarium.org/>

One of the few marine mammal rescue facilities in Florida

Mote Marine Laboratory
<http://www.mote.org/>

Another marine mammal rescue facility in Florida

Student Information Sheet I

Marine **mammals** are mammals that depend on the **marine environment** for part of their life. When people think of a marine mammal, they usually think of a bottlenose dolphin, like Flipper, or a sea lion. However, this group also includes polar bears, sea otters and manatees. Polar bears spend their winters on polar ice flows but forage on land during the summer. Manatees live their entire lives in the water, however, they can live in both fresh and salt water. This shows the diversity of the animals we call marine mammals.

The marine environment can be very challenging. Animals living in the water must adapt to conditions quite different from those on land. For example, water conducts heat much better than air. This means that a warm-blooded animal will lose heat

more quickly in the water. The animal must develop a way to maintain body temperature. Marine mammals face other challenges like:

- swimming long distances to find food
- diving down to reach food that may be over 200m deep in the ocean
- finding fresh water in an ocean filled with salt water
- staying warm in water much colder than their body temperature

What things could a marine mammal do to overcome these stresses?

These amazing animals come in all shapes, sizes, and colors. There are species of cetaceans and pinnipeds for each ocean of the world. So many species exist that scientists have discovered new whale species in the past few years!

Fun Facts about Marine Mammals



Elephant seal mothers spend about 73 days away from their pups while the mother goes to sea to look for food.

Female elephant seals can dive deeper than 1000m.

Bottlenose dolphins don't chew their food. They swallow fish whole.

Healthy adult sperm whales have been seen without a lower jaw!