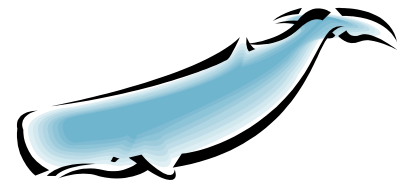


# Whales and Dolphins



A crossword puzzle grid with 25 numbered starting points for words. The grid consists of white squares for letters and black squares for empty space. The numbers are as follows:

- 1: Across, top row, starting at the first square.
- 2: Down, second square of row 1.
- 3: Down, first square of row 2.
- 4: Down, fourth square of row 2.
- 5: Across, third square of row 2.
- 6: Down, sixth square of row 2.
- 7: Across, seventh square of row 2.
- 8: Down, eighth square of row 2.
- 9: Across, ninth square of row 2.
- 10: Across, tenth square of row 2.
- 11: Across, eleventh square of row 2.
- 12: Across, twelfth square of row 2.
- 13: Across, thirteenth square of row 2.
- 14: Down, fourteenth square of row 2.
- 15: Down, fifteenth square of row 2.
- 16: Down, sixteenth square of row 2.
- 17: Across, seventeenth square of row 2.
- 18: Down, eighteenth square of row 2.
- 19: Across, nineteenth square of row 2.
- 20: Down, twentieth square of row 2.
- 21: Down, twenty-first square of row 2.
- 22: Across, twenty-second square of row 2.
- 23: Across, twenty-third square of row 2.
- 24: Across, twenty-fourth square of row 2.
- 25: Across, twenty-fifth square of row 2.

Across

1. "ancient whales"
5. Use of high frequency sounds for navigation
7. Family of porpoises, noted for having no beak, spade shaped teeth, and a triangular dorsal fin.
10. Bottom feeding baleen whales that feed on small crustaceans called amphipods
11. Layer of fat used for insulation, and sometimes acts as a food reserve.
12. Like our hair and fingernails, baleen is made from this material.
17. Organ located between the blowhole and rostrum of toothed whales. Helps focus sounds in desired locations.
19. "Beak or snout" at the front end of a cetacean. Makes the body streamlined.
22. Baleen whales that capture food by swimming near the surface with their mouths open, so zooplankton float inside
23. Family including the dolphin and killer whales. Distinguished by a beak, cone-shaped teeth, and a curved dorsal fin.
24. Ancestor of cetaceans that resembled short-legged wolves and hunted near the shore.
25. Mothers of all \_\_\_\_\_ provide milk for their young.

Down

2. The order of animals that includes dolphins and whales, originated from the Latin words for large sea animal and sea monster.
3. Baleen whales that have a pleat or fold that expands and holds water and its contents. The water is then pushed back through the baleen, trapping the food.
4. Fin on the back of most cetaceans used to help maintain balance and internal temperature.
6. The main food source for baleen whales
8. Fins that have bones resembling the human hand that are used for steering and balance. Also called flippers.
9. A tooth in the upper jaw of male narwhals that can reach up to 9 feet, used in dominance battles.
13. Change in an organism's body or behavior that helps it to survive
14. "toothed whales"
15. Cetacean body part used in respiration. Remain sealed shut in relaxed state.
16. Large paddle-like appendages at the end of a cetaceans tail made from fibrous connective tissue
17. Named for the Latin word for moustache. Fringe in baleen resembles a moustache.
18. Behavior when a cetacean leaps out of the water and splashes back down
20. Occurs when whales rest at the water's surface without swimming.
21. Spear-headed weapons used in whale hunting.
24. Groups of toothed whales

## WHALES & DOLPHINS CROSSWORD READING

All whales, dolphins and porpoises share certain characteristics that put them together in the scientific order Cetacea (from the Latin word "*cetus*" (a large sea animal) and the Greek word "*kEtos*" (sea monster)). They all have a fairly streamlined body, as well as other adaptations that allow them to live a completely aquatic life, without ever having to come onto land. Their front limbs have become paddle-like flippers, and, externally, they have lost their back limbs completely. While these features have caused them to become fish-like in appearance, they also all share a characteristic that strongly separates them from fishes, and links them to otters, cows, dogs, and people. They are all mammals.

### WHAT IS A MAMMAL?

So, then, what is a mammal? Mammals share several characteristics with other types of animals. Certainly, mammals breathe air with lungs, which immediately separates them from the fishes. This does not make them a mammal, though, since birds and reptiles also breathe air with lungs. Like birds, mammals are endothermic, which means that they maintain a constant inner body temperature (often referred to as "warm blooded"). For the most part, mammals give birth to live young. However, 3 species of mammals do lay eggs, and several species of fish and reptiles give birth to live young. Hair, or fur, is useful as a determining feature, since no other animals have "true" hair (The "hair" on some arachnids and insects are actually sensory bristles, and are not similar to mammal hair in anything but casual appearance). But many cetaceans are hairless, and some other mammals, like rhinos, are not immediately recognized as having hair. The one characteristic that **all** species of mammals possess is that the mothers produce milk for their young. No other type of animal in the world does this. It is this feature, in combination with the other characteristics that serve to separate mammals from all the other groups of animals.

Cetaceans, therefore, are referred to as Marine Mammals - Mammals that live in the ocean. Cetaceans aren't the only group of marine mammals, however. There are also pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), sea otters, and even polar bears! However, from ancient Greek pottery to today's advertisements and movies, cetaceans seem to have most completely captured the hearts and minds of people all over the world.

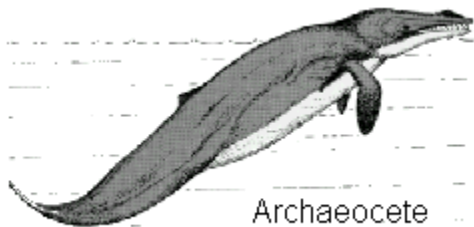
## CETACEAN EVOLUTION

Whales and dolphins evolved over a period of 55 million years from an animal that looked very different from the cetaceans that live today. The exact ancestor of cetaceans is still unknown, but recent fossil findings indicate that one of the earliest cetaceans is an animal called a **pakicetid**. Pakicetids lived on land and resembled a short-legged wolf with hoof-like claws. It walked on four legs and was a meat eater. Some pakicetids may have hunted along the shore, probably to catch fish. They may have begun to find more food in deeper waters or may have begun to escape from predators by swimming. Over time, the pakicetids' body began to change to gradually adapt to this new aquatic environment.



Illustration by Carl Buell and taken from <http://www.neoucom.edu/Depts/Anat/Pakicetid.html>

Over millions of years, pakicetids evolved into a primitive group of whales, called **archaeocetes**, which means "ancient whale." Initially, archaeocetes were small, seal-like animals, with four legs and few marine specializations. They may have spent some time on land at first. Gradually, the archaeocetes evolved into large, eel-like animals highly adapted for a marine life. Their limbs were replaced with paddle-like flippers to help them move in water. The archaeocetes ultimately evolved into two groups of whales, **mysticetes** (baleen whales) and **odontocetes** (toothed whales), which are still alive today.



The fossilized wrist bones of pakicetids reveal that they most likely evolved from the same ancestor as the modern day **artiodactyls** (even toed hoofed animals). So although they appear to be very different animals, the closest living relatives to whales and dolphins are cows, hippos, and giraffes!

### Cetacean Body Parts

#### *Flukes:*

The flukes are often referred to as the whale's tail. However, the flukes are large appendages at the end of the tail. The flukes are made up of fibrous connective tissue, without any bone or muscle inside. These paddle-like structures serve to help push the whale through the water, much like the swim fins of a human diver. Like a diver's fins, the flukes move up and down to push the whale through the water, as opposed to the side to side motion of fishes. When swimming near the

surface, the water displaced by the flukes causes smooth circular patterns to appear on the surface, which observers often call "footprints" or "flukeprints". The whales can actually be tracked by these prints as long as they remain near the surface. (The same effect can be observed in a bathtub or pool by putting your hands under the water and moving them up and down near the surface.)

#### *Dorsal Fin:*

The dorsal fin is the fin on the back of most cetaceans. Like the flukes, it is made of fibrous connective tissue. Most polar species (beluga, narwhals, right and bowhead whales), as well as gray whales, lack dorsal fins. Many scientists believe it helps keep balance, aids in turning when chasing prey, and assists in maintaining internal body temperature.

#### *Pectoral Fins:*

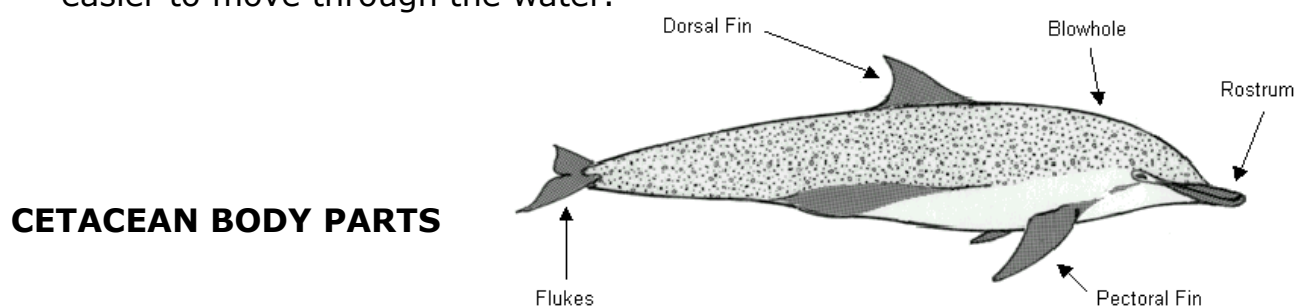
The pectoral fins, or flippers, are used mainly for balance and steering. The bones of a whale's flippers are similar to the bones found in a human hand. Differences in the size or shape of individual bones enhance the whale's ability to steer. Shortened wrist bones and longer finger bones provide added power, better balance, and help the whale to maneuver.

#### *Blowholes:*

A cetacean's nostrils, or blowholes, are located at the top of its head. This facilitates the movement of the cetacean through the water since only the top of the head needs to break the surface of the water to allow the cetacean to breathe. Cetaceans are voluntary breathers; meaning that, unlike land mammals, their nostrils are sealed shut in their relaxed state. The whale must open their blowholes to breathe. Mysticetes have two blowholes, and odontocetes have only one.

#### *Rostrum:*

The rostrum is the very front end of the cetacean, often called the snout or beak. It is structurally comprised of the same bones humans have between the bottom of their nose and their upper jaw. On cetaceans, these bones have been elongated to the rostrum. This gives the cetacean a more streamlined shape, making it easier to move through the water.



## CETACEAN ADAPTATIONS

An **adaptation** is a change in an organism's body or behavior that helps it to survive. An organism adapts to an environment very slowly over thousands of generations. Those that are better suited for their environment have a greater chance of surviving and passing their adaptations on to offspring. Whales and dolphins have particular body and behavior modifications that have helped them successfully adapt to a marine life.

### *Melon:*

The melon is a special organ located between the blowhole and rostrum of toothed whales. It is essentially a fatty, oil filled sack that most marine biologists agree serves as an "acoustical lens". The melon helps the whale to focus the produced sounds in a desired direction.

### *Baleen:*

Baleen is an adaptation Mysticete whales developed that aids in capture of very small prey in large amounts. It grows from the roof of the mouth and hangs down in structures called plates. Baleen is made out of **keratin**, just like our hair and fingernails, and works like a spaghetti strainer to filter small animals out of the water. The plates of baleen overlap a little and have a fringe to trap food on the inner side. There may be anywhere from 200 - 600 plates in their mouth. The frayed inner edge of the baleen looks like a moustache, from whence came the name mysticete (*mysti* from the Greek word for moustache).

### *Blubber:*

Unlike most mammals, whales do not rely on hair or fur for warmth. Instead, they have a thick layer of fat, called **blubber**, that acts like insulation to keep them warm. Blubber can also help to provide energy as a food reserve when food is scarce. In addition, blubber is lighter than water and can help the whale remain buoyant, or stay afloat, in the water. This important fat layer beneath the skin can be up to one foot thick!

### *Vestigial Pelvic Bones:*

Whales do not have hind legs like those of their terrestrial or land-dwelling ancestors. This improves their streamlining. Nevertheless, internally all whales have vestigial pelvic bones that are remnants of hind limbs that have gradually disappeared through evolution.

### *Breathing:*

Whales, like all mammals, have lungs and breathe air. Whales have one or two nostrils, called **blowholes**, on top of their head that allow them to breathe easier while swimming. The holes close tightly underwater so the animal does not drown. When the whale surfaces, the blowhole opens quickly to allow the whale to exhale, and take a breath. Since cetaceans spend most of their lives underwater, another important aspect of breathing is how long they can hold their breath. Some can only hold their breath for 3-5 minutes. But then there are the champion breath holders, the sperm whale and beaked whales, who can hold their breath for over an hour! The mechanisms allowing this incredible feat are not completely understood. It is known that these cetaceans have a higher affinity for oxygen in their tissues than land mammals. In some cases, it appears that the lungs completely collapse under the pressure of deep dives, indicating that the whale's lungs are empty when they dive! This would help reduce the amount of nitrogen that could be forced into their blood from the lungs by the pressure of a deep dive. It is nitrogen in the blood (or rather, the release of nitrogen dissolved in the blood) that causes the potentially lethal condition known as the bends that deep-sea divers sometimes get.

### *Sound:*

All cetaceans produce sound when underwater. Baleen whales produce powerful low frequency sounds that can travel over vast distances (potentially over hundreds of miles.) These sounds seem to serve mostly for communication. Toothed whales produce high frequency sounds. These high frequency sounds don't travel nearly as far as low frequency sounds, but when they bounce, or echo off objects, these high frequency sounds can provide a lot of information regarding that object. Toothed whales seem to use these sounds for navigation as well as communication. The use of these high frequency sounds for navigation is a process known as **echolocation**. The whale uses its nasal air sacs to make distinctive clicking sounds that are then transmitted out through the **melon**. These high frequency sound waves bounce off objects in the water, creating echoes that help the whale to determine the distance and size of an animal or object.

## **BALEEN WHALES**

Whales are classified into two major groups, toothed or baleen, based partially on feeding strategies. **Mysticetes**, or baleen whales have specialized structures in their mouth called baleen instead of teeth to help them catch food.

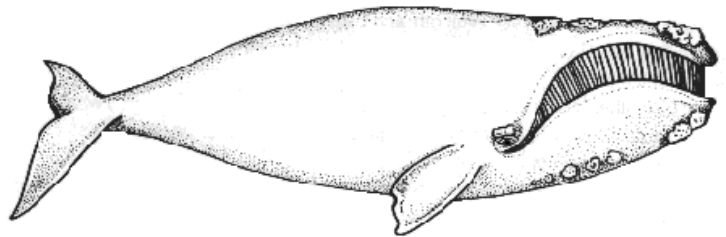
Amazingly, the largest animals on earth, baleen whales, survive by eating some of the smallest animals, called **zooplankton**. Imagine how much zooplankton a 100-foot blue whale must eat! A large Blue whale can eat more than 9,000 pounds (4,100 kilograms) in one day. Every time the whale swallows, over 100 pounds (50 kilograms) can go down its throat.

### **Different ways of feeding:**

#### *Skimmers:*

Some baleen whales feed by sifting plankton directly out of the water. They swim close to the surface with their mouths open. Zooplankton, like copepods, float into the mouth and are caught in the baleen. This type of feeding is best for capturing slow, surface-dwelling zooplankton that cannot swim away from the whale.

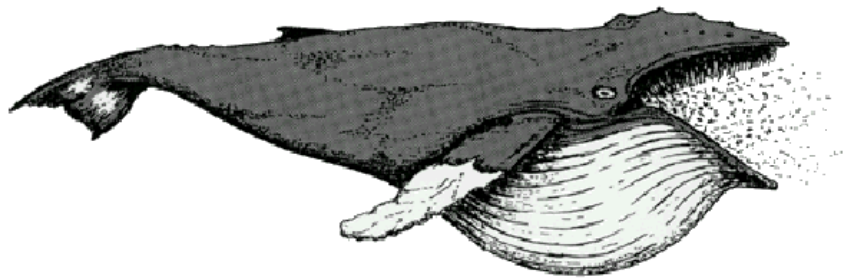
The Northern Right Whale



Right whales and bowhead whales are skimmers.

#### *Gulpers:*

These whales have specialized pleats, or folds, in their throats that expand out like a huge bag. They feed by taking huge amounts of water into their mouths, trapping the prey inside. The pleated throat balloons out to hold the water and food. The whale forces the water out past the baleen and the food gets trapped in the baleen. Gulpers are very good at catching fast swimming food, such as **krill** or small schooling fish.

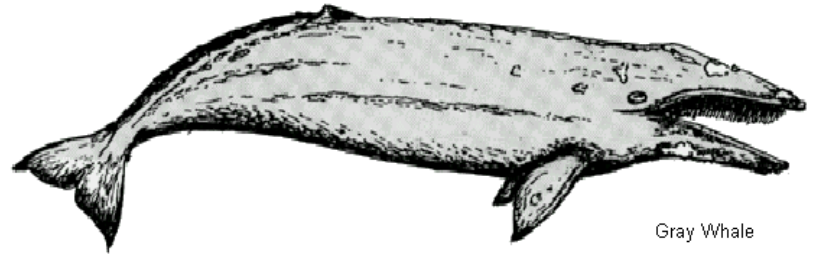


Blue whales and humpback whales are gulpers.



### Suckers:

Bottom-feeding whales travel down to the ocean bottom to feed on small shrimp-like crustaceans, called **amphipods**. They roll over on one side of their bodies and suck up large mouthfuls of mud. As they travel back to the surface, they squeeze out the mud and water through the baleen to trap the amphipods. These whales often leave large craters along the bottom where they vacuumed up their dinner.



Gray Whale

Gray whales are bottom-feeders.



Amphipod

### Fast Facts:

Baleen grows throughout a whale's lifetime. The inner edge and tip continually wears down.

Baleen whales have tooth buds during the embryonic stage. The tooth buds disappear before birth.

Baleen is sometimes referred to as "whalebone".

Baleen ranges in color from black to yellow to white, depending on the species.

The longest baleen belongs to the bowhead whale. Their baleen grows to over 14 feet long.

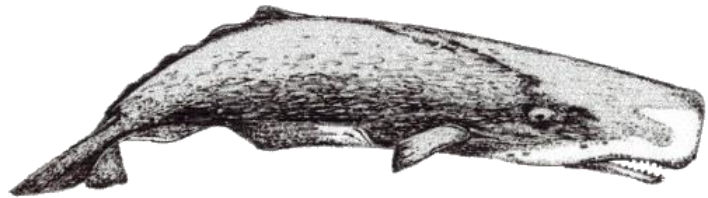
## TOOTHED WHALES

The second major group of whales are the toothed whales or **odontocetes** (*odont* from the Greek word for tooth) and includes dolphins and porpoises. Odontocetes are usually smaller than baleen whales and have one blowhole.

Unlike baleen whales, toothed whales are selective eaters. They often hunt down individual animals, such as fish, squid, seals or sea lions, and even birds. Toothed whales have the ability to locate and identify objects by listening for echoes. They **echolocate** by producing clicking sounds and then interpret the echo that comes back. Unlike many other animals with teeth, odontocetes do not use their teeth to chew their food. Odontocetes' sharp teeth help them to grab onto their prey. The food is swallowed whole or in large chunks. The number and placement of teeth a toothed whale has affects what it eats and how it captures its food.

## Teeth in jaws

Some toothed whales have teeth in their upper and lower jaws, like humans. Whales with small rows of teeth, such as the Bottlenose Dolphin, eat small, schooling fish. Other toothed whales, such as killer whales, have larger teeth and can hunt down larger fish and marine mammals.



Sperm Whale

## Unusual teeth

Some toothed whales are very unusual in their dental patterns. Most female beaked whales have no teeth at all, and most males only have two teeth on the lower jaw. And some of these teeth may be so modified as to be useless for feeding. The two teeth on an older male Strap-toothed whale may grow so large as to curve over the mouth and prevent it from opening completely! Fortunately, the whale can still suck squid into its mouth, using its beak and tongue like a vacuum cleaner.

Then there is the male narwhal, with its large (up to 9 feet) tusk. (It only has two teeth, too, but in their case they are in the upper jaw only). The tusk is actually one of the teeth (usually the left one)! It is obvious that these teeth cannot be used for eating. Scientists believe that these teeth are used in dominance battles, where males use non-lethal fighting to establish their place in their social order. The female narwhal also has two teeth in the upper jaw, but these rarely erupt into tusks.



## Natural History

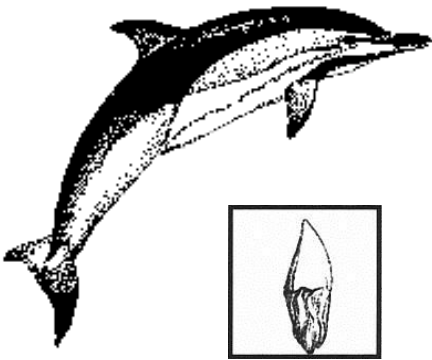
Toothed whales tend to form tight social groups. Some dolphins form groups, or pods, of over 1,000. Sometimes, the groups are divided by sex, with females and calves in so called "nursery pods" separate from the smaller male, or "bachelor" pods.

Sexual dimorphism is common in odontocetes, with the males being larger than the females. This is carried to extremes in the case of the sperm whale. The males may be 10-20 feet larger than the female!

## DOLPHINS AND PORPOISES

Dolphins and porpoises are toothed cetaceans. They are the smaller members of the suborder **Odontoceti** and have one blowhole like larger toothed whales. They are found in all the world's oceans, except for the coldest polar seas. A few species of dolphins live in large freshwater rivers in South America and Asia. Dolphins and porpoises are very closely related; they are often confused with each other because they have similar behaviors and live in similar environments. Dolphins and porpoises, however, are divided into different classification groups, called families, based on physical differences.

### Family Delphinidae



There are over 30 species of ocean dolphins. Dolphins usually have a beak, cone-shaped teeth, and a curved or hooked dorsal fin. A few larger species of dolphins are often called whales because of their size. Killer whales are actually the largest member of the dolphin family.

### Family Phocoenidae

They are smaller than dolphins and usually have small, triangular-shaped dorsal fins. Porpoises do not have a beak and have small spade-shaped teeth. They usually travel in smaller groups than most dolphins. There are six species of porpoises.



Dolphins and porpoises are social animals that often travel in groups, called **pods**. They are very efficient hunters and work together with members of their pods to round up large schools of fish. The pod herds the fish into a tight ball, and then each animal takes a turn swimming through the group of fish to feed on them while the others keep the fish trapped. Some species of dolphins and porpoises can dive down to more than 300 m (900 ft) to search for schooling animals, such as squid or mackerel. Traveling in pods may also provide protection from predators, as well as helping with rearing young dolphins, called calves. Often while the mother is feeding, other members of the pod keep an eye on the calf.



## CETACEAN BEHAVIORS

Very little is known about cetacean behavior because much of it occurs beneath the water. We do see a variety of whale and dolphin behaviors above the water. Scientists can only guess why cetaceans perform certain types of behavior. Using careful observations and different technology to listen to and track cetaceans, we are beginning to unlock the mysteries of the whale's world.



### *Breaching*

This behavior occurs when a whale or dolphin leaps out of the water and splashes back down. There are a variety of explanations about why different whales and dolphins perform this artful leap. Some researchers have proposed it may be a behavior to dislodge parasites off of the whale's back, while others have interpreted it as a form of communication. Some believe the whale is just having fun!



### *Bowriding:*

Boats create powerful pressure waves as the front of the boat, or bow, moves forward through the water. Smaller cetaceans, especially dolphins, often swim playfully in this bow wave, often just being pushed along. Dolphins may also "bowride" in the large waves created by larger whales. Perhaps the best explanation for this behavior is that the cetaceans are playing just for the fun of it!



### *Spyhopping:*

The whale slowly rises straight out of the water, until its eye is above the water surface. After a few moments, the whale sinks back down. Again, we cannot be sure why whales spyhop, but they may be coming up to take a look around.



### *Lobtailing:*

Cetaceans can often be observed lifting up their powerful flukes and slapping them down hard on the ocean surface. This behavior may indicate aggression or irritation, especially in humpback whales, killer whales, bottlenose and Risso's dolphins.



### *Flippering:*

The whale lifts one or both flippers out of the water and slaps them down against the surface of the water. This creates a loud sound that can be heard over large distances both above and below the water. It is also known as a pectoral slap.



### *Kickfeeding:*

Some whales use this interesting behavior to aid them in hunting by splashing the flukes down to surprise nearby fish.



### *Logging:*

This behavior occurs when a whale rests at the water's surface without swimming. The still whale resembles a giant floating log! Sperm whales are the most prone to logging. They must spend quite a bit of time on the surface after their extremely long deep dives, which can last over an hour!

## **A BRIEF HISTORY OF WHALING**

Whaling can be traced back over 2000 years through ancient stone carvings. Native Americans and Eskimos were among the first whalers. Hunting only a small number of whales, they had great respect for these creatures, and used every part of the animal's body. Not only was the meat a source of food, but other parts of the whale could be used to make tools or clothing.

Commercial whaling, or whaling for profit, began in Europe 1000 years ago. Whale blubber was in demand because it could be boiled down into oil, and used for lanterns. Using small boats and hand-held harpoons, these hunters focused on the slower moving whales readily found offshore. They eventually crossed the Atlantic to hunt off the coast of what is now the United States. When colonists came to the New World, they too began hunting whales. By the 1700's, a decline in certain whale populations occurred. Rather than limiting hunting, whalers turned to more efficient hunting methods to get the few that remained.

The right whale was one of the first species to be threatened with extinction. Its name came from its reputation as the "right whale" to hunt. Not only did the right whale have a great amount of blubber and long baleen, it was slow moving, and did not sink after being killed. But it was not the only species that was threatened. Sperm, bowhead, and blue whales were just a few of the species whalers turned to as right whale populations declined. Powerful and more accurate harpoons, together with faster and specially designed boats allowed whalers to kill more, and a bigger variety of whales. Many species were threatened with extinction, but whaling continued.

The first whale protection law was passed in 1929 to outlaw the hunting of right whales. Laws to protect the gray whales quickly followed. The International Whaling Commission, or IWC, was created to manage whale populations by restricting the numbers and species that should be hunted. Its first resolution was in 1965 to eliminate hunting of the endangered blue whale. In 1972, the United States became the first country to pass laws designed to protect all whales and dolphins. The International Whaling Commission later passed a worldwide ban or moratorium on whaling in 1986. While two countries, Japan, and Norway, continue to hunt certain species of whales, other countries may have occurrences of "pirate" whaling, since several whale populations are not recovering as quickly as they should. Organizations such as the American Cetacean Society, and individuals like you, continue to work hard to protect whales and their environment. While some whale populations seem to be on the road to recovery, they all need continued support to insure their survival.

## CETACEAN CONSERVATION

By practicing conservation, individuals preserve and protect not only animal and plant populations for a healthy environment now, but for generations to come.

Habitat destruction is a major threat to cetacean populations. Lagoons where they breed and give birth are being **developed**, or modified for human use, resulting in destruction of their natural, coastal habitat. Pollution is turning the ocean homes of whales such as the beluga and the killer whale into toxic areas. **Non-point pollution**, or pollution from sources difficult to trace such as storm drain runoff, greatly affects ocean health. Commercial fishing continues to be a major problem in many areas. Incidental kills (or death due to being caught in nets or other fishing apparatus) results in 3000 dolphin deaths per year in the tuna industry alone. Also being monitored is potential overfishing of ocean waters. Overfishing of an area can have a catastrophic affect on that area's foodchain, or productivity. As productivity declines, there is less plant matter and fewer animals for cetaceans to feed upon.

Through education and research, efforts have been and are being taken to protect whales and the oceans of the world. In 1972, the United Nations and the United States placed a moratorium, or stop on the commercial hunting of whales and other marine mammals. In 1986, the International Whaling Commission, IWC, also agreed to a ban on commercial whaling. A variety of environmental organizations, such as ACS, work to protect whales and prevent commercial whaling worldwide. Several small aboriginal (native) cultures around the world (including the U.S.) are still allowed to hunt for subsistence purposes only. They are not allowed to sell or trade the whale meat, however, since that would make it a commercial hunt.

Additional protection and conservation of whales is included in the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). CITES is an international agreement between over 150 governments regulating the trade in specimens of wild animals and plants to ensure that their survival is not threatened. Whales are listed on Appendix I, the most threatened level. This level includes species such as whales that are threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances. Some countries, such as Japan, are working to down list whales to Appendix II, which includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival. So far, Japan has not been successful in this effort. Anti-whaling nations and conservation organizations, including ACS, around the world vigorously oppose down listing whales.