Marine mammals

Major Groups of Marine Mammals

1. Pinnipedia – seals, sea lions and walrus
2. Carnivora – sea otter and polar bear
3. Sirenia – dugong and manatees
4. Cetacea – whales, dolphins and porpoises

2

Order Cetacea

- This order includes whales, dolphins and porpoises.
- Fore limbs are modified into flippers.
- Fin-like tail is known as a fluke.
- Nostrils are located on the top of the head as a single or double opening known as a blowhole.

3

Order Cetacea

- Within the cetacea, two suborders exist, toothed whales (Odontocetes) and baleen whales (Mysticetes).
- Visually, the two suborders can be easily distinguished by the presence of teeth and a single blowhole (Odontocetes) or baleen and two blowholes.
- **SIZE:** In general, baleen whales are much larger than toothed whales, ranging in length from about 6.4-27 m (21-85 ft.). Most toothed whales are less than 6.1 m (20 ft.) long.

4

Baleen whales have rows of flexible, fibrous plates known as baleen that hang from the upper jaws (seen in diagram below).

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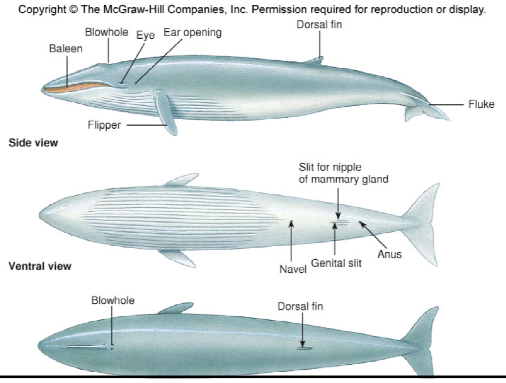

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Blue whale feeding

Order Cetacea

- Baleen whales are filter feeders. They take in huge mouthfuls of water containing small fishes or invertebrates. The baleen traps the prey, and water is forced back out of the mouth.
- Baleen whales are represented by 13 species, including the right whale, gray whale, blue whale, and humpback whale.

Examples of Baleen Whales

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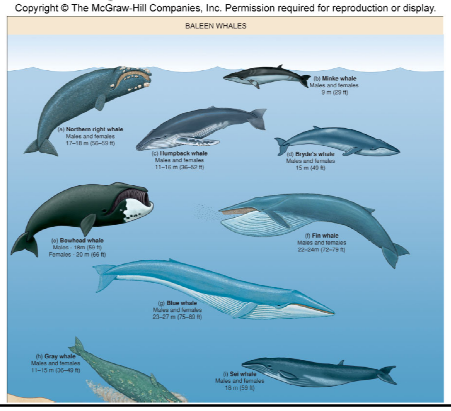

Order Cetacea

- Toothed whales are named for their simple, peg-like teeth, which vary considerably in number and size among the species.

Order Cetacea

- Toothed whales include dolphins, porpoises, belugas, narwhals, sperm whales, killer whales, river dolphins, and beaked whales.
- Depending on the species, toothed whales may be found in coastal waters, rivers or in the pelagic environment.

Examples of Toothed Whales

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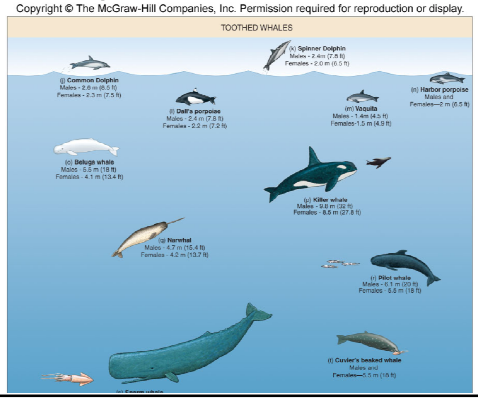


Captive orca

- 2010 large male, 22 foot 12000 pound kills trainer at seaworld.
- Involved in 1-2 other deaths
- Trainers were apparently not supposed to go into water with the orca
- Orca may have been “playing” with trainers ponytail
- This male is used for breeding purposes and has fathered about 15 calves at Seaworld

In defense of captive orcas

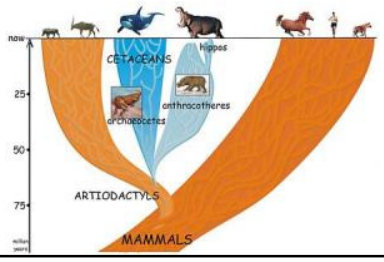
- Former SeaWorld head trainer Thad Lacinak says captive killer whales serve as ambassadors of the species to educate the public and help protect them in the wild. "These animals are invaluable in terms of what we can learn from them. And you cannot learn about killer whales through a pair of binoculars."
- Gary Wilson, a professor at Moorpark College in California, "If it was a perfect world we wouldn't need to have any animals in captivity, but the reality is in order to learn about these animals and to actually ensure their survival in the wild, we need to have them in captivity so we can study them and people can learn to appreciate them," Wilson said. "If SeaWorld didn't have dolphins and whales in captivity, there would be many fewer people in the world that even cared about them at all."
- Even in captivity, orcas rarely attack out of aggression, Lacinak said, adding that they are usually cases of a killer whale trying to play with a trainer. The whale likely saw the trainer's ponytail as a toy, then dragged the woman into the water and turned it into a game.

In opposition to captive orcas

- "Orcas are simply too big, too complex, too intelligent to be adequately accommodated in captivity," said Naomi Rose, a marine mammal scientist with the Humane Society of the United States. "The tanks are always going to be too featureless, too small. ... The number of incidents where trainers have been injured is much greater than most people know. They aren't all reported."
- Orcas in the wild can travel up to 100 miles in a day and thousands of miles in a lifetime in the ocean, where they are generally harmless to humans, said Howard Garrett, co-founder and director of the Washington-based nonprofit Orca Network.
- "Humans trying to incarcerate orcas or elephants or any type of large brain or large society species, it's proven it doesn't work," said Mark Berman, associate director at the environmental group Earth Island Institute in Berkeley, Calif. "They're just too big." "No animals were meant to entertain humans."

Evolution of cetaceans

- Closest living group: Hippos
- Were land animals that moved back to the water



Pakicetus

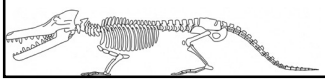
- About 60 years ago, researchers first suggested that cetaceans were related to plant-eating ungulates, specifically to even-toed, artiodactyl mammals like sheep, antelope and pigs.
- Traditionally, the origin of whales was linked to the mesonychids, an extinct group of carnivores that had singly-hoofed toes. Pakicetus, dog like with hooved feet, and triangular teeth like early whales
- 2009 phylogenetic analysis with DNA sequence data as well as morphological and behavioral characteristics suggest that this is not the ancestor of whales

Indohyus - 4 legged ancestor of whales

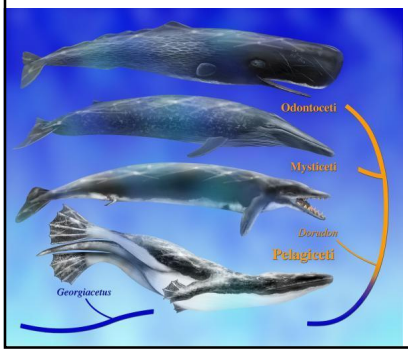
- The 48 million year old ungulate Indohyus from India. Indohyus is a close relative of whales, and the structure of its bones and chemistry of its teeth indicate that it spent much time in water. In this reconstruction, it is seen diving in a stream
- key similarities between whales and Indohyus in the skull and ear adapted for hearing underwater
- Indoyhyus was a plant eater
- http://www.youtube.com/

Ambulocetus – "walking swimming" whale

- Ambulocetids are large, powerful animals, with short limbs, but big feet, and a strong tail.
- only found in northern Pakistan and western India in rocks that indicate that the environment was nearshore marine and swampy.
- rocks cannot be dated with great accuracy, but they are clearly younger than the sediments in which pakicetids are found. Although ambulocetids could walk on land as well as swim, it is clear that they were not fast on either terrain.



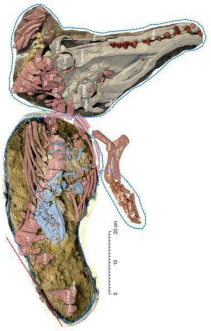
Evolution of the tail fluke - *Georgiacetus vogtlensis*



- previously unknown bones from the tail show that it lacked a tail fluke.
- it did have large back feet that it may have used as hydrofoils
- Undulating the body in the hip region was the key factor in the evolution of swimming.

Early whales probably came on land to rest and reproduce

- 47.5 million yr old extinct whale in the group known as Archaeoceti
- Fossils of female Maiacetus inuus with near-term fetus in utero, as found in the field. The female's skull is shaded white (teeth brown), and other parts of her skeleton are shaded red. The single fetus, in birth position inside the mother whale, is shaded blue (teeth orange).
- The fetus is positioned for head-first delivery, like land mammals but unlike modern whales, indicating that these whales still gave birth on land.



Cetacean intelligence

- Large brain size
- Complex sound production
  - Extensively study but does not appear to be language
- Behavior
- http://www.youtube.com/watch?v=TMCf7SNUb-Q

Total brain weight

Table 1. Approximate brain weights and body weights of some mammals, in order of brain weight.

Species	Brain Weight (approx.) grams	Body Weight (approx.) tonnes
sperm whale (male)	7,820	37.00
African elephant	7,500	5.00
fin whale	6,930	90.00
killer whale	5,620	6.00
bottlenose dolphin	1,600	0.17
human	1,500	0.07
cow	500	0.6

Relative brain weight

Table 2. Approximate brain weights as a percentage of approximate body weights of some mammals.

Species	Brain Weight as % of Body Weight
human	2.10
bottlenose dolphin	0.94
African elephant	0.15
killer whale	0.09
cow	0.08
sperm whale (male)	0.02
fin whale	0.01

Brain size confounding factors

- Relation to body size
- Effect of brain size within a single species
- Which part of the brain (quality vs. quantity)

Brain neocortex (greatly developed in primates and humans)

- spiny anteater (an egg laying mammal, related to the duck-billed platypus), neocortex (relatively much larger than that of a human.
- bottlenose dolphins have a much higher index of neocortex folding than humans. However, neocortex of the cetacean brain is relatively thin - about half that of humans - giving a total average dolphin neocortical volume about 80% of that of humans.
- REM sleep → brain repair; spiny anteaters and dolphins are the only mammals tested that don't have REM sleep

learning

Table 3. Learning set formation (data from various sources cited by Macphail,1982)

Species	Score % (trial2)	Encephalization Quotient (EQ)	Order
langur	98	1.29	primate
mink	95	? (1–1.5)*	carnivore
ferret	90	? (1–1.5)*	carnivore
bottlenose dolphin	87	5.31	cetacean
rhesus monkey	86	2.09	primate
cat	70	1.71	carnivore
rat	60	0.40	rodent
squirrel	60	1.10	rodent

* exact EQ not available, and these species have been given the general carnivore EQ range

Mirror self recognition

- humans and great apes show mirror self recognition

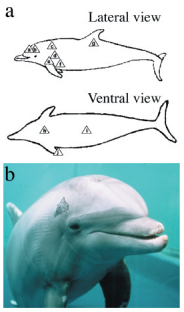


Fig. 2. (A) Locations of the nontoxic, temporary mark and the number of times the dolphins were marked in each location in mark and sham-mark sessions. Marks were applied to either side of the body. Subject 1: b, above eye (right, $n = 1$); c, above and posterior to ear (right, $n = 3$; left, $n = 4$); d, between ear and pectoral fin (right, $n = 2$; left, $n = 2$); e, above pectoral fin (right, $n = 2$; left, $n = 1$); f, posterior to pectoral fin (left, $n = 1$); g, below dorsal fin (right, $n = 3$; left, $n = 7$); h, between pectoral fin ($n = 2$); i, umbilical ($n = 1$); j, underside and tip of pectoral fin (right, $n = 1$). Subject 2: a, on melon (right, $n = 1$; left, $n = 2$); e, above pectoral fin (right, $n = 5$; left, $n = 2$); g, below dorsal fin (right, $n = 2$; left, $n = 1$; umbilical, $n = 2$); h, between pectoral fin ($n = 1$). (B) The dolphin marked above the right eye.

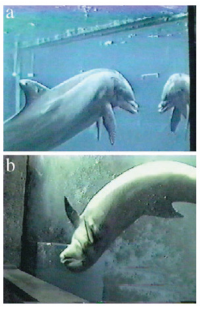
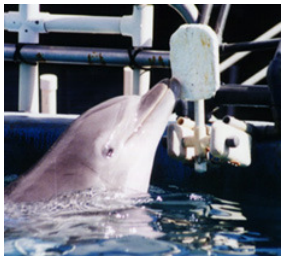


Fig. 4. (A) Mark-directed behavior by subject 1 a real mirror immediately after release from being marked. A narrow Plexiglas mirror, 41.9 cm × 101.6 cm × 0.32 cm is affixed in a vertical orientation to the exterior of one of the reflective walls (Wall 6). During this session, the mirror was the best reflective surface in the subject's environment. The faint white line on the wall indicates the location of mirror. (B) The dolphin at Wall 1, the best reflective surface in the session, exhibiting late sham-directed behavior: a continuous and repetitive sequence of 12 dorsal-to-lateral-ventral flips exposing the location of the sham-marked area of his body, the underside and tip of the right pectoral fin, to the reflective surface. This unusual behavioral sequence continued for 32 sec.

Akeakamai

- Yes no answer to symbolic references to objects that were or were not present



TV watching

- chimpanzees show at most a fleeting interest in television
- language -trained chimpanzee subjects, only learned to attend to and interpret television scenes after months of exposure in the presence of human companions who reacted to the scenes by exclaiming or vocalizing at appropriate times
- image of the trainer on the screen. The trainer then proceeded to give Akeakamai instructions through the familiar gestural language. The dolphin watched and then turned and carried out the first instruction correctly and also responded correctly to 11 of 13 additional gestural instructions