

MARINE MAMMALS: TOOTHED WHALES AND ECHOLOCATION

There are approximately 74 species of toothed whales, including porpoises, dolphins, sperm whales, beaked whales, and a number of other cetaceans (order Cetacea), all of which bear teeth and have a single blowhole. The toothed whales are all predators and eat fish, squid, and in one or two cases, other marine mammals. They have lost their sense of smell and have fairly good vision, although sight is of little use to the deeper-diving forms that probe the murky depths for prey. The best-developed sense in the toothed whales is hearing, which is used by some species for a very sophisticated behavior known as echolocation.

Color the illustration of echolocation in the dolphin.

Echolocation has been most thoroughly studied in the smaller toothed whales, especially the dolphins. Underwater, these animals emit a wide range of vocalizations from squeals, chirps, and moans to pulses, or trains, of very short "clicks." The former vocalizations are perhaps used in communication, while the "clicks" are used in echolocation. The dolphin is believed to generate the clicks by squeezing a tiny jet of air under high pressure between small sacs in the *blowhole* passage. The moving air vibrates the tightened nasal passage to produce a click in much the same way as air squeezed through the pinched neck of a balloon causes a squeak. As few as five or as many as several hundred of these clicks may be produced each second. The clicks are not emitted from the blowhole, but instead are reflected off the dolphin's concave *skull* (cranium) and focused in an *outgoing* directional beam of sound pulses in front of the dolphin by the *melon*. The melon is a large, lens-shaped organ made of fatty tissue, located on the dolphin's forehead. When the sound pulses strike a *target*, a portion of the signal is *reflected* back. The bony *lower jaw* receives and transmits the impulse via bone conduction to the bone-enclosed *inner ear*. Here the sound impulses are converted to nerve impulses, and these are directed to the brain. The dolphin is able to determine the distance to a target on a continuing, moment-to-moment basis apparently by measuring the time between emission of the clicks and their return. The rate of click production is regulated to allow the returning echo to be heard between outgoing clicks. Using this highly-evolved skill, the dolphin can determine the size, shape, direction of movement, and distance of an object in the water. It scans the water column with low frequency clicks and uses higher frequency clicks to make finer discriminations.

Color the sperm whale. The spermaceti organ is an internal structure exposed for identification. Also color the squid prey in the lower left corner.

The dark brownish-gray sperm whale is the largest of the toothed whales, with males exceeding 17 meters (56 ft) and 47,000 kg (52 tons). Their outsized snouts make up one-third of their length and contain the huge *spermaceti organ* (weighing up to 11,000 kg or 12 tons). This organ is physically very complex, consisting of a mass of oil-filled connective tissue surrounded by layers of muscle and blubber, and is probably analogous to the dolphin's melon. As in the dolphin, the origin of the sound pulses used in echolocation is thought to involve the blowhole passage. Likewise, the mode of focusing the outgoing sound is thought to utilize the sperm whale's concave skullbone as a reflector and the spermaceti organ as a lens. The sperm whale produces very loud, low-frequency clicks that travel for many kilometers. Some believe these loud clicks allow the sperm whale to scan the depths for its squid prey. Once located, the sperm whale dives for its prey. Dives have been recorded that reached depths of 1134 meters (3700 ft) and lasted 90 minutes.

Finally, color the killer whale and its prey. In the lower right corner, the toothed whales are drawn in relative scale to the blue whale. This endangered baleen whale (Plate 62) reaches 33 meters (108 ft), and is considered the largest animal ever to have existed on earth.

The striking black-on-white killer whale is the largest of the dolphins (9 meters, 30 ft) and, as with the sperm whale, the male is considerably larger than the female. The killer whale sports a mouth full of large, conical teeth that are closely spaced and interlock when the mouth is closed. They are skillful hunters that forage cooperatively in tightly knit matrilineal groups (pods). Two distinct types of killer whale pods are recognized along the west coast of North America. The first type remains resident in a defined geographic locale and feeds primarily on fish such as salmon. The second pod type is nomadic and ranges widely along the coast from the tropics to the polar regions, feeding primarily on marine mammal prey such as seals, sea lions, porpoises, and even the great baleen whales.

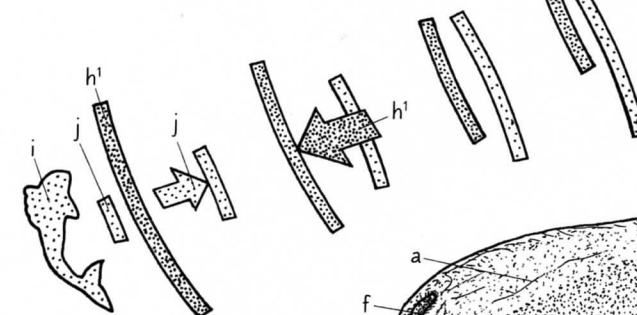
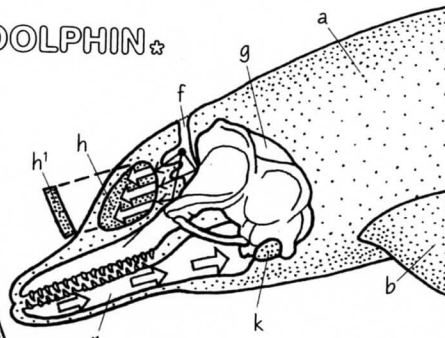
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1. How many species of toothed whales are there?
2. What is the best-developed sense in toothed whales?
3. How are the "clicks" of echolocation created by dolphins?
4. Describe the melon.
5. color!

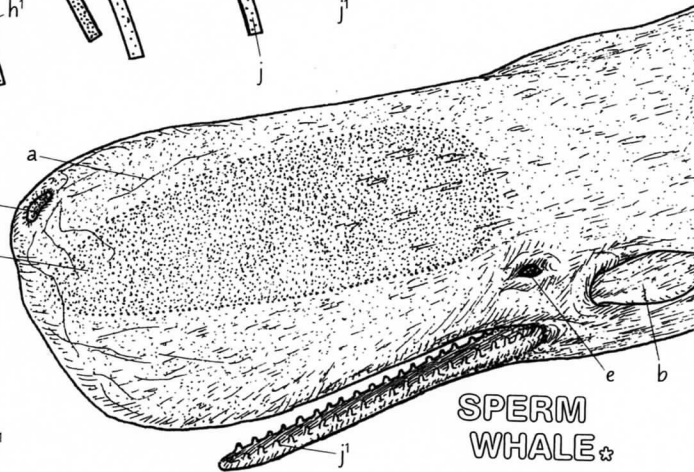
TOOTHED WHALES AND ECHOLOCATION

BODY_a
FORELIMB_b
FLUKE_c
DORSAL FIN_d
EYE_e

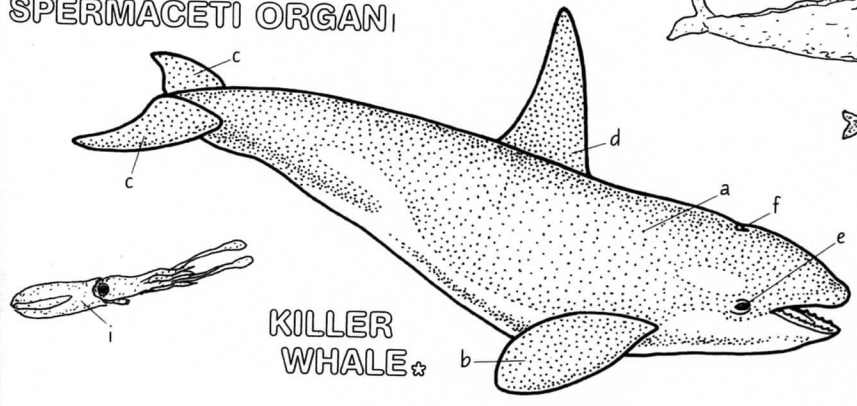
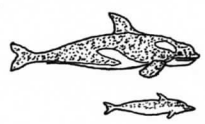
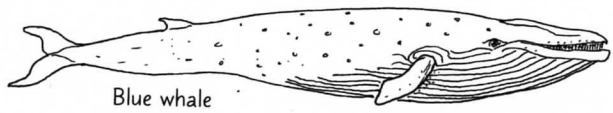
DOLPHIN*



ECHOLOCATION*
BLOWHOLE_f
SKULL_g
MELON_h
OUTGOING SIGNAL_{h'}
TARGET_i
REFLECTED SIGNAL_j
LOWER JAW_{j'}
INNER EAR_k
SPERMACETI ORGAN_l



SPERM WHALE*



KILLER WHALE*

