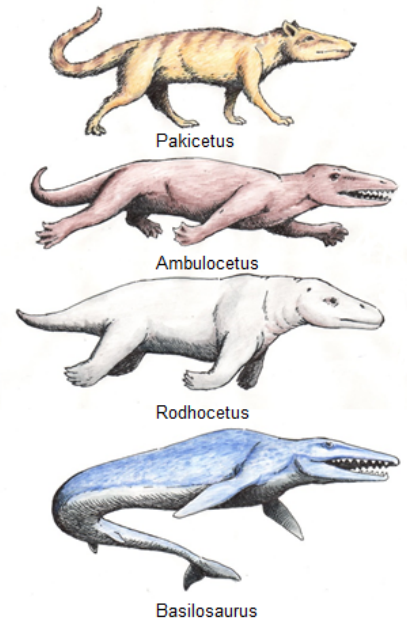




Name: \_\_\_\_\_ Date: \_\_\_\_\_ Group: \_\_\_\_\_

## Whale Evolution

(Lexile 960L)



- Whales are mammals that live their entire lives in the ocean. Has this ever made you wonder how whales evolved? The famous scientist Charles Darwin had this same question. He had observed black bears swimming with open mouths to catch insects. Darwin suggested that whales may have evolved from such bears that grew longer and longer snouts over generations. His attempt at explaining whale evolution was wrong, but the real story of whale evolution is in fact much more fascinating. Fossil finds since early 2000 have continued to fill in much of the story of whale evolution.
- The scientific name for whales is cetaceans. All whales are mammals that breathe air, give birth to live young, and feed their young milk. All mammals, even whales, have hair for at least part of their lives. Whales must breathe air, and they breathe through one or two blowholes on the top of their bodies. Why not their mouths? Their trachea, the tube connecting the blowhole to the lungs, does not connect to the throat. Whales have two flippers and a tail fluke. Fish swim by moving their tail back and forth. Whales, however, move by flexing their spine, moving their tail up and down. This movement is similar to how land animals, such as cheetahs, run. Some whales also have partial femurs and pelvis bones near the end of their spines. But perhaps most importantly, whale ears are unique to whales. Whale ears are adapted to hearing underwater and are used for echolocation. The bones in their ears are thick. There is also a hole in the jaw, making room for a fat pad that helps to conduct sound. No other mammals have this combination of traits. Their ears allow scientists to trace the evolution of whales, from possible land mammal to ocean mammal.
- Around 65 million years ago, dinosaurs on land became extinct along with large marine reptiles. The sea was teeming with many different fish, but it lacked large predators. Therefore, an animal that could take advantage of this newly open niche would find abundant prey. One of the first recorded mammals to take advantage of shallow water was called *Indohyus*. About the size of a housecat, it had dense bones to help reduce buoyancy while it stood in the water. Chemical analyses suggest that *Indohyus* ate mostly land plants, however. It may have dived under water to escape predators. What led scientists to think that *Indohyus* is an ancestor of whales? A technician working on a skull accidentally dropped it, exposing the ear bones. The ear bones are adapted to hearing underwater. Other scientists suggest that a different group of mammals are more likely to be direct ancestors to whales. Either way, these hairy four-legged ancestors are a long way from modern whales.



- 4 *Indohyus* may have been one of the first recorded mammals to use water to its advantage. Most scientists agree, however, that an animal called *Pakicetus* is a likely ancestor to modern whales. Although it still had four legs, its eyes are close together on top of its head. This suggests that it looked for things above the water. The ear bones are thick, but the jaw bone lacks the space for the fat pad. This combination shows a structure between modern terrestrial mammals and cetaceans. The structure and wear pattern of its teeth suggests that it was carnivorous and ate fish and small animals. More recently, about 50 to 48 million years ago, an amphibious mammal called an *Ambulocetus* hunted in the shallow ocean. *Ambulocetus* was three meters long, with back legs more suited for swimming than for walking. It could hear well underwater, and its teeth resemble those of modern cetaceans. Its limb anatomy suggests that it was slow both on land and in the water. *Ambulocetus* probably hunted much like modern crocodiles.
- 5 A diverse group of early whales occupied the shallow water between 49 and 35 million years ago. Although they still had four limbs, the limbs were shorter and some had tail flukes. They probably did not use their hind limbs for locomotion. Instead they swam by moving their tail up and down. Were these animals truly aquatic or still amphibious? One fossil appears to contain a fetus, positioned head first for birth. Animals born on land are born head first, while whales born in the water are born tail first. This suggests that at least some species still gave birth on land.
- 6 In 1840, a skeleton was discovered that was mistaken for a reptile. The discoverer therefore used “-saurus” in the name. *Basilosaurus* is similar to modern whales in both anatomy and size. They are up to 18 meters long. Along with a related family, the *Dorudontidae*, they were adapted to an entirely aquatic life. Both families had tail flukes. Their forelimbs were flipper-like, while the hind limbs were tiny and probably used only during mating. More recent fossils resemble modern whales even more closely. Modern whales are divided into toothed whales and baleen whales. The ancestry of toothed whales lies clearly with these toothed ancestors like *Basilosaurus*. Baleen whale evolution appears more complicated. Modern baleen whales eat tiny plankton. Early baleen whales had both teeth and baleen, hunting larger prey. As time went on, there were changes in ocean currents and temperatures along with changes in plankton. These changes may have driven relatively rapid evolution of whales that could take advantage of this new food source.



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- 7 Charles Darwin observed living animals but lacked fossil evidence. He tried to imagine how a terrestrial animal like the bear could change into an aquatic animal like the whale. Fossil evidence provides insight into the actual evolutionary path. Whale evolution went through many intermediate steps. It started with a small furry animal adapted to diving in shallow water and hearing underwater. The steps led to larger four-legged creatures that grew more amphibious. Even larger animals with smaller hind limbs and strong tails then developed. It appears that hearing underwater was an important early adaptation. The next steps were changing the location of the nostrils and efficient underwater locomotion. More recent anatomical changes added large brains to allow for complex social interactions and a melon organ in species that use active echolocation. New fossil discoveries fill in details of evolution. They can even lead scientists to rethink conclusions from previously discovered fossils. The story of evolution begun by Charles Darwin continues to be written by contemporary scientists.



- 1** Which of the following characteristics suggests that whales evolved from terrestrial animals?
- A** Whales feed their young milk.
  - B** Whales use a tail fluke for locomotion.
  - C** Whales have lungs and breathe air.
  - D** Whales lack hind limbs.
- 

- 2** Scientists hypothesize that early whale ancestors were amphibious. Which statement below is most consistent with this hypothesis? The fossil animals —
- A** were found near ancient sea shores.
  - B** had four legs of equal length.
  - C** had teeth consistent with being herbivores.
  - D** had long, flexible tails.



## Reading Science

- 3** Which part of *Pakicetus* anatomy most suggests that it is an ancestor of whales?
- A** Eyes near the top of the head.
  - B** Ears adapted partly for hearing underwater.
  - C** Teeth consistent with a carnivorous diet.
  - D** It had four legs.
- 

- 4** Which of the following statements is not true regarding *Ambulocetus*?
- A** It could hear well underwater.
  - B** It lacked hind limbs.
  - C** Its teeth resemble modern whale teeth.
  - D** It was a slow hunter.



- 5** How can scientists determine whether an extinct animal gave birth on land or under water?
- A** Location of the hind limbs of the fetus.
  - B** Position of the nostrils.
  - C** Position of the head of the fetus.
  - D** Location of the fossils.
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- 6** Modern whales lack hind limbs, and have tail flukes and ears specialized for hearing underwater. Which of the following is the correct order for the evolution of these whale characteristics?
- A** Loss of hind limbs followed by tail flukes and underwater ears.
  - B** Loss of hind limbs followed by underwater ears and tail flukes.
  - C** Tail flukes followed by loss of hind limbs and underwater ears.
  - D** Underwater ears followed by tail flukes and loss of hind limbs.