

SCIENCE·3D

BATTLE DEEP: SPERM WHALES

In this packet, sample student answers are provided in **red** and notes to teachers are in **blue**.

During this **Mission Research**, students will investigate evolutionary transitions in sperm whale ancestors and explore how ancient environments can be inferred from the fossil record. A second activity dives deeper into sperm whale ecology. A selection of these questions or activities can be completed to address specific standards (science or language arts) that you want to emphasize.

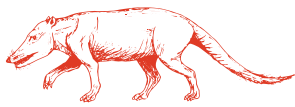


ACTIVITY I: EVOLUTIONARY TRANSITIONS

- Using information from the **Mission Reader**, **draw** the evolutionary transitions from land-dwelling ancestors to today's sperm whales in the space below. Be sure to include at least four steps. **Label** the characteristics (traits) that help show that today's whales and dolphins descended from land animals rather than from fish.

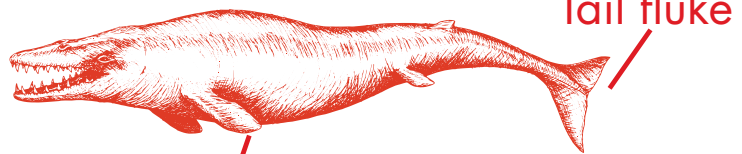
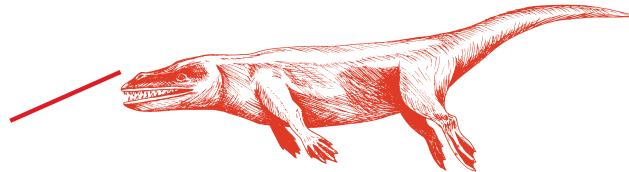


Traits students should point out include the transitions from nostrils to blowholes, legs to foreflippers, and the loss of hind limbs or development of a tail fluke. They might mention that whales are warm blooded and drink milk, which were cited in the text as characteristics of mammals.



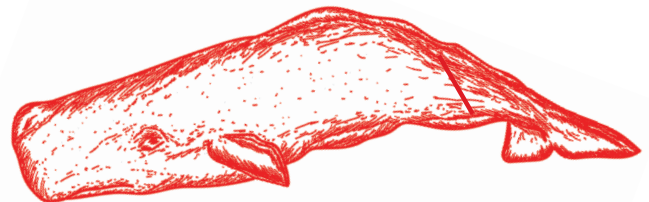
Webbed feet

Nostrils move back in skull



Tail fluke

Flippers form



Loss of hind limbs

2. Many fossils of ancient organisms are found in modern-day deserts, but that doesn't necessarily mean the area was a desert when the organism was living. How can fossils help determine what type of environment organisms lived in? What clues can you look for to determine this?

The types of rocks that fossils are found in, and other types of organisms present with the fossil, can help tell about the environment it lived in. For example, if other aquatic fossils, like crabs or turtles, are found with it, then the environment was probably in or near water. Specific characteristics of the fossil can also help determine the environment. If a fossilized animal had flippers or fins, then the environment was probably aquatic (even if the fossil was found in a desert).

ACTIVITY 2: ECOLOGY EXTENSION

Have students independently (or in small groups) create a poster or computer presentation to describe important information about sperm whale behavior and feeding ecology. Guide them using the questions listed below. Alternatively, assign particular questions to different groups to be used as the focus of their presentations. You may also select some of the questions below for students to answer independently or in groups. Remind students to provide evidence to support their answers.

Based on the instruction from your teacher, answer the questions in Activity 2 or make a presentation using the questions as a guide.

1. What kinds of groups do sperm whales live in?

Females live in family groups; males leave when they are young to be in groups with other younger males or are mostly alone when they are adults and just visit female groups to reproduce.

2. How deep do sperm whales dive? What are some adaptations that help them do this?

They can dive to more than 2,000 m (1.25 mi); they have a blubber layer that helps them stay warm; they can use echolocation to find their way and hunt for food.

Students can go online to find other adaptations including slowing heart rate; having blood go to critical places when diving; lungs collapsing at depth to avoid getting hurt when at the surface; a lot of myoglobin in the blood to carry oxygen.

3. What do sperm whales eat?

Primarily fish and squid. Much of their prey is located in the deep ocean, including giant squid .

4. **Compare** and **contrast** the lives of male and female sperm whales.

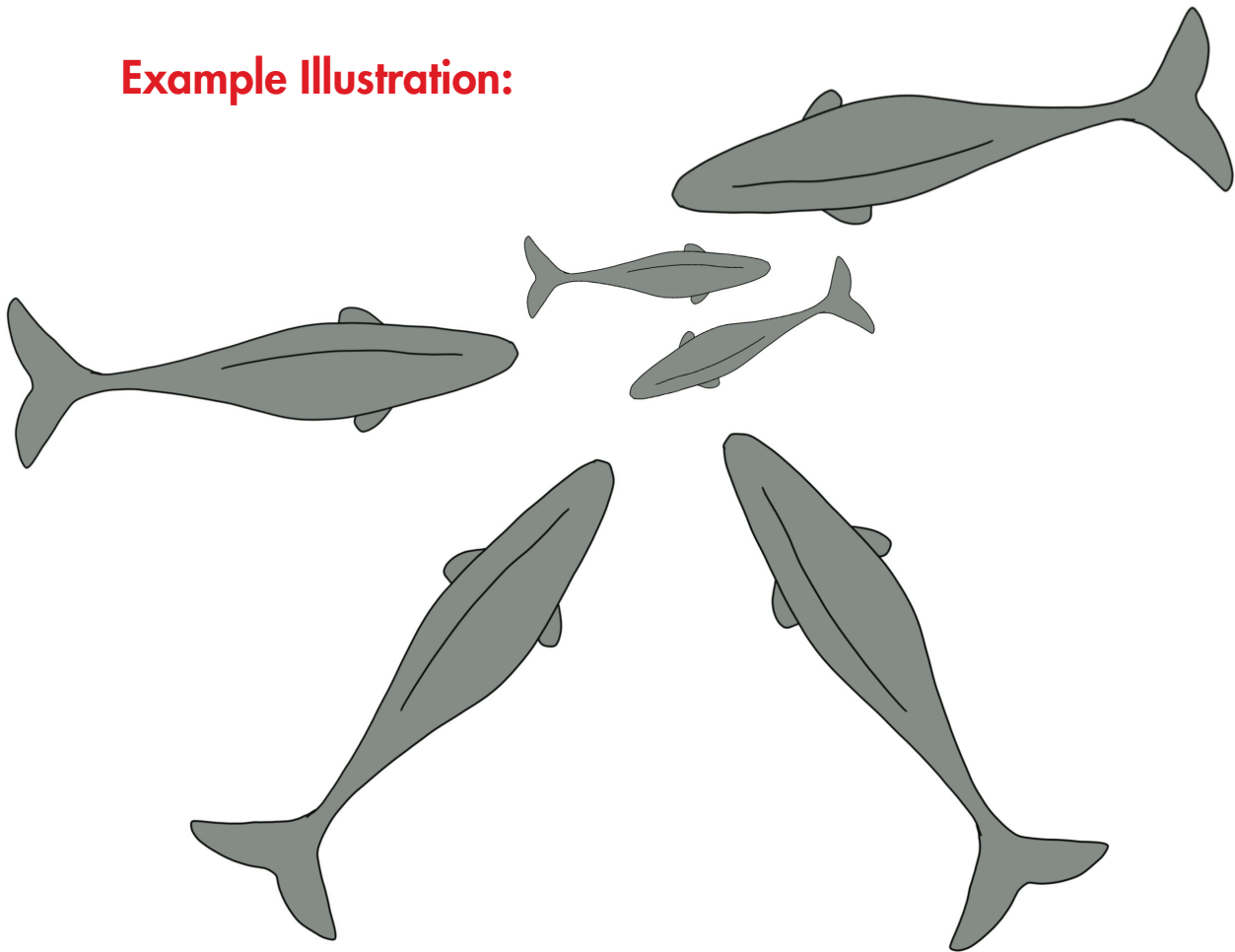
See answer to the first question; the other difference is that females stay in warmer waters all year but males go to cold waters where there is more food. They have to do this to feed their larger bodies since there is much more food in colder waters during the summer and less food in warmer waters year-round. Males also need to move among female groups to ensure they do not mate with family members.

5. Look at the map of sperm whale sightings around the world on page 9 in the **Mission Reader**. Are there any patterns on the map? Why do you think these patterns might occur?

It may surprise some students to not see sperm whales close to shore in many places. These patterns occur because sperm whales feed on deep-sea prey and can't find food in shallower waters close to shore.

6. **Draw** what a group of sperm whales protecting a baby from killer whales might look like if seen from an airplane.

Example Illustration:



7. **Compare** and **contrast** the behavior of sperm whales and elephants.

They have similar social structures, with female groups led by old females and males going off on their own. Male sperm whales go far away from females during some times of the year, but elephants don't do this. Also, elephants have to move around in search of scarce water; sperm whale female groups have to search for scarce food.

8. **Draw** a food web that includes sperm whales. **Label** the roles of different species in the food web. Be sure to include **producers, consumers, scavengers, decomposers,** and an **energy source**.

The food web should look something like the example below.

