NO PREP

Whales, Dolphins, and Porpoises

Cetacean Biology

Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

Whales, Dolphins, and Porpoises: Cetacean Biology

Meet the Ocean's Mammals

Cetaceans, a group that includes whales, dolphins, and porpoises, represent some of the most remarkable adaptations to life in the ocean. Unlike fish, they are mammals: warm-blooded, air-breathing, and nursing their young with milk. Their evolutionary history traces back to land-dwelling ancestors that re-entered the water about 50 million years ago. Today, cetaceans occupy nearly every marine habitat, from coastal shallows to the deepest trenches. They are divided into two main groups: baleen whales (Mysticeti), which filter-feed on plankton and small fish, and toothed whales (Odontoceti), which hunt larger prey using echolocation.

Name: Period: Date:

Whales, Dolphins, and Porpoises: Cetacean Biology

Meet the Ocean's Mammals

Cetaceans, a group that includes whales, dolphins, and porpoises, represent some of the most remarkable adaptations to life in the ocean. Unlike fish, they are mammals: warm-blooded, air-breathing, and nursing their young with milk. Their evolutionary history traces back to land-dwelling ancestors that re-entered the water about 50 million years ago. Today, cetaceans occupy nearly every marine habitat, from coastal shallows to the deepest trenches. They are divided into two main groups: baleen whales (Mysticeti), which filter-feed on plankton and small fish, and toothed whales (Odontoceti), which hunt larger prey using echolocation. Together, they reveal how mammals can evolve into fully aquatic lifeforms while retaining hallmarks of their ancestry.

Adaptations for Life in Water

Cetaceans have streamlined, fusiform bodies that minimize drag while swimming. Their forelimbs are modified into flippers, providing steering, while their tails end in horizontal flukes powered by strong muscles. Unlike fish, which move side to side, whales and dolphins swim with vertical, up-and-down strokes. Breathing adaptations are equally critical. A blowhole atop the head allows rapid inhalation and exhalation at the surface. Cetaceans can exchange up to 90% of the air in their lungs in one breath, compared to about 15% in humans. Deep-diving species, like sperm whales, store oxygen in muscle-bound myoglobin and can slow their heart rate dramatically, reducing oxygen demand while submerged. These adaptations enable dives lasting over an hour and depths exceeding 2,000 meters. Their insulating blubber maintains body heat, while specialized circulatory systems regulate temperature in frigid waters.

Baleen Whales: The Gentle Giants

Baleen whales lack teeth. Instead, they possess comb-like plates of keratin baleen that filter food from seawater. Species such as blue, humpback, and gray whales use different feeding strategies. Blue whales lunge through dense swarms of krill, engulfing huge volumes of water before pushing it out through baleen plates. Humpbacks employ bubble-net feeding, a coordinated behavior where groups release air bubbles to corral fish into tight clusters. These strategies allow baleen whales to exploit abundant but tiny prey. Their immense size—the blue whale reaches 100 feet and over 180 tons—confers advantages in long-distance migration and energy storage. Seasonal movements between polar feeding grounds and tropical breeding waters showcase how cetaceans synchronize their lives with global ecosystems.

Toothed Whales: Masters of Echolocation

Toothed whales, including dolphins, orcas, and sperm whales, rely on teeth to capture prey. More importantly, they use echolocation: emitting clicks and listening for echoes that bounce off objects. This biological sonar allows them to hunt in dark or murky waters where vision fails. The melon, a fatty organ in the forehead, focuses sound waves, while the lower jaw transmits returning echoes to the inner ear. Dolphins use echolocation not only for hunting but also for navigation and communication within pods. Orcas, the largest dolphins, are apex predators, hunting seals, fish, and even other whales. Sperm whales specialize in deep dives, pursuing giant squid in the ocean's twilight zone. Their skulls contain spermaceti oil, once prized by whalers, but in nature thought to aid buoyancy control and sound production. Echolocation highlights how cetaceans combine physical adaptations with advanced sensory biology to thrive in varied marine niches.

Social Structures and Communication

Cetaceans are renowned for their social complexity. Dolphins live in pods where cooperation and communication are central. Signature whistles act like names, identifying individuals. Orcas organize into matrilineal groups with unique dialects, passing cultural traditions such as hunting techniques across generations. Humpback whales are known for their haunting, complex songs that travel vast distances underwater. These behaviors demonstrate intelligence comparable to primates. Problem-solving, play, and even tool use (like dolphins covering snouts with sponges

while foraging) reflect advanced cognition. Such traits challenge assumptions about nonhuman animals, underscoring how culture and biology intertwine in the ocean.

Key Information

Cetacean Group	Feeding Adaptation	Key Feature	Example Species
Baleen whales	Baleen plates filter prey	Largest body sizes	Blue whale, humpback whale
Toothed whales	Teeth for hunting prey	Echolocation abilities	Orca, dolphin, sperm whale
Deep-diving whales	Myoglobin stores oxygen	Long dives, extreme depths	Sperm whale
Social dolphins	Signature whistles	Complex pods, culture	Bottlenose dolphin
Migratory whales	Seasonal movements	Long-distance travel	Gray whale

Case Study: The Songs of Humpback Whales

In the 1970s, scientists recording underwater sounds stumbled upon the long, eerie vocalizations of humpback whales. These songs, lasting up to 30 minutes, consist of repeated phrases and themes that slowly evolve over time. Remarkably, males across entire ocean basins may sing the same song, with new variations spreading like cultural waves through populations. Researchers hypothesize that these songs serve as mating displays, much like bird calls. Yet the complexity—structured, hierarchical, and evolving—suggests deeper cultural significance. Today, whale songs are also a tool for conservation, as scientists track populations using passive acoustic monitoring. The haunting beauty of humpback whale songs has inspired not only science but also art and environmental activism, reminding humans of the fragility and majesty of life beneath the waves.

1. How do baleen whales feed without using teeth, and why is this efficient in their ecosystems?

2. What does the spread of humpback whale songs across populations reveal about cetacean culture?

Multiple Choice

1. What structure enables dolphins to focus sound waves during echolocation?
    a) Flukes
    b) Blowhole
    c) Baleen
    d) Melon

2. Which of the following adaptations helps sperm whales dive to extreme depths?
    a) Spermaceti oil and oxygen-storing myoglobin
    b) Lightweight skeletal bones designed for diving
    c) Salt glands
    d) Baleen plates

3. Why do baleen whales migrate between polar and tropical waters?
    a) To escape predators
    b) To balance feeding and breeding needs
    c) To dry baleen plates
    d) To conserve oxygen in warm tropical waters

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Baleen plates	A) Complex communication, mating display
2. ___ Echolocation	B) Seasonal movements
3. ___ Myoglobin	C) Hunting with sound navigation
4. ___ Whale songs	D) Filtering krill and plankton
5. ___ Migration	E) Oxygen storage for dives

Fill-in-the-Blank

1. Dolphins use _____ to locate prey in dark waters.

2. The insulating fat layer in cetaceans is called _____.

3. Humpback whale songs may act as a form of _____ display.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain how baleen whales and toothed whales differ in their feeding strategies.

_____

_____

_____

2. What evidence suggests cetaceans possess culture and intelligence?

_____

_____

_____

3. Why might conservationists use whale songs as a monitoring tool?