



MACGILLIVRAY FREEMAN'S

HUMPBACK WHALES

PRESENTED BY PACIFIC LIFE



EDUCATOR GUIDE

ANATOMY AND ADAPTATION

OBJECTIVE

Students will observe anatomy form and function and how it relates to an animal surviving in their habitat. They will craft their own species of plankton to observe adaptations of marine organisms. Students will practice a variety of hands-on experiments to discover feeding strategies of various marine mammals, including the unique behavior seen in humpback whales called group bubble net feeding. In addition, they will observe adaptations humpback whales

possess to thrive in the ocean in a variety of temperatures.

KEY WORDS

Adaptation—A mutation or genetic change that helps an organism, such as a plant or animal, survive in its environment. As it is passed down through generations it becomes a part of a species.

Blubber—A thick layer of fat just under the skin of marine mammals that provides insulation, stores energy, and provides buoyancy.

Buoyancy—The ability of an object to float in liquid or in air.

Baleen—Bristles made of keratin, which is the same material that makes human hair and fingernails, hang from the upper jaw of baleen whales. They use the baleen plates to filter small fish and plankton from large quantities of water taken into their mouths during feeding.

Plankton—Aquatic organisms living in both marine and freshwater environments whose movements are determined by the currents. Though most plankton species are microscopic, they also include such drifting organisms as krill (zooplankton), a mainstay of the humpback diet, and jellyfish.

LESSON LENGTH

60 minutes (3 activities)

IN THE FILM

In the film we see the majestic humpback whales excelling in the ocean environment.

We see groups of whales cooperatively feeding, creating elaborate nets of bubbles as a team to herd their prey.

We see their ability to leap out of the air in acrobatic breaches, and observe how they can make a statement to other whales through “pec” slaps (pectoral flipper slaps) and tail slaps. In the film humpback whales are shown swimming across ocean basins to feed in one area near the poles and breed in another region closer to the equator.

MATERIALS

- Visit the *Humpback Whales* film website to watch the *Humpback Whales Bubble Net Feeding* video (www.humpbackwhalesfilm.com/education/bubblenetting). Project on screen or students can watch the video on individual devices.

Each student group will need:

Plankton Activity:

- Two graduated cylinders filled to top measurement with water

- Sculpey Clay (each student is given a nickel-size ball to act as plankton body)
- Toothpicks, pipe cleaners, and feathers to act as plankton appendages and cut into very small pieces in order to fit plankton into the graduated cylinder
- Stopwatch or timing device
- Video of plankton (see links below in activity “To Do”)

Marine Mammal Warmth and Buoyancy Activity:

- One large bowl
- Two Ziploc bags
- 1 - 2 cups of Crisco or other cooking shortening
- One thick sock and one thin sock

Lunch With a Whale Activity:

- Dried parsley flakes (6 tablespoons)
- One large bowl
- Tablespoon measuring spoon
- Measuring cup
- Two paper towels
- One large hair comb
- Four straws

TEACHER PREP NOTES

This lesson has three activities that focus on exploring adaptations by marine organisms.

The **Plankton Activity** explores buoyancy and an ocean organism’s use of appendages. Many species of plankton are in the upper water column since they either photosynthesize or feed upon photosynthetic organisms. Without large muscular bodies plankton rely on structures such as cilia and flagella to stay afloat.

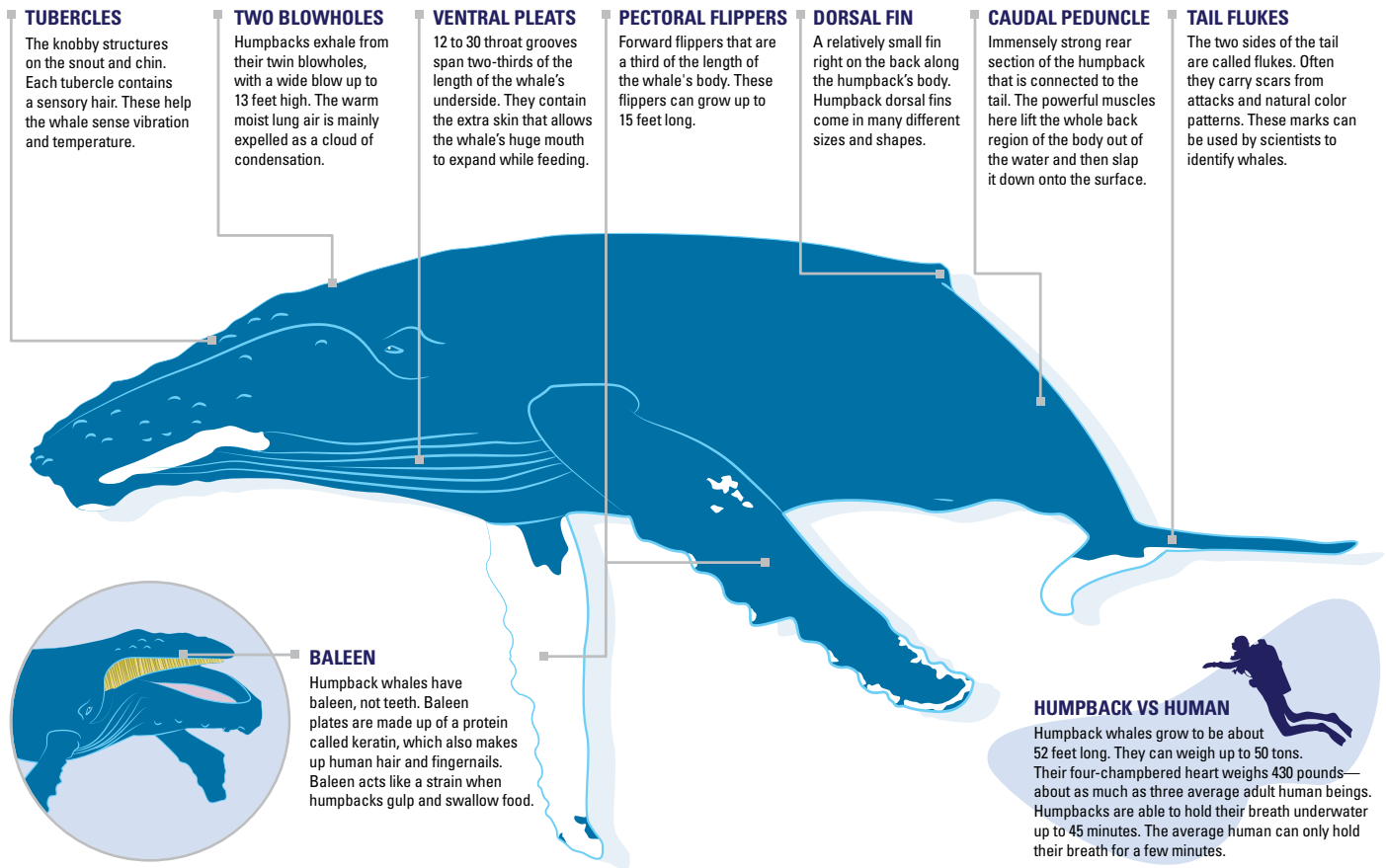
The **Marine Mammal Warmth and Buoyancy** activity looks at the function of blubber and fur in providing warmth for marine mammals.

The **Lunch With a Whale** activity explores humpback whale feeding strategies using their baleen, either lunge feeding as individuals or cooperatively herding fish as a group, called bubble net feeding.

BACKGROUND

Humpback whales are mammals, like humans. They possess the five characteristics shared by all mammals: warm-blooded, vertebrates, air breathing, hair or fur at

HUMPBACK WHALE ANATOMY



some point in their life, and live birth (although the two exceptions to giving live birth are the platypus and echidna). Being a warm-blooded animal in cool ocean water requires special adaptations to maintain body heat. Marine mammals employ several types of features such as thick skin, a thick blubber layer and dense fur. In order to remain buoyant and able to breathe air regularly near the surface, whales have strong tails, large tail flukes, and in the case of humpback whales, long flippers, all of which make them agile swimmers. In addition, a layer of blubber aids in floatation and helps whales conserve energy and warmth. Humpback whales travel to cold, nutrient-rich water near the poles to feed on krill, herring, and other small schooling fish. Krill (small shrimp-like zooplankton) is a common food item for humpback whales in the Southern Hemisphere. The whales' baleen plates are large sieves capable of capturing thousands of pounds per day by filtering ocean water.

TO DO

Plankton Activity:

1 Ask students if they can define and describe plankton. Follow with video of plankton from the Ted-Ed lesson

The Secret Life of Plankton. (www.ted.com/talks/the_secret_life_of_plankton#) The video is six minutes long and can also be found on the Ted-Ed YouTube page (www.youtube.com/watch?v=xFQ_f02D7f0).

- 2** Have students construct plankton using a small ball of Sculpey Clay as the plankton's body. Pipe cleaners, feathers, and toothpicks will act as the appendages that help plankton move and stay buoyant.
- 3** When ready to test their plankton, have students drop their plankton in the graduated cylinder at the same time and observe. Which plankton floats closest to the surface and stays there for the longest time?
- 4** Have students discuss their observations and how they can modify their plankton to increase buoyancy.
- 5** Modify and repeat.
- 6** Discuss how marine mammals move and stay buoyant. (They have fins, flippers for swimming and blubber to help them stay afloat). Ask students to compare how whales move to the way plankton move. If whales were the size of most small plankton, would they look the same? What if plankton were the size of a whale?



In this animated recreation from the giant-screen film, humpbacks use bubbles and sounds to herd a school of herring, then lunge upwards to capture the trapped fish.

Marine Mammal Warmth and Buoyancy Activity:

- 1 To observe blubber, students will be making their own insulation glove. Have students place shortening in one Ziploc bag and spread it along the sides and bottom. To minimize mess in assembly students can use the second plastic bag as a glove. (Option: make

several gloves ahead of time. Use duct tape to secure two Ziploc bags with Crisco in between. Students can share these gloves.)

- 2 Fill one of the large bowls with ice and water to mimic the ocean temperature in polar regions.
- 3 Students will take turns putting their hand in the clean and empty Ziploc bag, then in the blubber glove, and into the ice water.
- 4 Have them take turns placing their hand, now wearing the glove, in the cold water making sure they leave the top of the bag out of the water so no water leaks in.
- 5 When they have their gloved hand in the water, ask students to place the other hand in the water as well. Lead a discussion: What do you notice? Which hand is warmer? Not all marine mammals have skin and blubber like whales do. What other types of marine mammals are there? (Seals, sea lions, sea otters, the polar bear). What do they have to help stay warm? (fur)
- 6 To feel the difference between blubber and fur for warmth, have students take turns putting the sock on one hand and blubber glove on the other as well as alternating with a bare hand. Try different thicknesses of socks so they can see how fur thickness plays a role in marine mammals' ability to stay warm.

Lunch With a Whale Activity:

- 1 Take one large bowl and fill it with water. Sprinkle two tablespoons of parsley flakes on top. This represents krill in the ocean.
- 2 Ask students to scoop up parsley with the measuring cup and pour through the comb, so parsley gets stuck in the prongs of the comb. This is an example of gulping and filtering small prey such as krill and herring in the baleen bristles of humpback whales.
- 3 Wipe off parsley on to paper towel.
- 4 Students will now add more parsley to the bowl and use the straws.
- 5 Instruct students to work as a group, using straws, to gently blow into water to push parsley toward the center of the bowl.
- 6 Once most of the parsley is in the center of the bowl they can use the measuring cup to scoop up the parsley and filter it over the comb. Wipe the parsley on the other paper towel.
- 7 Ask students which method collected more parsley? Was there a difference? What did the two different strategies represent? Visit the *Humpback Whales* film website to watch the *Humpback Whales Bubble Net Feeding* video (www.humpbackwhalesfilm.com/education/bubblenetting) and discuss the behavior of the whales.

HUMPBACK FUN FACTS



LENGTH

Up to 55 feet,
with females larger
than males;
newborns are
about 15 feet long

WEIGHT

At birth: 1 ton
Adult: 25 - 50 tons

DIET

Krill,
small fish

LIFESPAN

50 to 90 years

APPEARANCE

Gray or black,
with white markings
on their undersides

THREATS

Entanglement in
fishing gear, ship
strikes, habitat
impacts

RESOURCES TO LEARN MORE

ALASKA WHALE FOUNDATION

alaskawhalefoundation.org

The Alaska Whale Foundation (AWF) was founded in 1996 by a team of passionate individuals who wanted to shed light on the amazing behaviors of the endangered humpback whales in Southeast Alaska. AWF continues to study humpbacks and their habitat, but with greater resources, established scientists, and ambitious graduate and undergraduate student participants.

AMERICAN CETACEAN SOCIETY

acsonline.org

The American Cetacean Society believes that the solution to threats facing cetaceans begins with education. Whales, dolphins, and porpoises (collectively known as ‘cetaceans’) have an exceptional ability to inspire people and serve as ambassadors for marine conservation. And yet they face more threats today than ever before—from entanglement in marine debris and fishing gear, ship strikes, noise pollution, climate change, ocean acidification, contaminants, loss of habitat and whaling.

DISCOVERY OF SOUND IN THE SEA (DOSITS)

dosits.org

The Discovery of Sound in the Sea website will introduce the science and uses of sound in the sea. There are several major sections on the site such as The Science of Sound in the Sea, People and Sound in the Sea, and Animals and Sound in the Sea. The Discovery of Sound in the Sea website has been developed by the University of Rhode Island’s Graduate School of Oceanography in partnership with Marine Acoustics, Inc. of Middletown, RI.

HAWAIIAN ISLANDS HUMPBACK WHALE NATIONAL MARINE SANCTUARY

hawaiihumpbackwhale.noaa.gov/explore/humpback_whale.html

The Hawaiian Islands Humpback Whale National Marine Sanctuary was created by Congress in 1992 to protect humpback whales and their habitat in Hawaii. The sanctuary, which lies within the shallow (less than 600 feet), warm waters surrounding the main Hawaiian Islands, constitutes one of the world’s most important humpback whale habitats. Through education, outreach, research and resource protection activities, the sanctuary strives to protect humpback whales and their habitat in Hawaii.

INTERNATIONAL WHALING COMMISSION

iwc.int/home

The International Whaling Commission (IWC) is the global intergovernmental body charged with the conservation of whales and the management of whaling. It was set up under the International Convention for the Regulation of Whaling signed in 1946. The Commission has a current membership of 88 governments from countries around the world. The pages on this website provide detailed information about the Commission, its meetings, decisions and its current work to conserve and manage whale populations throughout the world.

NATIONAL MARINE MAMMAL LABORATORY

afsc.noaa.gov/nmml/species/species_humpback.php

The National Marine Mammal Laboratory (NMML) conducts research on marine mammals important to the mission of the National Marine Fisheries Service (NMFS) and the National Oceanic & Atmospheric Administration (NOAA), with

particular attention to issues related to marine mammals off the coasts of Alaska and the North Pacific. Research projects focus on ecology and behavior, population dynamics, life history, and status and trends.

NOAA FISHERIES

nmfs.noaa.gov/stories/2012/10/noaa_fisheries_education.html

NOAA Fisheries is responsible for the stewardship of the nation’s ocean resources and their habitat. The resilience of our marine ecosystems and coastal communities depend on healthy marine species, including protected species such as whales, sea turtles, corals, and salmon. Under the Marine Mammal Protection Act and the Endangered Species Act, NOAA Fisheries works to recover protected marine species while allowing economic and recreational opportunities.

ONE WORLD ONE OCEAN CAMPAIGN

oneworldoneocean.com

MacGillivray Freeman Films, producer of the giant-screen film *Humpback Whales*, has created a multi-platform campaign that uses the power of film, television and new media to inspire, educate and connect millions of people worldwide in a common purpose: to protect and restore the health of the ocean. The goals of the campaign include: educate and inspire people to buy sustainable seafood; reduce plastic pollution in the ocean; and expand protected areas to 10% of the planet’s ocean. MacGillivray Freeman Films and the One World Ocean Campaign are located in Laguna Beach, California.

THE HAWAIIAN ISLANDS DISENTANGLEMENT NETWORK

hawaiihumpbackwhale.noaa.gov/res/rescue_network.html

The network was formed in 2002 in an attempt to free endangered humpback whales and other marine animals from life-threatening entanglements and at the same time gather valuable information that will help mitigate the issue of marine debris and future entanglement. The network is part of the larger Pacific Islands Marine Mammal Response Network headed by NOAA’s Pacific Islands Regional Office.

VOICES IN THE SEA

voicesinthesea.org

Voices in the Sea is an interactive multimedia exhibit and companion website created by the Pacific Life Foundation and the Whale Acoustics Lab at Scripps Institution of Oceanography that seeks to bring educational content about the natural history, acoustics, and conservation of whales to aquarium visitors, students, and the general public. The educational content is available online and includes 37 short videos featuring on-camera interviews with more than 20 leading whale scientists, resource managers and community leaders.

WHALE TRUST

whaletrust.org

Whale Trust Maui is a nonprofit organization dedicated to scientific research and public awareness of whales and their environment. Based on the Hawaiian Island of Maui, they conduct and support marine research and education programs around Maui and elsewhere throughout the Pacific Ocean.

NATIONAL ACADEMIC STANDARDS

Next Generation Science Standards

LS: Life Science

ESS: Earth and Space Science

PS: Physical Science

ETS: Engineering, Technology, and Applications of Science

Lesson 1: Seeing Songs in the Sea

Third Grade

- 3-LS1 From Molecules to Organisms: Structures and Processes (LS1.B)
- 3-LS2 Ecosystems: Interactions, Energy, and Dynamics (LS2.D)
- 3-LS3 Heredity: Inheritance and Variation of Traits (LS3.A and LS3.B)
- 3-LS4 Biological Evolution: Unity and Diversity (LS4.B and LS4.D)

Fourth Grade

- 4-LS1 From Molecules to Organisms: Structure and Processes (LS1.D)

Fifth Grade

- 5-ESS3 Earth and Human Activity (ESS3.C)

Middle School

- MS-PS4 Waves and Their Application in Technologies for Information Transfer (PS4.A)
- MS-LS1 From Molecules to Organisms: Structures and Processes (MS-LS1.B)
- MS-LS2 Ecosystems: Interactions, Energy and Dynamics (MS-LS.A and MS-LS2.C)

Lesson 2: Migration Match

Third Grade

- 3-LS1 From Molecules to Organisms: Structures and Processes (LS1.B)
- 3-LS2 Ecosystems: Interactions, Energy, and Dynamics (LS2.D)
- 3-LS3 Heredity: Inheritance and Variation of Traits (LS3.A and LS3.B)
- 3-LS4 Biological Evolution: Unity and Diversity (LS2.C and LS4.B and LS4.D)

Fourth Grade

- 4-LS-1 From Molecules to Organisms: Structures and Processes (LS1.D)

Fifth Grade

- 5-PS3 Energy (LS1.C)
- 5-ESS3 Earth and Human Activity (ESS3.C)

Middle School

- MS-LS1 From Molecules to Organisms: Structures and Processes (MS-LS1.B)
- MS – LS1 Science and Engineering Practices (MS-LS1-8)
- MS-LS2 Ecosystems: Interactions, Energy and Dynamics (MS-LS2.A and LS2.C)
- MS-LS3 Heredity: Inheritance and Variation of Traits (LS1.A and LS1.B)

Lesson 3: Anatomy and Adaptations

Third Grade

- 3-LS1 From Molecules to Organisms: Structures and Processes (LS1.B)
- 3-LS2 Ecosystems: Interactions, Energy, and Dynamics (LS2.D)
- 3-LS3 Heredity: Inheritance and Variation of Traits (LS3.A and LS3.B)
- 3-LS4 Biological Evolution: Unity and Diversity (LS2.C and LS4.B and LS4.C and LS4.D)

Fourth Grade

- 4-LS-1 From Molecules to Organisms: Structures and Processes (LS1.A and LS1.D)

Fifth Grade

- 5-PS3 Energy (LS1.C)

Middle School

- MS-LS1 From Molecules to Organisms: Structures and Processes (MS-LS1.B and MS-LS1.C)
- MS-LS2 Ecosystems: Interactions, Energy and Dynamics (MS-LS2.A and LS2.C)
- MS-LS4- Biological Evolution: Unity and Diversity (LS4.B and LS4.C)

Lesson 4: Bioaccumulation: It All Adds Up

Third Grade

- 3-LS1 From Molecules to Organisms: Structures and Processes (LS1.B)
- 3-LS2 Ecosystems: Interactions, Energy, and Dynamics (LS2.D)
- 3-LS4 Biological Evolution: Unity and Diversity (LS2.C and LS4.C and LS4.D)

Fourth Grade

- 4-LS-1 From Molecules to Organisms: Structures and Processes (LS1.A)

Fifth Grade

- 5-PS3 Energy (LS1.C)
- 5-LS1 From Molecules to Organisms: Structures and Processes (LS1.C)
- 5-LS2 Ecosystems: Interactions, Energy, and Dynamics (LS2.A and LS2.B)
- 5-ESS3 Earth and Human Activity (ESS3.C)

Middle School

- MS-LS1 From Molecules to Organisms: Structures and Processes (MS-LS1.C)
- MS-LS2 Ecosystems: Interactions, Energy and Dynamics (MS-LS2.A and LS2.B and LS2.C and LS4.D)
- MS-ESS3 Earth and Human Activity (ESS3.A and ESS3.C and ESS3.D)

Lesson 5: “Whale Safe” Engineering Challenge

Third Grade

- 3-LS4 Biological Evolution: Unity and Diversity (LS2.C and LS4.D)

Fifth Grade

- 5-ESS3 Earth and Human Activity (ESS3.C)
- 3rd – 5th Engineering Design (ETS1.A and ETS1.B and ETS1.C)

Middle School

- MS-LS2 Ecosystems: Interactions, Energy and Dynamics (MS-LS2.A and LS2.B and LS2.C and LS4.D and ETS1.B)
- MS-ESS3 Earth and Human Activity (ESS3.C)
- Middle School Engineering Design (ETS1.A and ETS1.B and ETS1.C)

Lesson 6: Whaling to Whale Watching

Third Grade

- 3-LS4 Biological Evolution: Unity and Diversity (LS2.C and LS4.D)

Fourth Grade

- 4-ESS3 Earth and Human Activity (ESS3.A)

Fifth Grade

- 5-ESS3 Earth and Human Activity (ESS3.C)

Middle School

- MS-LS2 Ecosystems: Interactions, Energy and Dynamics (MS-LS2.A and LS2.C and LS4.D and ETS1.B)
- MS-ESS3 Earth and Human Activity (ESS3.C and ESS3.D)

Ocean Literacy Principles

Lesson 1: Principles 5 and 6

Lesson 2: Principles 1, 5 and 6

Lesson 3: Principles 1, 4 and 5 and 6

Lesson 4: Principles 1, 5 and 6

Lesson 5: Principles 5, 6 and 7

Lesson 6: Principles 5, 6 and 7

Ocean Literacy Principles

1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean made Earth habitable.
5. The ocean supports a great diversity of life and ecosystems
6. The ocean and humans are inextricably interconnected
7. The ocean is largely unexplored

National Geography Standards

Lesson 1: Standards 4 and 5

Lesson 2: Standards 1, 3, 4, 5 and 6

Lesson 3: Standards 4

Lesson 4: Standards 4 and 5

Lesson 5: Standards 2, 4 and 5

Lesson 6: Standards 2, 4 and 5

National Geography Standards

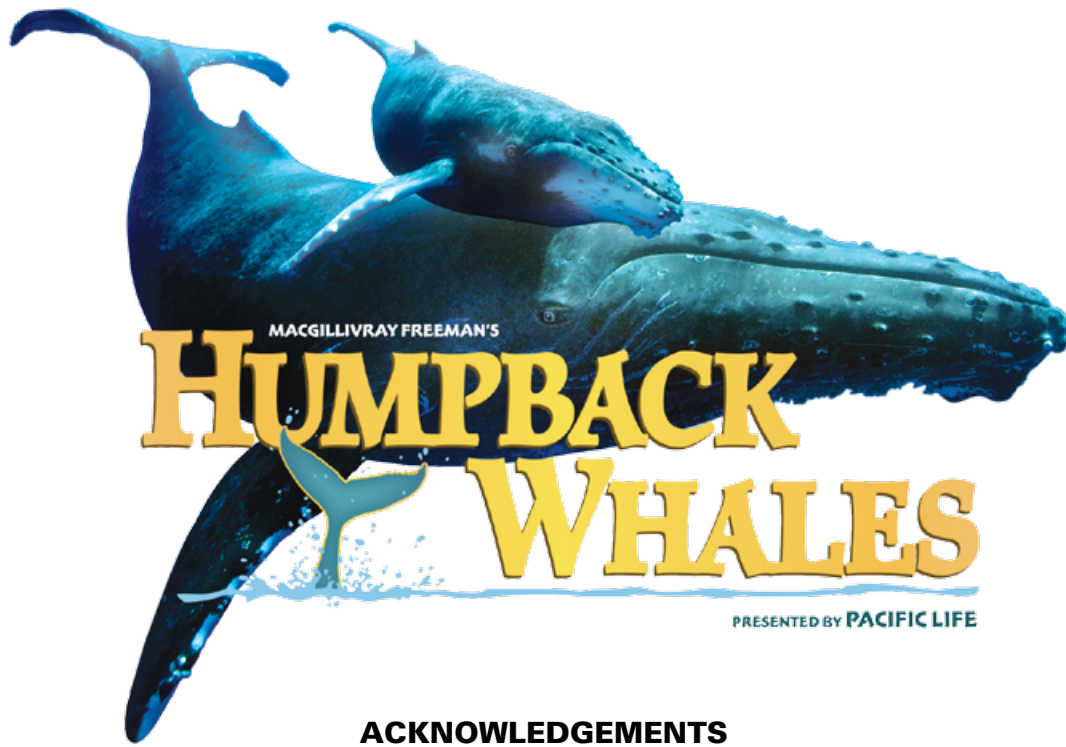
1. The world in spatial terms
2. Places and regions
3. Physical systems
4. Human systems
5. Environment and society
6. The uses of geography

Common Core Language Arts

Reading Informational Text—Lesson 2, 4 and 6

Writing—Lesson 5 and 6

Speaking and Listening—All lessons



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www.humpbackwhalesfilm.com.

