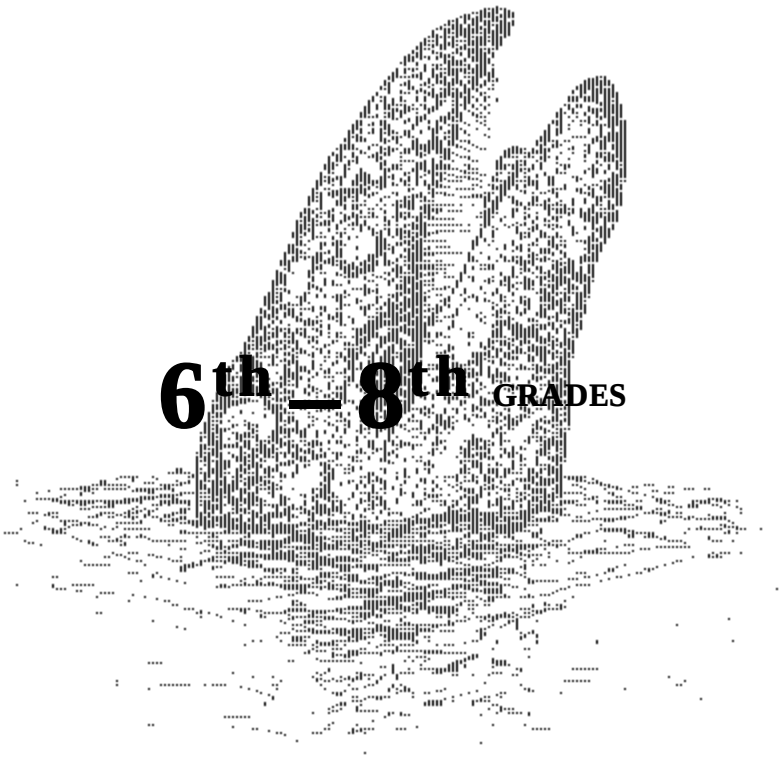
Creating
COASTAL
STEWARDSHIP
through Science

Observing Pacific Gray Whales

at Point Reyes National Seashore

2000 First Edition



6th – 8th GRADES

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EXXON

National Park FOUNDATION

POINT REYES NATIONAL SEASHORE ASSOCIATION

Publishing Information

This curriculum guide was funded with grants through the National Park Foundation.

The listing of a resource in this curriculum does not presume its endorsement by the National Park Service.

This guide may be obtained by participating in a teacher workshop at Point Reyes National Seashore or through a teacher in-service training at your school.

Teachers are encouraged to offer their feedback by filling out the enclosed evaluation form or contacting Point Reyes National Seashore directly.


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Preface

The intent of these guides is to provide middle school students with the opportunity to observe natural processes at Point Reyes National Seashore so they might take a greater interest in environmental stewardship and science. Teachers from fifteen area schools developed and field-tested seven "Creating Coastal Stewardship through Science" guides for classroom and field trip use. Each guide is carefully designed to facilitate a hands-on learning experience using science and the environment. Natural resources such as Pacific gray whales, northern elephant seals, tule elk, California quail, Douglas iris, and the San Andreas Fault are highlighted because they are easy to identify and to observe. All activities are linked to the California State Science Standards (2000) and the National Science Standards.

You may use this guide alone or in conjunction with other guides. We highly recommend that whenever you use a guide, you use the pre-visit activities to fully prepare the students for the field trip. These activities address student safety, wildlife observation techniques, equipment use, field journal development, and concepts that need to be taught prior to the Park visit. Use of the post-visit activities is also critical to the learning process because they guide the students in making scientific deductions and in developing their environmental stewardship ethics.

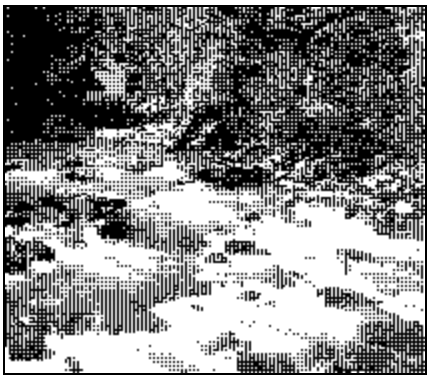
Following this preface, you will find background information on the National Park Service and an overview of Point Reyes National Seashore. To provide your students with a better understanding of the place they will be visiting, we recommend you share this information with them. For an in-depth overview of the National Park Service, visit our website at **www.nps.gov**.

Point Reyes National Seashore provides outstanding opportunities for learning about natural and cultural resources. There are also exceptional educational opportunities provided by Park partners such as the Point Reyes Bird Observatory, Audubon Canyon Ranch, and Point Reyes National Seashore Association. To learn more about the Park and our partners, visit our website at **www.nps.gov/pore**.

THE NATIONAL PARK SERVICE

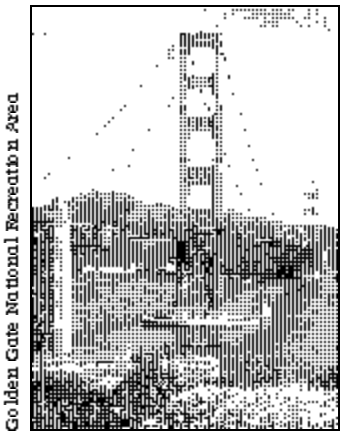
The National Park Service cares for special places saved by the American people so that all may experience our heritage.

Experience Your America


Olympic National Park

On August 25, 1916, President Woodrow Wilson signed the act creating the National Park Service, a new federal bureau in the Department of the Interior responsible for protecting the 40 national parks and monuments then in existence and those yet to be established.

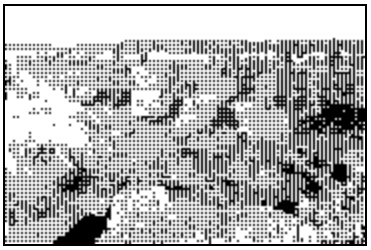
This "Organic Act" of 1916 states that "the Service thus established shall promote and regulate the use of Federal areas known as national parks, monuments and reservations . . . by such means and measures as conform to the fundamental purpose of the said parks, monuments and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."


Golden Gate National Recreation Area

The National Park Service still strives to meet these original goals, while filling many other roles as well: guardian of our diverse cultural and recreational resources; environmental advocate; world leader in the parks and preservation community; and pioneer in the drive to protect America's open space.


Mesa Verde National Park

The National Park System of the United States comprises over 379 areas covering more than 83 million acres in 49 states, the District of Columbia, American Samoa, Guam, Puerto Rico, Saipan, and the Virgin Islands. Although not all parks are as well known as the Grand Canyon and Yellowstone, all are areas of such national significance that they have been included in the National Park Service—ancient ruins, battlefields, birthplaces, memorials, recreation areas, and countless other wonders. Point Reyes National Seashore is one of ten national seashores.


Grand Canyon National Park

The future of the National Park System lies in understanding and protecting its meanings, values, and resources. Each part of the system represents the United States and a part of our heritage. Preservation of individual sites and the entire system will ensure the essence of quality remains in our lives and the lives of all future generations.

POINT REYES NATIONAL SEASHORE

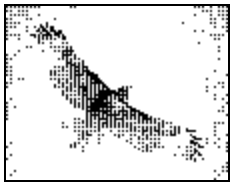

Bruce Farnsworth

Point Reyes National Seashore was established to preserve and protect the natural and cultural features and natural ecosystems along the diminishing undeveloped coastline of the western United States. Located just an hour's drive from a densely populated metropolitan area, the Seashore is a sanctuary for countless plant and animal species. With half of Point Reyes National Seashore designated as wilderness, it provides a sanctuary for the human spirit— for discovery, inspiration, solitude, and recreation—and a reminder of the human connection to the land.

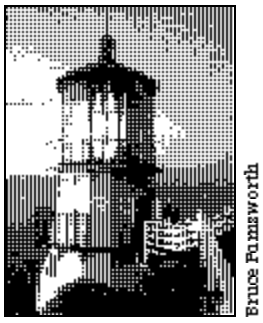

Sue Van Der Wahl

Point Reyes National Seashore comprises over 71,000 acres, including 32,000 acres of wilderness area. Estuaries, windswept beaches, coastal scrub, coastal grasslands, salt marshes, and coniferous forests create a haven of 80 miles of unspoiled and undeveloped coastline located just an hour's drive from an urban area populated by seven million people. Abundant recreational opportunities include 140 miles of hiking trails, backcountry campgrounds, and numerous beaches.

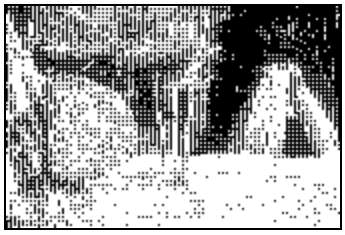
The San Andreas Fault separates the Point Reyes Peninsula from the rest of the North American continent. Granite bedrock found here and not found again until the Sierra Nevada range suggests the peninsula is geologically dynamic. According to geologists, the land that is now called Point Reyes has moved some 300 miles northwest over a period of 100 million years and is still moving.


Rich Stalkup

As wildland habitat is developed elsewhere in California, the relevance of Point Reyes as a protected area with a notably rich biological diversity increases. Over 45% of North American avian species and nearly 18% of California's plant species are found here. Point Reyes also contains some examples of the world's major ecosystem types. For this reason, and because Point Reyes is dedicated to the conservation of nature and scientific research, it was recognized in 1988 by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Man and the Biosphere program and named as part of the Central California Coast Biosphere Reserve.


Bruce Farnsworth

The cultural history of Point Reyes spans many lives and ways of living with the land. The Coast Miwok people are the first known residents of this peninsula. Archeologists have identified over 100 village sites in the Seashore and cultural traditions are still celebrated in the Park annually. Overlapping the Coast Miwok were Mexican land grantees, lighthouse keepers, and lifesaving station crews. To this day, agricultural operations that were built near the turn of the twentieth century continue within the Seashore's pastoral zone.


NPS Collection

Educational Opportunities at

POINT REYES NATIONAL SEASHORE

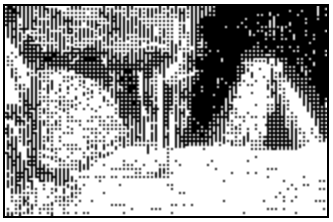
Point Reyes National Seashore provides an outdoor classroom and learning laboratory for the study of geological and ecological processes and changing land-use values in which a greater understanding of and caring for public lands can be fostered.

Ranger-led Curriculum-based Education Programs

Reservations for Ranger-led programs are requested in writing and assigned on a first-come, first-served basis. Visit **nps.gov/pore** for the reservation form and calendar.


NPS Collection

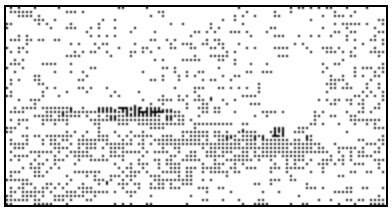
K-2 Students explore the natural resources of the Seashore with Park Rangers in the Bear Valley area or in their classroom.


NPS Collection

3-4 Students immerse themselves in the Coast Miwok culture by completing a comprehensive curriculum and visiting the Coast Miwok cultural exhibit, Kule Loklo.


NPS Collection

4 Students revisit the days of early lighthouse keepers while operating the original Point Reyes Lighthouse clockwork with Park Rangers.


NPS Collection

5 Students study the oceanic influences on the Point Reyes Peninsula by completing a classroom curriculum and viewing gray whales and elephant seals with Park Rangers.

6-8 Students participate in Ranger-led stewardship activities such as habitat restoration, water quality monitoring, and beach cleanups.

Ranger-led Training Programs


NPS Collection

9-12 Students become DOCENTS to assist middle school teachers with classroom teaching and use of scientific research tools on Seashore field trips (service learning credits earned).

Students become RESEARCH ASSISTANTS at the Pacific Coast Learning Center by participating in the inventorying and monitoring of Seashore resources.


NPS Collection

Teachers Teacher workshops are offered throughout the year for existing Park curricula and for field trip planning. Visit the Seashore's website at **www.nps.gov/pore** for a calendar of workshops.

Classroom and Field Trip Curriculum

Based on the National and State Science and Social Science Standards

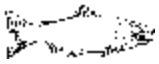
3 - 4

Teacher packets are available for field trips to the recreated Coast Miwok village, Kule Loklo, located near the Bear Valley Visitor Center.

The "Creating Coastal Stewardship through Science" middle school curricula are available to teachers who attend a one-day workshop at Point Reyes or a teacher in-service training.

6 - 8

Completion of the ***Identifying Resident Birds Curriculum,*** as a companion to a birdwatching field trip, will enable students to observe and identify different bird species, their habitats, and their behaviors. A visit to Point Reyes Bird Observatory will also enable students to observe bird banding and netting and to understand the most common threats to bird survival.



Completion of the ***Monitoring Creek Health Curriculum,*** as a companion to a Ranger-led creek program, will enable students to observe and understand the complexity and sensitivity of creek habitats and their role in protecting them.

Completion of the ***Discovering Northern Elephant Seals*** Curriculum, as a companion to an elephant seal viewing field trip, will enable students to observe and understand the amazing adaptations and behaviors of Northern elephant seals.

Completion of the ***Defining Habitats Curriculum,*** as a companion to a Park field trip, will enable students to observe and understand the complex land and ocean habitats of the Point Reyes Peninsula and their roles in habitat protection.

Completion of the ***Uncovering the San Andreas Fault Curriculum,*** as a companion to a geology field trip, will enable students to observe and understand the existence of the San Andreas Fault and the implications it has for area residents.

Completion of the ***Investigating Tule Elk Curriculum,*** as a companion to an elk viewing field trip, will enable students to observe and understand their behaviors and the issues that surround their management.

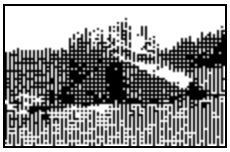
Completion of the ***Observing Pacific Gray Whales Curriculum,*** as a companion to a whale watching field trip, will enable students to observe and understand gray whale adaptions and behaviors, and the factors that influence their survival.

Educational Facilities

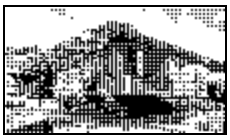
The **Historic Lifeboat Station** is available to educational groups for overnight use. Nightly fees are charged. Group size must be under 25 (including chaperones). Reservations are made on a first-come, first-served basis by completing the boathouse form on our website at **www.nps.gov/pore**.

The **Clem Miller Environmental Education Center** is an overnight facility available by lottery to school groups visiting for multiple-night stays September through May. The facility is used for summer camps during the summer months. Fees are charged. For information, contact Point Reyes National Seashore Association at (415) 663-1200, website **www.ptreyes.org**.

The **Pacific Coast Learning Center** is a day-use facility located on Highway 1. This facility is used by researchers and students to study the natural and cultural resources of the Seashore.

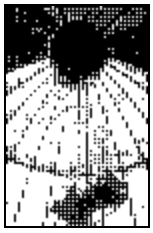


The **Bear Valley Visitor Center** is a day-use facility open to school groups Monday through Friday from 9 A.M. to 5 P.M. Exhibits on natural and cultural resources are found here. Books, brochures, and other educational materials are available.



The **Ken Patrick Visitor Center** is located on Drakes Beach, approximately 30 minutes from the Bear Valley Visitor Center. This facility is open year-round on weekends and holidays from 10 A.M. until 5 P.M. Ranger-led elephant seal programs meet at this Visitor Center. Exhibits and a 150-gallon saltwater tank are located here. Books, brochures, and other educational materials are available.

The **Lighthouse Visitor Center** is located on the outermost tip of the Peninsula, approximately 45 minutes from the Bear Valley Visitor Center. This facility is open Thursday through Monday from 10 A.M. until 4:30 P.M. (closed Tuesdays and Wednesdays). Ranger-led whale programs and lighthouse tours meet at this Visitor Center. Exhibits on maritime history and whale biology are located here. Books, brochures, and other educational materials are available.



The **Lighthouse** is located below the Lighthouse Visitor Center at the bottom of a 308-step staircase. The lens room is usually open from 2:30 P.M. until 4 P.M. Thursday through Monday or as weather and staffing permit. High winds always close the lens room. Space in the lens room is limited so reservations are required for groups. Call (415) 464-5100 to confirm existing weather conditions.

Group Camping/Overnight Opportunities

* This listing is provided for your convenience and does not constitute a recommendation or endorsement of any of these facilities.

All overnight camping in **Point Reyes National Seashore** requires a permit and advance reservations. Group sites are very limited and in high demand. Sky, Coast, and Wildcat Camps are all backcountry campgrounds that require hiking to access them. A fee is charged. For more information, visit the Seashore's website at **www.nps.gov/pore.**

The **Point Reyes Hostel** offers a domitory-style group cabin with a fully equipped kitchen and showers. For additional information and reservations, call (415) 663-8811 during office hours 7:30 to 9:30 A.M. and 4:30 to 9:30 P.M.

Samuel P. Taylor State Park, located 6 miles east of the Seashore on Sir Francis Drake Boulevard, offers campsites for groups. A fee is charged. Reservations are highly recommended. For more information, visit the reservations website at **www.reserveamerica.com.**

Olema Ranch Campground is located half a mile from Seashore headquarters on Highway 1. It is privately owned. Several large group sites are available. Fees are charged. For more information, call (415) 663-8001.

The **Marconi Center** is located 8 miles north of Seashore headquarters on Highway 1. This facility is operated by California State Parks. Lodging, conference rooms, and catered meals are provided for a fee. For more information, call 1 (800) 970-6644 or visit the website at **www.marconiconfctr.org.**

National Park Foundation

Creating COASTAL STEWARDSHIP through Science

EXXON

Observing Pacific Gray Whales

Creating
COASTAL
STEWARDSHIP
through Science

Observing Pacific Gray Whales

Teacher Preparation

Observing Pacific Gray Whales

Point Reyes National Seashore is an ideal place to view a portion of the Pacific gray whale's annual migration. This amazing whale swims over 10,000 miles each year, and has the longest migration of any whale species. This spectacular event is visible from the Point Reyes Headlands in the late winter and early spring.

Completion of this unit, as a companion to your Park field trip, will enable your students to observe and understand the phenomenal features and behaviors of Pacific gray whales.

Considerations

When: January through April (February is a slow month); on Mondays, Thursdays, and Fridays between 10 a.m. and 4:30 p.m. (the Lighthouse Visitor Center is closed on Tuesdays and Wednesdays).

Where: Lighthouse Observation Deck and Visitor Center. Whales are also visible from the Chimney Rock trail in March and April. Due to the narrowness of the Chimney Rock road, school buses cannot access the trailhead. Cars or vans (shorter than 24 feet) must be used.

How: This unit may be used independently of all other units. If you want to use an additional unit during your visit, we suggest the "Discovering Northern Elephant Seals" unit if you are visiting January through March. Elephant seals are usually visible from the Elephant Seal Overlook, located near the Chimney Rock parking lot.

Weather: The chart below lists average climate expectations based on previous years' data. The weather is subject to quick change and can vary dramatically from different locations within the Seashore on the same day

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature												
Normal Daily Maximum	53	55	55	57	60	62	64	64	65	62	58	54
Normal Daily Minimum	41	42	42	43	47	50	51	52	51	48	45	42
Extreme High	78	85	80	92	94	99	96	96	103	96	81	79
Extreme Low	21	26	29	32	32	39	39	42	39	32	29	18
Precipitation												
Normal	12.0	9.0	8.0	4.0	3.0	1.0	0.3	0.8	2.0	4.0	9.0	12.0
Maximum	20.0	16.0	15.0	11.5	8.0	4.0	2.5	6.0	7.0	13.0	18.0	19.0

Seasonal Events: Consult the chart below to assess which months may be best for a class visit to Point Reyes National Seashore.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Gray Whale Migration	X		X	X								
Elephant Seal Breeding	X	X	X									
Bird Migration									X	X	X	X
Coho Spawning	X											X
Steelhead Trout Spawning		X										X
Tule Elk Rut Season							X	X	X			
Peak Flower Blooms				X	X							
Tidepooling	X	X	X									
Geology	X	X	X	X	X	X	X	X	X	X	X	X
Ocean and Land Habitats	X	X	X	X	X	X	X	X	X	X	X	X
Resident Birds	X	X	X	X	X	X	X	X	X	X	X	X

Chaperone Preparedness and Assistance

The success of your field trip will depend on your ability to actively prepare and involve your parent chaperones in the field trip activities. Without adult guidance, many of the students will not complete their field journals. It is essential that your field trip have as much structure as your classroom lessons. To accomplish this, we recommend that you assign each of your parents to a small group of students with the field observations and with the journal questions. Provide each chaperone with their own copy of the student journals and encourage them to complete it with the students.

Suggested Lesson Plan

PRE-VISIT		**Time Needed: 8 hours**
Activity #1	How Can I Learn about the Lives of Pacific Gray Whales? *Students use a newspaper and vocabulary list to complete questions and activities about gray whales.*	2 hours
Activity #2	How Have Gray Whales Adapted to Life in the Ocean? *Students explore gray whales' adaptations for marine life.*	2 hours
Activity #3	Of What Importance are Whales and Dolphins in the Ecology of the Pacific Ocean? *Niches, habitat, and ecosystem components for cetaceans are examined.*	2 hours
Activity #4	What Can We Expect on our Field Trip to Observe Gray Whales at Point Reyes National Seashore? *Students create field journals for use on their field visit to Point Reyes National Seashore.*	1 hour
Activity #5	Safety and Stewardship Challenge *Proper behaviors around National Park resources are examined in a game format.*	1 hour
Activity #6	How Do I Use Binoculars? *Students practice using binoculars in the classroom and outside.*	varies
ON-SITE		**Time Needed: 3 hours**
Field Journal	How Can Teachers, Chaperones, and Students Make the Most of Their Field Trip? *Students observe gray whales and complete their field journals while visiting Point Reyes National Seashore.*	3 hours
Optional	How Can I Capture My Experience in a Story, Poem, or Drawing? *There are many ways to appreciate gray whales; here are some suggestions to foster creativity.*	time varies
POST-VISIT		**Time Needed: 3 hours**
Activity #1	What Can We Learn from Our Field Trip to Observe Pacific Gray Whales? *Students compile data from their field journals to draw conclusions between what they have previously learned in class and what they experienced in the field.*	2 hours
Activity #2	How Can I Access More Information on Whales? *Students and teachers are encouraged to participate and learn more about current whale research.*	1 hour
Activity #3	How Can I Choose and Complete the Best Stewardship Project? *Students develop action plans to complete a project that will benefit oceans and coastal areas.*	time varies

Field Trip Logistics

Things To Remember		
Students need:	*Teachers need:*	*Chaperones need:*
❒ rain gear	❒ rain gear	❒ rain gear
❒ warm, layered clothes	❒ warm, layered clothes	❒ warm, layered clothes
❒ gloves and hat	❒ gloves and hat	❒ gloves and hat
❒ sunscreen and sunglasses	❒ sunscreen and sunglasses	❒ sunscreen and sunglasses
❒ bag lunch with drink	❒ bag lunch with drink	❒ bag lunch with drink
❒ water	❒ water	❒ water
❒ waterproof boots or tennis shoes	❒ waterproof boots or tennis shoes	❒ waterproof boots or tennis shoes
❒ clipboard with field journal and pencil	❒ map with directions	❒ map with directions
❒ permission slip	❒ pencil sharpeners and extra pencils	
	❒ teacher backpack and field trip kits from Bear Valley Visitor Center	
	❒ first aid kit	
Optional:		
❒ small backpack	❒ small backpack	❒ small backpack
❒ binoculars	❒ binoculars	❒ binoculars
	❒ camcorder/ camera	❒ camcorder/ camera

Other Things to Remember:

- Gray whales pass Point Reyes during the rainy and windy season. Students need warm, waterproof clothing. Sunscreen is needed on sunny days.
- If you decide to visit the Chimney Rock area, remember ticks are abundant. Have everyone wear light-colored clothing and tuck their pant legs into their light-colored socks. Everyone will need to check themselves thoroughly for ticks before returning home.
- Binoculars and spotting scopes will assist the students in viewing the gray whales. These may be checked out from the Bear Valley Visitor Center. If you plan to use this equipment, it is essential that you train the students in how touse binoculars before their visit. See the enclosed binocular activity.
- Travel time from Point Reyes Station to the Lighthouse Visitor Center and Observation Deck is 1 hour. Most groups visit the Lighthouse area between10 a.m. and 1 p.m. If you plan to visit during this time, have students bring a bag lunch and something to sit on. Following lunch, have them check the entire area for trash.
- Bathrooms are available at Bear Valley Visitor Center, Chimney Rock and the Lighthouse Visitor Center. A water faucet is located next to the Lighthouse Visitor Center and Bear Valley Visitor Center.
- If you have a student with accessibility concerns, please call the Park for suggestions.

Evaluation Process

We need your help! Since this guide was designed for your use, only your feedback will make it work. Following the teacher preparation is a pre-addressed evaluation form. Please complete, fold in thirds, affix postage, and drop in the mailbox. In addition to the evaluation forms, we encourage other types of feedback. Please send any of the following items from your students:

1. Videotape or photos of Park field trip
2. Completed student journals
3. A class portfolio illustrating lesson activities
4. Any completed stewardship activities, including posters or newsletters
5. Any completed classroom projects or photographs of projects
6. Other ways of illustrating student feedback

Please indicate if these items need to be returned. We will use them to create a project library to highlight classroom efforts on our website and in Park publications, and to complete evaluations of student outcomes.

Send to: National Park Service
Point Reyes National Seashore
Division of Interpretation
Attn: Education Specialist
Point Reyes Station, CA 94956

Reservations

To avoid conflicts with other groups and to be notified about any unusual closures, please call the Park to notify us about your field trip date and time. Call (415) 464-5139 or e-mail **PORE_education@nps.gov**. You may also use the reservation form provided in this Teacher's Preparation unit.

Pacific Gray Whale Kit Contents

Kits are available for checkout at the Bear Valley Visitor Center. These are available on a first-come, first-served basis.

- ☐ 20-40 pairs of binoculars
- ☐ 1 spotting scopes
- ☐ teacher backpack with field guides
- ☐ 20-40 clipboards

California Science Standard Links

	"Observing Pacific Gray Whales" Unit										
	Pre-Visit						On-Site	Post-Visit			
	#1	#2	#3	#4	#5	#6	Field Journal	#1	#2	#3	#4
Sixth Grade											
1											
2											
3											
4											
5	a,b,-e		a,b,-c,d,e				a,b,e	a,b,-c,e			
6											
7	b,c		b	b		b	b,c,f,h	b,c,-d,e,-f,h	b,d,-e		
Seventh Grade											
1											
2	a										
3	e	a									
4											
5	a,d	a	a,c								
6						b,d					
7	a,d			a		a	a	a,c,e	a,b,-c,e		
Eighth Grade											
1											
2											
3											
4											
5											
6											
7											
8											
9	b							b			

Correlations to "A Child's Place in the Environment"
California's State Approved Environmental Education Curriculum

	"Observing Pacific Gray Whales" Unit									
	PRE-VISIT						ON-SITE	POST-VISIT		
	#1	#2	#3	#4	#5	#6	Field Journal	#1	#2	#3
A Child's Place in the Environment: Grade 6 Lessons										
What Are Some Components of an Ecosystem?	X		X				X	X		
What Role Does Diversity Play in an Ecosystem?	X		X				X	X		
How Does the Sun's Energy Flow Through an Ecosystem?			X							
What Interrelationships and Niches Can Be Identified in an Ecosystem?	X		X				X	X		
What Cycles Exist in an Ecosystem and How Do They Sustain an Ecosystem?	X		X							
What Examples of Ecological Principles Can Be Observed in an Ecosystem?			X				X	X		
What Are the Components and Relationships of Human Communities and How Do They Compare to Ecosystems?										
What Are Some Limiting Factors in Human Communities and in Ecosystems?	X						X			
How Do Energy Sources Used in Human Communities Compare to Those Used in Ecosystems?										
How Can Organic Solid Waste in Human Communities Be Composted?										
How is Land Used by Our Community and How Are Land-Use Decisions Made?										
How Can the Disposal of Solid Waste Affect the Quality of the Environment?										
How Does the Motor Vehicle Transportation System Affect the Environment?										
How Do Human Beings Affect Watersheds?										
What Human Actions Enhance, Protect, and Sustain the Quality of the Environment?	X									X
What Have Communities Done to Become More Sustainable?										X
What Projects Can Students Implement to Make Their Classroom and School or Community More Sustainable?										X

Acknowledgments

This unit was written by area teachers, Park Rangers, scientists, and local naturalists. Special thanks to the following people:

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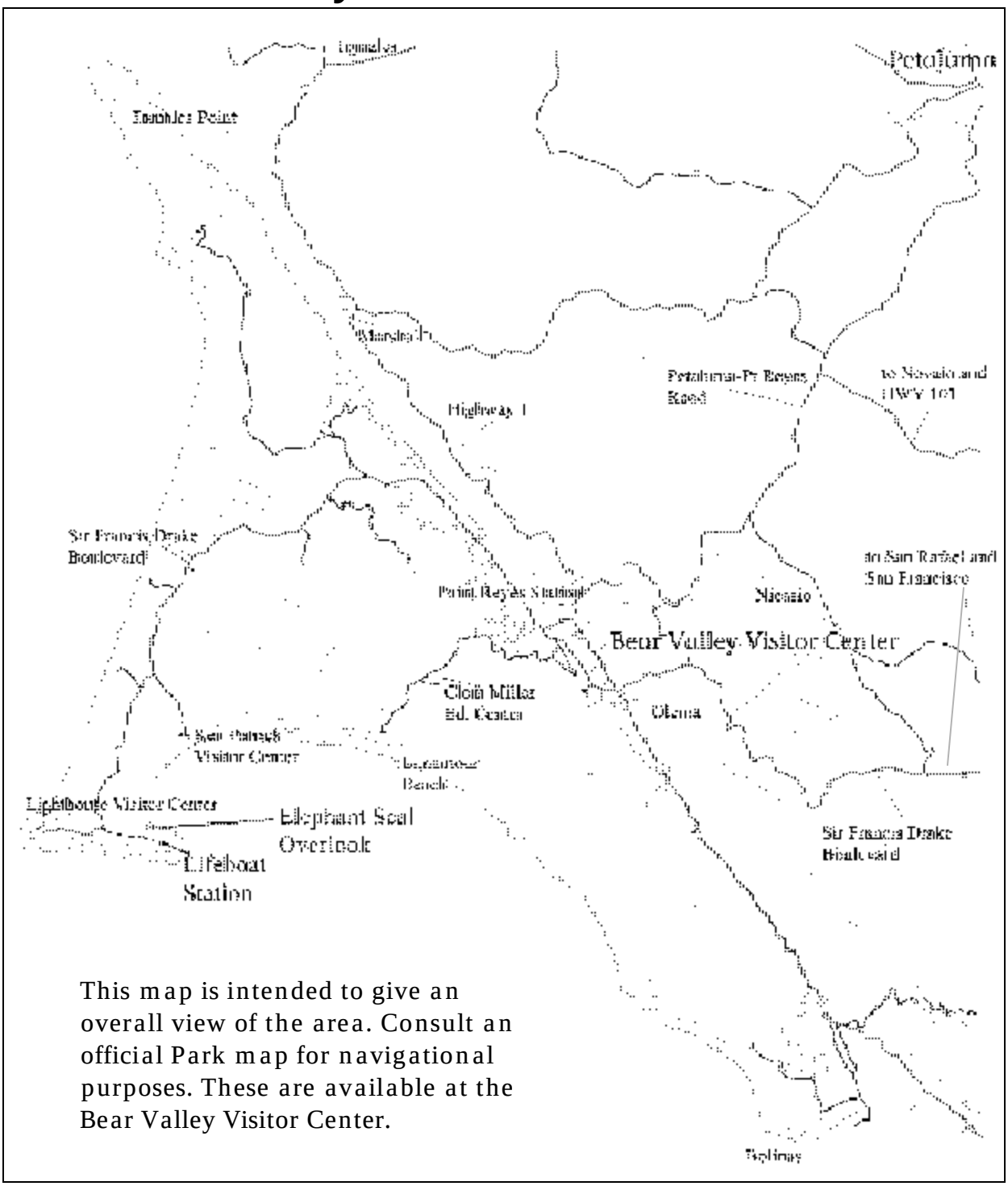
Point Reyes National Seashore

Attachment

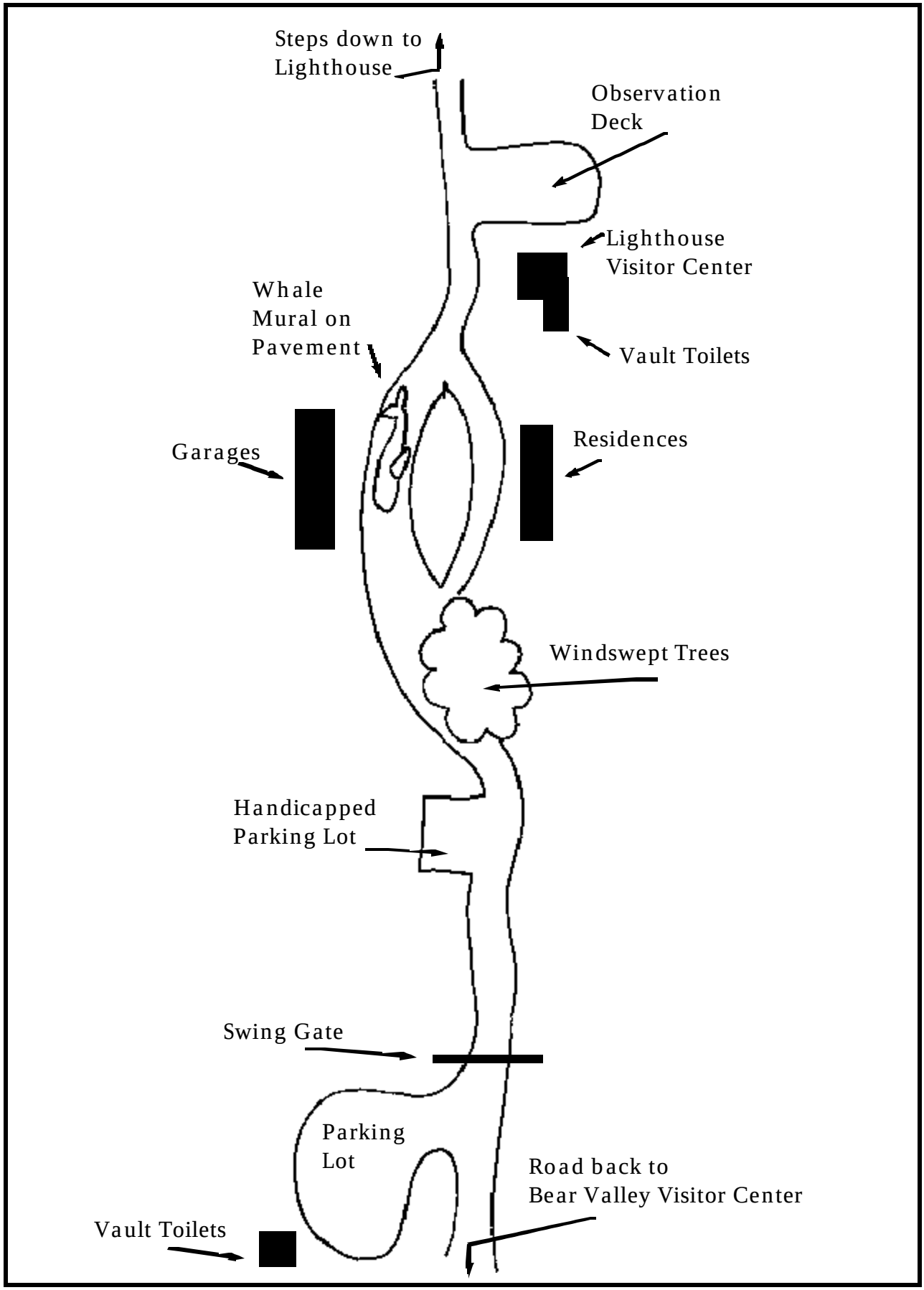


This map is intended to give an overall view of the area. Consult an official Park map for navigational purposes. These are available at the Bear Valley Visitor Center.

Approximate Driving Times/Distances

Petaluma to Bear Valley VC	40 min./19 miles
Novato to Bear Valley VC	40 min./19 miles
San Anselmo to Bear Valley VC	30 min./20 miles
Bear Valley VC to Limantour Beach	20 min./9 miles
Bear Valley VC to Tomales Point	30 min./19 miles
Bear Valley VC to Ken Patrick VC	30 min./15 miles
Bear Valley VC to Elephant Seal Overlook	45 min./22 miles

Point Reyes Lighthouse Area Map



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Map of the Chimney Rock Area

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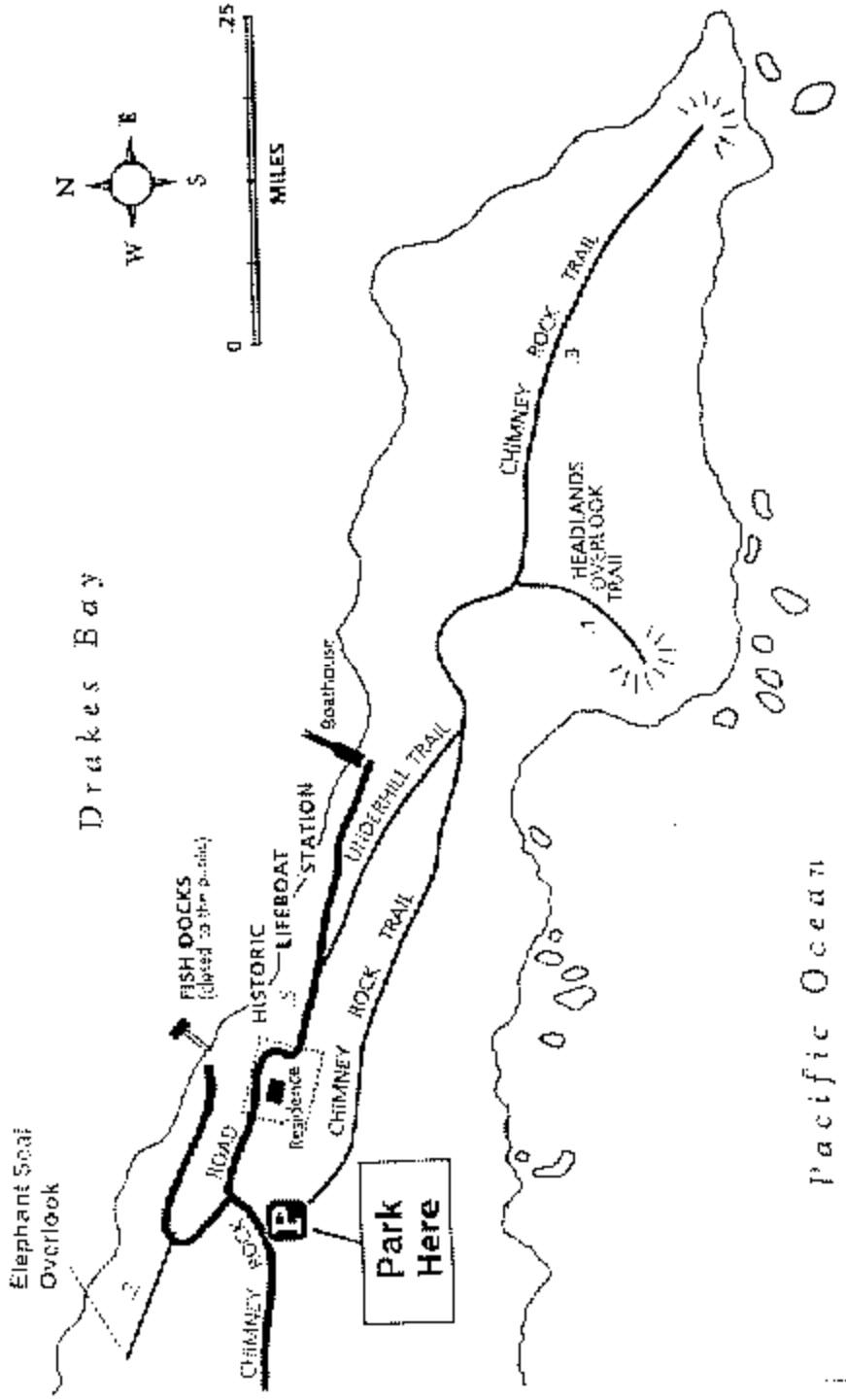


The Chimney Rock Road is CLOSED to buses. Use cars or vans to transport students to the overlook or trail.

The Historic Point Reyes Lighthouse

Punta de los Reyes . . . God help the hapless mariner who drifts upon it!"- San Francisco Chronicle 1887

Attachment

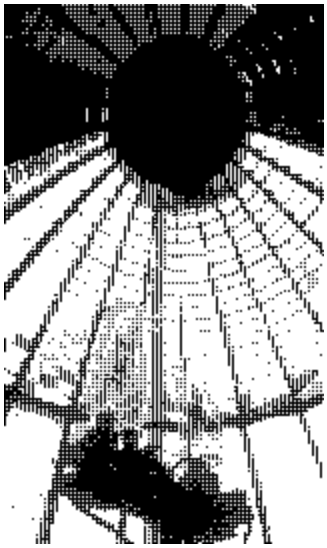
Point Reyes: A Treacherous Obstacle to Mariners

Point Reyes is the windiest place on the Pacific Coast and the second foggiest place on the North American continent. Weeks of fog, especially during the summer months, frequently reduce visibility to hundreds of feet. The Point Reyes Headlands, which jut 10 miles out to sea, pose a threat to each ship entering or leaving San Francisco Bay. The historic Point Reyes Lighthouse warned mariners of danger for more than a hundred years.

The historic Point Reyes Lighthouse, built in 1870, was retired from service in 1975 when the U.S. Coast Guard installed an automated light. They then transferred ownership of the lighthouse to the National Park Service, which has taken on the job of preserving this fine specimen of our heritage.

All lighthouses in the United States are now automated because it is cheaper to let electronics do the work. Many decommissioned lighthouses were transformed into restaurants, inns, or museums. The lighthouse at Point Reyes National Seashore is now a museum piece, where the era of the lightkeepers' lives, the craftsmanship, and the beauty of the lighthouse are actively preserved.

The Point Reyes Light First Shone in 1870



First-order Fresnel lens seen from inside the lens, Point Reyes Lighthouse. The electric lights are a modern addition.

The Point Reyes Lighthouse lens and mechanism were constructed in France in 1867. The clockwork mechanism, glass prisms, and housing for the lighthouse were shipped on a steamer around the tip of South America. The parts from France and the cast iron tower, which was built in San Francisco, were then hauled on ox-drawn carts from the landing on Drakes Bay to the cliff 600 feet above sea level. Meanwhile, 300 feet below the top of the cliff, an area had been blasted with dynamite to clear a level spot for the lighthouse. To be effective, the lighthouse had to be situated below the characteristic high fog. It took 6-weeks to lower the materials from the top of the cliff to the lighthouse platform and construct the lighthouse.

Finally, after many years of tedious political pressure, transport of materials, and difficult construction, the Point Reyes Light first shone on December 1, 1870.

Attachment

"No keepers ever volunteer to transfer to Point Reyes, and almost without exception the keepers on the station are the ones who have entered the service there." -Superintendent of Lighthouses, 1926

The Lighthouse, Fog Signal and Lifesaving Station Saved Lives

Lighthouses provide mariners some safety by warning them of rocky shores and reefs. They also help mariners navigate by indicating their location as ships travel along the coast. Mariners recognize lighthouses by their unique flash pattern. On days when it is too foggy to see the lighthouse, a fog signal is essential. Fog signals sound an identifying pattern to signal location to the passing ships. However, the combination of lighthouses and fog signals does not eliminate the tragedy of shipwrecks.

The highest wind speed recorded at Point Reyes was 133 m.p.h., and 60 m.p.h. winds are common.

Because of this ongoing problem, a lifesaving station was established on the Great Beach north of the lighthouse in 1890. Men walked the beaches in 4-hour shifts, watching for shipwrecks and the people who would need rescue from frigid waters and powerful currents. This lifesaving station was later moved to Drakes Bay near Chimney Rock and was active until 1968. Today it is a National Historic Landmark and can be viewed from the Chimney Rock Trail.

The Lonely Life of a Lighthouse Keeper

Keeping the lighthouse in working condition was a 24-hour job. The light was lit only between sunset and sunrise, but there was work to do all day long. The head keeper and three assistants shared the load in four 6-hour shifts. Every evening, a keeper walked down the wooden stairs to light the oil lamp, the lighthouse's source of illumination. Once the lamp was lit, the keeper wound the clockwork every 2 hours and 20 minutes to turn the lens so the light would flash. Then, throughout the night, he kept the lampwicks trimmed so that the light would burn efficiently, thus the nickname "wickie."

Daytime duties included cleaning the lens, polishing the brass, stoking the steam-powered fog signal, and making necessary repairs. At the end of each shift, the keeper trudged back up the wooden staircase. Sometimes the winds were so strong that he had to crawl on his hands and knees to keep from being knocked down by the wind.

The hard work, wind, fog, and isolation at Point Reyes made this an undesirable post. Even so, one keeper stayed for more than 20 years, a testament to his devotion and love of Point Reyes!

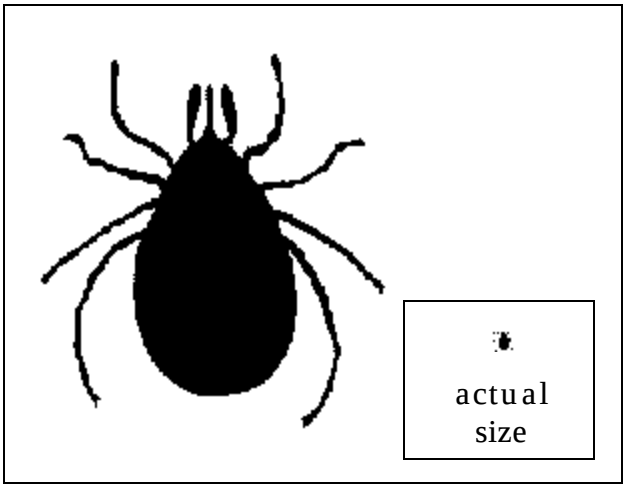
The Lighthouse Is an Enduring Historical Legacy

The historic Point Reyes Lighthouse served mariners for 105 years before it was replaced. It endured many hardships, including the 1906 earthquake, during which the Point Reyes Peninsula and the Lighthouse moved north 18 feet! The only damage to the Lighthouse was that the lens slipped off its tracks. Thirteen minutes after the earthquake, the Lighthouse was once again in working order.

The National Park Service is now responsible for maintenance of the Lighthouse. Park rangers now clean, polish, and grease it, just as lighthouse keepers did in days gone by. With this care, the light can be preserved for future generations - to teach visitors of maritime history and of the people who worked the light, day in and day out, rain or shine, for so many years.

Lyme Disease, Stinging Nettle, and Poison Oak

Lyme disease is an illness caused by bacteria transmitted to people by tick bites. Not all ticks carry the disease. Field studies in Marin County show that 1–2% of the western black-legged ticks carry Lyme disease. Since there are several other species of ticks in Marin, the odds of a tick bite producing Lyme disease is less than 1 in 100. Even so, Lyme disease can be severe; it is important to understand the prevention and symptoms.



Symptoms:

arthritis and joint pain
lethargy
heart problems
pain/limping
fever
kidney problems
depression
bull's-eye rash (50% of victims)

Tick species in California include:

Western black-legged tick and Pacific coast tick (West Coast)
Lone star tick and American dog tick (throughout U.S.)

How to avoid tick bites:

- Wear light-colored, long-sleeved clothes so you can more easily see the ticks.
- Tuck shirt into pants and pants into socks to keep ticks away from your skin.
- Stay on trails.
- Apply an insect repellent, labeled for ticks, to shoes, socks, and pants.
- Check yourself completely after a hike. Closely check any skin irritation. Ticks anesthetize the skin before biting so you'll seldom feel the original bite.

What to do if bitten:

- Use tweezers to grasp tick at point of attachment, as close to skin as possible. Gently pull tick straight out.
- Save tick, notify your doctor.
- Don't panic—ticks need to be embedded from 24 to 48 hours to transmit bacteria. The ticks that transmit Lyme disease are usually in a developmental phase in which they are smaller than the head of a pin.

References:

Ticks and Lyme Disease in the National Parks
Lyme Disease Foundation/**www.lyme.org**

Lyme Disease, Stinging Nettle, and Poison Oak
(continued)

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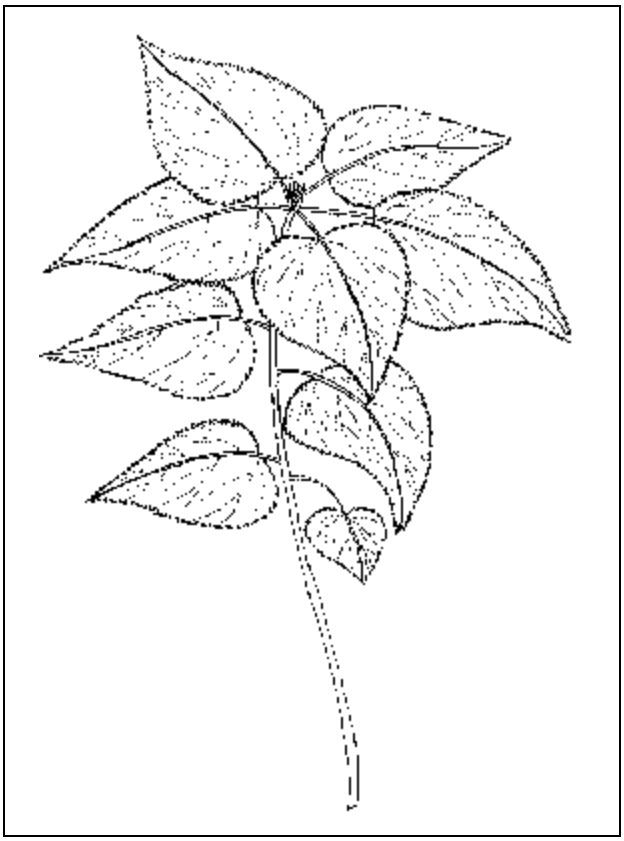
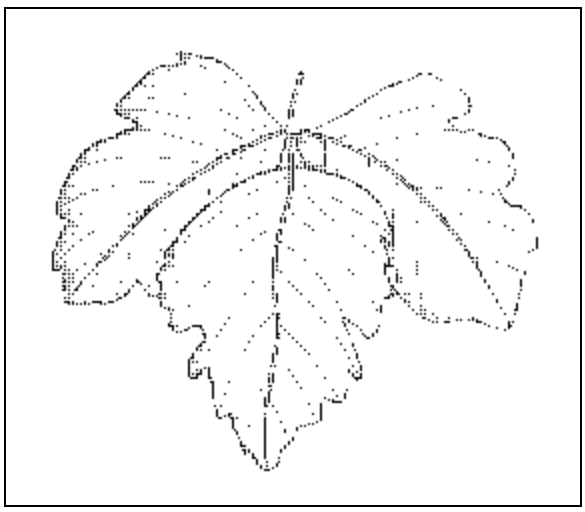


Stinging nettle is native to Europe, but grows at Point Reyes National Seashore. It can cause a painful rash that stings for up to 12 hours after brushing up against the plant. A topical analgesic (used to treat poison ivy or bug bites) can be applied to help alleviate the sting. Study the picture and have someone point out the plant in the Seashore to aid in its identification.

Poison oak usually causes an itchy rash if you are sensitive to it. You can get a rash by touching the plant, its leaves or its roots. You can also contract poison oak by petting your dog (if the oils are on its coat) or by touching clothing that has touched poison oak. Rashes may occur several days after the initial contact with the plant. Severe rashes may affect the lungs. If you have difficulty breathing, call 911 or go to the nearest emergency room immediately. Preventive topical ointments are available to help avoid reactions to poison oak. Learn to recognize the compound leaves with a shiny appearance.



Creating Coastal Stewardship through Science

Reservation

If you are planning a trip to Point Reyes National Seashore to use this curriculum, please notify the Park to avoid conflicts with other groups and to be notified about any unusual closures. Mail this form at least 2 weeks in advance (fold in thirds and affix postage) or call (415) 464-5139, to leave a message.

Teacher Name: _____

School Name: _____

School Address: _____

City/State: _____ Zip Code: _____

School Phone: _____ School Fax: _____

Email: _____

Grade: _____ Class Size: _____

Home Phone: _____

Field Trip Options

Monitoring Creek Health
Observing Pacific Gray Whales
Discovering Northern Elephant Seals
Defining Habitats
Investigating Tule Elk
Uncovering the San Andreas Fault
Identifying Resident Birds

Field Trip Preferences

Field Trip Topic	Dates (list three in order of preference)	Time
1. _____	_____	_____
	_____	_____
	_____	_____
2. _____	_____	_____
	_____	_____
	_____	_____

Comments

_____ Confirmation Letter
_____ Materials Sent

_____

_____

_____

National Park Service
Point Reyes National Seashore
Division of Interpretation
attn: Education Program Coordinator
Point Reyes Station, California 94956

Creating Coastal Stewardship through Science

Evaluation

Please help us develop and improve our programs by taking a few minutes to complete this form. This evaluation form is preaddressed, but needs to be folded in thirds and provided with postage. If you prefer, e-mail comments to: **PORE_Education@nps.gov**

Name: _____ School Name: _____

School Address: _____

City/State/Zip Code: _____

School Phone: _____ School Fax: _____

Email: _____

Class Size/Grade: _____

Date of Visit: _____ Program/Location: _____

Getting Your Visit Set Up

Do you have any suggestions to make logistics easier? (maps, directions, reserving programs)

Curriculum materials

Which lessons were the most effective?

Relevance of content to my students and curriculum:

Grade appropriateness?

Program assessment

How does this program fit into California/National Standards and your personal education program?

Strengths/weaknesses of program?

Best part of experience?

What is the level of support at your school for this program?

What could the National Park Service do to improve your education program?

Overall, how would you respond if a colleague asked about this program?
Highly recommended Recommended Recommended with some qualifications
Not recommended

National Park Service
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Amphipod a small crustacean with a laterally flattened body (order Amphipoda). Four families of amphipods make up 90% of gray whale diet.

Aphotic zone a zone in the ocean lacking light

Baleen plates that grow from the upper jaw of whales in the suborder Mysticeti. These plates form a fringe like sieve to filter food from seawater. The hardened tissue that makes up baleen is keratin which is made up of fingernails, hooves, and horns.

Benthic division the zone at the bottom of the ocean

Blowhole the nostril(s) of a whale that opens on top of the head

Blubber the layer of fat beneath the skin of marine mammals

Breaching the leaping of a whale above the water's surface

Carnivore a flesh-eating organism

Cetacean of the order Cetacea of aquatic marine mammals including the whales, dolphins, and porpoises

Community all of the plants, animals, and nonliving components living in the same area

Competition the active demand by two or more organisms, or kinds or organisms, for some environmental resource in short supply

Consumer an organism which obtains food by preying on other organisms or eating organic matter

Decomposer an organisms that returns organic substances to ecological cycles by feeding on and breaking down tissues

Diatom any of a class of small planktonic unicellular or colonial algae with silicified skeletons

Dorsal upper surface of an organism, the area along the backbone for whales

Dorsal fin the somewhat triangular appendage protruding above the backbone of some cetaceans

Vocabulary

Dorsal ridge the area along the backbone of some species of whales (when viewed from the side, looks like a series of knuckles). Gray whales have a dorsal ridge instead of dorsal fin. It may act as a keel to help keep the whale oriented upright.

Ecosystem the sum total of interacting communities, biotic (living) and abiotic (nonliving) components, in a unit of the environment

Euphotic zone the uppermost layer of ocean water that receives sufficient light for photosynthesis and the growth of green plants

Fluke the tail of a whale; when swimming the whale's fluke moves up and down, not side to side like a fish tail; used for propulsion through the water

Food chain a method to illustrate the transfer of body-building substances and energy when one organism eats another

Food web the multiple interrelationships between all species in an ecosystem or habitat; a series of organisms related by predator-prey and consumer-resource interactions; the entirety of interrelated food chains in an ecological community.

Forestomach the first stomach of a baleen whale which is surrounded by muscles to aid in grinding food

Habitat the place in the ecosystem where populations of organisms live and grow

Herbivore a plant-eating organism

Invertebrate an animals without a backbone

Krill small shrimplike marine crustaceans (order Euphausiacea); principal food of some baleen whales, not typically eaten by gray whales

Lagoon a shallow body of water located near, and at times connected with, a larger body of water

Latitude the angular distance north or south of the equator, measured in degrees along a meridian, as on a map or globe; Point Reyes' latitude is 38° North

Longitude the angular distance east or west of the prime meridian in Greenwich, England, measured in degrees along a meridian, as on a map or globe; Point Reyes' longitude is 123° West

Mammal a warm-blooded animals that breathes air, has hair, gives birth to live young, and nurses their young with milk from mammary glands

Midstomach the second stomach of a baleen whale which further digests food for nutrient absorption

Migration a seasonal movement from one region to another, usually for breeding or feeding

Migration route the general path of travel used by most animals in a species for their seasonal movements

Mottled color variegated pattern of shading with spots or blotches

Mysticete baleen whale (suborder Mysticeti); translates to "mustached whale"

National Park an area of national significance, scenic beauty, or historical importance, preserved for the use and enjoyment of this and future generations

Neuritic province well lighted zone of the ocean with seasonal variations in light, temperature, salinity, dissolved oxygen, nutrients, wave action, currents, and organisms. It has the greatest abundance and variety of fish.

Niche the ecological role, position, or function of an organism in a community of plants and animals; "profession"

Oceanic province a less productive zone than the neuritic province, but with less seasonal variation

Odontocete a toothed whale (suborder Odontoceti)

Omnivore one that eats both animal and vegetable substances

Organism a living species

Parasite an organism living in or on another organism

Pectoral flippers appendages located on either side of a whale, used to balance and steer

Vocabulary

Peduncle muscles that run length of whale's tail, and attach to fluke

Pelagic division living in open oceans

Plankton the drifting sea life floating near the surface of water. Zooplankton (animal in origin) examples include fish eggs, amphipods, larvae, and krill. Phytoplankton (plant in origin) examples include diatoms and other photosynthesizers.

Pod a group of traveling whales, usually segregated by age or sex

Population a number of individuals of the same species living in a distinct geographical area

Producer an organism such as a plant which can produce its own food and serves as a food source for other organisms

Pyloric stomach the third stomach of a baleen whale

Rostrum the long, flat ridge on dorsal side of a baleen whale's head, extending from blowhole to tip of mouth

Scavenger an organism feeding on dead things or garbage

Sounding a whale's dive from the ocean surface into the depths. As the whale begins a long dive, you may get a chance to see the fluke propelling the whale downward.

Species a distinct type of animal or plant. Members of the same species can breed naturally. Members of different species cannot interbreed naturally.

Spouting the exhalation of a whale at the water's surface. Warm air from the lungs condenses in the cooler air and creates the telltale "geyser" appearance, like a puff of smoke.

Spy-hopping a whale poking its head vertically above the water's surface

Stewardship choices and actions to protect our environment

Trachea passageway that carries air from nostrils to lungs. In humans, tracheas are for breathing and eating; in whales the trachea only carries air.

Umbilicus a small opening or depression similar to a navel

Upwelling the vertical movement of cold, nutrient-rich water from depths to surface

Ventral pleats grooves on the underside of a whale's mouth that allow the mouth cavity to expand when feeding. Gray whales have two to four ventral pleats.

Whalebone the term used by early whalers for baleen

Creating COASTAL STEWARDSHIP through Science

Observing Pacific Gray Whales

Pre-Visit Activities

How Can I Learn About the Lives of Pacific Gray Whales?

After reading a newspaper on gray whale ecology, students complete a series of activity sheets focusing on migration, relationship to other mammals, and human interventions. This activity will form the foundation for all other activities, including the on-site visit.

Time required: 2 hours

Location: classroom/ homework

Suggested group size: entire class

Subject(s): science, biology, mathematics, creative writing

Concept(s) covered: population dymanics, human ecology, life cycles, biology, ethics

Written by: Christie Denzel Anastasia, National Park Service

Last updated: 11/27/00

Student Outcomes

At the end of this activity, the students will be able to:

- Complete activity sheets based on their comprehension of the *Pacific Gray Whale* Newspaper.
- Understand how natural and human activities relate to gray whale populations.
- Understand the role and importance of students and Point Reyes National Seashore in conserving Pacific gray whales.

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade
- 5a- food webs
- 5b- organisms and the physical environment
- 5e- resources available and abiotic factors
- 7b- appropriate tools and technology to perform tests, collect data, and display data
- 7c- develop qualitative statements about the relationships between variables

7th grade	2a- differences between the life cycles and reproduction of sexual and asexual organisms 3e- extinction of a species occurs when the environment changes and the adaptive characteristics for a species are insufficient for its survival 5a- animals have levels of organization for structure and function 5d- reproduction 7a- appropriate tools and technology to perform tests, collect data, and display data 7d- construct scale models and appropriately labeled diagrams to communicate scientific knowledge
8th grade	9b- evaluate the accuracy and reproducibility of data.

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Think critically and logically to make the relationship between evidence and explanations; use mathematics in all aspects of scientific inquiry.
- Content Standard C - Structure and function in living systems; Reproduction and heredity; Regulation and behavior; Populations and ecosystems; Diversity and adaptations of organisms.
- Content Standard F - Science and technology in society

Materials

To be photocopied from this guide:

- **Pre- and Post- Evaluation** Activity Sheet
- *Pacific Gray Whale* Newspaper
- **Vocabulary** sheets located in Teacher's Preparation/ Attachments
- **Migration-What, Why, Who** Activity Sheet
- **Like and Unalike** Activity Sheet
- **Annual Behaviors** Activity Sheet
- **What's it Like to be a Gray Whale?** Activity Sheet
- **Technology, Intervention, Ethics** Activity Sheet
- **Whaling Computations** Activity Sheet

Vocabulary

amphipod, baleen, blubber, dorsal ridge, estuary, fluke, invertebrate, krill, lagoon, migration, niche, pectoral flippers, rostrum

Procedures

1. Pre- and Post- Evaluation

Distribute **Pre- and Post- Evaluation** activity sheets. Remind students this is not a graded test, but rather a measure of our success; each student will retake the same test after several lessons. (Note: You may choose to save these completed tests and redistribute in the first postvisit lesson. Students change their answers based on what they have learned.)

2. Distribute Newspaper

Students receive and read Pacific Gray Whale Newspaper. Students can work in pairs or individually to complete activities.

3. Reading comprehension

Read the *Pacific Gray Whale* newspaper as a class and clarify any questions or comments from students.

4. Activity sheets

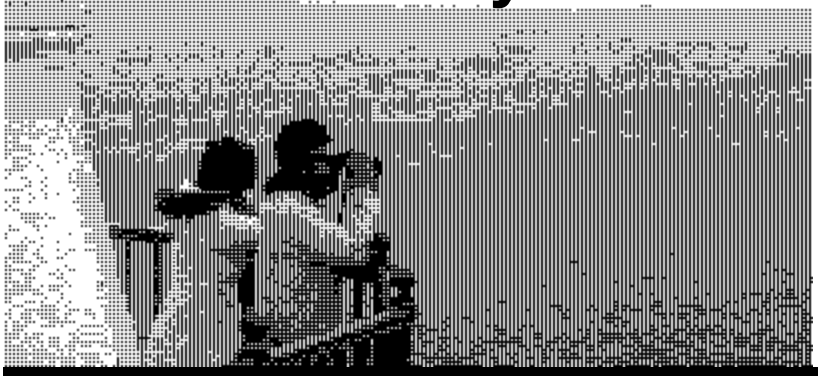
Give each student appropriate activity sheets, vocabulary list, and instructions for completion.

5. Conclusions

Review students' answers, exchange ideas, and relate these concepts to lessons already covered earlier in the year.

Pacific Gray Whales

Point Reyes National Seashore



Inside:

Passing by Point Reyes

Thousands of people come to Point Reyes National Seashore every year to look for gray whales. They awaken in us a sense of awe and wonder with their size and grace, and with their stunning life habits that are so different from ours.

A few decades ago, the delicate plume of a spout rising into the air and then slowly fading would have been a rare sight for whale watchers. Hunting had devastated the Pacific gray whale population and put them in danger of extinction. As a result of international and national protection, we can glimpse the gray whales once again as they travel on their annual migratory path.

Pacific gray whale migration route

Many whale species are visible from the the shore of Point Reyes, but the most common is the Pacific gray whale. Each year in January, gray whales pass by the Point Reyes Headlands as they migrate southward from their summer feeding grounds in the arctic Bering and Chukchi Seas to the warm calving lagoons of Baja California. In late March and early April, they pass by the Headlands on their northward return to their feeding grounds. We humans might find a commute of 50 miles much too long, but these whales make an annual round-trip journey of 10,000 miles and travel for almost 2 months each way!

Whales are completely at home in an environment that to us can be harsh and deadly. They dive to depths that would crush us and live itemperatures that would rapidly drain our warmth and life.

They are mammals, like us, and must breathe air to live, but they spend little time above water. They surface, exhale, and take a breath before they disappear back into the dark waters. The spout, a heart-shaped plume of mist, is like your breath on a cold morning, but much, much larger. It seems so thin and wispy from afar, but if you could stand on the back of a gray whale, you would see the spout whoosh up into the air some 10 to 15 feet.

Whales are the ambassadors of the incredible undersea world. They tell us about their lives and their world, but if we listen, they will also tell us about ourselves. They sing to us about the best and the worst of human nature and our own hope for the future.

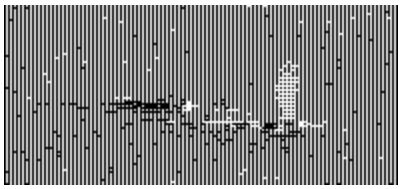
Since they were first seen, whales have most likely been viewed with the same sense of wonder we have today. However, 100 years ago (and more) whales were a commodity to be hunted and sold. The oil and baleen of thousands of whales produced a livelihood for hundreds of people. Wavering at the edge of extinction, many whale species nearly disappeared forever. Today, they are viewed as a natural gift to be treasured.

People made the choice to save the whales. Individuals spoke out to protect the whales that remained. Governments listened, and eventually passed laws that gave protection to these magnificent animals. And the whales recovered.

The world is an incredible place, infinitely and intricately interconnected, full of mysteries we are only slowly unraveling. Whales provide us with a connection to some of those mysteries. They are symbols of the resilience of nature and of the idea that it is not too late to make the world a better place. They symbolize our hope in the future. In today's world, it is important to know that each of us can make a difference. Maybe that is why people love to watch for whales.

Whale Adaptations

Gray whales are not the largest, fastest or deepest diving whale, but they are marvelous animals that have adapted to a life at sea. Gray whales have taken advantage of niches in the marine environment that other whales are unable to use.



During the northern migration, gray whale cows and their calves often swim so close to the shoreline that lighthouse whale watchers can hear them breathing.

Gray whales are an illustration of millions of years of adaptation. Fifty million years ago, mesoncychids, a primitive relative of the deer and the ancient ancestor of the whale, left the land in search of food. As their descendants adapted to living in the water, they became some of the most highly specialized creatures of all time. Gray whales share many of the adaptations that make whales in general so successful and have a few that make them unique.

SEAGOING MAMMALS

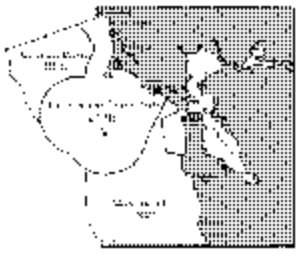
The body of the whale has adapted to make it more efficient in the water. The tail grew large muscles and developed flukes to gain more power for swimming. The forelegs developed into pectoral flippers that help it to maneuver and the hind legs slowly disappeared. Today, the only vestiges of those hind legs are small bones hidden inside the whale's body. The nostrils, or blowholes, moved to the top of the head to make breathing while swimming easier. The rostrum and the top of the head took on a shape that helps to direct the water around the blowhole so as not to flood the whale as it breathes. Unlike humans, whale's lungs and mouths are not connected. A whale can both breathe and feed at the surface, all without drowning. Like humans, gray whales are mammals. They are warm-blooded, give birth to live young, and have hair. Pacific gray whales give birth to their calves in the protected, warm bays and estuaries of Baja California. Most birthing occurs in January and February. At birth, a single calf weighs up to 2,000 pounds and is 15 feet long. The calf nurses from mammary glands tucked inside narrow slits on the belly of the female. The rich milk is about 40% fat and is the consistency of cottage cheese or margarine. After several months of consuming more than 50 gallons per day, the calf is 26-30 feet long and nearly double its original weight when finally weaned.

We all love the ocean's surface with its beautiful sparkle blue. But beneath it, down deeper, whales are moving with slow, drifting currents - whales that are great, gentle, cloudlike beings.

Roger Payne,

MIGRATION

The life of the gray whale includes a migration that ranks as one of the longest of any species of mammal. Migration is a behavioral adaptation that allows animals to take advantage of rich resources that may be available only at certain times in the year. Most gray whales migrate every spring from their birthing and breeding lagoons in Baja California to the shallow, muddy waters of the Bering Sea. This 5,000 mile journey takes over 55 days. They follow the coastal contours as they migrate, but are also thought to navigate by magnetic pathways. They often will avoid areas with heavy ship traffic or cloudy waters, such as the sediment-filled plume of San Francisco Bay. Not all gray whales make the full return journey to the northern waters of the Bering Sea. Some will linger along the migratory route or even summer at other locations. In recent years, small numbers of gray whales have summered in Tomales Bay and near the Farallon Islands. They can find food in Drakes Bay and Tomales Bay, where they are occasionally seen feeding just beyond the surf.



The National Oceanic and Atmospheric Administration (NOAA) provides additional protection to the ocean waters around Point Reyes National Seashore. The Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sactuaries protect over 7,100 square miles of California's marine habitat. Winds, waves and ocean currents converge along the continental shelf that stretches within these sanctuaries, creating a resource-rich environment. This habitat is essential to whales and other species, including humans.

Spotting Pacific Gray Whales at Point Reyes

Gray whales can be seen from January to early May.

The peak of the migration south to Baja, CA is in January.

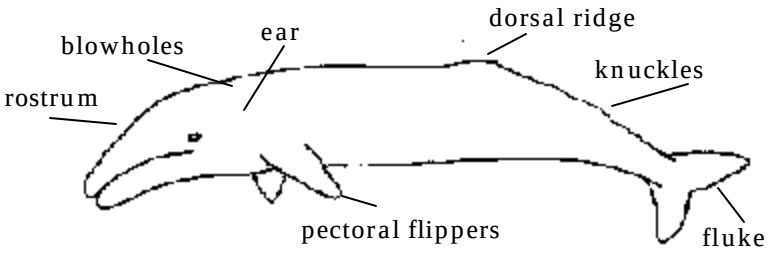
The peak of the migration north is in March.

Poor visibility and high wind speeds can greatly reduce sightings.

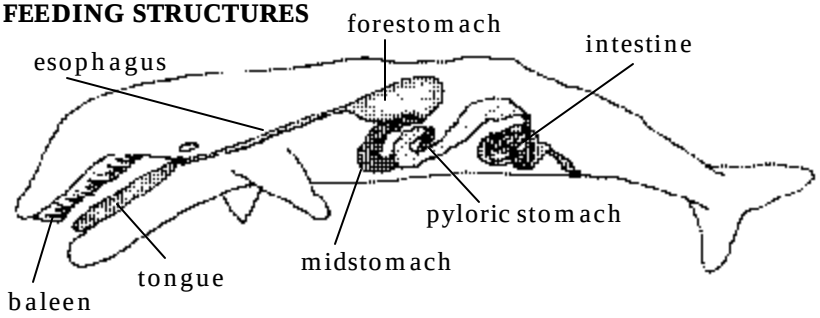
Evolution and Anatomy

When spotting gray whales, look for the external anatomy which can be easily seen. Locating a gray whale's blowholes is easy as soon as you see one spout. The spout is often the first thing that you will see but it is not the last. As the whale surfaces to breathe, its rostrum, back, dorsal ridge and knuckles come into view. When it sounds, you can often see the tail fluke. Keep your eyes open, sometimes a whale will breach and a full view of the external anatomy will be seen in all its splendor!

EXTERNAL ANATOMY



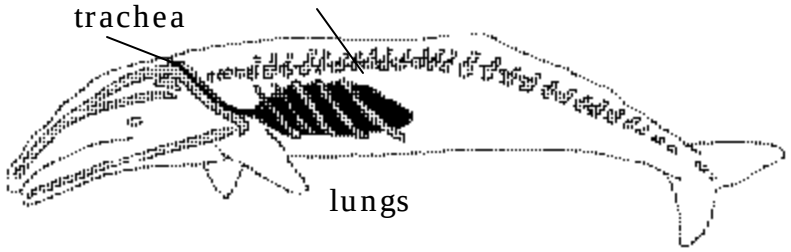
FEEDING STRUCTURES

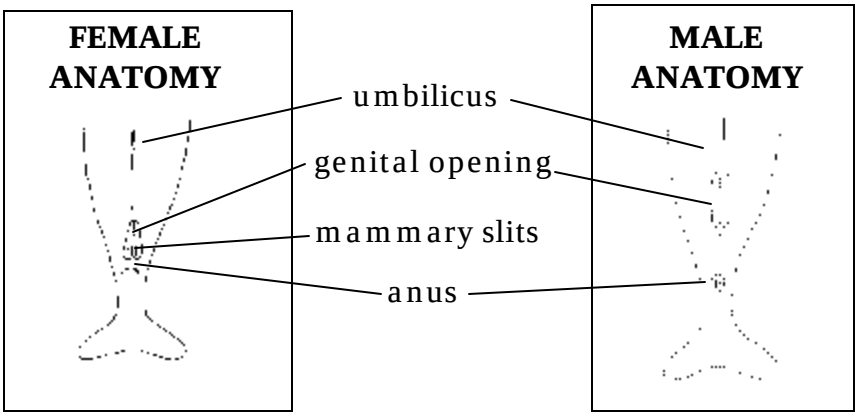


If you were an amphipod scooped up from the ocean floor by a gray whale, you would be in for an exciting ride. As the whale's tongue forced you against the baleen you would be separated from the mud and water that surrounded you. Then you would feel the mouth sweeping you toward the back of the throat to be swallowed. How much you would feel after that point could be debated. As a human however, there's not to much to worry about. The opening to the esophagus is much too small to accommodate anything of our size.

As a gray whale you would never have to worry about having your food go down your windpipe. That's because a gray whale's mouth and lungs are not connected. The lungs of a gray whale and all other whales are connected only to the blowholes, not to the mouth. If we had evolved similarly, we would be able to drink and breathe at the same time. This is not something that would concern a whale, however, because they never drink. Whales get all their water from the food they eat. If this is true, why would they have evolved in such a manner?

BREATHING STRUCTURES





Adapting to life in the ocean has brought many changes to the gray whales' anatomy, yet they are distinctly mammals. In that regard, we are not so different. We are both warm-blooded, nurse our young from mammary glands, have some hair and breathe air. We also have an umbilicus or "belly button". These common traits are shared by all mammals regardless of whether they swim in the ocean waters, walk on land, or fly in the skies. These traits also set us apart from birds, reptiles, amphibians and other types of life.

Filling a Niche

SHALLOW FEEDERS

Gray whales migrate and forage along the continental shelf and have adapted to diving in shallow water. Typically, they stay in waters approximately 30 fathoms (180 feet) deep. Most whales feed at the surface of the open ocean, using their baleen to filter the water for krill and small fish. Gray whales have adapted to a special niche that other whales don't feed in. Gray whales literally suck mud up from the bottom of the Bering and

Amphipod

Chuckchi Seas feeding on the invertebrates that inhabit the top few inches of mud. Gray whales mostly eat shrimp like amphipods, but also eat surface-dwelling swarms of krill and, sometimes, small schooling fish.

A Pacific gray whale feeds by swimming slowly above the surface of the muddy bottom, at depths of up to 200 feet. Rolling over on its side, it opens its mouth slightly, and retracts its tongue (which weighs around 2,500 pounds). This action forms a powerful suction that enables the whale to suck up the food-filled mud. The tongue then forces it through the baleen on the opposite side of the whale's mouth. Working as a filter, the baleen traps the invertebrates and then the tongue maneuvers the food for swallowing. “Right-handed" whales feed by tilting onto their right side. Some prefer to feed on their left - you can tell by the absence of barnacles on the side of the head that is rubbed against the ocean bottom. During each summer, gray whales can consume around 65 tons of food, gaining up to 30% in weight.

Much of the energy from this feeding is saved for the future. The food energy is stored as a thick layer of fat, or blubber. Blubber is an adaptation common among many marine mammals. It helps to insulate the whale in cold waters and provides a stored energy reserve for the rest of the year. While gray whales typically don't feed much after they leave the northern feeding grounds, they probably take advantage of food sources if they find them.

The presence of orcas and white sharks in the waters surrounding Point Reyes may force gray whales to travel very close to the shorelines as they travel north with their calv

IMPORTANT PART OF THE ECOYSTEM

Gray whales are an important part of the food web and play a large role in the success of their feeding-ground ecosystems. As they plow the bottom of the Bering Sea, one gray whale can dredge 100 acres of mud per summer. Their foraging behavior releases sediments upward into the water column. This provides a significant source of nutrients for other organisms in the coastal ecosystem. Furthermore, the deep depressions left by their plowing creates habitat for many of the organisms that colonize the ocean floor, or benthic zone. Among these organisms are the very amphipods the whales feed on.

Other species of animals have adapted to, and depend on, the presence of the whales. Orcas are one of the major predators of gray whales. The fins of many gray whales show the scars of their encounters with these predators. White sharks may prey on calves, but probably don't attack adult whales. Smaller creatures make their home on the grays. Several species of whale lice, amphipods related to the food of the gray whale, crawl about feeding on the skin of the whale. Several different

Whale lice

species of barnacles can be found on gray whales.

Whole colonies attach themselves to the whale's skin and live their entire lives there.

At Point Reyes, we watch the whales as they migrate past, but only glimpse a small part of their complex lives. Over thousands, if not millions, of years the whales have adapted to their environment, even as they have helped to shape it. Sometimes it is difficult to see the whales and appreciate the great changes and forces that have influenced their very lives. Like so many things in the world around us, each piece of the environment is interconnected and influences the other. Perhaps we should stop and ask ourselves where we fit into the lives of the whales.

For More Information

Point Reyes National Seashore
Point Reyes Station, CA 94956
www.nps.gov/pore

Gulf of the Farallones
National Marine Sanctuary
GGNRA, Fort Mason
San Francisco, CA 94123
www.farallones.org

American Cetacean Society
P.O. Box 2639
San Pedro, CA 90731-0943
http://www.acs-la.org

Marine MammalCenter
MarinHeadlands, GGNRA
Sausalito, CA 94965
www.tmmc.org

Humans and Gray Whales

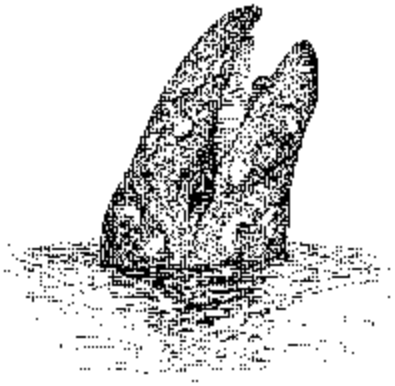
Our fascination with whales has had a huge impact on all species of whales world wide. Human demands have pushed many whale populations to the edge of extinction, or beyond, and human convictions have brought many of them back.

Using hand-held spears and small boats, Native Americans of Alaska and the Pacific Northwest hunted gray whales for food. Europeans used whale baleen in making hoopskirts, corsets, and buggy whips, and found whale blubber to be a valuable source of oil for lanterns and factory machinery. The growing industrial nations demanded this oil in huge amounts. At first, gray whales were not a popular target for many whalers. Their oil was of poor quality and their baleen was too coarse to bring much profit. Right and bowhead whales were preferred, but as those declined in number, the price of oil soared. Even if less valuable, an adult gray whale could produce up to 25 barrels of oil that sold for as much as $45 a barrel. Shore whaling stations sprang up along the migration route on the California coastline. New technology made whaling more efficient. Explosive harpoons, known as "bomb lances," were invented in 1865. By 1874, a whaling captain and early naturalist wrote:

"the mammoth bones of the California Gray Whale lie bleaching on the shores of those silvery waters and scattered along the broken coasts, from Siberia to the Gulf of California; and ere long it may be questioned whether this mammal will not be numbered among the extinct species of the Pacific."
-Captain Charles Scammon

As gray whales vanished, the shore stations closed. But in 1914, fast, new steam-powered whaling ships with harpoon- firing cannons made escape all but impossible. While electricity and petroleum products replaced whale oil in lanterns and machines, their oil was still used to make soap and their meat used in fertilizers and pet food. It has been estimated that as few as 1,000 Pacific gray whales were left alive in the 1930s.

Even the whalers realized that extinction seemed imminent. A ban on hunting gray whales was implemented in 1937. In 1946, an international agreement to ban commercial whaling was signed by most of the whaling



nations. Subsistence hunting still continues in some cultures and commercial whaling still continues in Japan, Finland, and Iceland.

Many people have learned to value whales beyond their monetary worth. The grandeur of whales has captured the hearts of people around the world. In the 1960s and '70s, many adults and school children wrote letters to Congress, expressing their concern for the protection of the environment and especially for the whales. Laws, like the Marine Mammal Protection Act, were created to help preserve whales and other marine mammals. These efforts led to the recovery of the gray whale population. Today there are an estimated 25,000 to 27,000 gray whales, perhaps nearing the number that existed before commercial whaling. Whale watching has replaced whaling as a profitable industry. Although gray whales are protected, there are still risks for them. Whales, and other sea mammals and birds, get caught in gill nets used for fishing. Unable to reach the surface to breathe, they drown. Whales are susceptible to pollution dumped into the oceans, and some have scars that show the danger of collisions with ships. New studies also indicate that noise pollution from ships and industry may cause harm to the whales' hearing and ability to navigate.

Gray whales have provided food, supplied power and wealth for growing nations, and have become a respected symbol of the ocean environment. More importantly, they symbolize how much impact our choices and decisions can have on the world around us - each of us can make the world a better place.

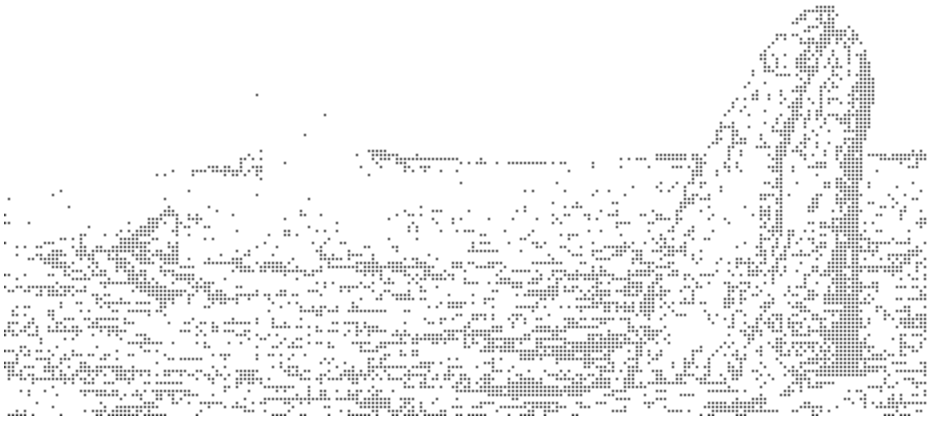
"We are the only species which, when it chooses to do so, will go to great effort to save what it might destroy."

Wallace Stegner

Humans and Gray Whales

Speculative Estimates of Historic Gray Whale Populations

Human Actions	Year	Gray Whale Populations
Traditional hunting for food	before 1800's	
Shore whaling starts in California	1854	
Discovery of Baja lagoons	1855	
Petroleum first used for fuel	1859	
Bomb lance invented	1865	
Whales find few gray whales	1875	
Native Siberian whalers starve	1880's	
Shore whaling in California dies out	1880-1900	
Spring steel replaces baleen in corsets	1909	
Steam-powered whaling ships start hunting gray whales	1914	
Factory ships process whales quickly at sea	1920's-30's	
Whalers ban hunting grays	1936	
International Ban on whaling	1947	
Marine Mammal Protection Act	1972	
Endangered Species Act (1973)		
Grays removed from Endangered Species List	1955	
Proposed and vetoed salt refining in Baja	2000	



Special Thanks

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Christie Denzel Anastasia
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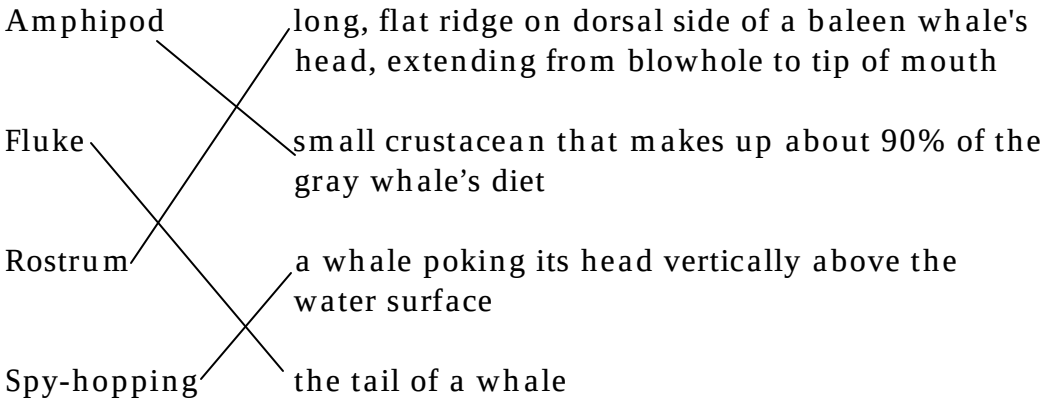
Pre- and Post- Evaluation

Activity Master

Vocabulary Match-Up

Draw connecting lines between words and their definitions.



Increase or Decrease

Place the following list of words in the appropriate column according to whether it increased or decreased the populations of gray whales: *discovery of breeding lagoons, international ban on whaling, bomb lance invented, Marine Mammal Protection Act, steam-powered hunting ships, Endangered Species Act, whalers ban hunting grays, factory ships process whales at sea.*

Increases gray whale populations	Decreases gray whale populations
international ban on whaling	***bomb lance invented***
Endangered Species Act	***factory ships process whales at sea***
whalers ban hunting grays	***steam-powered hunting ships***
Marine Mammal Protection Act	***discovery of breeding lagoons***

National Park System

Which part of the National Park System is closest to where you live?

Point Reyes National Seashore,
Golden Gate National Recreation Area, Muir Woods National Monument

True or False?

T/(F) gray whales are listed as an endangered species
T/(F) gray whales pass by Point Reyes four times a year.
(T)/F gray whales make a round-trip journey of 10,000 miles

Stewardship

What can you do to provide a clean ocean habitat and safe passage for gray whales? List your ideas on the back of this paper. ***answers will vary***

Name _____ **Date** _____

Activity Sheet

Pre- and Post- Evaluation

Vocabulary Match-Up

Draw connecting lines between words and their definitions.

Amphipod	long, flat ridge on dorsal side of a baleen whale's head, extending from blowhole to tip of mouth
Fluke	small crustacean that makes up about 90% of the gray whale's diet
Rostrum	a whale poking its head vertically above the water surface
Spy-hopping	the tail of a whale

Increase or Decrease

Place the following list of words in the appropriate column according to whether it increased or decreased the populations of gray whales: *discovery of breeding lagoons, international ban on whaling, bomb lance invented, Marine Mammal Protection Act, steam-powered hunting ships, Endangered Species Act, whalers ban hunting grays, factory ships process whales at sea.*

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Pacific Gray Whale Newspaper Activity

Migration- What, Why, Who

WHAT Is Migration?

Locate a definition of migration:

seasonal movement from one region to another

WHY Migrate?

Brainstorm all the reasons WHY animals migrate:

better food, better climate, reproduction, poor habitat

WHO Migrates?

Starting with the gray whale, list all the animals you can think of that migrate. Next, list their migration route and why they migrate:

Animal	Migration Route	Reason for Migration
gray whales	***Bering Sea to Baja California***	***breeding, food***
Rocky Mountain elk	***high elevation to low elevation***	***change of season, food***
northern elephant seals	***Pacific coast***	***food, breeding***
Monarch butterflies	***Canada/ Northern U.S. to Mexico***	***escape the cold?***
humans	***varies***	***war, relocation, herding***
birds	***varies***	***better climate, food, reproduction***

Pacific Gray Whale Newspaper Activity

Like and Unalike

Use the newspaper and your own ideas to brainstorm the following:

In what ways are gray whales like other mammals?	***breathe air*** ***warm-blooded*** ***nurse their young from mammary glands*** ***live birth***
How are gray whales different from other mammals?	***eat plankton*** ***specialized for life in ocean, spend most of their lives underwater*** ***fluke/flipper*** ***do not have a coat of hair for warmth*** ***hindlimbs completely lost (externally)***
In what ways are gray whales like other whales?	***both in order Cetacea*** ***all whales have fins, blowholes*** ***thick layer of blubber***
How are gray whales different from other whales?	***some whales toothed with one blowhole (Odonteceti)*** ***some whales have baleen and two blowholes (Mysticeti)***

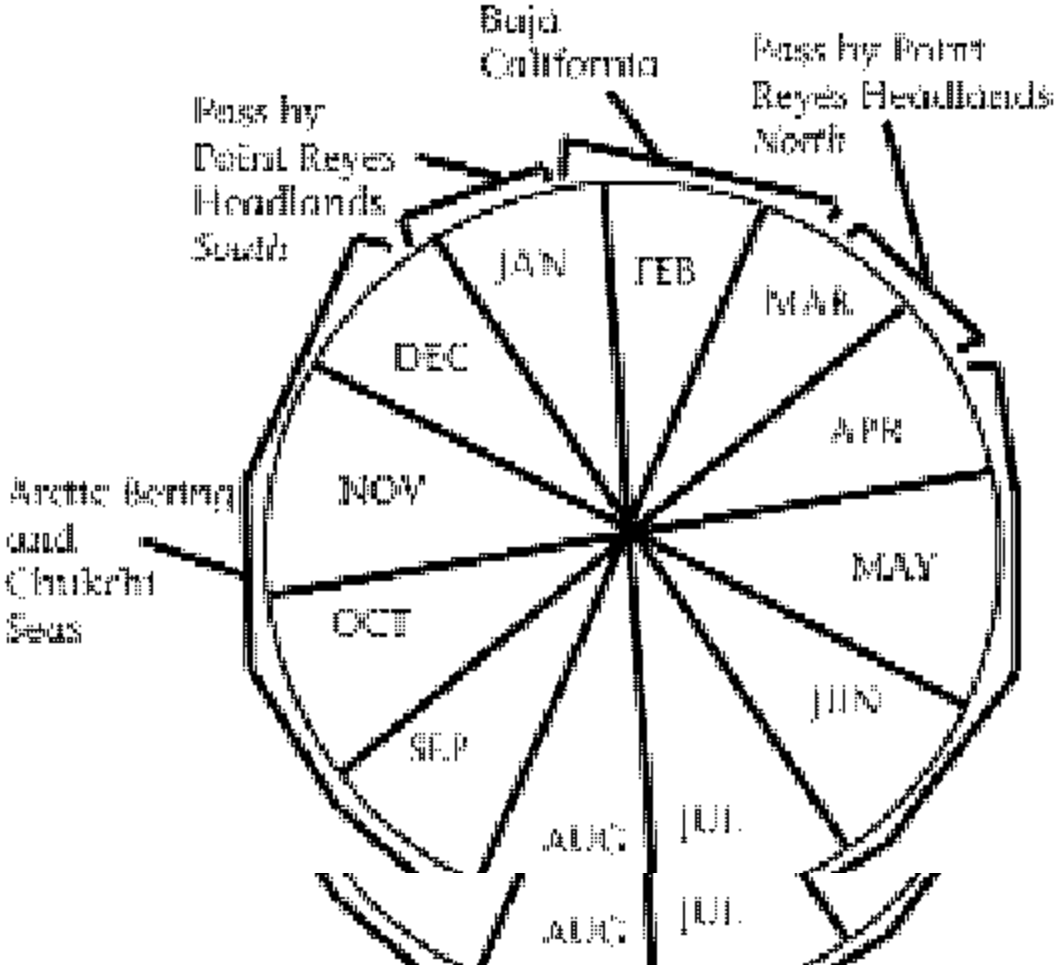
Annual Behaviors

1.Reread the *Pacific Gray Whale* newspaper. Use a blank piece of paper to record any information relevant to the Gray whale's lifestyle and what time of the year it occurs.

Be sure to include:

- Northern and southern Migration
- Breeding
- Pregnant females arrive at Baja lagoons
- Females give birth
- Seen at Point Reyes National Seashore (twice in a year)
- Arrival at feeding grounds
- Behavior at feeding grounds

2. Use the circle graph below to visually portray a gray whale's lifecycle over the course of a year. Colors and different styles of writing will help organize the information.



Pacific Gray Whale Newspaper Activity

What is It Like To Be a Gray Whale?

Imagine and write a story in the first person describing your life as a gray whale. Use some of the following ideas to get started:

Who are you traveling with?
Are you a male, female, or calf?
Are you pregnant? Does this affect your trip?
How do you know where to go?
What does the ocean floor look like?
Can you taste the differences in the water?
Do you see or hear humans or other animals or fish?
What is the difference in water temperature between the northernmost point of your route and the southernmost point? How does that feel?
What is the return trip like, after not eating much for five months?
Are you travelling with a new calf?
Is this your first baby? What is it like?
Are you hungry when you get back north?
There is much that humans don't know about whales. What would you like to tell them?

essays will vary

Pacific Gray Whale Newspaper Activity

Technology, Intervention, Ethics

Whale populations have been hunted for food and raw materials for hundreds of years. It was not until they were hunted for profit that their population numbers were significantly affected.

1. List three technological devices that increased efficiency/profit of whaling and their consequences on the total whale population.

Technology	Consequence
a. ***bomb lance invented***	***decline***
b. ***steam-powered whaling ships***	***decline***
c. ***factory ships at sea***	***decline***

2. List three interventions that helped gray whale populations make a comeback.

Intervention	Consequence
a. ***ban on hunting gray whales***	***increase***
b. ***international ban on whaling***	***increase***
c. ***Marine Mammal Protection Act***	***increase***

3. Do whales have a value regardless of whether humans can economically earn a profit?

   answers will vary

4. What is the value of a whale to Point Reyes National Seashore?

   answers will vary

5. What is the value of a whale to the National Park System?

   answers will vary

6. What is the value of a whale to you?

   answers will vary

Whaling Computations

In 1843 a whaling ship returns to harbor after three years, with the following:

520 barrels of Sperm Whale Oil
1,750 barrels of Whale Oil

1843 prices of whaling ship cargo:

$1.25/gallon Sperm Whale Oil
$ .43/gallon Whale Oil

If one barrel of oil holds 32 gallons

1) How many gallons of sperm whale oil and whale oil were brought ashore?

520 x 32 = 16,640 gallons of Sperm Whale Oil
1,750 x 32 = 56,000 gallons of Whale Oil

16,640 + 56,000 = 72,640 total gallons of oil brought ashore

2) How much money was earned from this trip?

520 x 32 = 16,640 gallons of Sperm Whale Oil
1,750 x 32 = 56,000 gallons of Whale Oil

16,640 + 56,000 = 72,640 total gallons of oil brought ashore

3) If one dollar in 1843 is worth $25 today, what would be the value of the ship's cargo today?

$44,880 x $25 = $1,122,000 value today

4) What was the yearly income of this ships cargo in today's dollar value?

$1,122,000/ 3 = $374,000 yearly income

Name _____ **Date** _____

Activity Sheet

Pacific Gray Whale Newspaper Activity

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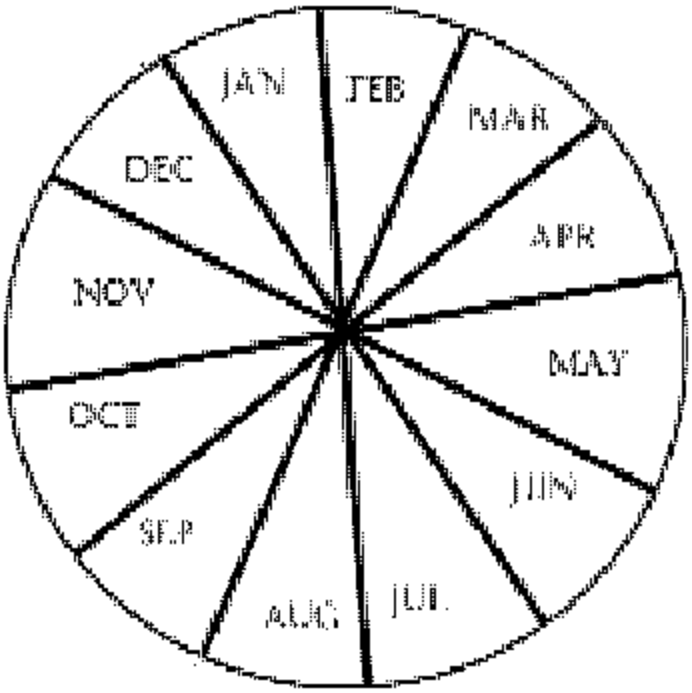

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Technology	Consequence
a.	
b.	
c.	

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Intervention	Consequence
a.	
b.	
c.	

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1843 prices of whaling ship cargo:

$1.25/gallon Sperm Whale Oil
$ .43/gallon Whale Oil

If one barrel of oil holds 32 gallons:

1) How many gallons of sperm whale oil and whale oil were brought ashore?

2) How much money was earned from this trip?

3) If one dollar in 1843 is worth $25 today, what would be the value of the ship's cargo today?

4) What was the yearly income of this ships cargo in today's dollar value?

How Have Gray Whales Adapted to Life in the Ocean?

Students explore the concept of mammals and whales becoming adapted to an ocean existence. Following a brainstorming activity, the students role-play a "Class Action Gray Whale" and relate physical features to specific adaptations for all whales.

Time required: 2 hours
Location: classroom
Suggested group size: entire class
Subject(s): science
Concept(s) covered: mammal characteristics, whale adaptations
Adapted from: A Class Action Whale
MARE Teachers Guide to the Open Ocean
Written by: Jim Corsetti, Petaluma Middle School
Last updated: 09/22/01

Student Outcomes

At the end of this activity, the students will be able to:

- Understand adaptations associated with mammals' transitioning from a land to marine existence.
- Role-play one physical part of a gray whale.

California Science Standard Links (grades 6-8)

This activity is linked to the Californian Science Standards in the following areas:

7th grade 3a-genetic variation and environmental factors are causes of evolution and diversity of organisms
5a-animals have levels of organization for structure and function

Pre-Visit Lesson Plan

Creating Coastal Stewardship through Science

Pre-Visit Lesson Plan

National Science Standard Links (grades 5-8)

This activity is linked to the National Science standards in the following areas:

- Content Standard C - Structure and Function in Living Systems, Diversity and Adaptations of Organisms, Reproduction and Heredity

Materials

To be provided by the teacher:

- Optional: 15-20 magazine pictures of various land mammals

To be photocopied from this guide:

- **What Is a Gray Whale?** Teacher Information Sheet
- **How Have Whales Adapted to Life in the Ocean?** Teacher Information

Vocabulary

dorsal ridge, fluke, pectoral flippers, peduncle, rostrum, ventral pleats

Procedures

1. Review adaptations

Introduce lesson by reviewing concepts and examples of adaptations.

2. Silent Mingle strategy

Students are instructed to mingle among other classmates without talking. When the teacher gives a predetermined signal, students stop and face the nearest student. Teacher poses first focus question and student pair discusses possible answers. After 2 minutes, the process is repeated with remaining questions. Students should not pair up with the same partner more than once.

Focus questions:

a) What are characteristics of mammals?

b) What are the strangest mammals you can think of? Why are they strange?

c) Why would it be difficult for a mountain lion to live in the ocean?

3. Think/Pair/Share

Have students share a desk with their last silent mingle partner. Pair will choose a land mammal (or a magazine photo of a mammal). The task is to decide how their particular land mammal could be adapted to successfully live in the ocean and why those adaptations are necessary. Let students jot down notes and draw pictures. Afterwards, students share ideas with class. Eventually, there will be a class brainstorm. List all of the ideas students came up with for adaptations and why adaptations are necessary.

4. Gray whale adaptations

Lead students in a discussion to brainstorm whale specific adaptations to an ocean life. Use the Teacher Information Sheet **How Have Whales Adapted to Life in the Ocean?** for additional ideas.

5. A "Class Action Gray Whale"

Let the students know they are about to become a Pacific gray whale. Allow plenty of space for students to become various parts of the whale, one part at a time. Use the Teacher Information Sheet **What Is a Gray Whale?** as guidance for instructions to give students. Also refer to the Teacher Information Sheet **How Have Whales Adapted to Life in the Ocean?** for brainstorming adaptations for each specific part of the whale as it is assembled. Use the section in the *Pacific Gray Whale* Newspaper for specifics on gray whale anatomy.

Extension ideas

1. Bring a bucket of sidewalk chalk to the playground and have students draw life-size whale and label anatomical parts. This could also be done on the blackboard with explanations of body parts provided by the student.

What Is a Gray Whale?

Rostrum: Two students

These students stand facing each other 2-3 feet apart. Their right arms are extended frontward and to the left. Their right hands are joined to make a point. Their heads should be lowered to shoulder level to be streamlined. They are now the large, flat upper jaw or rostrum.

Lower Jaw: Two students

Each student kneels next to the right hip of each half of the rostrum. Students extend their right arms so that their right hands meet under the rostrum. If they curve their arms, the lower jaw will be wider. Have students practice opening and closing the whale's mouth by raising and lowering their arms together. Only the lower jaw moves, the rostrum stays stationary.

Blowholes and Blow: Six students

Two students will represent a blowhole and one student the breath. With two blowholes, two trios working as a team will accomplish this function. Each "blowhole" will stand a few feet behind the mouth with their hands high and close together. Two "breaths" will stand under their respective blowhole. When the whale is underwater, the “breath” is crouched and the “blowholes” have themselves closed. When the whale surfaces, the “blowholes” open, making loud breathing noises, and the "breath" can jump up and yell "Thar she blows"." Practice a series of four to five blows.

Eyes: Two students

Each student stands facing out on each side of the mouth just behind the blowhole. The eyes will stick out quite a ways from the side of the whale's head. These eyes can help locate food.

Pectoral Flipper: Four students

Two students stand side by side, angling back from just behind the eyes on each side of the whale. They can hold their arms up and join hands. Their job is to balance the whale as it swims forward or tries to steer. The left flipper goes down for a left turn and the right flipper goes up. Right flipper down for a right turn and left flipper up. Have students practice left and right turning motions.

Dorsal Ridge: One student

This student will stand behind flippers. When the whale is surfacing and breathing, student should arch back "out of water."

Teacher Information

Peduncle: Two students

These students will sit on the ground on either side of the dorsal ridge. Have their legs extend out toward where the fluke will eventually be located. The peduncle is the strongest group of muscles in the animal kingdom. It is responsible for providing power for locomotion.

Fluke: Two students

These students sit on either side of the spine, on the ground, with their feet touching the feet of the peduncles. When the peduncles push their feet forward, the tail should be on a downstroke. The fluke lies down. When the peducles pull their feet back, the fluke sits up. This requires coordination with the peduncles and fluke working as a team. Allow some time to practice until it can be done smoothly.

Crustaceans, Copepods, Benthic Invertebrates: Remaining students

These students will swarm in front of the whale or hunker down low on the sea floor. Have the whale open its mouth and practice filter-feeding.

Putting the whole whale together:

Call out behaviors to get your whale working. Filter feeding in arctic waters; migration with flippers balancing; fluke moving up and down.

How Have Whales Adapted to Life in the Ocean?

Rostrum

Body and rostrum (upper jaw) have becomes long, flat, and streamlined to move more efficiently through the water.

Blowhole

Whales still retain the ability to breathe air. Their nostrils migrated to the top of their head in order to facilitate breathing. During diving the pressure of the water operates in such a way as to close the nostrils from the outside so that regardless of the depth, there can be no leak. These nostrils connect directly to the lungs (in humans, nostrils also connect to the trachea for food passage.) This allows whales to eat without the complication of flooding the lungs.

Eyes

Eyes have become less important over time and whales have no stereoscopic vision.

Pectoral Flippers

Pectoral flippers are modified front legs, used by the whale like wings to dive and steer its way through water and for courtship and mating. The digits on the flippers have become long and covered with skin to serve as paddles. Back legs have disappeared although there are still vestigial hind legs remaining inside the body.

Peduncle/ Fluke

Originally the fluke was a tail that widened over time. The peduncle is used to power the fluke and is the strongest group of muscles in the mammal kingdom. The fluke is driven up and down as opposed to side to side as in fish. These long muscles do the work and allow the whale to be more streamlined by not having to move side to side.

Crustaceans, Copepods, Benthic Invertebrates

Gray whales have the heaviest parasite load of all the cetaceans.

Hair

The hair on whales' bodies has disappeared, although some whiskers exist around the mouth.

Teacher Information

Baleen

Baleen allows enormous whales to eat low on the food chain, with more energy available at a low cost. Although adult whale no longer have teeth, they are still present in gray whale fetuses while developing.

Blubber

Blubber developed under the skin to serve as an insulator in cold water, protection from sharks/killer whales, and a source of stored energy.

Of What Importance are Whales and Dolphins in the Ecology of the Pacific Ocean?

Students will research various whales found in the Pacific Ocean to create a "seascape" mural depicting the oceanic habitat and ecosystem components.

Time required: 2 hours

Location: classroom

Suggested group size: entire class

Subject(s): science, biology

Concept(s) covered: niche, ecosystem, food pyramids, food chains,abiotic factors, food web

Written by: Christie Denzel Anastasia and Lynne Dominy, National Park Service

Last Updated: 09/22/01

Student Outcomes

At the end of this activity, the students will be able to:

- Visually perceive major life zones in the Pacific Ocean

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade
5a- food webs
5b- organisms and the physical environment.
5c- organisms can be categorized by functions
5d- different organisms may play similar ecological roles in similar biomes.
5e- the number and types of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.
7b- appropriate tools and technology to perform tests, collect and display data.

Pre-Visit Lesson Plan

7th grade 5a- animals have levels of organization for structure and function.
5c- how bones and muscles work together to provide a structural framework for movement

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Identify questions that can be answered through scientific investigation, use appropriate tools and techniques to gather, analyze, and interpret data, think critically and logically to make the relationships between evidence and explanations.
- Content Standard C - Structure and function in living systems, Reproduction and heredity, Regulation and behavior, Populations and ecosystems, Diversity and adaptations of organisms.
- Content Standard F -Populations, resources, and environments; Science and technology in society.

Materials

To be photocopied from this guide:

- **Cetacean Research** Activity Sheet (one per student)
- **Oceanic Energy Cycling/ Major Oceanic Life Zones** Teacher Information Sheet
- **Example of a Simplified Food Web for Pacific Ocean** Teacher Information Sheet
- **Pacific Ocean Seascape** Teacher Information Sheet

Vocabulary

amphipod, aphotic zone, benthic division, carnivore, cetacean, competition, consumer, decomposer, diatom, euphotic zone, food chain, food pyramid, food web, herbivore, neuritic province, niche, oceanic province, omnivore, pelagic division, producer, scavenger

Procedures

1. Ecology Discussion

Introduce concept of "niche". What physical and biological factors are necessary to a whale's survival? Explain that a habitat can be thought of as an organism's "address", while a "niche" is its "profession". Look over the **Cetacean Research** Activity Sheet to see if there are other terms or concepts that need to be explained.

2. Independent research

Students choose which whale species they are most interested in researching. This may be done individually, in pairs, or in teams. The list should include some of the following:

Humpback Whale
Blue Whale
Killer Whale
Finback Whale
Gray Whale
Sperm Whale
Cuvier's Beaked Whale
Baird's Beaked Whale
Orca
False Killer Whale
Sei Whale
Pilot Whale
Minke Whale
Risso's Dolphin
Pacific White-Sided Dolphin
Northern Right-Whale Dolphin
Common Dolphin
Harbor Porpoise
Dall Porpoise

3. Activity sheets

Students are responsible for several types of information in their research. They may use the **Cetacean Research** Activity Sheet to focus their findings. Each team should have visual aids (drawings, photocopies, etc.) of their cetacean and other associated organisms.

4. Construct mural

Using a large piece of paper, label primary zones and the ocean floor. Each student/group will present their findings on individual whales and tape their drawings on the large piece of paper. If there are connections between their whale and whales or organisms already displayed, string could be taped to mural during their presentation. Students should end up creating something similar to **Pacific Ocean Seascape** Teacher Information Sheet.

5. Complete and review mural

What other living (biotic) ecosystem components have not yet been accounted for? Identify and label on mural.

Phytoplankton
Zooplankton (krill, amphipods)
Benthic worms
Squid
Fish (hatchet fish, Atlantic herring, Atlantic cod)
Bacteria

What nonliving (abiotic) ecosystem components have not yet been accounted for? Identify and label on mural.

- Sunlight
- Topography/sediments/depths
- Ocean currents
- Wind
- Water/air temperature
- Tides
- Chemical salinity

Identify where niche overlap occurs (ie., competition).

Identify where specific adaptations have decreased potential competition and made their niche specialization more secure.

6. Wrap-up

Emphasize the ecology of the Pacific gray whale. This is the whale most likely to be seen on your upcoming field trip to Point Reyes National Seashore.

Extension ideas

1. Review role of raw material cycles in the ocean:
   - Decomposition
   - Nitrogen cycle
   - Water cycle
   - Oxygen cycle
   - Carbon cycle
   - Phosphorous cycle
   - Sulfur cycle
   - Upwelling
   - Sediments
2. Have students compare the stratification of ocean communities to land communities. Discuss the concept of "niche".
3. Have students recreate each species to a comparative scale. Using a list of the actual length of each species, students can designate a conversion that will apply to all species. Using posterboard or another type of large paper, students can then recreate the species using freehand or a grid duplication method. This will result in a realistic comparison of sizes. Students can recreate other means to compare whales, such as a human drawn to same scale. If there is enough room somewhere in the school, these can be displayed in a family tree organization or as a mobile.
4. Using rope, as long as the longest whale, students will mark off lengths of each species identified in this activity. Comparing the different lengths provides perspective on various species and their relation to human size.
5. Use field guides to marine mammals to compare and contrast something unique about each species.

Name _____ **Date** _____

Cetacean Research Activity Sheet

Activity Sheet

Use this sheet to focus research for your presentation.

Cetacean: _____

Ecological Role: _____

_____

_____

Feeding Strategy:

- ☐ Fasting
- ☐ Gulping
- ☐ Skimming
- ☐ Suctioning
- ☐ Seasonal variations in feeding?
- ☐ Straining
- ☐ Other

Depth of Feeding: _____feet to _____feet

Trophic Level (check all that apply):

- ☐ Producer
- ☐ Herbivore
- ☐ Consumer
- ☐ Carnivore
- ☐ Decomposer
- ☐ Omnivore
- ☐ Scavenger
- ☐ Other

Food Chain:

Preys on _____

Is preyed on by _____

Is in competition with _____

Food Pyramid:

Sketch a food pyramid for your cetacean on the back of this paper.

Food Web:

Sketch a food web for your cetacean on the back of this paper.

Activity Sheet

Name _____ **Date** _____

Habitat:

Requirements_____

Threats_____

Ecology:

Other environmental components

_____

Human activities that affect health of zone residents

_____

Status

Population size_____
Federal status_____
State status_____

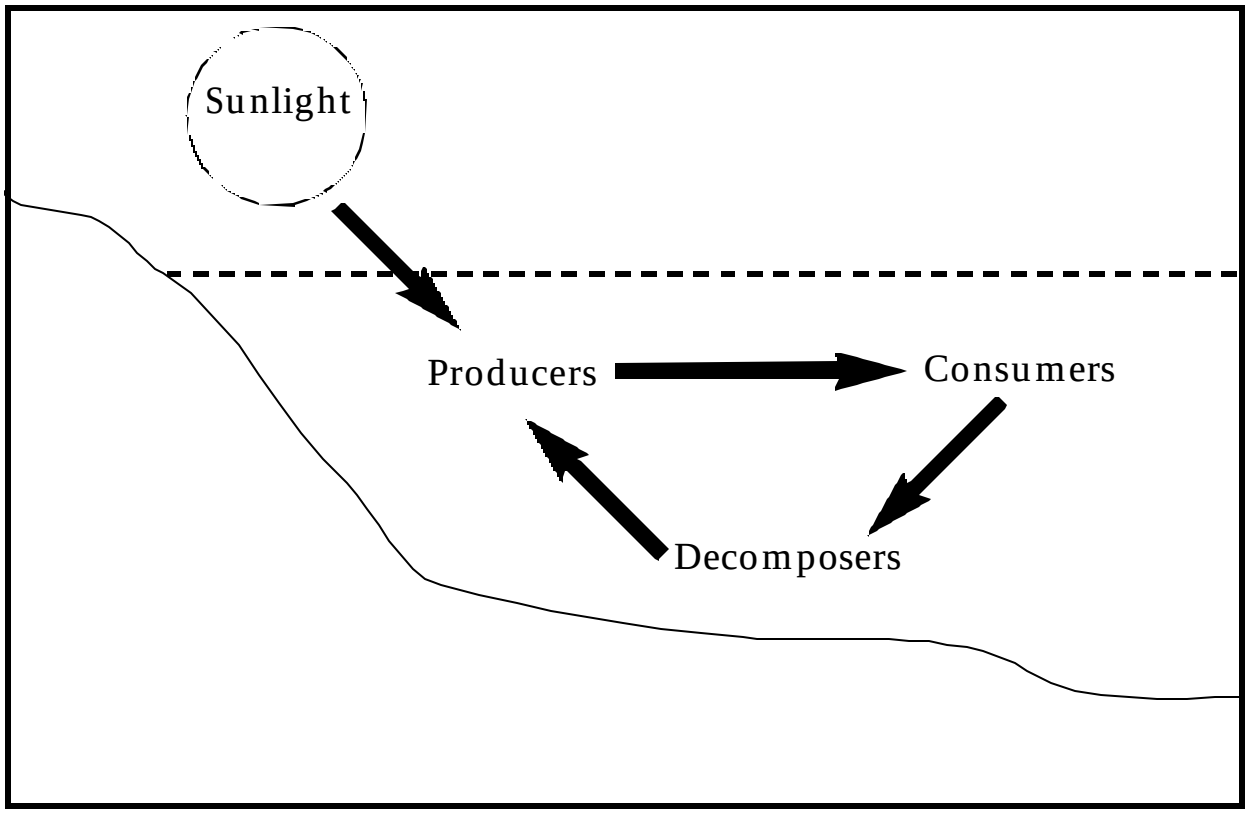
Summary:

What oceanic life zones can your whale be found in?

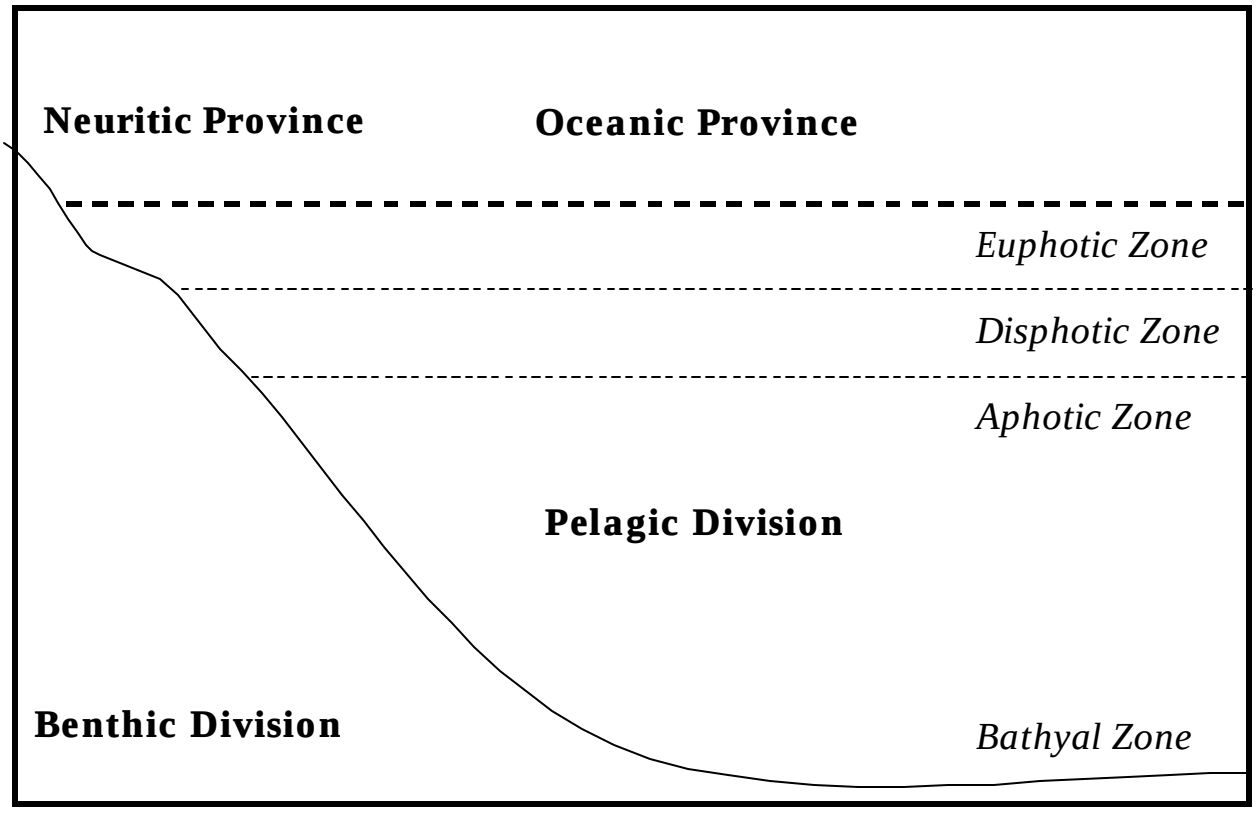
How would you define the niche of your particular whale?

Provide a drawing or photocopy illustrations of your whale and other organisms in its community.

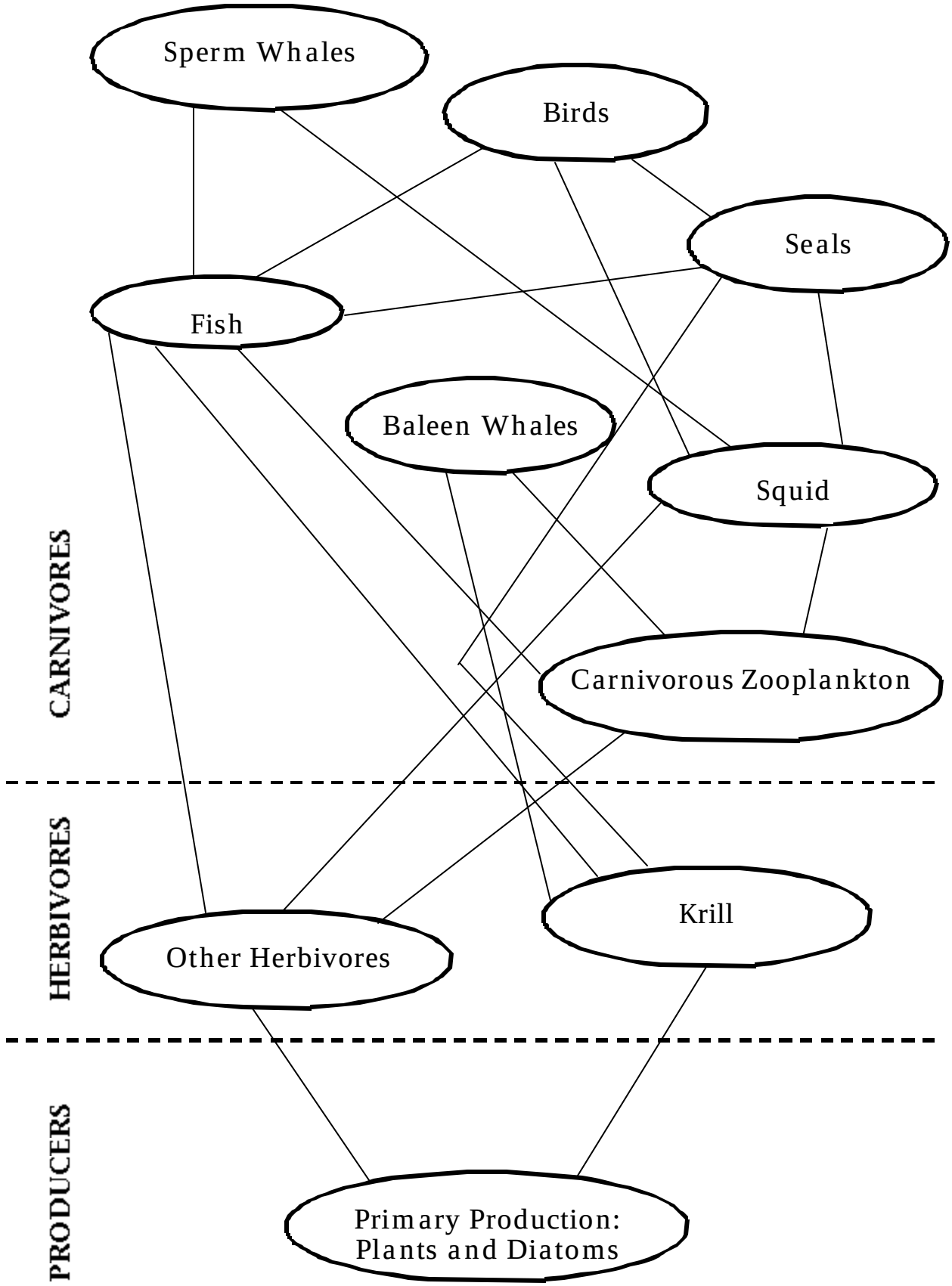
Oceanic Energy Cycling



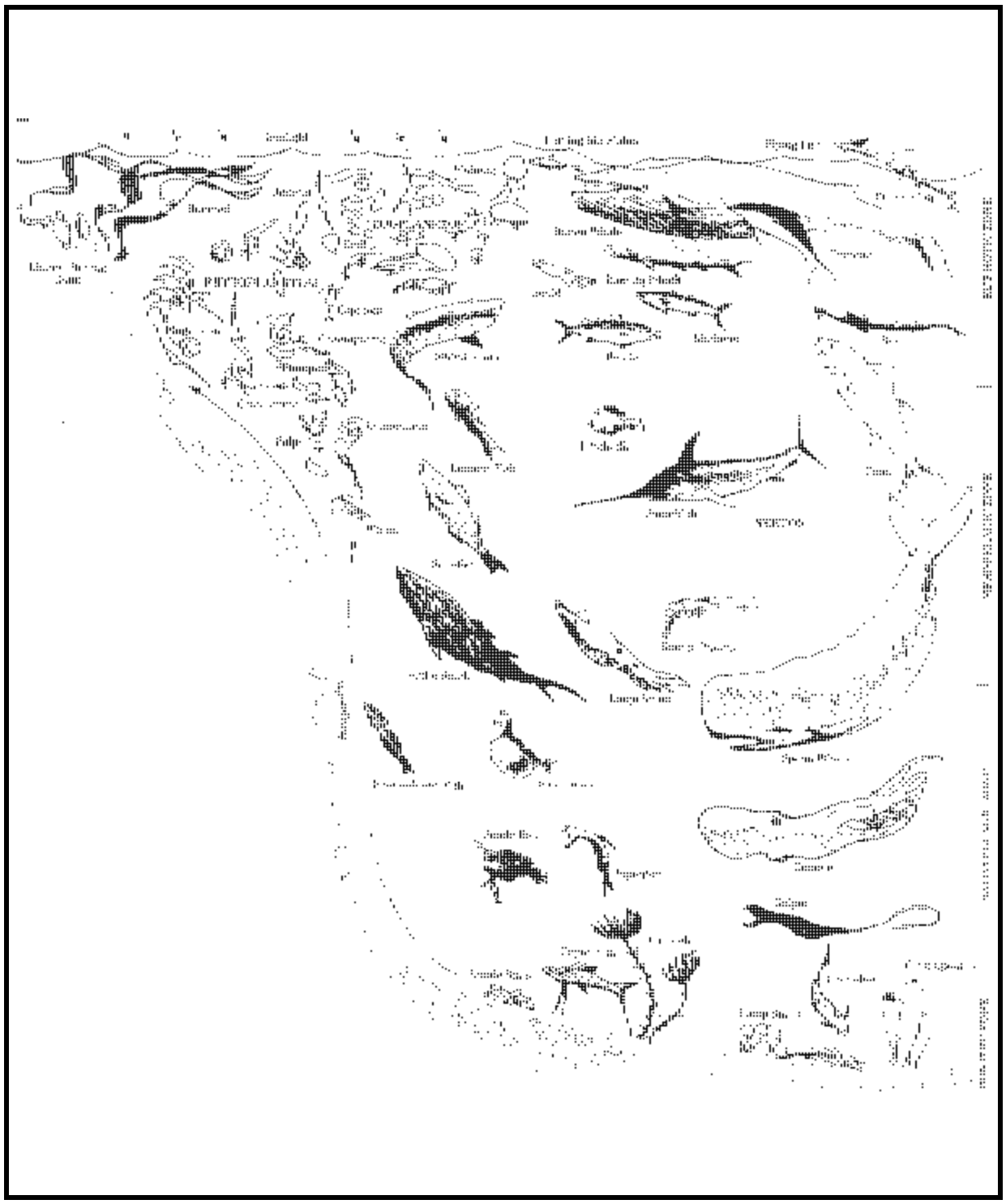
Major Oceanic Life Zones



Example of a Simplified Food Web for Pacific Ocean



Pacific Ocean Seascape



What Can We Expect on our Field Trip to Observe Gray Whales at Point Reyes National Seashore?

Students prepare for field activities while visiting Point Reyes National Seashore to observe gray whales. Journals are assembled and reviewed for content and expectations. It is imperative that students understand how to use their journals to get the most out of their field trip.

Time required: 1 hour

Location: classroom

Suggested group size: all

Subject(s): science, math, writing

Concept(s) covered: safety, gray whale behaviors, recording observations

Written by: Christie Denzel Anastasia, National Park Service

Last updated: 01/08/01

Student Outcomes

At the end of this activity, the students will be able to:

- Understand how to use their journal as a tool in field observations.

California Science Standards Links (grades 6-8)
This activity is linked to the California Science Standards in the following areas:

6th grade 7b- appropriate tools and technology to perform tests, collect and display data.

7th grade 7a- appropriate tools and technology to perform tests, collect and display data.

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A- Use appropriate tools and techniques to gather, analyze, and interpret data; understanding about scientific inquiry.

- Content Standard G- Science as human endeavor; Nature of Science: students formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.
- Content Standard F- Populations, resources, and environments

Materials

To be provided by the teacher:

- blank paper to be included in field journals

To be photocopied from this guide:

- **Field Journal Sheets** for each student(located in first onsite lesson plan)
- **Field Journal Master** for each teacher and chaperone
- **How Can I Capture My Experience in a Story, Poem, or Drawing?** Field Journal Sheet (second onsite lesson plan)

Vocabulary

baleen, invertebrates, krill, pods, sounding, spouting, spy-hopping, upwelling

Procedures

1. Create journals

Have students construct their field journals. See **Tips for Creating Field Journals**, following this lesson plan page. Distribute photocopies of the Field Journal Sheets and have students assemble their field journals.

2. Review field trip logistics

There are two primary activities included in this field visit: whale watching and a scavenger hunt. Ideally, students arrive at the Lighthouse Parking Lot, use restrooms, and walk toward the Lighthouse Visitor Center and Observation Deck (15-minute walk). Students will then be assigned to teams with a chaperone. Ideally five students per chaperone. All activities take place in a relatively close distance and allow for flexibility. Half of the teams will work on the Scavenger Hunt while the other half will whale watch. After a pre-determined amount of time, the teams will switch activities.

3. Review journal structure and expectations

Review field activities by having students turn to appropriate page in their journal as you review expectations. Students may also record their name and school name at top of each journal sheet.

• Things to Remember While on Field Trip
This journal sheet will be completed as a result of the next activity, "Safety and Stewardship Challenge".

• Gray Whale Field Guide
This page should be carefully reviewed in class prior to the field trip so students know what to expect to see. These behaviors will also be used in recording observations on **Whale Sighting Log**.

• Whale Sighting Log/Other Marine Species Sightings
Students will give their whale sighting an identification number, record behavior, and any other additional notes. They will also use the identification number to record approximate location on **Whale Sighting Map**.

• Whale Sighting Map
With the Lighthouse as a landmark, students will use their unique identification number for a specific whale to record approximate location of sighting. Some identification numbers will appear more than once if a dive sequence is visually followed. Direction of travel for whales will also be recorded.

• Scavenger Hunt Sheets A-J
Student teams will work on these activity sheets together. This "hunt" takes place in the Lighthouse Visitor Center and on the Observation Deck. All of the information needed to fill out the worksheets is located on displays or can be based on prior knowledge. All of the text for these displays is included after the first onsite lesson plan, **Exhibit Panels at Point Reyes Lighthouse Visitor Center for Scavenger Hunt**.

4. Review chart for gray whale sightings at Point Reyes
Use the chart on **Scavenger Hunt** sheet "G" to see where your visit will fall within the gray whale sightings for Point Reyes National Seashore.

5. Review "How to Whale Watch"
There may be a Park Ranger on the observation deck for your field trip. This ranger can give your class a demonstration on whale watching. Prepare your students by reviewing the information below.

- Scan the entire ocean surface for spouts without using your binoculars.
- Observe the surface from shoreline to horizon.
- Spouts will look like a "puff of smoke".
- Sometimes when it is windy, students will see whitecaps and think they are whales.

- If a whale has truly surfaced and spouted, you should be able to see a whale "footprint". "Footprints" are formed when the whale comes to the surface and dives below again. The area where the whale was located is glassy, smooth, and oval shaped.

- Focus your binoculars on where you saw a spout or a footprint. You should be able to locate where the whale will resurface next.

6. Review list of what students should bring on field visit

. See Teacher Preparation / Field Logistics

Tips for Creating Field Journals

Materials

- ☐ Field Journal Sheets for each student, teacher, and chaperone
- ☐ One package blank paper and one package lined paper
- ☐ Colored paper, card stock, or cardboard for journal covers
- ☐ Magic markers or colored pencils for decorating covers
- ☐ 3-hole punch
- ☐ String, binding tape or twigs and rubber bands for binding
- ☐ Pencil on a string for each student
- ☐ Two plastic pencil sharpeners and extra pencils for field trip
- ☐ One box of large ziplock bags to rainproof journals

Procedures

1. Photocopy all of the unit handouts and provide each student with double-sided copies. Use recycled paper if it is available.
2. Provide five additional blank sheets of paper and five lined sheets of paper to each student.
3. Have students create front and back covers for their journals using blank sheets of paper.
4. Have students bind their journals using binding tape, hole punches and string, cardboard, or a twig bound by rubber bands threaded through holes.
5. Once journals are bound, have students decorate the covers.
6. Have each student attach a sharpened pencil on a long string through a hole in the journal binding.
7. Have each student use a magic marker to write their name on the front cover of their journal.
8. Students will need a sturdy writing surface behind their field journals. Incorporate cardboard as the last page or have clipboards available for each student.

Extension ideas

1. Create a journal that is used throughout the year.
2. Share student journals with parents at open houses.
3. Students may choose to use their journals to create a class newsletter, resource newspaper, or a class website.

Safety and Stewardship Challenge

Students will learn methods for observing gray whales and understand proper behaviors in a National Park. This will be accomplished by simulating a group "game show" and completing the first page of their field journals.

Time required: one hour

Location: classroom

Suggested group size: any

Subject(s): science

Concept(s) covered: low impact use of natural areas, behaviors in a National Park, safety

Written by: Christie Denzel Anastasia and Lynne Dominy, National Park Service

Last updated: 06/20/00

Student Outcomes

At the end of this activity, the students will be able to:

- List three safety precautions for upcoming field trip.
- List three proper behaviors for viewing gray whales.
- Understand concepts of National Park System and stewardship.

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard F -Personal Health: Injury Prevention; Populations, resources, and environment.

Materials

To be provided by the teacher:

- Desk bell (or other device to indicate which team has the first answer)

To be photocopied from this guide:

- **Safety and Stewardship Challenge Questions** Teacher Information Sheet (one set)

Vocabulary

stewardship

Procedures

1. Divide class into teams.

Option A: If class can work as large teams, divide the class into two teams. Each team will need a spokesperson and team name. Answers will come from the entire group. Spokesperson can change throughout the game.

Option B: If class may get too loud, students can still be divided into teams, but answers will come from individuals on each team. One person from each team will be assigned a number. Team A and Team B will each have a #1, #2, etc. Randomly choose a number from hat. The student with that specific number from each team will be responsible for answering the question. Random choice of numbers will help students pay attention if they aren't quite sure when their turn will occur.

2. Draw Challenge Grid and Scorecard on blackboard.

There are four categories with questions of varying value. As a finale, there is a final jeopardy question. Draw this grid on the chalkboard:

<table>
<tr><td colspan="4">Safety and Stewardship Challenge</td></tr>
<tr><td>Category #1
Take Care of Yourself</td><td>Category #2
Minimize Your Impact</td><td>Category #3
Whale Etiquette</td><td>Category #4
The National Park Service</td></tr>
<tr><td>1 point</td><td>1 point</td><td>1 point</td><td>1 point</td></tr>
<tr><td>2 points</td><td rowspan="2">2 points</td><td>2 points</td><td rowspan="2">2 points</td></tr>
<tr><td>3 points</td><td>3 points</td></tr>
<tr><td rowspan="2">4 points</td><td rowspan="2">3 points</td><td>4 points</td><td rowspan="2">3 groups</td></tr>
<tr><td>5 points</td></tr>
<tr><td colspan="4">Final Challenge</td></tr>
</table>

3. Choose Game Show Hosts

Option A: Teacher is responsible for asking all of the questions.

Option B: Four students will become "Challenge Hosts". Each student receives questions for a specific category and will ask appropriate questions according to point value.

4. Rules of the Game

- A coin flip will determine which team goes first.
- The game will end when a predetermined time runs out or when all questions have been answered.
- Team will decide which category and value of question will be asked.
- Spokespersons or individuals will poise themselves on either side of the desk bell with one hand behind their backs.
- After the question is asked, the first team to have an answer will ring the bell and respond. If they are correct, the team receives the full point value.
- If they are incorrect, the other team gets a chance. If they also get it wrong, the first team can try again for one less point.
- When brainstorming answers, students should whisper, or the other team may hear their answer.
- When all of the categories are complete (or 5 minutes before a predetermined "game-over" time), class will go into "Final Jeopardy". Each team decides on amount of wager, listens to question, and writes down answer on a sheet of paper. Each team reveals answer.
- At the end of the game, the team with the most points "wins", but everyone wins if your visit to Point Reyes National Seashore will be safe for themselves and the resources.

5. Complete first page of field journal.

Using the information gained in this "game show", have students list at least three items under each category on the first page of their journal (**Things to Remember While on Field Trip**). Use the **Safety Issues: Whale Unit** Teacher Information Sheet at the end of this lesson as a guide.

Safety and Stewardship Challenge Questions

CATEGORY #1: Take Care of Yourself

1 point

Bring a water bottle and drink plenty of water because…

A …you will not be able to speak well with a dry throat.

B …not drinking enough water can give you a headache and cause you to make bad decisions.

C …a heavy water bottle will slow you down as you are walking.

D all of the above

2 points

If the sun feels warm, you should…

A …try to get a tan.

B …use sunglasses, sunscreen, and/or a hat.

C …take off your shoes and walk barefoot.

D all of the above

3 points

Cliff edges in Point Reyes National Seashore are…

A …made of granite and safe as long as you have one foot flat on the ground at all times.

B …sandy, loose, and slipper;, be careful at all times.

C …safe if you have good balance.

D …the best places for a good view.

4 points

The best way to dress for a field trip:

A Comfortable, close-toed shoes.

B A T-shirt and a heavy, waterproof jacket.

C "Like an onion", many thin layers with a waterproof one on the outside.

D A and C

Safety and Stewardship Challenge Questions

CATEGORY #2: Minimize Your Impact

1 point

When visiting Point Reyes National Seashore, you should stay on trails because…

A …you are more likely to pick up a tick in grassy areas.
B …when you travel off-trail you can damage plants.
C …you are speeding up erosion.
D all of the above

2 points

It's okay to take home just one rock from Point Reyes National Seashore ...

A Sure, it's just one, but let your teacher know.
B No, every rock is home to many bugs and plants.
C No, with 2.5 million visitors, the Seashore would be rock-less if every visitor collected just one.
D B and C

3 points

Trash is….

A …okay to hide behind bushes in a National Park because it will eventually break down.
B …not a good source of food for hungry animals.
C ...not a part of the Point Reyes National Seashore ecosystem and should be properly disposed of whether it's your trash, or trash that someone else accidentally left behind.
D …only the responsibility of the maintenance staff, wherever it is.

Safety and Stewardship Challenge Questions

CATEGORY #3: Whale Etiquette

1 point

If a gray whale has spent too much time diving, you should…

A …give up.
B …pay attention and wait until it resurfaces.
C …throw some of your lunch into the ocean.
D …stop looking for whales because you have lost patience.

2 points

Stay at least…

A 1 foot from a marine mammal.
B 10 feet from a marine mammal.
C 100 feet from a marine mammal.
D Get as close as you want.

3 points

The best way to observe gray whales is to:

A Have patience.
B Look for spouts or blows below the horizon.
C Pay attention
D all of the above

4 points

Feeding wildlife will…

A …be okay, because it is legal.
B …put you in danger from a bite or an attack.
C …accustom them to humans and possibly create behaviors harmful to the animal's survival.
D B and C

5 points

If you come across wildlife appearing sick or injured, you should:

A Try to capture the animal and seek medical attention.
B Report the location, species, and your observations to someone who is responsible for its management (Park Rangers in National Parks, Humane Society in urban areas).
C Leave it alone.
D Get as close as possible to observe what is happening.

Teacher Information

Safety and Stewardship Challenge Questions

CATEGORY #4: The National Park Service

1 point

Which of the following is not a part of the National Park System?

A Grand Canyon National Park, AZ
B Point Reyes National Seashore, CA
C Monterey Bay Aquarium, CA
D Golden Gate National Recreation Area, CA
E Yosemite National Park, CA

2 points

I should treat Point Reyes National Seashore with respect because…

A …it belongs to everyone in the entire United States.
B …it preserves a part of the ecosystem you live in and depend on.
C …it's one of the few places natural processes can happen with little intervention from human society.
D all of the above

3 points

Which of` the following is the mission of the National Park Service?

A Preserve natural and cultural resources.
B Provide for the enjoyment, education, and inspiration of this generation.
C To care for special places saved by the American people so that all may experience our heritage.
D Cooperate with other resource-conservation and outdoor-recreation organizations in our country and the world.
E all of the above.

Bonus for one additional point:

Is the Mission of the National Park Service a law?

Yes. The 1916 Organic Act mandates the National Park Service to preserve and protect the natural and cultural heritage of the United States for the enjoyment of its citizens, leaving them unimpaired for the enjoyment of future generations.

FINAL CHALLENGE

This question is worth the amount that each team agrees to wager.

What does stewardship mean?

Teacher is the final judge on this answer.

Safety Issues: Whale Unit

Personal Safety

- Watch where you are walking, the ground may be rocky and uneven.
- Stay with your group.
- Drink plenty of water to avoid dehydration.
- Protect yourself from the sun's rays, use sunscreen and/or a hat.
- Stay on paths and in picnic area. Grassy areas may have ticks known to transmit Lyme's Disease.
- Be aware of personal allergies or conditions that may cause concern on the trail.

Remember... You are in a part of the National Park System.

- Point Reyes National Seashore is a natural area set aside to protect living and nonliving components of an ecosystem. Treat everything with respect.
- Allow plants and rocks and everything to continue their existence as part of an ecosystem by leaving things as they are found.
- Stay on established trails.
- Pack out trash or use garbage cans.
- Enjoy your visit, this is your National Seashore!

How Do I Use Binoculars?

Students prepare for upcoming Pacific gray whale field trip by becoming familiar with binocular structure and use. The key to whale watching is being able to locate the whales first without binoculars, and then to quickly relocate the whale again with binoculars.

Time required: time varies

Location: in class and/or sections at Bear Valley Visitor Center

Suggested group size: entire class

Subject(s): physics

Concept(s) covered: binocular structure and use

Written by: Christie Denzel Anastasia, National Park Service

Last updated: 09/31/00

Student Outcomes

At the end of this activity, the students will be able to:

- Understand the structure of binoculars.
- Practice focusing on moving images with binoculars.

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade	7b-appropriate tools/technology to perform tests, collect/display data
7th grade	6b-to see an object, light emitted/scattered must enter eyes 6d-simple lenses used in optics 7a-appropriate tools/technology to perform tests, collect/display data

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Abilities necessary to do scientific inquiry: use appropriate tools and techniques to gather, analyze, and interpret data.

Pre-Visit Lesson Plan

Materials

To be provided by the teacher:

- Pacific Gray Whale Kit and 20-40 pairs of binoculars (available for checkout at Bear Valley Visitor Center)

Procedures

Note: This lesson can be done in various stages depending on whether or not students have access to binoculars in class.

If students can ***bring in a pair*** of binoculars to use in class:

this entire lesson can be conducted in class.

If students can ***share a pair*** of binoculars to use in class:

Procedures 1 and 2 can be taught to entire class. Student teams can experiment with binoculars in 10-minute intervals throughout day.

If students ***do not have access*** to binoculars:

Procedures 1 and 2 can be conducted in class, Procedure 3 at Bear Valley Visitor Center when students receive individual binoculars from the Pacific Gray Whale Kit..

1. How do binoculars work?

In Theory: Before prisms were available, lens barrels had to be very long to increase the distance between eyepiece lens and objective lens to achieve magnification. These are the traditional "piratescopes". With the introduction of prisms, the light was bent and barrels made shorter. Binocular vision allows two images to become one for depth perception. Monoculars are like binoculars, but made for one eye and provide no depth perception.

In Structure: There are four main components of binoculars. Power is a function of these components. A 6x30 binocular has 6x magnification and a 30-millimeter lens. A larger lens lets in more light.

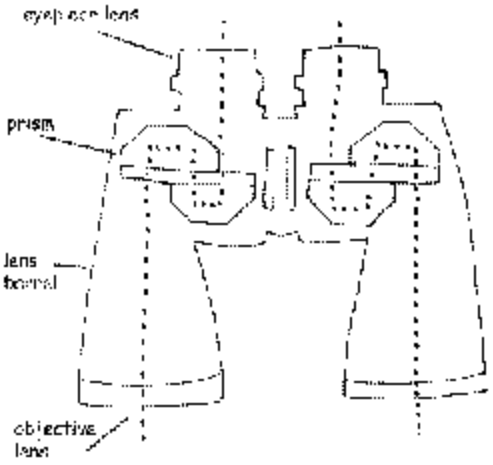
Eyepiece Lens: There are several convex lenses here for magnification. This is the lens closest to your eyes.

Prism: Bends light rays and returns reverse image to normal.

Lens Barrel: Keeps distance between eyepiece lens and objective lens. Blocks side lighting and protects from dirt.

Objective Lens: Gathers light in a convex lens. This is the lens that has a millimeter measurement (i.e., 6x30).

Diagram of Binocular Design



2. How do I get binoculars to work specifically for me?

Taking care of binoculars:

- Always keep them attached around your neck so they aren't accidentally dropped.
- While you are focusing binoculars, stand still. It would be easy to fall while focusing and walking.
- Clean binoculars properly.

If you wear eyeglasses:

- Keep your eyeglasses on.
- There is usually an "eye cup" rubber piece that folds back where your eyeglasses meet the eyepiece lens.

Things you adjust once:

- Barrel distance: The two barrels can be moved closer or further apart depending on the distance between your eyes.
- Focus right eyepiece: There is a knob on the right eyepiece that corrects for visual differences between your two eyes. If you are seeing more than one image, adjust the right eyepiece until there is one image.

Things you need to adjust with each observation:

- Center focus: Adjust the center focus with each observation to bring image into view.

Focusing on an image:

- Adjust barrel distance and right eyepiece
- Locate the image with your eyes. Are there any landmarks or reference points next to the image? These may help you find the image using the binoculars.
- Focus your eyes on the image. Without looking down, place the binoculars directly in front of your eyes. The rubber cup surrounding the eyepiece lens should rest against your eyebrow (unless you are wearing eyeglasses).
- Focus image into view with center focus.Keep elbows tucked in close to your body and both hands on binoculars to avoid a shaky image.

3. Practice using binoculars

Focus on a stationary object.

- Pick an object that doesn't move. Choose one somewhat near and one somewhat far. Use center focus.

Focus on moving objects in class.

- Right/left: Have a student walk slowly across the classroom while students use binoculars to keep in view. Speed up student walker to add a challenge.
- Away/toward: Choose a student to move toward and away from binoculars. Discuss range at which binoculars will work. At some point, object is too close to focus.

Focus on multiple moving objects at school.

- Attend a sporting event or practice at a lunch session in the cafeteria.
- Place a wildlife poster on a piece of cardboard and stick. Have a student move around the classroom with the posterboard: slow, fast, up, down, toward, away.

Focus on wildlife.

- Bring class outside in an area where they are likely to view moving wildlife such as birds.

Creating
COASTAL
STEWARDSHIP
through Science

Observing Pacific Gray Whales

On-Site Activities

How Can Teachers, Chaperones, and Students Make the Most of Their Field Trip?

Students will visit the Point Reyes Lighthouse to view the gray whale's migration past the Headlands. Their field journals will focus their observations on the migration and the Scavenger Hunt sheets will allow students to learn more about the gray whales natural history and ecology.

Time required: 3 hours and travel time

Location: Point Reyes National Seashore, Point Reyes, Lighthouse Visitor Center, Observation Deck

Suggested group size: consult with Education Coordinator when making reservations

Subject(s): science, writing

Concept(s) covered: recording observations, mapping migrations

Written by: Christie Denzel Anastasia, National Park Service

Last updated: 09/23/01

Student Outcomes

At the end of this activity, the students will be able to:

- Observe the Pacific gray whale migration and note observations in their field journals.

California Science Standards Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade 5a- food webs
5b- organisms and the physical environment.
5e- the number and types of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition
7b- appropriate tools and technology to perform tests, collect and display data

On-site Lesson Plan

Creating Coastal Stewardship through Science

7c-Construct appropriate graphs from data and develop qualitative statements about the relationship between variables
7f- interpret a simple scale map
7h- identify changes in natural phenomena over time

7th grade 7a- appropriate tolls and technology to perform tests, collect and display data.

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A- Use appropriate tools and techniques to gather, analyze, and interpret data; understanding about scientific inquiry.
- Content Standard G- Science as human endeavor; Nature of Science: students formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.
- Content Standard F- Populations, resources, and environments

Procedures

1. Travel to Bear Valley Visitor Center.

You may want to make the Bear Valley Visitor Center in Olema your first stop. Here you can pick up the Gray Whale Kit (binoculars, etc) and students may use the restrooms. There is also a slide show available upon request or students may look at the displays relating to the entire Seashore.

2. Travel to Point Reyes Lighthouse Visitor Center Parking Lot

Travel time from the Bear Valley Visitor Center to the Point Reyes Lighthouse Visitor Center Parking Lot is approximately 40- minutes.

3. Walk to Point Reyes Lighthouse Visitor Center and Observation Deck.

Once the bus arrives at the Parking Lot, there is a 15-minute walk to the Visitor Center and Observation Deck. Students or parents with accessibility issues may drive past the gate in a passenger vehicle to a designated parking area.

4. Split groups into teams.

The Observation Deck is located directly behind the Lighthouse Visitor Center. You may want to assign smaller groups to each chaperone. Half of the chaperone groups could go to the Observation Deck for whale watching while the other half could go to the Lighthouse Visitor Center to work on Scavenger Hunt sheets. Some of the Scavenger Hunt sheets use the displays located on the Observation Deck. After a predetermined amount of time, groups will switch locations and activities.

5. Travel back to parking lot and school

Allow 15 minutes to walk back to the parking lot, and at least 40- minutes to return to Olema.

Extension ideas

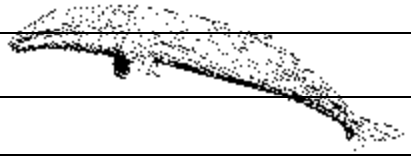
1.On the paved road, 250 yards before you get to the Lighthouse Visitor Center, you will walk on a life-sized painting of a gray whale. This mural provides a great opportunity for your students to understand the dimensions of a gray whale. If you "built" a whale in the classroom as a pre-visit activity, you could do a quick review on this painted whale, to reinforce what you did in the classroom. You could also quiz your students on the body parts of the whale by asking them to stand on a specific part as you call out its name (rostrum, fluke, blowhole, baleen, barnacles, etc.)

Things to Remember While on Pacific Gray Whale Field Trip

Three safety precautions:

1.

2.



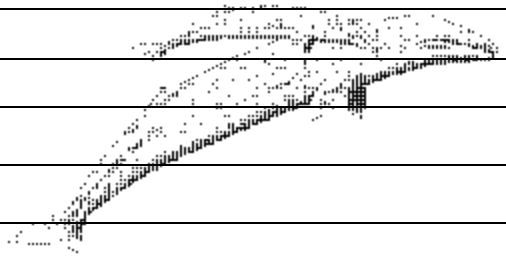
3.

Four resource protection behaviors:

1.

2.

3.

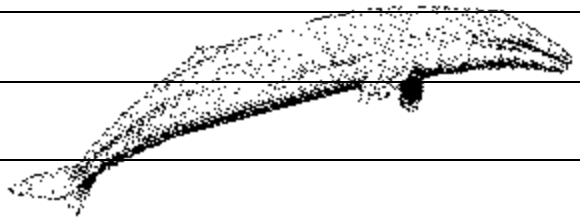


4.

Three things to keep in mind when visiting any part of the National Park System:

1.

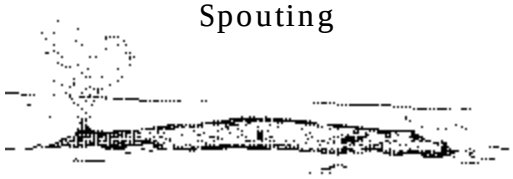
2.



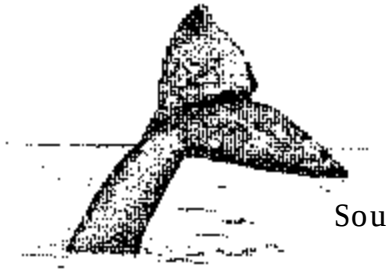
3.

Gray Whale Field Guide

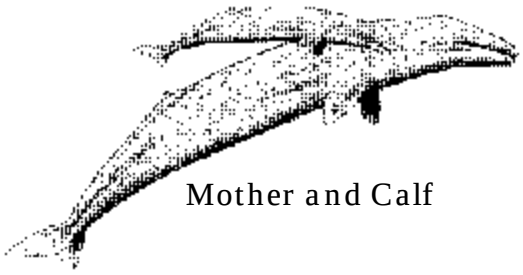
Spy-hopping



Spouting

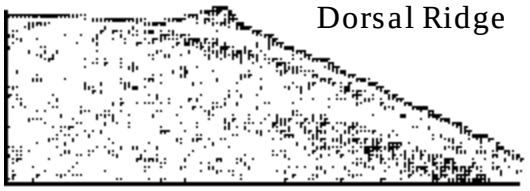


Sounding



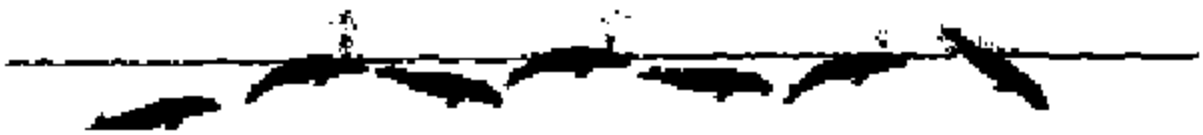
Mother and Calf

Pods



Dorsal Ridge

Behaviors observed, not listed above. Use the space below to sketch and record your observations.



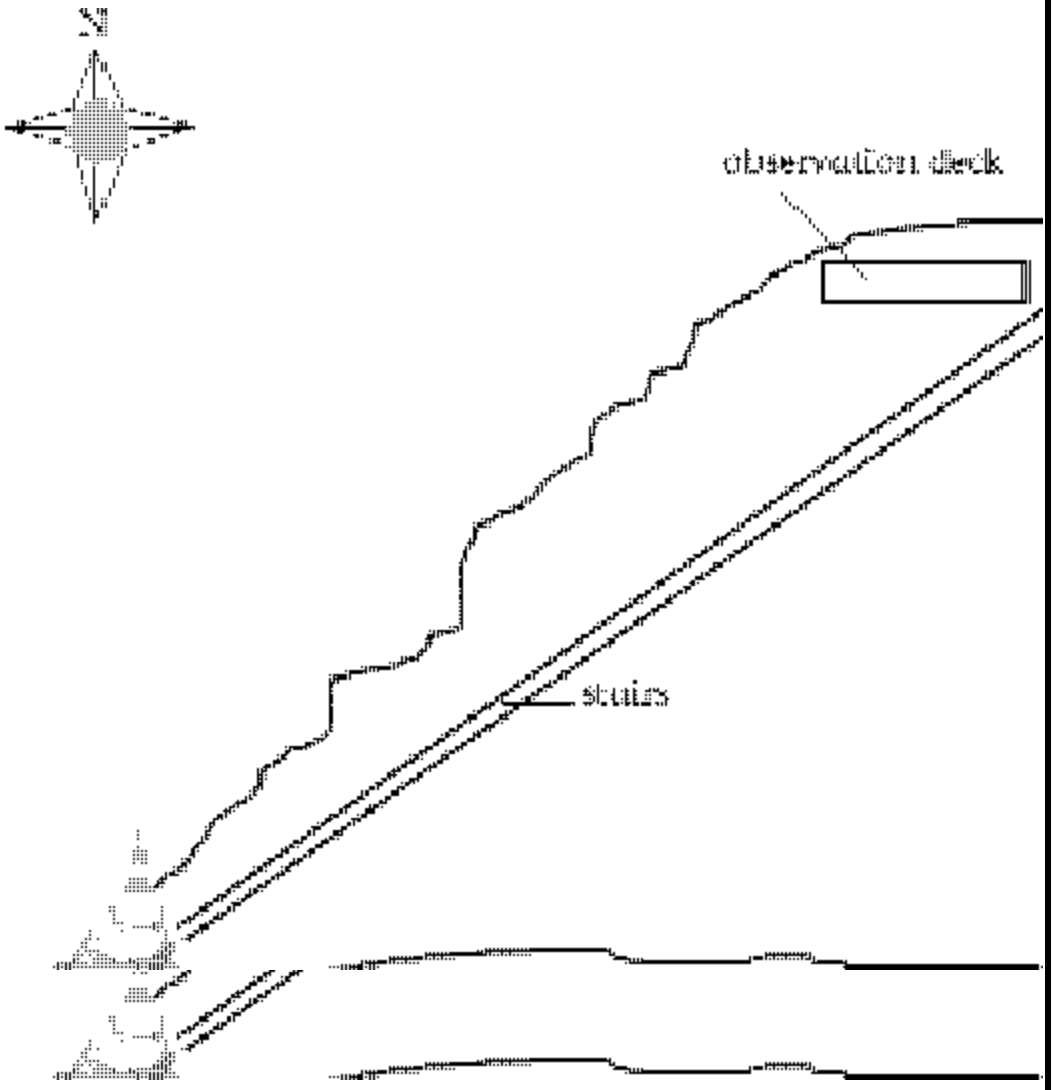
Diving Sequence

Whale Sighting Log			
Location:			
Weather: Cloud cover: clear - slightly cloudy - overcast - very cloudy - foggy Sea conditions: smooth - small waves - choppy - stormy			
Identification Number	Time	Behavior	Notes (* don't forget to record location on Whale Sighting Map, next page)

Other Marine Species Sightings		
What did you see?	What were they doing?	How many did you see?

Whale Sighting Map

Use the identification number from your Whale Sighting Log to mark the location and direction of your whales in relation to the Lighthouse.



A. Scavenger Hunt
What's Out There?

Gray whales are protected by federal law. Their Baja breeding grounds are protected as a sanctuary in Mexico. But only small sections of their 10,000-mile migration route are protected.

List three elements of a gray whale's habitat that are necessary for its survival.

1. ***no excessive noise***
   clean water
   safe from oil spills
   safe from net entanglement
   no huniing
2.

3.

If you could write a law to insure a healthy migration for gray whales, what would be the title of this law?

"Large Gill Nets Banned During Peak of Whale Migration"

What is the closest area to Point Reyes National Seashore that protects a portion of the gray whales ocean habitat? Why is this additional protection important?

Gulf of the Farallones

B. Scavenger Hunt
Upwelling...the Foundation

What could happen to the marine food chain if wind directions and ocean currents changed the spring weather patterns? What could happen to gray whales as a result?

could affect gray whale food source in arctic seas
migration patterns could shift
reproduction rates may fall or rise above average

Bonus: Is there a name given to these seasonal changes in wind direction and ocean currents?

El Niño
La Niña

C. Scavenger Hunt
Whales: Their Life Around Us

List two reasons why the waters offshore Point Reyes attract marine mammals.

1.

2.

abundant food source
shallow continental shelf

What three other types of whales may be seen here?

1.

2.

3.

blue whale
humpback whale
minke whale

D. Scavenger Hunt
Gray Whale Facts

Gray Whale Facts
Why do you think gray whales have evolved to filter-feed on tiny invertebrates and amphipods along the ocean floor?

less competition
only baleen whale with this feeding strategy
no choice
high protein source for migrations
low energy expenditure for large amount of food

Can you think of a land mammal or other organism with a similar feeding strategy?

hippopotamus, roseate spoonbill (bird)

E. Scavenger Hunt
Whale Watching...

List one reason why you think gray whales are performing each of the following behaviors:

Breaching

getting rid of lice, entertainment, aid to digestion, signalling to other whales (communication)

Spy-hopping

navigation, swallowing food, triangulation, lack of stereoscopic vision

Diving

searching for food, napping, navigation
Traveling in pods
safety, companionship, mating

Spouting

exhaling

Diving sequence of several short dives followed by a long dive

createing oxygen-rich blood supply before diving

F. Scavenger Hunt
Whale Watching...Diving

How many times a year do gray whales pass by Point Reyes?

twice a year, once on their winter migration south and once on their spring migration north

Why is the Point Reyes Lighthouse such a good place to spot gray whales?

high ground where you can look over and out to sea, the Point Reyes Headlands also stick out into the ocean about 10 miles

What is a "spouting"?

air exhaled through blowholes that rises 10-15 feet and condenses into white vapor

What is a gray whale's "swimming pattern"?

a series of short dives with spouting followed by a deeper dive lasting several minutes

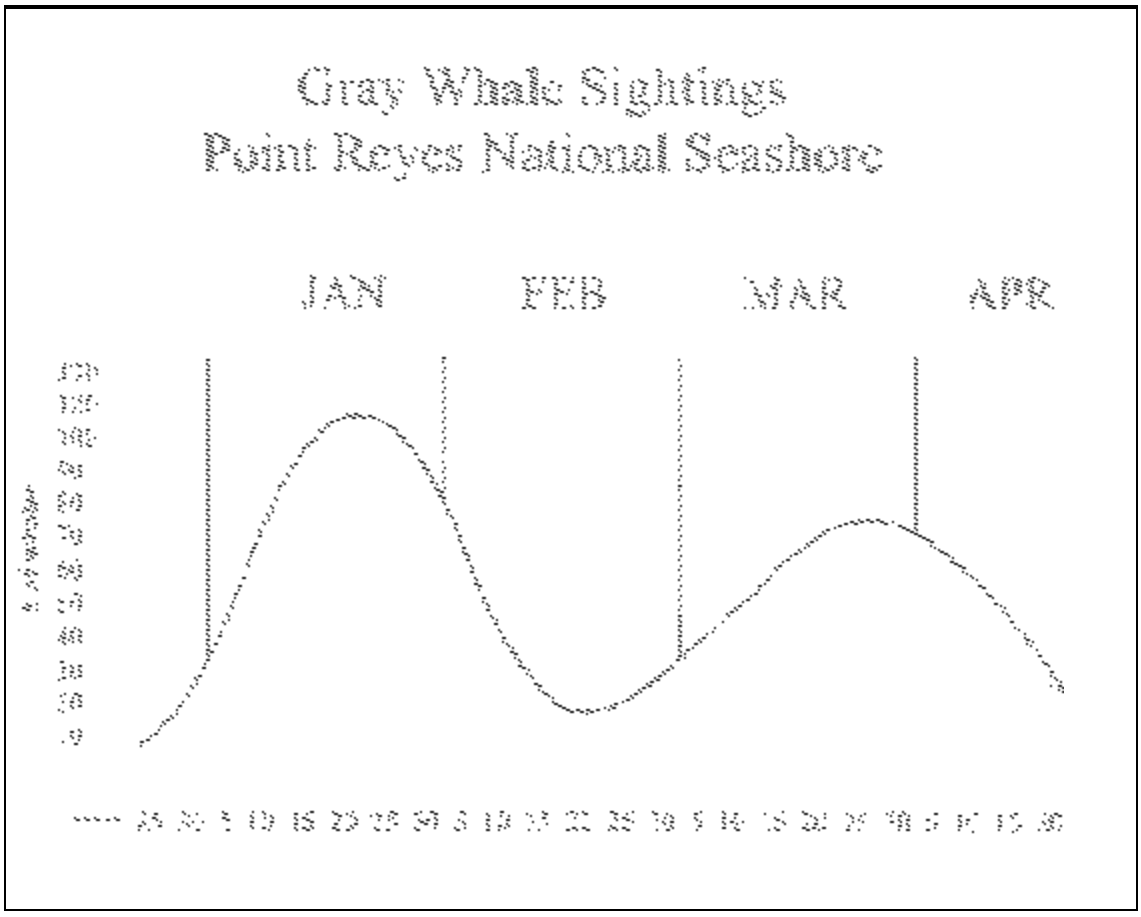
G. Scavenger Hunt
Gray Whale Migration

Based on this chart, how many gray whales might you expect to see over the full day of your visit?

answers will vary

What things could happen that would change how many whales you might see?

answers will vary



H. Scavenger Hunt
Whale Baleen

Look closely at baleen on "Please Touch" display.

Can you guess which part of your body is most closely similar to baleen?

fingernails or hair

How are the two similar?

both have a ridge-like texture, pliable frayed edges

How are they different?

colors, size, uses are different

Bonus: Are horns or antlers more similar to baleen? Why?

horns are more similar to baleen
antlers are more similar to bone

I. Scavenger Hunt
Photo Album

Turn to the back of the photo album to see a shark feeding on a dead gray whale. Draw arrows connecting the ideas below in a logical sequence.

1 and 10
Upwelling

8
Shark excretes nitrogen-rich food waste

6
Gray whale carcass floats on top of ocean

4
Gray whale feeds on zooplankton living in ocean and mud

2
Nutrients provided to plant life and phytoplankton in ocean

5
Gray whale dies

7
Shark feeds on whale

9
Food waste settles on ocean floor

3
Amphipods feed on marine plants

J. Scavenger Hunt
Barnacles, Krill, and Whale Lice

Look closely at the krill, barnacles, and whale lice found inside clear jars. Draw a line matching each organism to a descriptivbe characteristic. Some characteristics apply to more than one organism.

BARNACLES

True parasites, sucks blood from host

Once they glue themselves down(with one of the strongest known adhesives) they will most likely remain in the same spot fro the rest of their lives.

May feel itchy to the whale

Tend to gather around open wounds or scars

KRILL

Causes no harm to gray whale

Part of gray whale food

Hitchike on gray whale

WHALE LICE

A. Scavenger Hunt
What's Out There?

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List three elements of a gray whale's habitat that are necessary for its survival.

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2.

3.

If you could write a law to insure a healthy migration for gray whales, what would be the title of this law?

What is the closest area to Point Reyes National Seashore that protects a portion of the gray whale's ocean habitat? Why is this additional protection important?

Field Journal Sheet

B. Scavenger Hunt
Upwelling...the Foundation

What could happen to the marine food chain if wind directions and ocean currents changed the spring weather patterns? What could happen to gray whales as a result?

Bonus: Is there a name given to these seasonal changes in wind direction and ocean current

C. Scavenger Hunt
Whales: Their Life Around Us

List two reasons why the waters offshore Point Reyes attract marine mammals.

1.

2.

What three other types of whales may be seen here?

1.

2.

3.

Field Journal Sheet

D. Scavenger Hunt
Gray Whale Facts

Gray Whale Facts
Why do you think gray whales have evolved to filter-feed on tiny invertebrates and amphipods along the ocean floor?

Can you think of a land mammal or other organism with a similar feeding strategy?

E. Scavenger Hunt
Whale Watching...

List one reason why you think gray whales are performing each of the following behaviors:

Breaching

Spy-hopping

Diving

Spouting

Diving sequence of several short dives followed by a long dive

Field Journal Sheet

F. Scavenger Hunt
Whale Watching...Diving

How many times a year do gray whales pass by Point Reyes?

Why is the Point Reyes Lighthouse such a good place to spot gray whales?

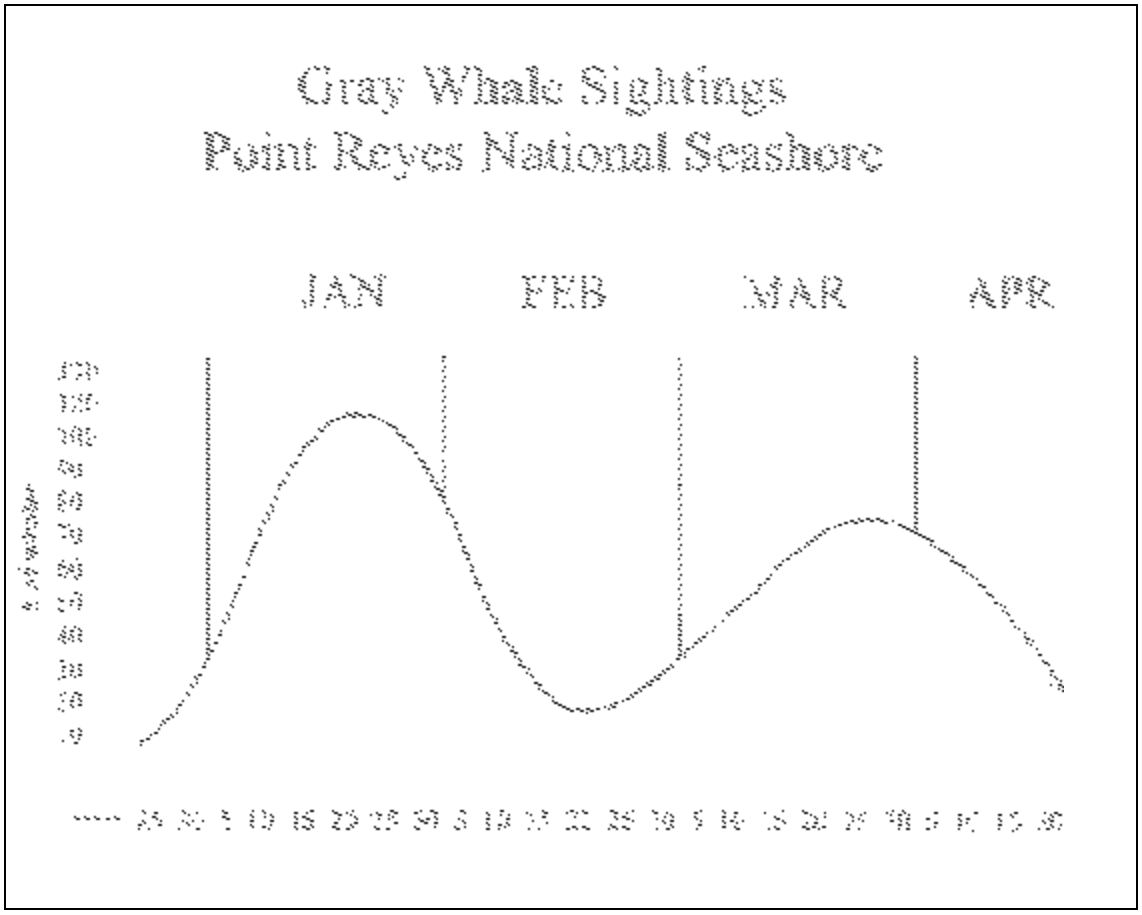
What is a "spouting"?

What is a gray whale's "swimming pattern"?

G. Scavenger Hunt
Gray Whale Migration

Based on this chart, how many gray whales might you expect to see over the full day of your visit?

What things could happen that would change how many whales you might see?



H. Scavenger Hunt
Whale Baleen

Look closely at baleen on "Please Touch" display.

Can you guess which part of your body is most closely similar to baleen?

How are the two similar?

How are they different?

Bonus: Are horns or antlers more similar to baleen? Why?

I. Scavenger Hunt
Photo Album

Turn to the back of the photo album to see a shark feeding on a dead gray whale. Draw arrows connecting the ideas below in a logical sequence.

Upwelling

Shark excretes nitrogen-rich food waste

Gray whale carcass floats on top of ocean

Gray whale feeds on zooplankton living in ocean and mud

Nutrients provided to plant life and phytoplankton in ocean

Gray whale dies

Shark feeds on whale

Food waste settles on ocean floor

Amphipods feed on marine plants

Field Journal Sheet

J. Scavenger Hunt
Barnacles, Krill, and Whale Lice

Look closely at the krill, barnacles, and whale lice found inside clear jars. Draw a line matching each organism to a descriptivbe characteristic. Some characteristics apply to more than one organism.

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Once they glue themselves down(with one of the strongest known adhesives) they will most likely remain in the same spot fro the rest of their lives.

May feel itchy to the whale

Tend to gather around open wounds or scars

KRILL

Causes no harm to gray whale

Part of gray whale food

Hitchike on gray whale

WHALE LICE

Exhibit Panels at Point Reyes Lighthouse Visitor Center for Scavenger Hunt

A.
What's out there?
Location: first panel to left of entrance inside Visitor Center

The ocean waters offshore of Point Reyes host a multitude of marine life rivaling the richest areas on earth. On a clear day, one can view the Farallon Islands approximately 20 miles south of the Headlands. These islands host close to 30,000 breeding seabirds and 7,000 seals and sea lions every year. In the spring, dense colonies of cormorants, auklets, common murres, and western gulls nest on the rocky slopes and in underground burrows. Elephant seals and sea lions crowd the pocket beaches and marine terraces in fall and winter.

Gulf of the Farallones National Marine Sanctuary
Marine life flourishes in such abundance in the region that the area was designated the Gulf of the Farallones National Marine Sanctuary in 1981. The Sanctuary protects the vast resources of these waters-seabirds, leaping dolphins, giant whales, floating microscopic life, and the medium that makes the world possible-water.

B.
Upwelling: the Foundation of Ocean Life
Location, second panel to left of entrance inside Visitor Center

Spring is the ocean's most productive season just as it is on land. Northwesterly winds and southerly ocean currents combine with the earth's rotation to move warm surface water offshore, drawing nutrient rich cold water from the depths below. With sunlight for energy, microscopic plants feed other forms of life, contributing to a complex food chain. Upwelling is the foundation of the rich and resilient marine food web that exists in this ocean environment.

The Intertidal Zone: A ribbon of life
Along the ocean's edge lies a ribbon of diverse marine life belonging to both the land and sea. The intertidal organisms must adapt to survive pounding waves, constantly changing temperatures and salinity, dehydrating air and sun, and fresh water run-off from the land in winter.
Drawing of upwelling showing how surface water moves offshore, and upwelling of nutrient-rich water occurs.

C.
Whales: Their Life Around Us
Location, fourth panel to left of entrance inside Visitor Center

The abundant food and shallow continental shelf in waters surrounding Point Reyes are calling cards for marine mammals- specifically whales. Within the offshore waters over 20 species of whales have been seen, including the blue whale, the largest animal that ever lived. Acrobatic humpback whales have been seen more frequently in recent years. The gray whale is the most commonly observed whale because it travels close to the coastline during its annual migrations. Several thousand gray whales are seen each year by visitors at the Lighthouse.

The Southern Migration: Late December through January
In October ice begins to form in the Arctic Seas, sending a message to gray whales that migration must begin to the warmer water of Baja California some 6,000 miles away. Traveling 100 miles each day, most of the gray whale population passes Point Reyes some time between late December and the end of January. By early February, only a few stragglers pass by the Headlands.

The Northern Migration: Late February through May
The Northern migration occurs in two pulses. The earliest returnees are pregnant females, adult males, and juveniles, who pass by Point Reyes mostly in March. Leaving Mexico almost a month later, the second pulse is composed of mothers with their newborn calves, which can be seen offshore through May.

D.
Gray Whale Facts
Location, fifth panel to left of entrance inside Visitor Center

Size: adults: 30-50 ft., 20-40 tons
Life Span: Average 30-40 years
Population: 15,000-21,000 (estimate)
Color: Slate gray, heavily mottled with barnacles and white from pigmentation
Vocalization: low tones or frequencies
Speed: Average speed 4-5 mph.
Normal Dive Depth: 120 ft.
Normal Duration of Dive: 3-5 minutes
Dorsal Ridge: No dorsal fin; a series of 6-12 knuckles or ridges

How Do Gray Whales Feed?
Unlike other baleen whales which feed in the open ocean, gray whales prefer to feed on bottom dwelling invertebrates in ocean sediments. The whales stir the mud on the ocean floor and draw in a mixture of prey, sediment and water. The average gray whale consumes approximately one ton of amphipods a day.

A Filtering System
Baleen whales filter food through fibrous plates that hang from the upper jaws. These plate, known as the baleen, are fringed with coarse hair which act as a sieve to capture the whale's food. As they feed on small shrimp-like crustaceans, the water is forced through the baleen and the food is strained by the hairy curtains.

E.
Whale Watching...
Location, sixth panel to left of entrance inside Visitor Center

The key to whale watching is patience and knowing what to look for. Scan the ocean all the way to the horizon for the telltale spout. Wear warm clothes, bring binoculars, and even a picnic lunch.

Spouting
Most visitors see spouting as whales pass the Headlands. The spout is formed by condensed moisture of the gray whale's exhalation. The plume can rise 10-15 feet in the air.

Sounding
As a gray whale begins a long dive, one may get a chance to see the powerful flukes that propel it on the migration journey. A typical sequence for diving is 3-4 spouts at intervals of 10-20 seconds followed by a deep dive of 3-4 minutes.

Spyhopping
Occasionally a gray whale can be seen raising its head out of the water 8-10 feet as if it wanted to look around. Thirty seconds or more may pass before it slips back into the water.

The Point Reyes Lighthouse, Tomales Point, and South Beach provide good vantage points to see the southern migration. The northern migrations best viewed from the Lighthouse and Chimney Rock.

Note: the information printed on the above panel has a mistake in its text. It should read in the last paragraph "...points to see the northern migration. The southern migrations best viewed..."

F.
Whale Watching
Wayside on Observation Deck behind Lighthouse Visitor Center

Winter Migration
Arctic region to Mexican calving areas whales swim south (to your left) past Point Reyes, November to February.

Spring Migration
Mexico to arctic feeding grounds whales swim north (to your right)
Past point Reyes, January -April.

California gray whales pass Point Reyes on their seasonal migrations, and often you can see them from this area. The best views are from high ground near the water where you can look down as well as out to sea.

In the spring whales stay close to shore look for them just beyond the breakers, past beaches, or next to the rocky walls of the Point Reyes headlands. Whales pass in the winter also, but usually farther off shore.

Spot gray whales by their spouts- air exhaled through their blowholes that rises 10-15 feet and condenses into white vapor.

Gray whales travel singly or in "pods" of three or more. Their swimming pattern consists of a series of short dives with spouting followed by a deeper dive lasting several minutes. By counting spouts you can plot their progress.

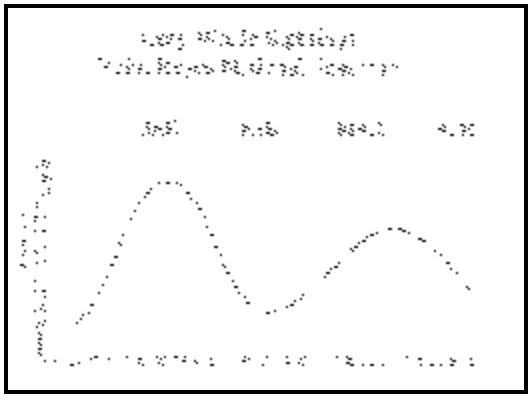
Gray whales swim at a good walking pace, 4-5 mph.

Breaching
Sometimes the gray whale will hurl half its thirty to fifty foot length out of the water and land smack on its back.

Spyhopping
Gray whales are occasionally seen with their heads above water, standing on their tails. Why? Perhaps to look around periscope style or to aid in swallowing food.

Diving
At the beginning of a steep dive, the huge tail flukes rise momentarily before disappearing into the deep.

G.
Gray Whale Migration Chart for Point Reyes
Located on wall behind "Please Touch" counter inside Visitor Center



H.

Gray Whale Baleen

Text located on wall behind "Please Touch" display, baleen located at "Please Touch" display; both inside Visitor Center

Baleen is found in the upper jaws of 11 species of large whales instead of teeth and is made of material similar to your hair and fingernails. These whales use their baleen to filter small food items from the sea. Commercially, baleen was once one of the most valuable parts of the whale. Flexible and strong, it was used for corset stays and umbrella ribs.

Large black baleen: adult humpback whale, composed of three plates

Large yellow baleen: gray whale, 5 feet on each side, 130 total plates on each side

Small black baleen: blue whale

Small yellow baleen: baby gray whale

I.

Photo Album

Located on shelf to left of lightship lens inside Visitor Center

This adult gray whale washed ashore in the urban area of Alameda (near San Francisco) on August 7, 1999. She had died out at sea, probably of old age. Park rangers believe she was about 45 years old. She was towed back out to sea, near Point Reyes National Seashore.
After a day floating at sea, the whale's skin is sunburned and in poor condition.
This shark researcher watched as a 15-20 foot great white took a bite out of the carcass.
These are bite marks left from the attack.
The shark almost took a huge bite from the whale's nose. The part you see underwater is the whale's lower jaw.
The researcher's boat is 20 feet long. How big do you think the whale is?
If the whale's body washes ashore again, the bones may be recovered and the whale skeleton reconstructed by a local 6th grade class.

J.

Barnacles, Krill, Whale Lice

Located at "Please Touch" counter inside Visitor Center

Three jars containing whale lice, barnacles and krill.

How Can I Capture My Experiences in a Story, Poem or Drawing?

Students will use their experience whale watching to create a story, poem, or drawing. Drafts or sketches may be made in their field journals and final writings or drawings completed in class. Students or teachers are able to choose which activities will be completed.

Time required: ½ hour

Location: on-site/classroom/ homework

Suggested group size: entire class

Subject(s): creative writing; science, language arts

Concepts covered: poetry; creative writing

Written by: Melinda Repko, National Park Service

Last updated: 12/08/00

Student Outcomes

At the end of this activity, students will be able to:

- Reflect on their experiences by sharing a poem, story, or drawing.
- Make emotional connections to the resources.

Materials:

To be supplied by teacher:

- Extra paper to be included into field journal

To be photocopied from this guide:

- **How Can I Capture My Experiences in a Story, Poem or Drawing?** Field Journal Sheet

Procedures

1. Include a copy of the **How Can I Capture My Experience in a Story, Poem, or Drawing?** activity sheet in each student's journal.
2. Either choose an activity for students to complete or have students decide which they would like to complete.
3. Allow at least one-half hour to complete this activity in the field. Students may refine their work once back in class.

On-site Lesson Plan

Creating Coastal Stewardship through Science

On-Site Lesson Plan

Extension ideas

1. Have students complete a variety of the activities, creating a booklet of their creative work.
2. Using canvas material and tempera paint, have students create a mural of their experiences at the Point Reyes Lighthouse Observation Deck.

How Can I Capture My Experiences in a Story, Poem, or Drawing?

Choose one of the following activities. Use blank paper in your field journal to complete your work.

1. Create a Haiku

A three-line poem originating in Japan based on syllables- not rhyming.

Line 1: five syllables
Line 2: seven syllables
Line 3: five syllables

2. Create a Diamante

This five-line poem is displayed in the shape of a diamond.

Line 1: noun
Line 2: adjective adjective
Line 3: participle participle participle participle
Line 4: noun noun noun noun
Line 5: noun

3. Freestyle Poem

A poem can rhyme or not rhyme. It can be many words or few. The only limitation is your imagination!

4. Create an Outline-Creation

Draw the outline of a gray whale in pencil. Use the outline as a guide to write your words on. OR use the outline as a guide to write your words in.
Use words or sentences that describe its characteristics. Hint: if you draw in pencil and write in pen, you can carefully erase the pencil when the ink dries.

5. Create a Comic Strip

Think about the different events that took place while you were visiting the Observation Deck. Create a comic strip depicting one of these events. Don't forget to give your comic strip a title.

6. Create a Story

Answer the question: "What would be missing from your life if gray whales had gone extinct and you never had the chance to see them?"

7. Create an Essay

What would be missing from your life if gray whales had gone extinct and you never had the chance to see them?

Creating
COASTAL
STEWARDSHIP
through Science

Observing Pacific Gray Whales

Post-Visit Activities

What Can We Learn from Our Field Trip to Observe Gray Whales?

Observations recorded at Point Reyes will be compiled into posters comparing and contrasting group findings. Results from Scavenger Hunt Activity will also be presented and discussed.

Time required: 2 hours

Location: classroom

Suggested group size: entire class

Subject(s): science

Concept(s) covered: gray whale biology, behaviors and migration, other marine species

Written by: Christie Denzel Anastasia, National Park Service

Last updated: 12/31/00

Student Outcomes

At the end of this activity, the students will be able to:

- Share results of gray whale field observations
- Reflect on Scavenger Hunt activities and their connection to observations made in the field

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade
- 5a- food webs
- 5b- organisms and the physical environment
- 5c- organisms can be categorized by functions
- 5e- the number and types of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition
- 7b- appropriate tools and technology to perform tests, collect and display data
- 7c- develop qualitative statements about the relationships between variables
- 7d- communicate the steps and results from an investigation
- 7e- evidence is consistent with a proposed explanation

	7f- interpret a simple scale map
	7h- identify changes in natural phenomena over time
7th grade	7a- appropriate tolls and technology to perform tests, collect and display data
	7c- communicate logical connections
	7e- communicate the steps and results from an investigation
8th grade	9b- evaluate the accuracy and reproducibility of data

National Science Standard Links (grades 5-8)

This activity is linked to the national science standards in the following areas:

- Content Standard A - Use appropriate tools and techniques to gather, analyze, and interpret data; think critically and logically to make the relationship between evidence and explanations; recognize and analyse alternative explanations; use mathematics in all aspects of scientific inquiry; understandings about science and technology.
- Content Standard C - Populations and ecosystems

Materials

To be provided by the teacher:

- Large paper, one for each student team
- Art supplies, such as colored pencils or markers
- **Pre- and Post-Evaluation** activity sheets (see Procedure #7 in this lesson)

Procedures

1. Recall field trip experience

How many whales were seen?
Who was able to follow the same whale through a diving sequence?
What were some of the most impressive observations?
What other wildlife was seen?

2. Create posters

Have students group themselves according to their chaperone groups on the field trip. Distribute large sheets of paper and colored drawing tools. Ask students to fold paper in third and record the following information in each one of the sections:

first section: Record all the types of behaviors they observed by gray whales. Provide drawings or descriptions.

second section: Recreate a map similar to the "Whale Sighting Map" from their field journals. Students should note whale individuals, direction of travel, behavior of specific whales and time viewed (if available)

last section: Note other marine species sightings.

3. Group presentations

Each group will present their posters to the class. Their poster should be left in the front of the class.

5. Discussion

How do the maps from the individual student teams vary? How are they the same? What types of behaviors are most observable from their field trip? Were whales travelling in the opposite direction? Why? How could observations be made more "scientific"?

6. Scavenger Hunt Results

Divide students into different teams to represent each Scavenger Hunt sheet. Each team will share its information with the class on that specific sheet. Ask students to relate the information from the Scavenger Hunt sheet to observations made on the field trip.

7. Pre- and Post- Evaluation

If you saved the **Pre- and Post- Evaluation** Activity Sheets from the first pre-visit lesson, redistribute them to the original students. Explain that students may change their answers based on what they have learned in class and on their field trip. If you choose this option, have students write in a different color pen or pencil with the date written in that color.

If you did not save the original activity sheets, make copies for each student of the **Pre- and Post-Evaluation Activity** Sheet(located in the first pre-visit activity: "How Can I Learn About the Lives of Pacific Gray Whales?"). We would like to see the results of these evaluations! Please consider mailing completed Pre- and Post- evaluation activity sheets back to Point Reyes National Seashore. We would like to measure the success of your use of this curriculum in changing knowledge, skills, and abilities.

Mail to: National Park Service
Point Reyes National Seashore
Attn: Education Specialist
Point Reyes, CA 94956

How Can I Access More Information on Whales?

Students and teachers will explore Internet sites for up-to-date information on whale research and interactive educational opportunities.

Time required: 1 hour

Location: classroom, computer lab, home, library

Suggested group size: entire class

Subject(s): science, biology, information technology

Concept(s) covered: whale research, current news, stewardship opportunities

Written by: Christie Denzel Anastasia, National Park Service

Last updated: **09/23/01**

Student Outcomes

At the end of this activity, the students will be able to:

- Share information about whales with other students.
- Participate on interactive websites.
- Generate ideas for stewardship action plans.

California Science Content Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade
- 7b- appropriate tools and technology to perform tests, collect and display data.
- 7d- communicate the steps and results from an investigation
- 7e- evidence is consistent with a proposed explanation

7th grade
- 7a- appropriate tolls and technology to perform tests, collect and display data
- 7b- Utilize a variety of print and electronic resources (including the World Wide Web) to collect information as evidence as part of a research project
- 7c- Communicate the logical connection among hypothesis, science concepts, tests conducted, data collected, and conclusions drawn from scientific evidence
- 7e- Communicate the steps and results from an investigation in written reports and verbal presentations

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Identify questions that can be answered through scientific investigation, understanding about scientific inquiry.
- Content Standard C - Populations and ecosystems, Regulation and behavior.
- Content Standard F - Populations, resources, and environments, Risks and benefits.
- Content Standard G - Nature of science

Procedures

1. There are many options to explore this lesson depending on computer access at your school, student's home, or in the local community. See "Gray Whale Websites" following this lesson for Internet address suggestions.

2. Ideally students can form pairs and pick an address site to explore. Since individual student interests vary, the same web address will yield different discoveries. Students can report back to the class on what they have learned and how it applies to their studies on gray whales.

3. More focus may be required while students are exploring web sites. Instruct students that their discoveries should help generate ideas for Stewardship Action Plans (see lesson **How Can I Choose and Complete the Best Stewardship Project?**)

Gray Whale Websites

Gray Whale Tutorial

Address: http://www.slocs.k12.ca.us/whale/whale1.html

Summary: Information on gray whales written for students, produced by San Luis County Schools.

Note: From the homepage, topics include: What Is a California Gray Whale, Migration, Feeding, Whaling, Whale Behavior, Calving, Whale Blowing.

Journey North

Address: http://www.learner.org/jnorth/

Summary: Journey North tracks the northward spring migration of various species of animals including humpback and right whales, monarch butterflies, loggerhead sea turtles, and peregrine falcons. Journey North provides information on the best maps, "ask-the-expert", and informational reports put together by students in classrooms around the world. Fax subscriptions are available for teachers without e-mail capabilities.

Note: Navigate to the Online Orientation for topics such as About Journey North, Migrations and Signs of Spring 2000, Journey North News Calendar, Choose your Focus, Maps for Tracking Fall's Journey South, Practice Reporting Your Sightings Now, Talk to Other Teachers, Tips from Teachers.

Monterey Bay Aquarium

Address: http://www.montereybayaquarium.org/

Summary: A broad range of information and a good overview of complex issues facing the ocean.

Note: From the homepage, explore topics such as Learning Center (for teachers and students), Exhibits, Features, and Conservation (for Endangered Oceans site), and Our Seafood Policy.

National Resource Defense Council

Address: www.nrdc.org

Summary: Information on immediate threat to gray whale breeding habitat.

Note: click on "Save Gray Whale Nursery"

WhaleNet

Address: http://whale.wheelock.edu/

Summary: WhaleNet is an international collaboration of scientists, researchers, and computer technologists working to get real data in the classrooms. WhaleNet homepage includes teacher/student resources, opportunities to have marine mammal questions answered, and links to its' affiliates homepages.

Note: From the homepage you may choose Students, Teachers, or Public. Topics include Gray Whale Migration, Active Satellite Tags,Humpback Fluke Photo ID Curriculum Unit, "Ask a Scientist", Whale Watching Research Data.

Other Gray Whale website addresses:

A Gray Whale Story
Written by a Santa Maria 5th grader; on a student created school site, with a link to Santa Barbara Channel Islands.
http://www.sbceo.k12.ca.us/~eagles/graywhal.htm

American Cetacean Society
Gray Whale Migration charts and summaries of annual migration since 1985.
http://www.acs-la.org/GWCensus.htm

The International Fund for Animal Welfare
www.savebajawhales.com

Sea World
Review and compare growth and comparison charts for whales, elephants and humans.
http://www.seaworld.org/

How Can I Choose and Complete the Best Stewardship Project?

The final lesson for this unit synthesizes all previous learning experiences. Students have gained an understanding of Pacific gray whales and ocean ecology. Now it's time to take action in making oceans healthier places for whales, dolphins, porpoises, and all the organisms that depend on clean, safe water, from plankton to humans.

Time required: time varies

Location: classroom, community, or Point Reyes National Seashore

Suggested group size: entire class

Subject(s): biology, art, computer skills, community service

Concept(s) covered: stewardship, educating others, environmental responsibility

Written by: Lynne Dominy and Christie Denzel Anastasia, National Park Service

Last updated: 12/31/00

Student Outcomes

At the end of this activity, the students will be able to:

- Synthesize all other pre-visit, on-site, and post-visit lessons from this unit.
- Plan and implement an environmental stewardship activity to benefit the ecosystem they live in and depend upon.

National Science Standard Links

As a result of this activity, all students in grades 6-8 should develop:

- Content Standard F- Science in Personal and Social Perspectives; Populations, Resources, and Environments.

Vocabulary

stewardship

Procedures

1. Decide on lesson approach based on time limitations

Review the teacher resource **Observing Pacific Gray Whales: Environmental Stewardship Projects** following this lesson. This resource explores the range of Stewardship Projects your class can complete according to time constraints. There are many possibilities ranging from short lessons to more in-depth, interdisciplinary projects that may fulfill educational standards for other subject areas.

2. Prior to any lesson, introduce concept of environmental stewardship

Begin a discussion of who has responsibilities for natural resources. There are federal agencies such as the National Park Service and the United States Forest Service, state agencies such as Calfornia Fish and Game, and local organizations. Introduce the concept that organizations such as schools and individuals such as students also have responsibility.

Every day we decide on an individual level what our impact will be on the environment based on our actions. It's usually positive or negative, rarely neutral.

3. Lesson options

- **How to Positively Effect Species and Their Habitats** Activity Sheet
- Create Tools to Educate Others
- Implement a Community /School Project
- Participate in Volunteer Programs at Point Reyes National Seashore
- Support Stewardship Organizations and Be an Advocate for Your Beliefs

(see the teacher resource **Observing Pacific Gray Whales: Environmental Stewardship Projects** following this lesson for more details)

4. Assist with evaluation of "Creating Coastal Stewardship through Science"

Please share your project ideas and results! If you develop a website, host a "Coastal Stewardship Day", or participate in a beach cleanup, let us know by sending photos, stories, or student materials. Call (415) 464-5139 to leave a message with the Education Coordinator of Point Reyes National Seashore.

Observing Pacific Gray Whales
Environmental Stewardship Projects

How to Positively Affect Endangered Species and Their Habitats

One to two lessons

Students use the **How to Positively Affect Species and Their Habitats** activity sheet to learn more about a particular federally listed endangered whale. Based on that research, students devise action plans for which they assume responsibility for contributing toward healthy oceans.

Create Tools to Educate Others

Arranged in order of possible time commitment, shortest to longest

Lead a class discussion to brainstorm ways students can educate others. Use the list below to help students generate ideas. Once there are some ideas, decide upon which project can be completed within a designated timeframe. The next step is to have students create a "plan of action". What are all the things that need to be done, in which order do they need to be done, who is going to do them, and what are the deadlines? How can students not only teach about the resource, but also impart stewardship values? Remind students to think about any safety issues and address these as a group.

Educational tool ideas:

- Develop a newsletter or newspaper to distribute to other students.
- Build an exhibit that is displayed for a Parents' Open House.
- Paint a mural, draw posters, or create a website that encourages ocean stewardship.
- Interview researchers about a whale research project. Share the answers.
- Organize a Coastal Stewardship Contest. Have students define stewardship through writing essays or creating art, poetry, or music.
- Videotape your field trip and stewardship activities. Have the students narrate this video and develop a presentation for other students sharing what they have learned and accomplished.
- Create a mentoring program that enables your students to teach younger students about resources and their stewardship.

Implement a Community/ School Project

Arranged in order of possible time commitment, shortest to longest

Instruct students as a homework assignment to find at least one local environmental issue that is being discussed among community members. Students may gain this information by looking through newspapers, talking to their parents, watching the local news, or listening to a public radio station. The next day in class, all local environmental issues should be discussed to some extent. Choose one project around which students may design a stewardship project. What are the possible stewardship activities that can be completed by students, and/or their parents, and communities? Follow the ideas in the procedure above to create a "plan of action".

Community/ School Project Ideas:

- Adopt-A-Whale project
- Beach cleanup
- Water conservation at school and home.
- Create a green school: investigate recycling and composting facilities or water conservation. Have students write a plan about how to make your school more environmentally friendly. Have them take action and implement some of their ideas.

Participate in Volunteer Programs at Point Reyes National Seashore

2 hours, full day, or regular commitment on weekly/monthly basis

Students may participate in programs such as restoration, rehabilitation, or research projects. Consult with the Volunteer Coordinator or Education Specialist for the most recent options as projects can change according to time of year and staffing availability. One example of participating in a restoration project would be to remove exotic plants from natural areas. To participate in the habitat restoration projects at Point Reyes National Seashore call (415) 464-5139.

Support Stewardship Organizations and be an Advocate for Your Beliefs

1 lesson to lifelong commitment

Introduce students to the concept of advocacy. Have them research and represent the missions of local and national stewardship organizations. Examples include: the National Park Service, the Marine Mammal Center, the Humane Society, the Sierra Club, the National Parks and Conservation Association, the Audubon Society. Have students write letters to their local, state, and national government officials regarding stewardship issues or have them submit articles to local newspapers. Encourage students to form educated opinions and to voice them.

Name _____ **Date** _____

Activity Sheet

How to Positively Affect Species and Their Habitats

Choose on of the following federally endangered species occurring in offshore waters of Point Reyes National Seashore to answer the questions below:

☐ Blue whale	Balaenoptera musculus
☐ Humpback whale	Megaptera novaeangliae
☐ Sei whale	Balaenoptera borealis
☐ Fin whale	Balaenoptera physalus

INVESTIGATION

1. How have population numbers of this particular species changed over time?

2. What are the threats to this species as an individual?

3. What are specific threats to the ocean habitat for this species?

4. What is the federal government doing to increase population numbers?

5. What would be different in your life if you never had the opportunity to see these whales?

Activity Sheet

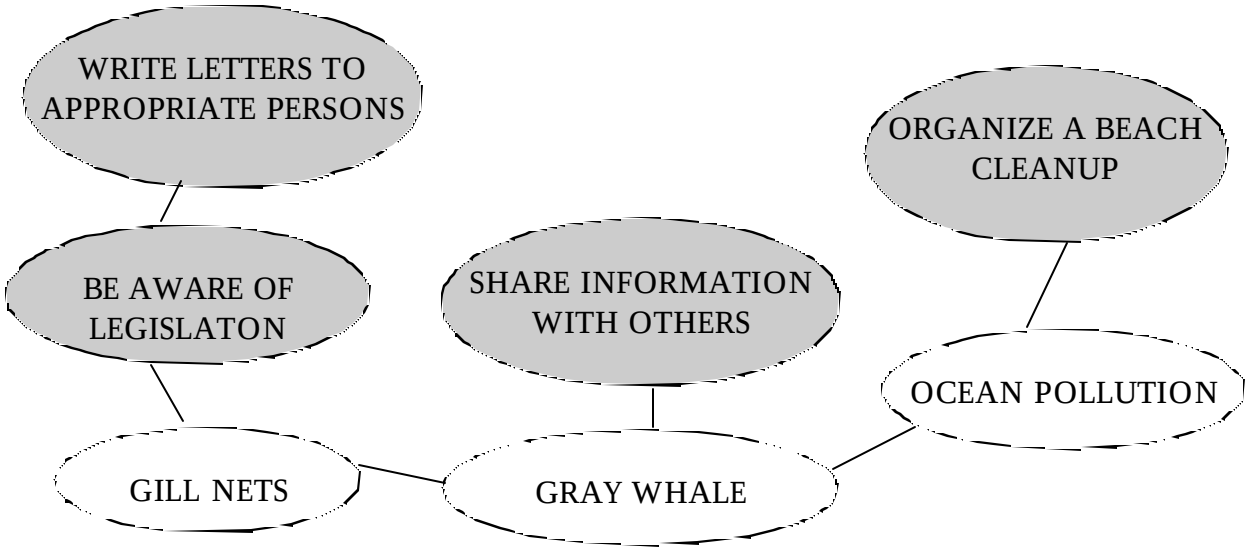
Name _____ **Date** _____

How to Positively Affect Species and Their Habitat (continued)

PROLEM SOLVING

Using a blank piece of paper, you will create a "mind-map".
Begin by writing the name of your species in the center of the paper and drawing a circle around it. Choose some of the threats to its survival and write those around the species name. Draw circles around each of the threats and connecting lines to the circle in the center. You should have something that looks like this:

Begin problem solving by thinking about actions that lessen the impact of specific threats. Write those actions in circles connected to the threat it seeks to solve. Example:



RESOLUTION

Review your mind-map to determine what type of actions YOU can take that will positively affect these species and/or their habitat.

Place "*" next to actions you are already doing,
place a "1" next to actions individuals can do,
place a "2" next to actions groups can do, and
place a "?" next to things you believe are not within your control.

Select an option and implement your plan.

This following list is incomplete, but is meant to provide ideas for additional teaching resources.

Education and Reference Materials

Carwardine, Mark and Martin Cramm. **Whales, Dolphins and Porpoises, A Visual Guide.** DK Publishers.

Fredericks, Anthony. **Exploring the Oceans, Science Activities for Kids.** Golden: Fulcrum Publishing.

Gordon, David G. and Alan Baldridge. **Gray Whales.** Monterey: Monterey Bay Aquarium, 1991.

Leatherwood, Stephen and Randall Reeves. **The Sierra Club Handbook of Whales and Dolphins.** San Francisco: Sierra Club Books, 1983.

Miller, Tom. **The World of the California Gray Whale**. Santa Ana: Baja Trails Publications

Nollman, Jim. **The Charged Border: Where the Whales and Humans Meet.** Henry Holt and Company, 1998.

Wade, Larry. **Whales in the Classroom Presents Getting to Know the Whales.** Minnetonka: Singing Rock Press, 1995.

Walker, Theodore. **Whale Primer.** San Diego: Cabrillo Historical Association, 1979.

Internet Addresses

Allied Whale
www.coa.edu

American Cetacean Society
www.asconline.org

Baleen Whales
www.enchantedlearning.com/subjects/whales/classification/Baleen.shtml
Explains the classification of baleen whales and other orders of whales.

California Coastal Commission
www.ceres.ca.gov

California Gray Whale Tutorial
www.slocs.k12.ca.us/whale/whale1.html
There is a 78K video clip of a Gray Whale blowing, and there is information about calving, whale behavior, whaling, feeding, and migration.

Center for Cetacean Research and Conservation
www.whaleresearch.org/
This site is loaded with information about conservation and research. There are some video clips included.

Center for Marine Conservation
www.cmc.org

Gray Whale Underwater Photographs
www.oceanlight.com/html/gray_uw.html

Gray Whale: ZoomWhales.com
www.enchantedlearning.com/subjects/whales/species/Graywhale.shtml
This site gives general information about the life and biology of Gray Whales. Also, the site has a nice gray whale printout that labels the various physical features of the whales.

Gulf of the Farallones National Marine Sanctuary
www.noaa.gov

Marine Mammal Center
www.tmmc.org

The Oceanic Society
www.oceanic-society.org

Point Reyes National Seashore
www.nps.gov/pore

Steinhart Aquarium, CA Academy of Sciences
www.calacademy.org.aquarium

Virtual Whales
www.cs.sfu.ca/research/Whales
Multimedia site on whales.

WhaleNet
http://whale.wheelock.edu/

Videos

After the Whale.
University of California, Extension Media Center, 2176 Shattuck Avenue, Berkeley, California 94704, USA,30 minutes.
"Documents the plight of whales today as technological improvements in the whaling industry have brought them nearly to extinction. Shows a scientist studying the behavior and physiology of whales and recording their underwater 'songs,' and argues for their conservation."
To Order: (510) 642-0460 /Available for purchase or rental.

Gray Whales with Christopher Reeve.
U.S. public television series In the Wild. Actor Christopher Reeve traces the migration route of the gray whale, following its 10,000-mile journey from the Arctic Circle to Mexico's Baja Peninsula, ultimately encountering the giant animal close up. Its behavior is examined, including breaching.
To Order: Available from PBS, (800) 329-PBS1.

In the Company of Whales.
Discovery Channel School. 51 min. $29.95.
Leading cetacean conservationist Dr. Roger Payne guides an expedition into the watery realm of the whale. See the intelligent hunting behavior of the killer whale. Discover how dolphins communicate using sonar. And find out how the pilot, blue, and sperm whales use sound instead of vision to orient themselves underwater.
To Order: 1-888-892-3484 or www.discovery.com

The Sounds of Discovery.
From the The New Explorers series on U.S. public television (PBS). Hosted by Bill Kurtis. This program features Chris Clark working with the U.S. Navy to track great whales via submarine listening devices, and Oregon State University marine biologist Dr. Bruce Mate, who is the first scientist to successfully place a satellite tag on a sperm whale. Satellite tags will enable scientists to follow the sperm whale (which spends only about 5 percent of its life at the surface) both above and below the surface.
To Order: Call (312) 878-2600, extension.43 or (800) 621-0660

The Whale Video Company.
PO Box 1052, Mechanicsburg, PA 17055-1052
They claim to have more videos about whales than any other company in the world!
To Order: For more information about their videos, write to the above address for more information, or visit their website:
http://members.aol.com/seewhales/index.html

Journal Articles, Newsletters, and Scientific Publications

"Gray whales win a round over lucrative salt mine (Mexico)", Montreal Gazette, 26 Mar. 1995, pB5.

McDonald, P. il. "The mystery of the friendly whales" (California gray whales in Laguna San Ignacio, Mexico). Reader's Digest, v147, Aug. 1995, p49-54.

"Mexican inlet at centre of national environmental debate: an important breeding area of the grey whale is the proposed site for a plant producing salt from seawater (San Ignacio Lagoon)". Globe and Mail. 27 Apr. 1995, pA22.

"Pacific coast grey whales off critical species list", Vancouver Sun, 16 Jun. 1994, pA22.

"The price of salt: environmentalists fear Baja mining project will threaten gray whales", Montreal Gazette, 12 Mar. 1995, pB4.

"Scientists rescue whale Inky". National Geographic World, v234, Feb. 1995, p24-5.

Svitil, K, il. "Whale warehouse" Discover,. v16, Aug 1995, p42-7.

"Whale boom (California gray whale).. Discover,. v16(1), Jan. 1995, p61.

"Whale of a mystery". OWL 20(2) Feb. 1995, p12-15.

Adoption Programs

Adopt A Humpback Whale
The Oceanic Society
Building E, Fort Mason Center
San Francisco, CA 94123
(800) 326-7491

International Wildlife Coalition/Whale Adoption Project
70 East Falmouth Highway
East Falmouth, MA 02536
(508) 548-8328
http://www.webcom.com.iwcwww

Pacific Whale Foundation
101 North Kihei Road
Kihei, Hawaii 96753
(808) 879-8860