



Exploring the Coastal Marine Environment Teacher's Science Journal

*Hope is the thing with feathers
That perches in the soul,
And sings the tune--without the words,
And never stops at all*
-Emily Dickinson

Name _____

Grade _____

School _____

Contents: News from the Farallon Islands
Ask a Scientist (Farallon Islands)
Restoring the Common Murre (Devil's Slide Rock)
Recording Murre Data & Live Web Cam Viewing
Word Search Puzzle



Webs Under Waves Exploring the Coastal Marine Environment



(Aerial view of the Farallon Islands)

News From the Island: Your Farallon Fanatic News Letter Data Sheet

The following data was collected by the scientists living on the Farallon Islands. The scientists collect this information so that they can observe changes to the marine mammals, seabirds and island conditions.

Month/ Year	Average Air Temperature (celsius)	Average Ocean Temperature (celsius)	Common Murre	Elephant Seals	Stellar Sea Lions	Humpback Whales (highest number seen in a day)	Cool News
August 2005	14.5°C	13.5°C	50	39	68	4	3 Western Gulls were found covered in oil
September 2005	15°C	13.3°	10	176	18	5	30 Hoary Bats on the island
October 2005	14.7°C	12.9°C	10,000+	378	46	11	A sea otter was seen diving for food
November 2005	13.9°C	12.7°C	30,000+	242	34	9	Scientists put 11 tags on sharks
December 2005	13.4°C	12.3°C	30,000+	187	42	3	Earliest elephant seal pup <u>ever</u> was born on December 8th

(Webs Under Waves, cont.)

Month/ Year	Average Air Temperature (celsius)	Average Ocean Temperature (celsius)	Common Murre	Elephant Seals	Stellar Sea Lions	Humpback Whales (highest number seen in a day)	Cool News
August 2004	15°C	13°C	50	43	38	1	Two sharks seen attacking seals
September 2004	15°C	13°C	10	166	51	13	Over 1000 seal lions on the island
October 2004	15°C	13°C	10,000	372	52	12	11 Sight-seeing boats visited the island
November 2004	14°C	14°C	20,000	375	64	5	“Cut-tail” (a well known shark) was seen feeding
December 2004	12°C	12°C	30,000	171	26	4	56 Gray Whales were seen

Month/ Year	Average Air Temperature (celsius)	Average Ocean Temperature (celsius)	Common Murre	Elephant Seals	Stellar Sea Lions	Humpback Whales (highest number seen in a day)	Cool News
August 2003	17°C	14°C	100	52	29	12	Lots of baby birds still on the island
September 2003	16°C	14°C	10	287	40	15	Fighter jet scared off many birds and marine mammals!
October 2003	16°C	12°C	3,000	474	86	15	It was 31°C during one day this month!
November 2003	14°C	12°C	15,000	827	131	20	Thousands of birds feeding on krill east of the island
December 2003	13°C	12°C	15,000	171	27	11	Last of the baby birds have fledged

Interpreting the Data (You are the scientist)

- How many Stellar Sea Lions were seen during the month of October 2003?
86 Stellar sea lions. This is time period when the Stellar sea lions and the Elephant seals return to breed
- What was the name of the shark seen on November 2004?
Cut-tail. Scientists can recognize individuals by their unique tail and fin shapes/patterns
- How many more Common Murres were there in December 2005 when compared to December 2003?
About 15,000. This shows two pieces of information: 1. that the population of Common Murres is increasing meaning that they are recovering from human impacts. 2. This is the time period when the birds return to islands and begin breeding
- How many Common Murres were seen in November 2004. Why were there so many?
30,000 This is the time frame when the Common Murres begin breeding

(Webs Under Waves, cont.)

More in depth look at the Cool News

- *Shark attacks happen on a regular basis as the island is a breeding ground for sea lions and harbor seals. Most likely there are shark attacks everyday! Scientists will put radio tags on the sharks to determine the shark population and the activities of individuals. This is done with long pole from a small boat.*
- *The Farallon islands are a well known bird colony, scientists and interns record daily bird activity and record numbers through out the month. Birds return to the island when upwelling occurs(meaning this is when plankton come near the surface of the ocean, which brings in larger zooplankton which brings in schools of fish which provides food for seals, sea lions, sharks and seabirds.*

Farallon Islands History

Human occupation of the island began in earnest with the arrival of Russian fur traders in the early 1800's. This period began the exploitation of the island wildlife that lasted until the turn of the century. Elephant seals were harvested for their blubber while fur seals, California sea lions and Steller's sea lions were harvested for their pelts. Eggs from common murre were taken by thousands and shipped to the mainland

The population explosion created by the goldrush of 1848 led to a shortage of agricultural products because farming was in the infancy stage at the time on the mainland. Newcomers to the area were supplied by murre eggs from the Farallones. Men claimed the island and established the Pacific Egg Company. Records show hundreds of thousands eggs collected each year. After about 20 years and much legal wrangling, an executive order was issued in 1881 which made egging illegal on the Farallons.

By that time a lighthouse had been established by the Lighthouse Service and light keepers and their families were living on the island. Through the years many projects were undertaken and abandoned. A weather station was erected in 1902 by the Weather Bureau operating on a cable that ran from the island to the Marin coast for the first year. A radio transmitter was deployed in late 1903. The Navy built its own weather station on the island in 1905 as it took over control of the island. The Weather Bureau abandoned the island in 1913 allowing Navy personnel to tear down the Weather Bureau building to improve the Navy facility. Four radio compass facilities were built on the island between 1920 and 1930. The first was claimed by the heavy seas, the second burned to the ground, and the third also burned, claiming the life of Henry Gustafson.

Living quarters had also been added to the island. In 1939 the US Coast Guard absorbed the Lighthouse Service. The Navy ran a secret radar station from the Farallons in World War II requiring more personnel. In 1942, up to 78 people were living on Southeast Farallon Island. The Navy withdrew from the island and the Coast Guard began automating equipment further reducing the number of island residents. The last family moved from the island in 1965 and only six men remained to operate the station.

(Webs Under Waves, cont.)

The US Fish and Wildlife Service began active management of the refuge in 1969 and the light was automated the following year. The automated light was judged reliable in 1972 and the last Coast Guard personnel stationed on the island departed. Biologists from PRBO Conservation Science (formerly Point Reyes Bird Observatory) had visited the island intermittently in 1967 and were permanent islanders by the end of 1968. The US Fish and Wildlife Service entered into a cooperative agreement to manage the refuge at that time.

The islands were left to the animals and biologists. Naturalists had occasionally visited the island since the 1800's usually for a few days to make basic observations. By 1968 sealing, egging, and operating a small village on the island had taken its toll on the wildlife. Feral cats, abandoned by former residents, preyed on birds. Introduced rabbits competed with nesting seabirds for space. The erection of all the buildings and trails reduced the overall amount of habitat available to the wildlife. Oil spills and other pollution took a toll on wildlife in the waters around the island. The US Fish and Wildlife Service and PRBO were faced with the task of reversing 150 years of history. In 1981 the waters around the island were protected with the creation of the Gulf of the Farallones Marine Sanctuary, administered by the National Ocean and Atmospheric Administration.

Webs Under Waves: Exploring the Coastal Marine Environment

What Do We Know About the Farallon Marine Environment?

Video: Day in the Life of a Farallon Island Scientist – 8 minutes

While viewing the video find the answers to these questions.

What jobs were the scientists doing on the island?

*Bird and, Marine mammal surveys (this includes numbers and species)
Removing exotic species of plants (plants that are not native to the island) Part of
the scientists job is to maintain the health and natural state of the island habitat,
thus they are constantly removing non-native plants and researching various
aspects of the marine life diversity.*

Can you name 2 seabirds:

*Common Murre, Ashy's Storm petrel, Western Gull, Brandt's Cormorants,
Cassin's Auklet*

*For a complete list visit the U.S. Fish and Wildlife Service website:
http://www.fws.gov/sfbayrefuges/farallon/Bird_List.pdf*

Can you two species of marine mammals:

*Elephant seal, Humpback whale, California sea lion, Harbor seal, Gray Whale, (There
are 36 documented mammal species in the Gulf of the Farallon islands)*

What do we want to know about the Farallon Marine Environment?

Let's Ask a Scientist!

List 3 questions you would like to ask a scientist. (you can write these on the whiteboard)

Students select one of these questions to ask a scientist

Question Selected to Ask a Farallon Island Scientist

e-mail your question to joelle_buffa@fws.gov

Joelle is the Manager of the Farallon Islands National Wildlife Refuge.
She or one of the Scientists on the Farallons will e-mail the answer to your class
within 2 weeks.

Scientist Answer:

Date: _____ **Name of Scientist** _____

Webs Under Waves: Exploring Coastal Marine Life



Location of Devil's Slide Rock

Restoring the Common Murre: News From Devil's Slide Rock

The Common Murre Restoration Project is reestablishing a colony of Common Murres on Devil's Slide Rock along the San Mateo Coast of Central California. An oil spill in 1986 killed 9,000 seabirds, 6,000 of which were Common Murres. The breeding colony on Devil's Slide Rock was wiped out as a result of the spill. A trust fund established to restore resources damaged in the spill is being used to reestablish the murre colony. The project has been underway since January of 1996. Social attractants, including decoys of adult murres, decoys of murre chicks and eggs, CD players projecting amplified murre sounds, and three-sided mirror boxes, were being used to lure the highly colonial birds back to the rock.

A. Data from Common Murre breeding seasons on Devil's Slide Rock.

(Number of Murre Breeding Pairs recorded)		
<u>Year</u>	<u>Year</u>	<u>Year</u>
1996--6	2000--100	2003--110
1997--9	2001--113	2004--190
1998--13	2002--123	2005--164
1999--70		2006--361

Graph the Common Murre Data (Webs Under Waves, cont.)

Number
of
Common
Murres

360												361
330												
300												
270												
240												
210									190			
180										164		
150							123					
120					100	113		110				
90				70								
60												
30	6	9	13									
0	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	

Year

B. What was the best breeding year on Devil’s Slide Rock?

2006

C. Live Web Cam Observation of Murres on Devils Slide Rock

www.fws.gov/sfbayrefuges/murre/murrehome.htm

Month/ Day/ Year	Number of Murres observed	First Murre egg observed	Behavior of Murres	Cormorant courting behavior	Other birds observed
		End of April to Mid May	-preening -egg laying -nest guarding, -fighting for nest space -breeding	Male-displays blue pouch with head back to show female	-Brandt’s Cormorants -Western gulls -Pigeon Guillemots
			-fighting with other birds -caring for fledgling	Male-brings seaweed nest material and female makes the nest	-Black Oystercatcher

Webs Under Waves: Exploring the Coastal Marine Environment

A W K N H K U P O Y K N X C W
M D E R W H R Y F O O D W E B
U P A H A E N Z A I C D C B X
R Y A P D H F N L S C M Y K B
R L R A T Y S A W K O R A P K
E E T M V A E I T S R C F Z S
N O I G P S T X Y Y M H E C A
R O X L N T Z I S H O S R A Z
R H T Y U O B Z O R R I A W N
E K E K S T U X Z N A F V J D
T G F O N N Z E N Q N K A B W
R R Y C R A A H J I T C V L B
L L I R K W L T O L S O K K S
T D V Z T U A P Z Y U R Q R W
L L I P S L I O M K B Q Q U P

ADAPTATION

KRILL

OIL SPILL

ROCKFISH

SUN

CORMORANT

MURRE

PLANKTON

SEALION

WHALE

FOOD WEB

OCEAN

PREDATOR

SHARK

Word Search Puzzle

Seabird Survival Card Game

Webs Under Waves: Exploring Coastal Marine Life

Students will play a card game in small groups (4-5 students) to test their knowledge about seabird adaptations.

Sample card game provided - Students can cut-out cards and play

Time: 10-15 minutes

Preparation: To make more game cards from the master.

Copy the attached pages and cut up the cards. To make a complete deck, you will need:

- 3 copies of the sheet that has 9 different adaptation cards, and 1 copy of the sheet that has 3 different adaptations cards.
- 2 copies of the sheet that has 12 environmental challenge cards.
- 1 copy of the sheet that has
- 4 environmental challenge cards (*human-made threat*) they are included with a different border.

To avoid card tears and loses, laminate the playing cards.

Print the adaptation cards on different colored paper than the environmental challenge cards for easier identification.

Enlarge, copy, and laminate the Seabird Survival Card Game Rules sheet.

Objectives

Students will...

- Play a small group card game to learn about seabird adaptations in a fun and interactive way. (4-5 students in a group works.)
- Learn how seabirds have adapted to different environmental challenges.
- Learn about several hazards that face marine life.

Vocabulary

Adaptation- A physical characteristic or behavior that helps an organism survive in its environment. Examples: physical bird adaptations include having hollow bones that help with decreasing weight in flight and the Common Murres pear-shaped eggs which roll in a circle instead of off the cliff edge. Behavioral characteristic include nesting in colonies which decrease predation.

Seabird- A bird that frequents coastal waters and the open ocean. Some species spend the majority of their lives for out at sea while others rarely venture for from the coast, but virtually all seabirds feed in the ocean waters.

Hazard- A source of danger; an event or object that may cause harm or injury.

Natural environmental challenge- The hazards an organism must face due to their environment. An example of a natural environmental challenge Common Murres must face is that they have to protect themselves and their eggs from gulls and ravens.

Human-made threat, environmental challenge- Human actions that can cause harm to an organism. An example of human-made threat, presented to Common Murres is plastic trash in the ocean where they hunt for food.

Introduction

This activity will reinforce students' knowledge of seabirds and their place in the coastal marine food web.

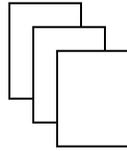
Seabird Survival Card Game Rules

1. The object of the game is to collect as many environmental challenge and adaptation card matches as possible. (Human-made threat challenge cards do not have matches.)
2. One student shuffles the deck and deals 4 adaptation cards to each player.
3. The rest of the adaptation cards and all the challenge cards are placed face down in 2 separate piles in the center of the playing area.
4. The player to the left of the dealer goes first. Continue clockwise.
5. When it is your turn, pick up a challenge card from the pile.
6. If you have the adaptation card that matches that challenge, you get to keep both cards and lay your match in front of you.
7. After a match, draw another adaptation card from the pile to make 4 adaptation cards.
8. Repeat steps 5 and 6 until you cannot make a match, at the end of your turn you should have 4 adaptation cards left.
9. If you cannot make a match leave the challenge card face-up next to the face down challenge card pile. This ends your turn.
10. If you pick up a *human-made threat* challenge card, tell others how you can help the threat on the card and keep the card. This card does not have a match. *This ends your turn for that round.*
11. Read your cards out loud and share the information with the other players.
12. The next player sees if they can match any or all turned up challenge cards. If they match all the turned up challenge cards, then they can draw from the challenge card pile. If they can't match any of the turned up challenge cards, they can draw from the challenge card pile.
13. The game ends when the adaptation pile is gone or time is up.
14. The winner is the player with the most matches.

Playing field

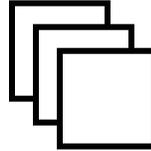
(face down)

Rule #3



(face down)

Rule #3



Rule #8



Player #1

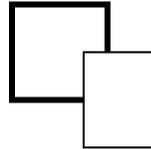
4 Adaptation cards

Rule #2



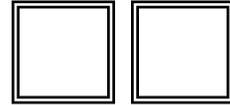
Matches

Rule #6



Human-made threat

Rule #9



Student Assessment

1. Name two seabird adaptations.
2. Explain why that adaptation is important to the murre's survival.
3. What is one environmental challenge (threat) that is caused by humans?
4. Describe one way you can help seabirds.

Extensions

- Students draw a Common Murre and label its adaptations.
- Students design their own coastal marine creature and its adaptations.

Additional Resources

The Common Murre Restoration Project

www.fws.gov/sfbayrefuges/murre/murrehome

PRBO Conservation Science Education

www.prbo.org/cms/index

Oikonos Ecosystem Knowledge Seabird Projects

www.oikonos.org/projects/projects

Project Puffin and the Seabird Restoration Program

www.audubon.org/bird/puffin/

Mark Rauzon, Seabirds. Franklin Watts, 1996.

Zoobooks, Seabirds. Wildlife Education Ltd., 1995

Source

Seabird Survival Card Game created for Webs Under Waves.

This adaptation game was inspired by this marine mammal adaptation

game: www.aeoe.org/conference/resources/2005/marinemammals/adaptationgame.pdf

Make 1 copy of this page

Adaptation Card

Oil Glands



Most seabirds have an oil gland that helps them stay waterproof.

Adaptation Card

Oil Glands



Most seabirds have an oil gland that helps them stay waterproof.

Adaptation Card

Oil Glands



Most seabirds have an oil gland that helps them stay waterproof.

Adaptation Card

Nests on cliff edges



Murres nest on steep cliff edges to reduce competition with other seabirds.

Adaptation Card

Nests on cliff edges



Murres nest on steep cliff edges to reduce competition with other seabirds.

Adaptation Card

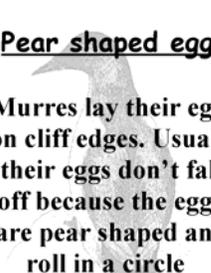
Nests on cliff edges



Murres nest on steep cliff edges to reduce competition with other seabirds.

Adaptation Card

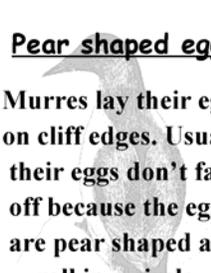
Pear shaped eggs



Murres lay their eggs on cliff edges. Usually their eggs don't fall off because the eggs are pear shaped and roll in a circle when bumped.

Adaptation Card

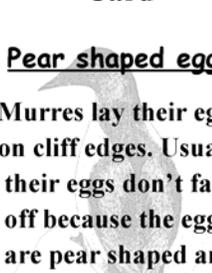
Pear shaped eggs



Murres lay their eggs on cliff edges. Usually their eggs don't fall off because the eggs are pear shaped and roll in a circle when bumped.

Adaptation Card

Pear shaped eggs



Murres lay their eggs on cliff edges. Usually their eggs don't fall off because the eggs are pear shaped and roll in a circle when bumped.

Make 3 copies of this page

**Adaptation
Card**

Salt glands

Seabirds can drink salt water since they have salt glands above their eye sockets, to remove extra salt.



**Adaptation
Card**

Air Sacs

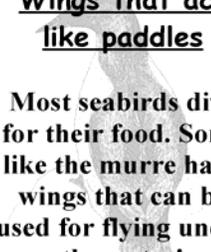
Flying is harder than walking, so birds have air sacs to help them take in more oxygen.



**Adaptation
Card**

**Wings that act
like paddles**

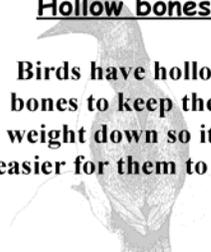
Most seabirds dive for their food. Some like the murre have wings that can be used for flying under the water!



**Adaptation
Card**

Hollow bones

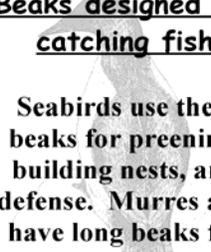
Birds have hollow bones to keep their weight down so it is easier for them to fly.



**Adaptation
Card**

**Beaks designed for
catching fish**

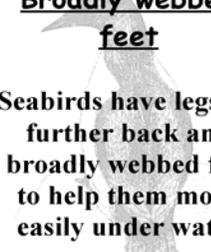
Seabirds use their beaks for preening, building nests, and defense. Murres also have long beaks for catching fish.



**Adaptation
Card**

**Broadly webbed
feet**

Seabirds have legs set further back and broadly webbed feet to help them move easily under water.



**Adaptation
Card**

Down Feathers

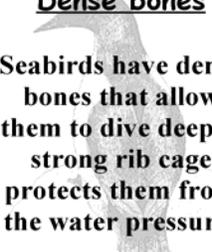
Down feathers are the fluffy under feathers that keep a bird warm.



**Adaptation
Card**

Dense bones

Seabirds have dense bones that allow them to dive deep. A strong rib cage protects them from the water pressure!



**Adaptation
Card**

Nest in colonies

Murres nest together in large colonies for protection from predators like gulls.



**ENVIRONMENTAL
CHALLENGE CARD**

You have to move quickly in the
water.

Adaptation: Legs that are set further
back and feet that are webbed

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

It is cold and wet in the ocean
and you need to stay dry.

Adaptation: Oil gland to keep feathers
waterproof

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

Its cold in the air when flying
high.

Adaptation: Down feathers

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You need extra oxygen to be
able to fly.

Adaptation: Air sacs that help you
breath

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You need to fly!

Adaptation: Hollow Bones

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You need to catch a slippery
fish for dinner.

Adaptation: Beak designed for catching
fish

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You have to dive deep to catch
your food.

Adaptation: Dense strong bones and a
strong ribcage

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You have competition for nesting
areas from other seabirds.

Adaptation: Nest on cliff edges

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You have to stay safe from
predators like gulls.

Adaptation: Nest in colonies

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

Your eggs are very close to the
cliff edge.

Adaptation: Pear shaped eggs

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You need to swim underwater to
catch your food.

Adaptation: Wings that act as paddles

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD**

You have to drink salt water.

Adaptation: Salt glands

If you don't have this adaptation:
Your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD
Human-made Threat**

There is trash in the ocean that
can hurt you.

Adaptation: NONE

Pick up one piece of trash and then
your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD
Human-made Threat**

You are caught in a fishing net.

Adaptation: NONE

Think of one reason birds get
caught in fishing nets and then your
turn is over

**ENVIRONMENTAL
CHALLENGE CARD
Human-made Threat**

There is plastic in the ocean that
you mistake for food.

Adaptation: NONE

Think of a type of plastic that
could get in the ocean and then
your turn is over.

**ENVIRONMENTAL
CHALLENGE CARD
Human-made Threat**

You swim through an oil spill and
get oil on your feathers.

Adaptation: NONE

Think of one way you can keep oil
out of the ocean and then your
turn is over.

Copying Directions:

Make 1 copy of the environmental challenge-human threat cards

Make 2 copies of each of the environmental challenge cards

Our pledge to the Ocean



It's future is in our hands



We support you

Class Pledge Banner:

Students can place their personal pledge cards around the banner to make a wall display.

Webs Under Waves:

Exploring the Coastal Marine Environment



I pledge to protect coastal marine life by:

Name: _____ Date: _____

Coastal Marine Pledge cards (provide one for each student)