

Activity Title: More than a Shark! Creatures of the Greater Farallones and Cordell Bank National Marine Sanctuaries *NOAA Teacher at Sea*

Focus: Organisms in marine ecosystems of the California Current off the north-central California coast

Grade Level: 7-8

Average Learning Time: 5 x 47 minute periods

Lesson Purpose: Students will use ACCESS (Applied California Current Ecosystem Studies) data to ask questions and research hypotheses about organisms in the Greater Farallones and Cordell Bank National Marine Sanctuaries.

Big Idea: Students will understand the critical importance of actively protecting the health of our local National Marine Sanctuaries.

Key Concepts:

1. Access National Oceanic and Atmospheric Administration (NOAA) research data.
2. Graph data gathered from the ACCESS website.
3. Ask a question about populations of organisms based on current data from the website.
4. Conduct research on the question.
5. Present results of research to the class.

Focus Questions:

1. What are specific biotic and abiotic factors in the CA Current?
2. What are the primary food web relationships among organisms in the CA Current?
3. How is data collected about the populations of organisms that live in the CA Current?
4. What can you learn from the data about your assigned organism?
5. Based on what you know and have learned about National Marine Sanctuaries, what can you do to positively affect them for the future of our planet?

Objectives:

1. Student groups will create an artifact of their choice (i.e. chart, map, poster, etc.) of what they learned about their question. Minimum score =17/24 according to the project rubric.
2. Student groups will create the artifact with a minimum score of 17/24 according to the Collaborative Work Skills Rubric.
3. 75% of students will score at least 75% on the post-assessment.

Background Information:

1. Students need to be reminded of Internet etiquette and computer expectations.
2. Students need to know how to navigate research web sites.
3. Students can become distracted or confused by too much information, and may need support to guide them in how to filter data to identify critical and/or important versus irrelevant material.

4. Teacher will provide students with exemplars of artifacts to help them conceptualize their finished product.

Common Misconceptions:

1. Students may have a preconception that the health of oceanic ecosystems is not relevant to human health.
2. Students may not believe that the choices they make can help the ocean.

Materials: notebooks, pen/pencil, graph paper, poster paper, markers, etc.

Technical Requirements: Computers or chromebooks with Internet access.

Teacher Preparation:

1. Teachers need to be familiar with both the NOAA web site and also have a vetted list of other websites students can search.
2. Schedule NOAA scientists and educators to visit the class.

Keywords: transect, ecosystem, food web, producer, consumer, predator, prey

Anticipatory Set:

Students view a video field trip *Best of Big Blue Live* and answer questions in writing about the food web relationships in the CA Current. This familiarizes them with some of the marine life found in the Greater Farallones and Cordell Bank National Marine Sanctuaries, although it was filmed in Monterey Bay. Additionally, their teacher spent her Teacher At Sea experience aboard the Research Vessel Fulmar, which appears in the video (1 x 47 minute period).

Lesson Procedure:

1. Students read their teacher's blog about her work aboard a research vessel, and answer questions in writing.
https://teacheratsea.noaa.gov/#/2017/Jennifer*Hartigan/ship (Includes Teacher at Sea material, National Marine Sanctuary photos and maps explaining transect locations) (1 x 47 minute class period).
2. Teacher facilitates question and answer session, highlighting the camaraderie, and the importance of each small piece of the data gathering efforts worldwide in building an essential information platform, as well as the value of communication.
3. Teacher provides students with artifact exemplar and discusses rubric (2 x 47 minute class periods). The artifact should define the species, present the data from the Greater Farallones National Marine Sanctuary and Cordell Bank National Marine Sanctuary, state their question, and explain what they learned.
4. Teacher breaks students into assigned groups of 3-4 students.
5. Each group chooses a species from the common species list to study: ex: humpback whale, blue whale, CA sea lion, northern elephant seal, northern fur seal, Stellar sea lion, black-footed albatross, sooty shearwater, common murre, Cassin's auklet.
6. Teacher shows students how to navigate NOAA web site to find their information.
7. Groups record population density estimates data for 2004 – 2017 on their transect map and data table.

8. Students graph their data, and look for patterns and trends.
9. From analysis of the data, students formulate a research question about their species. (1 x 47 minute class period)
10. Teacher provides students with list of web sites to research their question.
11. Groups research and create artifact. The artifact should define the species, present the data from the multimap, state their research question, and explain what they learned. Cite sources. Explain why it is important to protect national marine sanctuaries? (1 x 47 minute class period)
12. Groups present their artifact (1 x 47 minute class period).

Assessment and Evaluation:

1. Students take an entry-level survey to assess prior knowledge, and then take a post-test to assess learning.
2. Project Rubric
3. Collaborative Work Skills Rubric

Ocean Literacy Principles:

Principle #1: The Earth has one big ocean with many features. The ocean, which covers 70% of the Earth's surface, is the defining feature of the planet.

1.C.7: Ocean Circulation: Upwelling, which occurs mostly on west coasts, brings nutrients from deep water to the sunlit surface zone where photosynthetic primary producers grow.

Principle #5: The ocean supports a great diversity of life and ecosystems.

5.A: Diversity of Ecosystems: Ocean ecosystems vary widely, based on the variety of environmental factors and the community of organisms living there.

5.A.8: Primary Productivity: There are six places in the ocean, all on west coasts, with the right environmental conditions to create the most productive areas. These are coastal upwelling zones.

5.A.23: Any change in an ecosystem or an organism in the community may have an adverse effect on many other ecosystems.

Principle #6: The ocean and humans are inextricably interconnected.

6.D: Human Impact on the Ocean and Atmosphere: Human activity contributes to changes in ocean and atmosphere.

6.E: Responsibility and Advocacy for the Ocean: Individual and collective actions are necessary for maintaining, conserving and sustaining a healthy ocean.

6.E.1: Scientists are still learning about marine organisms and ocean ecosystems. New information is useful for helping guide policy decisions and individual actions.

6.E.6: It's important for the public to learn about issues regarding the ocean, and to take action.

Next Generation Science Standards (NGSS):

Disciplinary Core Idea LS2.A: Interdependent Relationships in Ecosystems

NGSS Performance Expectations:

MS-LS-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Additional Resources:

Applied California Current Ecosystem Studies: www.accessoceans.org/

Cordell Bank National Marine Sanctuary: <https://cordellbank.noaa.gov/>

Earth is Blue: <https://sanctuaries.noaa.gov/magazine/>

Greater Farallones National Marine Sanctuary: <https://farallones.noaa.gov/>

Monterey Bay National Marine Sanctuary: <https://montereybay.noaa.gov/>

National Oceanic and Atmospheric Administration: www.noaa.gov/

NOAA Teacher at Sea blog: https://teacheratsea.noaa.gov/#/2017/Jennifer*Hartigan/ship

Seabird and Mammal Mapping Tool: <https://data.pointblue.org/multimap/aocean/index.php>

Sanctuary Integrated Monitoring Network:

<https://sanctuarysimon.org/dbtools/project-database/index.php?ID=100382>

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Name _____
Date _____
Period _____

California Current Science and Marine Career Pre/Post Assessment

1. Make a food web of five important species in the California Current. (1 pt. for a web + 1 point per species = 5 points total)
2. What are transects and what do scientists learn from them to protect the marine ecosystem? (2 pts.)
3. Describe krill and explain why they are important. (2 points)
4. Choose a position in the NOAA Corps or a job in marine science. What degrees and internships are required to do this occupation? Explain the daily duties of this occupation. (3 points) Position = 1 point; degrees and internships = 1 point; daily duties = 1 point)

KEY

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California Current Science and Marine Career Pre/Post Assessment

1. Make a food web of five important species in the California Current. (1 pt. for a web + 1 point per species = 5 points total)

Phytoplankton, krill, blue whale, humpback whale, CA gull, fish, CA sea otter, CA sea lion, northern elephant seal, birds like pelicans

2. What are transects and what do scientists learn from them to protect the marine ecosystem? (2 pts.)

Transects are imaginary lines scientists use to sample organisms and abiotic factors like water, salinity and temperature.

3. Describe krill and explain why they are important. (2 points)

Krill are small shrimp-like organisms that form the base of the food chain. They are an important part of the ocean food web.

4. Choose a position in the NOAA Corps or a job in marine science. What degrees and internships are required to do this occupation? Explain the daily duties of this occupation. (3 points total: position = 1 point; degrees and internships = 1 point; daily duties = 1 point)

Name _____
Date _____
Period _____

The Food Web in the California Current Ecosystem
"The Best of Big Blue Live"

1. List 5 organisms that live in the Monterey Bay:
2. What is special about the Monterey Bay ecosystem? Why do animals come here?
3. What is the name of the NOAA Research Vessel used to film in the Monterey Bay?
4. How deep is the Monterey Canyon?
5. How is this a story of recovery in the Monterey Bay?
6. What are indicators of whale presence?
7. How do whales communicate with other whales to tell them they have found a food source?
8. How far do humpback whales travel in a migration, and how big are they?
9. What kinds of feeding behaviors do humpbacks engage in?
10. What is a group of killer whales called?
11. What do killer whales prey upon?

12. When and why were whales hunted?
13. When was commercial whaling banned worldwide?
14. Why were CA sea lions hunted in the early 1900's? How many were there then?
15. Where does the world's largest colony of CA sea lions live?
16. How big is a Great White Shark?
17. Humans are _____ times more likely to be killed by a bolt of lightning than by a great white shark.
18. What are some adaptations that CA sea lions have to evade sharks?
19. How often do California sea otters need to eat, and what do they eat?
20. Describe some group behaviors of common dolphins seen near Moss Landing.
21. What is bow wave riding?
22. What did the humpbacks do to the orca and why?
23. What are some features of blue whales?
24. What is an adaptation whales have to be able to eat large amounts of small organisms at a time?
25. Draw a model of a food web in the Monterey Bay. Include producers, primary consumers and secondary consumers. Indicate the predator-prey relationship with arrows.

KEY

The Food Web in the California Current Ecosystem "The Best of Big Blue Live"

1. List 5 organisms that live in the Monterey Bay: *CA Sea Otter, CA Sea Lion, Northern Elephant Seal (comes from the Gulf of Alaska and the Aleutian Islands), Blue Whale, Humpback Whale, fish, pelicans, gulls, phytoplankton, krill*
2. What is special about the Monterey Bay ecosystem? Why do animals come here? *Weather patterns and ocean currents cause an upwelling of cold water that is filled with nutrients.*
3. What is the name of the NOAA Research Vessel used to film in the Monterey Bay? *Research Vessel Fulmar*
4. How deep is the Monterey Canyon? *It's almost like standing on the edge of the Grand Canyon*
5. How is this a story of recovery? *Over the past 150 years in Monterey Bay, whales, otters and fish were hunted to extinction: kelp was deforested.*
6. What are indicators of whale presence? *Gulls and pelicans, "spout", tail slap, flukes*
7. How do whales communicate with other whales to tell them they have found a food source? *Song, tail slap*
8. How big are humpback whales, and how far do humpback whales travel in a migration? *60 feet 80,000 lbs. (with an 80 year lifespan). Over 1000 miles from the southern tip of Baja California and Costa Rica.*
9. What kinds of feeding behaviors do humpbacks engage in? *Bubble netting, lunge feeding, some travel over 10,000 miles per year.*
10. What is a group of killer whales called? *Pod*
11. What do killer whales prey upon? *Humpback whale calves, squid, dolphins*
12. When and why were whales hunted? *A century ago, people used blubber for petroleum, soap, candles and other whale products.*
13. When was commercial whaling banned worldwide? *1986*
14. Why were CA sea lions hunted in the early 1900's? How many were there then? *CA sea lions were hunted for hides, blubber and meat. There were 1500 in the early 1900's.*

15. Where does the world's largest colony of CA sea lions live? *The world's largest colony is in the Channel Islands National Marine Sanctuary. They migrate 200 miles to Monterey Bay. Warmer seas mean the fish are difficult to find. The mother has to travel farther to find food. There are now 240,000 CA sea lions.*
16. How big is a Great White Shark? *2 tons, 20 feet length, 35 mph, speed, 70-year lifespan.*
17. Humans are _____ times more likely to be killed by a bolt of lightning than by a great white shark. *10*
18. What are some adaptations that CA sea lions have to evade sharks? Features: *sharp eyes, sensitive whiskers, agile, acceleration, maneuverability.* Behaviors: *stay close to the rocks.*
19. How often do California sea otters need to eat and what do they eat? *CA sea otters need to eat half the day because they have very little blubber to insulate them from the cold ocean waters. They eat crabs, abalone, sea urchins and clams.*
20. Describe some group behaviors of common dolphins seen near Moss Landing. *Groups hunt shoals of fish, and communicate through clicks*
21. What is bow wave riding? *Swimming alongside the boat.*
22. What did the humpbacks do to the orca and why? *They chased them away because orca prey upon humpback calves.*
23. What are some features of blue whales? *As long as a 737. 34 meters long. Can spout up to 9 meters high, can dive to 1600 feet deep, weigh 200 tons, travel 25 mph, 25' wide fluke, eat 4 tons of krill per day, 8000-10,000 blue whales exist in the world today, eat krill and pelagic red crabs.*
24. What is an adaptation whales have to be able to eat large amounts of small organisms at a time? *Their jaw bones separate (they do not attach at a hinge) so their mouths can open very wide.*
25. Draw a model of a food web in the Monterey Bay. Include producers, primary consumers and secondary consumers. Indicate the predator-prey relationship with arrows.

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Teacher at Sea Blog

https://teacheratsea.noaa.gov/#/2017/Jennifer*Hartigan/ship

What are you wondering about the Fulmar research cruise?

July 18, 2017 What is the Research Vessel Fulmar like? Describe it.

What are transects and how do scientists use them?

July 23, 2017 What kinds of wildlife were observed today? Describe them.

July 24, 2017 What is a Tucker Trawl, and how and why is it used?

July 25, 2017 What are the responsibilities of one of the scientists?

July 27, 2017 Describe krill and explain why they are important.

Explain the duties of a NOAA officer.

July 30, 2017 At what universities do the graduate students study? What do they study?

If you got a job on the R/V Fulmar, what would you like to do and why?

Common Species in the Greater Farallones National Marine Sanctuary and Cordell Bank National Marine Sanctuary

Very Common Species:

Humpback Whale
Sooty Shearwater
Black-footed Albatross
Common Murre
Pacific White-sided Dolphin
CA Gull
Cassin's Auklet

See Most of the Time:

Stellar Sea Lion
CA Sea Lion
Pink-footed Shearwater
Northern Fur Seal

Not as Common but Present Regularly

Blue Whale
Northern Elephant Seal

Name _____
Date _____
Period _____

Seabird and Mammal Map in the Greater Farallones National Marine Sanctuary (GFNMS) and the Cordell Bank National Marine Sanctuary (CBNMS)

Part 1: Gather Data

1. Go to the Multimap: <https://data.pointblue.org/multimap/aocean/index.php> or click on the link in the *Marine Science* assignment on School Loop.
2. Select “ACCESS Cruises” for *Choose a Data Collection*.
3. Select your seabird or marine mammal for “Choose a Species”. (Scroll down for marine mammals.)
4. Select either “May”, “Jul”, or “Sep” for *Choose a date range*.
5. Select *Aggregate data across selected dates*.
6. Position the cursor on the underwater mountain ridgeline of the blue map of Greater Farallones NMS. Click.
7. Make colored dots on the map for all transects where your seabird or mammal was observed. Do your best to place the dots on the correct transect. If the dot is large, draw it large; if the dot is small, draw it small.
8. Look at the Multimap to find the Density Estimates. You should see a Density Estimate for many of the years from 2001-2017. If you don't, click around the blue area inside the National Marine Sanctuary until you find it (You may click directly on a red dot **only** if there is **only one** red dot). Record the density estimates for each year in the table.
9. Repeat Steps # 6-9 by positioning the cursor on the underwater ridge of the Cordell Bank NMS.
10. For each year, find the total density estimate for GFNMS and CBNMS combined. Record in the *Total* column.

Part 2: Analyze the data:

1. Using graph paper, graph your data to show number of organisms/km² for each year.
2. Based on the map and your graph, what patterns do you see in your seabird or mammal sightings in our local National Marine Sanctuaries?
3. Based on this data, what would you like to know about your seabird or mammal?

Part 3: Formulate a question:

Rewrite one of your wonderings from #10 into a question you can research.



Original and Expansion Area ACCESS Transect Lines

- Offshore Transect, Original
- - - Offshore Transect, Expansion
- Nearshore Transect, Original
- - - Nearshore Transect, Expansion
- Limited Survey Transect
- NMS Boundaries
- NMS Expansion Area
- Baseline Study Area

Applied California Current Ecosystem Studies (ACCESS)

For more information please visit www.accessoceans.org or contact Jaime Jahndke at jjahndke@pointblue.org

Name _____
Date _____
Period _____

Density estimate of _____ in _____
organism *month*

Year	GFNMS	CBNMS	Total
2004			
2005			
2006			
2007			
2008			
2009			
2010			
2011			
2012			
2013			
2014			
2015			
2016			
2017			

_____ in the Greater Farallones
name of organism

National Marine Sanctuary and Cordell Bank National Marine

Sanctuary in _____ 2004 – 1017
month



Density Estimate (organisms/km²) on y-axis

Year on x-axis

Greater Farallones / Cordell Bank NMS Project

Student Name: _____

Date: _____

CATEGORY	4	3	2	1
Content – Accuracy	At least 7 accurate facts (species name, description, graph of density estimates, transect map, names of National Marine Sanctuaries and research question) are displayed on the poster.	5-6 accurate facts are displayed on the poster.	3-4 accurate facts are displayed on the poster.	Less than 3 accurate facts are displayed on the poster.
Mechanics	Capitalization, punctuation and grammar are correct throughout the poster.	There are 1-2 errors in capitalization, punctuation or grammar.	There are 3 errors in capitalization, punctuation or grammar.	There are more than 3 errors in capitalization, punctuation or grammar.
Graphics – Relevance	All graphics are related to the topic and make it easier to understand. All borrowed graphics have a source citation.	All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation.	All graphics relate to the topic. Most borrowed graphics have a source citation.	Graphics do not relate to the topic OR several borrowed graphics do not have a source citation.
Knowledge Gained	Student can accurately answer all questions to explain what they learned from their research and why it's important to protect oceans.	Student can accurately answer most questions to explain what they learned from their research and why it's important to protect oceans.	Student can accurately answer about 75% of questions to explain what they learned from their research and why it's important to protect oceans.	Student appears to have insufficient knowledge to explain what they learned from their research and why it's important to protect oceans.
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout and neatness.	The poster is acceptably attractive, although it may be a bit messy.	The poster is distractingly messy or very poorly designed. It is not attractive.
Sources	At least 3 sources were used in the production of the poster. All are cited accurately.	At least 2 sources were used and cited accurately.	Fewer than 2 sources used or cited.	No sources were cited.

Total= _____/24

Collaborative Work Skills

Student Name _____ Date: _____

CATEGORY	4	3	2	1
Focus on the task	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.
Time management	Routinely uses time well throughout the project to ensure things get done on time. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Usually uses time well throughout the project, but may have procrastinated on one thing. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Tends to procrastinate, but always gets things done by the deadlines. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Rarely gets things done by the deadlines AND group has to adjust deadlines or work responsibilities because of this person's inadequate time management.
Problem-solving	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.
Contributions	Routinely provides useful ideas when participating in the group and in classroom discussion. A definite leader who contributes a lot of effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Working with Others	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.

Total= _____/24