Exploring Ocean Frontiers

Ocean Frontiers III:
Leaders in Ocean Stewardship & the New Blue Economy

Grades 7-12 / Secondary Lessons

Acknowledgements

green fire
PRODUCTIONS

ocean-frontiers.org
greatbearsea.net
greenfireproductions.org

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Introduction

The **Exploring Ocean Frontiers Secondary Educator Resources** are based on the *Ocean Frontiers* film series by Green Fire Productions, and can be used to engage students on an inquiry-based educational journey in ocean stewardship. The inspiring *Ocean Frontiers* films portray how unlikely allies – government, industry, science and conservation – are working together to find solutions that benefit ocean ecosystems and economies.

Students can learn about this new wave of ocean stewardship through these secondary lesson sets that build on real-world science and help make science more relevant. The lessons feature engaging classroom activities that include inspiring film clips, research data, local knowledge, place-based stories, role-playing, background information and more — providing educators curriculum-linked tools to incorporate ocean management and conservation perspectives into a variety of classroom settings. Themes include: collaborative science, ocean planning, stakeholder engagement, ocean data portals, marine biodiversity and ocean stewardship. All secondary lessons are connected to the Next Generation Science Standards and Ocean Literacy Principles.

> The films, secondary lesson sets and post-secondary discussion guides are available at no cost:
> https://ocean-frontiers.org/educator-resources

Ocean Frontiers Film Series

As the blue planet's burgeoning populace faces an uncertain future, never before have the world's oceans been called upon to serve so many, while suffering so much. To address this, people around the world are engaged in collaborative ocean planning. In North America, the U.S. and Canada have created ocean plans to help guide management and conservation of our oceans. State, federal and tribal governments are working together with scientists and a wide array of marine stakeholders including maritime commerce, fishing and recreation, plus the growing industries of offshore wind energy and aquaculture. Green Fire Productions has traveled North America from coast to coast, capturing the inspiring stories of people working together to sustain our seas and our ocean economies. The three *Ocean Frontiers* films focus on ocean planning in the U.S. and *The Great Bear Sea* portrays ocean planning in British Columbia, Canada.

Green Fire Productions, a non-governmental organization, produces documentaries on sustainability and conservation of natural resources. Founded in 1989 by Karen Anspacher-Meyer and Ralf Meyer, Green Fire films are used in classrooms worldwide and screened in community events, for government officials and on public television.

Ocean Planning

Our ocean use is growing rapidly, with massive new ships, soaring demand for offshore sand mining and proposed wind energy development offshore. Our busy waters are also home to endangered whales and sea turtles, and support vital fishing and recreation industries. It's more important than ever that we plan ahead for responsible ocean growth. In the face of both increasing development pressures and increasing interest in the conservation of nature, ocean planning has been identified by scientists, policy makers and stakeholders around the globe as a practical approach to manage both conflicts and compatibilities in the marine environment. It is a comprehensive, ecosystem-based planning process built on sound science to analyze and plan for current and anticipated uses of the ocean. Pioneered in Western Europe, ocean planning is underway in more than 60 countries, including the United States and Canada. For more background information on ocean planning, see page 12.

Resource Overview

Ocean Frontiers: The Dawn of a New Era in Ocean Stewardship

The first *Ocean Frontiers* film tells four ocean planning success stories from seaports and watersheds across the country — from the busy shipping lanes of Boston Harbor to a small fishing community in the Pacific Northwest; from America's coral reefs in the Florida Keys to the nation's premier seafood nursery in the Mississippi Delta. Lessons include:

- **Uncovering GIS Data: Saving Whales at Stellwagen Bank**
  Map interpretation; using GIS data to reduce ship strikes on whales.
- **Stakeholder Engagement: Playing and Working in the Florida Keys**
  Marine zoning and stewardship roles in coral reef conservation.
- **Rivers Connect: Iowa Farmers & the Gulf of Mexico**
  An inland perspective on reducing human impacts on the ocean.
- **Sustainable Fishing in Port Orford, Oregon: Collaboration in Action**
  Local knowledge, marine protected areas and collaborative research to preserve natural and cultural resources.

View film | Download film | Download Spanish version

Ocean Frontiers II: A New England Story for Sustaining the Sea

Ocean Frontiers II looks closely at Rhode Island's ocean planning work, the use of science and data to make better decisions and the subsequent siting of an offshore wind farm. The story focuses on how the offshore wind energy company worked with conservationists, fishermen and the Narragansett Indian Tribe to reduce conflicts and potential impacts. Lessons include:

- **Ocean Stakeholders: Every Voice Matters**
  Stakeholder engagement and collaborative decision-making.
- **Keeping Track Of It All: Using Data Portals for Ocean Planning**
  Understanding human activity in the ocean to reduce impacts on marine life.
- **Multi-Species Management: We're All In This Together**
  Food webs; keystone species; systems thinking; writing to Congress.
- **Collaborative Research: Block Island Wind Farm**
  Interpreting data; collaborative research and local knowledge to understand potential wind farm impacts to fishermen.

View film | Download film

Ocean Frontiers III: Leaders in Ocean Stewardship & the New Blue Economy
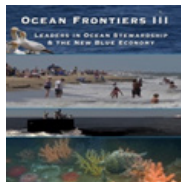
The most recent film in the series, *Ocean Frontiers III*, provides the best overview of U.S. ocean planning in the series. The film focuses on U.S. regional ocean planning efforts and how a broad array of people are using science and data to reduce conflicts and protect marine ecosystems.
Lessons include:

- **What is Ocean Planning: Charting the Ocean's Future**
  Stakeholder role-playing game; working together to resolve conflicts.
- **Ocean Data Portals: The Key to Smart Decisions**
  Exploring interactive mapping tools; scavenger hunt and map making.
- **Marine Biodiversity, Conservation & Healthy Oceans: Deep Sea Corals**
  How human uses of the ocean intersect with marine life; compatible uses; mapping.
- **Get Involved: Student Advocacy & Citizen Science**
  Writing to Congress; engaging in citizen science.

View film | Download film

The Great Bear Sea: Reflecting on the Past—Planning for the Future

The Great Bear Sea portrays marine planning in British Columbia. The film focuses on the collaboration between Indigenous communities and the Province of British Columbia to create marine plans to both protect their home and build sustainable coastal economies. 'Exploring the Great Bear Sea' curriculum resources include elementary, secondary and post-secondary resources that are available for free download online at www.greatbearsea.net. Themes include traditional and local knowledge, collaborative science, marine planning, biodiversity, sustainable resource management and marine stewardship. All resources are connected to the revised British Columbia curriculum.
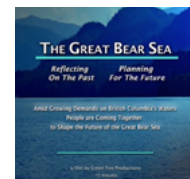
View film | Download film | Download Spanish version

Tips for Educators

The lesson plans, film clips and resources provide a framework for educators to teach key elements of ocean planning and ocean stewardship. All lessons are inquiry-based and activities can be customized to suit the needs of your environment or learners. Lessons can be taught individually or as units of study with the full four-lesson sets. When utilizing individual lessons, students will benefit from watching the associated full-length film in advance. At points it may be helpful to pre-teach new concepts or learning strategies. These have been noted, where appropriate, with guidance provided.

The resources have been divided into sections to guide the classroom teacher. For each lesson teachers will find essential questions, required materials, learning objectives, step-by-step instructions for suggested activities, extensions and additional resources, as well as learning materials (handouts, worksheets, etc.) to complete the lessons. A background information section is included for each lesson, highlighting additional content for educators. Prior to teaching these lessons, it is highly recommended that educators watch the associated film.

Post-secondary discussion guides are also available for each film and may be adapted by secondary teachers for their learning environment.

Resource Development & Contributors

We believe that teaching students about current marine policy decisions and the science-based, solutions-oriented approach of ocean planning is critical for them to become informed ocean stewards. Green Fire Productions created these resources to inform and motivate the next generation of ocean leaders.

Curriculum Author

Curriculum designer, Rebecca Clark Uchenna (Masters of Science in Environmental Studies, Conservation Biology) has worked in formal and informal classroom and outdoor educational settings, research centers and nonprofit organizations throughout New England and abroad. She has extensive experience in STEM education, project development and implementation. Her passion for marine conservation, science and place-based education has allowed her to develop a unique set of skills, enabling her to communicate effectively with fishermen, scientists, students and educators.

Contributors

There are materials included in this lesson set that were provided by individuals or organizations for use in this resource. Thank you to the following contributors for sharing these materials:

Lesson 1: Edpuzzle for *Ocean Frontiers III* - Kimberly Williams
Extension: "Ocean Planning: A Game of Balance" – Wildlife Conservation Society's New York Aquarium

Lesson 3: Custom Maps of Hudson Canyon – Created by Eva Barnett on the Mid-Atlantic Ocean Data Portal

Next Generation Science Standards & Ocean Literacy Table

Next Generation Science Standards	Lesson 1	Lesson 2	Lesson 3	Lesson 4
Middle School				
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.		✓		
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.				✓
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	✓		✓	
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	✓			✓
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.			✓	✓
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	✓			
High School				
HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.		✓	✓	✓
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	✓			
HS-ESS3-3. Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.	✓			
HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	✓	✓	✓	
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	✓	✓	✓	
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	✓			
Ocean Literacy Principles	Lesson 1	Lesson 2	Lesson 3	Lesson 4
Essential Principle #5: The ocean supports a great diversity of life & ecosystems.		✓	✓	
Essential Principle #6: The ocean and humans are inextricably linked.	✓	✓	✓	✓
Essential Principle #7: The ocean is largely unexplored.			✓	

What is Ocean Planning:
Charting the Ocean's Future

ESSENTIAL QUESTIONS

- What are some reasons why people are working together to plan for the future of our oceans?
- What are the traditional uses of the ocean and what are some newer uses?
- How can ocean planning support sustainable solutions to ocean challenges?

MATERIALS & RESOURCES

- Computer, projector and screen
- *Ocean Frontiers III* film (60 minutes)
  - ¤ Watch on Ocean Frontiers website https://ocean-frontiers.org/of3
  - ¤ Edpuzzle interactive video tool http://bit.ly/OF3Edpuz. Video with embedded questions; free; registration required (see Background Information). Answer Key provided.
- Ocean Frontiers III Guided Viewing Worksheet
- Props for the Navigation Game (optional)
- Ocean Solutions Game (each team gets one set of materials)
  - ¤ Instructions, Ocean Solutions Game Recordkeeping Worksheet, Map, Ocean Stakeholder Role Cards, Scenario Cards

OBJECTIVES

Students will:

1. Describe how ocean planning is being implemented in the U.S.
2. Explore how ocean planning is used to create collaboration between decision makers and ocean stakeholders.
3. Obtain, evaluate and communicate different viewpoints of ocean stakeholders to identify potential ocean conflicts.
4. Work collaboratively to solve a problem, using the key principles of ocean planning.

SUBJECTS

- Science – Ecology
- English Language Arts
- Geography
- Social Studies

DURATION 2 hours

Note: *Ocean Frontiers III* can be downloaded at http://bit.ly/OF3-DL

OVERVIEW

This lesson will help students understand the basic concepts of ocean planning and how it can support thoughtful, sustainable solutions to ocean challenges. Students will watch *Ocean Frontiers III,* giving them an overview of what ocean planning is and how it is being implemented in the U.S. Students will work together to solve different scenarios in a fictitious island community, using concepts from ocean planning. Each student will be given a unique role to play in their community, and as a team, students will have to work collaboratively to make sure that all ocean uses and stakeholders are represented and able to work together, while also conserving and protecting the marine ecosystem.

> "Ocean planning is critical in order for the Coast Guard and other agencies to work together in a collaborative manner to ensure the maritime transportation system is safe, secure, efficient and resilient."
>
> *Chris P. Scraba – United States Coast Guard*

ACTIVITIES

Activity 1 – Setting the Stage with *Ocean Frontiers III* (75 minutes)

1. Provide each student with a copy of the Ocean Frontiers III Guided Viewing Worksheet and review together as a class.

2. Watch *Ocean Frontiers III*. As students watch the film, have them record their answers to the questions on the worksheet. Alternatively, have students watch the film on their own time, via one of these methods:

   a. Ocean Frontiers website - As students watch the film online, have them record their answers to the questions on the Ocean Frontiers III Guided Viewing Worksheet.
   b. Edpuzzle – Have students answer the embedded questions and be prepared to discuss their answers with the class. Before meeting the students for discussion, the teacher should review the Edpuzzle answers as a basis for classroom discussion. See Background Information and Answer Key.

Activity 2 – Navigation: A Communication and Trust-Building Game (20 minutes)

1. Ahead of time, arrange a simple obstacle course in the classroom that represents the ocean that students will navigate in teams.

2. Divide students into teams and have students take turns navigating the "ocean" while blindfolded, with only their teammates to guide them.

   a. Teams must decide who is going to "captain" safely across the "ocean"; that student will be blindfolded.
   b. The remaining team members must stand on the sidelines to help the captain navigate safely across to the other side of the room. Teams must figure out the most efficient way to communicate with the captain. What works best when navigating? Does shouting work, is it better for one person to give directions, etc.? Physically guiding the captain is not allowed.

3. After everyone has successfully navigated the ocean, have a quick debrief on what worked well and what did not work well.

    a. How did it feel to move blindfolded through the ocean?

    b. Was it easy or difficult to communicate with the captain?

    c. How did it feel to watch the captain successfully/unsuccessfully navigate the ocean?

    d. What is ocean planning and how does this activity apply to ocean planning?

        i. *Ocean planning is a way to bring everyone to the table; it allows for open communication and cooperation between different ocean stakeholders and decision makers.*

        ii. *Ocean planning may help to reduce the sense of uncertainty when developing sustainable solutions to ocean challenges.*

Activity 3 – Ocean Planning Overview (10 minutes)

1. Once students have watched the film and filled out the Guided Viewing Worksheet or Edpuzzle, have a discussion on the following:

    a. What was the most surprising thing you learned during the film?

    b. Who are some ocean stakeholders? Who are considered "traditional ocean users" and who are considered to be "emerging ocean users"? *Traditional: shipping industry, fishers, conservationists, researchers, recreational users. Emerging: offshore wind energy companies, offshore sand mining, offshore aquaculture.*

    c. Why is ocean planning important? *It is a tool allowing ocean users to better plan for current and future ocean uses; it allows everyone to have access to ocean data; conservation is incorporated into ocean development and use.*

Activity 4 – Ocean Solutions Game (40 minutes)

1. Divide students into groups of 5 team members, with each person choosing a stakeholder role to play in the fictitious community of Shipwreck Rock. Note: If class has more than 15 students, scenarios may be repeated.

2. Provide Ocean Solutions Game Materials to each group, which include:

    a. Overview and Instructions

    b. Recordkeeping Worksheet

    c. Map of Shipwreck Rock

    d. Ocean Stakeholder Role Cards

    e. Scenario Cards

3. Each team member will have a unique role to play in their community.

    a. Ocean Stakeholder Role Cards:

        i. Surf Shop Owner

        ii. Oyster Aquaculturist

  iii. Marine Shipping & Transportation Manager

  iv. Active Citizen of Community

  v. National Oceanic and Atmospheric Administration (NOAA) Researcher

4. Once team members have chosen their roles, each team will draw one scenario card. Each scenario card lists pros and cons for the situation.

 a. Scenario Cards:

  i. Offshore Wind Energy Proposal

  ii. Increased Tourism

  iii. New High-Speed Ferry

5. While in character, each team must develop the best solution to the scenario, keeping in mind all the ocean stakeholders' needs and concerns. Students use the provided Recordkeeping Worksheet to record their different viewpoints and possible solutions. Creative thinking is encouraged, but students must engage in argument from evidence that their solution is realistic and can be applied in the real world. Teams must keep in mind other ocean uses and how the scenario might affect others, as well as how expensive solutions may be. Make sure students are realistic in their problem-solving approach.

Activity 5 – Wrap Up/Closure Questions (15 minutes)

1. Students will display their community solutions around the classroom and will have a gallery walk, where students and teachers can view the proposed solutions and ask questions to each group. This is an informal way to present work.

2. Compare the experience of navigating without much information (Activity 1) with playing the Ocean Solutions game and having more information about the situation and stakeholders. Would students have successfully completed the game without good information and communication between different stakeholders?

3. Allow the students time to discuss as a class or journal answers to the Essential Questions to check for student understanding and correct any misconceptions. Additional questions to consider:

 a. What are some important qualities that could help people with very different perspectives come to decisions?

 b. How might the needs of future generations affect the decisions being made about our oceans today?

BACKGROUND INFORMATION

Ocean Planning

Ocean planning has been identified by scientists, policy makers and stakeholders around the globe as a practical approach to manage both conflicts and compatibilities in the marine environment in the face of both increasing development pressures and increasing interest and understanding of human interdependence on healthy ecosystems. It is a comprehensive, ecosystem-based planning process, built on sound science to analyze and plan for current and anticipated uses of the ocean. Pioneered in Western Europe, ocean planning is underway in more than 60 countries.

In the early 2000s two bi-partisan ocean commissions, the Pew Ocean Commission and the U.S. Commission on Ocean Policy, articulated a vision for comprehensive ocean governance in the United States, seeing a growing need to support stewardship, multiple use management and science-based decision-making. Initial U.S. ocean planning efforts were local and state-based, with Massachusetts, Rhode Island, Oregon, Washington, New York and Connecticut creating state ocean plans for their coastal waters. Ocean planning has been used to reduce ship strikes on endangered whales outside of Boston Harbor by more than 80%, and the Florida Keys National Marine Sanctuary developed ocean plans to reduce conflicts among ocean stakeholders and to protect their coral reefs.

Ocean planning on a regional scale began as a result of the National Ocean Policy, established in 2010 by President Obama. This policy was the result of more than 10 years of work by scientists, policy makers and stakeholders, including ocean industries, coastal residents and conservationists. To implement ocean planning, nine ocean planning areas were designated in the U.S., mostly along large marine ecosystems. In 2016 the Northeast and Mid-Atlantic completed regional ocean plans and began implementing them in 2017. Other regions now have ocean plans in development.

In 2018 the White House revoked the National Ocean Policy, replacing it with one that emphasizes security and commerce over conservation and stewardship. The new policy shifts leadership of regional ocean planning to the states and allows for federal participation and data sharing to continue. With state leadership, ocean planning continues to move the U.S. away from an overly-simplistic issue-by-issue management approach toward comprehensive, informed and strategic ocean management.

Edpuzzle Instructions

The Edpuzzle in this lesson can be used by anyone, but in order for the teacher to collect the students' responses, it's necessary to sign up for an Edpuzzle account. Go to https://edpuzzle.com, click on 'Sign Up' and register as a teacher. Once you have an account, click on Content in the top menu, then select Edpuzzle from the sidebar. In the search bar, enter 'Ocean Frontiers' and perform the search. You'll see both *Ocean Frontiers II: A New England Story for Sustaining the Sea* and *Ocean Frontiers III: Leaders in Ocean Stewardship & the New Blue Economy*. Hover over the video you'd like to use and click on the copy icon to add it to your content.

Click on 'My Content' in the sidebar, select the video by checking its box and then click on 'Assign' at the bottom of the page. Click on 'Add new class' and fill out the form. Click on 'Assign' to finalize. Then click the 'Invite Your Students' button - you will receive a code that students can enter. For further information on using Edpuzzle, watch the tutorials or click on the 'Help Center' button at the bottom right.

ADDITIONAL RESOURCES

- *Ocean Frontiers III* clips playlist
- Northeast Ocean Plan
- Mid-Atlantic Regional Ocean Action Plan
- National Ocean Policy website from Obama Archives
- National Ocean Policy Executive Order
- Executive Order 13840
- Pew Ocean Commissions Report, America's Living Ocean
- U.S. Commission on Ocean Policy Report, An Ocean Blueprint for the 21st Century
- Keep the Ocean Working - Stories of people from a wide variety of stakeholder groups on why they support and participate in ocean planning.
- West Coast Regional Planning Body
- Pacific Islands Regional Planning Body
- Caribbean Regional Ocean Partnership

Edpuzzle Answer Key - Ocean Frontiers III

1. United States' economy is linked closely with the flow of goods into and out of its ports. Which of these four are among the busiest in the nation?

    A: Virginia, Maryland, The Tri-States (Pennsylvania, New Jersey, & Delaware), and New York

2. Especially as we face challenges of sustaining a healthy ocean, what is the idea behind the Regional Ocean Planning body?

    A: To bring all groups together so that every group's needs can be addressed.

3. List 3 stakeholders whose needs overlap in the Mid-Atlantic waters discussed in the film. (There are at least 4!)

    A: Answers may include commercial, national security, and conservation interests, or students may be more specific and list stakeholders associated with the military, shipping, wind energy, hydrokinetic energy, whale migrations, and coral canyons

4. What is the tool that Ocean Planners and Stakeholder Groups can use to ensure everyone has the same data when they make decisions about a particular part of the ocean?

    A: Ocean Data Portals

5. Why does the Fishing Captain think Ocean Planning is important?

    A: To ensure that all stakeholders' voices are heard and part of the plan.

6. What are the largest money makers for the coasts of the Mid-Atlantic US?

    A: Tourism & Recreation

7. Which of the following are correct links:

    A: Two answers are correct: Nearshore Activity = what is happening along the shoreline, such as surfing and swimming. Pelagic Activity = what is happening offshore, such as shipping and wind farm locations

8. What does the Data Portal show in this diagram?

    A: Red where there is a high abundance of endangered marine mammals

9. How many different types of data can be found on Data Portals like this one?

    A: Over 5,000

10. The fishermen were worried about having more regulations, but the government official explained to them that if they shared their information about where they fish and when, what would happen?

    A: Agencies regulating developments like wind turbines will understand where fishermen fish early in the process and fishermen's interests will be represented early in the process.

11. With the data the planners have from the fishermen, what kinds of decisions can they make?

    A: Where to locate wind turbines so that they will have the least impact on fishermen.

12. What two industries provide most of the coastal economy in Maine?

    A: Lobstering and Tourism

13. The Ocean Plan gives us the ability to include which Stakeholder who might otherwise be forgotten?

    A: People who work in the lobster fishery

14. What is happening that all stakeholders will have to cope with as they work to make a plan for how to share the ocean's resources?

    A: Climate is changing

15. If a fishery manager looks at this map on the Data Portal and sees the darker colors (like the dark red, for example) what would they be able to tell?

    A: That the area is used heavily for fishing.

16. What animal is being farmed to help boost the Mashpee Wampanoag economy and clear nitrogen pollution from the bay?

    A: Oysters

17. Why is aquaculture being used in this part of the Chesapeake Bay?

    A: To help supply demand while giving the wild populations time to recover.

18. What is unique about this aquaculture facility? Hint: think about its location compared to most aquaculture facilities shown in the film.

    A: It is the first aquaculture farm in federal waters in the Atlantic Ocean (most facilities are closer to shore)

19. Where is the only place in the US where there is an Offshore Wind Farm?

    A: In waters off Rhode Island.

20. True or False: Data Portals can be used to help the Wind Farm companies decide where to place the turbines so that they will be the most effective and least intrusive to all the stakeholders.

    A: True

21. What types of projects can be done with offshore sand?

    A: Beaches can be restored with offshore sand to protect valuable assets and habitat for humans, shore birds, and sea turtles.

22. Why are scientists concerned about disturbing deep sea corals?

    A: Because they live sometimes over 1,000 years and if disturbed, no one is sure how long it would take them to recover.

23. Who did the scientists enlist to help them gather data in Stellwagen Bank?

    A: Humpback Whales equipped with cameras and sensors

24. What was the problem with the Data Portal with regard to the location of whales?

    A: There was no data on that portal that indicated whales near New York City.

25. Which stakeholder do you most closely identify with? Why?

    A: Answers will vary.

Name:_____

Ocean Frontiers III Guided Viewing Worksheet

1. In your own words, develop a definition for "ocean planning." Why is ocean planning important?

2. List some of the stakeholders described in the film who are contributing to ocean planning. For one of those stakeholders, describe how they benefit by being engaged in ocean planning.

3. Sharing data is an important part of collaborating in the ocean planning process. Why do you think some ocean stakeholders may have been reluctant at first to share their data? How may they benefit from sharing data?

4. List some of the different types of data being collected for the Data Portals. Who is collecting the data and how? What new data do you think could contribute to the Data Portals to help in ocean planning for the future?

5. How might regional ocean planning help reduce conflicts over ocean uses? How might it help encourage compatible uses?

Ocean Solutions Game Materials

Overview

The quiet island community of Shipwreck Rock is seeing changes on and around the island. There has been an increase in tourism over the last several years and there are rumors that an offshore wind development company may be siting a new wind farm off the shores of the island. A new high-speed ferry has also been recently proposed to the town council, which would benefit the community in many ways but may be detrimental to the sensitive wildlife on and around the island. These changes in ocean use have caused great concern in the island community. Because you are familiar with ocean planning, the town has asked you to assemble a team to determine the best solutions to these issues.

Materials

- Ocean Solutions Recordkeeping Worksheet
- Master Map
- Ocean Stakeholder Role Cards
- Scenario Cards

How to Play

Form teams of 5 students, with each team member choosing an ocean stakeholder role card. They will "act" as this stakeholder throughout the game.

Ocean Stakeholders include:
- Surf Shop Owner
- Oyster Aquaculturist
- Marine Shipping & Transportation
- Active Citizen of Community
- National Oceanic and Atmospheric Administration (NOAA) Researcher

Once roles have been determined, each team will draw one of the Scenario Cards. While in character each team must try to develop the best solution to the scenario, keeping in mind all the ocean stakeholders' needs and concerns. Use the provided Recordkeeping Worksheet to keep track of different viewpoints and possible solutions. Teams are encouraged to be creative, but remember to keep the solutions as realistic as possible and be able to argue that they can be applied in the real world. Keep in mind other ocean uses and how they may be affected by the scenario, as well as how expensive solutions may be. *Make sure to be realistic in your problem-solving approach.* Good luck!

Recordkeeping Worksheet

Scenario:_____

Viewpoints…

Surf Shop Owner	Aquaculturist	Shipping Manager	Citizen	NOAA Researcher

Solution…

Because…

Shipwreck Rock

Map locations include: Deep-Sea Corals (A1), Mainland (5), Ferry Route, Oyster Farm, Marina, Crescent Beach, Harbor, Town, Surf Shop, Mansions, Seabird Colony.

Grid columns: 1, 2, 3, 4, 5
Grid rows: A, B, C, D
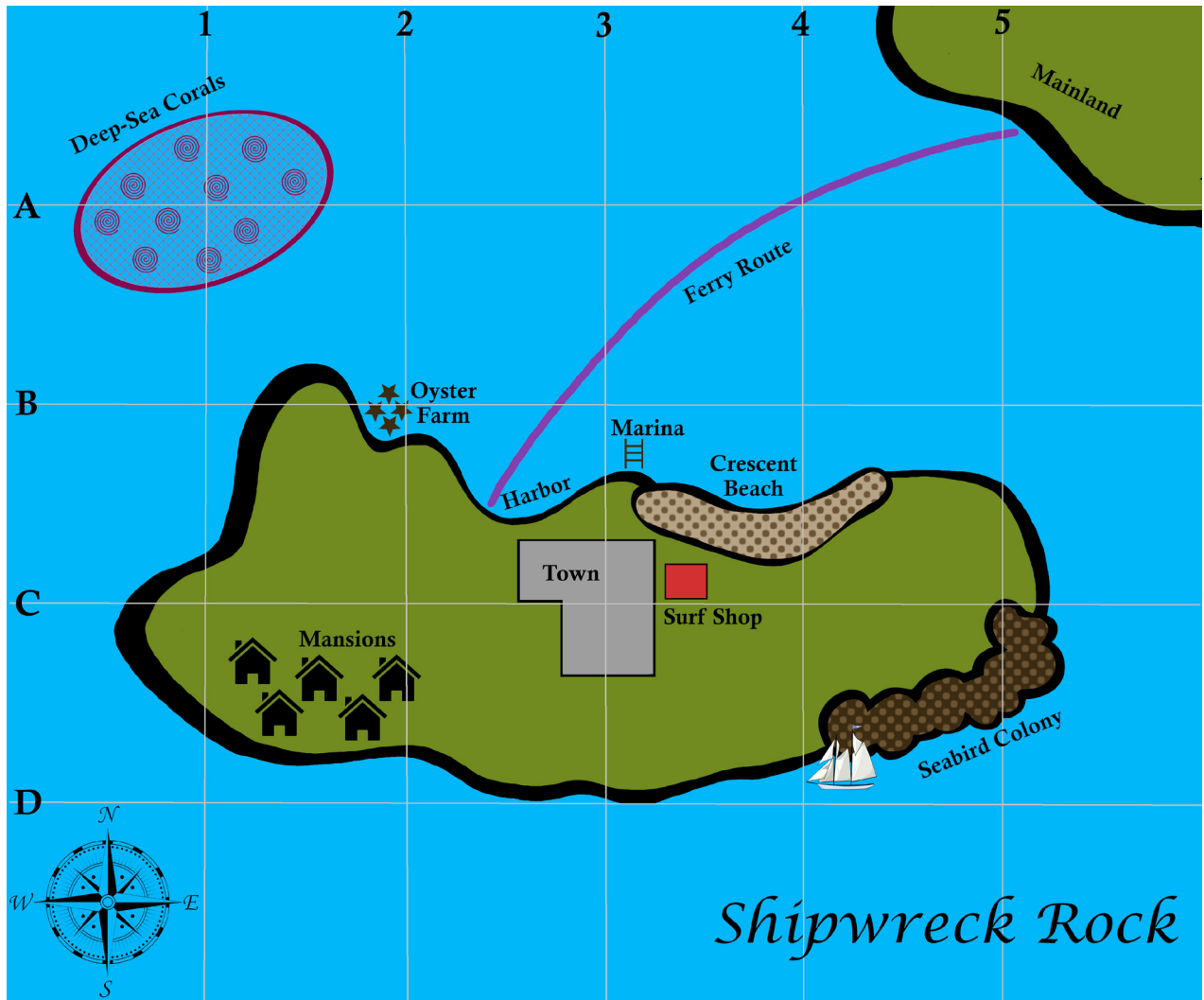
Compass: N, W, E, S

Surf Shop Owner

Name of owner:

_____

This shop has been open for over 30 years and is a landmark in the community. Tourists and year-round residents alike enjoy using the vast equipment that is available for rent at the shop. From surfboards to snorkels to sea kayaks, this shop has it all. Business has been great the past several years, and is particularly busy from late June to August. With more tourists coming and business booming, the owner is thinking of expanding the business and offering guided bird watching tours at the nearby seabird colony. The owner is also going to expand the marina for more recreational boat rentals.

Oyster Aquaculturist

Name of aquaculturist:

_____

This oyster aquaculture operation is celebrating its 10th anniversary this June. The oyster farm is located in a small cove near the harbor and although it is close to the busy port, there have been few conflicts between boaters or fishers and the farm. The farm is doing well and the farmer is pleased to see water quality improvements around the site. There is concern that if the tourist industry continues to increase, especially recreational boating, it may affect the farm.

Shipping & Transportation Manager

Name of manager:

_____

This shipping company transports goods and services to and from the island on a weekly basis. In the busy summer months, deliveries can be made twice a week. The company is looking to expand their services and incorporate a high-speed ferry to and from the island. Instead of a two-hour, one-way trip on the current ferry system, this ferry would take only 45 minutes one-way. This type of boat is "eco-friendly"; however, because of the powerful engine, it is loud and research has shown it affects seabirds and other marine wildlife. It also causes large wakes from the propellers.

Citizen **Name of citizen:** _____	This citizen is originally from this community and has seen a lot of changes over the years. They are passionate about the abundant wildlife around the island and the vast marine life that can been seen. They are dedicated to the protection of the deep sea coral habitat located just off the island, as well as the seabird colony. These habitats must be well protected and conserved for future generations.
NOAA Researcher **Name of researcher:** _____	This researcher from the National Oceanic and Atmospheric Administration is focused on deep sea corals. A coral site was discovered off the shores of the island, but more areas need to be explored. It is important to determine where these coral communities are located as increased offshore ocean development and activity occurs. Because corals are long-lived organisms, researchers don't know how long it would take for a colony to recover if they were disturbed.

Scenario Cards

Scenario #1	**Offshore Wind Energy Proposal** There has been a recent proposal for a new 5-turbine offshore wind energy site, located off the island. The best location for the site is located at A1 on the map because it does not interfere with any current ocean use. However, it so happens that this is where a known deep sea coral habitat is located. There is also a seabird colony on the island and bird strikes may increase from the turbines. Many island residents are concerned that the wind farm will be noisy and an eyesore in the community. Pros - 1. Electricity rates will decrease for island residents 2. Renewable energy source 3. Potential habitat as artificial reef Cons - 1. Proposed location near deep sea coral habitat 2. May interfere with seabird colony (i.e. more bird strikes) 3. Wind turbines may be noisy and/or an eyesore

Scenario #2	**Increased Tourism** There has been a huge increase in tourism to the island over the past several years and projections show it will increase significantly. This surge in tourism has greatly benefitted business owners, however the island is having difficulty sustaining that many people. Resources on the island are limited and the wildlife habitat is sensitive. Recreational boating is becoming more popular, which is starting to cause conflicts between different boat users and the oyster farm. Pros - 1. More money will be coming into the community 2. More business for local shop owners 3. More people can enjoy the island's beauty Cons - 1. Increased beach use overflowing into seabird sanctuary 2. Conflicts among recreational boaters and oyster farm 3. Inadequate bathroom facilities for day visitors decreasing water quality, particularly around the beach

Scenario #3	**New High-Speed Ferry**
	
	There has been a proposal to have a new high-speed ferry service to and from the island. Instead of the two-hour ferry crossing, it will only be a 45-minute trip. This will allow more tourists to visit the island, as well as allow for more goods and services to be provided to the community.
	
	Pros -
	    1. Increased money coming to the island from more tourists
	    2. More goods and services coming into and out of the community
	    3. Medical emergency responders will be able to arrive faster
	
	Cons -
	    1. Harbor will have to be expanded and dredged due to the large size of the ferry
	    2. Will affect the aquaculture operation in nearby cove from the ferry's large wake
	    3. Seabird colony and other marine wildlife may be affected because of the ferry's loud engine

Ocean Data Portals:
The Key to Smart Decisions

Essential Questions

- Why are science and data important for decision-making?
- Who is using the ocean and how?
- How might ocean data portals be used for decisions about the ocean?
- Why is it important to fill data gaps in the portals?

Materials & Resources

- Computer, projector and screen
- Film clips
  - ¤ *Ocean Frontiers II: Data Portal Layers* (1 minute) http://bit.ly/OF2Portal
  - ¤ *Ocean Frontiers III: Ocean Plans Rely on Latest Ocean Information* (5 minutes) http://bit.ly/OF3Portal
- Data Portal Maps (URLs in Resources Appendix)
  - ¤ Northeast Interactive Data Portal Map
  - ¤ Northeast Static Map Image
  - ¤ Mid-Atlantic Interactive Data Portal Map
  - ¤ Mid-Atlantic Static Map Image
- Regional Ocean Data Portals
  - ¤ Northeast northeastoceandata.org
  - ¤ Mid-Atlantic portal.midatlanticocean.org
  - ¤ Data Portal Tutorials in Additional Resources
- Data Portal Scavenger Hunt Worksheet
- Data Portal Scavenger Hunt Worksheet (Teacher Copy)

Objectives

Students will:

1. Recognize the importance of scientific and socioeconomic data collection.
2. Identify different ocean stakeholders within two regions of the U.S.
3. Gain proficiency with reading and navigating interactive, multi-layered maps.
4. Analyze and interpret different data layers within ocean data portals.
5. Construct explanations on how the data portals could be used to help resolve conflicts between ocean uses.

Subjects

- Science – Earth, Ecology, Marine
- English Language Arts
- Geography

Duration 90 minutes

Note: *Ocean Frontiers III* can be downloaded at http://bit.ly/OF3-DL

OVERVIEW

Ocean planning has spurred the creation of centralized sources of ocean data for each region – the ocean data portals. When looking at these portals, it quickly becomes clear that our oceans are not the quiet, blue vastness as we sometimes think. Indeed, our oceans are becoming busier by the day and with these changes come important decisions. The portals are a way to see human uses, ocean resources and marine environmental data – and their interactions – all in one place. The data play a vital role in decision-making, such as identifying potential project sites for offshore wind energy, aquaculture or sand exploration.

In this lesson students will be able to understand the importance of data collection and how the ocean data portals can be used in ocean management and decision-making processes. Students will have the opportunity to interact with the online data portals and will create their own maps. The final product of this lesson will be a collection of maps that students have created using one of the regional ocean data portals.

> "We set out to take data that had been sitting across the region in different offices and different silos, different state and federal agencies, and to bring it all together and try to make some sense of it. And in so doing, start to manage our ocean as though it was one connected place instead of a bundle of separate uses and jurisdictions."
>
> *Jay Odell – The Nature Conservancy*

NOTE: Before teaching this lesson, show *Ocean Frontiers III* in class or assign it as homework, if students have not yet watched the entire film (as directed in the first lesson in this set: What is Ocean Planning).

ACTIVITIES

Activity 1 – Data Portal Introduction (15 minutes)

1. Ask students what kind of ocean data might exist already. What data has already been collected? *Possible student responses include: fish, whales, fishing locations.*

   a. Who is collecting the data and who is using the data? *Possible student responses include: researchers (NOAA), scientists, fisheries managers, towns, transportation managers.*

2. Show the *Ocean Frontiers II: Data Portal Layers* clip and see if students thought of some of the ocean data mentioned.

3. Introduce the concept of ocean data portals to the class by having students watch the *Ocean Frontiers III: Ocean Plans Rely on Latest Ocean Information* clip.

   a. While watching the video, students should write down key words they hear mentioned. *Possible words include: wildlife, state and federal agencies, management, decision makers, common set of data, biodiversity*

   b. After watching the clip, have students share out what words they wrote down and have a short discussion.

    c. Possible discussion questions may include:
        i.   Was there anything that surprised you?
        ii. Why is it important to collect and share data?
        iii. How are different people working together to create well-informed decisions about our oceans?

Activity 2 – Write-Around (10 minutes)

1. Project onto a screen one of the Data Portal Maps from the Materials and Resources list (either the interactive web-linked map or the static image) or choose a detailed ocean map that is specific to your school's region. Teachers are also welcome to create their own map using one of the ocean data portals.

2. As a class, have students view the map and write down everything they observe in 3 minutes. Observations could be as simple as "lots of data represented" to "interactions between shipping traffic and whale migration routes".

    a. At the end of 3 minutes, have students share some observations and discuss the benefits of different type of maps, having layers on maps to allow for different types of data to be represented, etc.

Activity 3 – Data Portal Scavenger Hunt (20 minutes)

1. Provide each student with a copy of the Data Portal Scavenger Hunt Worksheet and review together as a class.

2. In groups or independently, have students open the regional data portal most appropriate for their location: Northeast U.S. or Mid-Atlantic U.S.

    a. Note: Additional regional data portals are available, though they may not be as comprehensive. See Additional Resources.

3. Ask students to fill out the worksheet to help them understand the basics of what the portals offer. Students will be able to answer the following questions after completing the Scavenger Hunt:

    a. Who uses the ocean and how do they use ocean resources?

    b. How could an ocean stakeholder use the data found within the data portal?

    c. How may data portals help with ocean management?

    d. Why is it important to fill data gaps in the data portals?

Activity 4 – Create a Map (40 minutes)

1. After completing the Data Portal Scavenger Hunt, students will use one of the portals to create their own map, using at least three data layers. If students are having difficulty, the teacher may have students focus solely on ecological data or human-use data, or have them work in pairs.

2. As a writing activity, students will answer the following questions about the map they have created:

a. What is the map depicting and why did you choose those data layers?

b. Identify any possible interactions you interpret from your map.

c. How might your map help solve a problem or be used in a real-world application?

3. Once students have completed their maps, volunteers will present their maps and the class will talk about the answers to the above questions.

Activity 5 – Wrap Up/Closure Question (5 minutes)

1. Allow students time to discuss as a class or journal answer to the Essential Questions to check for student understanding and correct any misconceptions.

EXTENSION

1. Students may visit the data portal websites below and choose a case study to examine further. It may be interesting for students to choose a case study focused on cultural resources within a region. Cultural resources are an important element to the ocean plans and data portals as they are inextricably linked with the ocean. Native American cultures in particular have been inherently connected to ocean waters for more than 12,000 years and the ocean remains an important element to the cultural fabric of present-day Native American life.

   Case Studies:

   a. Northeast Ocean Data Portal - Case Studies

   b. Mid Atlantic Data Portal - Ocean Stories

2. Have students source a current article about ocean planning and/or ocean data collection and write a synopsis of the article addressing the following questions:

   a. What information about the ocean is being collected or shared?

   b. How will this information contribute to ocean planning for the future?

   c. What follow up questions do you have after reading the article?

BACKGROUND INFORMATION

Ocean Data Portals

Ocean planning has spurred the creation of centralized sources of ocean data for each region – the ocean data portals. Where in the past data had been siloed in various agencies, universities and industry groups, key data has now been gathered in one place so that planners, stakeholders and the public can see the 'big picture' of what's happening in our oceans. With everyone able to access a common set of data – including ecosystem, marine life and human use layers – it becomes much easier for important decisions about our ocean to be made in a transparent and science-driven process.

There are several regional ocean data portals in the U.S., with additional portals being developed. The portals are centralized, peer-reviewed sources of data and interactive maps of the ocean ecosystem and ocean-related human activities, showing the richness and diversity of the ecosystem and illustrating the many ways that humans and environmental resources interact.

Several of the portals include case studies or story maps as examples of how the portals are used for regional ocean planning, fishery management, marine transportation, offshore wind development, aquaculture siting and many other applications. The portals serve as platforms to engage all stakeholders in ocean planning, putting essential data and state-of-the-art mapping and visualization technology into the hands of government agencies, industry and community leaders to inform and support sound decision-making.

ADDITIONAL RESOURCES

- Northeast Ocean Data Portal
  - ¤ Northeast Ocean Data Portal tutorials
- Mid-Atlantic Ocean Data Portal
  - ¤ Mid-Atlantic Ocean Data Portal tutorials
- West Coast Ocean Data Portal
- Caribbean Regional Ocean Partnership Marine Planner
- Governors' South Atlantic Alliance Coast & Ocean Portal
- Gulf of Mexico Data Atlas
- Great Lakes Observing System
- Alaska Ocean Observing System Data Explorer

Data Portal Scavenger Hunt Worksheet

This activity will help you understand the different components of ocean data portals. Explore the various functions of the portals to get a better understanding of how they may be used in ocean management.

1. **Visit ONE of the following ocean data portals:**

    - Northeast Ocean Data Portal - https://www.northeastoceandata.org
        - ¤ Tutorial - https://www.northeastoceandata.org/about/tutorials
    - Mid-Atlantic Ocean Data Portal - http://portal.midatlanticocean.org
        - ¤ Tutorial - http://portal.midatlanticocean.org/how-use-portal

2. **Explore the data layers and complete the table by finding three examples for each category.**

Human Use Data Layers	Marine Life & Habitat Data Layers
1.	1.
2.	2.
3.	3.

3. **An ocean stakeholder is an individual who has a vested interest in the ocean. Name at least three different ocean stakeholders found within the data portal:**

Ocean Stakeholders
1.
2.
3.

4. Answer the following questions:

A. Who uses the ocean and how do they use ocean resources? Choose one ocean stakeholder from the list above to answer this question.

B. How could an ocean stakeholder use the data found within the data portal?

C. How may data portals help with ocean management?

D. The film mentions missing lobster data in the portal. Why is it important to fill data gaps?

Data Portal Scavenger Hunt Worksheet (Teacher Copy)

Note: Examples of possible students responses are shown below in italics.

This activity will help you understand the different components of ocean data portals. Explore the various functions of the portals to get a better understanding of how they may be used in ocean management.

1. **Visit ONE of the following ocean data portals:**
   - Northeast Ocean Data Portal - https://www.northeastoceandata.org
     - ¤ Tutorial - https://www.northeastoceandata.org/about/tutorials
   - Mid-Atlantic Ocean Data Portal - http://portal.midatlanticocean.org
     - ¤ Tutorial - http://portal.midatlanticocean.org/how-use-portal

2. **Explore the data layers and complete the table by finding three examples for each category.**

Human Use Data Layers	Ecosystem-based Data Layers
1. *Marine Transportation*	1. *Habitat*
2. *Commercial Fishing*	2. *Marine Mammals*
3. *Recreation*	3. *Bathymetry*

3. **An ocean stakeholder is an individual who has a vested interest in the ocean. Name at least three different ocean stakeholders found within the data portal:**
   1. *Recreational boaters*
   2. *Commercial fishermen - identified using Vessel Monitoring Systems (VMS)*
   3. *Renewable energy development - offshore wind project sites*

4. **Answer the following questions:**

A. Who uses the ocean and how do they use ocean resources? Choose one ocean stakeholder from the list above to answer this question.

Recreational boaters use the ocean in different ways. Some paddle or sail while others use motor boats or large pleasure boats such as yachts. These differences alone may create different conflicts on the water. All recreational boaters need access to the water by using public (or private) docks and landings and may need to use moorings in harbors.

B.   How could an ocean stakeholder use the data found within the data portal?

Fishermen might be able to use the data portal to look at proposed ocean development projects, such as offshore wind project sites or aquaculture operations. That information may be helpful to start conversations early between ocean developers and fishermen, before conflicts arise.

C.   How may data portals help with ocean management?

Ocean data portals are a one-stop shop for ocean decision makers. It gives decision makers a common set of data to work with, allowing everyone the same access to vital information. All data has been peer-reviewed and is accepted by the scientific community.

D.   The film mentions missing lobster data in the portal. Why is it important to fill data gaps?

It is important to fill data gaps because otherwise policy and decision makers are not getting the full story of all ocean uses and resources, which may lead to the exclusion of certain stakeholders in decision-making processes.

Marine Biodiversity, Conservation & Healthy Oceans: Deep Sea Corals

ESSENTIAL QUESTIONS

- What does biodiversity mean and why is it important for marine ecosystems?
- What human uses of the ocean are compatible with deep-sea coral communities and which ones are not?
- What types of information do you need in order to make decisions to promote a healthy ocean?
- How can we responsibly use the ocean while protecting coral?

MATERIALS & RESOURCES

- Computer, projector and screen
- Film clips
  - *Ocean Frontiers III: Deep-Sea Coral Research & Protection* (5 minutes) http://bit.ly/OF3Corals
  - *Living in the Dark: Expedition in Search of Deep-Sea Corals* (4 minutes) http://bit.ly/CoralExpedition
- Regional Ocean Data Portals
  - Northeast https://northeastoceandata.org
  - Mid-Atlantic http://portal.midatlanticocean.org
  - Data Portal Tutorials in Additional Resources
- Custom maps of Hudson Canyon:
  - Coral Base Layers Map
  - Marine Biodiversity Layers Map
  - Human Use Layers Map
  - Combined Layers Map
  - See Data Layer Table below for URLs

OBJECTIVES

Students will:

1. Examine the complexities of healthy ocean ecosystems and the importance of biodiversity.
2. Analyze and interpret coral maps from one of the regional ocean data portals.
3. Construct explanations for how ocean planning can reduce the impact of human activity on marine biodiversity.
4. Obtain, evaluate and communicate the role corals play in the deep-sea environment.
5. Develop and ask questions about deep-sea corals that could be investigated by a deep-sea mission research cruise.

SUBJECTS

- Science – Ecology, Marine, Oceanography
- English Language Arts

DURATION 2 hours

Note: *Ocean Frontiers III* can be downloaded at http://bit.ly/OF3-DL

OVERVIEW

Effective ocean planning requires an understanding of the complexity and diversity of marine ecosystems. Incorporating ecosystem health criteria into decision-making, along with species abundance and distribution data, allows for dynamic conservation and restoration strategies to be developed. Ocean ecosystems are complex and continuously changing, and because humans are an integral part of the ecosystem it is critical to also address the compatibility between ocean uses in any planning efforts.

This lesson allows students to explore the importance of biodiversity and the different elements that make up a healthy ocean ecosystem. Students will analyze and interpret deep-sea coral maps and will understand why this data is needed in order to make informed decisions about our oceans. Finally, students will have the opportunity to investigate deep-sea corals and discover why they are important to the ecosystem and what major threats they face.

> "As we move toward ecosystem-based management, we need to know about everything that's out there. And if you want to understand the organisms, you also have to understand their habitats. It's really fostered this interdisciplinary type of work."
>
> *Martha Nizinski – Northeast Deep Sea Coral Regional Initiative,*
> *National Oceanic and Atmospheric Administration (NOAA)*

NOTE: Before teaching this lesson, show *Ocean Frontiers III* in class or assign it as homework, if students have not yet watched the entire film (as directed in the first lesson in this set: What is Ocean Planning). If students are new to interactive maps, have them do the previous lesson on the ocean data portals to build their skills.

ACTIVITIES

Activity 1 – What is Marine Biodiversity (20 minutes)

1. Show the *Ocean Frontiers III: Deep-Sea Coral Research & Protection* clip and have students discuss the following questions. See Background Information.

    a. Why is it important to protect and conserve the ocean?

    b. How can we promote a healthy ocean?

    c. What do you think marine biodiversity means and why is it important?

    d. Did you know that there are corals in deep cold water? Why is it important to continue exploring the ocean? *There may be areas of rich biodiversity, such as deep-sea coral colonies, and without knowing what is out there, it is less likely to protect and conserve these vital habitats when competing interests are at play. Researchers are still discovering deep-sea coral communities even in shallow waters that have already been explored.*

    e. Why is it important to understand where deep-sea coral communities are located? *Human uses of the ocean, such as fishing and deep-sea mining exploration and extraction, are moving into deeper waters which may impact deep sea coral habitat.*

Because they are so long-lived (some up to thousands of years old), researchers are not sure how long it would take for deep-sea coral colonies to recover if they were disturbed.

Activity 2 – Human Uses of the Ocean and Marine Data Layers (30 minutes)

1. Open the Mid-Atlantic Ocean Data Portal with the class and look at the area around Hudson Canyon off New York City. Along with being coral habitat, it is also an area of high marine biodiversity and many human uses. Using the links provided in Step 3 for the custom maps, work through the following data layers in four steps (allow time for the maps to load). Remind students to make observations and to look at the data layer legends. It may be useful to turn some data layers on and off to identify each data set. See Data Layer Table for an outline of the data layers and where they can be found on the portal.

2. While exploring the maps, prompt the students with some questions. Responses can be open-ended. Remind students to refer back to different parts of the film clip they just watched.

   a. What do you notice about the maps? What questions do you have?

   b. Which data layers do you find most interesting?

   c. What are the interactions you see in the maps? Are there overlaps between datasets in a particular area?

   d. How can ocean planners use these types of data to help with ocean management?

   e. How could this information help with ocean conservation, leading to healthy oceans?

   f. Are the maps complete? What data do you think might be missing? How would you go about finding this data? Do you think all deep-sea coral habitat has been identified? *These maps are not complete but they are a good starting point for continued research. There are expected to be many places in the ocean where deep-sea corals exist but have yet to be identified and mapped. It is important to remember that these maps are not fully complete, as deep-sea research/exploration is extremely challenging and expensive. Data gaps can be filled by advocating for more funding for research, participating in citizen science efforts, etc.*

3. Work through the following maps and data layers on corals, marine life and human uses.

   a. Coral Base Layers Map: Start with this baseline map.
      i. **Observed corals** - This layer shows where corals have been found, though much more exploration is necessary to accurately portray their distribution and abundance in the area.
      ii. **Coral protection area** - In this area commercial fishermen are prohibited from using most types of bottom-tending fishing gear, such as trawls, dredges, bottom longlines and traps. Exemptions exist for recreational fishing, as well as for commercial lobster and deep-sea red crab traps.
      iii. **Submarine canyons** - This layer shows rough outlines of the major canyons, making them easier to see.

   b. Marine Biodiversity Layers Map: Adding onto the base map, these four marine life layers show a high abundance of species in the area.
      i. **Cetaceans** - There is a high abundance of whales in the area, all of which are

protected under the Marine Mammal Protection Act and the Endangered Species Act.

    ii. **Highly migratory species** - Hudson Canyon provides essential fish habitat for sharks, tuna, spearfish and other highly migratory species. Click on any part of the map to see a list of species found there (scroll down in the Available Information box).

    iii. **Sea Turtles** - Four species have been sighted in this area, including loggerhead (Threatened) and leatherback (Endangered) sea turtles.

    iv. **Seabirds** - Pelagic (or offshore) seabirds find their prey in this nutrient-rich area. Shearwaters and storm-petrels are most abundant in summer, while gannets, phalaropes and jaegers migrate through in spring and fall.

    v. **Additional layers** - Allow students to come up to the computer and click more layers on and off to explore other marine life in the area.

c. Human Use Layers Map: For ease of viewing, the marine biodiversity layers have been removed while the class views these five human use layers that show areas of potential conflict and compatibility.

    i. **Squid fishing** - This is one of the most economically important commercial fisheries in this area. Though squid are mostly fished in the middle of the water column, at times the fishing gear still touches the bottom and can impact corals. This layer shows only where the squid are harvested, not their distribution and abundance.

    ii. **Pots and Traps** - Lobstering is another of the major commercial fisheries in the area. Since this fishery is not subject to canyon protections by the Mid-Atlantic Fishery Management Council, corals could easily be harmed by the lobster traps. Also, ocean warming is leading lobster populations out into deeper, colder water, pushing lobstering activities closer to coral communities.

    iii. **Submarine cables** - Many telecommunication cables either abut or cross Hudson Canyon. Since they are generally buried below the sea floor, they may damage corals and disturb their habitat.

    iv. **Unexploded ordnance** - Although these abandoned explosives slowly degrade, they still have the potential for detonation if disturbed, causing physical and chemical damage to benthic (ocean bottom) communities.

    v. **Charter boats** - Recreational fishing boats often spend time over the canyon, though this type of fishing generally does not typically impact corals due to the type of gear used.

    vi. **Additional layers** - Allow students to come up to the computer and click more layers on and off to explore other human uses in the area.

d. Combined Layers Map:

    i. By making all the layers mentioned above visible, students can see how many uses/interests are in play in one small ocean area and why we need tools like ocean planning and the data portals to help plan human activities in the ocean.

Activity 3 – Compatible vs. Incompatible Human Uses of the Ocean (40 minutes)

1. In groups of 3, assign each group an ocean use from the list below. Have students determine if their assigned ocean use is compatible or not with deep-sea corals by doing

some research using the Northeast or Mid-Atlantic ocean data portals. Give students about 10 minutes to develop their conclusions.

a. **Recreational Boating** - Because deep-sea corals are found at depths of more than 200 feet below the sea surface, recreational boats probably won't disrupt coral habitats, unless they anchor. Boat anchors can be destructive to corals. Some recreational boat anchors can reach depths of 300 feet, so it is important for boat captains to be aware of deep-sea coral areas and avoid anchoring in those locations. (*Compatible if not anchoring*)

b. **Commercial Fishing** – Compatibility depends on the type of fishing. Bottom trawling (a fishing method that drags large, weighted nets across the seafloor to catch fish and/or shrimp) is the greatest threat to deep-sea corals. Bottom-tending gear or fixed gear fishing (i.e. lobster traps or crab pots), may not be as detrimental but still may cause damage to corals. Lost traps and/or rope from fishing, known as ghost fishing, may also cause damage to corals. (*Incompatible or compatible, depending on gear-type and fishing method*)

c. **Offshore Wind Farms** - Wind farms that are anchored to the seafloor are usually located in depths of 200 feet or less and are unlikely to be placed in deep-sea canyons. However, noise generated from exploration, construction and operation of wind farms in nearby waters could impact noise-sensitive wildlife in deep-sea canyons. (*Incompatible or compatible, depending on location*)

d. **Commercial Shipping** - Because deep-sea corals are usually found at depths of more than 200 feet below the sea surface, shipping probably won't disrupt coral habitats. However, it is important for shipping companies to be aware of protected areas. Shipping lanes may be redirected around protected areas. (*Compatible*)

e. **Deep-Sea Mining Exploration and Extraction (oil and gas)** - These practices pose a huge threat to all deep-sea ecosystems, including deep-sea corals, because of the invasive nature of extraction. (*Incompatible*)

f. **Whale Watching Tours** - Because deep-sea corals are found many meters below the sea surface, whale watching tour boats probably won't disrupt coral habitats. However, it is important for boat captains to be aware of protected areas. (*Compatible*)

g. **Deep-Sea Exploration and Research** - Exploration and research are vital steps in coral conservation and preservation. The more we know about deep-sea corals, the better able we are to protect these habitats. (*Compatible*)

h. **Aquaculture** - Compatibility depends on where the aquaculture farm is located. Typically these farms are located in shallower waters closer to shore where there are no corals. Aquaculture is starting to expand into deeper (federal) waters, and as of now, the impacts on corals are unknown. (*Compatible in the near shore*)

i. **SCUBA Diving** - Because deep-sea corals are usually located at depths of more than 200 feet below the sea surface below the sea surface, SCUBA diving should not interfere with coral habitat. However, it is important for divers to be aware of protected areas. (*Compatible*)

j. **Marine Transportation** - Ferry boats or other transportation services should not disrupt or interfere with corals. However, it is important for captains to be aware of protected areas. (*Compatible*)

k. **Cable and pipeline deployment** - Deployment of gas pipelines and fiber optic cables can cause localized physical damage to deep-sea corals. (*Incompatible*)

2. Come back together as a class and have each student group present their case on whether or not their use is compatible with deep-sea corals. Groups must be able to field questions and comments from other students. This may lead to interesting discussions.

3. As a class, discuss how some of these ocean uses may be not just compatible, but complementary to the protection of deep sea corals. For example, how might research be of benefit to deep sea corals?

Activity 4 – Deep Sea Corals (20 minutes)

1. Students will explore deep-sea corals further by watching the short coral expedition video, *Living in the Dark: Expedition in Search of Deep-Sea Corals*.

2. After watching the video, have students brainstorm other questions they might ask if they were doing the research themselves. Encourage students to think like a scientific researcher.

3. Students will then write a short reflection, articulating what they have learned. The reflection should include a short description of why deep-sea corals are important to marine ecosystems, where they can be found and how ocean planning may be used in helping to protect corals. Students should also incorporate some of the research questions they just brainstormed and explain why those questions are important.

Activity 5 – Wrap Up/Closure Questions (10 minutes)

1. Discuss some easy ways to implement actions that students can take in their everyday lives that contribute to the protection of marine ecosystems. Changing the way we use the ocean is one way, but how we interact with water and other ecosystems makes an impact as well – everything is connected to the ocean.

2. Allow students time to discuss as a class or journal answers to the Essential Questions to check for student understanding and correct any misconceptions.

BACKGROUND INFORMATION

Marine Biodiversity

Biodiversity describes the variety of species found in Earth's terrestrial and marine ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. A diverse ecosystem provides many ecological services including primary plant productivity, habitat for different species and nutrient cycling. Scientists have found that declines in ecological diversity have consequences for the stable functioning of ecosystems.

Biodiversity in marine environments is essential for maintaining ecosystem function. Maintaining marine ecosystems in a healthy, productive and resilient condition will provide the services humans want and need, while supporting a healthy ocean. Ocean planning can help maintain ecosystem health if multiple uses, like those considered above, are effectively balanced. As we explored in this lesson, ocean data portals can facilitate good planning that leads to better decision-making around, on and in the ocean.

Deep-Sea Corals

Deep-sea corals are an important element of many marine ecosystems and are an example of how one species can create a rich diverse habitat for other species. They provide habitat for many organisms, including invertebrates like worms and lobsters, as well as vertebrates like fishes. Corals offer food, protection from predators and surfaces for invertebrates to attach to. Additionally, coral communities are nursery grounds for some fishes and invertebrates. All of these services lead to a very rich diverse ecosystem, especially in the deep-sea where structure-forming animals can be hard to find.

The deep sea covers most of our planet. However, because they live in places that are extremely challenging for humans to visit, very little is known about deep-sea corals. Researchers have discovered that some species are very long-lived (one coral colony has been dated to over 4000 years old!), can grow up to 30 feet tall and are consequently susceptible to disturbance from human activities. As our oceans are becoming more busy, it is vital

that proper research and conservation measures are developed before these corals, and the habitats they create, become threatened.

Below is an excerpt from Jeff Hyland on why deep-sea corals are important to marine biodiversity.

"Why do we care about deep-sea corals? First, their complex three-dimensional structure creates habitat for diverse communities of invertebrates and fishes, including commercially important species such as rockfish, shrimp, and crab. Some deep-sea corals may also be sources of compounds for the development of new drugs and medical treatments. However, due to their exposed structure, slow growth and recruitment rates, deep-sea corals may be especially vulnerable to natural or human disturbance such as bottom trawling, mineral extraction, and cable trenching — activities that result in physical disruption of the seafloor. Such disturbances could require very long periods for the coral communities to recover. Many nations are beginning to recognize the value of deep-sea corals and take steps to manage and protect them. With the availability of new underwater survey technologies have come recent scientific surveys and new opportunities to document more of these resources."

Jeff Hyland, National Centers for Coastal Ocean Science
Source: What are deep-sea corals and why do we care?

ADDITIONAL RESOURCES

- World Ocean Review
- NOAA Deep Coral Communities Curriculum
- Smithsonian: Deep-sea Corals
- Deep-Sea Corals: NOAA Educational Plans & Activities
- NOAA Deep Sea Coral Data Portal
- Whale Jenga: A Food Web Game, created by NOAA. *Please note, there is substantial prep work needed ahead of time to play this game*.

Data Layer Table

Corals, Marine Life and Human Uses Maps

Source: Mid-Atlantic Ocean Data Portal

A. **Corals Base Layers** - http://bit.ly/HCCoralMap

    a. Deep Sea Corals (observed) [Marine Life heading]

    b. Frank R. Lautenbuerg Deep-Sea Coral Protection Area [Fishing/Management Areas heading]

    c. Submarine canyons [Oceanography heading]

B. **Marine Biodiversity Layers** - http://bit.ly/OF3MarineLife [Marine Life heading]

    a. All Cetaceans: Abundance

    b. Essential Fish Habitat Highly migratory species (shark, tuna, spearfish, etc.) - click on canyon area for species detail

    c. Sea Turtles (endangered species)

    d. Birds - Offshore/Pelagic [Marine Life heading]

    e. Other layers to explore (not on prepared map)

        i. Dolphins

        ii. Birds - Divers and pursuit plungers

C. **Human Use Layers** - http://bit.ly/OF3HumanUse

    a. Squid 2015-16 (<4 knots) [Commercial Fishing/VMS]

    b. Pots and traps (2011-2015) [Commercial Fishing/VTR]

    c. NASCA Submarine Cables [Maritime heading]

    d. Unexploded Ordnance [Security heading]

    e. Party & Charter Boat Trips (Total 2000-2009) [Recreational Fishing heading]

    f. Other layers to explore (not on prepared map)

        i. Scallop 2011-2014 (<5 knots) [Commercial Fishing/VMS]

        ii. Maritime commerce [AIS Shipping Data]

D. **Combined Layers** - http://bit.ly/OF3Combined

    a. Includes all of the above layers except for the suggested other layers to explore.

Get Involved:
Student Advocacy & Citizen Science

ESSENTIAL QUESTIONS

- How has the film inspired you to take action? Which issues feel most important to you?
- Who are your Members of Congress? How and why would you communicate with them?
- How can student voices be heard?
- What is Citizen Science and how does it help with scientific research?

MATERIALS & RESOURCES

- Computer, projector and screen
- Letter Writing Template
- Film clip
  - ¤ *Ocean Frontiers III: Citizen Scientists Document New York Whales* (2 minutes) http://bit.ly/OF3CitSci

OBJECTIVES

Students will:

1. Obtain, evaluate and communicate current ocean issues to their Members of Congress.
2. Analyze and interpret citizen science data by exploring and researching several different examples of citizen science projects.
3. Become part of a larger scientific community through participation in a citizen science project.

SUBJECTS

- Science – Ecology, Environmental, Marine
- Civics
- English Language Arts

DURATION 90 minutes

Note: *Ocean Frontiers III* can be downloaded at http://bit.ly/OF3-DL

OVERVIEW

Documentary films can touch people profoundly, inspiring them to take action on issues they care about, and the *Ocean Frontiers* series has spawned many ocean advocates. In this lesson students will understand the importance of taking action in their communities and have the opportunity to reach out to their Members of Congress on ocean issues they feel passionately about.

Another way for students to engage in issues beyond the classroom is through citizen science. This type of science is conducted primarily by volunteers, with little to no formal scientific training, who help scientists with data collection, analysis and observations. In this lesson students will research, and may participate in, a citizen science project of their choice.

> "This is a really important time in history where beachgoers and other recreational users of the ocean actually have a voice in the process of decision-making. We really are bringing in all sectors and everyone who is interested in sharing their vision for the future of our coastal communities—and for holding our government agencies accountable for the decisions that they are making that affect our coastal communities and our ocean uses."
>
> *Melissa Gates – Surfrider Foundation*

NOTE: Before teaching this lesson, show *Ocean Frontiers III* in class or assign it as homework, if students have not yet watched the entire film (as directed in the first lesson in this set: What is Ocean Planning).

ACTIVITIES

Activity 1 – Get Involved (15 minutes)

1. Thinking back to the film, what are some current ocean or coastal issues that students are concerned about. As a class, have a conversation and start brainstorming a list of issues. *Issues may include climate change, renewable energy, marine conservation, oil and gas exploration, sand mining, marine policy.*

2. Have students share how these issues affect their lives, families and/or communities.

3. Why is it important for students to communicate their concerns and recommendations about the marine environment to decision makers? Brainstorm ways students' voices can be heard, despite not being voters. Responses may include letter writing, starting a student club or community organization, joining protests, documentary filmmaking.

4. Once the class has developed a substantial list of issues, explain that students will be given the opportunity to write letters to their Members of Congress based on an issue they have identified from the brainstormed list.

Activity 2 – Write to your Members of Congress (40 minutes)

1. Ask students if they know who their Members of Congress are. Then have them look up their Senators' and Representatives' contact information using the following websites:

    a. https://whoismyrepresentative.com
    b. https://www.congress.gov
    c. https://www.senate.gov/senators/contact

2. Provide each student with a copy of the Letter Writing Template and review together as a class.

3. Using the template, students will work either as a class, in small groups or independently to draft a letter based on an ocean issue that is important to them, their families and/or communities that they would like their Senators/Representatives to address. They can include references to topics learned in class and/or parts of the film that relate to their issue of concern.

4. Remind students to keep their "ask" simple. For example, encourage Senators or Representatives to do more to learn about the ocean and ocean stakeholders; this will enable them to make better decisions about ocean issues, which will benefit all ocean stakeholders in the long run.

5. Once drafts are completed, students may share their work by reading their letters aloud to the class.

6. As a class, discuss whether or not students feel comfortable sending their letters. If the class decides they would like to officially send their letters, work with students individually helping them to refine their letter. It may take more than one class period and/or outside work to complete letters.

7. Make sure students follow proper guidelines when formatting and finalizing their letters. It may be useful for teachers to reach out directly to congressional staffers who may be able to give additional guidelines. Remind students that their voices are important and are taken seriously. These letters will be read and will usually be replied to within several weeks.

Activity 3 – Become a Citizen Scientist (30 minutes)

1. Now that students understand one formal way to get involved, ask if they can remember a part of the film where citizens (everyday people) were engaging in ocean science or research. *Citizen science with Gotham Whale*

2. Show the *Ocean Frontiers III: Citizen Scientists Document New York Whales* clip and have a short discussion:

    a. Why did whale watching tours start in New York City? *There were many sightings of whales in the area and Gotham Whale wanted to start whale research, documenting these increases in whale sightings.*

    b. How are these whale watching tours contributing to whale data and research? *Several years ago there were few whale sightings in the area. Now that Gotham Whale is on the water, they are able to accurately collect whale data for that specific area.*

c. What types of data are collected on these whale watching tours? *Whale sightings are recorded, including the species and number of whales, where they are seen and their behavior. Information on other wildlife in the area is also gathered, helping researchers to get "the whole picture" of the ecosystem.*

d. How would you classify this type of scientific research, where everyday people are contributing to data collection? (*Citizen Science*)

e. Why do you think Citizen Science is important?

3. Allow time for students to do some research on their own to find an interesting citizen science project. The following websites may be useful:

a. https://scistarter.com

b. https://www.zooniverse.org

c. https://en.wikipedia.org/wiki/List_of_citizen_science_projects

4. Have students write a short summary paragraph on a citizen science project of their choice. Note: There are many citizen science projects out there, so this may be assigned for homework so students can take time to choose a project they are interested in.

5. As a class, have several student volunteers present the citizen science project they wrote about.

6. Ask students if they are interested in becoming members of a particular citizen science project. Students may choose a project, and/or the teacher may choose a project for the whole class to participate in. Alternatively, students could initiate their own citizen science project. Is there a community need that students could help research?

Activity 5 – Wrap Up/Closure Question (5 minutes)

1. Allow the students time to discuss as a class or journal answers to the Essential Questions to check for student understanding and correct any misconceptions.

EXTENSION

1. **Meet Your Lawmakers** - Take your Congressional letter writing one step further by scheduling an in-district meeting with your Member of Congress and staff. This is another way to have meaningful interactions with your representative and often allows for more time to talk with fewer interruptions.

   a. Face-to-Face with Congress: Before, During, and After Meetings with Legislators (Congressional Management Foundation)

2. **Citizen Science in Your Backyard** - Take the class out into the local community to have students observe the local ecosystem and come up with a question to explore in more detail. Have them plan their approach to addressing the question through a citizen science lens (how would they find more information, what data might they try to gather, how would they share their findings, etc.).

BACKGROUND INFORMATION

Writing to Congress

Letters to your Members of Congress are one of the primary forms of constituent contact, and every letter counts. Emailing a letter is the most effective way to send it as it gets filed right away, though letters can also be mailed or faxed. Below are some helpful letter-writing tips:

1. Use clean, white 8½ x 11 paper, with a letterhead if appropriate
2. Include the exact return of address on the letter as well as on the envelope
3. Keep the letter to a page or less
4. Identify your subject clearly
5. State your reason for writing. Explain how the issue affects you and your community.
6. Use your own words. This will strengthen your viewpoint and be much more influential than the words prepared by a group or organization.
7. Be polite and courteous at all times. Do not threaten or demand as this will not strengthen your viewpoint.
8. Consider the timing of your letter.
9. Thank your Senator/Representative, if appropriate.
10. Address the letter and envelope clearly and correctly; follow the format of a business letter and include the date.

Citizen Science

Citizen science is scientific research conducted primarily by volunteers with little to no formal scientific training, who help scientists with data collection, analysis and observations. It is a wonderful way for scientists to interact with the community, and both scientists and community members benefit by learning different things from each other. Citizen science allows individuals the opportunity to contribute to the global scientific community. Most projects are on an online platform and connect people all over the world. These projects not only teach the general public about the natural environment, they teach about the wider world around us.

ADDITIONAL RESOURCES

- National Education Association - Writing Letters to your Legislators
- AccessLex Institute - Write your Congressional Member Letter Template
- The Borgen Project - What is the Difference Between a Congressman and a Senator
- Heirs to Our Oceans - A rising tide of young leaders around the globe who are taking the ocean crisis into their own hands, educating themselves and others, bringing hope and solutions to the surface, and creating waves of change that will ensure the health of our blue planet for their generation and for future generations.

Letter Writing Template

How to write a letter to your Members of Congress

Your name:

Your mailing address:

Your email address:

Date:

The Honorable _____
Office: (United States Senate or House of Representatives)
Address: (Use Legislator's Washington, D.C. address)

Dear Senator or Representative (choose one) _____,

Introduce yourself (include the name of the school you attend) and explain why you are writing to your Member of Congress. What is the problem you are concerned about?

Explain why this issue is important to you and your community.

What do you want your Member of Congress to do?

Thank your Member of Congress for considering your concerns. Allow for follow-up by expressing your interest in hearing back from them.

Sincerely,

Your signature

Your name

Resources Appendix: List of URLs by Lesson

What is Ocean Planning: Charting the Ocean's Future

- *Watch Ocean Frontiers III* - https://ocean-frontiers.org/of3
- *Ocean Frontiers III* Edpuzzle - http://bit.ly/OF3Edpuz
- *Ocean Frontiers III* clips playlist - http://bit.ly/OF3playlist
- Northeast Ocean Plan - http://bit.ly/NortheastOceanPlan
- Mid-Atlantic Regional Ocean Action Plan - http://bit.ly/MidAOceanPlan
- National Ocean Policy website from Obama Archives - https://obamawhitehouse.archives.gov/administration/eop/oceans/policy
- National Ocean Policy Executive Order - https://obamawhitehouse.archives.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes
- Executive Order 13840 - https://www.whitehouse.gov/presidential-actions/executive-order-regarding-ocean-policy-advance-economic-security-environmental-interests-united-states
- Pew Ocean Commissions Report, America's Living Ocean - http://www.pewtrusts.org/en/research-and-analysis/reports/2003/06/02/americas-living-oceans-charting-a-course-for-sea-change
- U.S. Commission on Ocean Policy Report, An Ocean Blueprint for the 21st Century - http://www.jointoceancommission.org/en/policypriorities/U_S_Commission_Report_Folder/U_S_Commission_Report.aspx
- Keep the Ocean Working - http://keeptheoceanworking.com
- West Coast Regional Planning Body - http://www.westcoastmarineplanning.org
- Pacific Islands Regional Planning Body - https://pacificislandsrpb.org
- Caribbean Regional Ocean Partnership - http://caribbean-mp.org
- Ocean Planning: A Game of Balance - https://ocean-frontiers.org/wp-content/uploads/2018/05/2017_NYSS-AZA-Game-Packet_FINAL.pdf

Ocean Data Portals: The Key to Smart Decisions

- *Ocean Frontiers II: Data Portal Layers* - http://bit.ly/OF2Portal
- *Ocean Frontiers III: Ocean Plans Rely on Latest Ocean Information* - http://bit.ly/OF3Portal
- Northeast Interactive Data Portal Map - http://bit.ly/NEInteractive
- Northeast Static Map Image - http://bit.ly/NEStatic
- Mid-Atlantic Interactive Data Portal Map - http://bit.ly/MAInteractive
- Mid-Atlantic Static Map Image - http://bit.ly/MAStatic
- Northeast Ocean Data Portal - https://www.northeastoceandata.org
- Northeast Ocean Data Portal tutorials - https://www.northeastoceandata.org/about/tutorials
- Northeast Ocean Data Portal - Case Studies - https://northeastoceandata.org/case-studies
- Mid-Atlantic Ocean Data Portal - http://portal.midatlanticocean.org
- Mid-Atlantic Ocean Data Portal tutorials - http://portal.midatlanticocean.org/how-use-portal
- Mid Atlantic Data Portal - Ocean Stories - http://portal.midatlanticocean.org/ocean-stories
- West Coast Ocean Data Portal - http://portal.westcoastoceans.org
- Caribbean Regional Ocean Partnership Marine Planner - http://planner.caribbean-mp.org
- Governors' South Atlantic Alliance Coast & Ocean Portal - http://gsaaportal.org
- Gulf of Mexico Data Atlas - https://www.ncddc.noaa.gov/website/DataAtlas/atlas.htm
- Great Lakes Observing System - https://portal.glos.us
- Alaska Ocean Observing System Data Explorer - https://portal.aoos.org

Marine Biodiversity, Conservation & Healthy Oceans: Deep Sea Corals

- *Ocean Frontiers III: Deep-Sea Coral Research & Protection* - http://bit.ly/OF3Corals
- *Living in the Dark: Expedition in Search of Deep-Sea Corals* - http://bit.ly/CoralExpedition
- Coral Base Layers Map - http://bit.ly/HCCoralMap
- Marine Biodiversity Layers Map - http://bit.ly/OF3MarineLife
- Human Use Layers Map - http://bit.ly/OF3HumanUse
- Combined Layers Map - http://bit.ly/OF3Combined
- Northeast Ocean Data Portal - https://northeastoceandata.org
- Mid-Atlantic Ocean Data Portal - http://portal.midatlanticocean.org
- NOAA Ocean Explorer: Deep-Sea Corals - https://oceanexplorer.noaa.gov/edu/themes/deep-sea-corals/
- World Ocean Review - https://worldoceanreview.com/en/wor-1/marine-ecosystem/biodiversity
- NOAA Deep Coral Communities Curriculum - https://sanctuaries.noaa.gov/education/teachers/deep-coral-communities/
- Deep-Sea Corals: NOAA Educational Plans & Activities - http://ocean.si.edu/ocean-news/deep-sea-corals-noaa-education-plans-activities
- NOAA Deep-Sea Coral Data Portal - https://deepseacoraldata.noaa.gov
- Smithsonian: Deep-Sea Corals - http://ocean.si.edu/deep-sea-corals
- Whale Jenga: A Food Web Game, created by NOAA - http://www.cisanctuary.org/ocean-acidification/PDFs-WorkshopPage/Whale%20Jenga%20A%20Food%20Web%20Game_October_2015.pdf

Get Involved: Student Advocacy & Citizen Science

- *Ocean Frontiers III: Citizen Scientists Document New York Whales* - http://bit.ly/OF3CitSci
- Who Represents You in the U.S. Congress - https://whoismyrepresentative.com
- Congress.gov - https://www.congress.gov
- United States Senate - https://www.senate.gov/senators/contact
- SciStarter - https://scistarter.com
- Zooniverse - https://www.zooniverse.org
- Wikipedia: List of Citizen Science Projects - https://en.wikipedia.org/wiki/List_of_citizen_science_projects
- Face-to-Face with Congress: Before, During, and After Meetings with Legislators - http://www.congressfoundation.org/storage/documents/CMF_Pubs/cmf-face-to-face-with-congress.pdf
- National Education Association - Writing Letters to your Legislators - http://www.nea.org/home/19657.htm
- AccessLex Institute - Write Your Congressional Member Letter Template - https://www.accesslex.org/writing-congressional-members
- The Borgen Project - What is the Difference Between a Congressman and a Senator - https://borgenproject.org/difference-between-a-congressman-and-a-senator
- Heirs to Our Oceans - https://www.heirstoouroceans.com