



Module 1

Grade Level: High School

Teaching Time: 3 class periods with some homework

Materials:

- Reading resources
 - *Oyster Wars: The Historic Fight for the Bay's Riches*
 - *Sixteen decades of political management of the oyster fishery in Maryland's Chesapeake Bay*
 - *Investigating and Evaluating Environmental Issues and Actions: Skill Development Program* (Hungerford, et al, 2003)
 - *The Oyster Wars of Chesapeake Bay* (Wennersten, 1983), Optional
- Computer internet access (optional)
- Projector and screen (optional)
- Teacher pages
- Student pages
- Dry erase board or flip chart, and markers (optional)

Teacher Note:

See [Resources](#) section for more detailed list of readings, Web links, and other activity resources, that are provided for this Module.



An Historical Perspective of Oyster-Related Environmental Issues – The Historic Oyster Wars of Chesapeake Bay

Summary

Module 1, *An Historical Perspective of Oyster-Related Environmental Issues - The Oyster Wars of Chesapeake Bay*, introduces students to the Eastern oyster, and sets the stage for researching oyster-related issues in Chesapeake Bay. Students are provided an historical glimpse of the oyster industry in Chesapeake Bay beginning in the mid-19th century.

Effective resource management requires an understanding of how humans can affect the Earth's resources. Social constructs, such as politics, technology, and the economy all impact the decisions we make - even today. How did events affect the oyster industry - and the oyster population?

Resource management associated with the Eastern oyster in Chesapeake Bay is the focus in this Module, with particular emphasis on how human values may have contributed to the oyster's decline beginning in the mid-1800s. Students will compare the environmental issues that existed 150 years ago, to the current issues that exist through readings and internet resources.

Module 1 is where we begin the integration of the *Investigating and Evaluating Environmental Issues and Actions (IEEIA) model*, which is described in the *High School Unit Introduction*. In Module 1 of the Unit, students will analyze the article, *Oyster Wars: The Historic Fight for the Bay's Riches* (http://www.dnr.state.md.us/naturalresource/winter2008/oyster_wars.pdf). The IEEIA skills students will develop in this exercise include:

- Identifying environmental events, problems, and issues
- Evaluating the beliefs and values of stakeholders involved in an environmental issue

These skills are included in the *MD Environmental Literacy Standard 1: Environmental Issues* (<http://marylandpublicschools.org/programs/Documents/Environmental/MDEnvironmentalLitStandards.pdf>). Other activities and resources from the IEEIA model will be incorporated throughout the Unit. At the end of Module 1, students will identify current oyster-related environmental issues in the media, and practice these same skills using video, news articles, or other multimedia materials. Although some links to current oyster-related environmental issues are provided in the Resource section of the Module, the teacher should look for local resources to analyze and evaluate. Locally relevant issues spark student interest.

Background

The Chesapeake Bay region has long been considered one of the most productive estuaries in the world. Since the early 1970's, there has been a noticeable decline in many Bay species once considered to be economically important. Poor water quality, disease, and overharvesting have adversely affected the Bay ecosystem, and the economic foundation of rural communities, where fishermen of all types make their livelihood.

One such species is the native Eastern oyster (*Crassostrea virginica*), which has declined dramatically since the turn of the 19th century. Oysters were fought over for more than a century, even to the point of violence. During these early years, a combination of factors, including ineffective resource management, politics, and improved harvest technology led to the beginning of the decline in native Chesapeake oyster populations.

How did human beliefs and values contribute to the oyster's decline? How did the economic and political atmosphere and technological advances of the time influence the events of this historic struggle for oysters?

To this day, conflicts remain between different groups of people who disagree about how to manage the oyster population in Chesapeake Bay. Here, we will explore and compare historical and current management issues, and the factors that create environmental conflicts.

Learning Objectives

- Students will investigate conflicts over valuable natural resources that have led to violence between individuals or larger stakeholder groups.
- Students will evaluate the differences between environmental events, problems, and issues.
- Students will analyze how a person's beliefs and values influence where they stand on an issue
- Students will identify stakeholders, beliefs, and values from various written or multimedia sources.

- Students will compare historical oyster management issues and current oyster restoration management issues to demonstrate understanding of the complexity of environmental issues.

Guiding Questions

- How does one differentiate between *Environmental Events, Problems, and Issues*?
- How does our personal (prior) knowledge and experience shape our beliefs and values, and how does this affect our stand on an environmental issue? (How did stakeholder beliefs and values affect oyster management?)
- Why has the Eastern oyster population declined since the mid-1800s, and how has improved technology contributed to that decline?
- How have politics and oyster resource management in Chesapeake Bay contributed to the decline of the resource, both historically and from a current perspective?

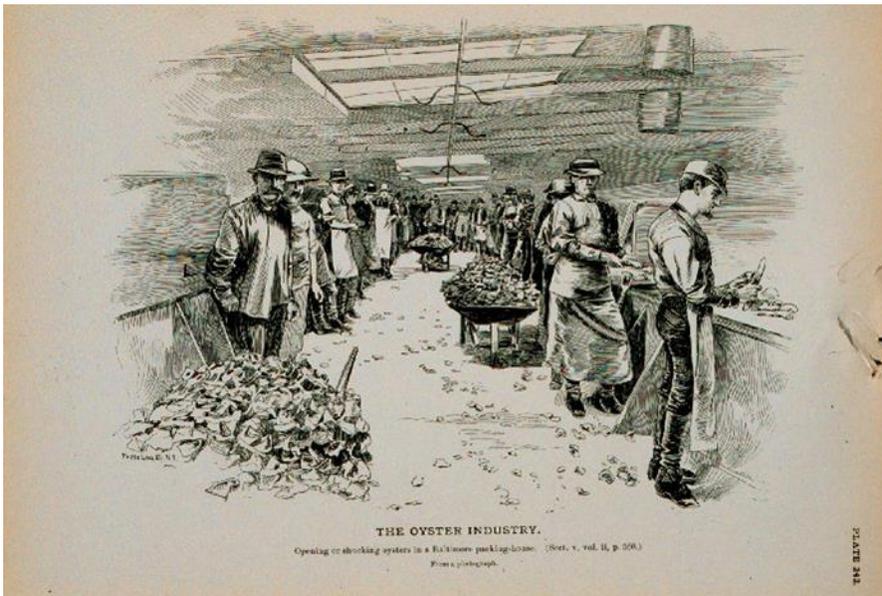


Photo Source:
 NOAA Photo Library



Photo Source: NOAA National Marine Fisheries Service

KEY WORDS for the reading,
Oyster Wars: The Historic Fight for the Bay's Riches, Kimmel (2008)

Industrial Revolution - the period of time from the 18th to 19th centuries during which rural agrarian society became more industrial and urban, marking a shift from manual labor and draft-animal-based economy to powered, special-purpose machinery, factories, and mass production.

Maryland Oyster Navy - a precursor to the Maryland Natural Resources Police.

Oyster - bivalve mollusk with a rough irregular shell, sometimes eaten as a delicacy; may be farmed for food or pearls. Native Chesapeake Bay oysters are the species, *Crassostrea virginica*.

Oyster Dredge - an implement, with a heavy iron frame with strong teeth along its lower edge, pulled behind a boat to scrape oysters into nets in deep water.

Oyster Pirates - people who engaged in illegal oyster harvesting from the late-1800s to the mid-1900s.

Oyster Wars - a series of sometimes violent clashes between oyster pirates, and authorities in the Chesapeake Bay from 1865 through the 1950s.

Sustainable Resource - a resource that can be harvested or used without depleting, damaging, or destroying it; a resource that can be renewed at the same rate is being used, if managed responsibly (e.g., water, trees, game birds, soil).

Vigilante - one who seeks justice for a crime without help from legal authorities.

Kimmel, Ross M. (Winter, 2008). *Oyster Wars: The Historic Fight for the Bay's Riches*. Natural Resources Newsletter. MD Department of Natural Resources.
http://www.dnr.state.md.us/naturalresource/winter2008/oyster_wars.pdf

You can also find this reading in APPENDIX D: Readings.

TEACHERS NOTE: Definitions for the following IEIJA Issue Analysis: Definition of Terms can be found in APPENDIX C: IEIJA Resources

- Event
- Problem
- Issue
- Players/Stakeholders
- Positions
- Beliefs
- Values
- Alternative Solutions

PROCEDURE

ACTIVITY I: Introduction – Resource Conflicts

ENGAGEMENT

Students will investigate conflicts over valuable natural resources that have led to violence between individuals or larger stakeholder groups.

To establish prior knowledge of your students, and to introduce the Eastern oyster as a subject of intense conflict, begin by sharing resources about what oysters are, and why they are valuable.

1. If you have live oysters or oyster shells available, pass them around to students, and ask them what they know about oysters. For more information about the ecosystem role of oysters in the Chesapeake Bay go to <http://chesapeakebay.noaa.gov/oysters/oyster-reefs>.
2. You can also show them photos of Eastern oysters or Eastern oyster reefs to elaborate further. Perform a Google search for *Eastern oyster reefs*.

Chesapeake Bay Foundation: Time lapse of oysters filtering water (4:44 minutes)

<https://www.youtube.com/watch?v=1Zm-yMpHsaQ>

NOAA Chesapeake Bay Office: Oyster Reefs

<http://chesapeakebay.noaa.gov/oysters/oyster-reefs>

3. Ask the students why oysters are valuable to humans.

Oysters are an important natural resource in Chesapeake Bay. They provide food and occupations for people; habitat for many Bay species; and have the ability to filter/clean the water. In fact, oysters have been so valuable to society that violence and war have resulted over who could harvest the oysters and in what rivers.

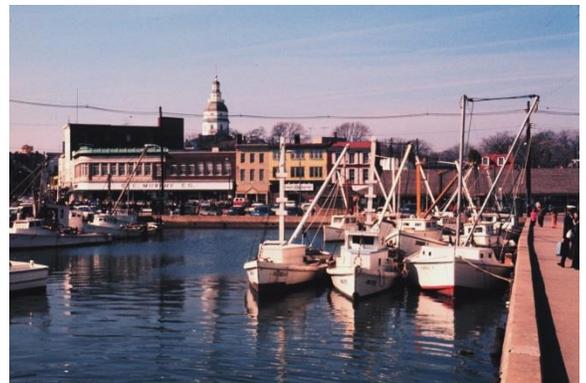


Photo Source: NOAA Photo Library

4. Throughout history, countries have battled over natural resources. Ask students to identify other local, national, and global natural resources that people have valued enough to fight for the right to claim those resources (e.g., water, oil, land, etc.)? Perform an internet search using *credible resource links* that address conflicts and natural resources. This can be facilitated together in class, or as a homework assignment.

EXAMPLES:

Search *War over Natural Resources*, or *Conflict over Natural Resources*; some search results include:

- The Environmental Literacy Council – Conflict and Natural Resources
<http://enviroliteracy.org/land-use/conflict-natural-resources/>
 - Business Insider – Nine Wars Fought Over Commodities
<http://www.businessinsider.com/nine-wars-that-were-fought-over-commodities-2012-8>
 - Water Wars: Who Controls the Flow?
<http://www.npr.org/2013/06/15/192034094/rivers-run-through-controversies-over-who-owns-the-water>
 - The Fish That Nearly Caused a War
<http://www.bbc.com/news/magazine-35431070>
6. After researching the topic of natural resources and conflict, continue the class discussion, and ask the following questions:
 - a. What were some of the natural resources that people fought over, and why?
 - b. Why did individuals or groups feel they had more of a right to “own” the resource than another?
 - c. What is the value that people placed on these resources? Why?
 - d. What countries, states, or local communities were involved?
 7. Begin developing a story board of the environmental problems presented using the following categories: local, state, national, or global. Students can bring in articles throughout the week or semester, and organize them by topic or region. Discuss the similarities and differences among the categories.

This discussion can be referenced in [Activity II](#).

ACTIVITY II: Resource Conflicts in Chesapeake Bay

EXPLORATION

Students will investigate conflicts over valuable natural resources that have led to violence between individuals or larger stakeholder groups.

1. Ask students to perform an internet search to answer the following questions:
 - Are there currently conflicts over natural resources in the Chesapeake Bay? Why do these conflicts exist?

After a brief discussion, explain to your students that you will be looking at one specific historic era when conflicts arose about where oysters could be harvested in the Bay, and by whom. These conflicts led to social problems, physical confrontations, and loss of human life.

2. Ask students to read the article, *Oyster Wars: The Historic Fight for the Bay’s Riches* (Kimmel, 2008). http://www.dnr.state.md.us/naturalresource/winter2008/oyster_wars.pdf. See also, APPENDIX D: Readings.

3. As a class, discuss what the students learned from the reading. What incidents led to the sharp decline of oysters in Chesapeake Bay?

Consider specific incidents related to politics, technology, and economics. Questions to ask during the discussion:

- Why were people fighting over oysters?
 - How was the oyster industry impacted?
 - How were oyster populations affected?
 - Were you aware of the violence that occurred over oysters in Chesapeake Bay? Can you think of any other times when a natural resource has been the center of a dispute, either currently or historically in Chesapeake Bay?
 - What do they know now that they didn't know before?
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ACTIVITY III: Identifying Environmental Events, Problems, and Issues

EXPLANATION

Students will evaluate the differences between environmental events, problems, and issues.

1. Provide students with the *How Do We Distinguish between Environmental Events, Problems, And Issues, Student Page*, in APPENDIX B. Allow students to use this page to write the definitions for *environmental events, problems, and issues*, and examples of each as you continue the discussion, or have them write the definitions and notes in their science journal.

TEACHER NOTE: Download the *IEEIA Issue Analysis: Definition of Terms* in APPENDIX C: IEEIA Resources.

2. Define an *environmental event* for your students. Examples are given below.

Examples of *natural events* include *severe weather events*, such as hurricanes, drought, a lightning strike or tornado, or geological events, such as an earthquake or volcanic eruption. Specific examples include *Hurricane Sandy* (2012), or the *Tsunami* in Japan (2011). You may want to share pictures of natural events with your students. The NOAA National Weather Service or NOAA Photo Library may be good sources. See, <http://www.weather.gov>, <http://www.photolib.noaa.gov>



Photo Sources: (left to right): Tornado - NOAA Photo Library; Lightning and Hurricane Katrina - National Weather Service

Humans may also be responsible for environmental events. **Examples** of specific *human related events* include the Deepwater Horizon oil spill or *introduction of nonnative invasive species* into an aquatic or terrestrial system (e.g. blue catfish, nutria, mute swan, northern snakehead, etc.).



Two Nutria. Photo by Steve Hillebrand, USFWS



Photo Sources and Credits: Blue Catfish, NOAA; Nutria, USFWS, Credit, Steve Hillebrand; Mute Swan, MD DNR; Northern Snakehead, MD DNR.

What other examples can students identify? Consider local, national, and global events.

Allow the students to research this, if time allows, and have them complete the questions on the *How Do We Distinguish between Environmental Events, Problems, and Issues?* in APPENDIX B: Student Pages, or complete the form using examples from the class discussion.

3. Define an *environmental problem* for your students. Refer to *Issue Analysis: Definition of Terms* in APPENDIX C: IEIJA Resources.

- Did the events discussed by your class create environmental *problems*? Examples are given below.
- What are some of the environmental *problems* associated with the *events* your students identified from the discussion above?

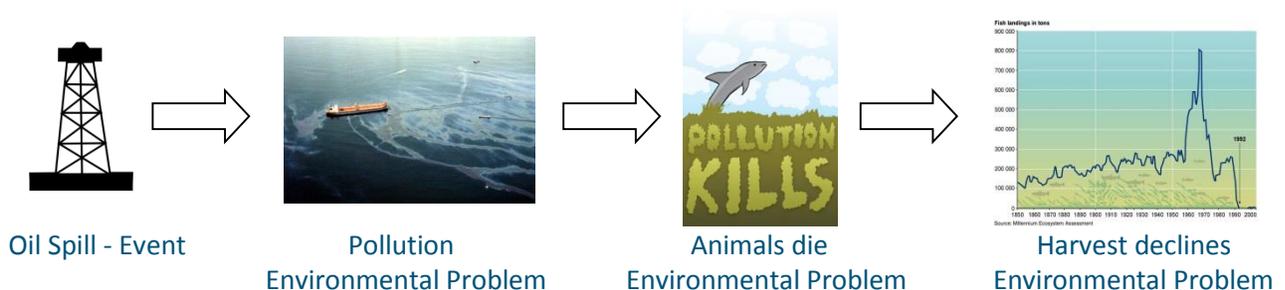
Examples of *Environmental Problems*

Invasive species crowd out native plant and animal species, resulting in a loss of habitat, food, etc.

- The “event” is the introduction of an invasive species.
- The “problem” is the loss of habitat and food.

An oil spill pollutes the water, killing birds and other wildlife; causes decline in fisheries harvests, which adversely affects the economy of the region.

- The “event” is the oil spill. This one event causes a host of environmental problems.
- The “problem(s)” could include:



- How did these problems threaten something that humans’ value?

4. Define an *environmental issue* for your students. Refer to *Issue Analysis: Definition of Terms* in APPENDIX C: IEIJA Resources.

Examples of environmental issues are given below. What, if any, environmental *issues* are associated with the *problems* your students identified from the class discussion? Consider current issues or issues from the recent past, such as:

- 1994 - Striped Bass – Should a moratorium be placed on striped bass in the Chesapeake Bay?
http://www.chesapeakebay.net/issues/issue/striped_bass#inline
 - 2001 - Should the mute swan population in Chesapeake Bay be eradicated?
http://dnr2.maryland.gov/wildlife/Documents/MuteSwan_TaskForceReport.pdf
 - 2010 - How should victims of the Deepwater Horizon oil spill be compensated?
<https://www.britannica.com/event/Deepwater-Horizon-oil-spill-of-2010>, See “*Legal Action.*”
5. Explain to your students that you will be looking more closely at the *events* that occurred during the Oyster Wars. Instruct them to answer the questions in *How Do We Distinguish Between Environmental Events, Problems, and Issues* in APPENDIX B: Student Pages.
6. Provide an example by identifying an *event* from the *Oyster Wars: The Historic Fight for the Bay’s Riches* for your students. (This will bring them back to the historical significance that resulted in an *environmental problem*). See *Events, Problems, and Issues* in APPENDIX A: Teacher Pages.

What *problems* resulted from this *event*? Were there *social*, as well as *environmental problems* that occurred?

TEACHER NOTE: Provide students with, *Oyster Wars – Event-Problem-Issue Chart* in APPENDIX B: Student Pages. There are two examples provided on this page. Students can complete portions of this during the discussion, or you could give it to them as an *assessment* of their knowledge/understanding of the terminology.

Examples of Historical Problem(s) from Kimmel (2008)

- Social problems, such as prostitution, drunkenness, and violence arose in towns where support industries sprang up.
- Increasing demand for oysters and the rise of associated businesses (e.g., packing and selling houses) led to an increase in harvest.*

TEACHER NOTE: *Refer to the *Historical Problems* in the example above. Note that we may *infer* that because *fishing pressure was placed on the resource* that there must have been a decline in the oyster population. This potential problem was never actually identified at this point in history. There was no research to support it.

After you have completed filling out the table for the Events, Problems, and Issues identified in the Oyster Wars article, answer the following questions:

- What *issues* resulted from the historical *event* and *problem* you identified from the reading?
- Why are *issues*, considered *issues*? Reflect on the definition once more.

- Why were there no *issues* associated with this *event* - the *Industrial Revolution* – in the reading?
 - How did improved technology impact oyster populations?
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EVALUATION

Students will evaluate their knowledge and comprehension of the reading(s) by identifying the environmental events, problems, and issues that occurred.

Ask students to list the environmental events, problems, issues (if they exist), and possible solutions recommended or actions taken related to the issue of declining oyster populations that occurred during the Oyster Wars in Chesapeake Bay. Students can then complete the [Environmental Events, Problems, and Issues Student Page](#) in [APPENDIX B: Student Pages](#).

TEACHER NOTE: More information about [Environmental Events, Problems, and Issues](#) can be found in Hungerford, et al, (2003).

H.R. Hungerford, T.L. Volk, J.M. Ramsey, R.A. Litherland, and R.B. Peyton, (2003). [Investigating and Evaluating Environmental Issues and Actions: Skill Development](#). Stipes Publishing, LLC: Champaign, IL.

TEACHER NOTE: [Teacher](#) and [Student Pages](#) can be found on in [Appendices A and B](#), respectively.

ACTIVITY IV: Identifying Beliefs and Values – Where Do You Stand?

ENGAGEMENT

Students will identify stakeholders, and analyze how a person’s beliefs and values influence where they stand on an issue by analyzing various written or multimedia sources.

1. To demonstrate how personal beliefs are different for us all depending on our knowledge, and experiences, students will share their opinions given a list of belief statements ([Where Do You Stand?](#)) in [APPENDIX C: IEEIA Resources](#).
2. Print the five [Where Do You Stand](#) signs in [APPENDIX A: Teacher Pages](#) that read: *Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree*.
3. Place the [Where Do You Stand](#) signs around the room. Allow students to review the belief statements prior to moving about the room.

TEACHER NOTE: *Where Do You Stand - Belief Statements* can be found in APPENDIX C: IEEIA Resources. (You may create additional value statements that you think would help illustrate current issues important to your students).

4. Read the belief statements aloud, and ask students to stand below the response that best matches how they feel about the statement. Allow time for discussion. Why do students take the stand that they do on the issue? (Ask that they are *respectful* of each other's opinions). Read through the various statements and record the responses for each question in a table. You may draw the table on a board or flip chart paper.
5. After you have completed this exercise, continue with a class discussion. Did students notice anything about this exercise that helped them to understand why their peers' beliefs may have been different from their own? Did their life knowledge and experiences lead to different beliefs about a potential issue? Did any of the students change their opinion based on the arguments presented by individuals in the group? How are an individual's knowledge, experiences, and beliefs linked?

ACTIVITY V: Identifying Stakeholders, Beliefs, and Values in Kimmel (2008), *Oyster Wars, The Fight for the Bay's Riches*

EXPLANATION/ELABORATION

Students will be able to identify the stakeholders, who are involved in an environmental issue, and the beliefs and values that form those stakeholders' opinions, or their position on an issue.

1. Define *stakeholders, beliefs, values, and positions* with your students (Hungerford, et al, pp. 29-37). Refer to *Issue Analysis: Definition of Terms* in APPENDIX C: IEEIA Resources.
2. Download and provide students with *Environmental Issues Value Descriptors* in APPENDIX C: IEEIA Resources. Review this page with your students.
3. As a class, identify the *Environmental Issues Value Descriptor* for each statement - *What Are the Values?* This Activity can be found in APPENDIX C: IEEIA Resources. Note that there is usually a word within each statement that calls out the *Value Descriptor*. There could be more than one value identified by your students for each statement. Allow them to justify why they have chosen a particular *Value Descriptor* if necessary.
(Answers to this exercise: 1). Ethical/moral 2). Human health/safety 3). Religious 4). Economic 5). Legal. 6). Scientific 7). Aesthetic 8). Social 9). Recreational 10). Egocentric 11). Ecological 12). Environmental 13). Political 14). Ethnocentric 15). Educational)
4. Using the Historic Oyster Wars article (Kimmel, 2008), have students identify the following:
 - Stakeholders and their position on the issue
 - Belief statement
 - Value descriptor that best matches their belief statement

Provide students with the *Stakeholders, Beliefs, and Values Chart* to complete this activity in APPENDIX C: IEEIA Resources.

ACTIVITY VI: Comparing Historical and Current Oyster-Related Issues

EVALUATION

Students will compare historical oyster management issues with current oyster-related environmental issues to demonstrate understanding of the complexity of environmental issues.

1. Below are links to two articles that focus on oyster sanctuaries in Maryland. Feel free to research other articles of local relevance to your students. Additional articles and links are listed in the *Resources* section of this module, but you may want to choose a more current article.

'Oyster wars:' Watermen aim to take back oyster bars as state panel reviews shellfish sanctuaries, The Baltimore Sun, by Scott Dance, September 1, 2016.

<http://www.baltimoresun.com/news/maryland/bs-md-oyster-restoration-20160723-story.html>

Changes loom for Maryland's oyster management, The Bay Journal, by Timothy Wheeler, July 23, 2016

http://www.bayjournal.com/article/changes_loom_for_marylands_oyster_management

This activity can either be a class discussion, or students may be assigned a writing exercise to evaluate their understanding of the skills required to analyze an environmental issue.

2. Provide your students with an article or video that is current (or very recent) and have them identify the *Stakeholders, Beliefs, and Values* of that story.

TEACHER NOTE: Use the *Events, Problems, And Issues Chart* can be found in APPENDIX C: IEEIA Resources (***) Pay attention to *people* the articles may identify *by name*. It is possible that your students could know or be related to these individuals! If you think that is a possibility, either change the names, or list them as *Person A, Person B*, etc.).

3. Review the article that the students analyzed, and compare the issues that currently exist to those in the historical article.
 - a. Develop a Concept Map explaining the various environmental events, problems, and issues reviewed thus far, OR
 - b. Create a Venn diagram to identify overlap of the historical and current issues. Include additional information for clarification, if needed.
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EXTENSION

1. **Differentiation** - Have students read, *Sixteen Decades of Political Management of the Oyster Fishery in Maryland's Chesapeake Bay*, (Kennedy and Breisch, 1983) a technical paper from Maryland Sea Grant providing more details related to the politics associated with the Oyster Wars. You may use this reading to complete the activities in this unit in place of, or in addition to, Kimmel's publication.
(http://www.mdsg.umd.edu/sites/default/files/files/16_Decades.pdf)

(This paper was originally published in the Journal of Environmental Management, Vol. 164, 1983, pp 153-171. You can obtain it from the link above).

Another excellent resource to consider is John Wennersten's book, *The Oyster Wars of Chesapeake Bay*, if there is sufficient time. It thoroughly details the unrest in the Chesapeake Bay region during the mid-1800s to mid-1900s (1981, 147 pages).
 2. Using the Kennedy-Breisch graph in **APPENDIX B: Student Pages** (MD Sea Grant), students will add technological advances to the graph to compare how policy, management, and technology impacted the oyster population from the pre-1700s to 1960. Also see **APPENDIX A: Teacher Pages** for a completed graph.
 3. Ask students to write a one-page essay discussing the solutions that they believe could have made a difference in creating a sustainable oyster population based on what they know from historical and current readings.
 4. Go to the NOAA National Marine Fisheries link below, and choose one or more fisheries species by clicking on *Species Locator*. Using the harvest data available, graph the harvest data, and compare these species to the Kennedy-Breisch graph over time. What similarities or differences do you see between these species trends, and trends in oyster data?
<https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index>
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EDUCATION STANDARDS

<p>NGSS – Disciplinary Core Idea(s)</p>	<p>HS-LS2.C: Ecosystem Dynamics, Functioning, and Resilience If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state, or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.</p>	<p>How Standard is Addressed</p> <p>HS-LS2.C: In Module 1, students learn how human events (economic, political, and social in nature) have affected the oyster population, which is a critically important ecosystem in Chesapeake Bay. Identifying the differences between environmental events, problems, and issues is integral to developing an understanding of locally relevant and complex environmental issues. They investigate and compare both historical and current events related to the oyster industry and management. They also explore how human beliefs and values determine how a person stands on a particular issue. (NOTE: See Oyster Harvest Simulation in the Middle School Oyster Unit for a refresher on how humans affect oyster populations through technology).</p>
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<p>NGSS - Disciplinary Core Idea(s)</p>	<p>HS-LS4.D: Biodiversity and Humans Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. (secondary to HS-LS2-7), (HS-LS4-6)</p>	<p>HS-LS4.D: Historical accounts illustrate how important oysters are to humans as a food source, and as an economic driver in the region. The oyster industry experienced a boom, due to faster transportation, better storage of perishable foods, and improved harvest technology. The numbers of oysters removed from the ecosystem could not keep up with oyster reproduction, and the population was decimated.</p>
<p>NGSS - Science/Engineering Practice(s)</p>	<p>Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> - Compare, integrate, and evaluate sources of information presented in different media formats, as well as in words in order to address a scientific question or solve a problem. - Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. 	<p>Engaging in Argument from Evidence Students have gathered evidence about oyster management and its impact on the population through various readings, graphs, data, or internet resources. They must integrate all of this information into writing that indicates their understanding of how and why humans make certain decisions about the environment.</p>
<p>NGSS – Cross- Cutting Concepts</p>	<p>Cause and Effect Students suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems.</p>	<p>Cause and Effect Students consider how management decisions and technology led to the decline in the oyster population.</p>

<p><i>Ties to MD Environmental Literacy Standards</i></p>	<p>Standard 1.0: Environmental Issues Topic A: Environmental Issue Investigation Indicator 1: Identify an environmental issue.</p>	<p>Standard 1.0: Environmental Issues Students differentiate between environmental events, problems, and issues. They are also able to identify the stakeholders involved in an issue, and what beliefs and values are reflected by the stand they take on the issue. Both historical and current oyster-related issues are analyzed.</p>
	<p>Standard 7: Environment & Society The student will analyze how the interactions of experience, learning, and culture influence social decisions and social change. Topic F: Technology and Environment Indicator 1: Investigate and examine the social and environmental impacts of various technologies and technological systems on the environment.</p>	<p>Standard 7: Environment & Society Students assess the beliefs and values of stakeholders, and how this influences the decisions they make regarding an issue. They evaluate how improved technology affected oyster populations, and how historical events and politics affect the management of the Eastern oyster.</p>
<p><i>Ties to MD State STEM Standards of Practice (Draft)</i></p>	<p>5. Engage in Logical Reasoning A. Engage in critical thinking.</p>	<p>5. Engage in Logical Reasoning Students engage in critical thinking to evaluate complex environmental issues.</p>
<p><i>Ties to C3 Framework for Social Studies</i></p>	<p>Dimension 2: History D2.His.14.9-12. Analyze multiple and complex causes and effects of events in the past.</p>	<p>Dimension 2: History Students analyze an in-depth investigation of how complex historical events (e.g., politics, management, economics, technology, etc.) affected both human and biological systems.</p>

<p>Ties to Common Core</p>	<p>ELA/Literacy</p> <p>RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-LS2-7)</p> <p>WHST.9-12.2: Write informative/explanatory texts, including narration of historical events. (HS-LS2-1, HS-LS2-2)</p> <p>MP.2: Reason abstractly and quantitatively.</p> <p>MP.4: Model with Mathematics.</p>	<p>RST.11-12.7: Students learn about a local environmental issue from an historic point of view, focusing on the complexity of oyster management in the Chesapeake Bay from the mid-1800s through the late-1950s.</p> <p>WHST.9-12.2: Students will draw comparisons between historical oyster management issues and current management issues related to oyster restoration to demonstrate understanding of the complexity of environmental issues.</p> <p>MP.2 & MP.4: Students analyze data/ graphs to compare if what the author(s) claim is true.</p>
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Hungerford, H.R., Volk, T.L., Ramsey, John M., Litherland, Ralph A., & Peyton, R. Ben. (2003). *Investigating and Evaluating Environmental Issues and Actions: Skill Development Program*. Champaign, IL: Stipes Publishing, L.L.C. <http://www.stipes.com/catalog/environmental-education>

Kennedy, Victor S. and Breisch, L.L. (1983). *Sixteen decades of political management of the oyster fishery in Maryland's Chesapeake Bay*. Journal of Environmental Management (16) (153-157). Retrieved from http://mdsg.umd.edu/sites/default/files/files/16_Decades.pdf.

A History of Oyster Harvests and Laws Graph from *Sixteen decades of political management of the oyster fishery in Maryland's Chesapeake Bay*. (1983). Data: Kennedy and Breisch; Graph: MD Sea Grant from http://mdsg.umd.edu/sites/default/files/files/16_Decades.pdf.

Kimmel, Ross. (Winter, 2008). *Oyster Wars: The Historic Fight for the Bay's Riches*. Natural Resource Magazine. Maryland Department of Natural Resources. Retrieved from the Maryland Department of Natural Resources; however, this resource is no longer available on the MDDNR website.

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http://marylandpublicschools.org/programs/Pages/Environmental-Education/elci_gb.aspxMD

Maryland Environmental Literacy Standards

<http://marylandpublicschools.org/programs/Documents/Environmental/MDEnvironmentalLitStandards.pdf>

Maryland Sea Grant, <http://www.mdsg.umd.edu/>

National Council for the Social Studies (NCSS), The College, Career, and Civic Life (C3) Framework for Social Studies State Standards: Guidance for Enhancing the Rigor of K-12 Civics, Economics, Geography, and History (Silver Spring, MD: NCSS, 2013).

Next Generation Science Standards: For States, By States, <http://www.nextgenscience.org/>

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

NOAA Chesapeake Bay Office, Oyster Reefs, <http://chesapeakebay.noaa.gov/oysters/oyster-reefs>

NOAA's Historic Fisheries Collection, NOAA Photo Library, <http://www.photolib.noaa.gov/>

The College, Career, and Civic Life (C3) Framework for Social Studies State Standards, <http://www.socialstudies.org/sites/default/files/c3/C3-Framework-for-Social-Studies.pdf>

Wennersten, John R. (1981). The Oyster Wars of Chesapeake Bay. Centerville, MD: Tidewater Publishing, 1981.

OTHER RESOURCES

MD Department of Natural Resources. (August 19, 2010). Maryland Oyster Restoration and Aquaculture Development Plan Public Hearing Comments. Department of Natural Resources. Retrieved May 8, 2014 from <http://www.dnr.state.md.us/fisheries/oysters/pdfs/080510dnroysterhearing%20.pdf>.

MDHSLIBRARYDEPT. (May 8, 2014). *Maryland on a Half Shell*. MD Historical Society Library. Retrieved November 23, 2016 from <http://www.mdhs.org/underbelly/2014/05/08/maryland-on-a-half-shell/>

Polus, Sarah. (January 3, 2014). [Maryland cracks down on oyster poaching](#). Southern Maryland Newspapers Online. Retrieved January 8, 2014 from <http://www.somdnews.com/article/20140103/NEWS/140109720/1056/maryland-cracks-down-on-oyster-poaching&template=southernMaryland>

Wieland, Robert. (February 20, 2007). *Managing Oyster Harvests in Maryland's Chesapeake Bay*. NOAA Chesapeake Bay Program. Prepared by Main Street Economics, 54 pages. Retrieved March 22, 2017, from <http://dnr.maryland.gov/fisheries/oysters/mtgs/111907/manageharvests.pdf>

HISTORICAL: Oyster Articles, Books, Multimedia, and Internet Sources

Newspapers, Periodicals, and Journals

The Life and Times of Chesapeake Oysters

Volume VI Number 17, April 30 - May 6, 1998 New Bay Times

http://bayweekly.com/old-site/year98/lead6_17.html

Kit Waskom Pollard. (June 03, 2014). *A brief history of Oysters in Chesapeake Bay*, The Baltimore Sun.

http://articles.baltimoresun.com/2014-06-03/entertainment/bal-a-brief-history-of-oysters-in-the-chesapeake-bay-20140603_1_crassostrea-oysters-aquaculture-development-plan

Graham, Karen. (July 5, 2012). *The Chesapeake Bay oyster wars, and the loss of a treasure*, Richmond History Examiner.

<http://www.examiner.com/article/the-chesapeake-bay-oyster-wars-and-the-loss-of-a-treasure>

Multi-Media

Stuff You Missed in History Class: Chesapeake Bay Oyster Wars – Podcast (28:04 minutes)

<http://podbay.fm/show/283605519/e/1376925816?autostart=1>

MD Sea Grant: *Restoring Oyster Reefs in Chesapeake Bay* (18:50 minutes)

<https://www.youtube.com/watch?v=v4pKoDPdmzM&list=PLai6hg8rng4QnwQTK5tz-jA2V4JBGpz8i&nohtml5=False>

NOAA Chesapeake Bay Office: Oyster Restoration

<http://chesapeakebay.noaa.gov/oysters/oyster-restoration>

Internet Resources

Commercial Fishers: Chesapeake Oysters

http://americanhistory.si.edu/onthewater/exhibition/3_5.html

Oyster Company of Virginia, <http://www.oysterva.com/oyster-history.html>

Oyster Wars of the Lower Chesapeake Bay

The Mariner's Museum

<https://www.marinersmuseum.org/sites/micro/cbhf/oyster/mod001.html>

Oyster History

Oyster Company of Virginia

<http://www.oysterva.com/oyster-history.html>

Chesapeake Bay oyster depletion

Encyclopedia of Earth

<http://www.eoearth.org/view/article/155099/>

Federal, State, and Non-Governmental Environmental Organizations

Alliance for the Chesapeake Bay, <http://allianceforthebay.org/>

Bay Journal, <http://www.bayjournal.com/>

Chesapeake Bay Foundation, <http://www.savethebay.org/>
MD Department of Natural Resources, <http://www.dnr.state.md.us/>
NOAA Chesapeake Bay Office, <http://chesapeakebay.noaa.gov/>
MD Sea Grant Education Programs, <http://www.mdsg.umd.edu/our-education-programs>
MD Sea Grant (search Publications), <http://www.mdsg.umd.edu/>
Oyster Recovery Partnership, <http://oysterrecovery.org/about/>
University of MD Center for Environmental Science, Horn Point Oyster Hatchery, <http://hatchery.hpl.umces.edu/>
Virginia Institute of Marine Science, <http://www.vims.edu/research/topics/oysters/>

Existing Curriculum

Annapolis Maritime Museum, <http://www.amaritime.org/images/OysterHarvestGame.doc.pdf>
Oyster Wars!! Chesapeake Bay Maritime Museum - Curriculum, Grades 6-10
<http://www.cbmm.org/pdf/Oystering%20Curriculum6-10.pdf>

CURRENT: Oyster Articles, Books, Multimedia, and Internet Sources

Newspapers, Periodicals, and Journals

Oyster poachers are stealing taxpayers' money

Baltimore Sun, May 5, 2011

http://articles.baltimoresun.com/2011-05-15/news/bs-ed-oysters-20110515_1_reef-balls-sour-oyster-stew-oyster-beds

Wheeler, Timothy B. (December 13, 2013) Florida shells to help revive MD's oysters

Baltimore Sun. www.baltimoresun.com/features/green/blog/bal-bmg-florida-shells-to-help-revive-mds-oysters-20131213,0,1996499.story

Dean, Gail. (April 16, 2014). Watermen, Council to challenge oyster restoration project, Star Democrat.

http://www.stardem.com/news/local_news/article_f4f912cc-46ff-594a-b1e6-c23e23e773f7.html

Rentz, Catherine and Wheeler, Timothy B. (April 4, 2015). Oyster poaching continues on bay despite enforcement efforts, Baltimore Sun. <http://www.baltimoresun.com/news/maryland/bs-md-oyster-enforcement-20150404-story.html#page=1>

Wheeler, Timothy B. (May 28, 2015). Watermen win changes to oyster reef restoration. Baltimore Sun. <http://www.baltimoresun.com/features/green/blog/bs-md-oyster-restoration-20150523-story.html#page=1>

Multi-Media

UPDATE: *Watermen Protest Md. Oyster Project in Dorchester County*, WBOC TV, Channel 16, May 1, 2014, <http://www.wboc.com/story/26051954/md-dnr-oyster-project-brings-in-stone-to-little-choptank>

MD DNR Oyster Project Brings in Stone to Little Choptank, WBOC TV, Channel 16, May 27, 2015. <http://www.wboc.com/story/26051954/md-dnr-oyster-project-brings-in-stone-to-little-choptank>

Internet Resources

Chesapeake Bay Program Newsletters, <http://www.chesapeakebay.net/news/newsletters/>

Work continues with fossil shell, MyEasternShoreMD, May 3, 2014

http://www.myeasternshoremd.com/stardem/news/local_news/article_0c33bd2c-b69d-52ec-9dbb-ad37a2251626.html

Blockading Watermen claim Maryland is screwing up Choptank with mud-coated shells from Florida in chancy planting project,

The Chesapeake Today, May 3, 2014

<http://www.the-chesapeake.com/2014/05/03/blockading-watermen-claim-maryland-screwing-choptank-mud-coated-shells-florida-chancey-planting-project/>

Dorchester County Council Meeting Minutes - May 6, 2014

<http://docogonet.com/uploads/File/Regular%20Meeting%20Minutes%20May%206%202014.pdf>

Lessner, Rebecca. *New law aims to protect oyster farms from poachers*, The Maryland Reporter, May 26, 2015.

<http://marylandreporter.com/2015/05/26/new-law-aims-to-protect-oyster-farms-from-poachers/>

Bay Journal, <http://www.bayjournal.com/>

Speakers

Local watermen – State Waterman’s Associations

Local historian – Museums

State or federal resource management agency scientists

Field Trip Suggestions

Chesapeake Bay Foundation, <http://www.cbf.org/join-us/education-program/student-field-programs>

Maritime Museums in Maryland and Virginia

Annapolis Maritime Museum, <http://www.amaritime.org>

Calvert Marine Museum, www.calvertmarinemuseum.com/

Chesapeake Bay Maritime Museum, <http://cbmm.org>

Maryland Maritime Museums, <http://www.maritimemuseums.net/MD.html>

Virginia Maritime Museums, <http://www.maritimemuseums.net/VA.html>

Waterman’s Museum, <http://www.watermens.org/>

Oyster Recovery Partnership, <http://www.oysterrecovery.org/>

Phillip's Wharf Environmental Center, <http://phillipswharf.org/>

Sultana Education Foundation, <http://sultanaeducation.org/>

NOTE: For more field trip suggestions, visit **Bay Backpack** at http://baybackpack.com/field_studies/

Curriculum References

Maryland Environmental Literacy Curricular Infusion by Grade-band

http://marylandpublicschools.org/programs/Pages/Environmental-Education/elci_gb.aspx

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