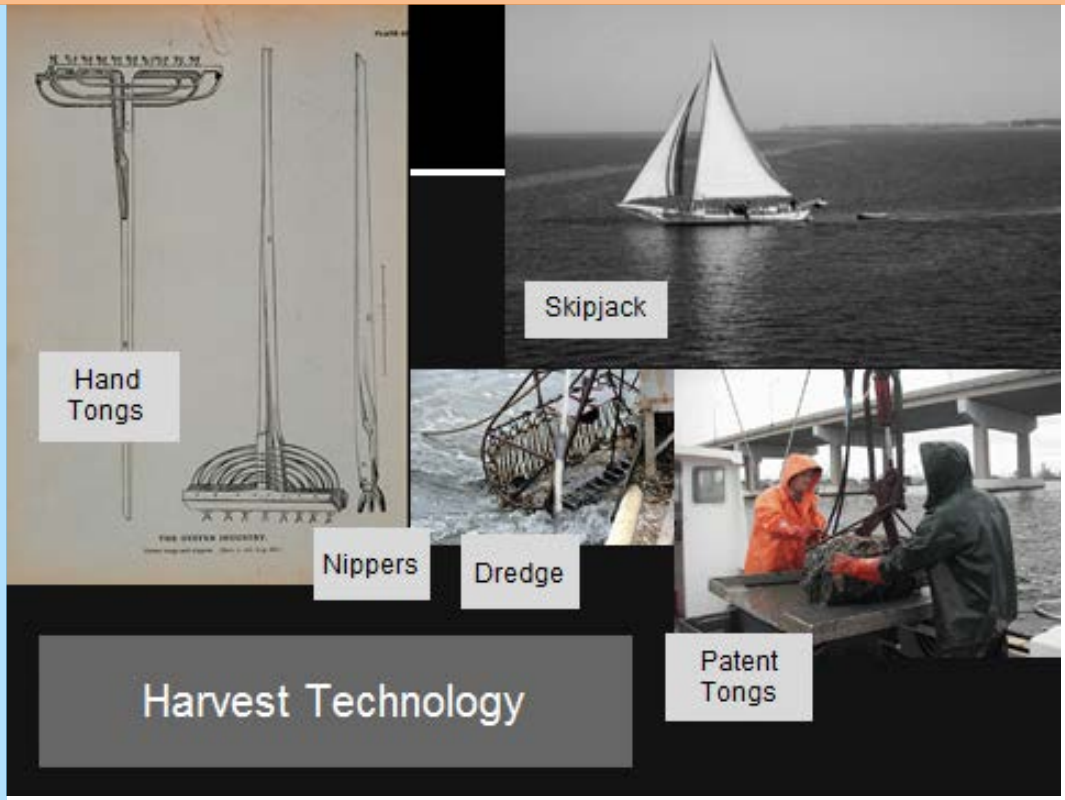
Module 2

Grade Level: Middle School

Teaching Time – 1-2 class periods

Materials:

- Student Data sheets 1 and 2
- Cookie sheet or watershed map
- 1 bag of dry white beans
- 1 bag of dry black beans
- Several pairs of chopsticks
- Several plastic spoons
- Several pairs of salad tongs (the kind that is connected with a pivoting pin in the middle)
- Small measuring cups of equal size



II. Oyster Harvest Simulation

Summary

This activity explores the historical and technological changes in the harvest of oysters through the years. It encourages students to think about how humans have affected the Bay and the Eastern oyster. During the game, dried beans represent oysters, and students test out four different types of oyster harvesting tools; nippers, hand tongs, skipjack dredges, and power dredges. After each round of "harvest", students observe and discuss how the structure of the reef has changed, and how the physical changes affect oysters and future populations.

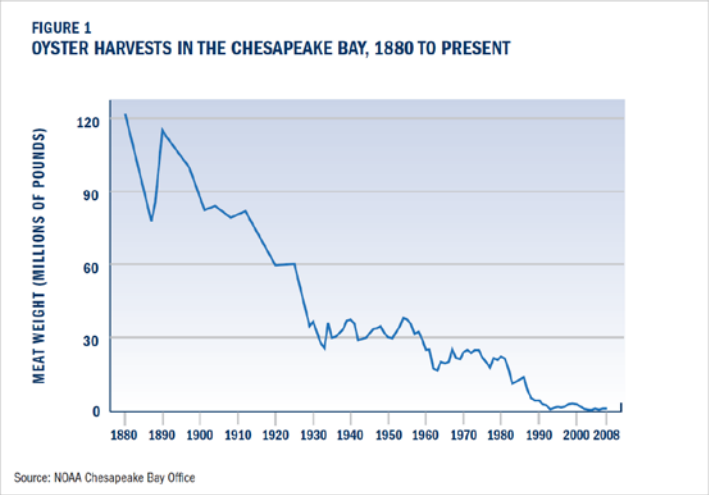
Learning Objectives

Students will be able to:

- Explain three methods of oyster harvest and how each method can impact oyster populations and oyster reef structure.
- Explain how a change in reef structure affect oyster populations.

Background Information

At one time, oysters were so abundant in the Chesapeake Bay that their reefs defined the major river channels. The reefs extended to near the water surface; to stray out of the center channel often posed a navigational hazard to ships sailing up the Bay. The oyster population in the Bay is less than 1% of what it once was. This activity will investigate one factor in the oyster population decline in the last 130 years, harvesting methods.



Key Words

Nippers – small tong for spotting and plucking one oyster.

Hand tongs – two-handled, double-headed tool that can reach down into the water and gather a group of oysters.

Dredges – hand or powered tool that is dragged across the seabed to scoop up large quantities of oysters.

Skipjack – wooden sailing vessel used for more than 100 years to dredge oysters from the Chesapeake Bay.

MSX – Oyster disease caused by a single-celled protozoan parasite, *Naplosporidium nelsoni*. Not harmful to humans but affects oyster populations.

Dermo – Oyster disease caused by a single-celled protozoan parasite, *Perkinsus marinus* found in the Chesapeake Bay since 1949. It affects the blood cells of the oyster but is not harmful to humans.

Activity Procedure

Adapted from Annapolis Maritime Museum Education Materials (amaritime.org)

Engagement

Show the Maryland Oyster Harvest graph and ask students to generate ideas about the population numbers represented in the graph. (These ideas will be revisited in later activities.)
Answer:

1. What do you think the annual oyster harvest was was before 1880? Higher than 7 million bushels. Even now we do not have a good handle on the actual oyster population and the number of oysters harvested is our best way to judge the size of the population.

2. What potential reasons have caused the downward trend on oysters on the Chesapeake?
   Answers will vary…Increased harvest, disease, pollution, predators
3. What historical event might have caused a slight rise in the oyster population in the 1940's?
   World War II because there were fewer people available to harvest.
4. What do you think the future trend will show? Answers will vary

Exploration

1. Students will use Data Sheet 1 to record their data. Use a large cookie sheet or flat surface, or a map of the Chesapeake Bay watershed for a better connection, and have the students make a mountain of dry beans on the surface to represent an oyster reef. Make sure that most of the beans are white, with a small proportion black. A sample table is provided to collect student data for 4 rounds (years) of harvesting.

2. In round 1, the students use chopsticks to pick up the beans/harvest the oysters, the chopsticks acting like nippers. Only give the students 10 seconds, to represent the oyster season in the winter. Discuss how Native Americans used nippers to harvest oysters, and have them record their results on Student Data Sheet 1 along with how this method has affected the shape and size of the bean mountain/oyster reef on the cookie sheet. Repeat for four "years" of harvest.

3. In round 2, students use a salad tongs to represent hand tongs. Collect data and note change in the shape of the underwater oyster mountain.

4. In round 3, students use spoons to represent skipjacks with hand dredges and how the technology of oyster harvest had advanced. Students should record changes in the the shape of the underwater mountain due to the use of this new technology.

5. In the 4th and final round, students harvest oysters using small measuring cups to represent power dredges and power engines that boats now have. Only allow 7 seconds instead of 10 because the oyster population has declined and regulations are tougher. Students should record changes in the shape of the underwater mountain resulting from the use of this new technology.

6. Throughout all of the rounds, if any oysters spill off the map, stop the round and have the students put them back on the pile. These beans represent oysters that were too small to take (less than the 3-inch legal size).

7. At the end of the activity, when the students' catch is much larger from power dredging than from hand tongs, tell them that the white beans are live oysters and the black ones are dead because diseases like MSX and Dermo, which have severely affected the oyster populations.

Explanation

Students will be using their knowledge of organizing and analyzing data to help come up with some conclusions on the data they have collected. This may involve learning how to use Excel to graph the data in the appropriate form. They will also have to interpret the data correctly in order to answer the discussion questions.

Step 1: Introduce students to the functions in Microsoft Excel that they will need to use throughout the project.

- They will have to be able to enter data into the correct cells.
- They will have to be able to highlight the correct cells and use Excel to create graphical representations of this data.
- Students will have to understand how to use a "drop down menu" in Excel.

Step 2: Give students some sample data to practice developing an Excel Document. Then have them put their own data into a document.

Step 4: Students should explain their analysis of the sample data by completing the follow-up questions in Data Sheet 1.

- Discuss how different types of harvest tools impacted the oyster reef
- Discuss changes in the ability of the oyster population to rebound once it becomes depleted due to changes in the reef and harvest methods.
- Discuss sustainable harvest, and what measures might help conserve and restore oyster populations in the Chesapeake Bay.

Extension

After playing the harvest game, have students review the graph in Student Data Sheet 2 comparing the oyster landing in Maryland and Virginia and complete the questions below. The "Chesapeake Bay Oyster Landings by State, 1880-2011" graph shows how Chesapeake landings declined over time to their current level of less than 1% of historical harvests. Two of the dips were probably caused by the spread of two oyster diseases, Dermo (which was first seen in the Chesapeake round 1949) and MSX (which appeared around 1959). The graph shows data from both states in each bar. For example, the total harvest in 1880 was 122,000 thousand pounds (each hash mark is 4 thousand) Maryland contributed 75,000 and Virginia contributed 47,000.

1. Which state typically harvested more oysters between 1880-2011? Maryland

2. The data points are much more numerous in the years 1928 through 2008. What might be a reason for this? Better monitoring, state and federal efforts increase because harvests are dropping

3. There are several years in which there is no data such as 1943. Why? There was a break in environmental monitoring because World War II caused many men to leave their jobs and monitoring was not a high priority.

4. How many thousands of pounds were harvested in Maryland in 1880? 75,000

5. How many thousands of pounds were harvested in Virginia in 1880? 47,000

6. How many thousands of pounds were harvested in Maryland in 1988? 4,000

7. How many thousands of pounds were harvested in Virginia in 1988? 2,000

8. Compare the harvest in Maryland in 1880 and 1988. The 1988 harvest is 4.9% of the harvest in 1880.

9. Based on the information of the graph, predict when new harvesting methods were started that used more efficient technology.

10. 2 oyster diseases, MSX and Dermo, were found in the Bay in the mid 1900's. Can you identify what impact these had on the oyster populations? There was a small drop in 1949 and steady drop of harvest in the 1950s.

Students may be curious about how oyster diseases (MSX and Dermo) and pollution have also played a role the decline in the harvest. This is an area of potential investigation or you can discuss as a group.

Background:

Dermo, caused by the pathogen Perkinsus marinus, was first recorded in the Chesapeake Bay in 1949, and is more prevalent in lower-salinity waters of the Bay. Another disease, MSX (caused by Haplosporidium nelsoni), was first found in the Chesapeake Bay in 1959, two years after it was first found in Delaware Bay. It is more common in higher-salinity waters. MSX probably arrived with the Japanese oyster, Crassostrea gigas, which was intentionally introduced into Delaware Bay to test its growth there (it did not grow well).

Of the two diseases, mortality is generally higher with MSX, which killed most of the oysters larger than 2 inches (51 mm) in higher-salinity waters (>15 psu) when it reached the Bay. Because most of the higher-salinity waters are in Virginia, this had a dramatic effect on the Virginia fishery. Many of the surviving high-salinity oysters recovered in the 1970s with wetter weather and thus lower salinity, which reduces the virulence of MSX as well as Dermo. Wet years tend to have higher oyster survival (because disease intensity is reduced) but lower oyster reproduction (because spawning and settlement require water that has 10-12 psu).

For oysters grown in aquaculture from hatchery seed, there are two main ways to reduce disease effects. One is to use artificially selected strains that have been selected for disease resistance. The other is to grow triploid oysters, which are produced in hatcheries to have three sets of chromosomes, rather than the naturally occurring pair of chromosomes. Triploid oysters grow faster than diploids, and usually reach market size before they succumb to one of the diseases. About 95% of Virginia oyster growers now grow triploid oysters.
(http://chesapeakebay.noaa.gov/fish-facts/oysters)

Evaluation

Data Sheets 1 and 2 can be used to review student understanding about the lessons.

Exit/Debrief: How did increasingly better harvesting technology affect the oyster populations? How was this model effective simulating actual harvest methods? How was it ineffective?

Three Dimensional Learning		How the Dimensions are Addressed
Disciplinary Core Idea(s)	**LS2.A Interdependent Relationships in Ecosystems** Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with non-living factors. Growth of organisms and population increases are limited by access to resources. Predatory interactions may reduce the number of organisms.	Students explore oyster harvesting methods and analyze graphs of historical oyster landings to determine the effect of the harvest methods on oyster populations and the health of oyster reefs.
Science/Engineering Practice(s)	**Analyzing and Interpreting Data** in 6-8 builds on K–5 experiences and progresses to extending quantitative analysis in investigations, distinguishing between correlation and causation, and basic statistical techniques of data analysis.	Students gathered evidence about harvest methods through a simulation that investigates 4 difference harvest methods. They also investigate the record of oyster populations in 2 states.

Cross-cutting Concepts	**Patterns can be used to identify cause and affect relationships.** **Stability and Change** - Students explain stability and change in natural or designed systems by examining changes over time.	Students review graphical information that they have collected and from a scientific source to construct an explanation that includes quantitative relationships between the oyster population and increasingly technological harvest methods. Students investigate oyster populations over time and the effects of harvesting methods on the population.
Ties to Common Core	WHST.6-8.9: Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2)	Students use a number of historical records to collect evidence about conditions in the Bay and compare that to current conditions.
Ties to MD Environmental Literacy Standards	Standard 4. Populations, Communities, and Ecosystems The student will use physical, chemical, biological, and ecological concepts to analyze and explain the interdependence of humans and organisms in populations, communities and ecosystems.	The student uses historical and current information about populations and habitats of the Chesapeake Bay to provide evidence for the effects of conditions on ecosystem health and organism populations.

Module References

http://ww2.mdsg.umd.edu/CQ/v08n2/main2/
http://chesapeakebay.noaa.gov/fish-facts/oysters
http://chesapeakebay.noaa.gov/fish-facts/oysters
https://www.amaritime.org/
http://www.cbf.org/document.doc?id=523

Maryland Environmental Literacy Standards
http://marylandpublicschools.org/programs/Documents/Environmental/MDEnvironmentalLitStandards.pdf

Additional Resources

http://www.eoearth.org/view/article/51cbee977896bb431f698ed7/
https://www.marinersmuseum.org/sites/micro/cbhf/oyster/mod007.html