Grade Level:
Grade 3

Teaching Time:
3 -5 minute sessions

Materials:
- Oyster shells (at least one per student) or photos of oysters
- Chart paper
- Plastic tubs (6-8)
- Water
- Legos
- Straws
- Sculpey or other plasticine clay
- Student science journals

It's a Group Thing

Activity Summary
Students learn about the properties and functions of oyster reefs by building and testing models of reefs. They also learn about the importance of reefs to oysters.

Learning Objectives
Student will be able to:
- Explain the function of healthy Eastern oyster reefs.
- Explain why being part of a healthy reef helps Eastern oysters obtain food, defend themselves and cope with changes.

Essential Questions
1. What role do Eastern oyster reefs play in the Chesapeake Bay?
2. How and why is a reef structure beneficial to the Eastern oyster?

Background Information
Oysters are bivalves that live in eastern coastal waters from the Gulf of St. Lawrence to the Gulf of Mexico. Large aggregations of oysters

can sometimes cover extensive areas of bottom in estuarine areas and may exist above the substrate attached to various objects such as stones, pilings, shipwrecks, and even discarded bottles. These dense groups of living oysters and shells are variously referred to as oyster bottoms, oyster beds, oyster bars, oyster banks, or oyster reefs. Because these terms sometimes are used interchangeably and are not well defined, it is important to note that not all species of oysters form dense clusters that we normally refer to as "oyster reefs". To help differentiate, we define oyster reefs here as large colonial aggregations of living oysters and oyster shells that can have submerged as well as intertidal portions, and provide habitat for a community of other species (e.g., tunicates, fish, crabs, worms, mussels, bryozoans, and barnacles). The best examples of oyster reefs are found along the Atlantic and Gulf coasts, where oyster reefs are formed by one species - Eastern oyster (*Crassostrea virginica*). As the older oysters die, they form the foundation for the reef and live oysters form a living layer atop and around the structure of older, nonliving shells.

Besides being excellent and tasty sources of food, oysters and oyster reefs serve vital roles in estuarine ecosystems. For example, oysters filter the water and reduce turbidity by extracting phytoplankton and organic and inorganic particles from the water column. Good water clarity, in turn, promotes the growth of submerged aquatic vegetation (SAV), which provides habitat for juvenile crabs, fish, and other organisms. In addition, the reefs may provide some protection from waves and currents. Oyster reefs form a complex ecosystem on and within their structure and provide large surface areas for attachment by other organisms such as barnacles, tunicates, mussels, sea anemones, and tube worms. Many of these organisms, like oysters, are filter feeders and contribute to the overall filtration capacity of the reef. They also serve as food for other reef inhabitants, such as crabs and fish. Small crustaceans called amphipods are abundant on most oyster reefs and are favorite prey items for some fish. In addition to providing habitat for prey items, oyster reef crevices and empty shells provide habitat and protection for a variety of animals. Some fish (e.g., gobies, blennies, skillet fish, and oyster toadfish) deposit their eggs inside the empty oyster valves, where they are less likely to be eaten by predators. Other fish normally found on East and Gulf Coast oyster reefs include spot, pinfish, lizardfish, sea trout or weakfishes, red drum, American eel, and black drum (an important oyster predator), which forage on the diverse invertebrate assemblage (Brietburg, 1995).

Oyster reefs in the United States are not only unique ecosystems that support multitudes of other organisms, but they are a valuable food source and constitute important commercial fisheries. The loss of oyster reefs in the United States during the past 200 years has not only significantly decreased the amount of food harvested from them, but has also removed habitat for other estuarine animals and plants, decreased water quality, and reduced income and jobs for workers in the oyster industry. Once the nation's crown jewel of oyster production, oyster harvests in Chesapeake Bay have reached an all-time low, and the once massive reefs have been reduced to 1 percent or less of their former mass. Similar scenarios have occurred in other

locations as well, due to disease, water pollution, overharvesting, cumulative loss of clutch base, and mining of shell resources.

Key Words

Bivalve - An aquatic mollusk that has a compressed body enclosed within a hinged shell.

Density – The amount of something in an area.

Disease - A condition that impairs the proper function of the body or of one of its parts.

Ecosystem - All the living organisms that occur together in a particular area.

Filter - To separate or remove matter.

Habitat - Place where an organism or a community of organisms lives; includes all living and nonliving factors or conditions of the surrounding environment.

Harvest – Process of gathering as in a crop.

Hatchery – Place where oyster larvae and young oysters are grown.

Larvae – Early form of an animal that is unlike its parent; Changes to look like/act like parent.

Mollusk - Invertebrate that has a soft unsegmented body and lives in aquatic habitats and often has a shell.

Oyster - Bivalve mollusk with rough irregular shell sometimes eaten as a delicacy and may be farmed for food or pearls.

Oystermen – Women and men who harvest oysters to sell to restaurants or to eat themselves

Phytoplankton – Free swimming algae.

Pollution – Contamination of air, water or soil with harmful substances.

Reef – Strip of oysters rising close to the surface of the water.

Restore – Bring back into existence.

Seed – Plant or lay down young oysters so they will grow.

Spat – Name for oyster larvae after the attach to a surface.

Substrate – Base on which an organism lives.

Water current - Part of a fluid body (as air or water) moving continuously in a certain direction.

Activity Procedure

Day 1

Engagement

Separate students into small groups and have them investigate oyster shells for a few minutes. Suggest they try to build with the shells. Or, give each small group several photos of oyster reefs to review. Have them record their observations and what they already know about oysters in their science journals. Discuss their entries.

Exploration

1. Pose the following problem to the students:
   There are many fewer oysters in the Chesapeake Bay than there were in the past. Since the Bay needs oysters to help keep it clean, scientists are conducting research to decide how to replenish the oyster population in the Bay. Scientists know oyster larvae attach best to other oyster shells, but they are not sure how to lay the shells in the water to help the oyster and the Bay ecosystem recover.
2. Divide the students into small groups and give each group Legos (to serve as oysters), straws, Sculpey or other plasticine clay, and a tub filled with several inches of water.
3. Have a student in each group place several individual Lego blocks on plasticine clay pads and submerge them (Lego/clay oyster reef sculpture) at one end of the tub. The blocks should sink and be covered by at least an inch of water. More clay can be added to the pads on which the Legos rest if needed.
4. Ask a student(s) in the group to place other Legos in the water at the opposite end from the reef sculptures, and using the straw, blow or nudge the free-floating blocks once or twice toward the submerged block. The floating Legos need to touch the blocks, but the students cannot guide the floating blocks clay to the reef sculpture with the straws. Have students try several times with several different size blocks. Record the data on the Student Response Sheet 1.

Explanation

1. Ask the students if the floating blocks touched the oyster reef sculpture. Why or why not? Discuss the data they recorded. Have them record their thoughts in their science journal and discuss with the class.

2. Ask the students to modify their Lego structure until they can blow or nudge the clay to have it touch the blocks. Discuss the modifications and observe the different shapes created.

3. Emphasize that taller and wider reefs catch more food. There is more surface area to block water, which carries the phytoplankton, and divert it to the oysters.

Day 2

Engagement

Watch the first five minutes of the video, "Restoring Oyster Reefs in Chesapeake Bay: Sea Grant Documentary." (https://www.youtube.com/watch?v=v4pKoDPdmzM) This section shows examples of healthy oyster reefs and the current state of oysters in the Bay.

Exploration

1. Have a student attach three blocks together to simulate a tiny group of oysters and submerge them in the tub. Plasticine clay can be used again to weigh down the blocks so they stay close to or on the bottom.
2. Another student should create wave action in the tub, from both sides of the tub with a straw or their hands. They can start gently and gradually increase the action. Have students record their observations in their journals.
3. Have the groups remove the clay, add a few more Legos to the original structure, and repeat the wave action. Students can keep track of the number of Legos used in their reef on Student Response Sheet 2.
4. Each group should continue making additions to their Lego reefs and repeat testing until the reefs move very little or not at all in the wave action.

Explanation

1. Discuss the activity and data with the students. Compare the number of blocks (oysters) needed to make the reef stable and withstand the wave action with the original three Lego structure.
2. If the students used different size blocks, discuss how the differing sizes affect the stability of the structure and ask how that could apply to oyster reefs.
3. Emphasize that larger, more complex reefs resist changes to their environment better (strong wave action, removal or addition of additional shells).

Day 3

Engagement

Watch minute 9:15 through minute 14:45 of "Restoring Oyster Reefs in Chesapeake Bay: Sea Grant Documentary." This section shows the results of "lightly seeding" (spreading shells in the water) and "densely seeding" (clumping shells in piles close together) oyster reefs for restoration. Note: You will need to explain what "seeded" and "density" mean prior to the video. Discuss the services healthy oyster reefs provide for the Bay besides filtering the water (nursery ground for young aquatic animals and source of food for larger animals).

Exploration

1. In groups, students should build new large reefs that will sit on the bottom of their tubs. These reefs should have a single color core made up of five to ten blocks with blocks of other colors around it. Make sure the solid color core can be seen through the outer layer. This design simulates an oyster reef where the outer shells will help protect the inner oysters.
2. The students repeat the Day 1 Exploration activity with their reefs trying to touch the solid color core of the reef with the floating block.
3. Ask them to record in their journals the number of times they tried and the number of actual core touched.
4. Have them repeat the activity placing multiple floating blocks in the water and recording the number of "hits" on the core of the reef on the Student Response Sheet 3.

Explanation

Discuss the activity and data emphasizing how oysters (blocks) with other oysters around them are less likely to be affected by predation (hits with the clay). Using different size blocks simulates predators at various levels of the water column. Refer back to the video section showing the predators and prey in a healthy oyster reef.

Revisit the original problem posed to the students:
There are many fewer oysters in the Chesapeake Bay than there were in the past. Since the Bay needs oysters to help keep it clean, scientists are conducting research to decide how to replenish the oyster population in the Bay. Scientists know oyster larvae attach best to other oyster shells, but they are not sure how to lay the shells in the water to best help the oyster and the Bay ecosystem recover.

As students to return to their groups and decide the best way to lay the shells based on their tests. Discuss their ideas as a whole class.

Extension

1. Give each pair or small group of students a card with one of the scenarios below. Have them discuss how living in a group (reef) with many generations of oysters helps or hinders the oysters in the situation and then share their conclusions.
    a. A boat passes dragging the propeller on the reef
    b. A bad storm arrives and waves pound the reef.
    c. A bad storm brings waves and sediment is dropped on the reef.
    d. Fisherman harvest oysters.
    e. One of the oysters catches a very contagious disease.
    f. A group of flat worms settle in the reef eating small oysters. (natural oyster predator)
    g. A very hungry blue crab visits the reef. (natural oyster predator)

2. Invite a speaker(s) who works with oysters and/or oyster restoration into your classroom. Ask them to describe what they do, how it affects the oysters in the Chesapeake Bay, and describe the career path they took. Have the students prepare questions about oysters, oyster reefs, and restoration ahead of time.

Evaluation

Formative:

1. Class discussions and participation
2. Model building
3. Journal entries

Summative:
Students can complete one or both of the following:

1. Have students draw the most effective oyster reef they built and prepare a written response to the following questions:
    a. What are the functions of healthy Eastern oyster reefs?
    b. Why does being part of a healthy reef help Eastern oysters obtain food, defend themselves from predators and cope with changes?
2. Revisit the problem posed to students at the beginning of the lesson. Have students write a letter to a scientist to convince them to place oysters or oyster shells in large groups around the Bay. A sample rubric for the letter is below.

Education Standards

Three Dimensional Learning		
Disciplinary Core Idea(s)	**3-LS2.D: Social Interactions and Group Behavior** Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. (3-LS2-1)	**How Standard is Addressed** Students learn how large reefs with oyster shells close together help oysters obtain food, defend themselves, and cope with changes by building and testing reef models.
Science/Engineering Practice	**Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model. (3-LS2-1)	Students construct oyster reef models and then use what they learned by testing them in various conditions to the ways large, healthy oyster reefs help and protect oysters so they can grow and help the Bay ecosystem.
Cross – Cutting Concepts	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1)	Students modify their reefs, retest them, and identify how the design changes affect the outcomes of the tests.
Common Core Standards		
Ties to Common Core	**W3.1** 1. Write opinion pieces on topics or texts, supporting a point of view with reasons. a. Introduce the topic or text they are writing about, state an opinion, and create an organizational structure that lists reasons. b. Provide reasons that support the opinion. c. Use linking words and phrases (e.g., because, therefore, since, for example) to connect opinion and reasons. d. Provide a concluding statement or section	Students write a letter to a scientist to convince them that large reefs with many shells benefit oysters and the Chesapeake Bay.

Maryland Environmental Literacy Standards		
Ties to MD Environmental Literacy Standards	**Standard 3 Flow of Matter and Energy** C. Interaction of Physical Systems and the Biosphere Indicator 1. Analyze and explain the movement of matter and energy through earth's systems and the influence of this movement on the distribution of life.	Students develop and test models of oyster reefs and analyze models of oyster reefs to the ways individuals and groups of organisms interact with each other and their environment.

Additional Resources

Web Resources

Protecting Our Water Resources: Student Activities for the Classroom Water and educational activities for Kindergarten through Ninth Grade
http://www.stormwater.ucf.edu/toolkit/vol3/Contents/pdfs/Student%20Activities/student_activities.pdf

Olly the Oyster: Visit this website for coloring pages, puzzles, word searches, crafts, and more.
http://www.ollytheoyster.com

Sammy's Corner: An Oyster Recycling Program: The site contains teacher resources including a poster, curriculum guides, and additional oyster activities.
http://oysterrecycling.org/sammys-corner/

YouTube Videos:

- Oyster Filtration: A one minute time-lapsed video of oyster filtration in action.
  https://www.youtube.com/watch?v=saAy7GfLq4w

- OYSTERFILTER: A one minute and 20 second time-lapsed video of six oysters filtering a gallon of water. https://www.youtube.com/watch?v=LOp3V_QpAyA

- Restoring Oyster Reefs in Chesapeake Bay: Sea Grant Documentary
  https://www.youtube.com/watch?v=v4pKoDPdmzM

TeacherTube Videos:

- Oyster Filtering: Excerpt from The Chesapeake Bay Foundation's documentary "Common Ground." (42 seconds)
- http://www.teachertube.com/viewVideo.php?video_id=211324

- Oyster Rap: An oyster restoration scientist raps about Eastern oysters in the Chesapeake Bay
- http://www.teachertube.com/viewVideo.php?video_id=93158

Book Resources

Allen, Elaine Ann. Olly the Oyster Cleans the Bay. Tidewater Publishers, May 1, 2008. ISBN-10: 0870336037.

Tate, Suzanne. Pearlie Oyster: A Tale of an Amazing Oyster. Nags Head Art, Inc., June 1, 1989. ISBN 10: 0961634472.

The Eastern Oyster in the Chesapeake Bay

Two halves of a single Eastern Oyster.

What are Eastern oysters, Crassostrea virginica?

Eastern oysters are **bivalve mollusks**. That means they have two shells. You will see one shell on the left side and one shell on the right side when you open an Eastern oyster.

Where do Eastern oysters live?

Eastern oysters live on the East Coast of North America from Canada to Venezuela.

Very young oysters float in water currents looking for a place to stick to and grow into adults. As they float, they grow a foot. They use the foot to find a hard surface to attach to. Then they make a cement-like glue to stick the foot to the hard surface. They cannot attach to mud and sand or to a place with too much sunlight. They need to be in flowing water where their food (**phytoplankton**) is. Other oyster shells are the best place for oyster **larvae** to attach. Once attached, the larvae are

called **spat**. Over time, the spat grow and make shells, and other oyster **larvae** attaches to them. As more and more oysters attach to older oysters, oyster reefs grow.

Oyster spat attached to oyster shell (left), restored oyster beds. Photo: NOAA

What do Eastern oysters look like?

Adult Eastern oysters have a grey and white bumpy shell. They are shaped like giant kidney beans with one skinny end. They can grow to eight inches long. There were once oysters as big as dinner plates! Those oysters had grown for many years because Native Americans could only **harvest** small numbers of oysters.

Why are Eastern oysters important to the Chesapeake Bay?

For thousands of years, people have eaten Eastern oysters, and Native Americans used oyster shells for jewelry and money in the past. Starting about 400 years ago, people also made money by harvesting and selling oysters.

Eastern oysters filter the water in the Bay. Oysters suck in water and filter out phytoplankton for food. They also filter **sediment** and **pollution** out of the water. Then they spit clean and clear water back

into the Chesapeake Bay. Without oysters, the water in the Bay would become cloudy and polluted; not a good place for other animals to live.

Oyster reefs also provide habitat to other animals such as small crabs and fish. The young animals live in the oyster reefs for protection from predators and for food.

What happened to the Eastern oysters?

For hundreds of years, Eastern oysters were known as the best tasting oysters in the United States. Oystermen harvested oysters faster than the oysters could reproduce. Oysters live close together in reefs, and their young like to stick to other oyster shells to grow. There were not enough oysters to reproduce or provide shells for oyster larvae to attach to, so fewer oyster reefs were made. People also used oyster habitat as places for building docks and houses.

Also, in the 1940s and 1950s, scientists found two diseases in Eastern oysters called MSX and Dermo. Both of these kill oysters and make it harder for more reefs to grow in the Chesapeake Bay.

What are people doing to help the Eastern oyster?

People are doing many things to help the Eastern oyster. Scientists are learning more and more about oysters and their habitat, and water currents in the Chesapeake Bay. They use this information to find the right places to place piles of empty oyster shells to give oyster larvae sticking places. The new reefs are often built on old oyster shells from restaurants.

People are also growing oysters from boat docks in bags that look like mesh socks and give the oysters to oyster **restoration** groups to put onto reefs when the young oysters are large enough. Businesses are growing oysters on floating rafts. They sell the oysters for food and use the shells to help new oysters grow.

What can you do to help the Eastern oyster?

Learning about the Eastern oyster is the first step toward helping more oysters grow in the Chesapeake Bay. You can share the story of the Eastern oyster and its importance to the Chesapeake Bay and to Maryland with others. You can also collect oyster shells from restaurants and take them to groups around the Chesapeake Bay who are working to **restore** oyster beds. If you live on the Bay, you can grow oysters from your dock in oyster socks and then take the sock to a group that will plant them on an oyster bed. And if you are boating in the Chesapeake, watch for oyster beds. Putting down your anchor on a bed can hurt the living oysters and destroy the bed. Anything you do to bring oysters back to the Chesapeake Bay benefits all Marylanders and Virginians.

Tiny oysters at a **hatchery**.

Sample rubric for scoring student letters

	Below Average	Average	Above Average	Excellent
Conclusion from Activity Analysis (Yes or no, oysters benefit from living in reefs/groups.)	No conclusion	Only writes a conclusion statement.	Writes and overview and a conclusion.	Clearly writes a brief overview of the activities AND states the conclusion they drew in response the problem.[1]
Main Concepts (Reefs help oysters get food, protects them from predators, and helps them adapt to changes.)	Does not cite any of the main concepts.	Includes one main concept.	Includes two main concepts.	Include all three main concepts to make argument for the conclusion.[2]
Concept Elaboration (Living in reef helps protect oysters from predators because…)	No elaboration or description.	Elaborates on one main concept or gives a general description.	Elaborates on two main concepts.	Elaborates on all three main concepts.[3]

Examples:
[1] In my class we did three activities to help us understand if oysters are better living by themselves or living in reefs. My conclusion is that oysters should live in reefs to survive.
[2-3]Living in reefs helps oysters get food because living in a wide and tall group blocks more food and keeps it from floating past the oyster. In class, we built Lego reefs and the larger reefs blocked more Cheerios. Oysters are also protected from changes when they live in reefs because reefs are less likely to move. The larger the Lego reefs we built the less likely they were to move in the waves and be destroyed. A reef also helps oysters survive predators. The more oysters there are in a reef the less likely they are to be completely eaten.

* This rubric addresses the science concepts. You may wish to include other items for evaluation.

Name _____

Data Sheet 1

Color a square each time the free floating blocks hits the block structure.

Block Number	Color	1st Hit	2nd Hit	3rd Hit	4th Hit	5th Hit	6th Hit

Name _____

Data Sheet 2

Do your blocks move when waves hit them? Check yes or no.

How many blocks are in your structure?	Yes	No
3		

How many blocks did you have to add to your structure for it to be stable in the water? Why?

_____

_____

_____

Name _____

Data Sheet 3

Did your floating block hit the inside blocks? Check yes or no.

Try	Yes	No
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Was it easy to hit the inside (protected) blocks? Why or why not?

_____

_____

_____

_____