Dauphin Island Sea Lab
DISCOVERY HALL PROGRAMS

Living Shorelines

Created by:
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Discovery Hall Programs
Dauphin Island Sea Lab

Living Shorelines

Subject: Life Science

thth
Grade Level: 6-8

Time Required: 60 min

Key Terms: erosion, oyster reef, intertidal zone, salt marsh, seagrass meadow, wetland, restoration, living shoreline

I. Course of Study

Alabama Course of Study (ALCOS)

th
6 Grade, Life Science, Content Standard 2
Describe factors that cause changes to Earth's surface over time.

th
6 Grade, Life Science, Content Standard 5
Describe layers of the oceanic hydrosphere, including the pelagic zone, benthic zone, abyssal zone and intertidal zone.

th
6 Grade, Life Science, Content Standard 7
Describe Earth's biomes.

th
7 Grade, Life Science, Content Standard 7
Describe biotic and abiotic factors in the environment

th
8 Grade, Physical Science, Content Standard 12
Classify waves as mechanical or electromagnetic

National Science Education Standards:

Science as Inquiry M.A.2 *Understanding about scientific inquiry*
Physical Science M.B.3 *Transfer of energy*
Life Science M.C.4 *Populations and ecosystems*
Science and Technology M.E.2 *Understandings about science and technology*
Science in Personal and Social Perspectives M.F.2 *Populations, resources, and environments*
Science in Personal and Social Perspectives M.F.3 *Natural hazards*
History and Nature of Science M.G.1 *Science as a human endeavor*
History and Nature of Science M.G.2 *Nature of science*

Ocean Literacy Standards

Essential Principle 1: *The Earth has one big ocean with many features.*
Essential Principle 5: *The ocean supports a great diversity of life and ecosystems.*
Essential Principle 6: *The ocean and humans are inextricably interconnected.*

II. Concepts

Erosion is the process by which soil, sand or rock is eaten away by forces such as wind or water. While erosion occurs naturally, human activities like dredging of ship channels and damming of rivers, has increased the rate at which it occurs along our coasts. This erosion has resulted in the loss of **wetland** habitat. **Salt marshes** and **seagrass meadows** occur along low energy shorelines and provide a number of important ecosystem services. Marshes trap sediment and pollutants as water runs off the land and both provide a nursery ground for baby animals. Much of the seafood that people like to eat grows up in the safety of salt marshes and seagrass meadows.

One common method of protecting shorelines from erosion is for property owners to build a bulkhead or seawall. Bulkheads are costly and are destined to fail over time. Instead of slowing wave energy, bulkheads reflect energy, often causing erosion on nearby unprotected shorelines. Bulkheads also cut off access between the land and water, which many animals of the intertidal zone depend on.

Fortunately, scientists and environmental managers are studying the use of alternative "living" methods to protect salt marshes from erosion and to restore oyster and seagrass habitat. **Living shorelines** use natural habitat elements to reduce erosion while providing critical habitat for wildlife. In living shoreline **restoration** projects, breakwaters are installed to absorb wave energy. This keeps strong waves from crashing onto the salt marshes that line the shore and also allows sediment carried by the waves to be deposited.

Engineered **oyster reefs** are often used as breakwaters in living shoreline projects. Eastern oysters, *Crassostrea virginica*, are mollusks that live in the **intertidal** and subtidal zones of marine and estuarine (brackish) waters. Oysters grow on top of one another forming large reefs or bars. Oyster reefs are important because they provide habitat for many species of crabs, shrimp, and fish and can improve water quality by filtering pollutants from the water.

Scientists at the Dauphin Island Sea Lab are studying the use of different types of engineered oyster reefs and how they can benefit the environment. The living shorelines used in their studies vary and include mesh oyster bags, concrete domes and steel rebar prisms. Scientists will determine which designs are the most effective at encouraging oyster settlement and growth, attracting crabs, shrimp, and fish, decreasing shoreline erosion, and stabilizing sediments for seagrass and salt marsh growth.

III. Learning Objectives

Students will:

- identify sources of coastal erosion, both man-made and natural
- explore the benefits of using living shorelines to protect against erosion
- view examples of shoreline stabilization alternatives
- experiment with creating their own living shoreline

IV. Materials

™
Reef Ball model Rulers Data Sheet
Aluminum pans Imitation grass Images of living shorelines
Sand Stiff plastic Computer
Water Rocks, shells, foam (oyster reefs)

V. Instructions

Opening

™
Show the students the Reef Ball model (or picture) without telling them what it is. Give them time to pass it around to get a closer look. Have the students write down what they think it is and what it is used for. Invite students to share their ideas with the class.

Development

™
Explain to the students that the object is a miniature Reef Ball and that the real ones can weigh up to 6,000 pounds! Describe the various uses (coral reef, oyster reef, mangrove restoration, etc.) and the specific type used in the Dauphin Island Sea Lab's oyster reef restoration projects. Explain how the holes slow waves as the water passes through and comes ashore, preventing erosion. Describe how the slowing of the water allows sediments to settle and makes the environment suitable for seagrasses and marsh grasses to grow. Discuss the biology and ecology of oysters. Express the importance of oyster reef communities in the environment and how engineered oyster reefs work to restore those environments. Discuss various types of living shoreline restoration techniques.

Activity

Groups of students should create a "beach in a pan" to visualize the effects of waves on a shoreline both with and without an oyster reef or other living shoreline implement in place. Using large aluminum pans and sand, create a shoreline on one end of the pan. Use green ribbon or other craft to create vegetation along the shoreline. Slowly fill the pan partly with water leaving some of the shoreline exposed. Students should use a sturdy piece of plastic or other waterproof material to create a steady series of waves from the open water end of the pan. Use a ruler to measure the wave height and record. Stop after 30 seconds and note the condition of the shoreline. As damage is likely to have occurred, rebuild the shoreline before beginning the next step. Using rocks, shells or other small objects, build an oyster reef across the middle of the pan. Create waves (of the same height as before) for 30 seconds and record the results. Continue this process, adjusting the dimensions and materials used in the reef to best control erosion of the shoreline.

Extension

Show students images of other engineered reefs and living shoreline alternatives. Ask students to come up with a list of pros and cons on the use of artificial reefs. Which methods do they think are the best, worst and why? Create your own living shoreline or artificial reef using modeling clay, foam or plaster.

Assessment
Show students a photo or drawing of an eroded shoreline. Have students draw/build their own artificial reefs. Ask them to supply reasoning behind their design. Encourage them to include all of the species that will benefit from their reef.

VI. Resources and References

Dauphin Island Sea Lab
www.disl.org

Dauphin Island Sea Lab - Discovery Hall Programs

http://dhp.disl.org

Reef Ball Foundation

www.reefball.org

National Oceanic and Atmospheric Administration (NOAA) - Restoration Center

http://www.habitat.noaa.gov/restoration/techniques/livingshorelines.html

NOAA - Office of Ocean and Coastal Resource Management

http://coastalmanagement.noaa.gov/shoreline.html

The Nature Conservancy

www.nature.org

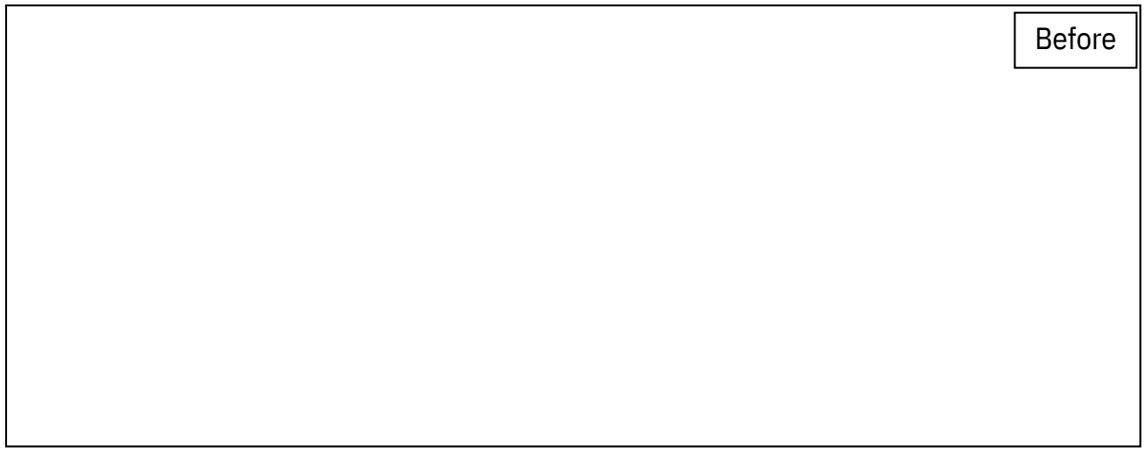
This document was developed by the Dauphin Island Sea Lab Discovery Hall Programs. DISL scientists participated in the monitoring of a large-scale oyster reef restoration project and DHP educators provided education and outreach for the project.

"This project was made possible through support provided by the NOAA and The Nature Conservancy, under the terms of ARRA Grant #NA09NMF4630304. The content and opinions expressed herein are those of the author(s) and do not necessarily reflect the position or the policy of the NOAA or The Nature Conservancy, and no official endorsement should be inferred.

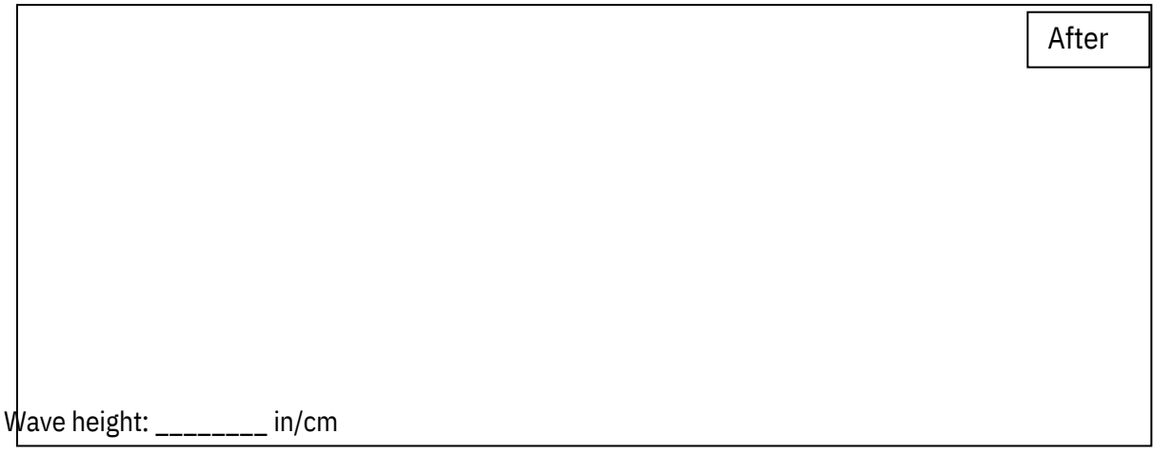
Data Sheet
Living Shoreline Activity

Draw your unprotected shoreline:

Before



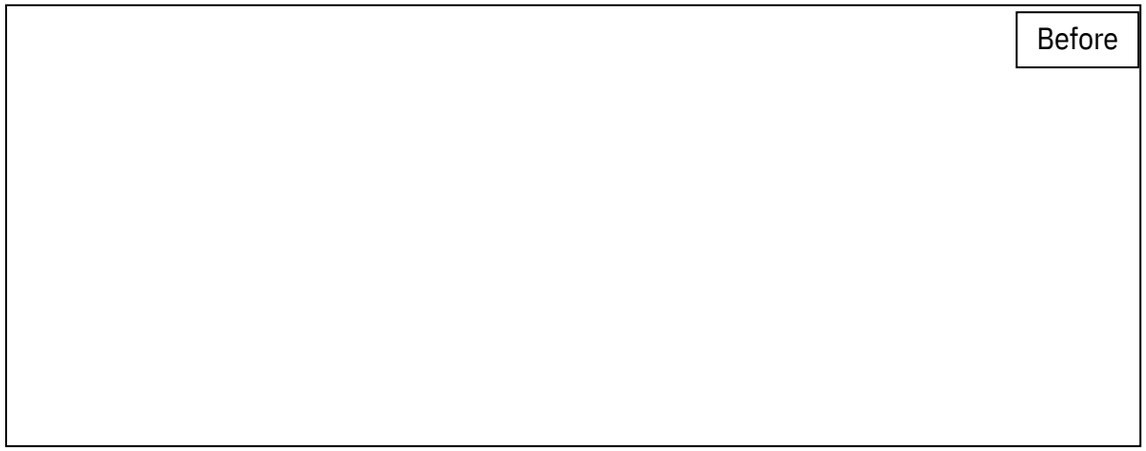
After

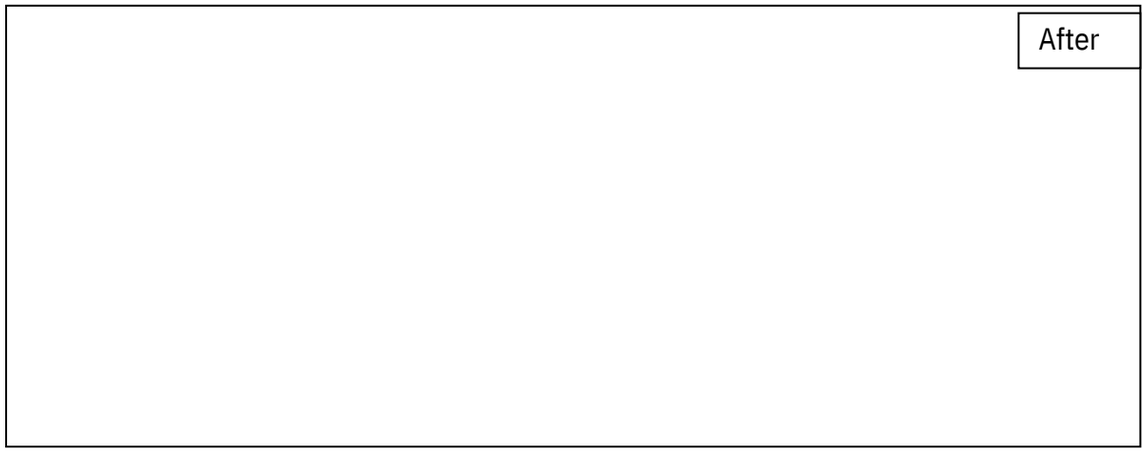


Wave height: _____ in/cm

Observations:

Draw your shoreline with oyster reef breakwater in place:





Wave height: _____ in/cm

Observations:

Dauphin Island Sea Lab

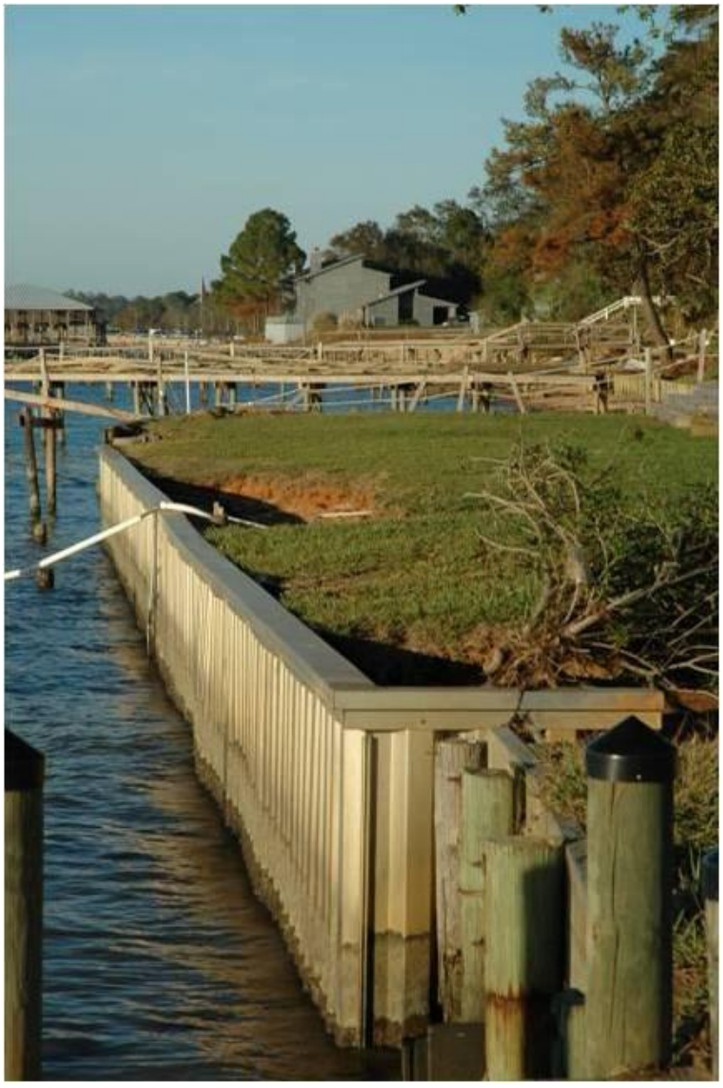
Living Shorelines

Images to Support
“Living Shorelines” Lesson Plan
For grades 6 - 8

Beth Young © The Nature Conservancy

Salt Marsh Erosion

Common Solution to Erosion



Bulkheads are often used to prevent property loss due to erosion. This bulkhead (above) is newly installed while the other (right) is older and failing. The land behind it is slumping from waves scouring the sediment away from the bottom of the wall.

Living Alternatives

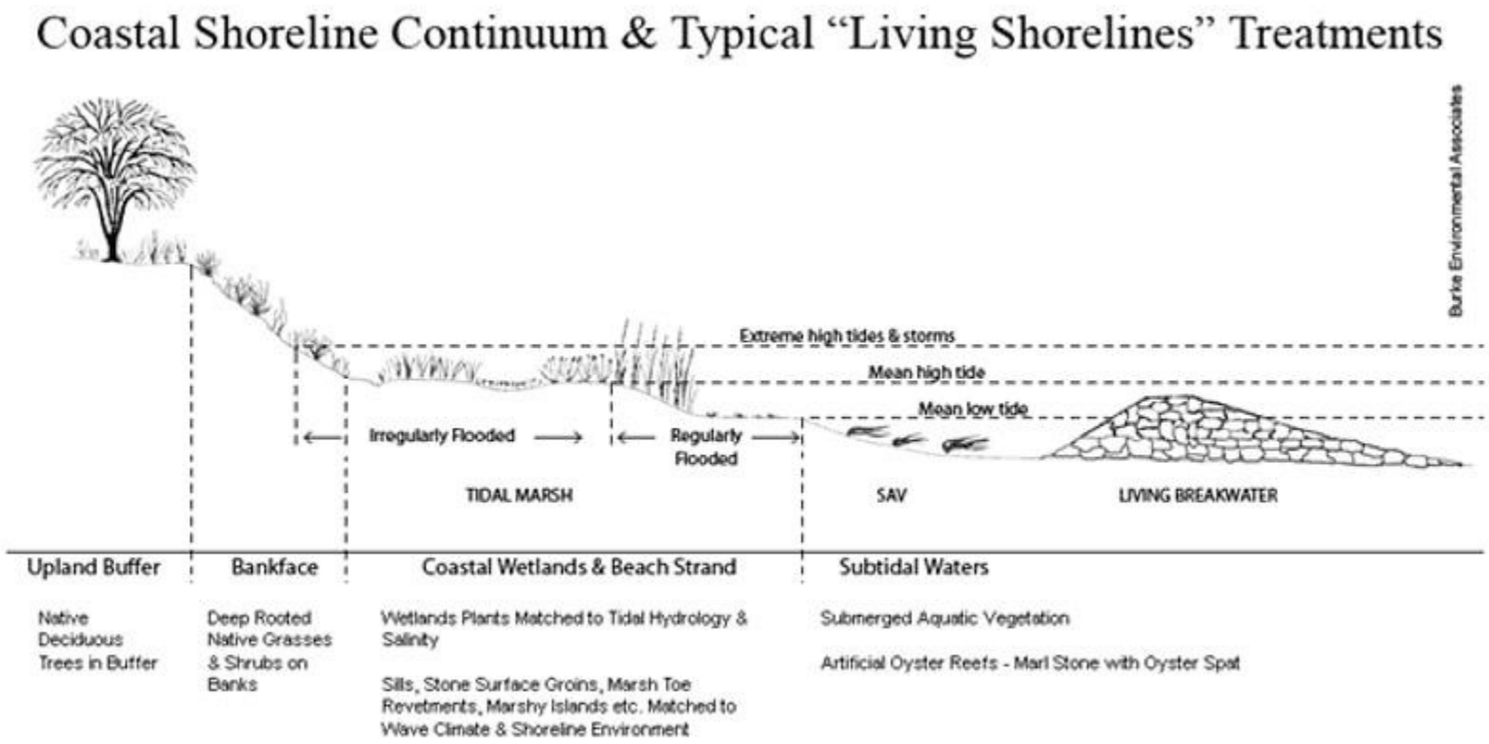


Image Credit: National Oceanic and Atmospheric Administration

Living Shorelines

IS "ARMORING" YOUR SHORELINE ALONG TIDAL CREEKS REALLY NECESSARY?

CCRM/Virginia Institute of Marine Science

A contrast in shorelines: The living shoreline on the left provides many water quality and wildlife benefits while blending in with the natural environment. The shoreline on the right is completely covered in stone and has no vegetation behind it to prevent erosion.

Many waterfront property owners who live on protected creeks and rivers see their neighbors' wooden bulkheads and rock walls and think that they are the only solution to erosion concerns. However, where there is low-to-moderate wave energy and minimal erosion, it is usually not necessary to install these hard structures. Not only are they more costly, but they can destroy shallow water habitats when wave energy is reflected back.

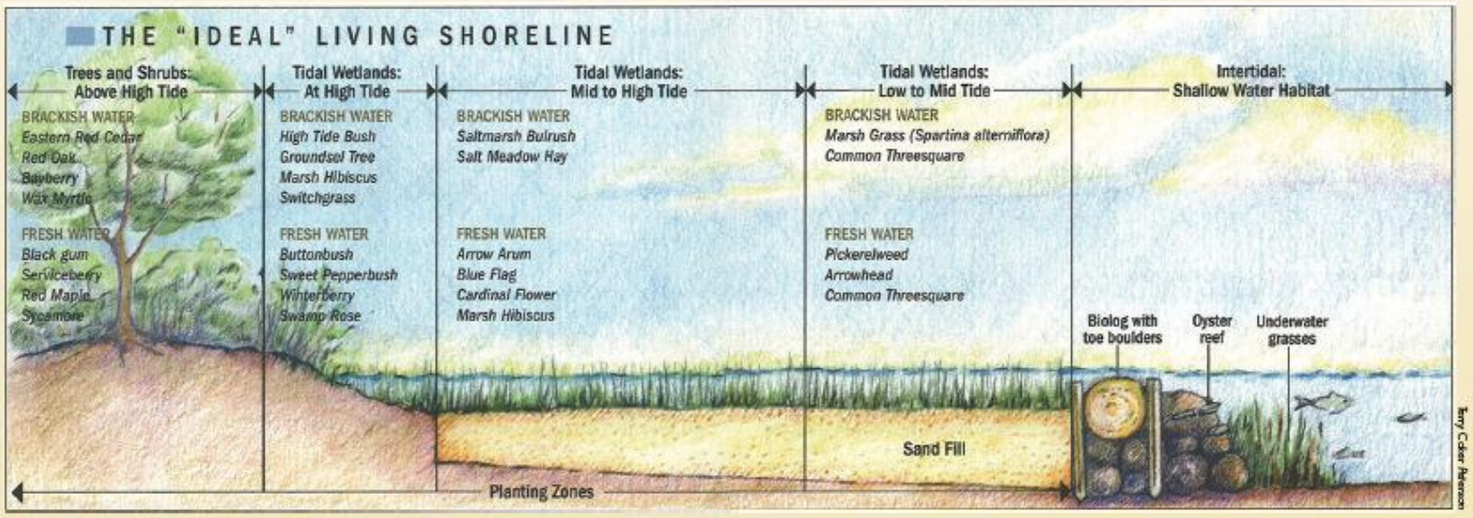
THE "IDEAL" LIVING SHORELINE

The "ideal" living shoreline in many tidal areas in the Bay watershed contains a succession of natural filters that normally would be found in undisturbed ecosystems. These filters include:

- riparian buffers above the tide line, made up of native trees and shrubs, including a mix of shrubs at high tide elevation;
- tidal wetlands, including grasses, rushes, and sedges at mid-tide elevation, and marsh grasses and common threesquare at low tide;
- oysters and an oyster reef—where appropriate; and
- underwater grasses in shallow water.

SELECTING NATIVE PLANTS

Native trees, shrubs, and grasses have expansive roots that hold soil in place and slow erosion from water and overland runoff. They add critical wildlife habitat and diversity, as well as beauty and value, to your property. Plant selection will depend on your site conditions.



Acknowledgements: Text and images provided courtesy of the Chesapeake Bay Foundation, visit: www.cbf.org/livingshorelines.
RainScaping Campaign sponsors—Chesapeake Bay Small Watershed Grants Program, and RainScaping Campaign Partners.
For beautiful solutions to water pollution, visit: www.RainScaping.org.

Oyster Reef Breakwater

Bagged Oyster Shell

Photo credit: Press-Register, Bill Starling

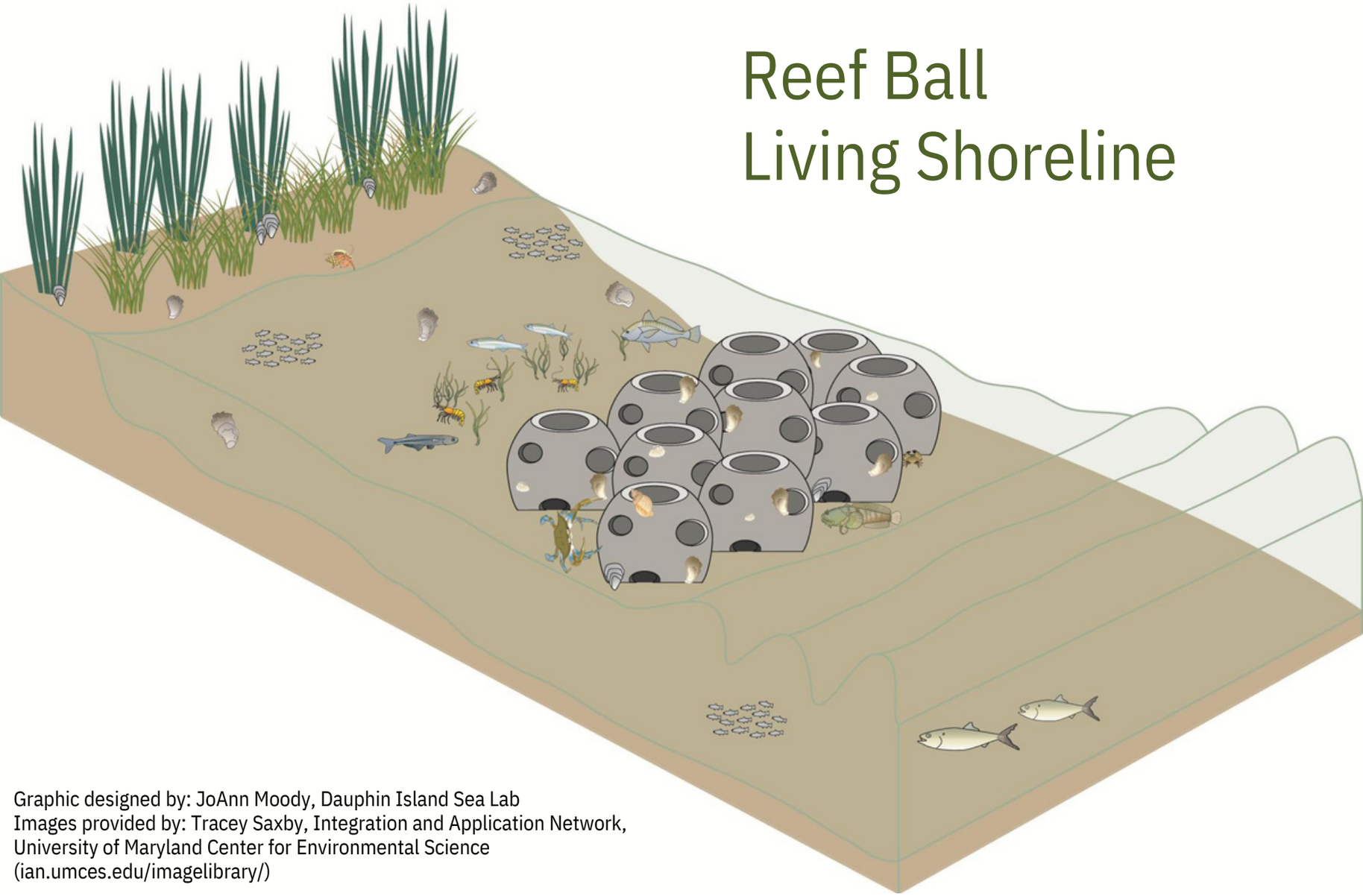
Bagged Oyster Shell Living Shoreline

Graphic designed by: JoAnn Moody, Dauphin Island Sea Lab
Images provided by: Tracey Saxby, Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/)

Oyster Reef Breakwater

™ Reef Balls

Reef Ball
Living Shoreline



Graphic designed by: JoAnn Moody, Dauphin Island Sea Lab
Images provided by: Tracey Saxby, Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/)

Oyster Reef Breakwater

Reefblk℠ Cages

Photo Credit: The Nature Conservancy

ReefblkSM Living Shoreline

Graphic designed by: JoAnn Moody, Dauphin Island Sea Lab
Images provided by: Tracey Saxby, Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/)

Oyster Reef Breakwater

Cement Oyster Rings

Rock Sill and Marsh Plants

Photo credit: Mississippi Alabama Sea Grant

Biolog

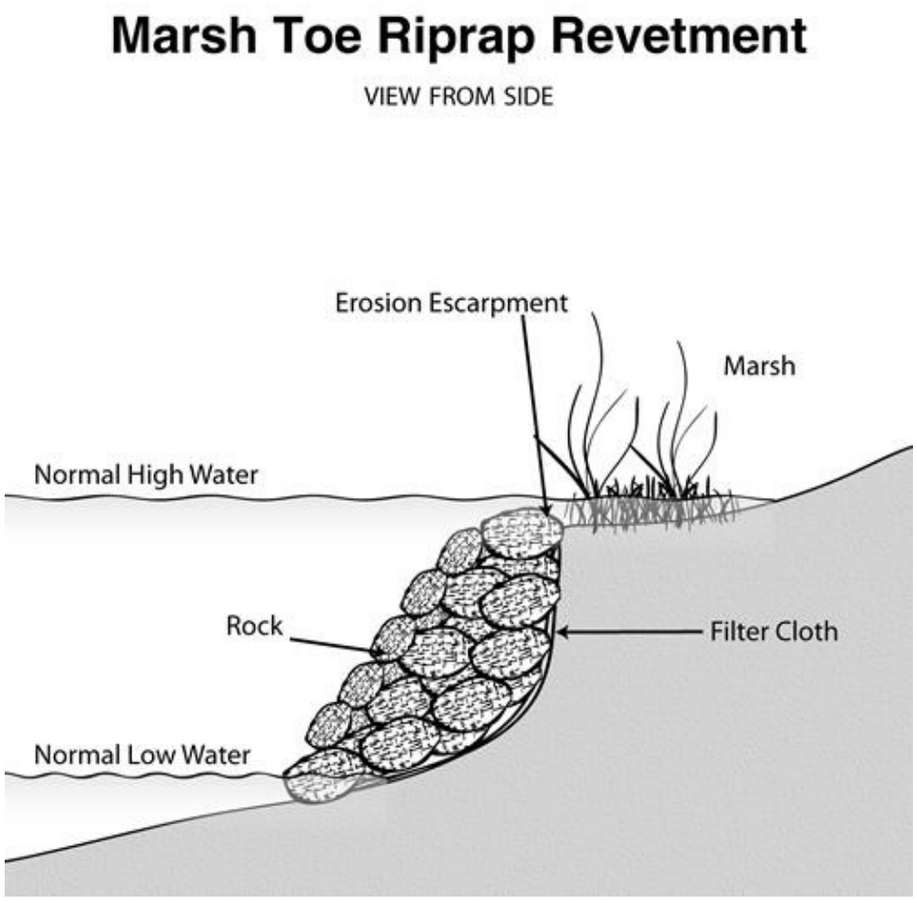
Sediments are trapped by a barrier called a "biolog," which allows marsh grasses to grow.

Credit: Haskin Shellfish Research Laboratory, Rutgers University

Biolog with Native Grasses

Photo credit: Gulf of Mexico Alliance

Rock alternatives



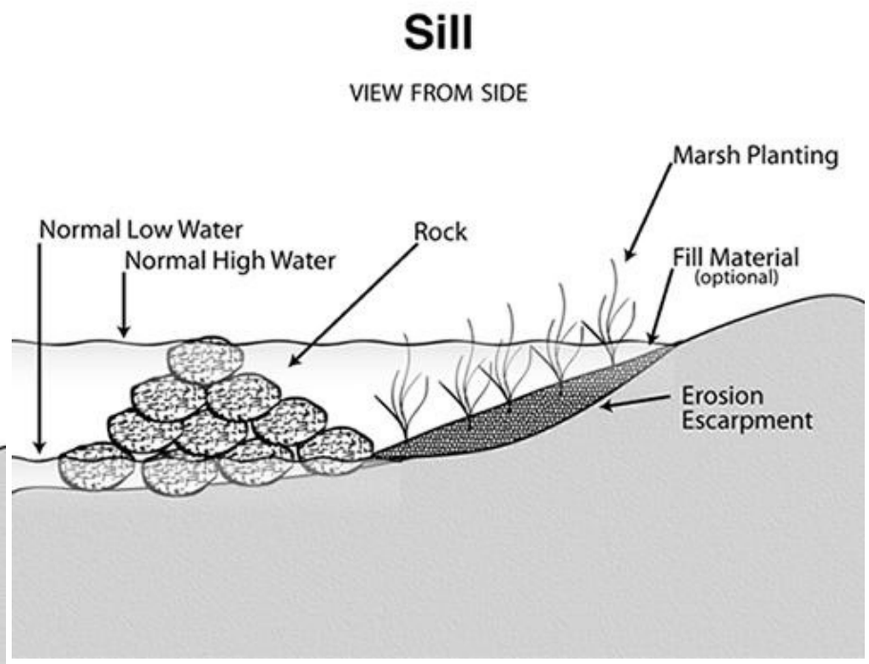


Image credit: North Carolina Division of Coastal Management

Resources

Dauphin Island Sea Lab -
www.disl.edu

Dauphin Island Sea Lab-Discovery Hall Programs
www.disl.edu/dhp

Reef Ball Foundation
www.reefball.org

National Oceanic and Atmospheric Administration (NOAA) - Restoration Center
www.habitat.noaa.gov/restoration/techniques/livingshorelines.html

NOAA - Office of Ocean and Coastal Resource Management
coastalmanagement.noaa.gov/shoreline.html

The Nature Conservancy
www.nature.org

Integration & Application Network – Image Library
http://ian.umces.edu/imagelibrary/

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Steel Reefblk^{SM} cages

Reefblk^{SM} cage

Reef Ball^{TM} concrete domes

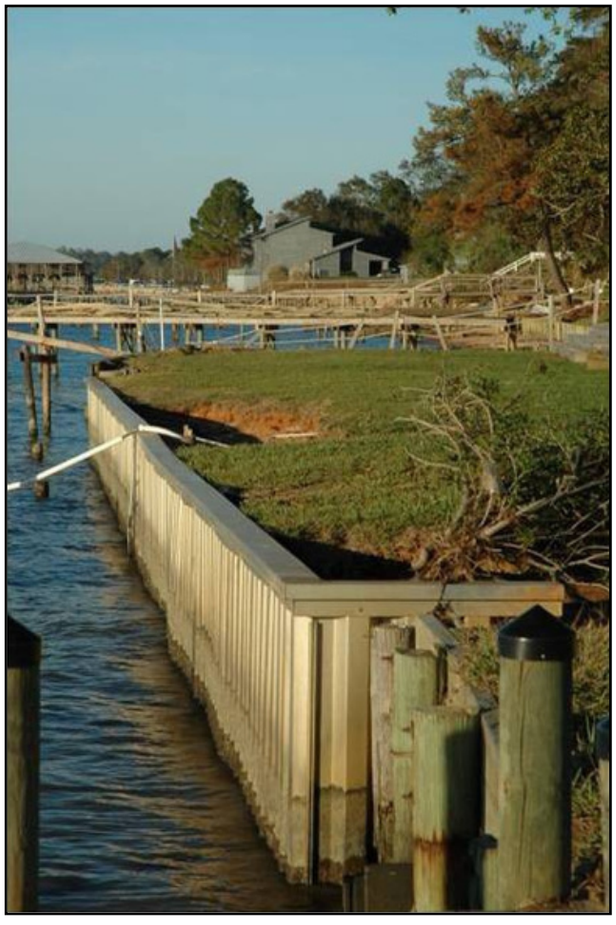
Reef Ball^{TM}

Mesh bagged oyster shell

Mesh bagged oyster shell

Eroded shoreline along Coffee Island, Alabama

Newly installed bulkhead



Failing bulkhead