Restore an Island

GRADE LEVEL: 1-6

TIME: 1-1.5 hrs

SUMMARY

In this lesson, students will learn about the Poplar Island Ecosystem and Restoration Project and "restore" an island of their own using natural materials.

OBJECTIVES

- Students will learn how the Port of Baltimore is beneficially reusing dredged material for island restoration.
- Students will learn how water erosion affects the shape of the land.
- Students will learn how different materials affect the rate of water erosion .

VOCABULARY

- **Acre -** A unit of land area equal to 4,840 square yards (0.405 hectare). For a point of reference, one football field is 1.32 acers.

- **Chesapeake Bay** - A large body of brackish water located in Maryland and Virginia. The Chesapeake Bay is an estuary, or connection between the Atlantic Ocean and upstream rivers. It is one of the largest estuaries in the world, and provides habitat to thousands of different species.

- **Container Ship** - A ship specially designed or equipped for carrying containerized cargo.

- **Dredging** - The process of removing sediment from shipping channels.

- **Dredged Material** - The sediment removed from the shipping channels.

- **Dredged Material Containment Facility -** A placement site for sediment removed from shipping channels. DMCFs are planned, constructed, and monitored by government agencies.

- **Erosion** - The process of sediment being removed by wind, water, or other natural agents.

- **Habitat** - The natural home or environment of an animal, plant, or other organism.

- **Geotextile Fabric -** A strong synthetic fabric usually used in civil engineering construction projects (such as highway or dam building) that stabilizes loose soil and prevents erosion.

- **Habitat -** The natural home or environment of an animal, plant, or other organism, which provides food, water, shelter, and space.

- **Habitat Loss** - When a natural habitat, such as a forest or wetland, is altered so dramatically that it no longer supports the species it originally sustained. Plant and animal populations are destroyed or displaced, leading to a loss of biodiversity.

- **Island** - A piece of land surrounded by water.

- **Restoration** - The act or the process of returning something to its original condition.

- **Sedimentation** - The process by which sediment, or loose particles of sand, silt, and clay, sink to the bottom of a body of water, such as the Chesapeake Bay or Patapsco River.

- **Shipping Channels** - Areas in the water that are maintained to a depth that can accommodate cargo ships. They are marked by buoys and identified on nautical charts (so captains know where to travel).

- **Uplands -** An area of high or hilly land.

- **Wetland -** Ecosystems containing water, specialized soils, and plants adapted to living in water-saturated soils. Marshes, swamps, and bogs are types of wetlands.

MATERIALS

- Flat tray
- Sand
- Rocks
- Wooden Sticks
- Fabric
- Water
- Cup or spray bottles
- Spoons or small trowels

BACKGROUND

The Port of Baltimore brings financial prosperity to the state of Maryland and provides many jobs for residents. In order to keep the Port open for business, shipping channels must be kept deep enough so large ships that typically travel in the ocean can safely reach Baltimore. Placement sites are used to contain the sediment dredged from these channels and are sometimes beneficially used to restore and support habitat. An example is the Poplar Island Ecosystem Restoration Project which uses the sediment to restore remote island habitat within the Chesapeake Bay. This habitat attracts a wide array of animals which benefit from the protection provided by the island's remote location away from mainland predators.

ACTIVITY

1. **Lesson Prep (15-20 mins):**

Materials* for this lesson include:

- **A tray.** To build the island on. Plastic lunch trays are preferred, but other trays will work as well. Just remember that the tray will be used to put various natural materials on like sand, sticks, and rocks so anything that will be used to cook or hold food is not recommended. Make sure to build the island in an area that can get sandy and wet. Doing the activity in an outside area is recommended.

- **Sand.** To represent the dredged material the students will use to restore their island. Play sand can be easily found at craft and hardware stores. If sand is not available, other materials like topsoil or dirt from the backyard can be used. Just remember to do no harm to the environment if you take any materials from nature.

- **Building materials.** Such as rocks, sticks, and fabric. This represents some of the building materials used by construction workers at the sites. Rocks represent armor stone that is used on the perimeter of the island to prevent erosion. Sticks and Fabric represent other materials that are used as well.   .

- **A cup filled with water.** This will be used to pour on the finished island to see how well it withstands erosion. Other things can be used as well, like a spray bottle filled with water, or a fan to represent wind erosion. Try and test out different items to see how that affects the rate of erosion.

* Materials are provided if educators come to your site, but feel free to add additional recycled materials.

2. **Engage/Elicit (10-15 mins):**
    The Port of Baltimore Environmental Education Team has felt board and corkboard lessons that they can bring to your students to introduce the information explained below.

Start the lesson explaining the history of Poplar Island, an island in the mid-Chesapeake Bay, not far from Tilghman Island in Talbot County. The first land survey of Poplar Island was completed in 1847. Ask the students if they know what a land survey is. A land survey is when the area of the land is measured to see how big it is. They measured the area of Poplar Island and found that it was about 1,140 acres in size. Ask the students what an acre is commonly compared to the size of? One acre is about the size of a football field, so Poplar Island was over 1,000 football fields large. Ask the students if they think that's a pretty good-sized island?

Some people back then thought it was a good size and decided to live on Poplar, but the island needed some work. They needed to clear the land to build their homes and other buildings. Ask the students what was used on the island to help build the people's homes? They used wood from trees to make lumber to build buildings on the island. They also needed to get food. What were some ways they could make their own food on the island? They could hunt, or they could grow their own food by growing crops or raising livestock. However, at that time, the island was covered in tall grasses. Ask the students what they think had to be done to prepare the land for growing their food? They had to remove all the grasses to prepare the land for their livestock and crops. Ask the students what they think happened to the native animals that lived on Poplar without all the trees and grasses? They lost their habitat, or homes. Some of the animals were not able to survive and others simply moved away by swimming or flying.

During the late 1800s early 1900s the island was home to a town called Valliant which housed about 100 individuals, eleven farms, a general store,

schoolhouse/church, post office and a sawmill. However, during this time something else was happening to the island. Ask the students what happens when a plant is removed from the ground. The plant brings up roots and the roots bring up dirt. The roots of the plant help hold soil together and help prevent land from falling apart. Ask the students what they think happened to the island when the root system was taken away and forces like wind, waves, and rain happened. The land washed away. Ask the students if they know what the word is called when forces cause the land to wash away. Erosion is the gradual wearing of rock and soil caused by factors such as water, wind, or ice. Without the root system to help hold the island together, the island started to erode at a rapid rate. Erosion is a natural process and in a healthy ecosystem erosion is balanced by other processes. However, since the island root system that held captured sediments had been removed, the island started to erode at a rapid rate.

By the early 1900's the island was said to be eroding away at about 15 feet per year, and by the 1920's all the residents of Valliant had to move off the island. The island continued to erode as the years went on and Poplar went through many owners. That was, until 1993 when the U.S. Army Corps of Engineers (USACE) conducted another land survey. They found that the island had shrunk to less than 5 acres and had split into four tiny islands that they called remnant islands. Ask the students how much land was lost, from 1,140 acres in 1847 to 5 in 1993? The island lost over 1,135 acres, that is over 99% of its landmass!

It was estimated that by the year 2000 the island would erode completely. However, if you look at a map of Poplar Island today you can see that it is much larger than 5 acres. How could it be that four small islands became one large island? The answer to the erosion issues that impacted Poplar Island came from the Maryland Department of Transportation Maryland Port Administration (MDOT MPA) and the USACE, who are responsible for maintaining the shipping channels within the Chesapeake Bay leading to the Port of Baltimore. Each year about 5 million cubic yards of dredged material needs to be removed from the shipping channels to maintain the depth needed for cargo ships to pass through effectively. That's enough sediment to fill the M&T bank stadium in Baltimore! Ask the students what a restored island in the middle of the Chesapeake Bay has to do with maintaining shipping channels. All of that sediment that is dredged up needs a place to go. The solution, which has been called a win-win, is to use the dredged material to restore a historic island in the Chesapeake Bay and to provide needed habitat for native animals.

2. **Explore (30-45 mins):**
   The students' challenge for this lesson is to use the materials provided to restore their own island that will withstand the forces of erosion. The goal is to use every day natural items that replicate the materials used at the Dredged Material Containment Facilities and Restoration Sites, like Poplar Island. Once the island is built the students will put it to the test of various erosion forces to see if it withstands or erodes.

   I.   (Optional) Engineers with the USACE and the MDOT MPA will create a design plan of their design and share it with their peers to review. Have the students plan out their island before they begin building their island . The students can make a list of supplies to be used and make a drawing or sketch of what their island will look like.

   II. Have the students gather supplies they will use to build their islands. If in a classroom setting and the students are in groups, it might be easier to give students the same amount of each supply to start out with and have them request more if needed.

   III. Students will have a set amount of time to use the supplies and build their island. Let the students build their island without much guidance from the teachers or adult chaperones to allow students to build problem solving skills but be available to keep the students on track and help as needed.

   IV. Allow the students more or less time depending on their interest level. If time allows, students can clean up their area and put back any unused supplies. This will help prevent the students from continuing to build their island past the building time and prevent any distractions when testing out the island stability.

3. If they're strong enough, have the students bring their tray with their restored island up one at a time for testing. If the island is too heavy for the students to move, the tests can be done where each group is located. Have the students talk about their completed island, for example if it has a name or some of the thought process when building. Then use the cup of water and pour it on the island to see if it withstands water erosion. Once the island has been hit with

erosion discuss if the island was successful at preventing erosion.

3. **Explain (5-10 mins):**

After all students have tested their designs and materials have been cleaned up, gather students for a wrap-up discussion. Ask the students what did or did not help prevent erosion on the island. Ask questions such as: Was it easy to build? Harder than they thought? What made it easy/hard? Would they do anything differently?

Explain how the rocks, wood, or fabric were placed would influence the rate of erosion. However, the more materials used, the more expensive the project gets. Engineers and contractors work very hard to make projects like Poplar Island as efficient and cost effective as possible.

Evaluate/Wrap-Up (5-10 mins):
Poplar Island was built to make sure erosion doesn't happen like it did in the past. The perimeter of the island is built out of a special material called armor stone. It is very similar to riprap, the 50-to-100-pound stones that are commonly used to strengthen shorelines. However, armor stone is much larger than riprap. Each stone weighs between 200 and 4,000 pounds and is specifically cut for island protection. The tides, water depth, and wind direction determine exactly where and how the armor stone is placed. Larger rocks are put in areas that have more potential

to be affected by erosion. The armor stone perimeter is also built with layers of smaller stones, geotextile fabric and sand to make sure it is as strong as possible. The island is then filled with dredged material. In addition to habitat, the island has roads made of sand so thatpeople who work there can move around the site.

DIVE DEEPER

Ask the students what was missing from the islands they made. The islands didn't have plants on them, so they didn't have the root system to hold the land together. After the island is filled with material then two types of habitats are created, wetlands and uplands. Ask the students what will naturally come back once these habitats are planted. The animals will come back to the restored habitat. Ask the students what plants and animals they think could be found in Poplar Island's wetland and upland habitats. Educators can provide a species list for common plants and animals found on the island.

Have the students look at the Greenport Resources and Publications page: https://mpa.maryland.gov/greenport/Pages/publications.aspx to research and learn about different ways the Port of Baltimore is using dredged material for restoration. You can watch the video "Sediment to Solutions: Channeling Innovation for Beneficial Reuses" https://vimeo.com/396790121. Also look at other programs offered by the Port of Baltimore Environmental Education Team to learn more about habitat restoration that is made possible thanks to the beneficial use of dredged material.

NGSS ALIGNMENT

Dredging and Habitat Restoration: Restore an Island				
Grade	Performance Expectations	Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
K-2	1-LS1-1*** 2-LS4-1** 2-ESS2-1*** 2-PS1-2*** K-2-ETS1-1*** K-2-ETS1-2*** K-2-ETS1-3***	LS1.A PS1.A LS1.D PS2.A LS4.D PS2.B ESS2.A PS3.C ESS2.E ETS1.A ESS3.A ETS1.B ESS3.C ETS1.C	Cause and Effect Scale, Proportion, and Quantity Systems and System Models Energy and Matter Structure and Function Stability and Change	Asking Questions and Defining Problems Developing and Using Models Planning and Carrying out Investigations Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Engaging in an Argument from Evidence Obtaining, Evaluating, and Communicating Information
3-5	3-LS4-3** 5-ESS2-1** 3-LS4-4*** 5-ESS3-1*** 3-ESS3-1*** 3-5-ETS1-1*** 4-ESS2-1*** 3-5-ETS1-2*** 4-ESS3-2*** 3-5-ETS1-3***	LS1.A ESS3.C LS2.C PS2.A LS4.C PS2.B LS4.D PS3.C ESS2.A ETS1.A ESS2.B ETS1.B ESS2.E ETS1.C	Cause and Effect Scale, Proportion, and Quantity Systems and System Model Stability and Change	
MS	MS-LS2-1*** MS-LS2-4*** MS-LS2-5*** MS-ETS1-1*** MS-ETS1-2*** MS-ETS1-3*** MS-ETS1-4***	LS2.A ESS3.C LS2.C PS3.C LS4.D ETS1.A ESS3.A ETS1.B ETS1.C	Cause and Effect Systems and System Models Stability and Change	