PORT OF BALTIMORE

ENVIRONMENTAL EDUCATION

Environmental Stewardship at Maryland's Dredged Material Placement Sites

Sponsored by the Maryland Department of Transportation Maryland Port Administration

Presented by Maryland Environmental Service

Acknowledgments

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View this publication online https://mpa.maryland.gov/greenport/Documents/teachers_guide.pdf

Dear Educator,

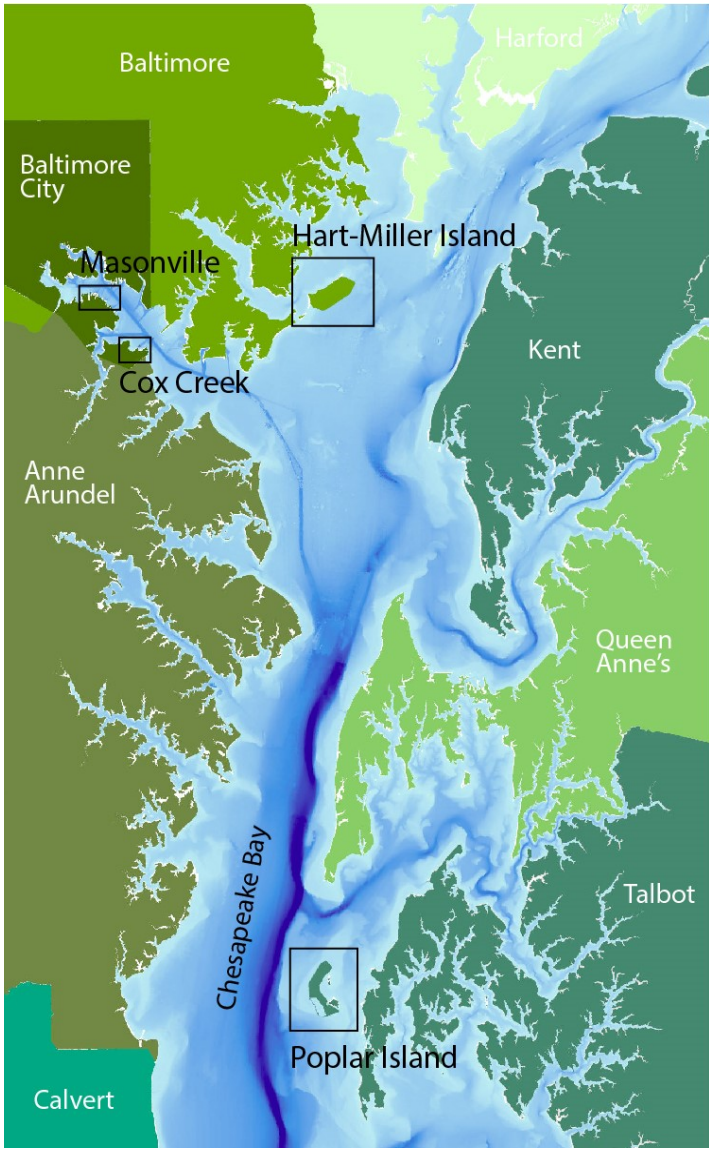
Thank you for using "Port of Baltimore Environmental Education" as a resource in your classroom! This Teachers' Guide includes the on-site activities your students will be completing on their field trip to Hart-Miller Island, Cox Creek, Masonville or Poplar Island. Maryland Environmental Service staff will be on-site to direct these activities. Other included lesson plans will help you prepare students for their trip and to review and reinforce concepts after visiting one of our sites. We hope that these activities provide a valuable learning experience for your students.

Both maritime commerce and the ecology of the Chesapeake Bay are vitally important to Maryland. Each year, more than 2,000 cargo vessels and cruise ships call on the Port of Baltimore, moving over 10 million tons of cargo and generating more than $2 billion in revenue. As they travel, these ships pass through the Chesapeake Bay, Maryland's natural treasure and the nation's largest estuary.

As a result, the Maryland Department of Transportation Maryland Port Administration has dual responsibilities. One is to ensure that vessels traveling to and from Baltimore have safe and navigable channels. The second is to support regional goals for clean water and healthy wildlife habitat in the Chesapeake Bay.

The Maryland Port Administration is committed to beneficially reusing material dredged from shipping channels and doing required mitigation projects. This has created unique opportunities to showcase how the commercial industry can help restore valuable habitat in the Bay. We offer free educational field experiences at Maryland's Dredged Material Containment Facilities and restoration sites:

- Hart-Miller Island
- Swan Creek Wetland at Cox Creek
- Masonville
- Poplar Island



Each lesson plan contains:

- Summary
- Appropriate grade levels
- Time required
- Objectives
- Materials needed
- Activity procedure
- Extensions/related activities
- Background information
- Vocabulary
- Other student copy sheets

Most Background Information readings are written for an upper middle school audience. You may either print this to distribute to your students or review the information through a class discussion.

Our Dredged Material Placement Sites are active construction sites and therefore, strict safety protocol must be followed while touring these locations. We welcome visitors of all ages to tour Hart-Miller Island, Cox Creek, Masonville, and Poplar Island. However, due to safety restrictions, students below 3rd grade may not participate in hands-on activities while on-site. Accordingly, most lessons and activities included in this Guide are best suited for students in grades Pre-K through 12. Extensions for younger and older students are included when applicable.

We welcome your feedback and encourage you to share your experiences with us so that we may improve our program. Enclosed at the end of this Teachers' Guide is a Participant Survey. Thank you for your participation!

We look forward to seeing you on-site! We hope the enclosed lessons are a valuable resource for your students' learning experience.

This curriculum was compiled by the following staff at Maryland Environmental Service:
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Last updated July 2020

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An Introduction to the Port of Baltimore and Dredging

Maritime commerce and the ecology of the Chesapeake Bay are vitally important to Maryland. Each year, more than 2,000 cargo vessels and cruise ships call on the Port of Baltimore, moving over 10 million tons of cargo and generating more than $2 billion in revenue. As they travel, these ships pass through the Chesapeake Bay, Maryland's natural treasure and the nation's largest estuary. Many of the water routes these ships travel require frequent dredging to maintain the 50-foot depth needed by many of today's ships.

As a result, the Maryland Department of Transportation Maryland Port Administration (MDOT MPA) has dual responsibilities. One is to ensure that vessels traveling to and from Baltimore have safe and navigable channels. The second is to support regional goals for clean water and healthy wildlife habitat in the Chesapeake Bay.

On average, 4.7 million cubic yards of sediment is removed from shipping channels in the Chesapeake Bay and Baltimore Harbor every year. MDOT MPA is committed to beneficially reusing material dredged from shipping channels and the mitigation projects associated with dredged material placement. This has created unique opportunities to showcase how the commercial industry can help restore valuable habitat in the Bay.

Sediment Quality

Sediments (mostly fine silts, clay, and some sand) accumulate and deposit in the shipping channels. The geologic formations in the region, as well as human activities, affect the character of the sediment in different locations. Sediment dredged from the navigation channels is tested and managed safely in accordance with state and federal requirements.

Placement and Use of Dredged Material

Dredged material is generally placed in a carefully engineered area enclosed by a dike, called a placement site. Over time, the sediment dries and can be used to restore eroded wetlands, create upland wildlife habitat, and build new terminal space for the Port. MDOT MPA is working with stakeholders to demonstrate that dredged material can be innovatively reused to provide landfill cover, cap brownfields, and produce engineered fill. The MDOT MPA conducts a planning process to ensure that Maryland always has 20 years of dredged material placement capacity available.

Advisory committees, along with state and local agencies participate in the dredged material management program and ensure that communities and stakeholders have information and access to the decision-making process. The

MDOT MPA and the Baltimore District Corps of Engineers are studying the feasibility of widening channels in the Chesapeake Bay to maintain the Port's economic competitiveness.

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For more information, visit www.marylandports.com/greenport.

Fun with Felt Boards: The Story of Poplar Island

GRADE LEVEL: K - 3

TIME: 30 MIN

SUMMARY

In this lesson, students will learn about the need for dredging for the Port of Baltimore as well as how dredged material is placed at Poplar Island.

OBJECTIVES

1. Describe why the Port of Baltimore (PoB) shipping channels need to be dredged.
2. Explain what is being constructed at the site they will visit.
3. Name one benefit to the environment provided by the site.
4. Identify how human activity changes an island landscape.

VOCABULARY

- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **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.
- **Clamshell Bucket** - A type of scooping bucket used in dredging. Clamshell buckets have two sides which open and close with a hinge (like a clam); and are used to scoop up sediment.
- **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.
- **Draft** - The vertical distance between the water surface and the bottom of the ship.
- **Erosion** - The process of sediment being removed by wind, water, or other natural agents.
- **Export** - Send (goods or services) to another country for sale.
- **Habitat** - The natural home or environment of an animal, plant, or other organism.
- **Import** - Bring (goods or services) into a country from another country for sale.
- **Island** - A piece of land surrounded by water
- **Ocean** - A very large expanse of sea, in particular each of the main areas into which the sea is divided geographically.
- **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).
- **Watershed** - An area or ridge of land that separates waters flowing to different rivers, basins, or seas.

MATERIALS

- Felt board for dredging
- Felt board for Poplar Island
- Free nature images and graphics can be found on https://ian.umces.edu/

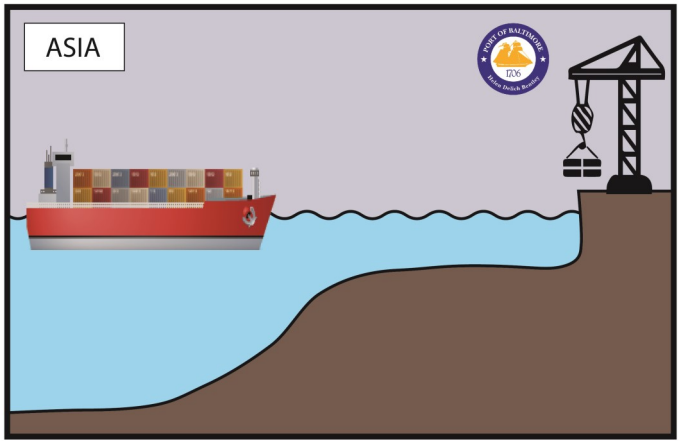
BACKGROUND

The Port of Baltimore is important to the state of Maryland because it brings financial prosperity to the state and provides many jobs for Maryland residents. In order to keep the Port open for business, shipping channels must be kept deep enough to maintain safe passage for large cargo ships with 50-foot drafts. Maintenance dredging is performed every year and the sediment dredged is put into placement sites and is often used to support and construct habitat restoration projects. A wide variety of animals are found in the restored Chesapeake Bay habitat that is found at dredged material placement sites like Poplar Island.

ACTIVITY
Part One - Port of Baltimore Felt Board

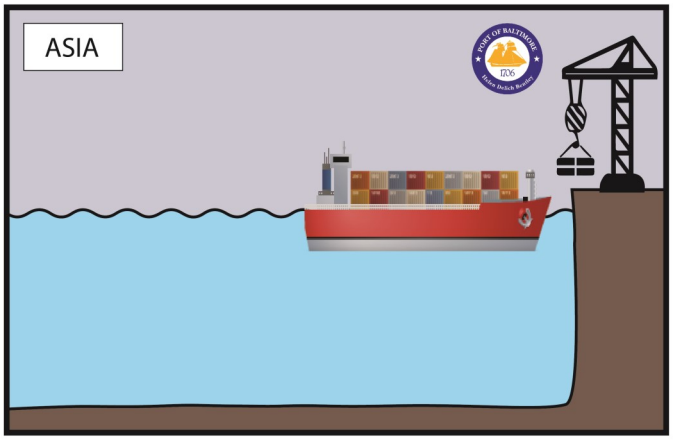
1. **Engage/Elicit (2-3 mins):**
   Explain to students that this lesson is going to be told in two separate but related stories. Begin the first story by asking students if they have ever been to the Port of Baltimore (POB) and seen any large ships docked there. Ask them if they have ever wondered what was on the ship or where it came from. Ask them if they ever wondered why the ships are in Baltimore. Today they will learn about the journey that the ships take, and the journey that cargo takes after it leaves the ship. Tell students they will also learn about the fact that these ships coming to Baltimore helps wildlife in the Chesapeake Bay.

2. **Explore (2-3 mins):**
   Hold up the dredging felt board, lean it, or have a volunteer hold it for you. Tell students that today is an exciting day! They all have their driver's license and they get to buy this awesome green car (refer to the laminated green car picture in the felt board kit)! Ask where the car might be made. Explain that in this example, our car was made in a place on the continent of Asia. Place the car picture on the shore of Asia. Point out to students that they live in Maryland and point to it on the board. Something separates you from your car. (Answer: The Pacific Ocean). How do you get your car across the Pacific Ocean? Explain that airplanes are an expensive way to ship things, guide students to cargo ship. Place the ship on the board and the car on the ship. "Sail" the ship across the Pacific Ocean, mentioning that it will go through the Panama Canal to get to the Atlantic Ocean and then the Chesapeake Bay.



3. **Explain (2-3 mins):**
   As the ship approaches the Port of Baltimore, ask the students what will be the problem as the large cargo ships approach the Chesapeake Bay (Answer: The bay is only 21 feet deep on average and the cargo ships need 50 feet of water to safely travel. The water is too shallow, and the ship will run aground and get stuck.) Ask students what could be done to allow the ship to get into the POB. Guide them to the answer of digging up the extra sediment. Define that process as dredging. Have a student come up and remove the dredged material felt pieces from the board and hold onto it. "Sail" the cargo ship into the POB and unload the car. Tell the students they can now head to a dealership and pick up their new car!

4. **Evaluate/Wrap-Up (2-3 mins):**
   Why is the Bay so much more shallow than the ocean? Explain sedimentation: when it rains, loose soil washes down through the watershed and into the Chesapeake Bay. Its average depth is 15-21 ft; cargo ships need 50 ft of water to accommodate

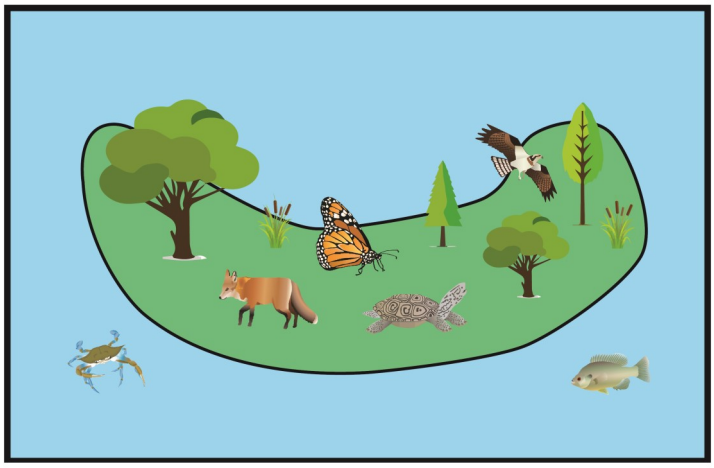


   their deep drafts. What if we didn't dredge shipping channels in the Bay? Cargo ships couldn't enter the POB. Goods would not be delivered. Thousands of people would lose their jobs. Millions of dollars would be lost for the state of MD.

   Tell the student holding the "dredged material" felt pieces to hold on a few more minutes because they are going to have an important role in our next story.

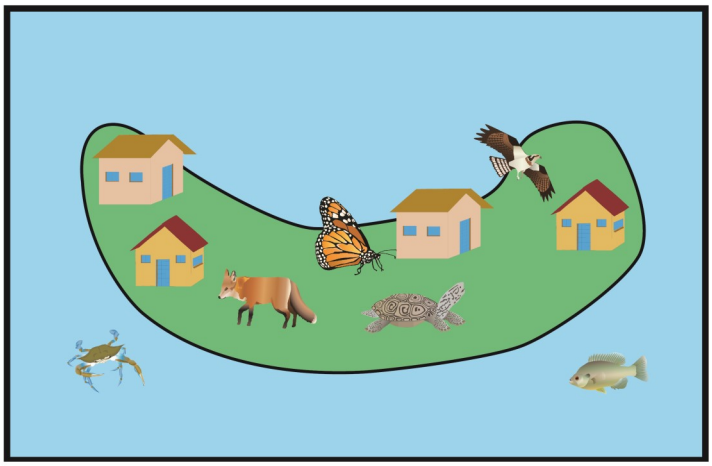
Part Two - Poplar Island Felt Board

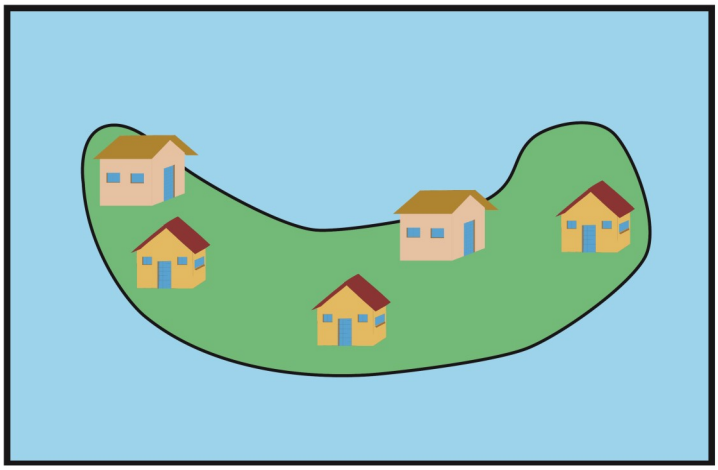
1. **Engage/Elicit (2-3 mins):**
   Display the second felt board. Explain that in the 1800s this is what Poplar Island looked like. Many plants and animals called this area their home because it was excellent habitat (it had the necessary food, water, shelter, and space). There used to be 1100 acres of land on Poplar Island!

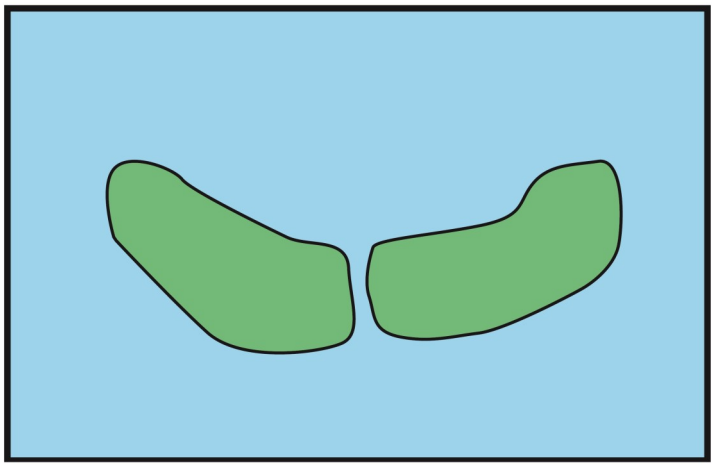


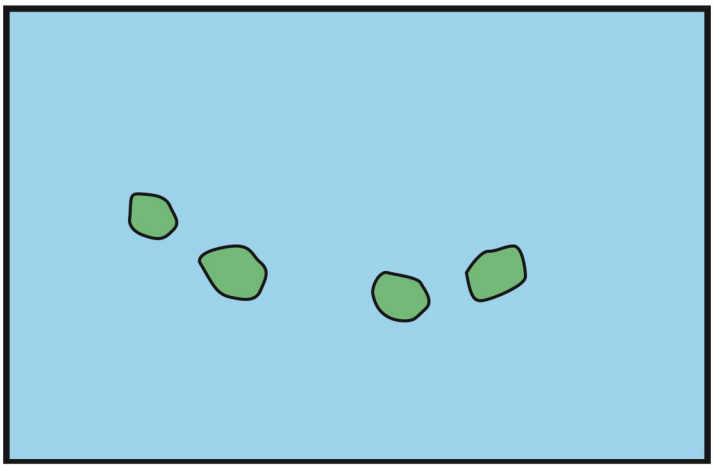
2. **Explore (2-3 mins):**
   Explain that in the 1800s, people decided that Poplar Island would be a great place to build a town. They decided to name the town Valliant. People cut down trees to use as building supplies and cleared land for building homes and growing food. Have students remove the trees and wetland grasses. What did that do to the animals? (Answer: lost habitat, animals had to leave or die.) Have students remove the animals on the board, symbolizing that they either leave or die. When the trees were removed, the roots that hold soil in place were also removed. What happens when wind and waves hit all this loose soil? (Answer: erosion, a natural process that can be sped up by removing vegetation.) The island began to erode.

   Explain how as erosion continued, the island got smaller (instructor can take away the largest piece of Poplar Island felt land), and smaller (take away the two medium-sized pieces felt land), like when you build a sand castle too close to the water and one wave at a time it gets washed away. By the year 1993 Poplar Island had washed away to be only 5 acres! (Have older students do this "quick math" in their heads: "How many acres were lost if we started with 1,140 and were left with 5?")



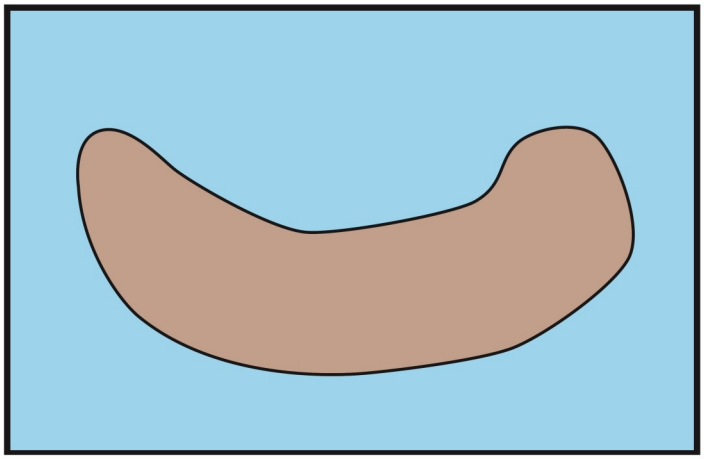


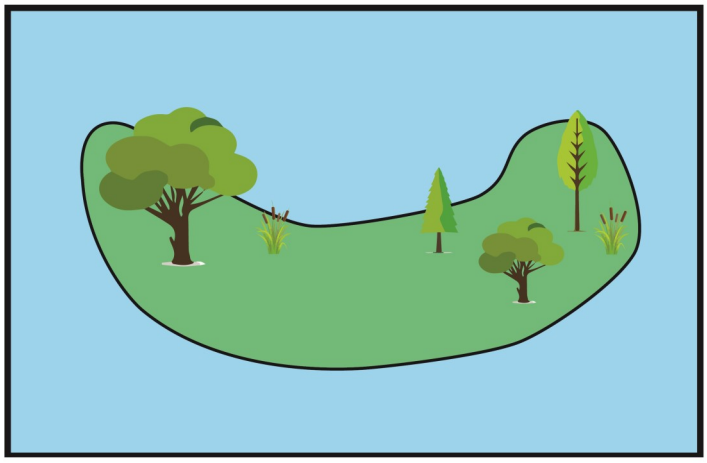


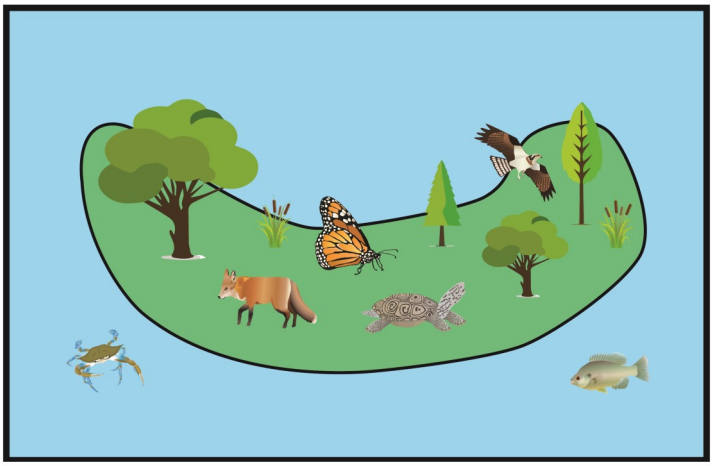


3. **Explain (2-3 mins):**
Does this look like good habitat for animals in this area? (Answer: no, there is not enough food, water, shelter, and space anymore). If we wanted to build Poplar Island to give the animals more space, what would we need? (Dirt). Where can we get a bunch of dirt that isn't being used for something else all ready? (Bottom of the Chesapeake Bay, dredged material).

Have the student holding the dredged material felt piece from the POB board place the dredged material over the remaining pieces of Poplar Island. Does this look like good habitat though? (No, needs vegetation). Place green Poplar Island felt piece back on top. Scientists planted native species of grasses and trees on the island. What will that attract? (Wildlife.) Have students place the animals back on the island. Scientists didn't bring any wildlife to the island. Anything the students see on the island swam, flew or floated there.



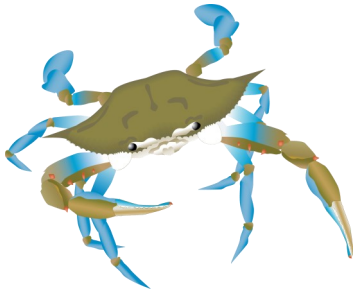




4. **Evaluate/Wrap-Up (2-3 mins):**
· Ask students to describe why the POB needs to be dredged.
· Explain what is being constructed at Poplar Island.
· Name one benefit to the environment the rebuilding of Poplar Island has provided.

DIVE DEEPER

Create your own "island" using sand. Pour water over it and observe what happens. Compare this to what happened to Poplar Island from the 1800s to 1993.



Parachute Party: "Find A Creature Who Can…"

GRADE LEVEL: Pre-k - 2

TIME: 35 MIN

SUMMARY

In this lesson, students will learn about plants and animals that have special adaptations to help them survive on Poplar Island.

OBJECTIVES

1. Participants will be able to name organisms that live on Poplar Island and their adaptations.

VOCABULARY

- **Adaptation** - A behavior or physical feature that enables an organism to survive in its habitat.
- **Amphibian** - A cold-blooded vertebrate animal which spends part of its life cycle in the water, and part on land. Amphibians have an aquatic gill-breathing larval stage followed (typically) by a terrestrial lung-breathing adult stage. Examples of amphibians include frogs, toads, newts, and salamanders.
- **Carnivore** - An animal who eats meat.
- **Habitat** - The natural home or environment of an animal, plant, or other organism, which provides food, water, shelter, and space.
- **Herbivore** - An animal who eats plants.
- **Crustacean** - An animal who has a shell (typically a marine animal). Examples of crustaceans include lobsters, crabs, and shrimp.
- **Insect** - A small animal that does not have bones, has many legs and typically has wings. Examples of insects include beetles, bees, and ants.
- **Mammal** - A warm-blooded vertebrate animal. Mammals have fur or hair, produce milk for their young, and (typically) give birth to live young (rather than laying eggs). Examples of mammals include dogs, fox, deer, and humans.
- **Nocturnal** - An animal who sleeps during the day and is active at night. Examples of nocturnal animals included owls, bats and mice.
- **Reptile** - A cold-blooded vertebrate animal. Reptiles have dry, scaly skin and typically lay soft-shelled eggs on land. Examples of reptiles include snakes, lizards, crocodiles, turtles, and tortoises.
- **Wetland** - Ecosystems containing water, specialized soils, and plants adapted to living in water-saturated soils. Marshes, swamps, and bogs are types of wetlands.

MATERIALS

- Poplar Island Parachute – Show the sun in the center surrounded by sky, then land (Poplar Island), then the water (Chesapeake Bay). The perimeter of the parachute will depict twelve animals found on Poplar Island (see picture for example).
- Nylon parachute
- Paint
- Several short pieces of rope

BACKGROUND

The Port of Baltimore is an important institution in the state of Maryland because it brings financial prosperity to the state and provides many jobs for Maryland residents. In order to keep the Port open for business, the Port of Baltimore must make sure that shipping channels are deep enough for large ships that typically travel in the ocean. Because the Port of Baltimore performs maintenance dredging each year (see general introduction) to keep the shipping channels deep enough, placements sites for the dredged material removed from shipping channels are constantly used to contain the sediment. The sediment is often used to restore and support habitat at the placement sites. The restored habitat at these placement sites has attracted a wide array of animals by providing thriving habitats. Animals that are attracted to these sites have special adaptations that allow them to live in the restored Chesapeake Bay habitat that is found at dredged material placement sites like Poplar Island.

ACTIVITY

1. **Engage/Elicit (5 min):**
   Spread the parachute onto the floor and have students stand in a large circle around it. To gain focus of the group, have students clasp their hands together and hold them in front of them as you model the motion. This can also be done throughout the lesson to help regain focus if needed. Ask students to quietly look at all of the pictures on the parachute and raise their hand if they recognize any of the animals painted on it.
2. **Explore (10 min):**
   Have everyone look at the parachute. Explain that this parachute represents a wetland on Poplar Island and that you are going to tell them the very interesting story of this special place. Use the following questions to frame the story of Poplar Island so students are involved in the storytelling.
   - In the center is the big yellow circle that makes the Earth warm, makes plants and trees grow, makes us wear special glasses when we go outside…what is it?
     a. The Sun.
   - Around the Sun is the bright blue sky with some birds flying around. What does the green circle represent?
     a. The grasses that grow in the wetland on Poplar Island.
     b. Marsh grasses, cattails, some flowers, bushes, etc.
   - What is a wetland?
     a. A type of habitat that has water and grasses. Wetland often have squishy ground, and they are great homes to different kinds of plants and animals. There are many wetlands on Poplar Island.
   - What does the other blue circle represent?
     a. The water around Poplar Island.
     b. **Action**: From a seated or kneeling position have the students make small, slow waves with the parachute to represent waves.

Tell the story of Poplar Island quickly covering the following points:

- Long ago Poplar Island was a very large island. Many plants, animals, and people lived on it.
- When people lived on the island, they used the trees build houses. They decided to make farms by taking plants out of the ground. Does anyone know what part of the plant grows in the ground? Roots. Well the roots on this island helped to keep dirt together to make the land. When the trees and plants were gone, waves and wind and storms started to wash the land away. Guess what happened to the island? Do you think it got bigger or smaller? It got smaller.
- **Action:** Ask students to make waves again with the parachute, then little by little, scoot toward to center of the circle, making the parachute smaller and smaller.
- Explain that the island got smaller and smaller. Before it could fit over 1,000 football fields, and after the land began washing away, it could only fit less than 5.
- **Action:** Have students spread the parachute back out and point to the blue water.

- Explain that something amazing happened. Ask students if they have ever seen big cargo ships in the water. Explain that when the ships came by Poplar Island, that had to go in a special section of the water that was deep enough. The section that was deep enough was dug out by the Port of Baltimore to make sure they could get to Baltimore safely. The dirt that they dug needed to be put somewhere safe, and someone had a great idea. Put the dirt back on Poplar Island and make it big again!
- It was a big and difficult project, and they had to make sure the dirt didn't wash away again. What should they put in the ground? Plants! Now that the island was big enough with plants to hold it together, many animals came to live there. We are going to learn about some of the special animals that now call Poplar Island their home.

3. **Explain (15 min):**
   Adaptations Preparation: For the next part of the activity explain to the students that they will be seated around the edge of the parachute with their hands clasped together and held in their laps listening to the directions.

   One by one, the instructor will choose an animal depicted on the parachute to describe to students allowing them to guess which one it is by pointing to the picture. After the instructor gives several clues and most students seem to have guessed correctly, tell them which animal they were describing and teach the students how to mimic their adaptations in the form of a parachute action (see chart). After each action, they will sit down, clasp their hands together, and hold them in their laps to guess the next animal. The action will represent the special adaptations that the animals have that makes Poplar Island their perfect habitat.

4. **Evaluate/Wrap-Up (5 min):**
   1. Ask students if they could be any animal on Poplar Island, which one would they choose and why?
   2. Ask students if they were happy Poplar Island did not wash away. Why?
   3. Ask students if they remember where the dirt came from that rebuilt Poplar Island.
   4. Tell students that if they ever see a big cargo ship, they should try to remember that because they come to Baltimore, Poplar Island was given a second chance!

DIVE DEEPER

If time allows, MES can provide a visit with terrapins from Poplar Island. Have students look for special terrapin adaptations specified by the instructor, one at a time. After explaining that these terrapins will return to Poplar Island, ask students to tell their terrapin something about Poplar Island that they learned.

What is on Poplar Island?

Name	Description	Action
Wetland grasses	• Grow tall up towards the sun • Gently blow in the breeze • Animals hide in them, eat them, and use them to build shelter	Students start with the parachute at the ground and slowly raise it up above their heads (grasses growing towards the sun). Slowly rock back and forth to represent the grasses bending in the breeze.
Muskrat	• Furry, brown, long skinny tail chews down wetland grasses • Big sharp front teeth • Has webbed feet that make it a good swimmer	Hold the parachute above their heads and slowly lower it to the floor making chewing noises (muskrats eating grasses).
Great Blue Heron	• Stands about 3 ft tall • Skinny long legs, long bill, covered in blue feathers • Eats fish, frogs, and snakes	Have students stand with the parachute at waist height. Then they stand on one foot and look for a fish in the parachute. When they "see" one they dive down with their face into the parachute and catch a fish in their "bill".
Blue Crab	• Can be a dark, olive green color • It is a crustacean • It has a shell and two claws • Their scientific name means "beautiful swimmer" in Greek	Have students stand sideways with the parachute at waist height. Then they stand with their left hand on the parachute and their right hand up to form their "crab claw." The students will move in a circle as they do their best impression of a crab and you can change directions and hands as many times as you see fit.
Great Horned Owl	• Nocturnal • Flies without making a noise • Eats skunks • Goes "whoooo"	From a seated position, students will put their legs under the parachute and pull themselves under it. The parachute edge will be up by their necks like they are all owls tucked into bed because it is day time.
Tern	• Feeds on small fish, crustaceans and insects • They hover over the water and dive or skim for prey • They have feathers • Nest in colonies	Students will leave the chute on the ground and they will become a "hovering" tern looking for food. When students spot the "food" they will quickly "dive" for the food by getting as low to the ground as possible before jumping back up to standing position.

Name	Description	Action
White-tailed Deer	• It is a herbivore (feeds on plants) • Has a four-chambered stomach • Sometimes people hunt these • The males have antlers • They enjoy forest-like habitats	Students will stand with the chute held high above their heads. Take turns calling out months of the year. When a student's birthday month is called, they will hold up their hands on their heads to create their "antlers". They will do their best white-tailed deer leap to a new spot on the other side of the chute.
Rock fish	• They feed on fish eggs, insects, worms, and small fish • Live in coastal estuaries or the ocean • They can live roughly 30 years • People sometimes fish them for sport • Also known as the Striped Bass	Going fishing (Cat and Mouse). Everyone holds the chute stretched out at about 12 inches off the ground. One student becomes a rockfish (mouse) and goes underneath the chute to swim in the wetland. Another student becomes a fisherman (cat) and goes on top after removing his/her shoes. The rest of the group tries to hide the rockfish (mouse) by moving the chute up and down. Select a new rock fish and fisherman as time allows.
Frog	• They are amphibians (need to live near water to survive) • They grow from an egg to a tadpole before reaching adult age • They are carnivorous and eat insects • They have webbed feet, they like to jump	Students will pull the chute tight and crouch to take the stance of a frog while holding the chute to the ground. Students will sit quietly observing their new habitat. The students will listen as you explain that when you say "hop" they will all hop into the middle. While hopping they will raise their arms up and back down as they land their frog hop in the middle, creating a bubble in the middle of the chute.
Periwinkle Snail	• They are very small and only about 1.5 inches long • They are a terrapin's favorite snack • They lay 100s of eggs and only a few survive • You can eat these • They have a hard shell.	Students will stand and hold the parachute in their left hand at waist height. Students will walk around in a circle at snail speed, change directions at snail speed, and go the other direction in a circle at snail speed.

Name	Description	Action
Monarch Butterfly	• It is a type of insect • It has beautiful black and orange markings • Females look for a special plant called milkweed • It has 4 stages of life: egg, caterpillar, pupa or chrysalis, and adult	Students will hold the parachute at waist height when standing. Slowly make butterfly wing flapping motions. Then have them hold the parachute over their heads. On the count of 3 have the girls "migrate" or run across under the parachute to a different spot. Then the boys, the people with brown hair, with birthdays that month, etc.
Snake	• Long skinny reptile • It uses its long forked tongue to find food and smell the air • They are very important because they can eat mice and other rodents that can carry disease	Throw the short pieces of rope onto the middle of the parachute and have the students shake the parachute to move the snakes, but don't bounce them off!
Diamondback Terrapin (Do the terrapin last so you can have a secret/ wrap up meeting INSIDE the shell)	• Maryland's state reptile • About 1,000 babies are born on Poplar Island each year • They have hard shells that have a diamond pattern	Students will raise the parachute up over their heads, step under the parachute, and pull the edge back behind themselves and sit down to make a giant turtle shell with everyone sitting inside. Conduct your wrap-up inside the giant turtle shell or a super-secret turtle meeting.

Design-a-Diamondback

GRADE LEVEL: K - 5

TIME: 30 MIN

SUMMARY

In this lesson, students will learn about turtle adaptations as they "design" a diamondback terrapin using a volunteer as a life-sized model.

OBJECTIVES

1. Identify and describe physical adaptations that are unique to turtles and specifically diamondback terrapins.
2. Explain how differences in habitat lead to different adaptations that help them to survive.

VOCABULARY

- **Adaptation** - A behavior or physical feature that enables an organism to survive in its habitat.
- **Brackish Water** - A mixture of saltwater and fresh water.
- **Camouflage** - Natural coloring of animals that help them to blend in with their background.
- **Carapace** - The bony top of a turtle's shell
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** The sediment removed from the shipping channels.
- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **Lungs** - Each of the pair of organs situated within the rib cage, consisting of elastic sacs with branching passages into which air is drawn, so that oxygen can pass into the blood and carbon dioxide be removed.
- **Plastron** - The bony underside of a turtle's shell.
- **Predator** - An animal that naturally preys on other animals.
- **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).
- **Scute** - A bony plate of a turtle's shell made of keratin.
- **Webbed Feet** - Feet that have a piece of skin between the toes to aid in swimming.
- **Wetland -** Ecosystems containing water, specialized soils, and plants adapted to living in water-saturated soils. Marshes, swamps, and bogs are types of wetlands.

MATERIALS

- Laminated yellow and blue adaptation cards (may need duplicates to accommodate larger classes)
- Clothes pins
- Laminated wetland photo
- Spray bottle with water
- Adaptation props to correspond with yellow and blue cards (costume)
    - Felt turtle costume
    - 2 whoopie cushions
    - Foam turtle mask
    - 4 white legwarmers with black spots
    - Felt cut-outs (scutes)
    - Goggles
    - 4 swim fins with foam board toenails

BACKGROUND

Because the Port of Baltimore performs maintenance dredging each year (see general introduction), placement sites for dredged material removed from shipping channels are constantly used to contain the sediment. The sediment is often used to restore and support habitat at the placement sites. The restored habitat at these placement sites has attracted a wide array of animals by providing thriving habitats. Animals that are attracted to these sites have special adaptations that allow them to live in wetlands. One animal is the diamondback terrapin. A terrapin is a type of turtle and shares many adaptations with other turtle species. It also has specialized adaptations that make it perfect for the restored Chesapeake Bay habitat that is found at dredged material placement sites.

ACTIVITY

1. **Engage/Elicit (5 min):**
   Describe the Port of Baltimore including its contribution to the financial wellbeing of the state, and the stewardship it provides to Chesapeake Bay wildlife. Explain that one of the many animals that has benefitted from habitat restored by the Port of Baltimore is the diamondback terrapin. The reason the diamondback terrapin has benefitted is that it has special adaptations that allow it to live in Chesapeake Bay habitats. Discuss and define adaptation (a trait that helps a plant or animal survive in its environment). Explain that "today we are going to explore the world of turtles and look at some adaptations of a special kind of turtle, the diamondback terrapin."

2. **Explore (5 min):**
   Ask for a volunteer. This student will be turned first into a turtle, then into a diamondback terrapin. Distribute all flash cards (yellow and blue) to students. Keep all props at the front with you.

3. **Explain (15 min):**
   Begin building a generic turtle. Start by calling on students with the yellow cards. (See chart on the next page) Ask them to read the card aloud. Find any other students that have the same card. Have students come up and find the prop(s) that fit the adaptation (help students if necessary) and hand the props to the volunteer to wear. As students attach items to the volunteer's costume, elaborate on the adaptation (as suggested in the third column). After the first transformation to a turtle is complete, announce "Now that our volunteer has been turned into a turtle, let's take it a step further and turn them into a special kind of turtle – a diamondback terrapin." Explain that terrapins are turtles that live in brackish water. Ask for someone to explain the definition of brackish water (a mixture of salt and fresh water). Explain that because terrapins live in this special kind of water, they have special adaptations. Have the volunteer stand on the laminated wetland photo to demonstrate this habitat preference. Spray the area around the volunteer ***lightly*** (not enough to saturate!) with the water spray bottle. Announce "Our turtle is now a brackish water-loving terrapin!" Next, as with the "generic turtle", ask students with the blue flash cards to help "build a terrapin." Call on them in turn to read the card aloud and come up and find the prop(s) that fits their adaptation. Discuss the adaptations as you proceed (third column).

4. **Evaluate/Wrap-Up (5 min):**
   What makes a turtle a turtle (hard shell, lungs, strong beak)? Describe three special adaptations of terrapins that set them apart from other turtles (thin skin with spots, scutes with diamond patterns, salt gland, large webbed feet with long nails). Why would terrapins need these adaptations (because they are the only kind of turtle to live in brackish water so they need special ways to deal with living in the marsh)?

DIVE DEEPER

If time allows, bring out a live terrapin and point out each adaptation. If applicable, follow DNR regulations regarding minimum age allowed to handle the terrapin, and provide gloves to those who are old enough.

Adaptations Unique to Turtles

Adaptation on front of card	Student will read (from back of card):	You say:	Prop to be used
Hard Shell	A hard shell protects a turtle's soft body.	The shell on a turtle's belly is called a plastron. The shell on a turtle's back is called the carapace. The carapace is actually its backbone!	Felt costume
Lungs	Many turtles can hold their breath underwater for several hours, but they all have lungs just like people.	Here are the lungs so that the turtle can breathe air.	Whoopie cushions (plus clothes pins)
Strong Beak	Turtles have a strong beak to crush their food.	Turtle have no teeth so they use their beak along with their front feet to rip and crush their food.	Foam mask

Adaptations Unique to Diamondback Terrapins

Adaptation on front of card	Student will read (from back of card):	You say:	Prop to be used
Thin skin with spots	Camouflage helps terrapins blend in with their surroundings.	Where do terrapins live? (wetlands/marshes) The spots on their skin help them blend in with marsh grasses.	2 white legwarmers with black spots. Put them on the volunteer's wrists.
Scutes with diamond patterns	These diamond patterns help with camouflage and give the diamondback terrapin its name.	A terrapin's carapace is covered in tile-like sections called "scutes."	Felt cut-outs (plus clothes pins or Velcro). Place them around the back of the felt costume.
Salt gland	Because terrapins live in water that has salt in it, they need to have a way to get rid of salt from inside their body.	The salt leaves the terrapin's body through a gland next to their eye.	Goggles/sunglasses
Large webbed feet with long claws	Thin skin between their toes helps terrapins paddle through the water. Long claws help them crawl through mud.	Picture a diamondback terrapin's habitat. They spend most of their time in the water, so they need to be able to swim well. When the females lay a nest, they need to be able to dig in the mud.	2 swim fins with foam board toenails. Place these on the volunteer's hands.

Yellow Cards (Turtle Adaptations) Title Slide

Hard shell	Lungs
Strong beak	

Yellow Cards (Turtle Adaptations) Description Slide

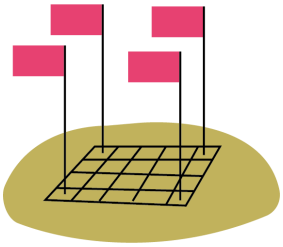
Many turtles can hold their breath for several hours, but they all have lungs just like people.	A hard shell protects a turtle's body.
	Turtles have a strong beak to crush their food.

Blue Cards (Terrapin Adaptations) Title Slide

Thin skin with spots	Scutes with diamond patterns
Salt gland	Large webbed feet with long nails

Blue Cards (Terrapin Adaptations) Description Slide

These diamond patterns help with camouflage and give the diamondback terrapin its name.	Camouflage helps terrapins blend in with their background.
Thin skin between their toes helps terrapins paddle through the water. Long nails help them crawl through mud.	Because terrapins live in water that has salt in it, they need to have a way to get rid of salt from inside the body.



Becoming a Terrapin Researcher

GRADE LEVEL: 2- 5

TIME: 30 MIN

SUMMARY

In this lesson, students will learn how scientists monitor and collect data from diamondback terrapin nests.

OBJECTIVES

1. Collect and record measurements of the nest size and eggs.
2. Learn about threats and predators to terrapins.
3. Identify actions that can prevent potential harm posed to terrapin nests.

VOCABULARY

- **Average** - A number expressing the central or typical value in a set of data, in particular the mode, median, or (most commonly) the mean, which is calculated by dividing the sum of the values in the set by their number.
- **Brackish Water** - A mixture of seawater and fresh water.
- **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.
- **Clutch** - The group of eggs produced by birds, amphibians, or reptiles, at a single time, particularly those laid in a nest.
- **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.
- **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.
- **Monitoring** - Observe and check the progress or quality of (something) over a period of time; keep under systematic review.
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **Predation** - The act of hunting and consuming of another animal.
- **Predator** - An animal that naturally preys on others
- **Reptile** - A cold-blooded vertebrate animal. Reptiles have dry, scaly skin and typically lay soft-shelled eggs on land. Examples of reptiles include snakes, lizards, crocodiles, turtles, and tortoises.
- **Restoration -** The act or the process of returning something to its original condition.

MATERIALS

- Plastic container (2' wide, 1' long, 1' deep)
- 20 lb bag of sand
- 13 mock terrapin eggs
- 1 ruler
- 1 scale
- 1 mesh screen (10" by 10")
- 4 pink marking flags
- 1 dry erase marker
- 1 laminated work sheet
- 1 set of research station signs

  * These materials will create one "nest"/ station (appropriate for one group of up to **four** students)

BACKGROUND

Poplar Island is a special island located in the Chesapeake Bay just off the coast of Talbot County's Tilghman Island, Maryland. In 1847, Poplar Island was surveyed for the first time, and was found to be to be roughly 1,140 acres (461 hectares) in size. An acre is about the size of a football field, making the island approximately 1,140 football fields large! This island was a critical habitat for diamondback terrapins. Due to erosion, Poplar Island shrank to just 5 acres by the 1990s. The Maryland Department of Transportation Maryland Port Administration and the U.S. Army Corps of Engineers have restored Poplar Island with material dredged material from Chesapeake Bay shipping channels. Diamondback terrapins became a species of concern in the Chesapeake Bay due to a variety of factors, including habitat loss. These turtles found their way back to Poplar Island's sandy beaches, which provide excellent nesting habitat. Scientists come to Poplar Island to research and revitalize the diamondback terrapin population.

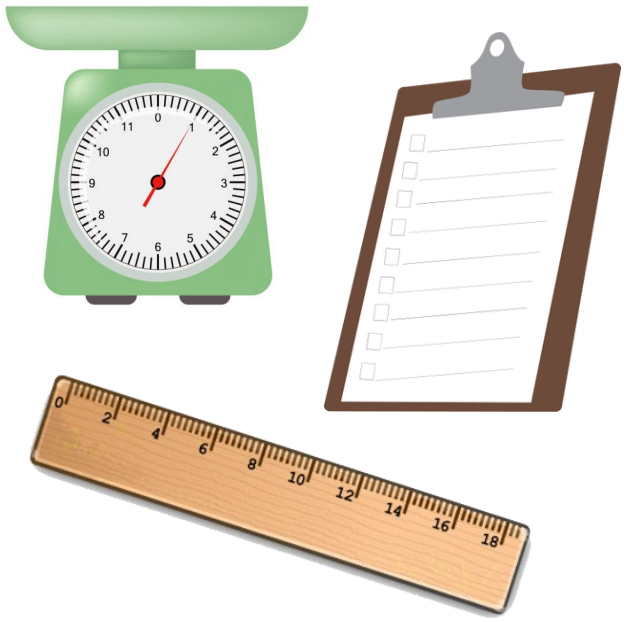
PREPARATION BEFORE ACTIVITY

In preparation for the activity you will need to obtain the necessary materials. *One sandbox can accommodate up to four students at one time.* If you wish to have more students working at the same time, consider creating more than one sandbox.

Place the dry sand into the plastic container. Dig a hole about six inches deep into the sand. Place between six to thirteen eggs per nest and cover up the hole with the sand.

ACTIVITY

1. **Engage/Elicit (5 min):**
   Describe the history of Poplar Island. Explain how the island eroded away and was restored with material dredged from shipping channels leading to the Port of Baltimore. Explain that one of the many animals that has benefited from habitat restoration is the diamondback terrapin. Discuss the types of nesting habitat that diamondback terrapins need.
2. **Explain (5 min):**
   Explain that scientists called "herpetologists" work on Poplar Island in the summer to collect data about the terrapins. These researchers are working to preserve and revitalize terrapin populations in the Chesapeake Bay. Tell students that though this activity, they will be just like the real-life herpetologists on Poplar Island, and that they will be learning how to study and take measurements of terrapin nests.

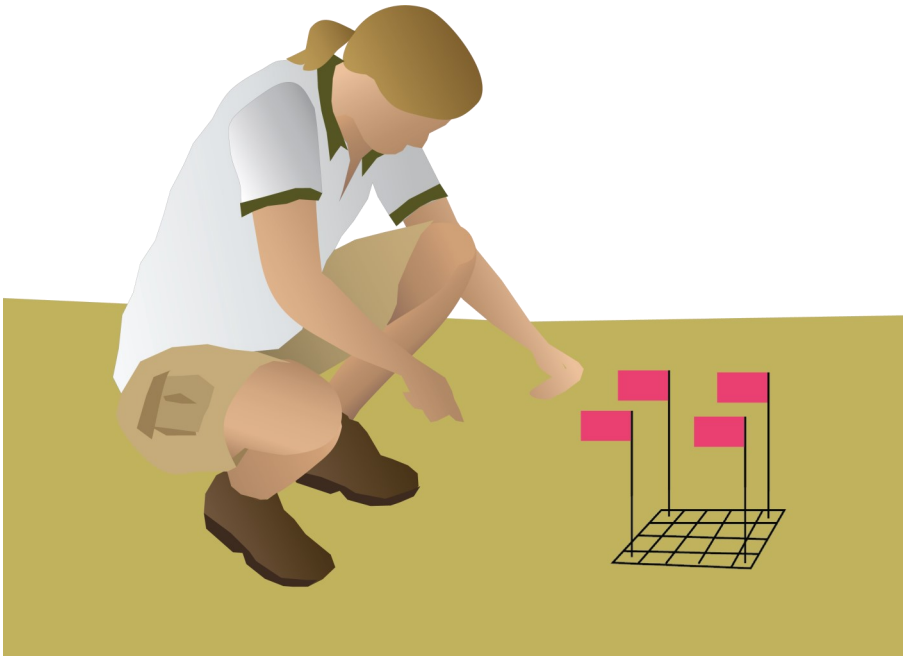


3. **Explore (10 min):**
   Divide the students into groups of four students per sandbox. The students will follow the introductions on the laminated worksheet. Tell the students that they are on Poplar Island and found diamondback terrapin tracks leading up to this nest. Ask the students to carefully uncover all of the eggs in the nest. Once all of the eggs are removed, tell them to begin recording the following measurements on their worksheet with a dry erase marker. The students will take turns measuring and recording the data. Record the number of eggs found in the nest and their color. Use the ruler to record the depth of the nest and the length of the eggs. Use the scale, weigh and record the weight of the eggs. Once the students have recorded their data, explain that they have to rebury the eggs the same way they found them. Finally tell the students to cover the nest with a 1' by 1' sheet of mesh and mark the four corners with a flag.
4. **Evaluate/Wrap-Up (15 min):**
   Once the students finish, explain that we are going to discuss our data. Ask the students "how deep was everyone's nest?" Explain that the temperature

of the nest will determine the sex of the diamondback terrapins. If the eggs are incubated at a warm temperature the terrapins will be females and if the eggs are incubated at a cold temperature the terrapins will be males. Explain that on Poplar Island the beaches are in the direct sun and there are few trees until upland habitats regrow through restoration. Ask the students "Based on this information about Poplar Island, do you think the terrapins will be females or males"? Tell the students that 90% of the terrapins hatched on Poplar Island are females because their nests are very warm. Ask the students how many eggs did they find in their nests. Explain that the eggs in the nest are referred to as a clutch. Diamondback terrapins can lay up to three clutches a season and they have on average 13 eggs per clutch. Ask the student "Why do you think they covered up the nest with mesh and marked it with four flags"? Discuss the types of predators that would eat the terrapin eggs, which includes foxes, raccoons, snakes, and birds. Explain that the mesh will prevent their predators from harming the nest and the flags will help you find the nest again.

DIVE DEEPER

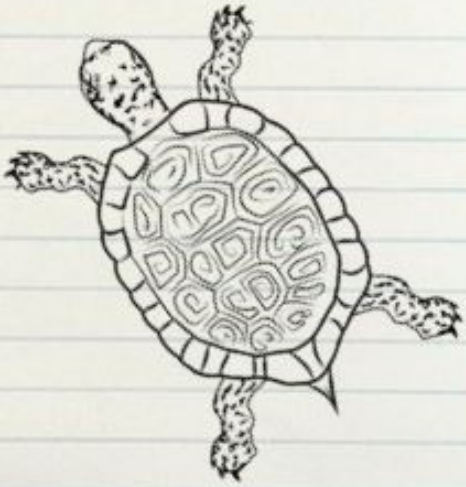
If time allows, ask the students to graph their data. Tell them to create two bar graphs, one that tracks the eggs lengths and the eggs weights. Discuss what are the average lengths and weights and if they have any outliers.



TERRAPIN RESEARCH

HOW TO STUDY A TERRAPIN NEST:

1. USE YOUR HANDS TO CAREFULLY UNCOVER ALL OF THE EGGS IN THE NEST. BE GENTLE!
2. OBSERVE THE EGGS USING YOUR EYES.
3. TAKE MEASUREMENTS OF THE NEST. TRY TO ANSWER ALL THE QUESTIONS ABOUT THE NEST.
4. WRITE DOWN YOUR MEASUREMENTS. DRAW PICTURES OR WRITE DOWN OTHER THINGS YOU OBSERVE ABOUT THE NEST AND EGGS.
5. CAREFULLY RE-BURY THE EGGS IN THEIR NEST. PUT A SCREEN ON TOP OF THE NEST WHEN YOU ARE FINISHED TO KEEP HUNGRY ANIMALS OUT! PUT FLAGS AROUND THE NEST SO THAT YOU CAN FIND IT AGAIN EASILY.



TERRAPIN RESEARCH

CROSS OFF EACH STEP ONCE YOU'VE COMPLETED IT!

UNCOVER OBSERVE MEASURE RECORD COVER + PROTECT

TERRAPIN NEST OBSERVATIONS AND MEASUREMENTS

HOW DEEP IN THE SAND IS THE NEST? _____

WHAT COLOR ARE THE EGGS? _____

HOW MANY EGGS ARE IN THE NEST? _____

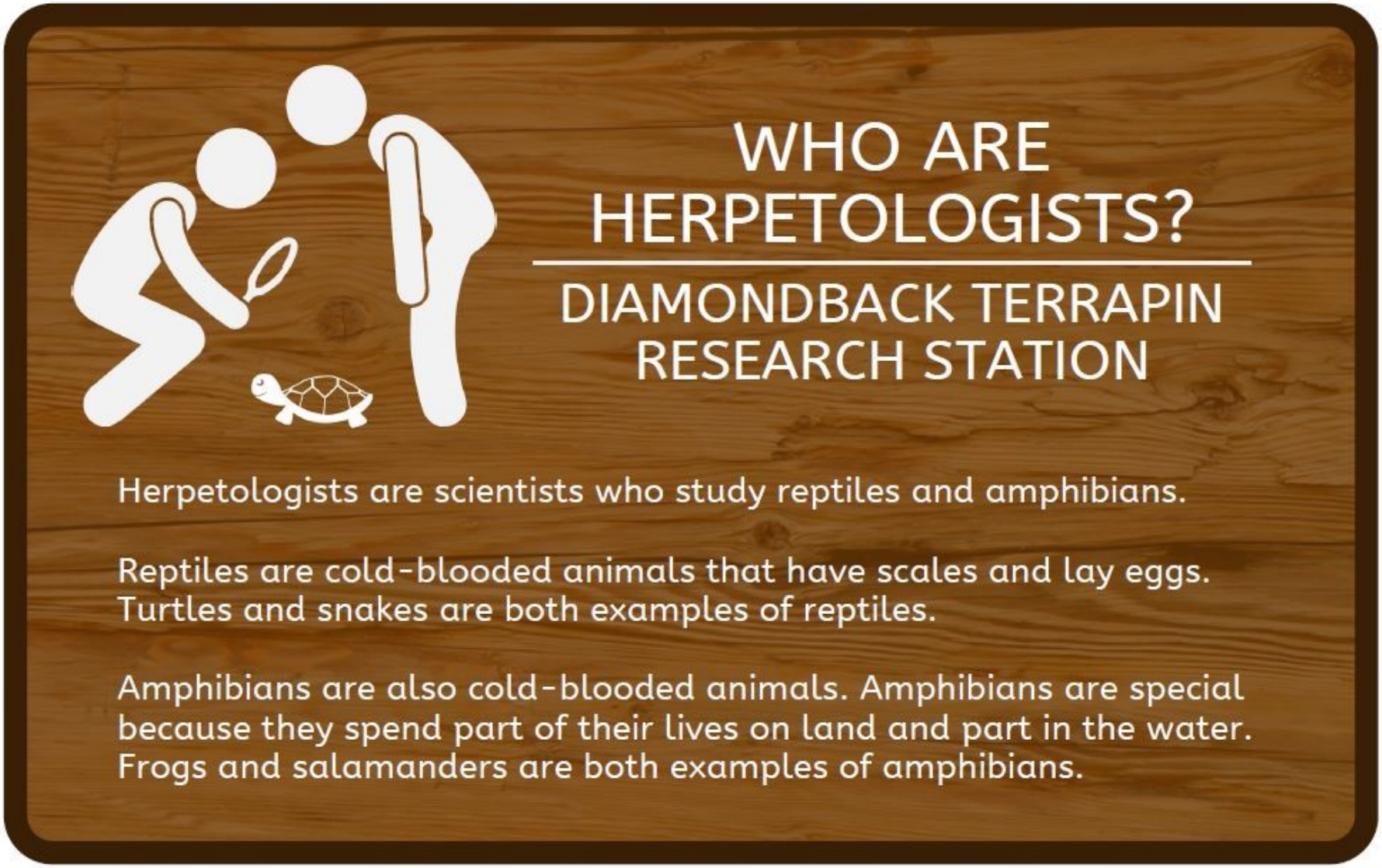
ARE ALL THE EGGS THE SAME SIZE? _____

HOW BIG IS THE LARGEST EGG? (MEASURE IT!) _____

HOW SMALL IS THE SMALLEST EGG? (MEASURE IT!) _____

HOW MUCH DOES ONE EGG WEIGH? (WEIGH IT!) _____


TERRAPIN EDUCATION AND RESEARCH ON POPLAR
TERP
SINCE 2009
DIAMONDBACK TERRAPIN RESEARCH STATION
POPLAR ISLAND, MD
Welcome to the Terrapin Research Station on Poplar Island. Here, researchers called *herpetologists* study terrapins throughout their lives. This includes studying terrapin eggs and nests, terrapin hatchlings, and adult terrapins. Join our research team to learn more about Maryland's favorite turtle!


WHO ARE HERPETOLOGISTS?
DIAMONDBACK TERRAPIN RESEARCH STATION
Herpetologists are scientists who study reptiles and amphibians.
Reptiles are cold-blooded animals that have scales and lay eggs. Turtles and snakes are both examples of reptiles.
Amphibians are also cold-blooded animals. Amphibians are special because they spend part of their lives on land and part in the water. Frogs and salamanders are both examples of amphibians.

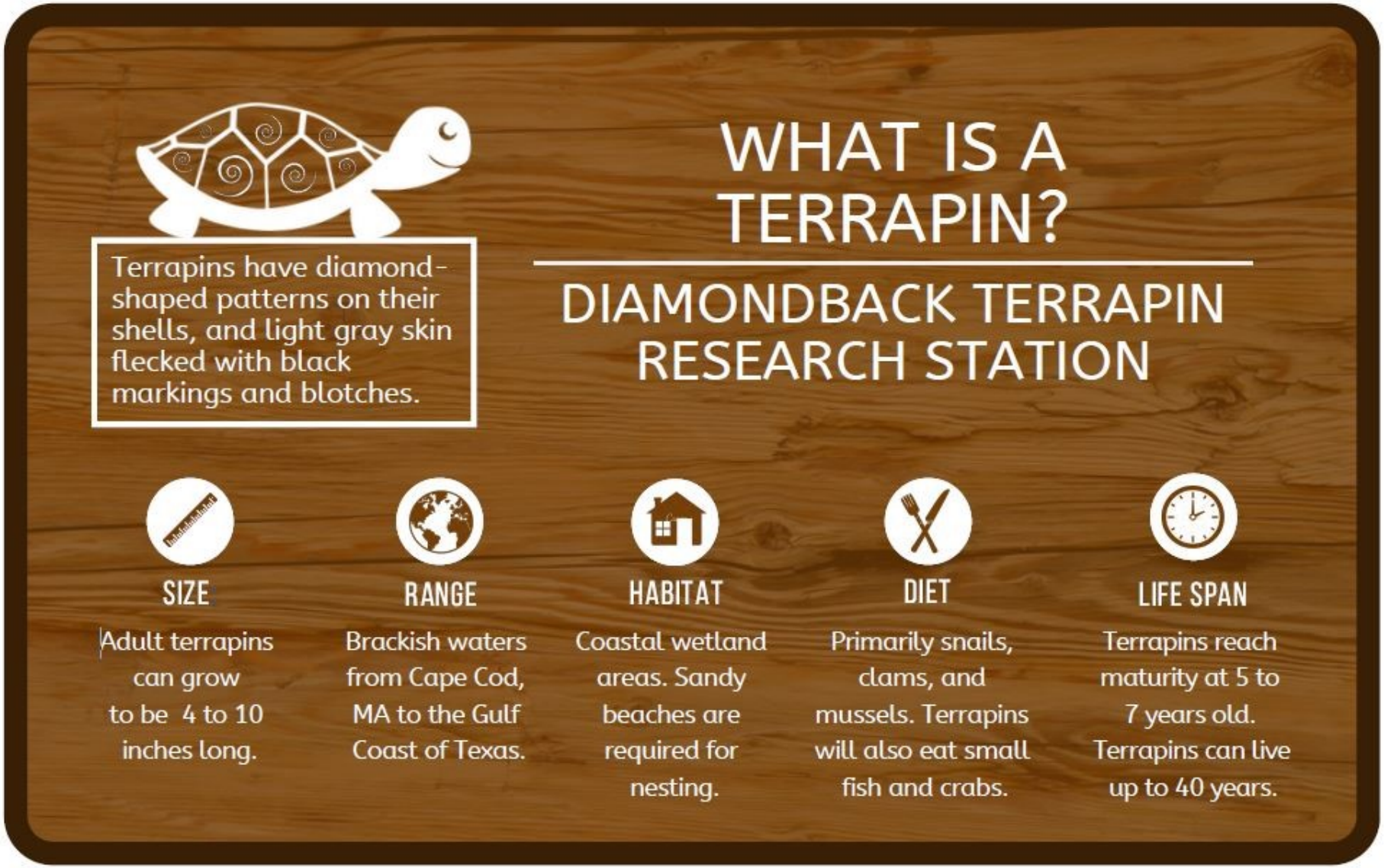
WHERE IS POPLAR ISLAND?

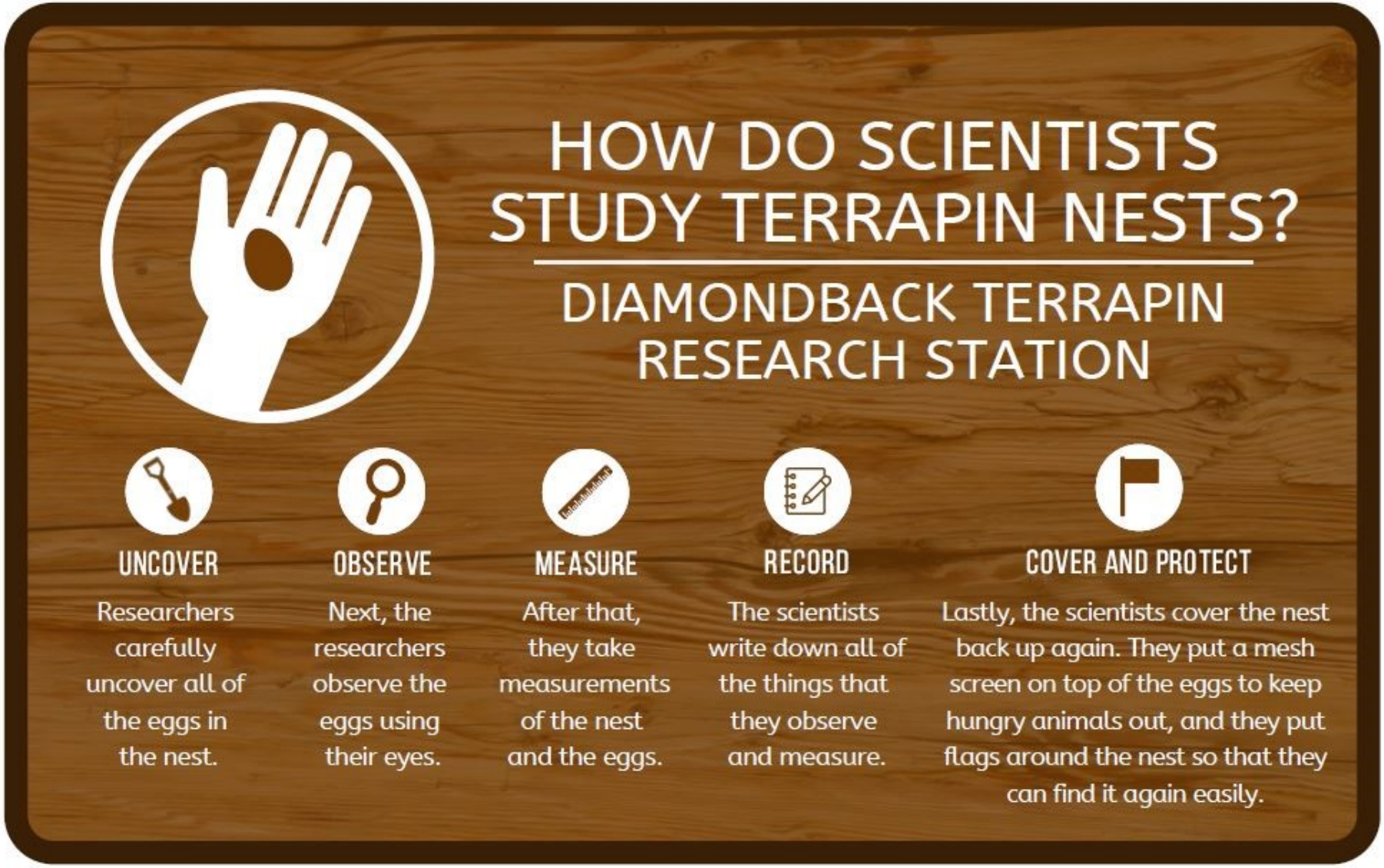
DIAMONDBACK TERRAPIN RESEARCH STATION

Poplar Island is located in the Chesapeake Bay, in Maryland. In the 1800s, Poplar was a large island where people and animals lived. But as the island changed, both people and animals moved away.

By 1993, the island was only the size of 4 football fields. No people lived there anymore, and because the island had gotten so small, not as many animals lived there either.

Poplar Island has been restored (fixed) by people to give animals a place to live, find food, raise their babies, and rest while migrating. Today, hundreds of different kinds of birds, insects, and other animals (like terrapins!) call Poplar Island home. No people can live on the island-- it's a protected space just for wildlife.


WHAT IS A TERRAPIN?
DIAMONDBACK TERRAPIN RESEARCH STATION
Terrapins have diamond-shaped patterns on their shells, and light gray skin flecked with black markings and blotches.
SIZE
Adult terrapins can grow to be 4 to 10 inches long.
RANGE
Brackish waters from Cape Cod, MA to the Gulf Coast of Texas.
HABITAT
Coastal wetland areas. Sandy beaches are required for nesting.
DIET
Primarily snails, clams, and mussels. Terrapins will also eat small fish and crabs.
LIFE SPAN
Terrapins reach maturity at 5 to 7 years old. Terrapins can live up to 40 years.


HOW DO SCIENTISTS STUDY TERRAPIN NESTS?
DIAMONDBACK TERRAPIN RESEARCH STATION
UNCOVER
Researchers carefully uncover all of the eggs in the nest.
OBSERVE
Next, the researchers observe the eggs using their eyes.
MEASURE
After that, they take measurements of the nest and the eggs.
RECORD
The scientists write down all of the things that they observe and measure.
COVER AND PROTECT
Lastly, the scientists cover the nest back up again. They put a mesh screen on top of the eggs to keep hungry animals out, and they put flags around the nest so that they can find it again easily.

WHY ARE SCIENTISTS STUDYING TERRAPINS?

DIAMONDBACK TERRAPIN RESEARCH STATION

Numbers of terrapins living in Maryland have dropped because of many threats terrapins face. Threats are problems or challenges that make it hard for an animal to survive. One threat that terrapins and other animals face is habitat loss-- the places they live changing so that they cannot live there anymore.

The restoration of Poplar Island has given terrapins valuable habitat. Poplar's protected marshes and sandy beach began to draw terrapins soon after restoration began. Since restoration began on Poplar Island, researchers have seen more and more terrapins returning to the island to nest. Now over 800 terrapins hatch on Poplar Island every year!

Terrapin Travels

GRADE LEVEL: 4 - 8

TIME: 40 MIN

SUMMARY

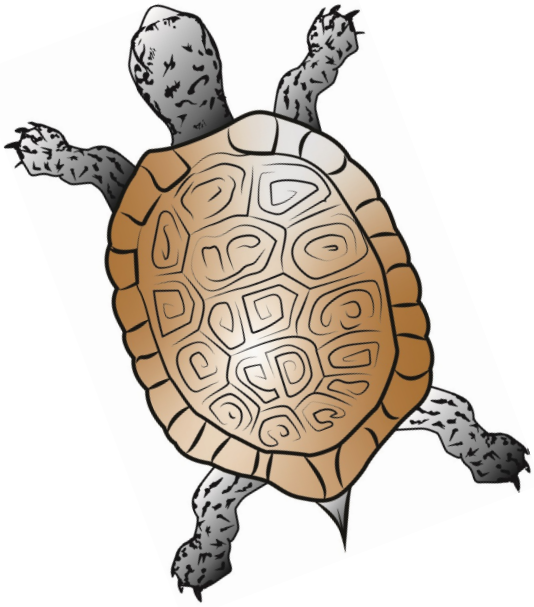
In this lesson, students will learn about the many challenges the diamondback terrapin faces as it matures. Students will play a life-sized board game that simulates the terrapin life cycle.

OBJECTIVES

1. Identify factors that affect the diamondback terrapin's life cycle in positive and negative ways.
2. Explain how the diamondback terrapin is affected by changes in its ecosystem.
3. Make suggestions for ways they can help protect nesting habitat for diamondback terrapins.

VOCABULARY

- **Bycatch Reduction Device** - This device prevents larger-shelled terrapins from entering crab pots.
- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **Crab Pot** - A underwater trap used to catch crabs.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** The sediment removed from the shipping channels.
- **Draft -** The vertical distance between the water surface and the bottom of the ship.
- **Habitat -** The natural home or environment of an animal, plant, or other organism.
- **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.
- **Human Impact** - This refers to the effect of human development on the environment that includes changes to biophysical environments and ecosystems, biodiversity, and natural resources caused directly or indirectly by humans.
- **Hurricane** - A storm with a violent wind, in particular a tropical cyclone in the Caribbean.
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **Predation** - The act of hunting and consuming of another animal.
- **Red Tide** - A discoloration of seawater caused by a bloom of toxic red dinoflagellates, known as algae.
- **Restoration** - The act or the process of returning something to its original condition.
- **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).
- **Tagging** - One of the methods for studying the biology, movements, and migrations of animals. Tagging is used to study the long-range regular and irregular movements of animals and to determine their life span.



MATERIALS

- 25 game pieces with attached game cards
- 5 large foam dice: placed at cards 1, 8, 9, 13, and 15.
- Flagging: placed at card 6

BACKGROUND

Because the Port of Baltimore performs maintenance dredging each year (see general introduction), placements sites for dredged material removed from shipping channels are used to contain the sediment. The sediment is often used to restore and support habitat at the placement sites. The restored habitat at these placement sites has attracted a wide array of animals by providing thriving habitats. Many previously threatened species have benefitted from the restored habitat as their populations rebounded through increased environmental protection measures. One such animal is the diamondback terrapin, a type of aquatic turtle found in the Chesapeake Bay.

The diamondback terrapin is faced with many challenges as it matures to adulthood. Review with students factors affecting the terrapin population. It takes a terrapin about 7 years to sexually mature before they have the ability to reproduce, this results in a slow growing population. They have numerous predators such as fox, raccoon, birds, snakes, and humans. They encounter obstacles such as crab pots, pets, vehicles, habitat loss due to shoreline development or erosion, and over harvesting (historically, the terrapin fishery closed in 2007).

ACTIVITY

1. **Engage/Elicit (10 min):**
   Explain to students that they will be playing a life sized life cycle game where they will learn about diamondback terrapins and their survival to adulthood. First go over the following background information:

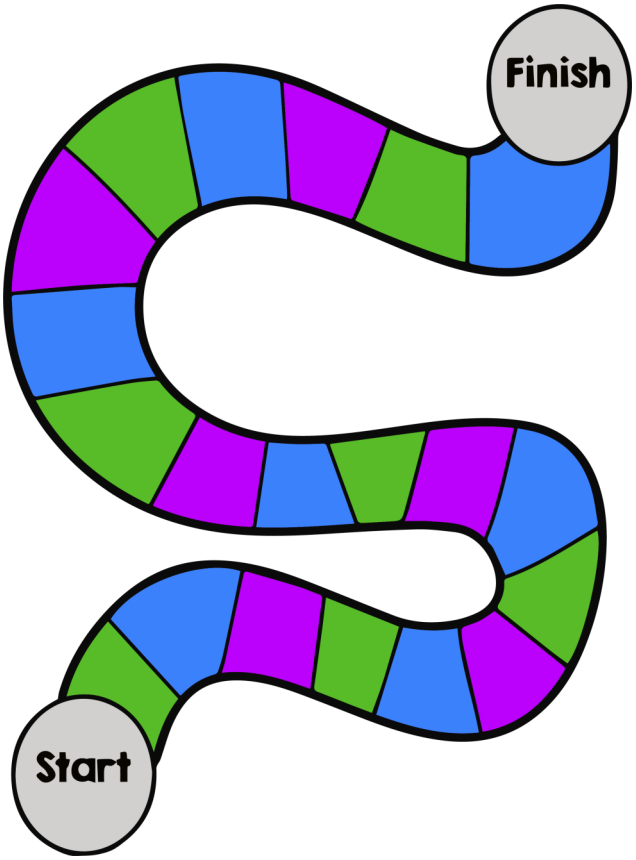
   Explain that diamondback terrapins need habitat to survive, and appropriate habitat can be found on Poplar, an island restored using dredged material in the Chesapeake Bay.

   Explain why and how the Port of Baltimore restored habitat at Poplar Island that is attracting terrapins to nest. Some of these terrapins hatched on Poplar Island are involved in a head start program where students help raise them in classrooms for a school year, making the terrapin stronger and more capable of surviving when they are returned to the island the following summer.

   Researchers on Poplar Island are studying the survival of head started terrapins.

   Up to 1000 diamondback terrapins hatch every on Poplar Island year. There are less mammal predators on Poplar Island, so survivorship is higher than typical habitat locations. They use the newly created wetland habitat as nesting grounds in the summer.

2. **Explore (15 min):**
   Tell the students to line up at the first block of the gameboard. Read the card, roll the die and move ahead that many spaces. Ask the students to "act out" what the card says to do. Make sure to follow the directions on cards exactly. (Jump up and down, duck and cover, etc.) If time allows, they may play the game more than once, leaving about 15 minutes left at the end for conclusion and explanation. Supervise game play, answer questions, etc.
3. **Explain (5 min):**



Ask the students to sit down once they have completed the game. By a show of hands ask how many students survived as terrapins? How many did not? How many were able to lay eggs? Ask how hard it was to survive as a terrapin.

4. **Evaluate/Wrap-Up (10 min):**
   Explain that there are many obstacles that terrapins face for survival and ask the students to share some examples of both positive and negative things that happened to them. Ask the students to share the number of times they survived and the number of times they died. If they died, what was the cause of death (predation, accident, weather, etc.)? For those who survived, did you find fish, lay eggs, did your young survive? Ask students what they thought of the game. Is becoming an adult terrapin hard or easy? What role does habitat at places like Poplar Island play in the ability for the terrapin to survive? Ask them if they think the headstart program makes a difference for the terrapin survival? If so, how? Ask them if they think it makes a difference to create and protect nesting grounds and habitat: food water, shelter, and space.

DIVE DEEPER

Ask students who survived and have a red dot on their "food" clothes pin (picked up during the game). Tell students that they didn't do anything wrong. A terrapin scientist captured you and gave you a passive integrated transponder (PIT tag). If terrapins with PIT tags are recaptured throughout their life, to find out if they hatched on Poplar Island, and if they were part of the head start program. Understand the population and life cycle of terrapins? Will it help us to assess whether projects such as the restoration of Poplar Island is a success?

1

Watch out! Birds are circling above you.
Duck down close to the ground
then roll the die and move ahead the number of stations indicated.

2

Good news! You found marsh periwinkles to eat! Smack your “beak” 10 times and move ahead 5 stations.

3

Uh-Oh. A red tide made you sick! Sit down, hold your stomach and count to 20. Groan 10 times. Then move ahead 1 station.

4

Kids playing in the water would love to catch you and play with you!
Freeze, count to 40, and then sneak ahead 2 stations.

5

Good news! You escaped a predator, but you hurt your leg. Slowly swing your left arm around 10 times. Move ahead 1 station.

6

Scientists catch you for research. They put a tag called a PIT tag in your leg. Tie a piece of flagging around your ankle.
Move ahead 2 stations.

7

You get caught in fishing line and you can't eat. You are weak and hungry. A wildlife rehabilitator cuts the line and feeds you.
Hop on 1 leg in a circle then move ahead 4 stations.

8

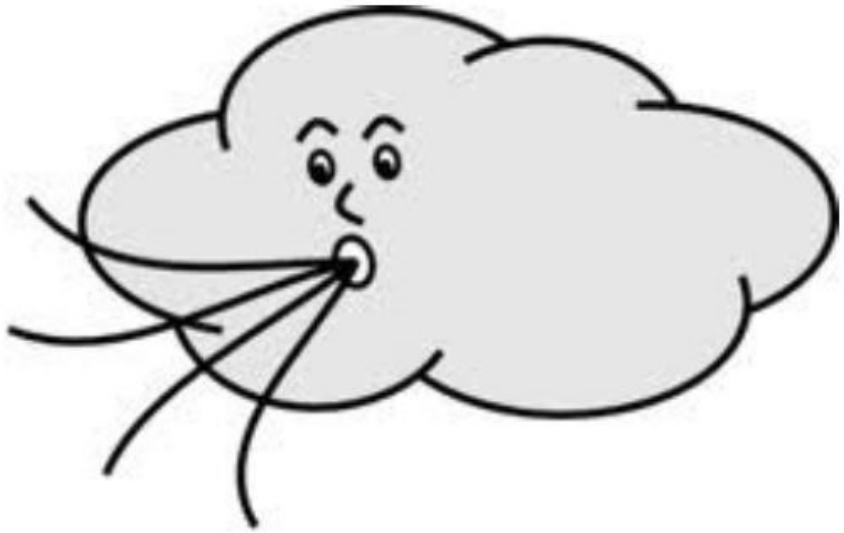
You discover a newly planted marsh that was created as habitat restoration. Stretch out on a log and bask for 10 seconds. Roll the die, then move ahead that number.

9

There's a hurricane! Squat down and cover your head. Count to 50 to ride out the storm. Roll the die, then move ahead that number.

10

Strong winds are pushing the tides back. Roll the die and blow backwards that many stations.



11

You are tired and want to take a rest on the beach. There is a dog that scares you away. Make 3 big circles waiting for the dog to leave. You only have the strength to move ahead 1 station.

12

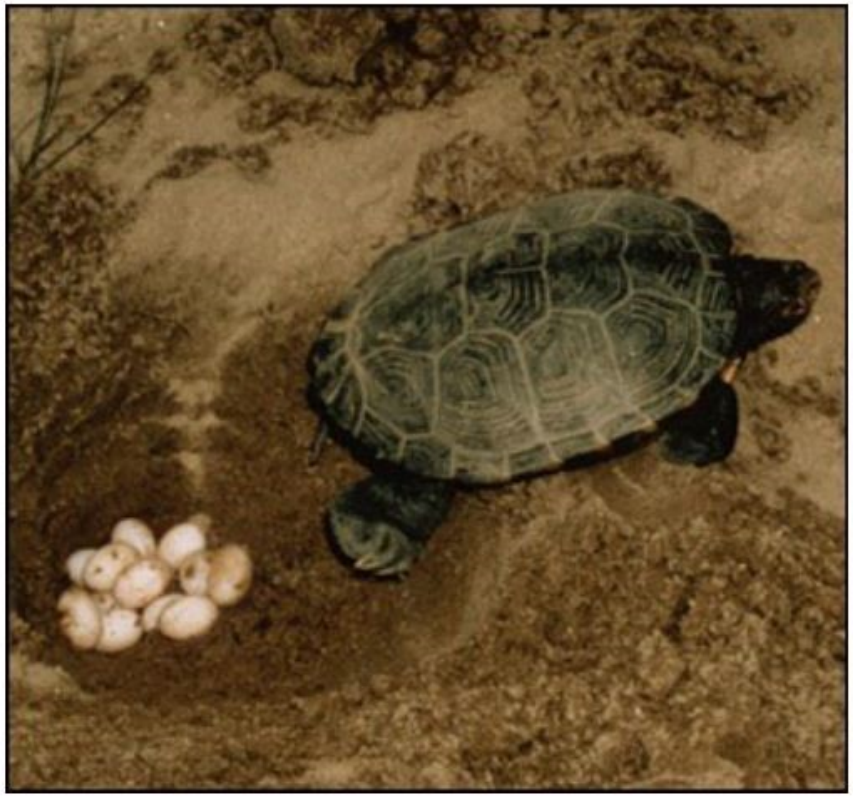
Whew! While swimming near the channel you almost collide with a boat! Bounce back 3 spaces while you recover.

13

You arrive at a large wetland. There is plenty of clean water, food and shelter. Rub your stomach 15 times and move ahead 4 stations.

14

You are ready to nest!
Roll the die and move ahead that number of stations.



15

As you make your way up the beach a loose dog catches you and bites your leg! You are injured and need time to heal. Limp back one station.

16

You accidently swim into a crab pot that does NOT have a By-catch reduction device and your drown!
Die dramatically then go back to the beginning.

17

Good news! You have the beach all to yourself
as you climb ashore to make your nest.
Roll the die and move ahead the number of stations indicated.

Stu Weiss

18

Vrrrrrrrmmmmmm!!!!

A 4 wheeler comes out of no-where and runs you over! You have died!

Die dramatically then go back to the beginning.

19

You are in a protected wildlife area. Take your time nesting without worrying about people or cars. Stroll ahead 5 stations.

20

This has been a long journey for you!
Spend time resting and fueling up on little fish you catch.
Make a fish face for 10 seconds and then move ahead 4 stations.

21

Yikes! An unexpected freeze makes food scarce. Shiver for 5 seconds then go back 2 stations and look for more food.

22

Bad luck! Someone released a pet turtle that was carrying a disease. You caught it and died! Die dramatically then go back to the beginning.

23

Oh no! The beach you planned on nesting in is now someone's water front home! Go back one station while you look for better habitat.

24

Spend 5 days relaxing and feeding in the wetland after you've laid your nest. You're ready to swim to the finish!

25

Congratulations! You successfully nested and survived another year!

Osprey Odyssey

GRADE LEVEL: 4 - 8

TIME: 40 MIN

SUMMARY

In this lesson, students will learn about the many challenges the osprey faces as it matures. Students will play a life-sized board game that simulates the osprey life cycle.

OBJECTIVES

- Identify factors that affect the ospreys life cycle in positive and negative ways.
- Explain how the osprey is affected by changes in its ecosystem.
- Make suggestions for ways they can help protect migratory habitats for osprey.

VOCABULARY

- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **DDT** - A synthetic organic compound used as an insecticide. Like other chlorinated aromatic hydrocarbons, DDT tends to persist in the environment and become concentrated in animals at the head of the food chain. Its use is now banned in many countries.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** The sediment removed from the shipping channels.
- **Draft -** The vertical distance between the water surface and the bottom of the ship.
- **Habitat -** The natural home or environment of an animal, plant, or other organism.
- **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.
- **Human Impact** - On the environment or anthropogenic impact on the environment includes changes to biophysical environments and ecosystems, biodiversity, and natural resources caused directly or indirectly by humans.
- **Hurricane** - A storm with a violent wind, in particular a tropical cyclone in the Caribbean.
- **Insecticide** - A substance used to repel insects.
- **Migration** - The seasonal movement of animals from one region to another.
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **Pesticide** - A substance used to repel organisms who is in an area who could harm plants or other organisms.
- **Predation** - The act of hunting and consuming of another animal.
- **Red Tide** - A discoloration of seawater caused by a bloom of toxic red dinoflagellates, known as algae.
- **Restoration** - The act or the process of returning something to its original condition.
- **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).
- **Tagging** - One of the methods for studying the biology, movements, and migrations of animals. Tagging is used to study the long-range regular and irregular movements of animals and to determine their lifespan.

MATERIALS

- Osprey Odyssey game pieces
- Five large foam dice
- Flagging tape
- Pictures of osprey
- Migration route
- Clothes pins, half should be marked with red dots

BACKGROUND

Because the Port of Baltimore performs maintenance dredging each year (see general introduction), placements sites for dredged material removed from shipping channels are used to contain the sediment. The sediment is often used to restore and support habitat at the placement sites. The restored habitat at these placement sites has attracted a wide array of animals by providing thriving habitats. Many previously threatened species have benefitted from the restored habitat as their populations rebounded through increased environmental protection measures. One such animal is the osprey, a large bird that specializes in preying on fish.

Osprey are faced with many challenges as they mature to adulthood. Review with students' factors affecting the bird population. Habitat loss due to shoreline development, erosion, etc.

ACTIVITY

1. **Engage/Elicit (10 minutes):**
   Explain to students that they will be playing a life-size life cycle game where they will learn about osprey and their survival to adulthood. First go over the following background information:

   The Port must keep shipping channels deep enough for ships to get to Baltimore safely. They do this by removing sediment in the shipping channels to make sure they are at a depth of 50 feet.

   The sediment is relocated to a containment site in Maryland, and the sediment will be used to restore habitat that was lost or habitat may be restored near to the containment sites. These thriving habitats support a variety of wildlife, including a special bird called the osprey.

   Osprey are migratory birds. This means they spend the winter in southern US (Florida, Georgia) to South America. They will return to northern habitats, such as Swan Creek at Cox Creek or Poplar Island around mid-March.

   Osprey diets consist of 99% fish.

   When Osprey reproduce, they will typically have 3 chicks that leave the nest in the fall. However, only I/3 fledglings are predicted to make it to adulthood.

2. **Explore (15min):**
   Tell the students to line up at the first block of the gameboard. Read the card, roll the die and move ahead that many spaces. Ask the students to "act out" what the card says to do. Make sure to follow the directions on cards exactly! (Jump up and down, duck and cover, etc.). If time allows, they may play

3. **Explain (10 minutes):**
   Ask the students to sit down once they have completed the game. By a show of hands ask how many students survived as osprey? How many did not? How many were able to lay eggs? Ask how hard it was to survive as an osprey.

4. **Evaluate/Wrap-Up (5 minutes):**
   Explain that there are many obstacles that osprey face for survival and ask the students to share some examples of both positive and negative things that happened to them. Ask the students to share the number of times they survived and the number of times they died. If they died, was it caused by predation, accident, weather, etc.? For those who survived, did you find fish, lay eggs, or did your young survived? Ask students what they thought of the game. Is migration hard or easy? What role does habitat at places like Swan Creek and Masonville play in the osprey's migration? One way to help protect the osprey population is to protect breeding and nesting grounds and habitat: food, water, shelter, and space.

DIVE DEEPER

Ask students who survived and have a red dot on their "food" clothes pin (picked up during the game). Tell students that they didn't do anything wrong, but something bad happened. There was no way to know what was happening to them while they were playing the game. Explain that these ospreys (ones with red dot on clothespins) ate fish that were contaminated with DDT. DDT is a chemical that was used in pesticides. This chemical makes the eggshells of apex predators like osprey brittle. When the female osprey sat on their eggs to keep them warm, the eggs would break. Ask the students to guess, what would happen to the osprey population if their eggs continue to crack from DDT exposure? Explain that their population dropped quickly and dramatically. The United States banned the use of the chemical DDT in 1972. The osprey is an EXCELLENT example of a species on the rebound from extinction.

1

It's time to head back to Swan Creek Wetland in Baltimore, MD! Stretch your wings and get ready for the 3,000 mile flight. Roll the die and move ahead that number of blocks.

2

Good news! You found a small pond full of yummy fish. Rub your belly 10 times and move ahead 5 blocks.

3

Uh-Oh. You couldn't find any fish to eat today. You are weak and tired. Crawl ahead only 1 block.

4

Oh no! A farmer thinks you are trying to eat his chickens! Freeze and hide for 20 seconds and then sneak ahead 2 blocks.

5

Good news! An eagle tried to steal your fish but you were too fast for him to catch you! You're tired now though. Move ahead only 1 block.

6

You've caught a lucky break and snagged 2 big fish from a lake! Clip a clothespin on your shirt and skip ahead 2 blocks.

7

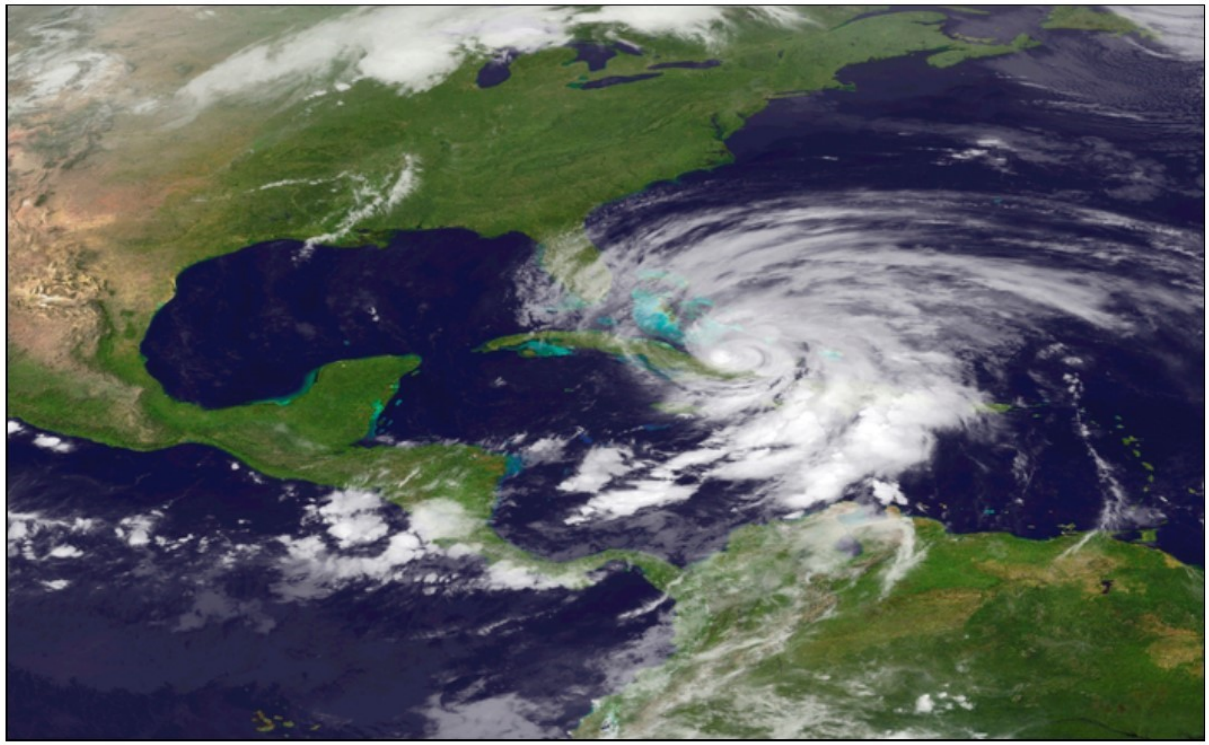
You get caught in fishing line and waste a lot of energy trying to get free. Luckily a wildlife rehabilitator cuts the line and feeds you. Hop on 1 leg in a circle then move ahead 4 blocks.

8

You are getting ready for the big flight over the Caribbean Sea! Spend a night along the shoreline of South America resting up. Roll the die, then move ahead that number.

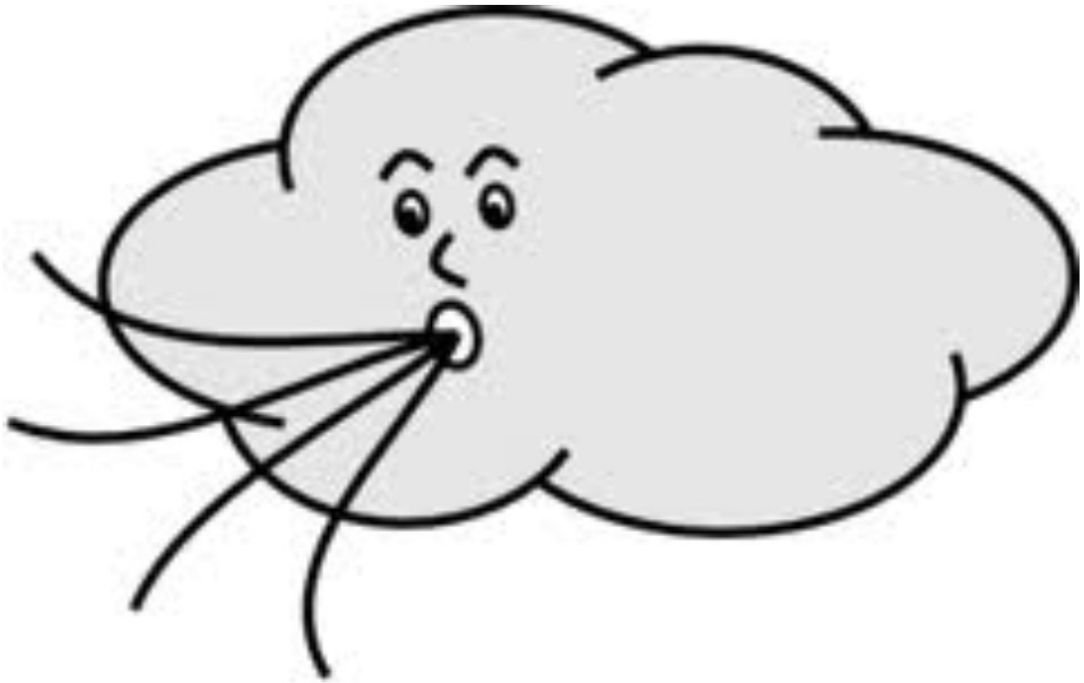
9

There's a storm over Cuba! Squat down and cover your head. Count to 50 to ride out the storm. Roll the die, then move ahead that number.



10

Strong winds push you WWWAAAAYYYYYYY off course. Roll the die and blow backwards that many blocks.



11

You made it to Florida! That was a long flight and you're tired. You only have the strength to move ahead 1 block.

12

Whew! While flying near the channel you almost collide with a boat! Bounce back 3 spaces while you recover.

13

You arrive at a Swan Creek wetland! There is plenty of clean water, food and shelter.

Rub your stomach

15 times and move ahead 4 blocks.

14

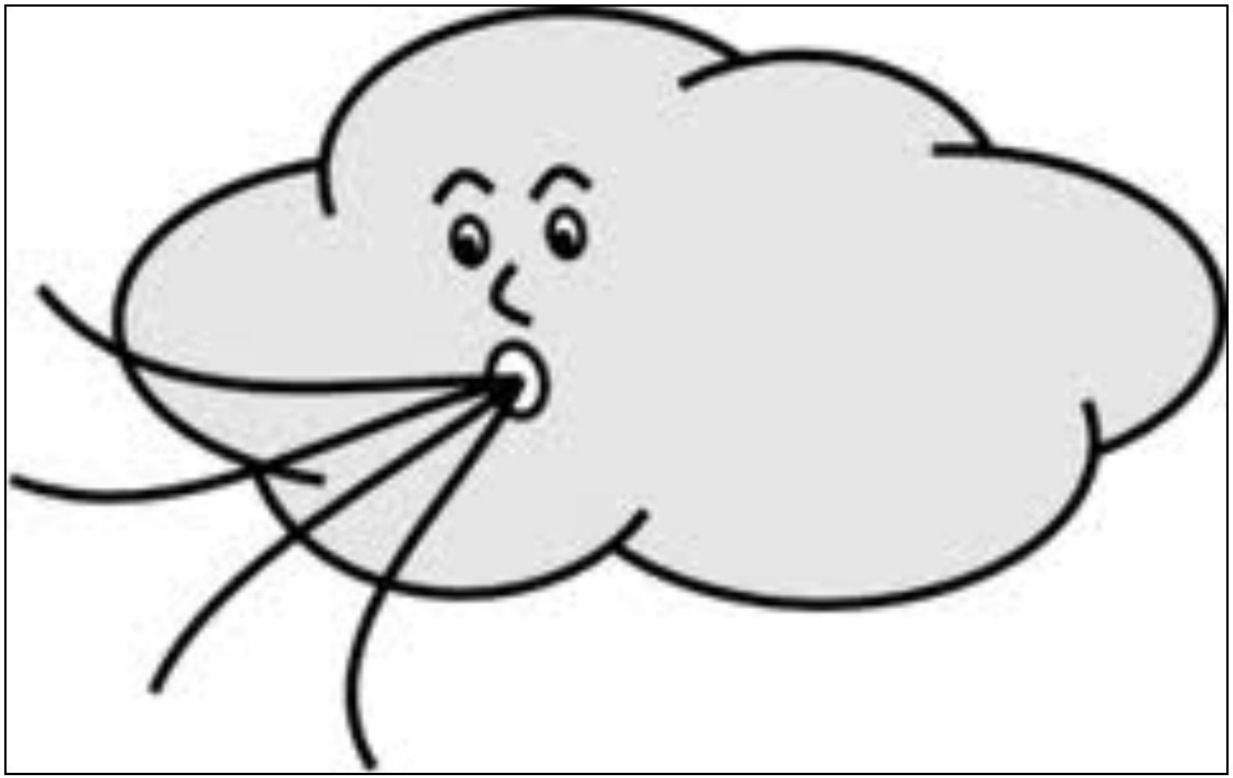
You are ready to nest!

Roll the die and move ahead that number of blocks.

15

Your nest gets blown over in a strong wind storm!

Limp back one block.



16

You accidently fly too low to the road and get hit by a semi-truck on Route 695! Die dramatically then go back to the beginning.

17

Good news! You and your mate have laid 3 eggs! Roll the die and move ahead the number of blocks indicated.

18

Flap your wings as hard as you can!!! You have a HUGE rockfish in your talons but he is just too heavy for you to pull out of the water. Your wings are too wet to fly and you drown in the Patapsco River. Die dramatically and go back to the beginning.

19

You are in a protected habitat at Swan Creek Wetland. Take your time caring for your eggs. Stroll ahead 5 blocks.

20

Your eggs will be hatching soon! Spend time resting and fueling up on fish you catch. Make a fish face for 10 seconds and then move ahead 4 blocks.

21

Yikes! An unexpected freeze makes food scarce. Shiver for 5 seconds then go back 2 stations and look for more food.

22

Bad luck! A raccoon climbs into your nest and eats your eggs. You were un-successful at nesting this year. Sulk back to the beginning.

23

Your chicks have hatched! Jump for joy and move ahead one block.

24

Oh no! A Great Horned Owl ate one of your chicks! Go back two blocks while your nest recovers.

25

Congratulations! All three of your chicks survived until Fall. Show off with your best victory dance!

Captain Trash Wheel is Coming!

GRADE LEVEL: 1 - 8

TIME: 40 MIN

SUMMARY

In this lesson, students will be introduced to the history of Masonville Cove. Students will learn about an innovative engineering project that is showcased at Masonville Cove, Captain Trash Wheel. Through an interactive game, students will learn about the functions of different parts of the trash wheel.

OBJECTIVES

1. Students will interpret and discuss the pictures of the Trash Wheel parts, learning the function of each.
2. Students will participate in the game "Captain Trash Wheel is Coming!", which uses their knowledge of the trash wheel parts and their function.
3. Students will review the background surrounding the acquisition of a trash wheel at Masonville Cove.

VOCABULARY

- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** The sediment removed from the shipping channels.
- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **Incinerator** - A waste treatment process that involves the combustion of organic substances contained in waste materials.
- **Litter** - Trash, such as paper, cans, and bottles, that is left lying in an open or public place.
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **Nonpoint Source Pollution** - Those inputs and impacts to the environment which occur over a wide area and are not easily attributed to a single source.
- **Point Source Pollution** - A single, identifiable source of pollution, such as a pipe or a drain.
- **Restoration** - The act or the process of returning something to its original condition.
- **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).
- **Solar Energy** - Radiant energy emitted by the sun that is transformed into electric power using specially designed panels.
- **Trash Wheel** - A trash intercepting device placed in a river to collect and remove any floating debris before it reaches a harbor. Generally powered by both sunlight and water, the wheel lifts trash and debris from the water onto a conveyor belt that deposits into a connected floating dumpster.
- **Watershed** - An area of land defined by the body of water at its lowest elevation that receives all precipitation that has flowed over the land.
- **Water Wheel** - A large wheel driven by flowing water, used to work machinery or to raise water to a higher level.

MATERIALS

- Map of Masonville Cove and the Chesapeake Bay.
- Laminated pictures of the parts of a trash wheel.
- Laminated statements describing the function of the trash wheel parts.
- Display board to which pictures and words can be attached.
- An open space to play a run-around game.

BACKGROUND

In the early to mid-1900s, industry really began to boom in the Baltimore area. Products were being shipped in and out of the Port of Baltimore, and the need for railroad lines to carry these goods to other areas, like the mid-western US, became hugely apparent. The Baltimore and Ohio (B&O) railroad extended their lines through the Masonville community and the area slowly became more industrial rather than residential. While this development was good news for the state of Maryland (the Port was growing and there were jobs available) there were resulting negative effects on the Masonville community.

Masonville Cove was once a recreational area used by residents for fishing and swimming but the railroad tracks cut the community off from the Cove. After the recreational cove area was cut off, it turned into a dumping ground. Washing machines, household trash, tires, etc., accumulated in the cove area.

The area of the dredged material containment facility (DMCF) was a dumping ground as well, but for different materials including disassembled ships, concrete timbers, etc. This was relevant to the community because as unused buildings fell into disrepair and former recreation areas were used as dumping grounds, these elements of their home community were lost. Former community members had strong memories and emotional ties to Masonville Cove, and it took away from their sense of place and community when those areas were lost. Today, Masonville Cove and its surroundings offer a picturesque waterfront setting for nature exploration. The great effort to restore the cove, was achieved because of the mitigation associated construction of the Masonville DMCF for the placement of dredged material.

One of the mitigation projects is the Masonville Trash Wheel, also known as Captain Trash Wheel, a name chosen by the surrounding community. A Trash Wheel is an invention that combines old and new technology to harness the power of water and sunlight to collect litter and debris flowing through the storm drain culvert and stream of Masonville Cove.

Before

After

The stream's current provides power to turn the Trash Wheel's water wheel, which turns a conveyor belt, which lifts trash and debris from the water and deposits it into a floating dumpster barge. When the stream does not provide enough water current, a solar panel array provides additional power to keep the machine running. When the dumpster is full, it's towed away by boat, and an empty dumpster is put in place.

The trash that washes in through the Masonville storm drain culvert and stream originates as litter on surrounding streets that are part of the Masonville Cove watershed. The litter washes into storm drains on the

street during precipitation events. The storm drains funnel the mixture of rainwater and litter into the nearest body of water, in this case, Masonville Cove. If the litter were not intercepted, it could flow from Masonville Cove to the Patapsco River, to the Chesapeake Bay, and eventually the Atlantic Ocean. This type of nonpoint source pollution is called runoff pollution. Trash in the water is only one type of runoff pollution, and wildlife could ingest the trash or become entangled by it. The trash wheel mitigation project helps to remove trash from the water before it enters Masonville Cove and all of the connected waterways and wetlands, leaving the environment in a better state and safe for wildlife.

ACTIVITY

1. **Engage/Elicit (15 min):**
   The instructor should introduce the importance of the Port of Baltimore and briefly explain the concept of dredging to keep channels navigable. Explain the need for Masonville DMCF and point out Masonville Cove and the students' school on a map of the Chesapeake Bay watershed.

   Explain that runoff pollution travels through storm drain pipes and in this area the pollution will flow straight into Masonville Cove. Explain the concept of mitigation and what has been done at Masonville to reduce the environmental impact of the DMCF construction. Also explain what has been done by MDOT MPA to make the environment healthier than it was. Introduce one of the mitigation projects, Masonville's Captain Trash Wheel. Using the pictures provided, explain each different part of the trash wheel and its function. Ask the students to spot each part on the actual Trash Wheel as you go. Trash Wheel parts are depicted in the laminated pieces: (See Chart - Parts of Captain Trash Wheel)

   Explain to students that they will be using their knowledge of the trash wheel parts to act them out in a fun game called "Captain Trash Wheel is Coming!"

2. **Explore (20 min):**
   State the rules of the game "Captain Trash Wheel is Coming!" and have a few people model the actions you describe as you go.
   Rules:
   Assign one person to be the Captain Trash Wheel (CTW). The role of CTW is to call out the actions and dismiss the players who don't do the actions quick enough or who break from character. Once the CTW calls an action, each player has 3-4 seconds to start performing the action. If they don't find a group fast enough for the action involving more than one person or perform the right action, they are out of the game. Refer to the Call to Action Chart to explain the actions to the participants. (See Chart - Call to Action)

   Play as many rounds as you can and reserve 5 minutes at the end to review.

3. **Explain (10 min):**
   Rebuild the Trash Wheel: Pass out the pictures of trash wheel parts and descriptions, mixing them up throughout the group. If there is not enough for each participant to have their own, designate groups to share them. Give students 2 minutes to silently and correctly assemble the picture of the trash wheel on the board like you did at the start of the activity. Once the students have gotten it right, review the reason that Captain Trash Wheel is at Masonville.

4. **Evaluate/Wrap-Up (5 min):**
   Play the "Ask or Answer for a Prize" game. Terms will have been posted on the board for passive learning. The instructor will give students the option to ask a question about what they learned or answer with the term that matches a set of clues given by the instructor to earn a prize. If students choose the latter, the instructor begins to describe one of the words and students will race to raise their hands to guess which term they are describing. If possible, they or their group can earn a giveaway prize for their answer.

   - RUNOFF POLLUTION: Masonville Cove is part of the Chesapeake Bay watershed and is impacted by all human activity in the surrounding region as a result of runoff pollution.
   - STORM DRAIN: Litter on the ground within the Masonville Cove watershed washes into storm drains when it rains, transporting it to the stream at Masonville Cove. The trash wheel is stationed at the end of this stream.
   - TRASH WHEEL: This is a machine that is

positioned at the location of storm drain pipes to catch floating litter before it flows into the main body of water.

- CARGO SHIPS: These are large vessels that carry goods to be sold in Maryland and throughout the country that were originally made in countries across the ocean.
- PORT OF BALTIMORE: This is the area in Baltimore where ships dock and offload their goods for transport throughout the United States. Goods are taken from the ships and placed on trucks and trains to get to their final destination.
- 50 FEET: This is the depth of water that is needed for cargo ships to travel safely into Baltimore Harbor.
- 21 FEET: This is the average depth of the Chesapeake Bay, which is not naturally deep enough to accommodate large cargo ships.
- DREDGING: Dredging shipping channels is something that occurs annually to keep channels in the bay deep enough for cargo ships to travel through. It is economically beneficial to the Port of Baltimore and Maryland as a whole because Port business brings a lot of money to the state of Maryland through jobs. It must be done to allow large cargo ships to get to the Port of Baltimore without running aground.
- DREDGED MATERIAL CONTAINMENT FACILITY: The sediment that is dredged from the bottom of the channels must be placed in special designated facilities, often located close to the area where the sediment was dredged.
- MITIGATION: Out of this economic need to dredge, habitats like Masonville Cove are restored. Masonville Cove provides unique Chesapeake Bay habitat to important resident and migratory species.

End with the final message: This is what we call a "win-win" situation. The Port of Baltimore can remain open for business and stay competitive with other ports while Maryland's environment can be protected for wildlife use. The Port of Baltimore has made it a priority to conduct dredged material containment projects that are environmentally responsible and desirable to the neighboring communities. Installing a trash wheel at Masonville Cove as a mitigation project helps to alleviate the impact of runoff pollution that threatens wildlife and wetlands.

DIVE DEEPER

Have students engage in a group discussion to answer the following questions:

1. What is the overall impression that students have of the Trash Wheel invention?
2. In what ways does it help to make the Masonville area better?
3. Do they think it is serving the purpose of offsetting the known impacts of the DMCF construction to the existing natural resources in the area?
4. Were there any elements of the Trash Wheel invention that surprised the students?

Parts of Captain Trash Wheel

Parts	Functions
Barge	Keeps the trash wheel floating
Wheel	Water flow and solar power makes it turn, and powers the conveyor belt as it moves trash into the dumpster
Dumpster	Holds trash and debris
Boom	Directs trash and debris to the front of the trash wheel
Solar Panel	Provides stored solar energy, which powers the wheel when the water current is not strong enough
Sail Cloth Cover	Protects the dumpster from the elements
Rake	Physically moves trash that has been channeled by the booms from the water onto the conveyor belt
Conveyor Belt	Transports trash from the water to the dumpster

Captain's Commands

Call	Action
Captain Trash Wheel's Coming!	Everyone stands at "attention" (in a salute) facing CTW, and they can't move from this position until the caller says, "At Ease!" If they laugh or break from the attention, they are dismissed.
Starboard!	Players run to the right.
Port!	Players run to the left.
Canvas!	Each student brings their hands together over their head and curve their arms down to imitate the canvas over the trash wheel.
Boom!	Groups of two students hold hands and create a V-shape with their arms to imitate the booms that lead trash to the trash wheel.
Conveyor Belt!	Groups of three students stand side by side. One person on the end acts like the rake scooping the trash to the conveyor belt, and the other two people shuffle their hands back and forth imitating the motion of the trash along the conveyor belt of the trash wheel.
Barge!	Groups of four students join hands to make a square shape between their arms imitating the shape of a rectangular barge.
Wheel!	Groups of five students stand in circle with their hands stacked in the middle. They walk around in a circle to imitate the Trash Wheel.

Hot Commodities

GRADE LEVEL: 5 - 8

TIME: 50 MIN

SUMMARY

In this lesson, students will learn about everyday items that are top imports at the Port of Baltimore (POB) and how the international trade of these items help to habitat.

OBJECTIVES

1. Students will be able to identify commodities that pass through the Port of Baltimore.

VOCABULARY

- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** The sediment removed from the shipping channels.
- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **Container Ship** - A ship specially designed or equipped for carrying containerized cargo.
- **RORO** - Roll-on, roll-off ships are vessels designed to carry wheeled cargo that are driven on and off the ship on their own wheels.
- **TEU** - Stands for Twenty-Foot Equivalent Unit which can be used to measure a ship's cargo carrying capacity.
- **Transportation** - The action of moving someone or something from one location to another.
- **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).
- **Shipping Logistics** - Planning, implementing and controlling the efficient flow (forward and backward) and storage of goods, services and related information between the point of origin and the point of consumption (customer).

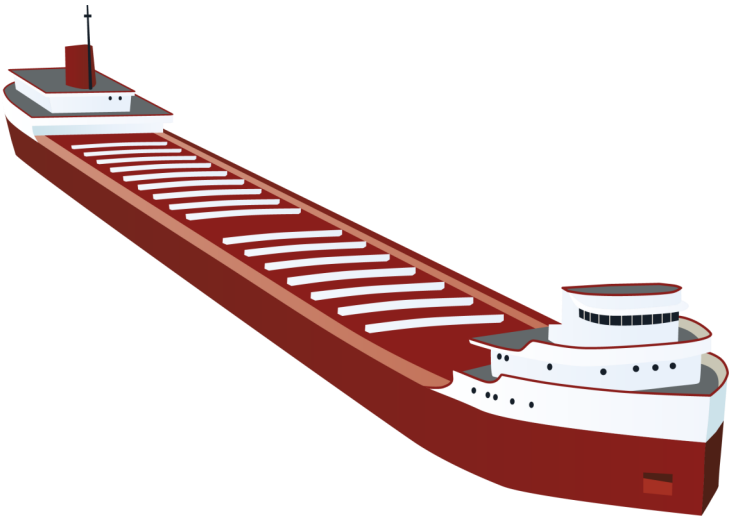
MATERIALS

- Code one set of items with a red dot and another with a blue dot to determine which team wins.
- Toy car and toy tractor (representing Japanese commodities)
- Toy chair and piece of plywood (representing Chinese commodities)
- Salt (representing Chilean commodities)
- Kleenex and coffee bag (representing Brazilian commodities)
- Steel items (representing United Kingdom commodities)
- 5 containers for countries
- 2 containers to hold commodities at start line

BACKGROUND

The Port of Baltimore is ranked in the top ten largest ports in the United States of America. Each year, more than 2,000 cargo vessels and cruise ships enter and leave the POB, moving over 40 million tons of cargo and generating more than $2 billion in revenue. Asia is the POB's largest market. Approximately 19 million tons of cargo was exported to Asia in 2018, consisting of mostly raw materials such as coal, lumber, and waste paper. Countries importing coal from the POB include India, Japan, and South Korea. The largest imports from Asia to the POB include consumer goods such as furniture, construction equipment, and automobiles. Europe continues to be the POB's largest trading partner. Imports and exports to and from Europe tend to be balanced. POB imports aluminum from the Middle East and exports automobiles. The POB exports previously owned vehicles to Africa and imports new BMW automobiles. Salt, tissue-making pulp, coffee, sugar, and automobiles are imported from both Central

America and South America. The POB is the top ranked automobile port in the United States. It is also the top ranked port for roll on/roll off (RO/RO) cargo imports in the United States, which includes construction and agriculture machinery.



ACTIVITY

1. **Engage/Elicit (10 min):**
   Review with students that the POB shipping channels are dredged for cargo ships to deliver goods to the POB. The Port needs Dredged Material Containment Facilities (DMCF) to stay competitive. Review the need for mitigation and make specific examples of the site you are focusing on (see background for more information). If you are on-site, connect the idea to your location. If you are in a classroom, select a site and use photos to illustrate the appearance of a DMCF and examples of mitigation projects.

   Play the following flash card logo games:

   Cargo Logos: The cargo ships are carrying many goods that we know and or use every day.

   Play flashcard game to identify common logos (use only the brand cards).

   Baltimore Wildlife: After students identify logos, reiterate that the plants and animals they see in the habitat around them wouldn't be at the mitigation site they are learning about if it weren't for those goods being shipping through the POB.
   Have students try to identify the wildlife cards (Use only the animal and plant ones).

   These species are all symbols of Maryland.

   Conclusion: The brands and goods that we use every day help to create habitat for the "logos" or symbols of Maryland. Some of these species live at the mitigation site they are learning about.

2. **Explore (20 min):**
   Explain to the students that they will be competing in "The Hot Commodity Race" to learn what types of cargo or commodities are imported and exported through the POB.
   - Set a starting line with two containers filled with commodities.
   - Place 5 containers labeled China (6,000 mi), Japan (5,900 mi), Chile (4,100 mi), Brazil (3,100 mi), and United Kingdom (3,000 mi) to their according distances away from Baltimore. (China the furthest from the starting line).
   - Behind the starting line, have students line up in two lines (2 teams, red and blue) next to a container filled with commodities (one container for each group).
   - Explain the goal of the game. Each team member at the front of the line will continue this relay race until all commodities are sorted by country of origin. Pick up a commodity and race down to the containers, placing the commodity in the container labeled with its country of origin.
   - The next person in line must wait until the first person crosses the starting line on their return trip.
   - When both teams have finished, pull the items out of the containers and see if the teams were correct.
   - If they aren't correct tell the participants that some are wrong and give them a chance to correct their choices.
   - The first team to accurately complete the race wins.

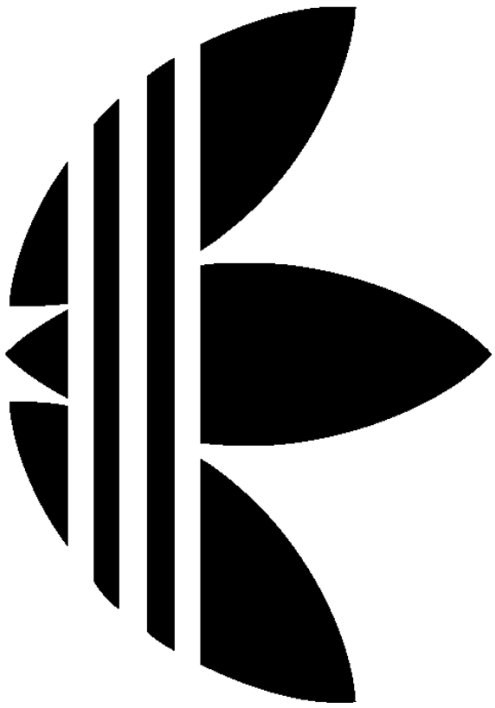
3. **Explain (10 min):**
   Ask students what they learned about commodities in the Port of Baltimore. Explain that Baltimore is a desirable location for commodities because it is further inland than other ports, this minimizing travel costs to get goods to the center of the United States.

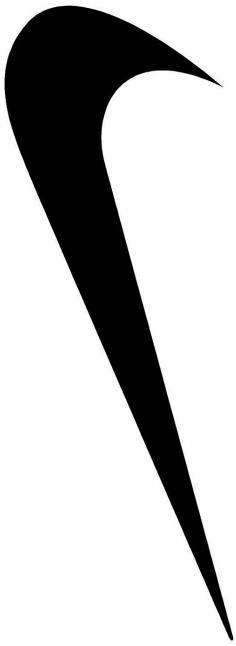
4. **Evaluate/Wrap-Up (10):**
   Discuss the commodities that are shipped through the POB using the table below.
   1. What surprised students the most? (Furniture from China?)
   2. What imports have the longest trip?
   3. What imports have the shortest trip?
   4. Name one import and how it affects your daily life.

DIVE DEEPER

For older groups focus on the economics impacts of having a port in your city. Discuss the following:

1. How do ports make money?
2. How do ports affect international trade?





Hollister	ADIDAS
Nike	Mercedes-Benz

Black-Eyed Susan	**Striped Bass**
White Oak	**Baltimore Oriole**


Willem M. Roosenburg

Diamondback Terrapin	**Baltimore Checkerspot**
Patuxent River Stone Agate	**Blue Crab**


TM

Xbox	Apple
Starbucks	John Deere

Careers in Dredging

GRADE LEVEL: 1 - 8

TIME: 40 MIN

SUMMARY

In the lesson, students will be introduced to different careers that are part of the dredging process. Students will learn that these careers require a variety of educational backgrounds and can involve many different activities throughout the work day.

OBJECTIVES

1. Learn about the history of Poplar Island and the dredging process that resulted in its restoration.
2. Identify different careers involved in the dredging process and explore the daily life of those jobs.

VOCABULARY

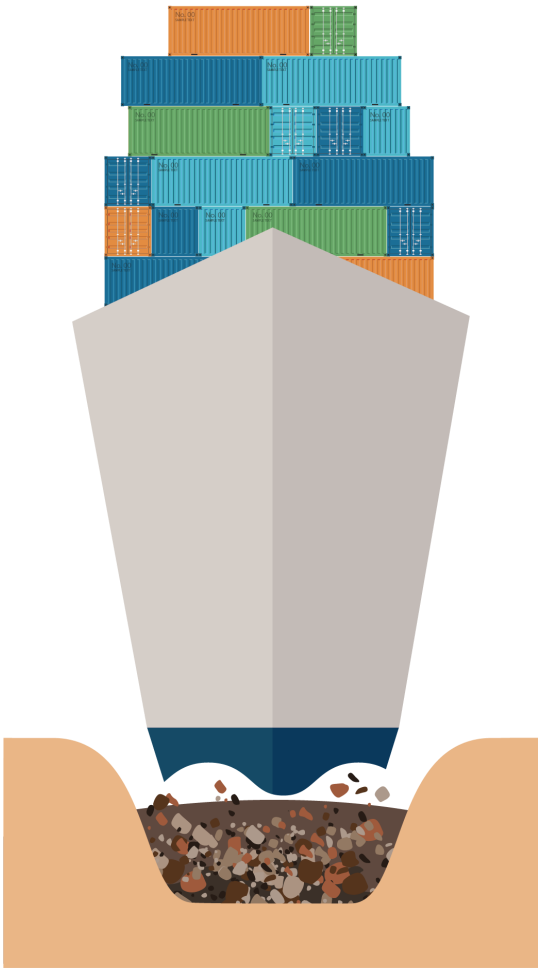
- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another
- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** The sediment removed from the shipping channels.
- **Dredge Technician -** A person who coordinates and monitors dredge material placement.
- **Dredging Outreach and Education Specialist -** A person who teaches students and adults about the dredging process in Maryland and the resulting ecological restoration.
- **Environmental Specialist -** A person who collects data about the environment.
- **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 ship captains know where to travel).

MATERIALS

- "Careers in Dredging" Power Point
- Career costumes:
    - Dredge technician (hard hat, work boots, safety vest, safety glasses, toy construction vehicles)
    - Environmental specialist (safety vest, waders, sunglasses, clipboard, binoculars, bird checklist, toy crab
    - Outreach education specialist (baseball hat, sunglasses, safety vest, large bus cutout)

BACKGROUND

When people think about careers involved with the Port



of Baltimore, most automatically think of life on ships. However, many jobs are involved in maintaining the shipping channels and keeping the Port open for business. One very important job is to dredge shipping channels to make sure they are deep enough for ships to safely navigate to the Port of Baltimore terminals. Because the Chesapeake Bay has an average natural depth of only 21 feet, the approach channels to the Port of Baltimore are naturally too shallow to accommodate ships that require a maximum draft of 50 feet. The Maryland Department of Transportation Maryland Port Administration and the United States Army Corps of Engineers maintain the shipping channels to a depth of 50 feet to make it safe for cargo ships to travel to the Port terminals. Ships that travel to the Port of Baltimore travel 150 miles further inland, allowing for more cost effective and efficient transport of goods closer to the center of the country.

ACTIVITY

1. **Engage/Elicit (35 min):**
   Walk through the "Careers in Dredging" PowerPoint with students. This will give background on the Poplar Island story and introduce the role of the Port of Baltimore in the restoration of the Island.

2. **Explore (integrated into above-mentioned PowerPoint):**
   At the "Meet the Worker" slides, have a student volunteer put on the associated costume and perform the motions specified when describing their day. Students in the audience can participate by chanting the phrase that describes the volunteer student's motion.

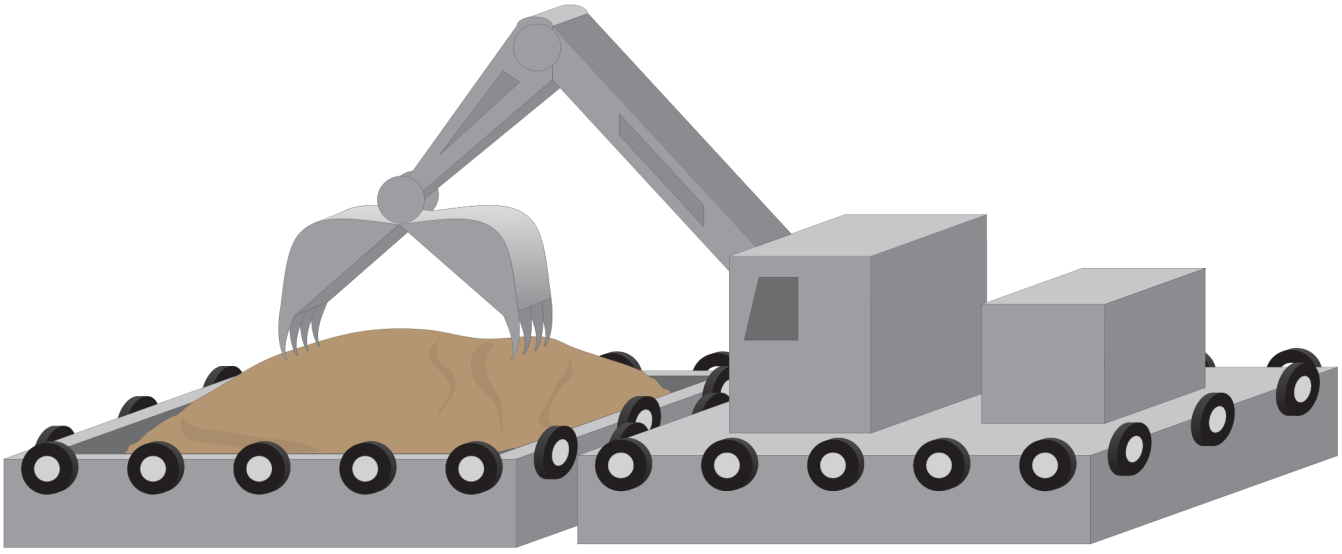
3. **Explain (integrated into above-mentioned PowerPoint):**
   Encourage discussion after the "Meet the Worker" slide. Ask what would be fun about the job, and if students would be interested in this job as an adult. Point out the general educational requirements for the job listed on each slide.

4. **Evaluate/Wrap-Up (5 min):**
   On the classroom board, write a list of the words and concepts that were covered in the lesson (dredged material, shipping channels, environmental specialist, dredge technician, 50 feet, 21 feet, port, cargo ship, erosion, Poplar Island, outreach education specialist). One by one, describe each word and allow students to guess which one you are describing. Once they have been reminded of all the lesson's vocabulary, ask students whether they would be interested in any of the jobs that they learned about and why.

DIVE DEEPER

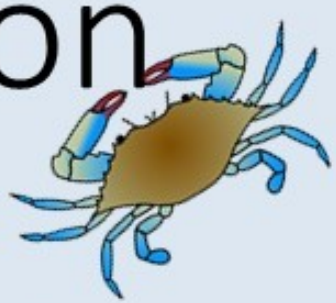
Have students brainstorm a list of other jobs that could be involved with the dredging process. As a homework assignment, have them choose one job to complete independent research to find the following:

1. Level of education needed
2. Average hourly wage
3. One interesting part of the job



When I Grow Up…

Jobs in Dredging and Restoration




Port of Baltimore
Poplar Island
Chesapeake Bay

PORT OF BALTIMORE
1706
Helen Delich Bentley

STARBUCKS
COFFEE

Orioles

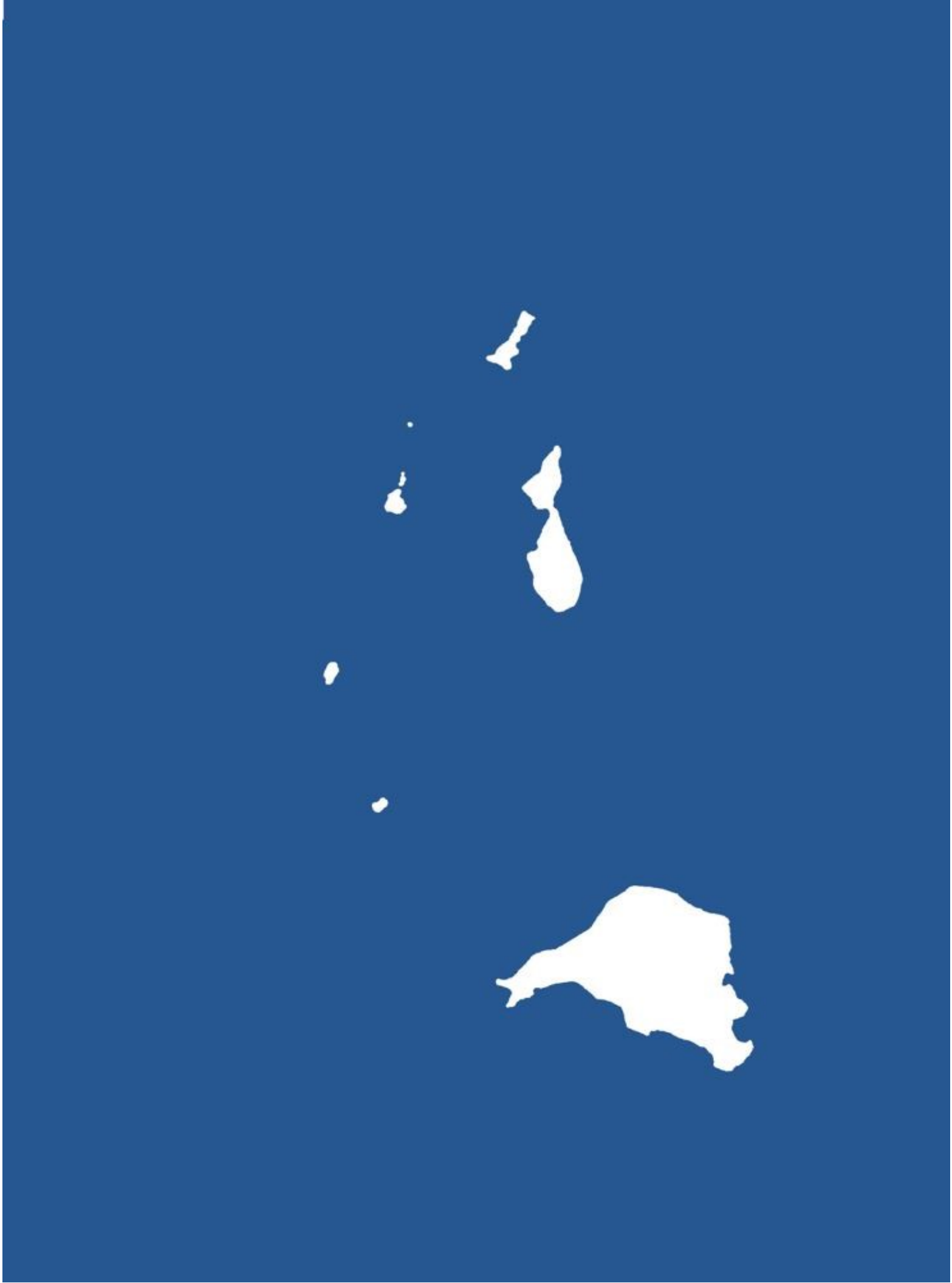
PORT OF BALTIMORE
1706
Helen Delich Bentley

PORT OF BALTIMORE
1706
Helen Delich Bentley

Poplar Island, 1847

Poplar Island

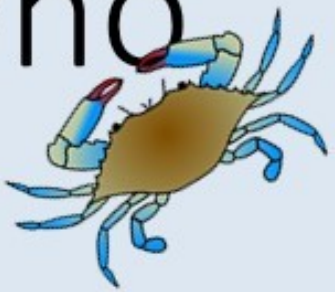
How much did Poplar Island change?



Can We Fix Poplar Island?

Whose Job Is It?

Meet the people who do this work!



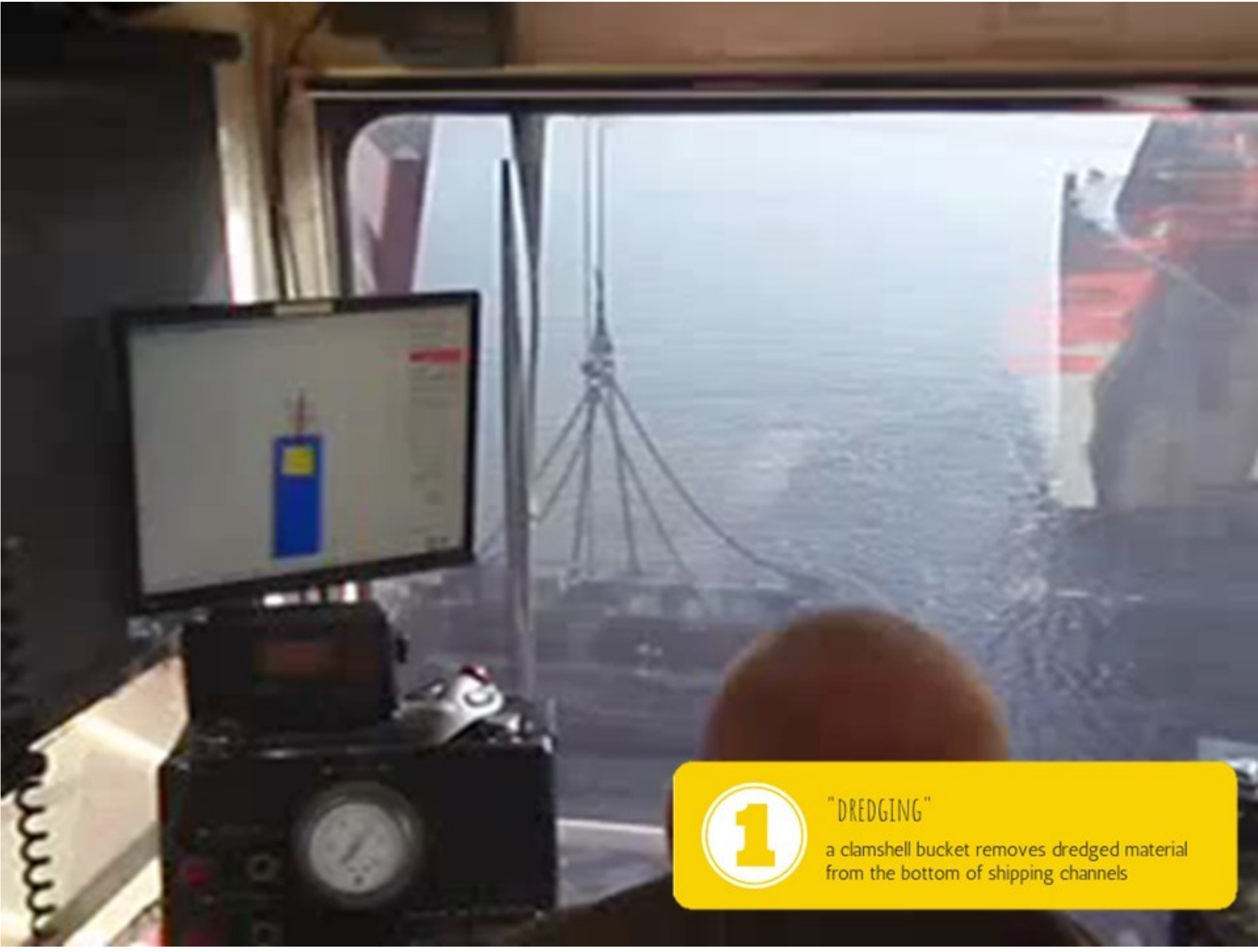
Meet the Dredge Technician!

Scoop that dirt!
Place that dirt!

1

"DREDGING"

a clamshell bucket removes dredged material from the bottom of shipping channels


1
"DREDGING"
a clamshell bucket removes dredged material
from the bottom of shipping channels


2
"SCOW"
dredged material is placed in a special, flat-bottomed boat, called a "scow," so it can be transported

3 "SLURRY"

dredged material is mixed with water from the Chesapeake Bay, creating a "slurry"

4

"INFLOW"

the slurry can be easily pumped or sprayed into a special placement site for dredged sediment

5 "DEWATERING"

after settling, the water from the slurry is pumped off or drained off the top of the dredged material

May

June

July

August

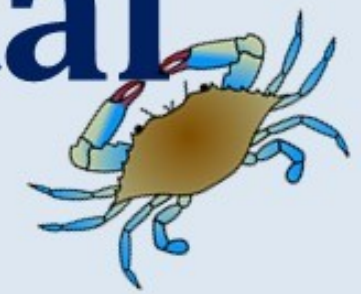
September

October

November

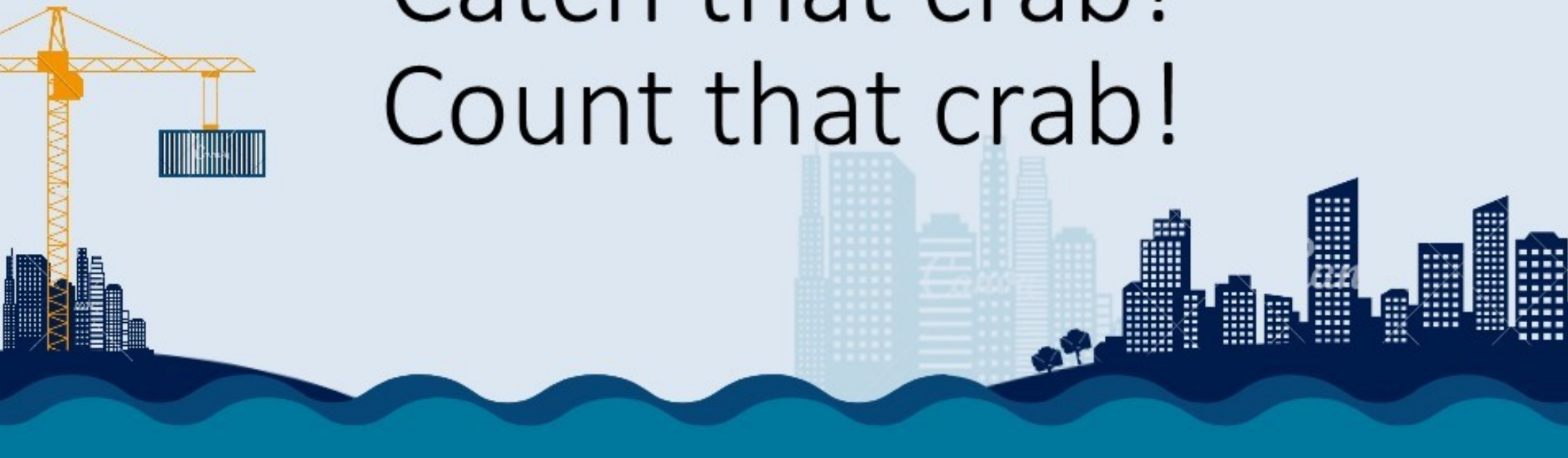

3 years later...

Meet the Environmental Specialist!

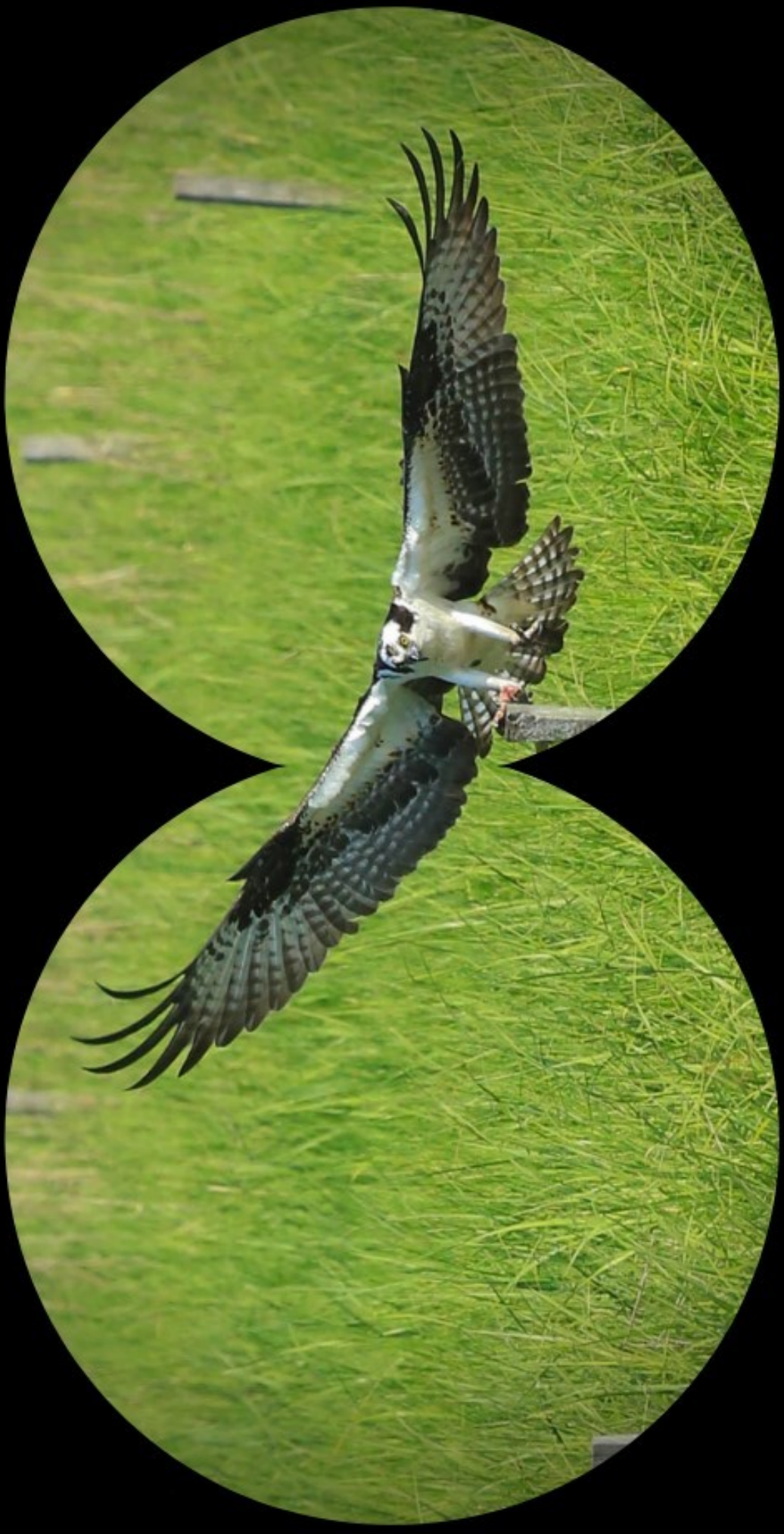



204 bird species have been documented on Poplar Island

Spot that bird!
Count that bird!
Spot that turtle!
Count that turtle!
Catch that crab!
Count that crab!



FULL STUDY BOARD
MAFOE

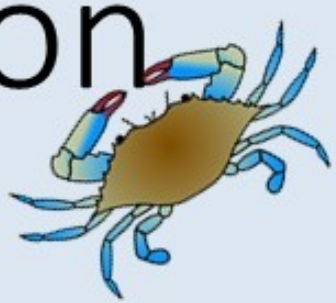


Meet the Outreach Educator!

How interesting!
How interesting!

When I Grow Up…

Jobs in Dredging and Restoration



Masonville Mitigation Rotation

GRADE LEVEL: 6- 12

TIME: 45 MIN

SUMMARY

In this lesson, students will be introduced to the concept of mitigation by studying mitigation projects at Masonville as part of the Dredged Material Containment Facility (DMCF) construction. They will understand Masonville mitigation projects have benefitted numerous species in a variety of ways.

OBJECTIVES

1. Learn about the Masonville DMCF and related mitigation projects.
2. Identify different animals and plants that have benefitted from the Masonville mitigation projects, and describe the benefits.

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 acres.
- **Benefit -** To receive an advantage.
- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - Any ship which is not a passenger ship, a ship of war and troopship, a ship which is not propelled by mechanical means, a wooden ship of primitive build, a fishing vessel or a mobile offshore drilling unit.
- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **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.
- **Endangered Species -** A species of animal or plant that is seriously at risk of extinction.
- **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 providing the required food, water, shelter, and space for survival.
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **Monitoring -** Observing and checking the progress or quality of a measurable indicator over a period of time; keeping the indicator under systematic review.
- **Patapsco River -** A river in central Maryland that flows into the Chesapeake Bay whose mainstem is 39 miles (63 km) long.

- **Reef Ball -** A structure made of a special marine friendly concrete that is designed to mimic a natural reef system. It is placed in the water to provide habitat and shelter to marine species.
- **Seining** - The process of catching organisms with a fishing net that hangs vertically in the water and has floats at the upper edge and sinkers at the lower.
- **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 primarily vegetated by large trees.
- **Urban -** A town or city.
- **Watershed** - A region or area from which all water ultimately drains into the same body of water.
- **Wetland-** Ecosystems containing water, specialized soils, and plants adapted to living in water-saturated soils. Marshes, swamps, and bogs are types of wetlands.
- **Wildlife Refuge -** An area designated for the protection of wild animals, within which hunting and fishing are either prohibited or strictly regulated.

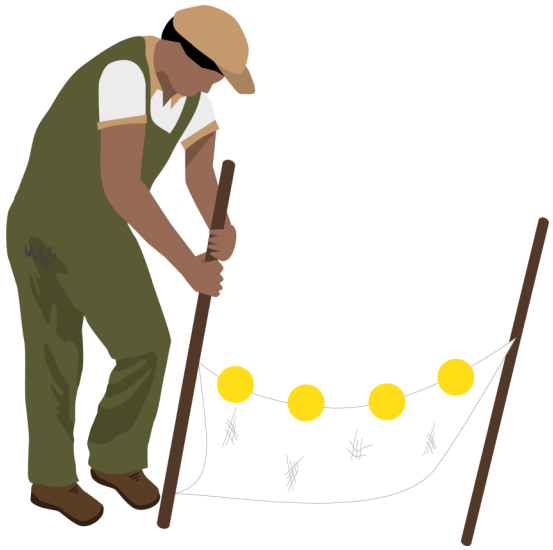
MATERIALS

- Masonville species lists
- Markers/highlighters, pens
- Station Packages (Provided by MES):
    - *Cleaning Up the Cove:* Photos of trash removed from the cove; information about how the geotextile layer, soil capping, and how they worked around the trees so as not to suffocate the roots
    - *Wetland Restoration and Construction*: Information about the acreage of restored and newly constructed wetland areas; Information about the benefits of wetlands
    - *Trash Interceptors:* Trash Wheel spinner board
    - *Reef and fish habitat*: information about the numbers of reef balls and acreage of improved habitat; Information from the Cox Creek map activity lesson plan about reef balls; miniature reef balls
    - *Terrestrial Habitat and Tree Planting*: information about the acreage of restored uplands and list of tree species planted; Information about the Masonville trees; tree ID book; tree cookies
    - *Education Center and Urban Wildlife Refuge Partnership:* U.S. Fish and Wildlife Service fact sheet

BACKGROUND

In order to keep the Port of Baltimore open for business, the Maryland Department of Transportation Maryland Port Administration must ensure that shipping channels are deep enough for cargo ships to travel through without running aground. Shipping channels in the Chesapeake Bay and the Baltimore Harbor must be dredged because the Chesapeake Bay has an average depth of only 21 feet, and as a result the approach channels to the Port of Baltimore are naturally too shallow to accommodate ships that require a maximum draft of 50 feet.

Dredging is the process of removing sediment from shipping channels using construction equipment. The sediment that is removed must then be placed in a dredged material placement site which is regulated and monitored to protect the surrounding environment. Prior to construction, placement sites are carefully planned and designed, and potential impacts to the environment are assessed before they can receive dredged material. If the assessment identifies ways that the environment, such as a wetland habitat will be impacted during construction, mitigation is then



required in the form of projects or programs intended to offset the known impacts to an existing historic or natural resource. Because the construction of the Masonville DMCF enclosed space that had been open water habitat in the river, mitigation at Masonville serves to counterbalance the site construction impact on habitat and wildlife. The Masonville DMCF has a 141-acre footprint that used to be 130 acres of tidal open water and river bottom, 1 acre of vegetated wetland, and 10 acres of upland. Mitigation projects encompass the restoration of 70 acres of water, including the placement of 2,000 reef balls and restoring 20 acres of shallow water habitat; as well as the enhancement or creation of 54 acres of land, including 11 acres of wetlands and one acre of fringe marsh.

ACTIVITY

1. **Engage/Elicit (15 min):**
   Introduce students to the concept of dredging in the Baltimore Harbor and the existence and background of the Masonville DMCF based on the Teacher Guide Introduction.

2. **Explore (20 min):**
   In small groups, students will be rotating between six different stations that provide information about some aspect of mitigation at Masonville. The students will have copies of the list of species documented at Masonville. At each station, they must look at the information provided and determine which species are benefitted by that type of mitigation. Students should be able to identify several species that benefit and be able to defend their choice of species. The groups will only have about 3 minutes at each station and will then rotate to the next station.

3. **Explain (10 min):**
   At the end, each group will give an example of one species that benefits from each mitigation project and provide a one-sentence explanation for why/how that animal benefits. No two groups can use the same animal example (groups should select a few animals that benefit from each type of mitigation rather than focus on just one species, as all groups must have different animal examples).

4. **Evaluate/Wrap-Up (15 min):**
   After the groups have rotated through the stations, take 10-15 minutes for students to present the species that they believed benefitted from each mitigation project, and for short debriefs about each type of mitigation.

DIVE DEEPER

Have students engage in a group discussion to answer the following questions:

1. What is the overall impression that students have of mitigation at Masonville? Does it appear to be positive? Do they think it is serving the purpose of offsetting the known impacts of the DMCF construction to the existing natural resources in the area?
2. There's a word for how many different kinds of animals are at a site: biodiversity. Do the students feel that there is good biodiversity at Masonville? What can that tell us about the quality of the habitat?
3. Was there any mitigation effort that surprised the students (that they didn't expect would be included)? Are there any mitigation they would include if they were designing the project?
4. Are there other examples of industry development and environmental mitigation that students are aware of? In their communities or near their schools?

U.S. Fish & Wildlife Service

Masonville Cove Urban Wildlife Refuge Partnership

Baltimore, Maryland

urban wildlife refuge PARTNERSHIP

What began as the restoration of an abandoned and contaminated area near Baltimore Harbor has grown into a nationally recognized partnership connecting the city's residents to the outdoors. The U.S. Fish and Wildlife Service designated Masonville Cove as the nation's first Urban Wildlife Refuge Partnership on September 26, 2013.

A thriving community once flourished at Masonville Cove. However, railroad tracks were built in the mid-1900s preventing access to the river, and the area was eventually abandoned.

The Maryland Port Administration built the Masonville Dredged Material Containment Facility, east of the cove on the Patapsco River. The facility is a repository for material dredged from Baltimore Harbor to maintain shipping channels. To mitigate impacts from the construction of the facility, the local community is working with MPA to implement a plan with three core elements: to restore Masonville Cove; to establish an environmental education facility at the site; and to secure seed funding for environmental education. Since 2007, the Masonville Cove project has resulted in the removal or recycling of more than 60,000 tons of debris, some of which is said to have originated from the Great Baltimore Fire of 1904.

The partnership has also established the Masonville Cove Environmental Education Center, housed in a prototype net-zero energy efficient building opened in 2009. Living Classrooms, the National Aquarium and other organizations have provided environmental education programming at the center since that time, as well as in the Baltimore schools since 2007. To date, they have reached more than 8,000 students and 330 teachers.

In October 2012, a portion of Masonville Cove's nature area was opened to the public. To ready the site, invasive plants, unhealthy trees, and dangerous and hazardous debris were removed from an 11-acre parcel of land. The area was capped with clean soil and is being replanted with native trees, shrubs and wetland plants. The nature area includes walking trails and offers opportunities for bird watching and fishing from a designated pier. A floating dock was installed for kayakers and canoeists. The nature area in just a few years time is planned to include 71 acres of water and 54 acres of land open for free use by the public.

In May 2013, Masonville Cove competed nationally to be designated as an Urban Wildlife Refuge Partnership. The U.S. Fish and Wildlife Service has been working with Masonville Cove partners for almost two years to provide assistance with visitor services and wildlife management at the site.

The designation of the Masonville Cove Urban Wildlife Refuge Partnership is a formal recognition of excellence under the Service's Urban Wildlife Refuge Initiative. Under the initiative, the Service is striving to make the outdoors more meaningful and accessible to urban audiences. This partnership provides a cost effective, innovative way to enable urban communities to learn more about the National Wildlife Refuge System and wildlife conservation, and to gain an appreciation for the outdoors.

Living Classrooms will continue to provide environmental education opportunities, field trips, community programs and internships at Masonville Cove. The National Aquarium will provide community-based restoration opportunities, volunteer environmental monitoring training, and reach students through their field-based education programs.

Learn more at
http://www.masonvillecove.org

USFWS

Shoreline planting at Baltimore Harbor

living classrooms learning by doing

MARYLAND ENVIRONMENTAL SERVICE

GreenPort of Baltimore

Chesapeake Conservancy

NATIONAL AQUARIUM

Baltimore Rivers to Harbor Urban Wildlife Refuge Partnership

Baltimore, Maryland

Karen Mullin

Community Garden Planning

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The Masonville Cove Environmental Education Center opened in 2009. In October 2012, a portion of Masonville Cove's nature area was opened to the public. The nature area includes walking trails and offers opportunities for bird watching and fishing from a designated pier. A floating dock was installed for kayakers and canoeists.

Since it's designation in September 2013, The U.S. Fish and Wildlife Service, Living Classrooms Foundation, the Maryland Port Administration, and the National Aquarium have leveraged over $1.9 million at Masonville Cove through a variety of grants. Approximately 14,500 student and more than 660 teachers have participated in environmental education programs.

Given the successes at Masonville Cove Urban Wildlife Refuge Partnership, the partners have created a plan for an expanded "Baltimore Rivers to Harbor" Urban Wildlife Refuge Partnership. Collaborating with community-based organizations, government agencies, and other institutions, the Service will connect residents with green corridors and Chesapeake Bay waters. Building stronger connections to nature and wildlife will enhance the social and economic vitality of Baltimore communities and will provide the foundation for a shared regional ethic of environmental stewardship.

Over the course of the next 10 years, the Partnership will grow from the communities around the Middle Branch and Masonville Cove into the key watersheds of Jones Falls, Gwynns Falls, and the Patapsco River through:

- Expanding youth employment opportunities and conservation careers
- Enhancing connectivity and accessibility of green spaces
- Restoring and protecting green space through habitat restoration and land protection projects that provide wildlife habitat, climate change resiliency, and community recreation and education.

Partners

Partners include the U.S. Fish and Wildlife Service, Greater Baltimore Wilderness Coalition, Maryland Department of Natural Resources, USGS, City of Baltimore, Maryland Environmental Service, GreenPort of Baltimore, Chesapeake Conservancy, Baltimore's National Aquarium, Living Classrooms, and Parks & People Foundation.

Learn more at Baltimore Rivers to Harbor Urban Refuge Partnership.

For more information, contact:
National Wildlife Refuge System
U.S. Fish & Wildlife Service
5275 Leesburg Pike
Falls Church, VA 22041-3803
www.fws.gov/urban

urban wildlife refuge PARTNERSHIP

September 2016

Masonville Cove Wetlands

WHERE IS MASONVILLE?

Masonville is located southwest of Fort McHenry, on the western shore of the Patapsco River in Baltimore City.

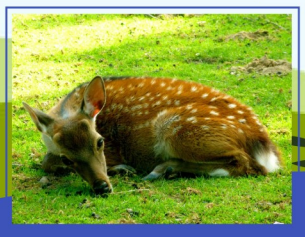
WHAT IS MASONVILLE COVE?

Masonville Cove is an area containing restored wetlands and uplands, a pier on the Patapsco River, and over 8,000 feet of trails. Wetlands like those at Masonville Cove were once common habitats in coastal Maryland, and are extremely valuable to fish, birds, and people.

WHY HAVE WETLANDS CHANGED?

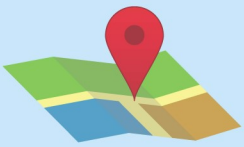
Many wetlands have been degraded or destroyed by human activities. By around 1950, the wetlands and other habitats at Masonville Cove had become a dumping site for garbage and debris.

WHO USES WETLANDS?



WHO DAMAGED WETLANDS?

Masonville Cove Wetlands



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WHO USES WETLANDS?

MIGRATORY BIRDS:
Wetlands act as important stopovers for migratory birds looking to find food and rest.

WETLAND PLANTS AND ANIMALS:
Many species of plants and animals are only found in this habitat, and support the land-water connection.

EVERYDAY PEOPLE:
Wetlands naturally control floodwaters and buffer the severe effect of storms and hurricanes on surrounding areas.

ENDANGERED SPECIES:
More than 1/3 of endangered species in the U.S. live exclusively in wetlands. More than half of endangered species use the wetlands at some point in their lives.

HUNTERS AND FISHERS:
Wetlands are popular with hunters and fishermen because of the abundant fish and animals that live in wetlands.

YOUNG ANIMALS:
Wetlands serve as a nursery for animals that spend the latter part of their life elsewhere. Wetlands provide abundant food and hiding places to many kinds of young animals.

WHO DAMAGED WETLANDS?

18th CENTURY HUMANS:
During this time people regarded wetlands as wastelands, and as centers of disease and insect infestation. They commonly avoided or eliminated these areas.

19th CENTURY DOCTORS:
After multiple yellow fever epidemics, wetlands were drained to destroy the breeding grounds of the mosquitoes that carried the disease.

EVERYDAY PEOPLE:
Until the recent past, wetlands were considered undesirable areas, and many people treated them as dumping grounds. Also, litter from surrounding areas turned into runoff pollution, flowing down the landscape with the rain and polluted wetlands.

FARMERS:
Wetlands were converted into farmland, and specialist plants and animals were replaced with crops and livestock. As a result, these areas no longer functioned as wetlands.

DEVELOPERS:
Wetlands were drained and the areas were used for industrial and residential buildings that benefited from proximity to the water.

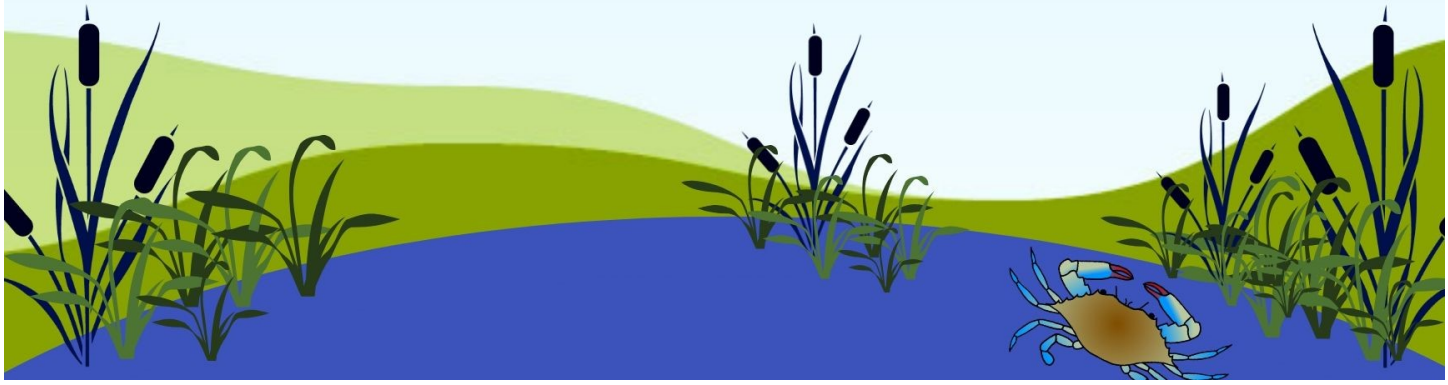
Masonville
Cleaning up the Cove

By around the 1950s, Masonville had become a dumping site for garbage and debris. Some of this was in the area that the DMCF now occupies; other litter and debris were in the Cove area. Debris from the Great Baltimore Fire (1903), old cars, broken appliances, tires, and other garbage was dumped at Masonville.

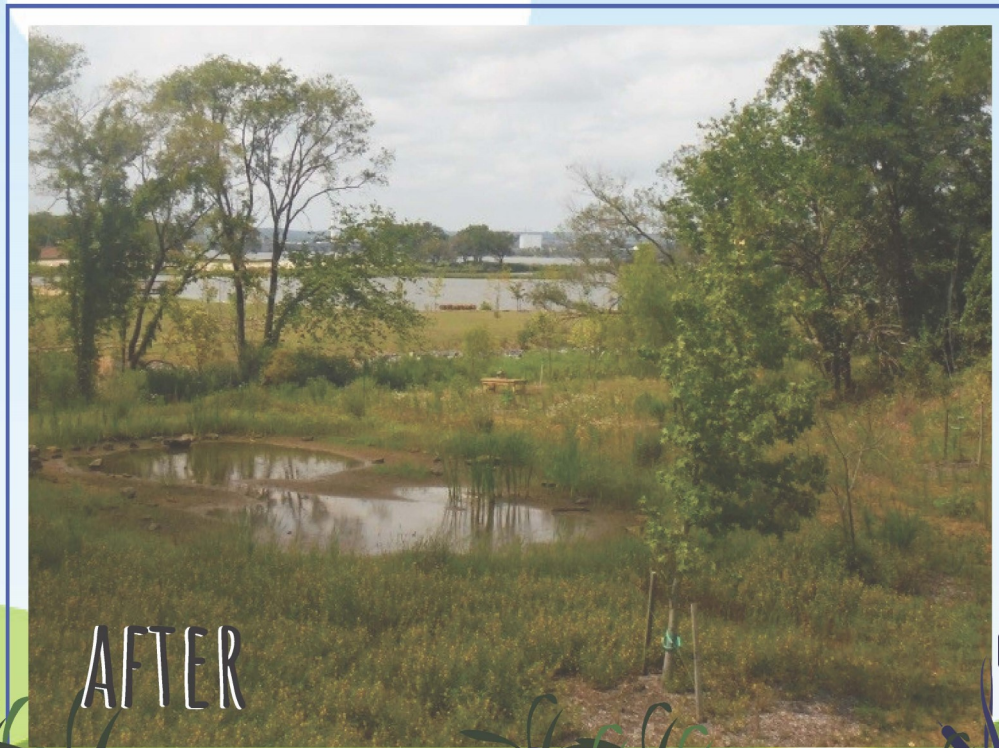
Restoration of Masonville Cove began in 2007. The extensive clean-up has included the removal of derelict vessels and debris from the water and surrounding land. Over 14,000 tons of metal, wood, and concrete were removed from Masonville Cove.

As a part of cleaning up the site, a "geotextile" layer was placed on top of the existing contaminated soil in the Cove, creating a physical barrier to the contaminated soil. At least two feet of clean soil was then placed on top of this, "capping" the site and providing clean, healthy soil for plants and wildlife. The Cove was planted with a native plant mixture.

Today, Masonville Cove has restored wetlands and uplands, a publicly accessible pier, over 8,000 feet of educational trails, and is the site of the Masonville Cove Environmental Education Center.



Masonville Cove
Before and After



BEFORE


BEFORE

AFTER

REEF BALLS

REEF BALLS

Masonville Cove Wetlands
Mitigation by the Numbers

2 ACRES existing tidal wetlands enhanced

4.1 ACRES new tidal wetlands created

5 ACRES new non-tidal wetlands created

1 ACRE new fringe marsh created along the DMCF dike

Volunteers from the National Aquarium, local Brooklyn schools, and other community members have helped plant in the wetlands at Masonville Cove.

The wetland species planted include Spartina (a grass species), wax myrtle, groundsel bush, and marsh elder.

Masonville Cove
Trees

TREES PLANTED

IN ZONE 1

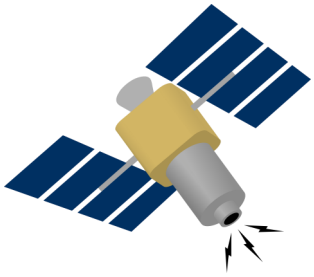
Black Willow
Redbud
River Birch
Silver Maple
Sycamore
Sweetbay
Magnolia
Red Maple
Pin Oak
Willow Oak
Chestnut Oak
Swamp White Oak
Sweet Gum
Black Gum

IN ZONES 2 AND 3

Loblolly Pine
Black Gum
Pin Oak
Hawthorn
Dogwood
Willow Oak

TREE SURVIVAL

Species	Dead	Alive	Total Counted	Survival Rate (%)
Pin Oak	7	231	238	97%
Willow Oak	1	361	362	99%
Loblolly Pine	67	199	266	75%
Black Gum	11	226	237	95%
Hawthorn	7	279	286	98%
Dogwood	11	45	56	80%
Total	104	1341	1445	93%



Geocaching

GRADE LEVEL: 6- 12

TIME: 45 MIN

SUMMARY

In this lesson, students will learn how satellites interact with Global Positioning System (GPS) devices. Students will learn how to interpret geographical coordinates in order to locate geocaches.

OBJECTIVES

1. Participants will learn how to use a GPS device.
2. Participants will understand how a geocache works with satellites.
3. Participants will take part in geocaching to explore a Port of Baltimore mitigation site.

VOCABULARY

- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **Dredging-** The process of removing sediment from shipping channels.
- **Dredged Material-** Sediment removed from the shipping channels.
- **Latitude** - A measure of the angular distance of a location from the earth's equator (north or south). Latitude is usually expressed in degrees and minutes.
- **Longitude** - A measure of the angular distance of a location from the meridian at Greenwich, England (east or west). Longitude is usually expressed in degrees and minutes.
- **Satellite** - An artificial body placed in orbit around the earth or moon or another planet in order to collect information or for communication.
- **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).

MATERIALS

- Geocache – example: waterproof box that contains a few small items/prizes in addition to a log and pen
- Multiple GPS devices or Smartphones with the Geo-caching Application
- White board
- Markers

BACKGROUND

Geocaching is an outdoor recreational activity for all ages. Individuals explore new environments throughout the world while searching for "geocaches" or "cashes". Inside the geocache, there are a variety of small objects and a log where you can find out who else has also found the box. Participants have the option to take one of the small items and replace it with one of their own objects to leave for someone else to find. In order to find the geocache, one enters its geographical coordinated into a Global Positioning System (GPS) device or a smart phone with the Geo-caching application to locate its position.

ACTIVITY

Engage/Elicit (15 min):
Have students sit around in a circle. Open with the following questions:

1. Do you know where you are?
2. How did you get here?
3. What do you do when you get lost?

Explain one way people keep track of their location is by using Global Positioning System (GPS) units that use satellites to pinpoint their location in the world. (Hint: This is why you can only use them outside). You need three satellites to have an accurate location. If you have

more, you will have an accurate elevation too. By using three satellites, they triangulate your location.

2. **Explain (10 min):**
   GPS units tell us where we are by using coordinates on a map. Draw a map or a circle on the board. The earth is split up into quadrants. The first way the earth is divided is by the equator. It gives us the northern hemisphere and the southern hemisphere. The earth is then again divided by east and west, using the prime meridian. *We are located in the NW quadrant.*

   Before the students head out to find the geocaches, explain what they are looking for by using the example cache. Explain that after they find the cache, open it up to read the message inside. After they read the message, take the prize and re-hide the cache in "the same exact spot". After instructions were given have the students find the geocaches. Help students who are having trouble.

   How to use the GPS: The easiest way to have students feel comfortable with the GPS is having them do these steps as you walk through them. First explain the buttons to the students. Explain they should not have to use the 3-button (left) side.

   1. Look at the two-button (right) side. Press and hold the button with the light bulb on it. The GPS should make a sound as it turns on.
   2. The GPS will start acquiring satellites. Once the satellites are acquired it will flip to the map screen.
   3. Explain that the button with an X on it is how you flip through the different screens.
   4. Flip to the blue screen which is the orienteering screen. Explain that this is the screen they will be using when they are trying to find the caches. They will be following a red arrow that will show them the direction. The top right box is also important. It tells you how far away they are from the cache.
   5. Using the X button, flip to the main menu screen. Explain how on this screen they will be using the joystick to move around on this screen. Using the joystick move down and highlight the word "Find". Push down on the joystick to go into the "Find" sub-screen.
   6. Using your joystick highlight the word "Waypoints" and push down on the joystick to enter the waypoints submenu.
   7. Using the joystick highlight the assigned letter. Push down on the joystick. The screen tells you about this cache. The word "Go to" should be highlighted. Push the joystick down again.

   Using the X button scroll to the blue compass screen. Follow the red arrow to the cache. IMPORTANT: The arrow only points in the correct direction while you are moving. When you get within 15-30 ft. start looking. If they get lost, see the piece of paper attached to the GPS (below)

3. **Explore (20 min):**
   Let students use the GPS units to find their identified geocache(s). Assist students who are having difficulty with GPS units or finding the geocache.

4. **Evaluate/Wrap-Up (10 min):**
   When the group has reassembled, review each of the geocaches' site information with the students. Explain how human interactions with the environment can cause positive and negative effects on the environment. Have students think about how they can cause positive changes to the site they have visited.

DIVE DEEPER

Ask students if they were able to design mitigation projects, what would they do? What was their favorite project that they learned about? Do they have any new ideas that could benefit the environment?

Become a Birder

GRADE LEVEL: 4- 12

TIME: 40 MIN

SUMMARY

In this lesson, students will be introduced to the concept of bird identification, study adaptations of native birds of Maryland, and think about how birds can serve as valuable indicators of ecosystem health. This activity will take place outside at a mitigated/restored site. Students will learn how dredging in the Chesapeake Bay has supported mitigation projects at Cox Creek and Masonville and environmental restoration projects at Hart-Miller Island and Poplar Island. Students will also learn how these projects benefit numerous species, especially birds.

OBJECTIVES

1. Learn about the Cox Creek Dredged Material Containment Facility (DMCF), the Masonville DMCF, and environmental restoration projects at Hart-Miller Island and Poplar Island.
2. Identify different adaptations of birds and explain how they are beneficial.
3. Explain how birds serve as indicator species in an environment.

VOCABULARY

- **Adaptation -** A behavior or physical feature that enables an organism to survive in its habitat.
- **Biodiversity -** The variety or diversity of organisms in a habitat or ecosystem.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** Sediment removed from shipping channels.
- **Dredged Material Containment Facility -** A placement site for sediment removed from shipping channels. DMCFs are planned, constructed, and monitored by government agencies.
- **Fauna -** The animals in an area.
- **Flora -** The plants in an area.
- **Habitat -** The natural home or environment of an animal, plant, or other organism, which provides food, water, shelter, and space.
- **Indicator Species -** An organism that is sensitive to changes in the environment, and which acts as an indicator of an ecosystem's quality and health.
- **Migration -** The movement of animals from one location to another based on seasons
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **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.
- **Wetland -** Ecosystems containing water, specialized soils, and plants adapted to living in water-saturated soils. Marshes, swamps, and bogs are types of wetlands.

MATERIALS

- Binoculars
- Laminated photographs of birds
- Clothes pins
- Maryland bird identification booklet

BACKGROUND

At Cox Creek and Masonville, the construction of DMCFs required using space that had originally been open water habitat in the river. Therefore, mitigation projects were created at both locations to offset the impact of the construction and the DMCF on habitat and wildlife. At Hart-Miller Island and Poplar Island, hundreds of acres of island habitat are being restored using dredged material.

Both mitigation and environmental restoration projects associated with dredging are used to improve habitat in Maryland—at Cox Creek, Masonville, HMI, and Poplar Island, thousands of acres of tidal open water, river bottom, vegetated wetlands, and uplands are created or restored to their original conditions. Providing birds with high quality habitat is essential for their populations to thrive. Since many birds migrate, improving habitat through mitigation or restoration also has the potential to benefit countless birds as they travel along their migratory flightpath, the Atlantic flyway. Birds will use restored habitat as places to stop, rest, and find food before they continue migrating.

Environmental specialists monitor the birds and other wildlife found at Cox Creek, Masonville, HMI, and Poplar Island. Nearly 300 species of birds have been identified at Cox Creek and Hart-Miller Island, over 230 species of birds at Masonville, and over 240 species of birds at Poplar Island. Given the large number of different kinds of birds found at each site, it can be said that the biodiversity at these sites is high. As birds are considered an indicator species, the presence of large numbers of diverse species serves as one indication of the quality of these restored and mitigated habitats.

PREPARATION BEFORE ACTIVITY

Survey the expected location prior to the activity. Print, cut out, and laminate the images of birds provided. Use clothes pins to attach the images to plants and other objects; aim to space the images out evenly in the area used for the activity. Identify and define boundaries where students can stand to view images so that they remain a certain distance away from the laminated photos (and must use their binoculars).

ACTIVITY

1. **Engage/Elicit (5 min):**
   Begin by explaining the concept of dredging in the Chesapeake Bay and the background of the mitigated or restored site where the activity is based. Explain to students that they will be learning about and identifying birds. There are several reasons that studying birds can be valuable. For instance, birds are an indicator species, meaning that their presence and health can be a sign of the health or quality of the environment they are in. Additionally, anyone can study birds; birds are relatively easy to observe, and birding does not require much equipment.
2. **Explore (15 min):**
   Instruct students to find a partner with whom they will work for the lesson. Explain that each pair will be using a pair of binoculars and a bird guide to identify the bird photos that have been placed in the outdoor area and clarify the physical boundaries of the activity (where students can stand to view the photos). Briefly review how to use binoculars. Provide the students with binoculars and picture identification booklets of native birds to Maryland. Instruct the students that they will have 5-10 minutes to identify the pictured birds the provided supplies; pairs should attempt to identify all the bird photos in that time. Adding a competitive element (e.g., the first group to ID all the birds correctly wins) often stimulates additional engagement in the activity.
3. **Explain (10 min):**

At the end, ask the students "If you were a scientist, how would you take measurements to determine if the environmental mitigation was successful"? Explain the concept of indicator species and discuss what wildlife they observed.

4. **Evaluate/Wrap-Up (10 min):**
   Ask students to share their experience of bird identification. Was it challenging? The instructor will provide the correct names of the species pictured at the site.

   (Optional) If there is extra time, challenge groups to independently identify one living bird onsite, and to note its natural surroundings/habitat as well as a few of its adaptations.

DIVE DEEPER

The instructor should facilitate a group discussion to answer the following questions:

1. What is the overall impression that students have of the site? Do they think it is serving the purpose of providing a habitat?
2. Were there any mitigation/restoration efforts at the site that surprised the students (things that they didn't expect that would be included)? Are there any elements that they would include if they were designing the project?
3. Ask students if they know the word that refers to how many different kinds of organisms are found at a site: biodiversity. Do the students feel that there is high biodiversity at this site (e.g., are there many different species)? What can that tell us about the quality of the habitat?
4. Why would different adaptations of a bird's beak and color pattern be useful?

American Goldfinch

American Robin

Bald Eagle

Baltimore Oriole

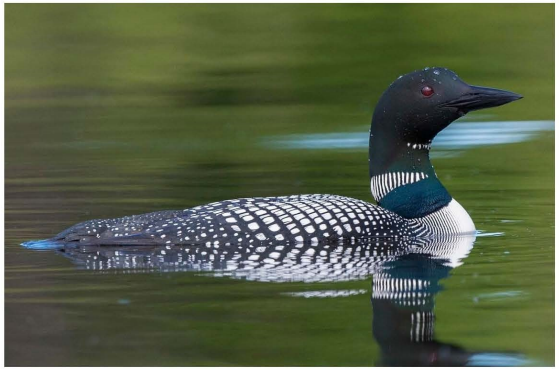
Black Vulture

Blue Jay

Cardinal

Carolina Chickadee

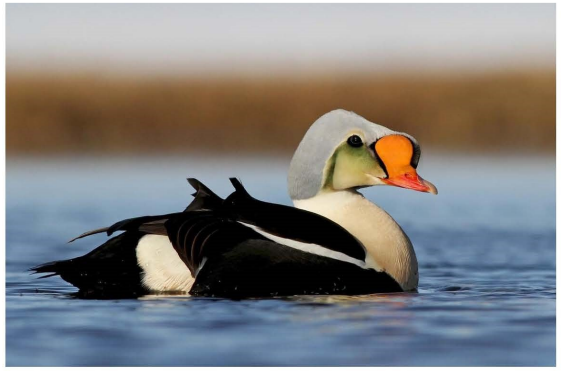
Clapper Rail



Common Loon

Eastern Towhee

Great Blue Heron



King Eider

Orange-crowned Warbler

Osprey

Purple Martin

Red Crossbill

Red-necked Grebe

Red Bellied Woodpecker

Red Winged Blackbird

Rough-legged Hawk

Snow Goose

Snowy Egret

Tree Swallow

Turkey Vulture

Wild Turkey

Yellow-crowned Night-Heron

Map-tivity: The Story of Poplar Island

GRADE LEVEL: 9 - 12

TIME: 50 MIN

SUMMARY

In the lesson, students will gain an understanding of the unique history of Poplar Island.

OBJECTIVES

- Students will interpret and discuss the map/ infographic within small groups.
- Students, in small groups, will provide presentations to the class on the information they interpreted from their map/infographic.
- Students will use critical thinking skills to discuss and connect the four class presentations to tell the story of Poplar Island.

MATERIALS

- 4 White Boards or large easel pads
- Dry erase markers (assorted colors) or use markers, crayons, etc. on large Post-it easel pads
- Poplar Island maps/infographics/posters
    - "Vanishing Islands of the Bay" short story
    - "Poplar Island 1914" map
    - "Poplar Island 1969" map
    - "The Port of Baltimore: How Do We Dredge?" infographic
    - "The Port of Baltimore: Economics 101" infographic
    - "What's in Dredged Material?" handout
    - "Dredging for Safe Passage" handout
    - "Economic Impacts, Cargo and More!" video*
    - "Why is Dredging Important?" video*
    - Jar of wet dredged material**
    - "Sediment to Solutions: Channeling
    - Innovation" infographic (front and back)
    - "Innovative & Beneficial Use" handout
    - "What is Dredged Material?" video*
      "Other Uses for Dredged Material" video*
    - Jar of dry dredged material**
    - "Restoration of Poplar Island" poster
    - Lists of fauna observed on Poplar Island as of May 2017, which includes spiders and insects, amphibians and reptiles, birds, mammals, fish, and decapods.
    - "In Chesapeake Bay, Poplar Island is a man-made miracle" news article

**Videos can be located on the Port of Baltimore's YouTube page. Links as follow.*

- "Economic Impacts, Cargo and More!" video https://www.youtube.com/watch?v=iPlGNxqifvE
- "Why is Dredging Important?" video https://www.youtube.com/watch?v=IRwarQxkUYQ
- "What is Dredged Material?" video https://www.youtube.com/watch?v=CnjgdimzMSA
- "Other Uses for Dredged Material" video https://www.youtube.com/watch?v=SRv_TU54AMQ

***Jars of wet and dry dredged material can only be included in the lesson if MES Education and Outreach staff presents the lesson in a classroom or field trip setting.*

BACKGROUND

Poplar Island is a special island located in the Chesapeake Bay just off the coast of Talbot County's Tilghman Island, Maryland. In 1847, Poplar Island was surveyed for the first time, which found the island to be roughly 1,140 acres (461 hectares) in size. An acre is about the size of a football field, making the island nearly 1,140 football fields large!

The first record of anything happening on the island was in 1627. In 1627, William Claiborne owned and named the island after his friend Richard Popeley. For some time, the island was known as Popeley's Island but over the year the name got butchered and eventually became Poplar. There are no known significant events that occurred on Poplar Island in the 18th century, but it is known that people lived on the

Island and raised livestock, as well as farmed the land for corn, wheat, tobacco and other things.

The next record of events on Poplar Island was in 1847. Charles Carroll, the grandson of the Charles Carroll that signed the Declaration of Independence, owned Poplar Island. Mr. Carroll became an entrepreneur. He somehow found out that there was a great market in China for black cat fur. Mr. Carroll started his own black cat farm on Poplar Island. He purchased black cats from people in the community for $.02/each. Surprisingly, his black cat farm went really well until the winter. The Chesapeake Bay is rather shallow, on average only 21 feet deep, and the winter was so cold that the Bay actually froze over. The frozen Bay served as a bridge and allowed all of the cats to run back to the mainland.

In the 1880s there was a town on the island, named Valliant; about 100 people lived on the island. There were roads, a church, a general store, a post office, a school house, and even a saw mill. The saw mill was located on the north end of the island; it was used to cut down trees to either build their homes or to clear the land for farming. Coincidentally, the 1880s is about the time when erosion of Poplar Island became noticeable. When the trees were removed, so was the root system, or the glue that held the island together. The erosion got so bad that the residents of Valliant were forced to move back to the mainland by the 1920s.

In the 1930s, members of the Democratic Party (Democratic Club) purchased both Poplar islands and neighboring Jefferson Island. The Club built a lodge on Jefferson Island and started an exclusive, men's-only hunting and fishing club. They would invite elected officials to purchase a membership to come out to Poplar on the weekends to hunt, fish, and talk politics. The two most famous people to visit Poplar were Harry S. Truman and Franklin Delano Roosevelt. Unfortunately, in 1946, the lodge burned down due to an electrical failure, which ended the Democratic Party's visits to Poplar.

After the Democratic club left, the Bailey family lived on the neighboring Jefferson Island and served as caretakers from the late 1940, to the early1950s. The family was forced to move back to the mainland in the 50s because of continued erosion of the island. Peter Bailey, the youngest of the Bailey family, currently lives in Easton and wrote a book entitled "Poplar Island: My Memories as a Boy." After the Bailey family left Poplar, the Smithsonian Institute purchased Poplar Island. The Smithsonian used the island for research but there was no further excitement concerning Poplar Island until it was taken on by the Maryland Department of Transportation Maryland Port Administration (MDOT MPA) and the United States Army Corps of Engineers (USACE).

Over the course of 150 years, the island nearly eroded away entirely. Wind, waves, currents, all crashed down on the island, and slowly broke away pieces of land and washed the sediment into the Bay. This erosion was accelerated by the human activities that took place on Poplar Island for over 100 years. In 1993, USACE surveyed Poplar Island again and found that the island had not only shrunk in size but it had also split apart into 4 tiny remnant islands. The 1993 survey revealed that only 5 acres remained of Poplar Island. Poplar Island virtually disappeared. In response, the USACE is working with MDOT MPA to rebuild Poplar Island back to its historical size of about 1,140 acres. USACE and MPA are able to use dredged material to rebuild the island. Dredged material is sediment that is dredged from the bottom of shipping channels to allow safe passage for large cargo ships carrying imports and exports. The material used to rebuild Poplar Island is dredged from the bottom of the shipping channels in the Chesapeake Bay.

Each year, hundreds of cargo and cruise ships travel to and from the Port of Baltimore. The navigation/ shipping channels these ships use to travel require frequent dredging to maintain the channel depth of 50 feet that is required by many of today's ships. On average, five million cubic yards of sediment is dredged from shipping channels in the Baltimore Harbor and the approach channels in the Chesapeake Bay every year. MDOT MPA and USACE work together to conduct annual dredging and find placement sites for the dredged material.

Sediment in the Chesapeake Bay consists of clay, silt, and sand. Regional geologic formations and human activities affect the character of the sediment in different areas of the Bay. Industrial activity, agriculture, and urban development are some of the activities that can impact the sediment that ends up in the shipping channels of the Chesapeake Bay. Sediment dredged from the channels is tested and managed in accordance with state and federal requirements.

Usually, material dredged from the channels is placed in a placement site which is an area enclosed by a dike.

The material is placed in these sites and allowed to dry out and becomes new land. Dredging usually occurs between November and March. Dredging is conducted in the colder months for two reasons. One reason is that it is less disturbing to any species of fish that may be spawning in the Bay. The second reason is to allow the material to settle and dry during the warm, summer months.

During the dredging season, a dredging contractor will go to the shipping channel and take what is called a clam shell bucket and dig down to a depth of about 50 feet. There is specialized equipment associated with maintaining the channels at a depth of 50 feet, but the most important is the dredge itself. A dredge is essentially a crane on a barge. The cables of the crane are connected to the clam shell bucket and used for the excavation the channels. The dredge operator will bring a bucketful of sediment to the surface and place it into a large barge with an open top called a scow. Some scows can hold up to 8,000 cubic yards of sediment. Once a scow is full, it is tugged to Poplar Island. The dredged material is rather hard to work with. To make the material easier to move, it is watered down using an unloader. An unloader has a large, maneuverable arm that houses water cannons and a snorkel-head. The scow full of dredged material will be pushed up against the side of the unloader and the arm will be lowered into the scow and into the dredged material. The water cannons pump Bay water into the scow at a very high velocity, agitating the material into a liquid slurry. As a result, this makes the mixture about 90% water and 10% dredged material, which will be pumped hydraulically through pipes onto the island. This first major step of island creation is known as inflow.

The next step, known as crust management, is when the material is dewatered and dried. The Island is dewatered by using metal structures called spillways. Spillways at Poplar Island have two large pipes that run underneath the perimeter dike that allow the water within the cell to be pumped out in to the Bay. Before water is released back in to the Chesapeake Bay, it is heavily monitored and tested. Inspectors on the island visit each spillway on a daily basis and test the water for turbidity, pH, and metals. Water quality standards set by the Maryland Department of Environment (MDE) must be met before water can be released from the island. If standards are met, then inspectors will open the spillways and release the water into the Bay. If the acceptable levels are not met, the water will remain within the perimeter of the dike and given time to naturally reach MDE standards and the water is continuously tested until standards are met. This step is considered crust management because it is when the material is dewatered and given time to dry out into a crust. These steps are repeated until the cell is completely filled and the material is completely dried out. At that point, tidal wetlands and upland habitats can be created and the island can be planted with native species.

Dredged material is not just used to build islands. It has also been used to restore wetlands, create upland wildlife habitat, and build new terminal space for the Port of Baltimore. Other ports around the world have used dredged material to cap landfills and brownfields, remediate former mines, and make building materials such as aggregate. If dredging did not occur, cargo ships could not safely get through to the Port of Baltimore, which could cost the state of Maryland billions of dollars and thousands of jobs. Dredging the navigation channels is pertinent to the Port of Baltimore maintaining its economic competitiveness.

Historically, "open water placement" was used to dispose of dredge material, meaning the material would be placed in an unconfined manner in other areas of the Bay. Open water placement ceased in 2010 because it was mandated by law. This enabled the state to move in the direction of confined disposal and beneficial use, to do something beneficial with the dredged material by restoring lost habitat rather than placing the material back into the Bay or ocean. USACE and MDOT MPA are rebuilding Poplar Island and restoring important Chesapeake Bay habitat. This is an example of a win-win situation: MDOT MPA is able to keep the shipping channels safe for passage, and the sediment is rebuilding habitat that was nearly lost.

USACE and MDOT MPA started construction of Poplar Island in 1998. The first 3-4 years of construction was just building the border perimeter of the island out of large armor stone. The perimeter of the island restores the historical 1,140 acre footprint. Inflow of dredged material began in 2001 and the projected completion date for the entire project is 2044.

When the island is completed it will have two types of habitat: wooded upland habitat and intertidal wetlands. These will provide unique habitat for animals including migratory birds, ground nesting birds, diamondback terrapins, muskrats, deer, and many others. Poplar Island will remain an uninhabited, restored ecosystem.

PREPARATION BEFORE ACTIVITY

In preparation for the activity you will need to obtain the necessary materials including white boards and dry erase markers, and print all the maps, infographics, posters, article, and short story.

ACTIVITY

1. **Engage/Elicit (5 min):**

   Introduce the Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island and point out Poplar Island on a map of the Chesapeake Bay.

   Tell the students that instead of you talking at them about Poplar Island for 45 minutes you are going to empower the students to interpret the story of Poplar Island on their own.

   Explain that the students will be divided into 4 groups. Maps, infographics, posters, or short stories will be provided to each group.

   These tools will be used to help each group interpret part of Poplar Island's story.

   Add that you think they are smart enough to figure out what Poplar is all about on their own but you or other educators can serve as a resource if the groups have questions or get stuck.

   Explain that they will have 15-20 minutes to interpret and discuss their maps, infographics, posters, or short stories amongst their group.

   Tell the students they will be using the white boards and markers (or easel pads) to prepare a 5 minute presentation about their findings. The presentations can be as creative as they want but cannot go over 5 minutes.

2. **Explore (20 min):**

   Break participants into four groups and provide each group with their folder of maps, infographics, posters, or short stories. Make clear their job is to interpret their tools and present back to the group what they learned. Encourage them to think beyond the information they get from the maps, infographics, posters, or short stories.

   Reminder: Students are allowed to ask for help if there are things they do not understand. Let students know that they don't have to be "right" but should have an educated guess.

   Give the groups 15 to 20 minutes (depending on their interest) to review the information and prepare presentations.

3. **Explain (20 min):**

   Students will give 5 minute presentations about the information they interpreted from their clues and share with the group the important information they discovered about Poplar Island. Groups should present in order and groups 2, 3, and 4 should try to connect their presentation to the previous presentations.

   During their presentation, groups can bring up any questions they have. Questions can either be written up on the board or be answered at the end of each presentation.

   During presentations, fill in any gaps not addressed or misinterpretations and continue the conversation if students are interested. Below are a list of printed materials and points that should be drawn out by students.

   Group 1 folder includes:
   - "Vanishing Islands of the Bay" short story
   - "Poplar Island 1914" map
   - "Poplar Island 1969" map

   Concepts students in Group 1 should be sure to discuss:

   Island habitat in the Chesapeake Bay is eroding at a rapid rate. Natural erosion occurs on tidal shorelines but the erosion occurring today has been exacerbated by human activity, development, and sea level rise.

   Group 2 folder includes:
   - "The Port of Baltimore: How Do We Dredge?" infographic
   - "The Port of Baltimore: Economics 101" infographic
   - "What's in Dredged Material?" handout
   - "Dredging for Safe Passage" handout
   - "Economic Impacts, Cargo and More!" video
   - "Why is Dredging Important?" video
   - Jar of wet dredged material

Concepts students in Group 2 should be sure to discuss:
What dredging is and why is it important/necessary. Sediment dredged from the shipping channels is clean and managed safely in accordance with state and federal laws. Successful dredging and dredged material management is achieved through collaboration of state agencies, citizens, and other stakeholders.

How does Group 2's information relate to Group 1? *This may be difficult and you can come back to this after Group 3 presents.*

Group 3 folder includes:
- "Sediment to Solutions: Channeling Innovation" infographic (front and back)
- "Innovative & Beneficial Use" handout
- "What is Dredged Material?" video
- "Other Uses for Dredged Material" video
- Jar of dry dredged material

Concepts students in Group 3 should be sure to discuss: The Port of Baltimore is an economic driver for the state of Maryland. Dredged material can be used in a variety of ways including site reclamation, construction material, topsoil, or environmental restoration. MPA is working with other state agencies to develop regulatory framework that will facilitate opportunities for the innovative and beneficial use of dredged material. Poplar Island Ecosystem Restoration Project is an international model for the beneficial use of dredged material to restore island habitat.

How does Group 3's information relate to Group 1 and Group 2?

Group 4 folder includes:
- "Restoration of Poplar Island" poster
- Lists of fauna observed on Poplar Island as of May 2017 which includes spiders and insects, amphibians and reptiles, birds, mammals, fish, and decapods.
- "In Chesapeake Bay, Poplar Island is a man-made miracle" news article

Concepts students in Group 4 should be sure to discuss:
Poplar Island is an exemplary example of the beneficial use of dredged material. Poplar Island Ecosystem Restoration Project is a man-made island and a success. The success of Poplar Island is shown by the 400+ unique species of fauna that call Poplar Island home. How does Group 4's information relate back to Groups 1, 2, and 3?

Concepts that should be discussed once all 4 groups have presented:

How do all 4 presentations connect? How did we get from vanishing islands to Poplar Island exploding with biodiversity? Dredging has to occur but MPA wants to make every effort to benefit the environment and the general public. Island habitat is disappearing throughout the Bay, Poplar and Holland Island (mentioned in the "Vanishing Islands" story) are not unique.

4. **Evaluate/Wrap-Up (5 min):**

Once all four groups have presented, wrap up by summarizing what the students interpreted for themselves.

Poplar Island was on the verge of disappearing into the Bay and becoming another vanished island. Dredging of the shipping channels is something that occurs annually and is economically beneficial to the Port of Baltimore and Maryland as a whole.

The sediment that is dredged from the bottom of the Bay must be placed somewhere.

The Port of Baltimore has made it a priority to find innovative and beneficial ways to reuse dredged material such as rebuilding an island.

Out of this economic need to dredge, habitats like Poplar Island are able to be restored. Poplar Island provides unique island habitat that is disappearing all over the Bay.

This is what we call a "win-win" situation. The Port of Baltimore can remain open for business and stay competitive with other ports and vanishing island habitat is able to be rebuilt, restored, and protected for the sole purpose of wildlife use.

EVALUATION

Students will be evaluated by the presentations each group provides as well as their involvement in the group discussion.

RESOURCES

Other resources could include the Poplar Island websites (listed below) provided by Maryland Environmental Service (MES), MDOT MPA, USACE, and the Poplar Island Restoration website. There is also a short memoir entitled "Poplar Island: My Memories as a Boy" written by Peter K. Bailey who grew up on neighboring Jefferson Island. Another option is to have an Outreach and Education specialist from MES come to your classroom and provide additional lessons.

http://www.menv.com/pages/outreach/poplar.html

http://www.mpa.maryland.gov/greenport/Pages/dmmp.aspx

http://www.nab.usace.army.mil/Missions/Environmental/Poplar-Island/

http://www.poplarislandrestoration.com/

DIVE DEEPER

Poplar Island provides free tours that are open to school groups, community organizations, and individuals. Tours and activities can be adapted to suit your needs and interests. Generally, tours and educational programs at Poplar Island focus on details related to the beneficial use of dredged material to create remote island habitat.

You can have an environmental specialist visit your classroom and teach your students about the Port of Baltimore and habitat creation at Poplar Island! Groups can also visit MPA's other sites: Hart-Miller Island (another beneficial use site) as well as Masonville and Cox Creek Dredge Material Containment Facilities (DMCF) for educational programming.

*Map-tivity for Hart-Miller Island, Cox Creek, and Masonville Cove are available upon request

Vanishing Islands of the Bay

April 8, 2013

Built in 1888, this Victorian home from a different era has braved the elements and fought shoreline erosion on Holland Island in Chesapeake Bay for well over a century. Holland Island is not unique and many islands in the Bay are meeting the same fate. Despite former resident and owner Stephen White's best efforts to save the house and protect the island, the waters would overcome both the house and the island and erased them from the map.

Early History

Holland Island was originally settled in the 1600's and for nearly two hundred years life was largely uneventful for the small island, with a small colony settlement occupying the shores. In the 1850s a small fishing and farming boom in the Chesapeake area brought many to the islands in the Bay including **Poplar Island** and Holland Islands. By 1910 the Holland Island housed nearly 360 residents, making Holland the most populated island in Chesapeake Bay. At its peak, Holland Island was a thriving community. It had nearly 70 structures including homes and shops, a school, post office, several general stores, and a church. The island also had its own doctor, a community center, and even a baseball team that would travel by boat for away games.

Geography & Erosion

A unique feature to the islands in Chesapeake Bay is the composition of mud and silt rather than rock; this makes many islands like Holland Island, **Poplar Island**, Hart-Miller Island, Smith Island, and Tangier Island, in the Chesapeake Bay more susceptible to shoreline erosion from exposure to crashing waves. Additionally, Sea Level Rise and development has further accelerated the erosion process for the islands of Chesapeake Bay. Holland Island started to noticeably lose shoreline in 1914. The residents tried desperately to save their island by importing stones to build walls and in some cases sinking boats in an attempt to slow the erosion, but all attempts failed. This rapid erosion forced most residents of Holland to tear down their homes and relocate to the mainland. Some stayed and took their chances, but a tropical storm in 1918 was the final straw for those that tried to tough it out.

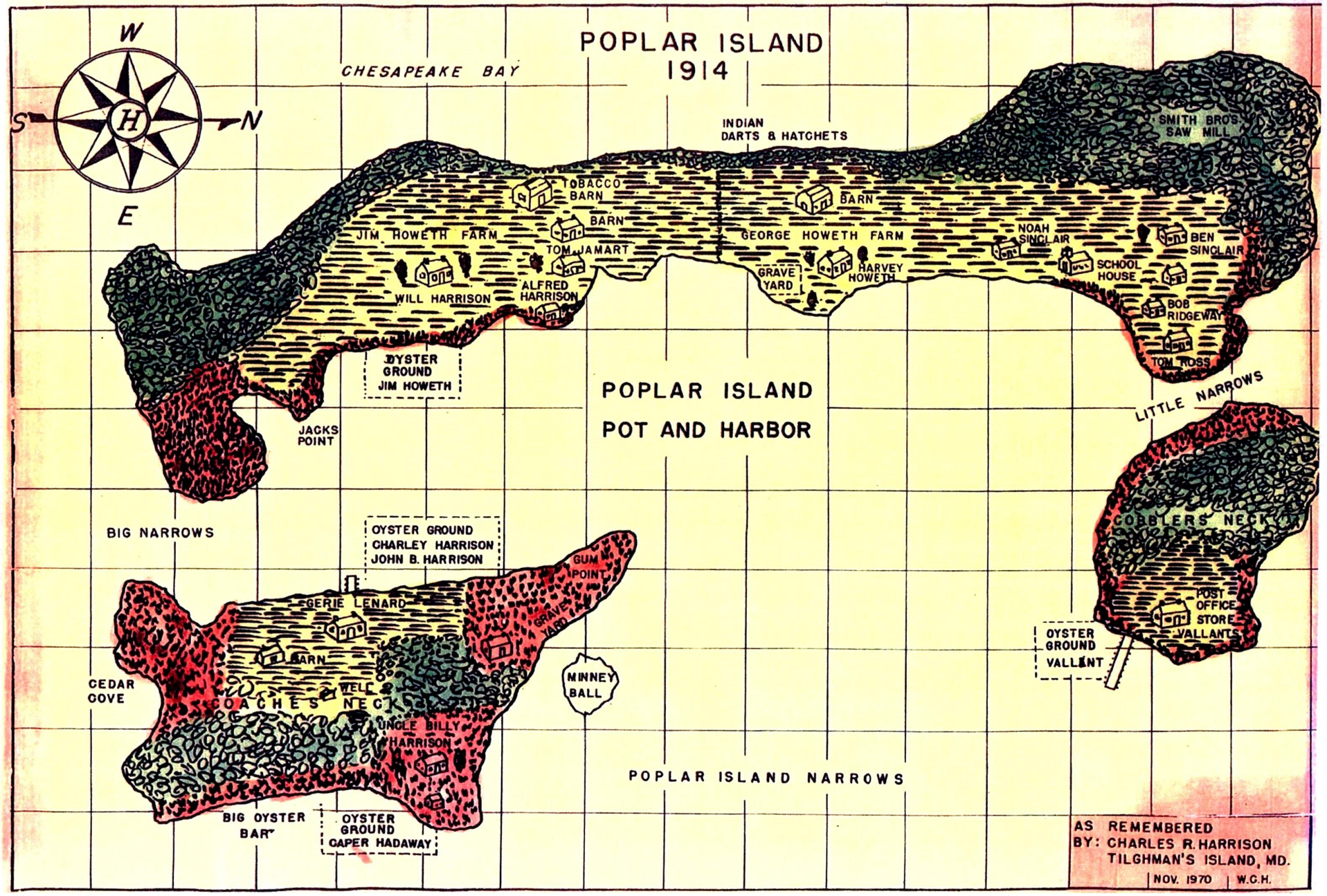
Shrinking Island

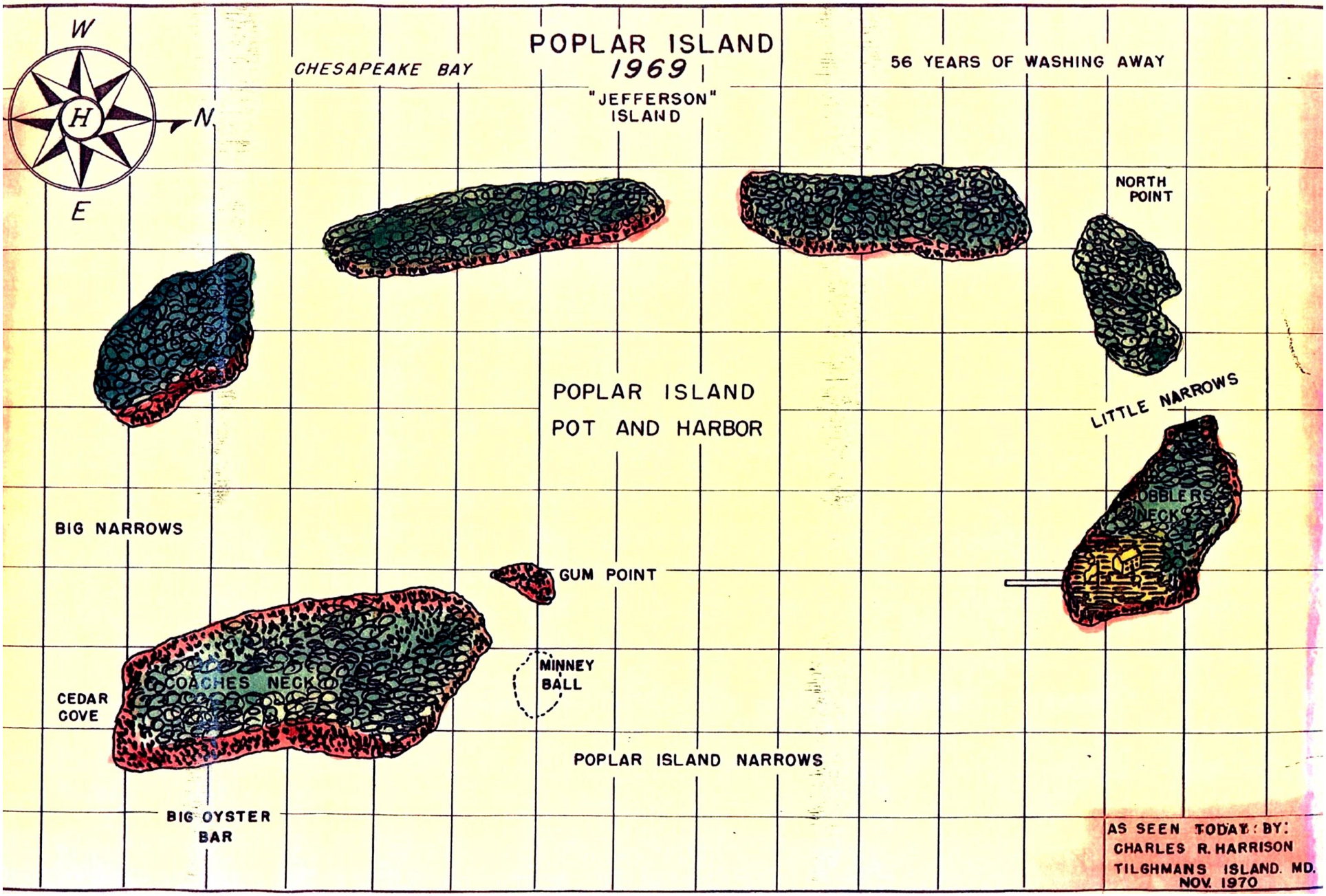
In 1999, the Maryland governor appointed a task force to study the erosion issues affecting Chesapeake Bay. In 2000, the task force released the report which revealed that **"the state of Maryland loses approximately 260 acres of tidal shoreline due to erosion each year."** From 1915 to 2005, Holland Island went from 160 acres to 80 acres. In 2003, Hurricane Isabel hit Holland Island destroying 60% of the remaining trees and sealed the Islands fate.

Collapse

In mid-October of 2010, the last house on Holland Island succumbed to the elements. After 125 years of braving the elements, the Victorian home crumbled. Over the next several months the water re-claimed the wreckage and by 2012 the island had completely eroded away.

Open water where the last house on Holland Island once stood.

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POPLAR ISLAND
1969
56 YEARS OF WASHING AWAY
CHESAPEAKE BAY
"JEFFERSON"
ISLAND
NORTH
POINT
POPLAR ISLAND
POT AND HARBOR
LITTLE NARROWS
BIG NARROWS
GUM POINT
COACHES NECK
MINNEY
BALL
CEDAR
COVE
POPLAR ISLAND NARROWS
BIG OYSTER
BAR
AS SEEN TODAY: BY:
CHARLES R. HARRISON
TILGHMANS ISLAND. MD.
NOV. 1970

Dredging for Safe Passage

IN THE CHESAPEAKE BAY & BALTIMORE HARBOR

Quick Facts

- Major shipping channels in the Chesapeake Bay and Baltimore Harbor are maintained at a 50-foot depth; other channels are maintained at a 35-foot depth
- Approximately five million cubic yards of dredged material are cleared from the channels every year
- Laws govern the safe placement and use of dredged material
- No negative effects on water quality
- Successful dredging and dredged material management result from collaboration among agencies, citizens, and other stakeholders

Every year, cargo vessels and cruise ships travel to and from the Port of Baltimore. Many of the water routes they travel require frequent dredging to maintain the 50-foot depth required by many of today's ships. On average, almost five million cubic yards of sediment is removed from shipping channels in the Chesapeake Bay and Baltimore Harbor every year. The Maryland Department of Transportation Port Administration (MPA) and the US Army Corps of Engineers work together to conduct dredging and find placement sites for the dredged material. Dredging usually occurs in the fall and winter.

Sediment Quality

Sediment in the Chesapeake Bay and its rivers has been deposited over a long period of time, and the process continues today. Sediment consists of clay, silt, and sand. The geologic formations in the region as well as human activities affect the character of the sediment in different locations. Industrial activity, agriculture, and urban development have all left their mark.

Sediment dredged from the navigation channels is tested and managed safely in accordance with state and federal requirements.

Placement and Use of Dredged Material

Dredged material is generally placed in a specially designed area enclosed by a dike, called a placement site. Over time, the sediment dries and becomes new land. Dredged material is also used to restore eroded wetlands, create upland wildlife habitat, and build new terminal space for the port. Other ports have demonstrated that dredged material can be used to cap landfills and brown-fields, remediate former mines, and make building materials such as aggregate.

The MPA conducts a planning process to ensure that the Maryland always has 20 years of dredged material placement capacity. Advisory committees, state and local agencies, and elected officials participate in the dredging program and ensure that communities and stakeholders have information and access to the decision-making process.

The MPA and the Baltimore District Corps of Engineers are studying the feasibility of widening channels in the Baltimore Harbor and Chesapeake Bay to maintain economic competitiveness.

For more information, visit www.marylandports.com/greenport.

The Port of Baltimore: Economics 101

How does the Port benefit Maryland and the U.S.?

The Port of Baltimore generates:

- 37,300+ MD jobs
- 15,330+ direct jobs
- $3.3 billion in wages annually
- $395 million in state and local tax revenues annually

Baltimore ranks #1 in:

- autos and light trucks
- roll-on and roll-off heavy equipment
- imported sugar and gypsum

Baltimore ranks #2 in:

- exported coal

The Port of Baltimore connects the U.S. to international ports in countries around the world.

9 Baltimore ranks 9th in foreign cargo value ($59.7 billion)

10 Over 10 million tons of cargo passed through the port in 2018

11 Baltimore ranks 11th in foreign cargo tonnage (43 million tons)

What does the Port need to be successful?

50 ft

Draft

Cargo ships can have a draft (the part of the ship that is underwater) of up to 50 feet.

Channels

Ships must use shipping channels as they navigate the Chesapeake Bay and enter Baltimore. These channels are dug to a depth of 50 feet through dredging.

Dredging

Sediment enters shipping channels throughout the year. Periodic dredging must occur to keep shipping channels usable, and the Port accessible.

Sediment continuously washes into the channels of the Chesapeake Bay from erosion throughout the watershed.

Sediment is dredged, or removed, from shipping channels yearly to maintain a safe depth for large vessels.

The Port of Baltimore: How Do We Dredge?

1

"DREDGING"

a clamshell bucket removes dredged material from the bottom of shipping channels

2

"SCOW"

dredged material is placed in a special, flat-bottomed boat, called a "scow," so it can be transported

3

"SLURRY"

dredged material is mixed with water from the Chesapeake Bay, creating a "slurry"

4

"INFLOW"

the slurry can be easily pumped or sprayed into a special placement site for dredged sediment

5

"DEWATERING"

after settling, the water from the slurry is pumped off or drained off the top of the dredged material

6

REPEAT!

maintenance dredging occurs frequently to make sure that channels remain deep enough for large ships to pass

What's in Dredged Material?

- Runoff from all over the Chesapeake Bay watershed carries **sediments** that end up in the shipping channels
- Dredged material is **clay, sand, and silt** sediment removed from the shipping channels
- Geologic and human activities (industrial activity, agriculture, and urban development etc.) influence the character of the sediment

Is Dredged Material Safe?

- Characteristics of dredged material have been studied and monitored for a long time
- In general, dredged material does not contain pollutants at levels that could cause human or environmental harm, and is not classified as hazardous
- The US Army Corps of Engineers samples sediment from the shipping channels for chemical analysis every three years

Innovative & Beneficial Use

DREDGED MATERIAL AS A VALUABLE RENEWABLE RESOURCE

Quick Facts

- 5 million cubic yards (mcy) of sediment are dredged annually throughout the Bay, an amount that would fill the Ravens' stadium 2.6 times.
- 1.5 mcy of sediment is dredged from the Baltimore Harbor each year.
- The goal is to recycle 500,000 cy of material annually.
- Many options are available to safely use dredged material, including:
  - Mine reclamation
  - Restoration of eroded islands and wetlands
  - Roadway and construction materials
  - Manufactured topsoil
  - Land restoration
- An interagency regulatory workgroup is underway.

Dredging maintains safe passage for vessels making their way through the shipping channels of the Port of Baltimore and supports a key economic driver for waterborne commerce in Maryland. Removing sediment annually from the channels not only ensures the safety of our marine highway, but helps business at the Port of Baltimore continue to thrive.

Innovative Reuse is the recycling of dredged sediment in place of (or in combination with) other raw materials for manufacturing, construction and reclamation projects. Beneficial Use can benefit the environment by restoring wetlands and eroded shorelines and islands, with the potential to mitigate the effects of sea level rise. Innovative and beneficial use can spur innovation, benefit the environment, and contribute to the growth of Maryland's economy.

Currently, dredged sediment is transported to dredged material placement sites or used for beneficial projects like the restoration of Poplar Island. All of these activities are permitted by environmental regulatory agencies, such as the Maryland Department of the Environment. Years of testing and sampling data demonstrate no adverse impacts.

New Solutions Needed

The Port of Baltimore is in critical need of placement capacity for dredged material. It is difficult to find locations for new placement sites because property adjacent to the port is densely populated and developed. New approaches to the management of dredged material are needed, so the Maryland Department of Transportation Port Administration (MPA) is looking for innovative solutions to recycle dredged sediment.

Making Innovative & Beneficial Use a Reality

The MPA has set a long-term goal to recycle 500,000 cy of dredged material each year. The MPA has also recently convened an interagency workgroup to recommend policy changes that will establish a clear and transparent regulatory framework that will enable opportunities for the successful reuse of sediment in a variety of ways. Close coordination with key partners will help to ensure that projects are safe to human health and the environment. Private sector, local governments, citizens and industry leaders are providing important feedback throughout this process, helping to promote the safe and economic use of dredged material.

SEDIMENT TO SOLUTIONS: CHANNELING INNOVATION

THE PORT OF BALTIMORE IS A KEY **ECONOMIC DRIVER** for the State of Maryland

- 100K+ jobs
- 30+Million tons of cargo
- $3 Billion in annual wages & salaries

DREDGED MATERIAL

is sediment removed from the shipping channels

DREDGING MAINTAINS SAFE PASSAGE FOR VESSELS

making their way through shipping channels and keeps the Port **OPEN FOR BUSINESS**

SEDIMENT (MOSTLY FINE SILTS, CLAY, AND SOME SAND) ACCUMULATES AND DEPOSITS IN THE SHIPPING CHANNELS

Dredged material is a **REPLENISHABLE RESOURCE** that can be **REPURPOSED** in a variety of ways to benefit the economy and environment

- SITE RECLAMATION
- CONSTRUCTION MATERIALS
- MANUFACTURED TOPSOIL
- ENVIRONMENTAL RESTORATION

SEDIMENT IS TESTED & ANALYZED TO

ensure it meets environmental and human health requirements

UP TO 5 MILLION CU. YARDS REMOVED PER YEAR

1.5 MILLION FROM THE BALTIMORE HARBOR CHANNELS

FINDING NEW PLACEMENT CAPACITY IS A CHALLENGE IN THE BALTIMORE REGION

Property adjacent to the Port is densely populated and developed

CURRENT PLACEMENT OPTIONS:

CONTAINMENT FACILITIES & ENVIRONMENTAL SITES

Cox Creek
Masonville
Poplar Island

THE MARYLAND DEPARTMENT OF TRANSPORTATION PORT ADMINISTRATION IS **EXPLORING NEW SOLUTIONS**

INNOVATIVE AND BENEFICIAL USE

HOW CAN WE MAKE INNOVATIVE & BENEFICIAL USE A REALITY?

The Maryland Department of Transportation Port Administration is committed to making innovative and beneficial use a significant part of the agency's management plans. A long-term strategy was approved in 2014, with the advice and input of key stakeholders and the public. As part of that work, the Interagency Regulatory Workgroup was formed in the summer of 2015 to identify policy recommendations and new processes to advance the potential for dredged material reuse.

"NEW SOLUTIONS NEEDED"

The Workgroup's desired outcome is to establish a clear and transparent regulatory framework that facilitates opportunities for innovative products and beneficial use projects. Close coordination with regulatory agencies and other key partners, including the Innovative Reuse Committee, Harbor Team and other Dredged Material Management Program (DMMP) Committees, is taking place to ensure that these projects are safe to human and environmental health and can successfully be implemented. Representatives from the private sector, local governments, and industry are continuing to provide important feedback on this process so they can make dredged material a regular part of their business.

Tell us your thoughts on innovative and beneficial uses of dredged material by contacting us at: greenport@marylandports.com

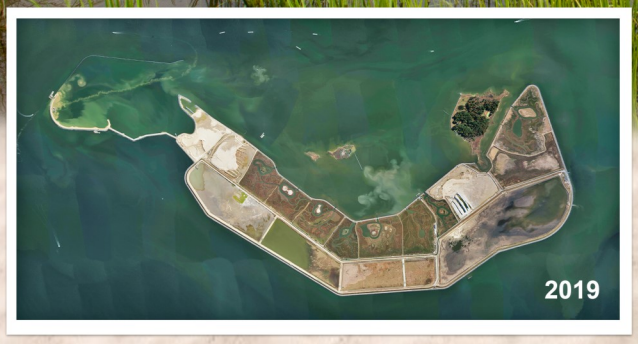
Dredged material is valuable – removing it from shipping channels keeps the Port of Baltimore **OPEN FOR BUSINESS**, and exploring new uses can spur innovation, benefit the environment, and grow Maryland's economy.

SEDIMENT TO SOLUTIONS:
CHANNELING INNOVATION
Learn more at: www.marylandports.com/greenport/dmmp

GreenPort of Baltimore

November 2016

RESTORATION OF POPLAR ISLAND



Poplar Island is located in Talbot County, MD, and was estimated to have comprised 1,140 acres in 1847. The island supported over 100 human residents and diverse wildlife. Extensive erosion reduced the island to five acres by the early 1990s. Federal and state environmental agencies, including the U.S. Army Corps of Engineers and the Maryland Department of Transportation Maryland Port Administration, began the restoration project of Poplar Island in 1994. Today, Poplar Island measures over 1,140 acres, and is undergoing an additional expansion. When completed, the island will contain 1,750 acres of protected island habitat.

The Poplar Island Environmental Restoration Project is an international model for beneficial use of dredged material. Modern technology has been implemented to create wetland and upland habitats.

Poplar Island serves as a wintering site, transient stop, and nesting location for local and migratory wildfowl. It also provides shelter and quiet water habitats for diamondback terrapins, crabs, rockfish, and killifish.

Tours and educational programs at Poplar Island focus on beneficial uses of dredged material to form a remote island habitat. Students study water quality monitoring, habitat restoration, erosion/deposition, and species diversity. Students also learn about cultural history from the 1600s to today.

In Chesapeake Bay, Poplar Island is a man-made miracle

By Nevin Martell
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Zipping across the Chesapeake Bay, I had a hard time spotting Poplar Island. Although one end of it rises 20 feet high, much of the small landmass is a mere eight feet above sea level — and parts of it are even lower. There is one significant stand of trees, but the island is covered mostly with low-growing shrubs and grasses or is nothing but uncultivated dirt.

The diminutive parcel may sound unimpressive, but it's nothing short of a man-made miracle that it's here at all.

That's why I headed there for a two-hour tour on a sunny September morning. When it was first surveyed, in 1847, it measured a robust 1,140 acres. The next survey in 1993 by the U.S. Army Corps of Engineers revealed that wind, waves and current had shrunk it down to a mere five acres, spread out across four small blips of unconnected land. If something wasn't done quickly, it would disappear into the depths without leaving a trace.

Working with the Maryland Port Administration, the Corps started rebuilding Poplar Island in 1998. The project was instrumental in achieving two goals simultaneously. It created a place to safely dump dredged materials in a manner that wouldn't interfere with the bay's fragile ecosystem, and it restored a crucial wildlife habitat.

They began by outlining the 1847 parameters of the island with a rock wall. After that, they divided it into cells and began filling them in with soil dredged up from the floor of the bay, a natural byproduct of creating the 50-foot clearance required for large ships accessing Baltimore Harbor. To date, they've poured in 28 million cubic yards of mucky matter. They'll use 68 million to finish the job, so they're not even halfway finished. (The project is currently on track to be completed in 2043.)

Karen Walsh, a teacher at Broadneck Elementary School in Arnold, Md., says goodbye to their turtle, Pebbles. (Sarah L. Voisin/THE WASHINGTON POST)

The rebuilding project has created a vibrant wildlife preserve, where 203 species of birds and 155 species of insects (including 31 butterfly species) have been spotted. On top of that, it's a nesting ground for diamondback terrapins. So the public can appreciate this natural bounty, Maryland Environmental Services offers free tours on weekdays from spring through fall departing from Tilghman Island, a 25-minute boat ride away. It's the only way to access the emerging ecosystem, which is an active construction site.

After we moored on the island's south shore, I was presented with contrasting imagery. On one hand, there were wild birds galore perched on the dock's railing, flying overhead and wading in the nearby wetlands. In juxtaposition, there was a plethora of yellow-and-black heavy-duty construction machinery and several clusters of squat buildings for the equipment and staff. No one lives on the island. Workers are shipped over daily for shifts that usually run from 7 a.m. until 5:30 p.m., unless they're receiving dredge materials during the winter months, which requires round-the-clock crews.

Thankfully, we were here to focus on the outdoorsy elements and learn a little local history. The small isle has an interesting past. In the early 17th century it was discovered by settlers and named Popeley's Island, which similarly eroded over the years to become "Poplar." The British used it as a staging area for troops during the War of 1812. By the late 19th century, there was a small settlement of approximately 100 people, a post office and a sawmill. All those inhabitants left by 1920. In 1931, it became a hunting and fishing preserve for prominent Democratic politicians; presidents Franklin Roosevelt and Harry Truman both visited.

After a short introductory talk, a dozen other sightseers and I boarded an air-conditioned bus for a tour of the boomerang-shaped island. Soon we passed a small sandy beach, a nesting ground for diamondback terrapins. Their nests were marked with small pink flags and will later be covered with enclosures to deter predators. Last year, approximately 1,000 turtles were born on the island. Two hundred and fifty of them ended up in a "head start" program of sorts. Each Oreo-size reptile was shipped off in the fall to a different classroom around the state. Six months later, in May, they came back to the island, "the size of a cheeseburger," according to tour coordinator Megan DiFatta. Their increased bulk helps them avoid herring gulls and laughing gulls, who usually devour many of the tiny youngsters

During a stop at a small visitors center, I checked out a tank full of week-old turtles. Several dozen bobbed or paddled through the slightly green water while a lone terrapin sunned itself in the rays of a heat lamp. Its head was halfway tucked in, probably catching a few Z's while it warmed up. The rough concentric circles on its shell looked like small topographical renderings of a cluster of hills; its tiny webbed feet displayed miniscule nails shorter than thumbtacks.

This is only a fraction of the wildlife I saw. During the tour, we passed a number of restored wetlands, home to many types of birds. One grassy, bushy section hosts a plethora of cattle egrets, snowy egrets and great blue herons; another, a bounty of least terns and common terns. Nearby there's a barren dirt mound inside a small pond, where 4,600 double crested cormorants lived during nesting season earlier this year. Their droppings are so acidic that they killed off almost every piece of greenery on the island-within-an-island. Now only a fraction remain, hanging out onshore and swimming in the surrounding waters.

In another restored cell, a series of barges were beached to help prevent the remaining land from washing away while crews worked to reconstruct the island. Now the rusting hulls are covered in fecal buckshot and home to a number of species, including osprey, which build giant prickly-looking nests of sticks and grasses on them. Assistant tour coordinator Chris Homeister calls the grounded ships "bird condominiums."

The boat the Terrapin brings students back to the mainland after releasing turtles on Poplar Island. (Sarah L. Voisin/THE WASHINGTON POST)

If birders are lucky during the winter, they might be able to see a rare snowy owl. Normally, there aren't tours at that time of year, but DiFatta tries to round up groups of ornithologists to come out if they're interested.

Nature lovers of all shades should take advantage of Poplar Island while they can. When its reconstruction is complete, all the roads, machinery and human traces will be removed. There will be no commercial development allowed. In fact, people might not even be permitted to set foot on it. Poplar Island will be wild and full of life once again.

Glossary

- **Adaptation -** A behavior or physical feature that enables an organism to survive in its habitat.
- **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.
- **Amphibian** - A cold-blooded vertebrate animal which spends part of its life cycle in the water, and part on land. Amphibians have an aquatic gill-breathing larval stage followed (typically) by a terrestrial lung-breathing adult stage. Examples of amphibians include frogs, toads, newts, and salamanders.
- **Average** - A number expressing the central or typical value in a set of data, in particular the mode, median, or (most commonly) the mean, which is calculated by dividing the sum of the values in the set by their number.
- **Benefit -** To receive an advantage.
- **Biodiversity -** The variety or diversity of organisms in a habitat or ecosystem.
- **Brackish Water** - A mixture of seawater and fresh water.
- **Bycatch Reduction Device** - This device prevents larger-shelled terrapins from entering crab pots.
- **Camouflage** - Natural coloring of animals that help them to blend in with their background.
- **Carapace** - The bony top of a turtle's shell
- **Cargo** - Goods carried on a ship, aircraft, or motor vehicle.
- **Cargo Ship** - A ship that transports goods and materials from one port to another.
- **Carnivore -** An animal who eats meat.
- **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.
- **Clamshell Bucket** - A type of scooping bucket used in dredging. Clamshell buckets have two sides which open and close with a hinge (like a clam); they have an opening at the bottom used to scoop up sediment.
- **Clutch** - The group of eggs produced by birds, amphibians, or reptiles, at a single time, particularly those laid in a nest.
- **Container Ship** - A ship specially designed or equipped for carrying containerized cargo.
- **Crab Pot** - A underwater trap used to catch crabs.
- **Crustacean** - An animal who has a shell (typically a marine animal). Examples of crustaceans include lobsters, crabs, and shrimp.
- **Commodity** - A good or service that can be bought or sold.
- **Draft-** The vertical distance between the water surface and the bottom of the ship.
- **Dredging -** The process of removing sediment from shipping channels.
- **Dredged Material -** Sediment removed from shipping channels.
- **Dredged Material Containment Facility -** A placement site for sediment removed from shipping channels. DMCFs are planned, constructed, and monitored by government agencies.
- **Dredge Technician -** A person who coordinates and monitors dredge material placement.
- **Dredging Outreach and Education Specialist -** A person who teaches students and adults about the dredging process in Maryland and the resulting ecological restoration.
- **Endangered Species -** A species of animal or plant that is at serious risk of extinction.
- **Environmental Specialist -** A person who collects data about the environment.
- **Erosion** - The process of sediment being removed by wind, water, or other natural agents.
- **Export** - Send (goods or services) to another country for sale.
- **Fauna –** The animals in an area.
- **Flora –** The plants in an area.

- **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.
- **Herbivore –** An animal who only eats plants.
- **Human Impact** - On the environment or anthropogenic impact on the environment includes changes to biophysical environments and ecosystems, biodiversity, and natural resources caused directly or indirectly by humans.
- **Hurricane** - A storm with a violent wind, a tropical cyclone in the Caribbean.
- **Litter** - Trash, such as paper, cans, and bottles, that is left lying in an open or public place.
- **Import** - Bring (goods or services) into a country from another country for sale.
- **Indicator Species -** An organism that is sensitive to changes in the environment, and which acts as an indicator of an ecosystem's quality and health.
- **Insect** - A small animal that does not have bones, has many legs and typically has wings. Examples of insects include beetles, bees, and ants.
- **Insecticide** - A substance used to repel insects.
- **Latitude** - A measure of the angular distance of a location from the earth's equator (north or south). Latitude is usually expressed in degrees and minutes.
- **Longitude** - A measure of the angular distance of a location from the meridian at Greenwich, England (east or west). Longitude is usually expressed in degrees and minutes.
- **Island** - A piece of land surrounded by water.
- **Lungs** - Each of the pair of organs situated within the rib cage, consisting of elastic sacs with branching passages into which air is drawn, so that oxygen can pass into the blood and carbon dioxide be removed.
- **Mammal** - A warm-blooded vertebrate animal. Mammals have fur or hair, produce milk for their young, and (typically) give birth to live young (rather than laying eggs). Examples of mammals include dogs, fox, deer, and humans.
- **Migration -** The movement of animals from one location to another based on seasons.
- **Mitigation -** In environmental work, these are projects or programs intended to offset the known impacts to an existing historic or natural resource.
- **Monitoring -** Observe and check the progress or quality of (something) over a period of time; keep under systematic review.
- **Muskrat** - A large, aquatic, North American rodent, Ondatra zibethica, having a musky odor.
- **Nocturnal** – An animal who sleeps during the day and is active at night. Examples of nocturnal animals included owls, bats and mice.
- **Nonpoint Source Pollution** - Those inputs and impacts to the environment which occur over a wide area and are not easily attributed to a single source.
- **Ocean** - A very large expanse of sea, in particular each of the main areas into which the sea is divided geographically.
- **Patapsco River -** mainstem is a 39-mile-long (63 km) river in central Maryland which flows into the Chesapeake Bay.
- **Pesticide -** A substance used to repel organisms who is in an area who could harm plants or other organisms.
- **Plastron** - The bony underside of a turtle's shell
- **Point Source Pollution** - A single, identifiable source of pollution, such as a pipe or a drain.
- **Predation** - The act of hunting and consuming of another animal.
- **Predator** - An animal that naturally preys on others.
- **Red Tide** - A discoloration of seawater caused by a bloom of toxic red dinoflagellates, known as algae.
- **Reptile** - A cold-blooded vertebrate animal. Reptiles have dry, scaly skin and typically lay soft-shelled eggs on land. Examples of reptiles include snakes, lizards, crocodiles, turtles, and tortoises.
- **Reef Ball** - They are made of a special marine friendly concrete and are designed to mimic natural reef systems.
- **Restoration** - The act or the process of returning something to its original condition.
- **RORO** - Roll-on, roll-off ships are vessels designed to carry wheeled cargo that are driven on and off the ship on their own wheels.
- **Satellite** - An artificial body placed in orbit around the earth or moon or another planet in order to

collect information or for communication.

- **Seining** - The process of catching organisms with a fishing net that hangs vertically in the water and having floats at the upper edge and sinkers at the lower.
- **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).
- **Shipping Logistics** - Planning, implementing and controlling the efficient flow (forward and backward) and storage of goods, services and related information between the point of origin and the point of consumption (customer).
- **Solar Energy** - Radiant energy emitted by the sun that is transformed into electric power using specially designed panels.
- **Scute** - A bony plate of a turtle's shell.
- **Tagging** - One of the methods for studying the biology, movements, and migrations of animals. Tagging is used to study the long-range regular and irregular movements of animals and to determine their lifespan.
- **TEU** - Stands for Twenty-Foot Equivalent Unit which can be used to measure a ship's cargo carrying capacity.
- **Transportation** - The action of moving someone or something from one location to another.
- **Trash Wheel** - A trash intercepting device placed in a river to collect and remove any floating debris before it reaches a harbor. Generally powered by both sunlight and water, the wheel lifts trash and debris from the water and deposits into a dumpster float boat.
- **Uplands -** An area of high or hilly land.
- **Urban -** A town or city.
- **Webbed Feet** - Feet or toes that have a piece of skin between the toes.
- **Wetland -** Ecosystems containing water, specialized soils, and plants adapted to living in water-saturated soils. Marshes, swamps, and bogs are types of wetlands.
- **Watershed** - A region or area from which all water ultimately drains into the same body of water.
- **Waterwheel** - A large wheel driven by flowing water, used to work machinery or to raise water to a higher level.

- **Wildlife Refuge -** An area designated for the protection of wild animals, within which hunting, and fishing are either prohibited or strictly regulated.