Holding the Paddle Properly

- If paddling on the right side of the canoe, hold the grip with your left hand with fingers facing away from the body (Tell the students to "high five" their paddles to place their hands in the proper position.). Hold the shaft wherever your right hand falls comfortably, fingers facing down.
- If paddling on the left side, reverse this so that the right hand is on the grip and the left hand is on the shaft. The shaft of the paddle should always go across the front of your body.

Forward Stroke

1. If paddling on the right side of the canoe, extend the right arm forward and dip the blade straight into the water. Make sure paddle is perpendicular to the canoe.
2. Pull the blade straight back towards you, pushing the water backwards and propelling the canoe forwards.
3. Stroke ends when the top arm is fully extended.
4. Turn the paddle sideways, lift it from the water, and return to the starting position.

Note that doing this stroke on the right side of the canoe will make the boat veer left; paddling on the left will make the canoe veer right. For example, in a canoe of two students, if both students paddle on the right side of the canoe will go LEFT; if both paddle on the left the canoe will go RIGHT; if they paddle on opposite sides the canoe will go STRAIGHT.

Backstroke

1. If paddling on the right side of the canoe, bend the right arm backward and dip the blade into the water behind you, flat to the surface.
2. Extend you right arm and move the blade forward through the water, pushing the water away and propelling the canoe backwards.
3. The stroke ends when your lower arm has fully extended.
4. Turn the paddle sideways, lift it from the water, and return to the starting position.

Note that doing this stroke on the right side of the canoe will make the boat veer right; paddling on the left will make the canoe veer left.

Away Stroke (optional)

1. Paddle enters the water directly alongside the boat. Blade of the paddle should be parallel to the canoe.
2. Push the paddle through the water straight out away from the canoe.
3. Canoe will move sideways, away from where you're pushing. For example, if you push away on the right rear of the canoe, the rear of the canoe will turn left while the front turns right. If you push away on the right front of the canoe, the front of the canoe will turn left will the rear turns right.

Draw stroke (optional)

1. Paddle enters the water directly to the side of the paddler, out away from the canoe. Blade of the paddle should be parallel to the canoe.
2. Pull the paddle through the water straight towards the canoe, drawing water towards the boat.
3. The canoe will move sideways, towards where you're drawing. For example, if you draw on the right rear of the canoe, the rear of the canoe will turn right while the front turns left. If you draw on the front right of the canoe, the front of the canoe will turn right while the rear turns left.

Supplement B: Background Information: Environmental Observation

Changing Climate and Maryland's Land Changes in the Chesapeake Region

According to scientific studies, sea level rise appears to be accelerating. Even so, the Chesapeake Bay is rising at two to three times the rate of worldwide sea levels. It rose more than a foot over the past 100 years, compared to an average 4 to 8 inches during the same amount of time in other regions. The bay is very likely to rise 2 to 5 feet more by the end of this century.

Rising water is frequently attributed to "climate change". Whatever the cause, there is no question that the water level in the Chesapeake Bay is getting higher. This is caused by a combination of the sea rising 3 to 4 millimeters per year, and subsidence, otherwise known as "land sinking", at about 1.3-7 millimeters per year. There are several technical reasons for subsidence to occur. However, 80 % of the time it is caused when we remove water and other materials from the earth, leaving a void underground. Under the right conditions, this can cause land to sink. Erosion from the land is then redeposited in other areas in large amounts, also contributing to subsidence.

The land in the Chesapeake region has been sinking over the past 1,000 to 2,000 years. The rise in sea levels is a relatively new phenomenon and is part of a global trend. As the earth warms, polar ice caps melt, the volume of water in the oceans expands, and sea levels rise.

Maryland has 7,700 miles of coastline. It is difficult to determine the effect of local man-made structures, such as seawalls, bulkheads, and homes on the shoreline. However, it is already easy to observe areas of land in homeowners' yards on the eastern shore that are wet most of the year. This would not have been the case 35 years ago. Additionally, more than 13 islands in the bay have disappeared as of 2017.

In addition to sea level rise, scientific studies also predict more intense storms, bigger water surges during storms, and higher high tides. Policymakers need to make tough decisions on where to spend limited resources to protect the shoreline and what to let go.

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Climate Change and the Chesapeake Bay The ... 25,000 copies of the map are being © 2017 The Conservation Fund

Erosion and Shoreline Background Information

Erosion is the process of wind, rain, and waves moving soil from one place to another, such as from the land to the water. While erosion is a natural process, it can be made worse by human development. For example, clearing land quickens the pace of erosion by removing trees and other plants which play a large role in erosion prevention by anchoring the soil in place with their roots.

Waterfront landowners face the challenge of keeping their property from eroding away. The most common method is building up a retaining wall called a bulkhead, made from wood or synthetic materials. The MDE banned the building of bulkheads in tidal areas, except for the replacement of pre-existing bulkheads. In areas of high wave action, rock riprap revetments are also used.

While bulkheads and riprap revetments do a fair job of keeping their landowner's property intact, they present some problems. Bulkheads and riprap revetments don't provide the grassy wetland habitat needed by various aquatic animals, such as small or baby fish, molting crabs, and other crustaceans. Bulkheads also suffer wear and tear and eventually need to be replaced, putting more expense on the landowner. Additionally, bulkheads and riprap don't diffuse wave energy; they simply pass it on to cause erosion on adjacent properties, as well as the churning up of the underwater soil, so that submerged aquatic vegetation (SAV's) cannot grow.

Wooden Bulkhead

Riprap Revetment

Living shorelines present an environmentally-friendly alternative. Using bio-logs made from coconut or other natural fiber, stakes, sand, and many native wetland plants, we can build a natural shoreline that serves the same purpose of preventing erosion and provides much needed habitat for aquatic life.

The Maryland Department of the Environment (MDE) now prefers the installation of living shorelines as the best erosion-prevention method in areas with low wave action. Even in areas with moderate wave action, living shorelines can be installed as long as they are protected by rock riprap.

Supplement C: Discussion Points and Questions

Motivation/Warm-up – Poster Discussion

Point/Question	Discussion/Answer
Animals	
Plants	Submerged aquatic vegetation (SAVs) are aquatic plants such as underwater grasses and are important sources of food and habitat for wildlife.
Bulkheads	Bulkheads are man-made wooden structures put in place to help prevent shoreline erosion. However, the water beats against the bulkhead instead of being slowed down. This action against the bulkhead prevents wildlife from being able to live there. Bulkheads are usually built with chemically treated wood to preserve the wood. These chemicals often leech into the water and are toxic to wildlife. They are now banned in tidal areas.
Riprap	Riprap is man-made rock structure to help prevent shoreline erosion. Due to the rough surface area, rock riprap slows the water on the way in and on the way out. However, because there is no plant life, they do not provide shelter or food for wildlife and do not make good habitats.
Living Shoreline	Living shorelines are plants put in place to prevent erosion. They slow water on the way in and on the way out. The plants provide shelter and a food source for wildlife. Submerged plants (SAVs) also provide dissolved oxygen in the water through the process of photosynthesis. They also filter out excess nutrients carried from the land and preventing them from entering the water.

Evaluation

Point/Question	Discussion/Answer
What are the physical characteristics of the different types of shorelines?	Bulkheads are hard and flat, riprap is hard but has many gaps, the living shoreline has many grasses, etc.
Why do you think people build different	The living shoreline provides habitat and food for grass shrimp, small fish, larvae, molting crabs, and many other creatures. Bulkheads and riprap don't

types shorelines?	provide sheltered habitat for wildlife. They also don't diffuse wave energy; they simply pass it on to cause erosion on adjacent properties, as well as churning up of the underwater soil, so that submerged aquatic vegetation (SAVs) cannot grow. People might build riprap and bulkheads because they don't require the same amount of maintenance as living shorelines and are cheaper to implement.
Which is the best way to prevent shoreline erosion?	Building living shorelines with native grasses is the best way to prevent shoreline erosion. These slow down waves from boats and storms which cause shoreline damage. Grasses also slow down and filter storm water runoff from the land and provide habitat for aquatic animals. Rock rip rap and wooden bulkheads help prevent erosion but they do not dampen the waves. They provide only limited habitat, and they don't filter or slow down runoff from the land. Often erosion will develop behind these structures over time. These structures also make it difficult for amphibians and terrestrial animals to get in and out of the water to preform activities such as building nest and laying eggs.
When you canoed into the cove toward the wetland, did you notice a difference between the plants on the left compared to the plants on the right?	There is less diversity on the left side than on the right. The plants on the left are a nonnative, invasive species called phragmites. Phragmites grows so aggressively that it does not allow other plants to grow. Phragmites can also threaten rare and endangered plants. The right side of the cove is a natural wetland with many different kinds of native plants such as cord grass and cattails. These native plants provide food for animals (pollen, nectar, fruits, roots and seeds) and provide more habitat for birds, insects and other animals.