FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

MARSHLAND MARVELS

SUBJECT AREA: Science – Earth Science, Environmental Science.

GRADE LEVEL: Sixth through eighth.

DURATION: 45 minutes to an hour; staff will need 30 minutes to set up demonstration.

AUDIENCE SIZE: 25 to 30 students.

Intertidal oysters and mangroves at GTM Research Reserve.

OVERVIEW: In the lesson, students look at different ways to protect coastlines. Students first will hear from DEP environmental scientists regarding shoreline erosion and different armoring techniques. Students will then use a hands-on model to explore the role of different materials in protecting coastlines. As they progress, students learn how and why living shorelines are being used to protect coastlines throughout Florida.

OBJECTIVES:

The student will:

- Model and compare ways in which coastlines can be protected.
- Solve quantitative problems (percent change calculations) to illustrate differences between various coastal erosion protection solutions.
- Understand why coastal erosion is an important conservation issue with significant engineering challenges.
- Know that engineering solutions to coastal erosion include use of natural systems as well as artificial structures.
- Comprehend that coastal erosion has negative effects on human property and wildlife habitat.
- Classify methods of coastal erosion protection as “hard” or “soft” engineering.

DISCUSSION:

Once students complete the shoreline stabilization challenge, the following discussion topics will take place:

- Hard versus soft armoring techniques.
- Estuary ecosystem services.
- Benefits of living shorelines as an armoring technique.

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SUNSHINE STATE STANDARDS:

SC.6.E.6.1 - Describe and give examples of ways in which Earth's surface is built up and torn down by physical and chemical weathering, erosion and deposition.

SC.6.E.6.2 - Recognize that there are a variety of different landforms on Earth's surface such as coastlines, dunes, rivers, mountains, glaciers, deltas and lakes, and relate these landforms as they apply to Florida.

SC.6.E.7.8 – Investigate how natural disasters have affected human life in Florida.

SC.6.E.7.8 - Describe ways human beings protect themselves from hazardous weather and sun exposure.

SC.6.N.1.4 - Discuss, compare and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

SC.8.N.4.1 - Explain that science is one of the processes that can be used to inform decision making at the community, state, national and international levels.

ELA.K12.EE.1.1 - Cite evidence to explain and justify reasoning.

MA.K12.MTR.7.1 - Apply mathematics to real-world contexts. Mathematicians who apply mathematics to real-world contexts:

- Connect mathematical concepts to everyday experiences.
- Use models and methods to understand, represent and solve problems.
- Perform investigations to gather data or determine if a method is appropriate.
- Redesign models and methods to improve accuracy or efficiency.

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BACKGROUND

Watch the video on salt marsh habitats
Read the article: Living shorelines vs. Bulkheads

Protecting salt marsh and estuarine habitats is vital for a healthy coast. An estuary is where river meets sea and saltwater combines with fresh water to create brackish water. A salt marsh is a coastal habitat that forms between the land and the estuary, and is dominated by grasses. The salt marsh and estuary are nursery areas for many fish and other aquatic animals.

In Florida, several techniques are used to protect estuarine shorelines from erosion. Coastal erosion is the loss of surface land and can be caused by rising water levels and waves from boat wakes, wind and storms. Hard structures, such as bulkheads, jetties or seawalls, are often used to protect shorelines. However, these structures may not offer sufficient protection against large storms and do not integrate with nearby habitats.

Living shorelines are another way to protect tidal shores from erosion. Unlike traditional hard structures, living shorelines use natural elements like oyster shells or native marsh grasses. These natural elements work to stabilize the shoreline while providing critical habitat at the same time.

Living shorelines mimic salt marsh and estuarine systems and can offer many benefits, including:

- providing food and shelter for many creatures.
- serving as critical nurseries for important marine species.
- filtering pollutants from stormwater runoff, the top source of pollution along the coast.
- protecting the land from wave energy, storm surges and tides.
- providing aesthetic value, enhanced views and a sense of place.

VOCABULARY

Erosion - The loss of surface land that can be caused by rising water levels and waves from boat wakes, winds and storms.

Deposition - The addition of surface land that can be caused by waves from boat wakes, winds and storms.

Seawall - A hard structure erected to protect local shorelines.

Riprap - Loose stone used to protect local shorelines.

Living shoreline - Coastal management technique that stabilizes shorelines, reduces erosion and protects property using natural materials like vegetation, sand and oyster reefs rather than hard structures like seawalls.

Shoreline stabilization - The practice of managing the land-water boundary to protect against erosion caused by waves, currents and storms.

Estuary - A location where river meets sea and saltwater combines with fresh water to create brackish water.

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MATERIALS

- Five clear plastic containers (11in. x 16in., 15 quart).
- Sand.
- Water.
- Five Water Bottles (one for each station).
- Towels.
- Five rulers (one for each station).
- Colored tape (one for each station).
- Large gravel.
- Small gravel.
- Legos.
- “Estuary Ecosystem” (sponge with aquarium vegetation attached).
- “Oyster Reef“ (small sandbags with pebbles or rocks inside).

ACTIVITY

Engage (15 minutes)

Introduce the historic aerials on the Student Appendix page to students, asking them to make observations of the shoreline across the timeline. Introduce the concepts of seawall and deposition and use the historic aerials to highlight where this has taken place. Ask students to make a claim regarding the possible causes of these changes over time.

On the board, write “only sand”, “seawall”, “riprap”, “living shoreline with grass”, “living shoreline with grass and reef”. Tape images of the five different shorelines under their description. Have students add a tally mark underneath the shoreline they think will do the best job protecting the land/sand in places when the waves come. The images will provide a visual cue for students.

Let the students know that these images show different ways that coastal estuarine shorelines can look or be protected. Review examples of estuaries in Florida (such as the Everglades), if necessary.

Explore (30 minutes)

Split students into five small groups. Each group will represent a team of “engineers” that will be tasked with slowing erosion and providing shoreline protection during larger storm events.

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Provide each team with a station similar to that outlined below:

Provide students 5 minutes to discuss which one of the five stabilization techniques (that they voted on earlier in the lesson) they would like to pursue and what materials they will use to build it. Materials could include large gravel, small gravel, legos, “Estuary Ecosystem” (sponge with aquarium vegetation attached) and “Oyster Reef” (small sandbags with pebbles or rocks inside).

Review rules for water use:
Keep waves moderate (not too gentle, but also not too rough); demonstrate to the students how to make a proper wave.

Provide 5-10 minutes to each team to build their erosion slowing model.
Have students mark with tape where the shoreline ends (where water stops and sand begins) before they make waves.

For two minutes, the students will produce waves by placing the water bottle in the water adjacent to the sand and move it up/down to simulate a storm event.

Have students mark with tape where the shoreline ends (where water stops and sand begins) following the storm event.

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Using a ruler, students can measure how much of the shoreline eroded from the original piece of tape.

Allow students to rotate through the five stations to observe other students' models and record how much erosion took place. Allow 2-3 minutes per rotation, totaling about 10 minutes.

Have each student fill in the Shoreline Stabilization worksheet to document their designs and make observations as they move through this activity.

Explain (10 minutes)

After rotating through all of the stations, allow the students to discuss the different shorelines in their small group. On the worksheet, have students answer Part 1 of the Review Questions

1. Which shoreline lost the most sand during the wave experiment?
2. Which shoreline kept the most sand during the wave experiment?
3. What happened to the sand (where did it go)?
4. What do you think the different shorelines would look like a year after a hurricane season?
5. How do you think the plants and coral reefs can help keep the surrounding water clean?
6. Which shoreline do you think would be a better home for fish and other animals?

Elaborate (10–15 minutes)

Using a wave tank, insert the various shorelines to demonstrate which one does the best at minimizing wave action.

Evaluation (5 minutes)

Have students come back up to the board and mark a tally underneath the shoreline example they now think is best at protecting the land using a different color marker.

Extensions

Schedule a field trip where students can visit shorelines with varying types of shoreline stabilization methods.

Submit a request to one of the Florida Department of Environmental Protection's regulatory district offices to provide a presentation of different shoreline stabilization projects they have worked on.