Looking Forward (Scenario A: Learning Experience #2)
Lesson Plan

Overview
Students explore the mitigating measures taken by Smith Island's residents who construct bulkheads and plant marsh grasses in an effort to hold back the rising waters. The students' final assignment is to examine the effects of climate change in their home region.

Lesson Essential Question: What can we do to reduce water erosion of coastline areas in the long term?

Objectives
Students will:
- work productively as a part of a project team.
- use a variety of resources to investigate the background information necessary for this project.
- research and summarize information about climate change as it relates to rising sea levels and its effects on coastal areas.
- research and summarize information about techniques for controlling erosion and model a living shoreline.
- keep accurate, complete records in a journal.
- communicate their ideas and results to classmates.

Materials Needed for *Looking Forward* (LE #2)
- One packet per group containing a copy of each of the following documents:
  - *Saving Our Land* (Student Sheet #1)
  - *Your Great Big Carbon Feet* (Student Sheet #2)
  - *What's Up in Your Backyard?* (Student Sheet #3)
- Notebooks or small binders or folders to be used as journals, one for each student
- Chart paper and markers

Optional materials for class demonstration of a living shoreline

- Stream table or wave tank
- Sand
- Sod
- Water
- Small stones
- Bucket or tub
- A container which will hold at least 3L of liquid

Target Grade Level: 8-12

Subject Areas
Climate science, environmental science, geology, technology

Setting
Classroom or computer lab

Timeline
Teacher preparation: 20 minutes
Student learning experience: 90 minutes

Skills
Research in print materials and on websites; organize information; solve problems as part of a team; communicate ideas with team and to classmates; record observations in a journal.

Vocabulary
Bulkhead, carbon footprint, climate, climate change, erosion, living shoreline, post-glacial subsidence, sea level rise, weather

Procedure

1. Post the essential question for this learning experience. Instruct students to record the essential question in their journals and write a preliminary answer after a discussion with their teams. Remind students to leave some space for additional information, as the class will revisit the question at the end of the learning experience.

2. Remind students that teams are playing the role of a parent committee at a school located on Smith Island that wants to reduce the amount of flooding in the school and save the ability to live on Smith Island for their children.
    a. Ask the class to predict what will happen to the island in the next 100 years if no action is taken in the future to save it.
    b. Students should write their predictions in their journals and support them with data and information from *Getting Your Feet Wet* (Learning Experience #1).

3. Inform students that, while there are government agencies and private organizations that may be interested in saving Smith Island, these potential funders will want to know what the committee plans to do with the money they are requesting for their project. Before groups can apply for financial assistance for their project, they must research several possible techniques that are used for erosion control on coastlines and decide which one will be most appropriate for their island. Teams should complete the questions in *Saving Our Land* (Student Sheet #1), then write a reflection in their journals about what they have learned about restoration of coastlines.

4. Each team will present the information gathered about erosion control measures to their classmates. During the presentation, groups should address the following:
    a. What are they proposing to their funders and why?
    b. Which method(s) seem to be the most effective in terms of cost and long-term prevention of shoreline erosion?

5. Optional demonstration of a living shoreline: see separate page.

6. Ask student teams to recall the reasons behind the flooding and loss of acreage on the islands and coastlines of the Chesapeake Bay. (*sea level rise and post-glacial land subsidence*) Follow up by asking the students to respond to the following questions in their science journals and post their ideas on a class list:
    a. What do climate scientists and geologists say about human impacts on these two phenomena?
    b. Do human activities affect the rate at which either is occurring? If so, what should we do to slow the rate at which we are losing coastal land?

7. Lead a class discussion regarding the fact that humans can do nothing to change the rate of land subsidence in the regions beyond the leading edges of the glaciers of the last ice age. That being said, the overwhelming majority of scientists think that human activities resulting in release of greenhouse gases into the atmosphere are responsible for the alarming acceleration in the rate of global sea level rise in the past century. Students will complete *Your Great Big Carbon Feet* (Student Sheet #2) and consider how they can reduce the amount of greenhouse gas that they contribute to the atmosphere as they live their everyday lives.

8. State that climate change has been occurring throughout the history of the Earth — from its formation and subsequent cooling.
    a. Ask students to think about the following question: *What is different today compared to climate change in the distant past?*
    b. Students will consider the effects of climate change in their own region by completing *What's Up in Your Backyard?* (Student Sheet #3) and then share their ideas with the class.

9. Ask student teams to imagine that they will be taking part in a meeting with a climate scientist. Students should record the following question in their science journal, and share their response with the class. *What is one question that you would like to ask the climate scientist during your meeting?*

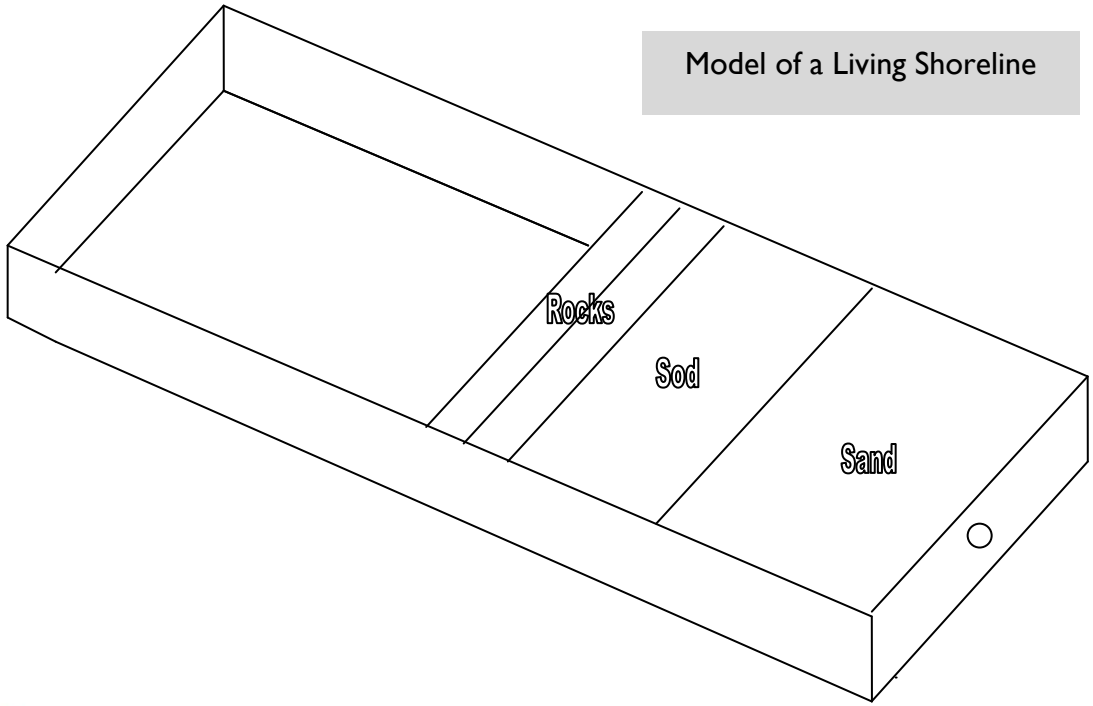
A Living Shoreline (Scenario A: Optional Class Demonstration)
Looking Forward

This demonstration may be used as a model to illustrate the techniques of an armored beach and a living shoreline to prevent shoreline erosion. Living shorelines are being introduced across the United States in areas where coastlines are eroding and the restoration of native wetlands has potential to reduce scouring by storm surges. Living shorelines have the added advantage of providing nursery habitat for aquatic animals. "Creating a living shoreline involves building a stone barrier, backfilling the area with sand, planting marsh grasses, and then letting nature take over." Christian Science Monitor, November 15, 2007.

Materials Needed for *A Living Shoreline*

- Stream table or wave tank
- Sand
- Sod
- 3L container
- Water
- Small stones
- Bucket or tub
- Support for under top end of stream table
- Plug for hole at bottom end of stream table

Model of a Living Shoreline



Advanced Preparation Needed for *A Living Shoreline* Demonstration

Place the stream table on top of a tabletop or counter at a slight pitch so that a bucket or tub can be placed under the hole to catch any water flowing from the table. Fill the lower half of the tank with sand approximately two inches deep (this represents the beach on the shoreline that you are trying to save). Slowly add just enough water to the upper end of the tank to completely dampen the sand, then remove the plug at the lower end of the table.

Procedure

1. Place a bucket or tub under the hole to catch the water that flows out (this water will be reused throughout the demonstration). Quickly dump two or three liters of water into the tank at the upper end (this represents a storm surge of bay or sea water hitting an unprotected shoreline).
    a. What happened to the beach?
    b. Your students should record their observations in their science journal.

2. Drain the excess water out of the bucket and use the sand to rebuild the beach in the tank. Next, build a two inch tall barrier of small stones across the tank where the water meets the beach. Ask students to predict what they think will happen this time. Send another storm surge of equal force against the reinforced beach and catch what flows out and into the bucket.
    a. Ask your students if they observed any differences between the models of the unprotected beach and the beach with stone armoring.
    b. Students should describe observations in their science journal.
    c. Drain the excess water out of the bucket and retain the sand to rebuild the beach in the tank. Replace the rock barrier four to six inches out from the beach (toward the upper end) and add a strip of sod that occupies one-quarter of the length of the tank between the rocks and the sand (see diagram on previous page). Fill in the remaining part of the lower tank with wet sand (this model represents a shoreline where aquatic grasses have been planted behind a rock breakwater just beyond the beach). Ask students to predict what they think will happen this time. Send another storm surge against the reinforced beach with grasses and catch what flows out and into the bucket. Ask your students what differences they observed between the models of an unprotected beach, a beach with stone armoring (rocks), and a beach with a rock breakwater and submerged aquatic vegetation.
    d. Students should describe observations and what they learned from this demonstration about erosion control in their science journals
    e. Ask students to respond to the following questions in a class discussion: *Was this is a perfect model? Why do scientists sometimes use models before they build a full-scale project?*