Grades: K-2 **Length:** 90 min

Oysters are Shoreline Protectors

Summary: In this hands-on lesson, students design and build a structure that can break wave energy before it hits land. They collaborate through the engineering design process, figure out that there are many possible ways to solve the problem, and reflect on the role that oysters play as natural breakwaters.

Outline

- **Observe changes to New York Harbor (10 min)**
- **Plan and build a breakwater structure (35 min)**
- **Test each group's structure (25 min)**
- **Discuss and reflect (20 min)**

LESSON OVERVIEW

Objectives (Students will be able to…)

- Design and build a structure that models how oysters break wave energy in order to compare multiple shoreline protection solutions in New York Harbor

Standards

- K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*
- 2-ESS2-1: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*
- K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

BOP Connections

- Standalone Lessons: Pairs well with "Oysters are Keystone Species" which provides overview of the ecosystem functions oyster provide.
- ORT / ORS: Supplements the Oyster Research Tank or Oyster Research Station by modeling an important ecosystem function of oysters, that isn't as easily visible

BEFORE YOU GET STARTED

Supplies

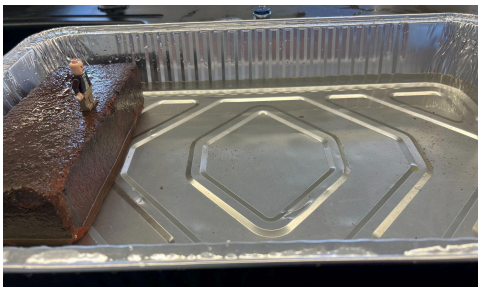
- Grade K-2: Slides
- Grades K-2: Handout (for each student)
- Building materials (for each group):
  - Things to build with (e.g. recyclables, sponges, legos, shells, gravel, etc.)
  - Duct tape
  - Scissors
- Testing materials:
  - Water source
  - "Waves" (e.g. plate, cup)
  - "Harbor" (e.g. large bin or aluminum pan filled with water)
  - "Land" (e.g. brick or a tall tupperware filled with water)
  - Ruler

Tips for Teachers

- Review with students:
  - Norms (what it may look like and sound like) for teams to work together productively
  - Steps of the engineering design cycle
- Decide:
  - How will students get building materials (e.g. distribute identical sets to each table, students choose from a "store", one student selects for the group, etc.)?
  - How many groups will test at a time (e.g. one group or multiple testing stations)?
- Heads up:
  - Students can get excessive with materials - consider giving each group a pre-measured amount of items (e.g. pre-cut duct tape stuck to the side of their table).

Materials Preparation

- Collect enough varied materials for each group to build structures - consider what is easily accessible, and what students may be able to help collect (e.g. bringing in recyclables)
- Identify where you'll test designs - fill up a large pan/bin with water, and place a figurine on the "land" flush against the bin.
  - Identify where to get water (e.g. use pitchers, use sink, take students outdoors and use hose)
  - Identify where to put wet structures after testing
  - Gather towel(s) to clean up any spilt water.



Vocabulary

- Weather: the conditions outside at a particular place and time
- Storm: a powerful change in the weather that brings rain, snow, wind, thunder, or lightning.

INSTRUCTION PLAN

OPENING:
Observe changes to New York Harbor. (10 min)

1. **Show:** Display an image from the aftermath of Hurricane Sandy in Staten Island, NYC. [slide 2]
    - **Ask:** *What do you see happening in this photo? What do you think caused this?*
    - **Explain:** In these photos, it is clear that some big event happened that caused a lot of damage.

2. **Show:** A bird's eye view of the geography of Staten Island. [slide 3]
    - **Ask:** *What do you notice about where this event happened?* (there are neighborhoods, there is an ocean, etc.)
    - **Explain:** This neighborhood in Staten Island where the damage happened is surrounded by water. All of New York City is surrounded by water, and all the water bodies combined are called the New York Harbor.
    - **Ask:** *How could all this water end up on land?*

3. **Define:** A storm is a powerful change in the weather that brings rain, snow, wind, thunder, or lightning. [slide 4]

4. **Explain:** During big storms, such as one named Hurricane Sandy that happened in 2012, the wind can become really powerful. The wind can make waves in the ocean so big they can reach places beyond their normal limits. If there is nothing stopping these big waves from hitting land, they can cause a lot of damage to shorelines and habitat. [slide 5]

5. **Show:** Display an image of an oyster. [slide 6]
    - **Ask:** *If we were to look at the shorelines of New York City 400 years into the past, many animals such as these surrounded New York City. What are they?* (oysters!)
    - **Explain:** These living things are called oysters. Oysters are animals that provide food and shelter for many other animals in the New York Harbor.

6. **Show:** Display an image of an oyster reef. [slide 7]
    - **Ask:** *How would you describe the shape that the oysters make as they grow?* (they grow in groups or piles, they form a wall, etc.)

7. **Explain:** Oysters grow in reefs along shorelines, which naturally would have been able to break down some of the power of big waves during storms. Now, without oyster reefs, and with our paved roads and buildings, water more easily comes crashing onto land. Human activities have changed the natural landscape of New York Harbor so much that the effects of big storms and flooding are stronger than they would've been 400 years ago.
    - **Ask:** *How can we slow down storm waves and keep so much water from coming to shore?* (sea wall, rebuild soft shorelines, restore oysters, etc.) [slide 8]

ACTIVITY:
Plan and build a breakwater structure. (35 min)

1. **Frame:** There are many ways we can look to slow down storm waves and prevent water from coming to land. Today you'll work in small groups to design and build a structure that can slow down waves and keep water from reaching the land so strongly. [slide 9]
    - **Share:** Review the steps of the engineering design cycle.

2. **Share:** To block the water from reaching the shore, designs must: [slide 10]
    - Slow down the "storm wave" before it hits the "land" - to break up wave energy
    - Stay intact when 10 big "waves" come - since storms last a long time
    - Prevent "person" on "land" from getting knocked over by "waves" - structure successfully prevents damage on land

3. **Share:** Given the materials, there are some guidelines to the designs: [slide 10]
    - Materials: only use materials provided
    - Team members: work in groups
    - Time: 30 minutes to create
    - Size: fit inside the "harbor"

4. **Facilitate:** Provide time frames for students to design and build their structures.

- Suggested end of Class 1 -

Test each group's structure. (25 min)

1. **Facilitate:** Outline the procedure for how students will test their designs, including normalizing that some structures may break and need redesign - that is okay! Invite group(s) up to test their structure at the designated testing site. [slide 11]
    - Tell us about your design
    - Place structure in bin, in front of the "land" that has figurine on top
    - Use plate to push 10 big "storm waves" toward land
    - **Ask:** *Did the design stop the storm waves from hitting land? How is this design different from the previous one?*
    - Take out design, put figure back up, and next group tests!

DEBRIEF:
Discuss and reflect. (20 min)

1. **Discuss as a whole group**: [slide 12]
    - *Was there only one right way to stop the storm waves from hitting land? How can you tell?*
    - *What shapes did you notice working really well?*

2. **Explain:** Just like how there wasn't one right way to build your structures, engineers have designed many different types of solutions to prevent damage from storms and to protect shorelines. Some of these solutions include building a seawall, restoring the natural soft shoreline ecosystem to absorb water, and creating breakwater structures with living things. [slide 13]

3. **Show:** One notable project is the "Living Breakwaters". This restoration project started specifically to protect the Staten Island shorelines, after the Hurricane Sandy storm caused a lot of damage from large waves. It is a big, complex set of rocks and other materials, designed to slow large waves before hitting Staten Island. Billion Oyster Project is restoring one billion oysters to New York Harbor, and has added living oysters to this rocky structure. [slide 14]
    - **Ask:** *Why would designers add oysters to their structures?* (helps the oysters live, helps other animals, etc.) [slide 15]

4. **Distribute:** Provide handout for each student.
    - ***Write:*** *What is one thing you would add or change to your built design?* [slide 16]
    - **Draw***:* Students draw a design of a structure that could protect shorelines from storm waves. This drawing can be based on their own tested designs and/or inspired by the designs of their classmates and those shared by engineers.