# OCEAN CLASSROOM

# Coastal Erosion

## Protecting the Shoreline

EDUCATOR GUIDE

THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY

# Guiding Questions

**"What happens when humans design a barrier to reduce coastal erosion?"**

**"What natural barriers protect coastal erosion?"**

# Good to Know Ocean Circulation

## Waves

- **Crest** — the highest point of a wave
- **Trough** — the lowest point of a wave
- **Breaker** — a wave in which the crest has tumbled forward
- **Wavelength** — the distance between one crest of a wave to the next
- **Amplitude** — the distance from a place of rest to the crest of a wave
- **Tsunami** — a giant wave caused by an earthquake on the ocean floor

Ocean waves are caused when energy disturbs the water. This energy is mostly caused by wind blowing across the surface. Small ripples develop into waves. In open water winds increase. A difficult concept for students is understanding that, in the ocean, this energy travels, but not water. A drop of water would not move forward, but would dive up and down in a circular motion from the crest to the bottom of the wave. One activity that demonstrates this concept is a quick 10-minute lesson that students find interesting and fun. Showing the video, *Wave Machine Demonstration,* is another option and can also solidify understanding.

# Good to Know Ocean Circulation (Continued)

## YouTube Demonstration

An inexpensive, easy demonstration that has a huge impact on understanding.

**Materials:**

— Suggestion: Three 5 oz. bags of YUMEarth Organic Sour Twists (gluten, dairy, and nut free products)
— 50 wooden bamboo skewers
— One roll of duct tape

Follow steps on Wave Machine Demonstration video.
*https://www.youtube.com/watch?v=VE520z_ugcU*

## Wave Machine Demonstration

- **Erosion** — Movements of rocks and soil caused by wind and water
- **Weathering** — Breaking of rock into smaller sizes
  Physical: breaking down of rock material in size not in mineral make-up
  Chemical: change in mineral make-up as a rock breaks into smaller size
  Sediment: Broken pieces of rock carried in water
- **Types of Seawalls** — This video (Types of Seawalls *https://sciencing.com/types-seawalls-8394254.html)* provides educators with background knowledge to assist students developing this concept.
  Preview this video *(https://youtu.be/3yNoy4H2Z-o)* to further understand this STEM activity. After students conduct the activity, share and discuss.

# Activity A

# An Oceanic Conference: Protecting Our Coastlines

Students watch the music video of "Catch a Wave" by the Beach Boys *https://youtu.be/af2rY1bmfZM*

*Time required: 40 to 45 minutes*

### Suggestion 1:

Write the questions on index cards or large "post-it" paper for each host.

### Suggestion 2:

During the conference display ocean wave visual and sound.
*https://www.youtube.com/watch?v=vPhg6sc1Mk4*

- Students share what they know about waves and erosion.
  - ☐ What causes a wave?
  - ☐ Why do waves increase in size?
  - ☐ What damage is caused by waves?
  - ☐ How can coastal erosion be prevented?
  - ☐ What are the parts of the wave? Why do they crash at the shoreline?
  - ☐ What can humans do to prevent beach erosion?
  - ☐ Can human intervention worsen the effects of coastal erosion?
- The idea of the conference is to generate background knowledge and to guide instruction to clarify any misunderstanding of concepts. Break students into manageable groups of three or four students.
  1. Assign one student as the host at each table discussion. The host stays at the table while each group rotates from one table to the next.
  2. The host presents the questions and generates a group discussion.
  3. Each question should be timed for five minutes. Three minutes to discuss and two minutes to write student input on a large poster size "post- it," dry erase board or large piece of construction paper.
  4. After groups have rotated to each table, the host presents the question to the class and shares 2-3 common responses.
  5. All students review concepts and the teacher sees misconceptions that can be corrected, developed and understood in the star activity.

# Star Activities Gaining Knowledge

Students make observations of “Ocean Overwashing , Cape Hatteras, NC” and “Pacific Coastal Erosion.” These videos shows some preventive measures humans are developing to mitigate further damage.

**Ocean Overwashing: Cape Hatteras, NC:** *https://youtu.be/UJW6TGxJ6b8*

**Pacific Coastal Erosion Update:** *https://youtu.be/am6E4nZdm3o*

# Activity B Creating Barriers

*Time required: 40 to 45 minutes*

## STEM Challenge: “What happens when humans design a barrier to reduce coastal erosion?”

Students make notes of any barriers used to prevent further beach erosion.

- Discuss observations
- Gaining concept understanding
- Present STEM challenge
- Identify a problem — Ask
- Imagine
- Plan
- Create
- Improve

1. Students will work in science groups to create barriers that protect the coastline.
2. Following is a list of possible supplies. All groups should be provided with these materials. Limit the number of items taken to further the challenge and to create a fair design for all groups. Materials should be used that can withstand water and have the ability to mold into needed shapes.

# Activity B Creating Barriers (Continued)

**Materials**

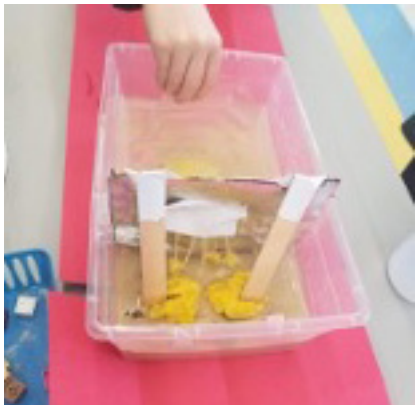
- Aluminum foil
- Paper towel rolls - students discover they can cover the rolls with aluminum foil to create a curved barrier.
- Clay or Play-Doh
- Rocks
- Plastic cups - various sizes
- Wooden blocks - various sizes
- Lego pieces
- 2 large pieces of construction paper
- 1 plastic tub per group (One plastic container, approximately shoe box size — 35.6 cm X 20.3 cm X 12.4 cm or sweater box size — 42.9 cm X 29.2 cm X 14.9 cm)
- Paper Towels
- Water
- 1-liter bottle to transport water

**Procedure**

1. Teacher places two cups of sand at one end of the plastic container (Materials List next page).
2. Fold two large pieces of red, black or blue construction paper to create 64 squares (an array).
3. Place construction papers on the testing table. Then place two books on the colored paper.
4. Place the container with the beach end on the books to create a slope.
5. Fill the container with water until the beach sand becomes wet.
6. Students place small plastic houses (Lego pieces or Monopoly houses) on the beach.
7. Test design by making three waves using a paper plate from one end of the container toward the beach. Be sure to stop each time at the same point . (Suggestion: Use a marker to draw a dot on the top of the container so you know where to stop each wave.)
8. Record results on criteria sheet.Activity B Creating Barriers (continued)

# Activity B Creating Barriers (Continued)

**STEM Activity Set-up**



**Assessment**

Students understand the challenges creating engineered barriers against coastal flooding. An assessment sheet is provided for measuring the success of each design. Students score themselves on the initial and final design of their engineered barrier. The idea of STEM learning is to imagine and create solutions. Compare scoring of the first design to the improved second barrier. Students should see improvements as the design of the barrier improves.

# Activity B Creating Barriers (Continued)

**Wrap It Up** *Complete Activity Sheets and Analyze Results*

After conducting the activity students are engaged and identify their own model with a tested barrier that matches closely to one in this video. While viewing the following video ask students to:

1. Identify a barrier in the video that matches their design the best. What were the results on the video with this design?
2. hat design overall worked best in the video? Why?
3. Stop the video at 10:38. Ask students to think about what they have learned. Draw a design off shore that they think would work best to stop coastal erosion.

Watch the remainder of the video and discuss.

**Wave tank demonstration—You Tube:** *https://youtu.be/3yNoy4H2Z-o*

- Students were shocked by devastation of storm surges in coastal areas.
- They were able to understand the wave energy is far greater in nature than the STEM activity could possibly demonstrate.
- Efforts can be made, but cost efficiency and aesthetic restraints do not always make building barriers the best option.
- Students discussed negative effects of humans' hard structures.
- Create lists of natural barriers that prevent coastal erosion.

**Natural Coastal Barriers:** https://youtu.be/CzXPKa_a5fA
https://www.youtube.com/watch?v=fxo6dTP1b0k
https://youtu.be/DwSrTICsG2I

# Star Activity

Name: _____ Date: _____

Group Members: _____

_____

1. **Ask:** What happens when humans design a barrier to reduce coastal erosion?

_____

_____

2. **Imagine:** Design, draw and label a barrier that will protect the shoreline from erosion.

**Design #1** _____

_____

3. **Plan:** What materials will you need to create your design? Will your design meet the criteria? Review the Criteria Sheet. (See page 12.)
4. Materials needed:

_____ _____ _____

_____ _____ _____

_____ _____ _____

I believe this design will meet the criteria: (Circle one) YES NO

Explain why: _____

_____

_____

# Star Activity (Continued)

### Set Up for Testing Design #1

See directions on page 6. Record results on criteria sheet.

5. **Create:** Create the barrier.
   Take a photo of Design #1: (Check): _____
   Test Design #1 (Check) _____
   Complete the Erosion Barrier #1 Test Result Sheet
6. **Improve:** How can you redesign the barrier to be more successful in preventing waves from causing erosion? What improvements do you propose to make? How will they improve the outcome?
   Design, draw and label the new design (#2):

**Design #2** _____

_____

List the changes made for Design #2:

_____

_____

_____

Why do you think these changes will be successful?

_____

_____

_____

Take a photo of Design #2: (Check): _____
Test Design #2 (Check) _____
Complete the Erosion Barrier #2 Test Result Sheet

# Criteria Sheet, #1

"***What happens when humans design a barrier to reduce coastal erosion?"***

Name: _____ Date: _____

## Testing Results: Design #1

Evaluate the barrier and circle each score below.
Add the four scores for a final total (0 to 12 points).

**1. Stands on its own without added support (prior to experimenting)**

- Stands easily, score = 3 points
- Stands on its own with a little work, score = 2 points
- Stand, then falls or leans, score = 1 points
- Does not stand on its own, score = 0 points

**2. Water results (Amount measured outside bucket on grid paper)**

- No water drops on the paper grid = 3 points
- One quarter or less of the paper grid wet = 2 points
- Half to three-quarters of paper grid wet = 1 point
- More than three-quarters of paper grid wet = 0 points

**3. Structure withstands wave experiment**

- Does not sway or move during the experiment = 3 points
- Moves slightly, but is still standing after experiment = 2 points
- Leans at the end of the experiment = 1 point
- Structure is destroyed = 0 points

**4. Beach Erosion**

- House did not move = 3 points
- House slightly shifted = 2 points
- House moved a distance from the original placement = 1 point
- House is underwater = 0 points

*Total Points:* _____

# Criteria Sheet, #2

"***What happens when humans design a barrier to reduce coastal erosion?"***

Name: _____ Date: _____

## Testing Results: Design #2

Evaluate the barrier and circle each score below.
Add the four scores for a final total (0 to 12 points).

**1. Stands on its own without added support (prior to experimenting)**

- Stands easily, score = 3 points
- Stands on its own with a little work, score = 2 points
- Stand, then falls or leans, score = 1 points
- Does not stand on its own, score = 0 points

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*Total Points:* _____

# Natural Barriers or Human Barriers?

Name: _____ Date: _____

## CER — Assessment

**Scenario:** As a valued member of the Rhode Island Climate Change Committee you need to make an important decision to protect the Rhode Island beaches from further erosion. Home owners along the shoreline are not happy with the current idea to build a sea wall. They are concerned about the tremendous cost for the project and the obstructed view of the ocean the barrier will create. Residents are concerned that the wall will not prevent further beach erosion in the future. Your team is proposing to create natural barriers to prevent further erosion at the local beaches. The team is convinced the natural barriers will be more cost efficient, saving money while making a new habitat for the marine life that survives along the shore. As a team you are convinced this will make a visually more pleasing site along the shoreline.

***Prompt:*** **As a member of the committee, what type of barrier would protect the shoreline while still addressing the concerns of the home owners?**

Claim: _____

_____

_____

_____

Evidence:_____

_____

_____

_____

Reasoning: _____

_____

_____

_____

_____

_____

# Rubric

## NGSS — Writing a Scientific explanation

### Claim

*Points*

**2** — Student makes an accurate and complete claim.

**1** — Student makes a claim that is inaccurate or incomplete.

**0** — Student does not make a claim

### Evidence

*Points*

**2** — Student provides two or more accurate pieces of evidence using science words.

**1** — Student provides one to two accurate pieces of evidence.

**0** — Student does not provide evidence or only provides inappropriate or vague evidence.

### Reasoning

*Points*

**2** — Evidence is connected to the claim and includes scientific principles and vocabulary.

**1** — Student cites a reason, but it is inaccurate or does not support the claim. Student uses science words to explain.

**0** — Student does not connect the evidence to the claim.

# Natural Barriers or Human Barriers?

## CER — Assessment

**ANSWERS**

**Scenario:** As a valued member of the Rhode Island Climate Change Committee you need to make an important decision to protect the Rhode Island beaches from further erosion. Home owners along the shoreline are not happy with the current idea to build a sea wall. They are concerned about the tremendous cost for the project and the obstructed view of the ocean the barrier will create. Residents are concerned that the wall will not prevent further beach erosion in the future. Your team is proposing to create natural barriers to prevent further erosion at the local beaches. The team is convinced the natural barriers will be more cost efficient, saving money while making a new habitat for the marine life that survives along the shore. As a team you are convinced this will make a visually more pleasing site along the shoreline.

*Prompt:* **As a member of the committee, what type of barrier would protect the shoreline while still addressing the concerns of the home owners?**

### Claim:

Natural barriers are a better choice in preventing beach erosion.

### Evidence:

- Cost efficient
- Provides new habitats for marine life
- Visually more pleasing
- Uses natural resources

### Reasoning:

The use of natural barriers can help prevent shorelines from beach erosion. The use of natural barriers are readily available and are less costly than human made sea walls. Sea walls are not always successful in preventing erosion due to poor designs. Human made walls are expensive to make and can obstruct the view of the ocean. Natural barriers provide habitats for marine life to thrive. Finally, natural resources are kinder to the environment and are readily available. Natural barriers such as rock placement, oyster shells, coral reefs, and natural vegetation are a preferred and helpful method in the fight against beach erosion.

# Resources

**Methods used to slow down erosion:** *https://youtu.be/nujYG_b8lI8*

**Coastal erosion and methods used to prevent It :**
*https://youtu.be/_eeKpz8oD7E*

**Erosion and soil:** *https://youtu.be/im4HVXMGI68*

**Soil erosion experiment:**
*https://www.lifeisagarden.co.za/soil-erosion-experiment/*

**Sand erosion experiment:** *https://youtu.be/IWZmOvwt5Zc*

# Educational Standards

## Ocean Literacy Principles

- OLP 1 — The Earth has one big ocean with many features.
- OLP 2 — The ocean and life in the ocean shape the features of Earth.
- OLP 3 — The ocean is a major influence on weather and climate.
- OLP 4 — The ocean makes Earth habitable.
- OLP 5 — The ocean supports a great diversity of life and ecosystems.
- OLP 6 — The ocean and humans are inextricably interconnected. (Much of the world's population lives in coastal areas.)
- OLP 7 — The ocean is largely unexplored.

## Next Generation Science Standards, Grade 4
## 4-ESS2-1 Earth's Systems

- Science and Engineering Practices:
  - — Planning and Carrying Out Investigations
  - — Analyze and Interpreting Data
- Disciplinary Core Ideas:
  - — ESS2-A:Earth Materials and Systems