

ENGINEERING WORKBENCH

Waves and Erosion

How can you prevent losing beaches to erosion?

As ocean waves wash ashore, some of the matter from beaches gets washed away. Over time, this can change the landscape and can cause some beaches to be lost. One way to prevent this loss is through the use of a breakwater system. Breakwaters are structures, usually made of rocks or concrete objects, that are used to prevent erosion of ocean shorelines. These barriers help to diminish the force of incoming waves by interfering with their movements and scattering their energy.

You have been asked by the Army Corps of Engineers to design a breakwater system to reduce the rate of loss of our shorelines. In this activity, you will develop and test your breakwater system to protect a simulated beach from erosion.

Focus on Engineering Practices

SEP 1 Define the Problem

SEP 2 Develop and Use Models

SEP 3 Plan and Carry Out Investigations

SEP 6 Design Solutions

Materials Per Group

- Beaker or plastic cup
- Clay
- Gravel
- Paint tray liner
- Pipecleaners
- Ruler, 15 cm
- Sand
- Scissors
- Tap water
- Toothpicks

Safety

This activity is considered to be nonhazardous. Be sure to follow all laboratory safety guidelines and all safety procedures provided by your teacher. Find more information about the safety icons in the Safety Section.

Develop a Solution

1. **SEP Define the Problem** In your own words, briefly define the problem.

2. **SEP Identify Criteria and Constraints** What will make your design a success? How will you know? What limitations will your design account for? You may choose to consider cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts when identifying criteria and constraints. List all the criteria and constraints you have identified or that your teacher has provided.

Criteria	Constraints

3. **SEP Obtain Information** Go online and research breakwaters to help you develop your system. Look for information related to the following questions.
 - a. What is the relationship between a wave’s amplitude and its strength/ability to erode a beach?

 - b. What is the relationship between a wave’s wavelength and frequency and its strength/ability to erode a beach?

- c. What is the relationship between a wave's speed and its strength/ability to erode a beach?

 - d. How can these relationships impact the type of system you build to diffract water waves and reduce their impact on a beach?

 - e. What is the economic cost of breakwaters? About how often will they need to be repaired?

 - f. What is the environmental impact of breakwaters? How might they affect wildlife?
- 4. SEP Design a Solution** Decide how your breakwater system will be developed. For example, where on the beach or in the water will it be located? Which materials will you use? Describe your reasoning.

5. SEP Design a Solution Draw a model of your breakwater system.

6. SEP Test Your Solution Describe how your group will test your system. Will your teacher or a group member make waves? What are some ways you can promote consistency in the testing? Record your observations.

7. SEP Evaluate Your Solution Review your group's criteria and constraints. Based on your observations, do you consider your breakwater system successful? Why or why not? Be specific and use evidence to support your claims.

- 8. SEP Communicate Your Solution** Shoot a video about your design. Be sure to include your design planning, testing, and evaluation steps, in addition to the final design. When complete, upload your video to the Student Project Video Center.

- 9. SEP Refine Your Solution** Review your classmates' Waves and Erosion projects in the Student Project Video Center. How well did they do? What improvements could they have made? Leave constructive comments for the projects you view. Compare your system with those your classmates produced. How might you improve your system to better meet your criteria and constraints? Would you modify any of your criteria or constraints?