HYPOTHESIS ACTIVITY

Beaches are a popular tourist destination, and many hotels are built very close to the ocean. Hypothesize the consequences of the following situations:

1. A hotel is built on a barrier island.

2. A hotel is built slightly inland, but on a location below sea level.

3. A hotel is built behind a sea stack.

4. A road is built on a beach with jetties to control particle deposition.

QUESTIONS—SIMULATION 4

1. Draw a sketch showing the movement of waves and sand in this simulation. Label places where sand is eroded with an "E" and places where sand is deposited with a "D."

2. How did the introduction of jetties to the inlet affect the movement and deposition of sediment?

3. Why do you think jetties are built on both sides of an inlet? How would shortening their length or altering their angle to the open water affect the movement or deposition of sediment?

2. Describe the movement of the sand particles along the beach during the simulation. In what direction did they move?

3. What did you observe happening to the inlet?

4. If the simulation were to continue for a longer period of time, what topographic feature might you expect to form at the mouth of the inlet?

4 Activity

PROCEDURE—Simulation 4

A. Clean out the inlet area from your setup in Simulation 3, and position two jetties about 50 to 70 mm apart at the entrance of the inlet. To set up the jetties, slide two plastic support stands along the edge of each of the two jetty panels so they will remain upright and in place along the inlet entrance. Allow the jetties to stick out about 100 mm or so beyond the edge of the shoreline, and anchor each jetty with some sand along its base.

B. When your setup is complete, begin wave generation as before, but at a slight approach angle to the shoreline as shown in the simulation diagram. Observe the movement of any beach sediments, and answer the questions that follow.

2. The sea stack in this simulation represents a small, isolated, rocky island which has been detached from the headland by wave erosion. Describe the movement of sand in the area immediately behind the sea stack in your simulation.

3. If the sand movement you described above were to continue over time, what would happen to the sand behind the sea stack? Why?

3 Activity

PROCEDURE—Simulation 3

A. Next, set up your wave tank to create a small inlet as shown in the diagram for Simulation 3.

B. Repeat step B as in Simulation 1, but angle the direction of your wave fronts slightly so that the waves hit the shoreline at a slight angle as shown. Run the simulation for at least 5 minutes as before.

QUESTIONS—SIMULATION 3

1. Draw a sketch showing the movement of waves and sand in this simulation. Label places where sand is eroded with an "E" and places where sand is deposited with a "D."

b. How is increased energy usually transferred to waves?

c. What factors can influence the size and the force of waves breaking the shore?

2 Activity

PROCEDURE—Simulation 2

A. Rearrange the sand in your wave tank to create a headland as shown in the diagram for Simulation 2. Place the rock provided a short distance from shore to simulate a sea stack.

B. Repeat step B as outlined in Simulation 1. Answer the questions that follow.

QUESTIONS—SIMULATION 2

1. Draw a sketch showing the movement of waves and sand in this simulation. Label places where sand is eroded with an "E" and places where sand is deposited with a "D."

QUESTIONS—SIMULATION 1

Use both your observations and the background material at the beginning of this lab (including lecture) to answer the following questions.

1. Draw a sketch showing the movement of waves and sand in this simulation. Label places where sand is eroded with an "E" and places where sand is deposited with a "D."

2. How is your method of generating waves in this activity different from the way waves are created in the natural environment?

3. Describe the movement of the sand particles as the waves reached the shoreline. Was there any difference in the movement of the larger sand particles versus the finer sand grains? If there was a difference, explain it.

4. Beaches often look different in the summer and the winter because powerful storms create larger, more energetic waves.

   a. How do you think increasing the energy of the waves would change the character of the beach?

WAVE TANK AND COASTAL PROCESS SIMULATION

Overview

In this activity, you will be setting up a simple wave tank and shoreline simulation. You will work in small groups of 3–5 students to perform the four simulations.

Prepare the Tank and Practice Making Waves

Fill the wave tank with water to a depth of about 15–20 mm (approx. 2 gallons). Practice creating waves by holding the white plastic panel in the water so that it just touches the bottom of the tank and is parallel to the first 10 cm mark. Move the panel in a steady motion from one mark to the next, and then remove the panel from the water.

This entire process should take about one second. Be sure to keep the panel in a position perpendicular to the bottom of the tank, and maintain a fluid motion as you move the panel through the water. Practice this motion until you can produce uniform waves.

When you are ready, add sand to the tank to set up the four basic simulations described on the following pages and depicted by your instructor in the handout. You should run each simulation (make waves) for at least 5 minutes, noting the wave characteristics and movement of sand particles during that time. Once you've added the sand, you can adjust the water level (if necessary) to optimize each simulation. When you are finished, siphon the water from the tank using the tubing provided, and allow the sand to dry out in the sieves provided for re-use. Do NOT wash any sand down the sink.

1 Activity

PROCEDURE—Simulation 1

A. Once you have mastered wave generation, add the sand to your wave tank to create a shoreline as shown in the diagram for Simulation 1 (handout provided). Place the sand in the tank at the end opposite where you have marked your wave generation points. Make sure the sand is spread uniformly across the end of the tank so that at least half of the sand remains above water level and the total sand area occupies no more than about 1/4 of the tank's length.

B. With the sand now in place, position your wave generator panel in the center of the water, and begin generating waves by moving the panel between the two marks on the side of the tank. Continue to generate waves in this manner for at least 5 minutes, making sure the position and pace of the waves is constant. During this time, observe the wave characteristics and movement of sand particles along the shoreline.

When waves break, they stir up and mobilize the sand and sediment, pushing it up the beachface at an angle. However, the return flow is straight back, producing a zigzag pattern (Figure 7-3). The waves hitting the beach at an angle is called the **longshore current** and results in the movement of sediment down the beach in a process called the **longshore drift**. Longshore currents carry large amounts of sediment down the shoreline and are partially responsible for the formation of geologic features such as baymouth bars and spits (Figure 7-4). In North America, most sediment is transported south by the longshore current. As waves move toward the shoreline, they also interact with any structures or geologic features that may be present, for example jetties, breakwaters, and groins (Figure 7-5). Coastal areas are very dynamic and are constantly being modified by wave action, tidal currents, longshore currents, and storms.

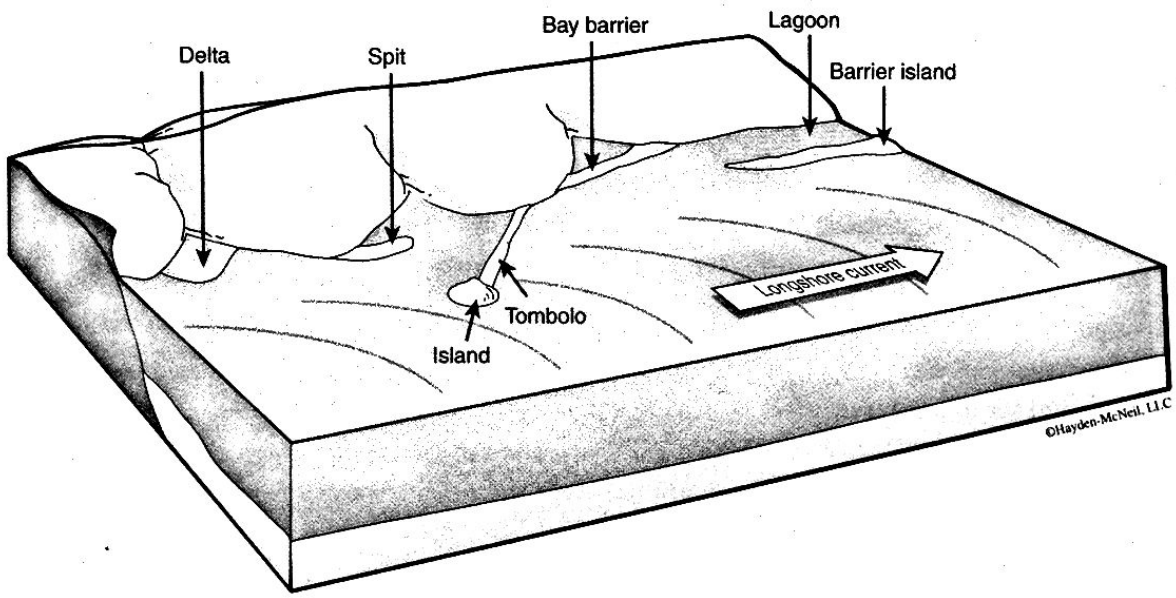

Figure 7-4. *Geologic features commonly found along the coast*

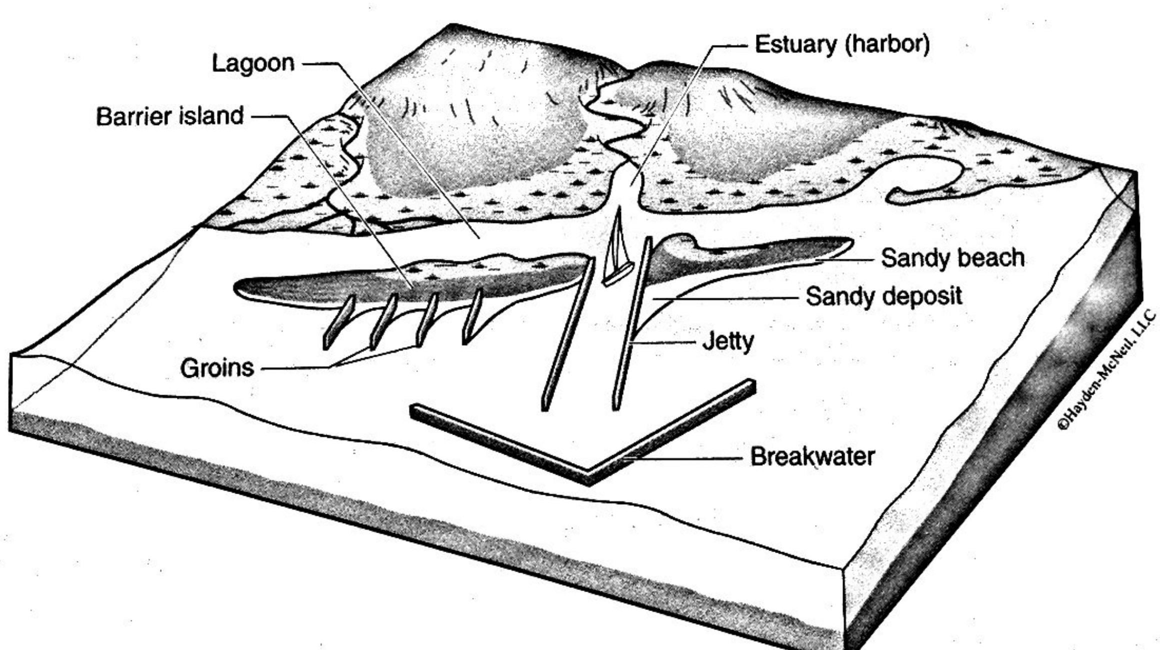

Figure 7-5. *Man-made structures commonly found along the coast*

Shallow-water waves form as waves approach the shoreline and interact with the seafloor. As the water becomes shallower, the wave is affected by friction between the seawater and the seafloor, usually when water depth becomes less than half the wavelength. At this point, the bottom of the wave slows down, but the top of the wave continues to move at its original speed. As the wave approaches the shoreline, the wave height continues to increase until it eventually topples over, forming a breaker (Figure 7-2). Both the original wave height and the steepness of the seafloor determine the size and force of breakers. The steeper the seafloor is near the shore, the greater the force of the breakers. Regardless of the type of shoreline, waves impact the coastal topography by eroding surface landforms and transporting sediments back and forth across the shore zone.

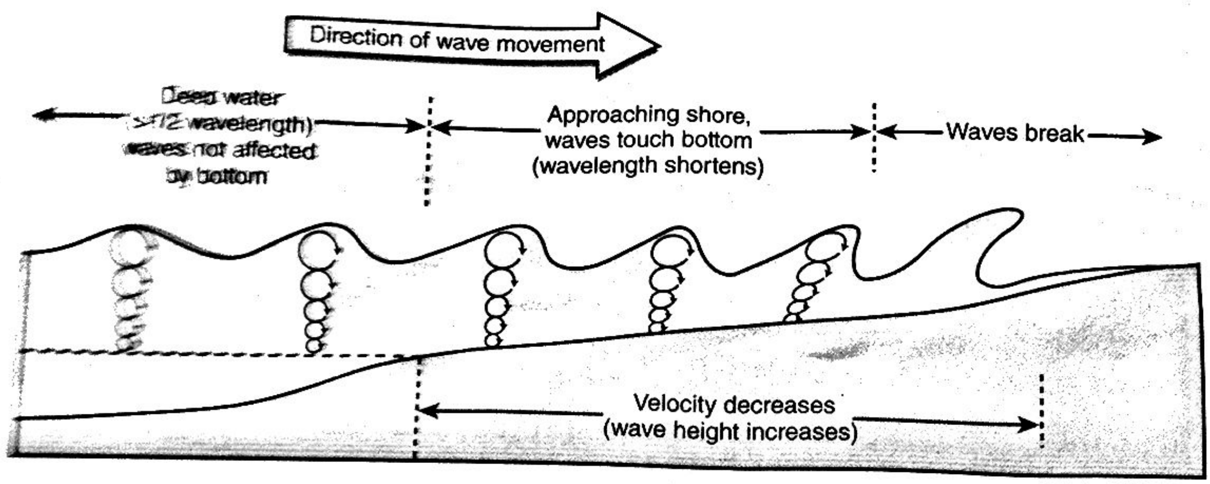

Figure 7-2. *Waves as they approach the shoreline*

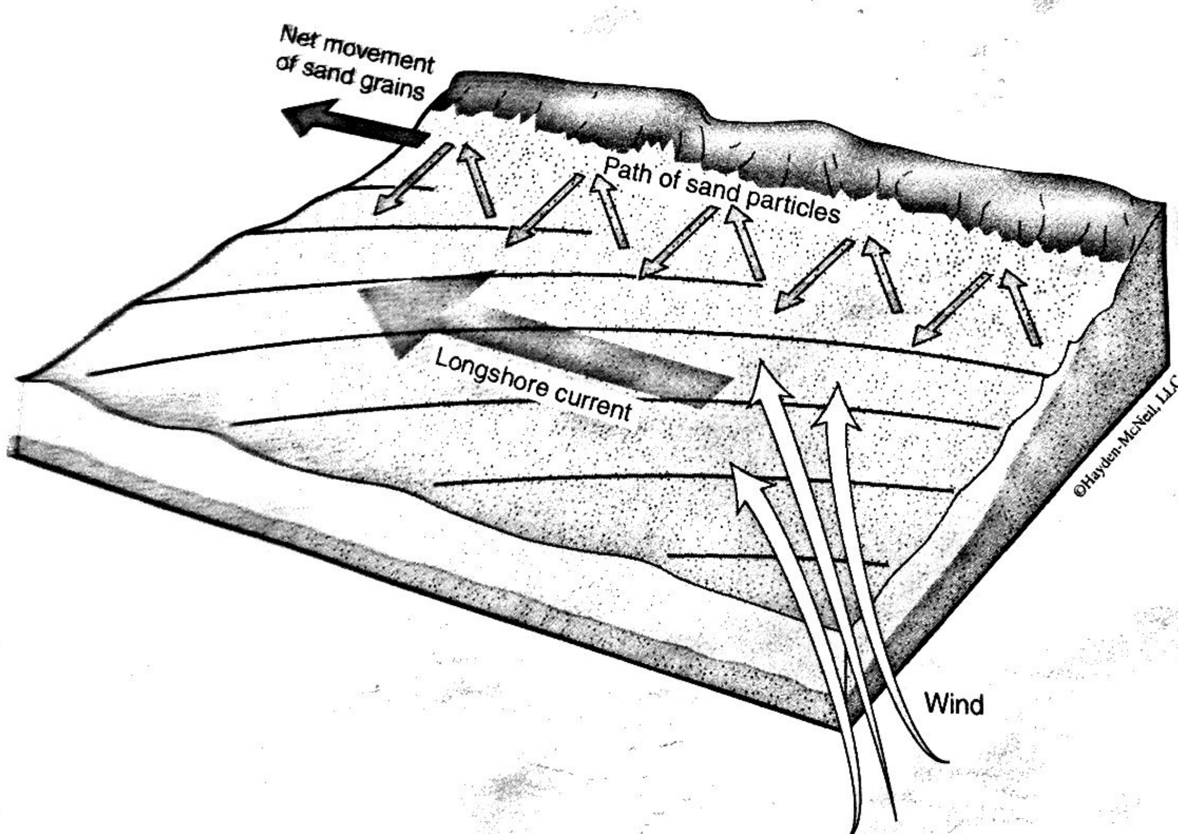

Figure 7-3. *Zigzag sand movement resulting in longshore drift*

MATERIALS

- Laptop computer
- Wave tank
- Rock barrier
- Wave maker
- Jetties
- Sand
- Colored pencils

BACKGROUND

Waves are most often caused by winds blowing over a body of water. For example, when wind blows over the ocean's surface, the friction between the air and the water pulls the water in the direction of the wind, creating waves. Wave size depends on how far, how fast, and how long the wind blows. The friction creates wave orbits that transfer energy from the surface to deeper depths (Figure 7-1). In some cases, you might see a boat or seagull bob up and down instead of moving. This is the wave traveling through the water.

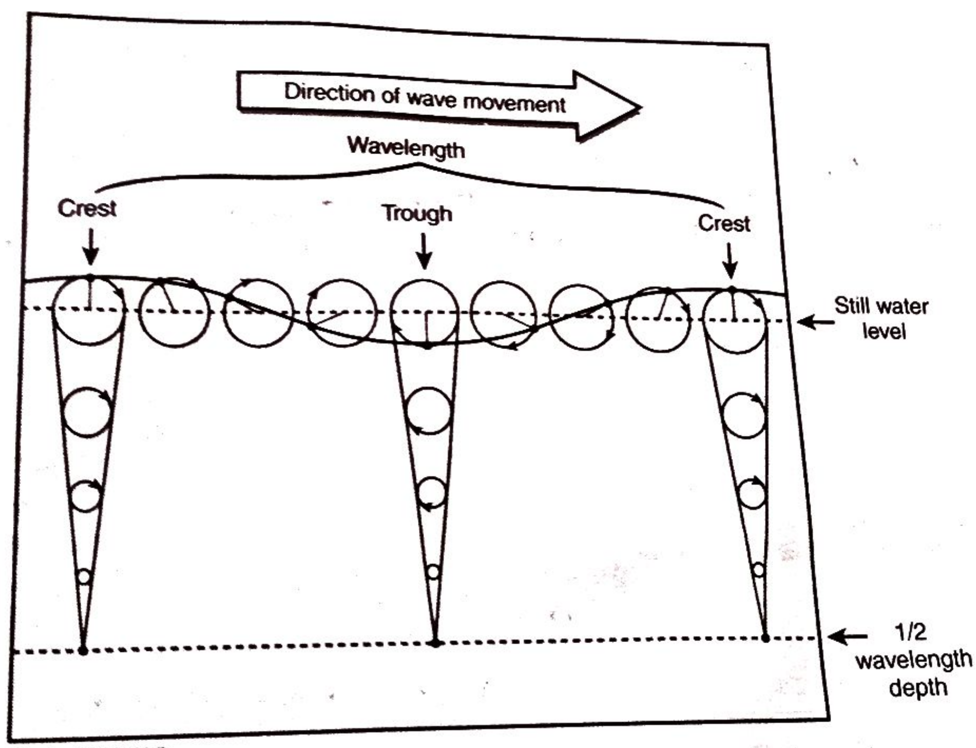

Figure 7-1. *Circular wave orbits and wave features*

7 Wave Erosion