

CHAPTER 12 Agents of Erosion and Deposition

SECTION 1

Shoreline Erosion and Deposition

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is a shoreline?
- How do waves shape shorelines?

National Science Education Standards
ES 1c

How Do Waves Form?

Waves form when wind blows over the surface of the ocean. Strong winds produce large waves. The waves move toward land. When waves crash into the land over a long time, they can break rock down into smaller pieces. These pieces are called *sand*.

A **shoreline** is a place where the land and the water meet. Most shorelines contain sand. The motion of waves helps to shape shorelines. During *erosion*, waves remove sand from shorelines. During *deposition*, waves add sand to shorelines. ✓

STUDY TIP

Summarize Read this section quietly to yourself. Talk about what you learned with a partner. Together, try to figure out the answers to any questions that you have.

WAVE TRAINS

Waves move in groups called *wave trains*. The waves in a wave train are separated by a period of time called the *wave period*. You can measure the wave period by counting the seconds between waves breaking on the shore. Most wave periods are 10 to 20 s long.

When a wave reaches shallow water, the bottom of the wave drags against the sea floor. As the water gets shallower, the wave gets taller. Soon, it can't support itself. The bottom slows down. The top of the wave begins to curl, fall over, and break. Breaking waves are called *surf*.

READING CHECK

1. Compare How is wave erosion different from wave deposition?



Waves travel in groups called wave trains. The time between one wave and the next is the wave period.

Math Focus

2. Calculate A certain wave train contains 6 waves. The time between the first wave and the last wave is 72 seconds. What is the wave period?

SECTION 1 Shoreline Erosion and Deposition *continued*

POUNDING SURF

The energy in waves is constantly breaking rock into smaller and smaller pieces. Crashing waves can break solid rock and throw the pieces back toward the shore. Breaking waves can enter cracks in the rock and break off large boulders. Waves also pick up fine grains of sand. The loose sand wears down other rocks on the shore through abrasion. ✓

READING CHECK

3. Identify Give two ways that waves can break rock into smaller pieces.

Critical Thinking

4. Identify Relationships When may a storm not produce high-energy waves?

TAKE A LOOK

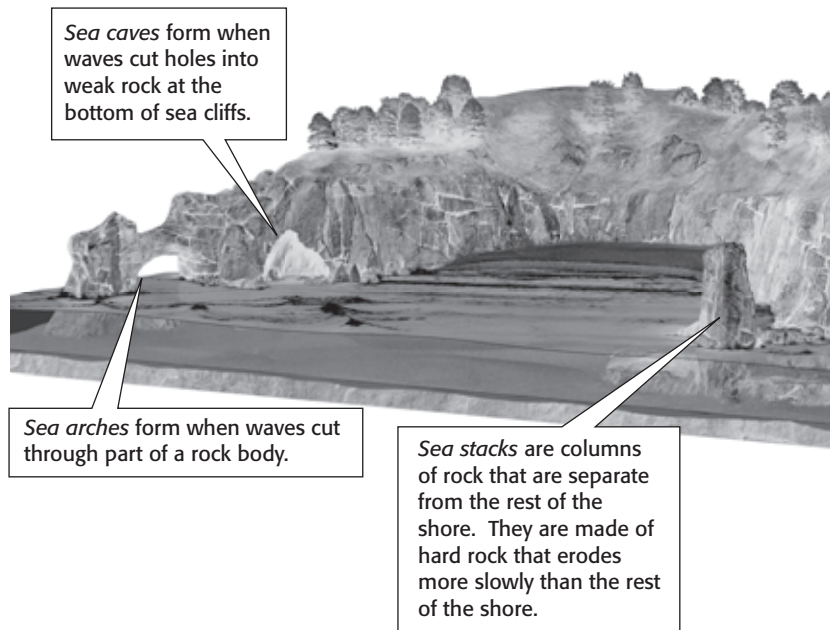
5. Compare How is a sea stack different from a sea arch?

What Are the Effects of Wave Erosion?

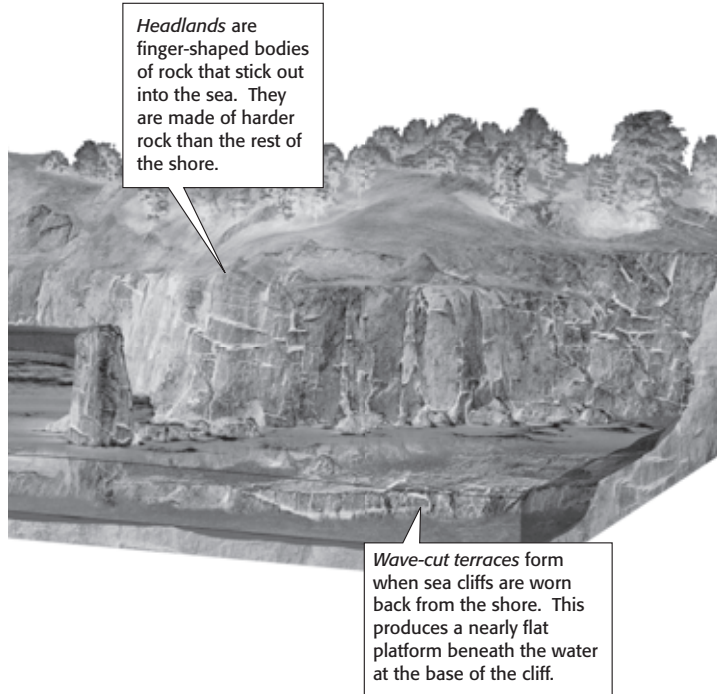
Wave erosion can produce many features along a shoreline. For example, *sea cliffs* form when waves erode rock to form steep slopes. As waves strike the bottom of the cliffs, the waves wear away soil and rock and make the cliffs steeper.

How fast sea cliffs erode depends on how hard the rock is and how strong the waves are. Cliffs made of hard rock, such as granite, erode slowly. Cliffs made of soft rock, such as shale, erode more quickly.

During storms, large, high-energy waves can erode the shore very quickly. These waves can break off large chunks of rock. Many of the features of shorelines are shaped by storm waves. The figures below and on the next page show some features that form because of wave erosion.



SECTION 1 Shoreline Erosion and Deposition *continued*



STANDARDS CHECK

ES 1c Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

6. Define What is a headland?

What Are the Effects of Wave Deposition?

Waves carry many materials, such as sand, shells, and small rocks. When the waves deposit these materials on the shoreline, a beach forms. A **beach** is any area of shoreline that is made of material deposited by waves. Some beach material is deposited by rivers and moves down the shoreline by the action of waves. ✓

Many people think that all beaches are made of sand. However, beaches may be made of many materials, not just sand. The size and shape of beach material depend on how far the material traveled before it was deposited. They also depend on how the material is eroded. For example, beaches in stormy areas may be made of large rocks because smaller particles are removed by the waves.

The color of a beach can vary, too. A beach's color depends on what particles make up the beach. Light-colored sand is the most common beach material. Most light-colored sand is made of the mineral quartz. Many Florida beaches are made of quartz sand. On many tropical beaches, the sand is white. It is made of finely ground white coral. ✓

Beaches can also be black or dark-colored. Black-sand beaches are found in Hawaii. Their sands are made of eroded lava from volcanoes. This lava is rich in dark-colored minerals, so the sand is also dark-colored. The figures on the next page show some examples of beaches.

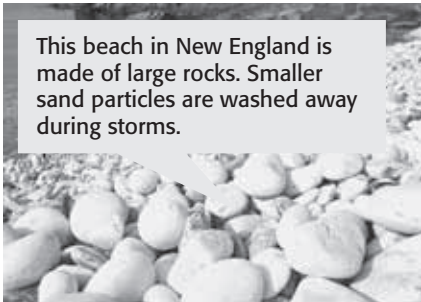
READING CHECK

7. Define Write your own definition for *beach*.

READING CHECK

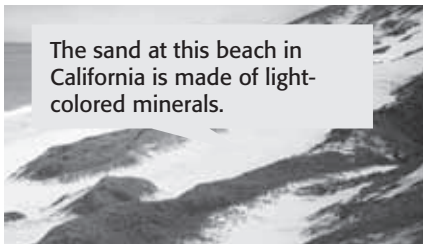
8. Identify What mineral is most light-colored sand made of?

SECTION 1 Shoreline Erosion and Deposition *continued*



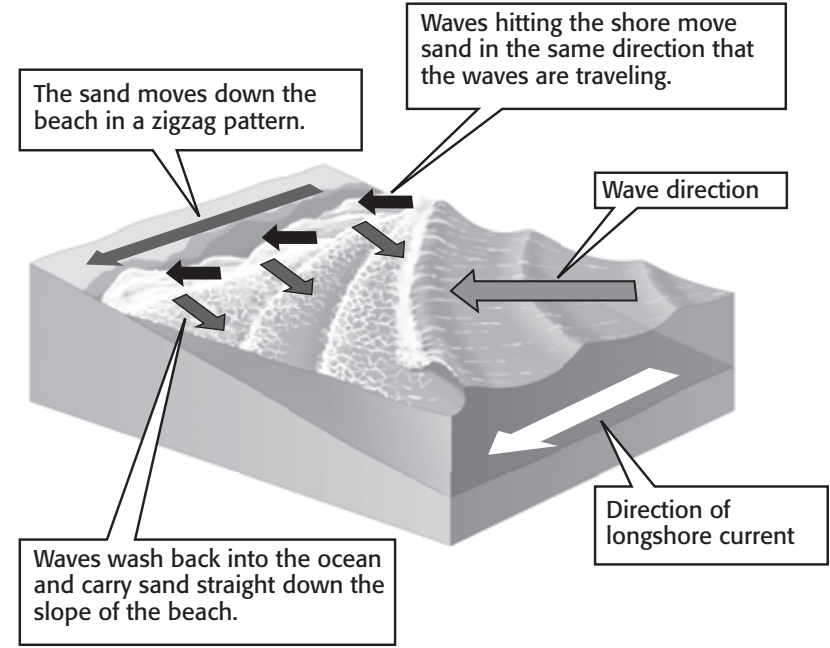
TAKE A LOOK

9. Explain Why are some beaches made mostly of larger rock pieces, instead of sand?



WAVE ANGLE AND SAND MOVEMENT

Waves can move sand along a beach. The movement of the sand depends on the angle at which the waves hit the shore. *Longshore currents* form when waves hit the shore at an angle. The waves wash sand onto the shore at the same angle that the waves are moving. However, when the waves wash back into the ocean, they move sand directly down the slope of the beach. This causes the sand to move in a zigzag pattern, as shown in the figure below.



TAKE A LOOK

10. Infer Why don't longshore currents form in places where waves hit the shore head-on?

SECTION 1 Shoreline Erosion and Deposition *continued*

OFFSHORE DEPOSITS

Longshore currents can carry beach material offshore. This process can produce landforms in open water. These landforms include sandbars, barrier spits, and barrier islands.

A *sandbar* is a ridge of sand, gravel, or broken shells that is found in open water. Sandbars may be completely under water or they may stick up above the water. ✓

A *barrier spit* is a sandbar that sticks up above the water and is connected to the shoreline. Cape Cod, Massachusetts, is an example of a barrier spit. It is shown in the figure below.



Cape Cod, Massachusetts, is an example of a barrier spit. Barrier spits form when sandbars are connected to the shoreline.

A *barrier island* is a long, narrow island that forms parallel to the shoreline. Most barrier islands are made of sand.



Santa Rosa Island in Florida is an example of a barrier island.

READING CHECK

11. Define What is a sandbar?

TAKE A LOOK

12. Identify What is a barrier spit?

TAKE A LOOK

13. Compare What is the difference between a barrier island and a barrier spit?

Section 1 Review

NSES ES 1c

SECTION VOCABULARY

beach an area of the shoreline that is made up of deposited sediment

shoreline the boundary between land and a body of water

1. Compare How is a shoreline different from a beach?

2. Explain Where does the energy to change the shoreline come from? Explain your answer.

3. Identify Give two examples of different-colored beach sand and explain why each kind is a certain color.

4. Explain How do longshore currents move sand?

5. List Give five landforms that are produced by wave erosion.

4. Shale has a high porosity but a low permeability. It can hold a lot of water in its pores, but because the pores aren't linked, the water can't flow through it.
5. They touch the water in many places.
6. precipitation
7. when the water table meets the Earth's surface and water flows out
8. a crack in the cap rock above an aquifer
9. Well 1 will produce water because it taps the aquifer.
10. limestone
11. Stalactites hang from the ceiling; stalagmites grow from the floor.
12. Sinkholes can form when caves collapse.

Review

1. The water table provides a fresh source of water for people and the environment. If people want to drill a well, they need to know where the water table is located to know where and how deep to make the well.
2. Rocks with many different particle sizes tend to have lower porosities than rocks made of a uniform particle size.
3. If roads are built over a recharge zone, less water will be able to seep into the aquifer.
4. A well is a hole that is dug deep into the earth to reach the water table, to get water. A spring forms when the water table reaches the surface naturally and flows out of the ground.
5. caves and sinkholes
6. A stalactite and a stalagmite grow so large that they join together.

SECTION 4 USING WATER WISELY

1. pollution that comes from a single source
2. Runoff can carry chemicals to water bodies.
3. oxygen that is dissolved in water
4. animal waste
5. They clean waste materials out of water.
6. Not all pollutants in water are solids that settle out; some are dissolved in the water. Primary treatment removes only wastes that settle out.
7. It adds chlorine to the water to disinfect it.
8. to help clean wastewater when no sewage treatment plant is available
9. bathing, toilets, laundry
10. 81/100

11. Things You Can Do to Conserve Water
• Use water-saving toilets and showerheads.
• Water the lawn at night, or don't water it at all.
• Run the dishwasher and washing machine only when they are full.
• Turn off the water when you brush your teeth.
• Collect rainwater for use in watering plants.
• Take shorter showers.

Review

1. Pollution can decrease the amount of dissolved oxygen in the water. Animals and plants depend on this oxygen to live. They will die if there is not enough oxygen.
2. Sewage treatment plant: Wastewater passes through several tanks. Bacteria use oxygen to eat the waste. Water is treated with chlorine and released into a water source. Plant treats water from many houses.
Septic tank: Wastewater passes into one tank. Water is released into the ground. Tank treats water from one house.
In center: Wastewater flows into tanks, and waste sinks to the bottom. Bacteria eat the waste.
3. When farmers water their crops, much of the water seeps into the groundwater. This runoff then travels to the river. The water can carry pollutants such as pesticides, fertilizers, and animal waste. Since this pollution comes from many different farms, it is nonpoint-source pollution.

Chapter 12 Agents of Erosion and Deposition

SECTION 1 SHORELINE EROSION AND DEPOSITION

1. Waves remove sand from shorelines during erosion and add sand during deposition.
2. 12 s
3. Crashing waves can break solid rock apart. Water can enter cracks in the rock and break pieces off.
4. If the storm does not include strong winds, large waves will probably not be produced.
5. Sea arches are connected to the mainland, but sea stacks are not.
6. a body of rock that sticks out into the sea

7. A beach is an area along a shoreline that is covered by materials that were carried there by waves.
8. quartz
9. Sand particles are washed away during storms.
10. Waves wash onto the beach in the same direction that they wash off the beach, so there is no sideways movement of water.
11. a ridge of deposited material in open water
12. a sandbar that is connected to the shoreline
13. Barrier spits are connected to the shore, but barrier islands are not.

Review

1. A shoreline is the boundary between land and water. A beach is part of a shoreline that is made of deposited sediment.
2. Answers include: wind (produces waves, which erode and add to the shore), waves
3. The sand can have different colors, which come from the kind of rock it is made from. Black sand can form from the weathering of dark-colored lava. Light-colored sand may be made of light-colored minerals, such as quartz.
4. Waves carry sand up the shore parallel to their direction of travel. The waves wash back into the ocean perpendicular to the shoreline. This causes sand to move in a zig-zag pattern parallel to the shoreline.
5. sea arches, sea stacks, headlands, wave-cut terraces, sea caves

SECTION 2 WIND EROSION AND DEPOSITION

1. They hold the soil and rock in place.
2. Large particles are too heavy, and the wind doesn't have enough energy to carry them.
3. the process in which small sediment particles are removed by the wind, leaving behind larger particles

Process	Description
Saltation	Large particles bounce and skip along the ground.
Deflation	Small particles are removed by wind.
Abrasion	Rock pieces are worn away by wind-carried sand.

5. Fast winds have more energy, so they can lift larger particles.
6. a mound of wind-deposited sand

7. the same direction the wind is blowing
8. The windward slope has a gentler angle than the slip face.

Review

1. desert pavement, deflation hollows
2. areas with little plant cover and/or with fine, loose soil or sand, such as coastlines and deserts
3. Student should label the gently sloping side "windward slope" and the steeply dipping side "slip face"; the arrow should point to the right.
4. When wind hits a barrier, such as a plant, a rock, or a building, it slows down. The sediment that it has been carrying is deposited onto the barrier, making the barrier larger. Eventually, the barrier is completely covered by sediment, forming a dune.
5. The wind can carry small particles the farthest because they weigh the least.

SECTION 3 EROSION AND DEPOSITION BY ICE

1. continental and alpine
2. a huge, moving sheet of ice
3. Glaciers are made of frozen water.
4. Horns and arêtes form when two or more cirques affect the same part of a mountain.
5. It contains particles of many different sizes.
6. Stratified drift is material that is deposited by water that comes from melting glaciers.

Review

1. till, stratified drift
2. lateral, medial, terminal, ground
3. Continental glaciers form on large areas of relatively flat land. Alpine glaciers form on top of high mountains.
4. Snow falls on an area but does not melt over the course of the year. Over time, more snow builds up in the area. The weight of the snow above pushes down on the snow below, causing the snow at the bottom to turn into ice. This ice is a glacier.
5. A block of ice is left behind as a glacier retreats. When the ice melts, the material in it gets deposited around the outside of the block. This makes a depression, called a kettle, in the center.