6-5 What are the stages of a river?

Objective ▸ Name and describe the three stages in the life cycle of a river.

TechTerms

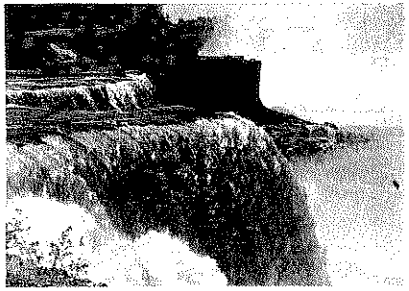
- **meanders** (mee-AN-durs): loops in a mature river
- **oxbow lake:** lake formed when a meander is cut off from the rest of the river

Life Cycle of a River Rivers go through three stages in their life cycles. The three stages in the life cycle of a river are youth, maturity (muh-CHOOR-ih-tee), and old age. The stage of a river's life cycle is not determined by the age of the river in years. The stage of a river depends upon how fast the water in the river flows and other features of the river.

Identify: What are the three stages in the life cycle of a river?

Youthful River A youthful river has a steep slope and fast-moving water. The Colorado River and the Niagara River are examples of youthful rivers. The fast-moving water erodes the river bed, or bottom. A narrow, V-shaped valley is formed by a youthful river. The river fills almost the whole valley from side to side.

Many rapids and waterfalls are found along a youthful river. As the moving water rushes over steep slopes, rapids are formed. Sometimes the slope drops straight down. Then a waterfall is formed.



Infer: What evidence indicates that the Niagara River is a young river?

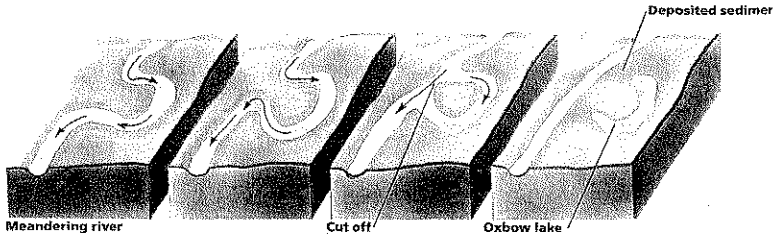
Mature River The waters of a mature river mov slower than the waters of a youthful river. A mature river does not have rapids and waterfalls As a result of erosion, the river becomes wider. I winds back and forth in loops called **meander** (mee-AN-durs). The Missouri River and the Ohi River are mature rivers.

Define: What are meanders?

Old River Water moves very slowly in an ol river. The Mississippi River is an old river. An ol river has a nearly flat slope. Because of the fla slope, an old river often overflows during period of heavy rain. The overflowing of river water i called flooding.

As a result of flooding, erosion and depositio take place along the meanders of an old rive Sometimes a meander is cut off from the rest c the river. As a result, a C-shaped lake called a **oxbow lake** is formed.

Describe: How is an oxbow lake formed?



Name _____ Class _____ Date _____

6-5 What are the stages of a river?

Lesson Review

Part A *Complete the table by placing a check mark in the proper column or columns.*

Table 1 River Characteristics

Characteristic	Youth	Maturity	Old Age
1. Slow-moving water			
2. Meanders			
3. Fast-moving water			
4. Waterfalls			
5. Nearly flat slope			
6. Narrow, V-shaped valleys			
7. No waterfalls or rapids			
8. Oxbow lakes			
9. Wide valleys			
10. Rapids			

Part B *Classify each of the following as a young river, a mature river, or an old river. Write the terms "young," "mature," or "old" in the spaces provided.*

_____ 1. Niagara River _____ 2. Colorado River

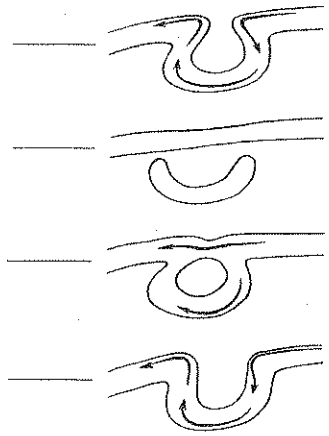
_____ 3. Missouri River _____ 4. Ohio River

Skill Challenge

***Skills:** sequencing, identifying*

Use the diagrams to complete the following.

1. Place the diagrams in the correct order by writing the numbers 1 through 4 in the spaces provided.
2. Label the meanders and the oxbow lake on the diagrams.



6–6 How does running water create landforms?

Objective ▸ Describe three landforms created by running water.

TechTerms

- **delta:** triangular-shaped deposit of sediment located at the mouth of a river
- **flood plain:** flat area on the side of a river where sediments are deposited during floods
- **sediment** (SED-uh-munt): soil and rock particles that settle to the bottom of a river

Valleys The bed of a river is often solid rock. Small pieces of rock bounce along the bed of a fast-moving river. Abrasion occurs as these pieces of rock scrape the river bed. Over a long period of time, the bed is cut deeper into the rock and a valley is formed. Fast-moving rivers can cut very deep valleys.

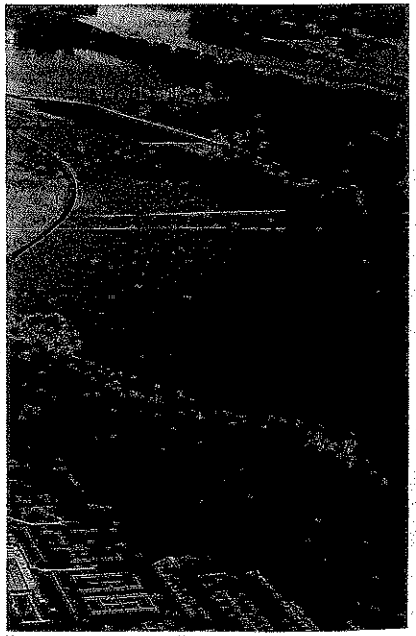
Identify: What is a valley?

Deltas A triangle-shaped deposit of muddy land called a **delta** often forms at the mouth, or end, of a river. The word "delta" is the name of a Greek letter. The Greek delta looks like a small triangle.

Nile River delta

How does a delta form? The water at the mouth of a river moves very slowly. Pieces of rock and soil carried by slow-moving water are dropped. The particles of soil and rock that settle to the bed of a river are called **sediment** (SED-uh-munt). Sediments in the water are deposited in a delta.

Locate: Where does a delta form?



Water spills onto the flood plain.

Flood plains During heavy rains, an old river overflows its banks, or sides. When an old river floods its banks, fertile soil carried by the river is deposited at the sides of the river. The fertile soil is deposited in flat areas called **flood plains.** The soil deposited in flood plains was carried to the river by tributaries that feed the river.

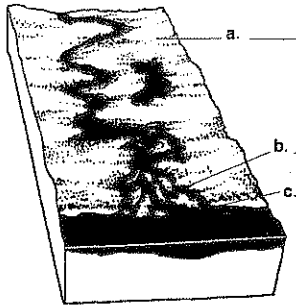
Define: What are flood plains?

Name _____ Class _____ Date _____

6–6 How does running water create landforms?

Lesson Review

Complete the following. Write your answers in the spaces provided.



1. Label the **flood plain, mouth,** and **delta** of the river shown.
2. Draw a triangle on the diagram around the delta of the river.
3. The place where a river ends is called its _____
4. Soil and rock particles that settle to the bottom of a river are called _____.
5. What is a flat area on the side of a river where sediments are deposited during floods called? _____
6. What kind of river forms flood plains? _____

Skill Challenge

Skills: *researching, building vocabulary, modeling*

Use a dictionary to fill in the blank spaces in the table. Then, answer the questions.

Table 1 Letters of the Greek Alphabet

	Letter	Symbol	Position in Alphabet
	Delta	Δ	4th
1.	Omega		
2.	Sigma		
3.	Pi		
4.	Lambda		
5.	Chi		

6. In mathematics, the symbol π (pi) has a value of 3.14. What is pi used to measure? _____
7. What does "omega" mean? _____
8. What is the meaning of the term "fraternity"? _____
9. A member of a college fraternity wears a sweatshirt with the symbols ΛΧΣ. What fraternity does this person belong to? _____

6–7 What is a glacier?

Objectives ▸ Explain how a glacier is formed.
▸ Name two kinds of glaciers.

TechTerm

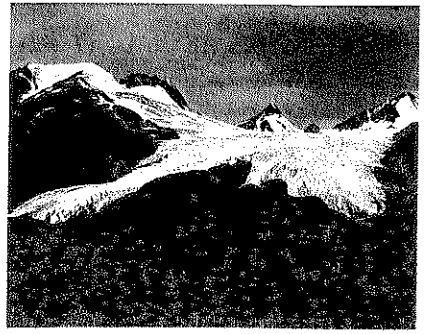
▸ **glacier** (GLAY-shur): moving river of ice and snow

Glaciers A **glacier** (GLAY-shur) is a moving river of ice and snow. Glaciers form in places where the temperature is cold for most of the year. In these places, snow does not melt after heavy snowfalls. More snow falls on top of snow that already is on the ground. The snow gets deeper and deeper. Ice forms at the bottom of this deep layer of snow. The pull of gravity and the weight of the snow on top of the ice causes the ice to move. A glacier is formed. Very slowly, the glacier begins to move downhill.

Define: What is a glacier?

Kinds of Glaciers There are two kinds of glaciers. Glaciers that form in mountains and move slowly downhill through valleys are called valley glaciers. Other glaciers form near the earth's poles. These glaciers form large sheets of ice called icecaps, or continental glaciers.

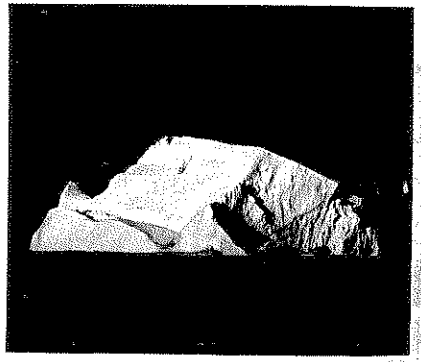
Name: What are two kinds of glaciers?



Icebergs When a continental glacier reaches the ocean, a large piece of the glacier may break off and float away. A large piece of floating ice is called an iceberg. Large amounts of sediment may be frozen into an iceberg. As the iceberg melts, these sediments are dropped into the ocean. The sediments sink to the ocean bottom.

Most of an iceberg is below the surface of the water. Only a small part of an iceberg is visible above the surface. Many ships have crashed into icebergs. To protect ships at sea, the U.S. Navy watches for icebergs and keeps track of where they are moving. The Navy also may use icebreakers to break icebergs apart and clear passages for ships.

Explain: Why are icebergs a problem for ships?



Ice Ages An ice age is a period of very cold temperatures. Glaciers grow and spread during ice ages. There have been many ice ages in the history of the earth. The last ice age ended about 11,000 years ago. During the last ice age, the sheet of ice around the North Pole got larger. The icecap finally covered most of North America.

Identify: What is an ice age?

Name _____ Class _____ Date _____

6–7 What is a glacier?

Lesson Review

Match each term in Column B with its description in Column A. Write the letter of the correct term in the space provided.

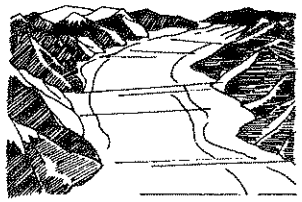
Column A	Column B
_____ 1. moving river of ice and snow	a. iceberg
_____ 2. glacier that forms in mountains	b. glacier
_____ 3. glacier that forms near the poles	c. ice age
_____ 4. large piece of floating ice	d. valley glacier
_____ 5. period of very cold temperatures	e. continental glacier

Skill Challenge

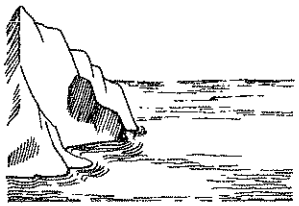
Label each diagram as a valley glacier, a continental glacier, or an iceberg. Write your answer in the space provided.

1.

2.



3.



1. _____

2. _____

3. _____

6–8 How do glaciers cause erosion?

Objectives ▸ Explain how a glacier causes erosion. ▸ Describe two results of glacial deposition.

TechTerms

- **erratics** (uh-RAT-iks): rocks left behind by a retreating glacier
- **hanging valley:** small glacial valley above a main valley
- **till:** rock material deposited by a glacier

Glacial Erosion Gravel and pieces of rock are frozen into the ice at the bottom of a glacier. As the glacier moves over bedrock, the rocks in the glacier scrape against the bedrock. Small pieces of the bedrock are carved away by the scraping rocks. These pieces of bedrock are pushed along in front of the glacier.

Explain: How does a glacier cause abrasion?

Hanging Valleys As a glacier scrapes away the floor of a valley, the valley becomes U-shaped. Sometimes small side glaciers flow into the main glacier. As the side glaciers melt and disappear, they leave small valleys high above the main valley. These valleys are called **hanging valleys.**

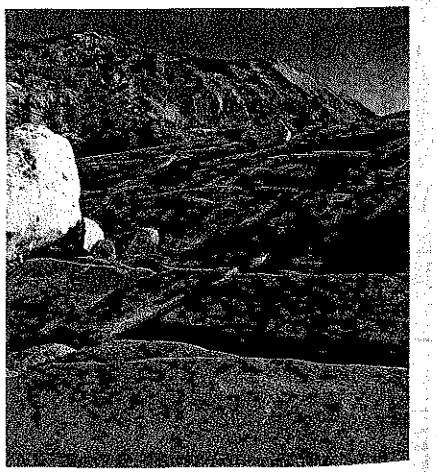
Define: What is a hanging valley?

Glacial Deposition Large rocks and sediments are often frozen into a glacier. As the glacier moves, these rocks and sediments are carried to new places. As a glacier moves into a warmer area, the ice begins to melt around the edges of the glacier. The glacier appears to be shrinking, or retreating. Rocks and sediments that were frozen in the ice are left behind. This loose material deposited by the glacier is called **till.**

Define: What is till?

Erratics Boulders left behind by a retreating glacier are called **erratics** (uh-RAT-iks). Central Park in New York City has many boulders. These boulders are not like the bedrock underneath the park. The boulders are like bedrock located hundreds of kilometers away. The boulders are too large and too heavy to have been moved by running water. How did they get to Central Park? The only way they could have been moved is by a glacier. The boulders were frozen into the ice and left behind when the glacier melted.

Explain: How are erratics moved?



Name _____ Class _____ Date _____

6–8 How do glaciers cause erosion?

Lesson Review

Circle the term that makes each statement true.

1. A moving river of ice and snow is (a glacier, an erratic).
2. As a glacier moves over bedrock, small pieces of the bedrock may be carved away by (erosion, abrasion).
3. As a glacier scrapes away the floor of a valley, the valley becomes (V-shaped, U-shaped).
4. Small valleys left high above a main valley are called (hanging, talus) valleys.
5. A glacier that is melting is said to be (retreating, advancing).
6. Rock and sediments that are left behind by a melting glacier are called (talus, till).
7. Large boulders that are left behind by a retreating glacier are called (till, erratics).
8. Till can best be described as (small, large) pieces of rock and sediment.

Skill Challenge

Skills: *analyzing, applying concepts*

Use the diagrams to answer the questions.

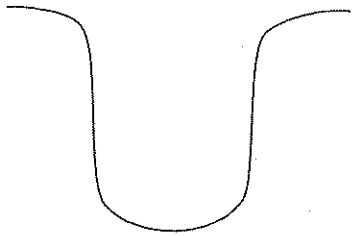


Figure A

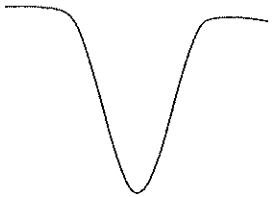


Figure B

1. Which valley was more likely to have been created by a glacier? _____
2. How does a glacier help to form a valley? _____
3. Is the formation of a valley by a glacier an example of erosion, deposition, or both? Explain. _____

6-9 How do glaciers create landforms?

Objective ▸ Describe two landforms created by glaciers.

TechTerms

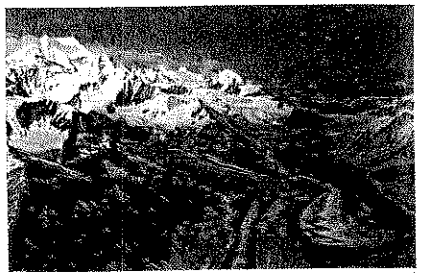
- **drumlin:** oval-shaped mound of till
- **kettle lake:** lake formed by a retreating glacier
- **moraine** (moor-AYN): ridge of till deposited by a retreating glacier

Moraines When a glacier retreats, it deposits till. The till builds up a long, low ridge. This ridge of till is called a **moraine** (moor-AYN). When till is deposited at the front edge of a glacier, a terminal (TUR-muh-nul) moraine is formed. When till is deposited along the sides of a glacier, a lateral (LAT-uhr-ul) moraine is formed.

Name: What are two kinds of moraines?

Drumlins Sometimes when a glacier retreats, it leaves behind oval-shaped mounds of till. These mounds of till are called **drumlins.** The tip of a drumlin points in the direction the glacier was moving. Most drumlins form in groups. Drumlins can be seen in the farmlands of Vermont.

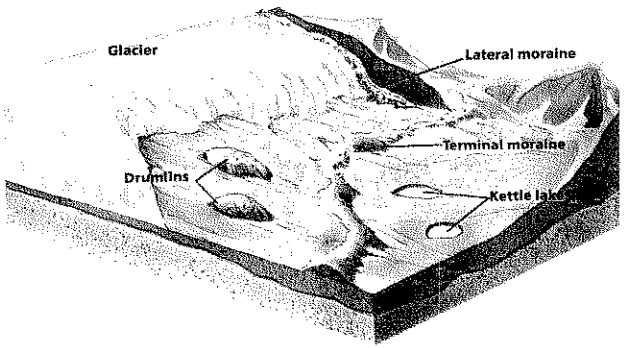
Define: What is a drumlin?



Glacial Lakes During the last ice age, glaciers formed in river valleys. The glaciers eroded the valleys and made them deeper. As the glaciers retreated, till carried by the glaciers was dropped. Then the glaciers melted. The water of a melting glacier is called meltwater. Meltwater filled the valleys with water and formed lakes. Glacial lakes are usually long and deep. The Great Lakes and New York's Finger Lakes are glacial lakes.

Sometimes, a retreating glacier left behind a huge block of ice. The ice blocks were covered with sediments. When the block of ice melted, a large hole was left in the ground. The sediments carried by the glacier were dropped. The hole filled with meltwater and a lake was formed. A lake formed in this way is called a **kettle lake.**

Identify: What is a kettle lake?



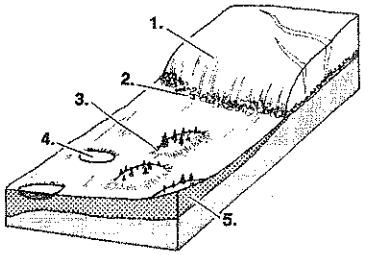
Name _____ Class _____ Date _____

6–9 How do glaciers create landforms?

Lesson Review

Part A *Use the terms listed in the box to label the parts of the diagram. Write your answers in the spaces provided.*

TERMS
glacier
moraine
kettle lake
drumlin
till



1. _____
2. _____
3. _____
4. _____
5. _____

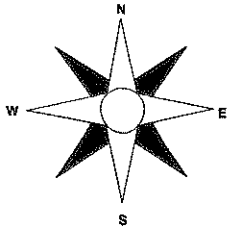
Part B *Circle the term that makes each statement true.*

1. When a glacier retreats, it deposits (till, talus).
2. The Great Lakes and New York's Finger Lakes are (glacial, kettle) lakes.
3. When till is deposited at the sides of a glacier a (terminal, lateral) moraine is formed.
4. Oval-shaped mounds of till left by a retreating glacier are called (drumlins, moraines).
5. If a glacier moved south, the tip of a drumlin formed by the glacier would point (north, south).

Skill Challenge

Skills: *interpreting, identifying, applying concepts*

Study the drumlins. Then use the compass to identify the direction the glacier that formed each drumlin was moving. Write the direction in the space provided.



1.  1. _____
2.  2. _____
3.  3. _____
4.  4. _____

6-10 How do ocean waves cause erosion?

Objectives ▸ Describe how ocean waves cause erosion. ▸ Name five shoreline features that are caused by wave erosion.

TechTerms

- **sea arch:** gap formed when waves cut completely through a section of rock
- **sea stack:** column of rock remaining after the collapse of a sea arch
- **wave:** up-and-down movement of water
- **wave-cut terrace:** flat section of rock formed by the erosion of a sea cliff

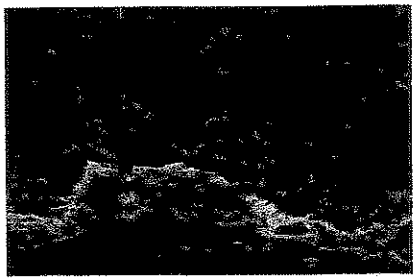
Wave Erosion A **wave** is an up-and-down movement of water. Ocean waves are formed when wind blows over the water. Waves also are caused by tides, storms, and earthquakes.

The force of waves striking the shoreline can break up rocks into small pieces. The pieces of rock grind against one another. This grinding causes abrasion. Abrasion wears down the rock and forms particles of sand. The sand is then carried away by the waves.

Waves also cause chemical weathering of the rocks along a shoreline. As waves meet the shoreline, salt water is forced into cracks in rocks. The chemical action of the salt water breaks down the rock and makes the cracks larger. Broken pieces of rock are then carried away by the waves.

Describe: How do waves cause erosion along a shoreline?

Sea Cliffs, Caves, and Terraces Waves pound against the bottom of the rocks on a rocky shoreline. As a result, the rocks are broken down into small pieces. The broken rock is carried away by the waves. A sea cliff is formed. A sea cliff is a steep rock face caused by wave erosion. Soft rock is eroded more quickly than hard rock. When waves erode the soft rock in a sea cliff, a sea cave is formed. A sea cave is a hollowed-out part of a sea cliff.

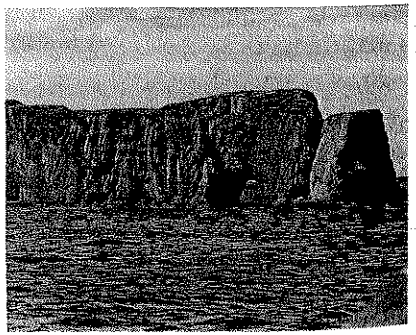


Over time, the bottom of a sea cliff may be slowly worn away. The sea cliff is worn farther and farther inland. As the sea cliff is worn away, a flat section of rock remains below the surface of the water. This flat platform is called a **wave-cut terrace.**

Define: What is a sea cliff?

Sea Arches and Sea Stacks When waves cut completely through a section of rock, a **sea arch** is formed. A sea arch looks like a natural bridge. In time, the top of a sea arch may fall into the water. The remaining columns of rock are called **sea stacks.** The sea stacks were once the sides of the arch.

Identify: What is left when the top of a sea arch falls into the water?



Name _____ Class _____ Date _____

6–10 How do ocean waves cause erosion?

Lesson Review

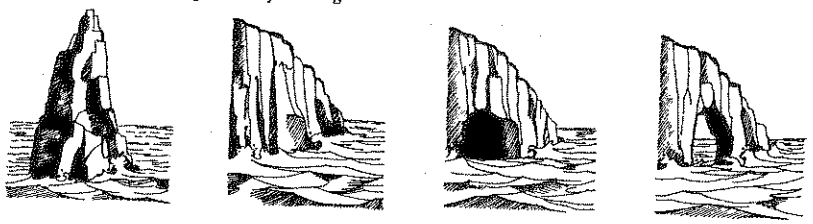
Match each term in Column B with its description in Column A. Write the correct letter in the space provided.

Column A	Column B
_____ 1. gap formed when waves cut completely through a section of rock	a. wave
_____ 2. up-and-down movement of water	b. wave-cut terrace
_____ 3. column of rock remaining after the collapse of a sea arch	c. sea arch
_____ 4. flat section of rock formed by erosion of a sea cliff	d. sea stack
_____ 5. steep rock face caused by wave erosion	e. sea cliff
_____ 6. hollowed-out part of a sea cliff	f. sea cave

Skill Challenge

Skills: *identifying, sequencing*

Use the diagrams to complete the following.



A. _____ B. _____ C. _____ D. _____

1. Label each structure as one of the following: **sea cave, sea cliff, sea arch, sea stack**
2. Each of the structures shown forms from one of the others. Place the diagrams in the order in which they are most likely to have formed. _____
3. Which agent of erosion forms each of the structures shown? _____
4. What structure, not shown, is formed when the bottom of a sea cliff is worn away Describe this structure. _____

6-11 How do waves create landforms?

Objective ▸ Describe three shoreline features created by wave deposition.

TechTerms

- **longshore current:** movement of water parallel to a shoreline
- **sand bar:** long, underwater deposit of sand parallel to a shoreline
- **spit:** long, narrow deposit of sand connected at one end to the shore

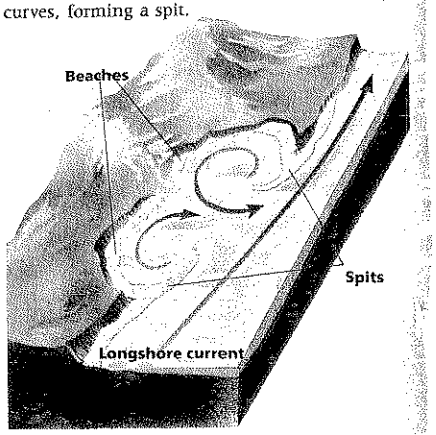
Beaches A beach is a nearly flat stretch of shoreline. Waves carry rock particles and other material away from a shoreline. This material may be deposited at another place on the shoreline. A beach is formed when sand and rock particles are deposited on a shoreline by waves.
Materials that form beaches may vary in size and color. Pebble beaches are found along some shorelines. Along the east and west coasts, weathered quartz forms white sand beaches. Weathered volcanic rock forms black sand. Black sand beaches are found in Hawaii. Some beaches in Florida are made up of pieces of broken shells.

Explain: How is a beach formed?

Longshore Currents A **longshore current** is a stream of water moving parallel to a shoreline. Waves do not usually move straight into a shoreline. They come in at an angle. A longshore current is formed as waves approach a beach at an angle. A longshore current can carry sand away from the beach.

Define: What is a longshore current?

Spits A curved or hooked deposit of sand is called a **spit.** One end of a spit is connected to the shore. How is a spit formed? A longshore current carries sand away from a beach in a direction parallel to the beach. The sand keeps moving in a straight line until the beach changes direction. Then the sand is deposited at the spot where the beach curves, forming a spit.



Describe: How is a spit formed?

Sand Bars Waves can carry a lot of sand away from a beach, especially during the winter. Most of the sand is dropped offshore. A sand deposit builds up parallel to the shoreline. A long, underwater deposit of sand is called a **sand bar.** If a sand bar reaches above the water, a barrier beach is formed. Miami Beach, Florida is built on a barrier beach.

Describe: What is a barrier beach?

Name _____ Class _____ Date _____

6–11 What shoreline features are created by waves?

Lesson Review

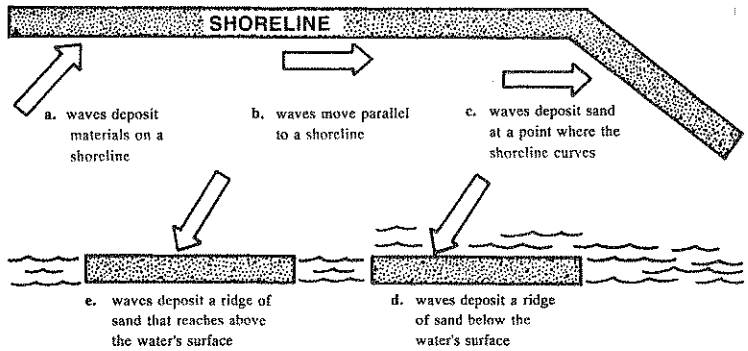
Complete the following.

1. Which agent of erosion creates beaches? _____
2. What kind of material forms white sand beaches? _____
3. What is a longshore current? _____
4. What kind of beach is formed by weathered volcanic rock? _____
5. What is a spit? _____
6. What is a sand bar? _____
7. How does a barrier beach differ from a sand bar? _____
8. Where is most of the sand that is carried away from a beach deposited? _____

Skill Challenge

Skills: *interpreting, relating cause and effect*

The arrows in the flowchart show wave movement. Read the description bedside each arrow. Then, in the space with the same letter as each arrow, write the name of the feature each wave forms. Use the terms: ***spit, beach, longshore current, barrier beach, and sand bar.***



a. _____ b. _____ c. _____

d. _____ e. _____