

CHAPTER 11 The Flow of Fresh Water

SECTION 1 **The Active River**

BEFORE YOU READ

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

- How does moving water change the surface of Earth?
- What is the water cycle?
- What factors affect the rate of stream erosion?

National Science Education Standards
ES 1c, 1f

What Is Erosion?

Six million years ago, the Colorado River began carving through rock to form the Grand Canyon. Today, the river has carved through 1.6 km (about 1 mi) of rock!

Before the Grand Canyon was formed, the land was flat. Then the rock in the area began to lift upward because of plate tectonics. As Earth’s crust lifted upward, water began to run downhill. The moving water cut into the rock and started forming the Grand Canyon.

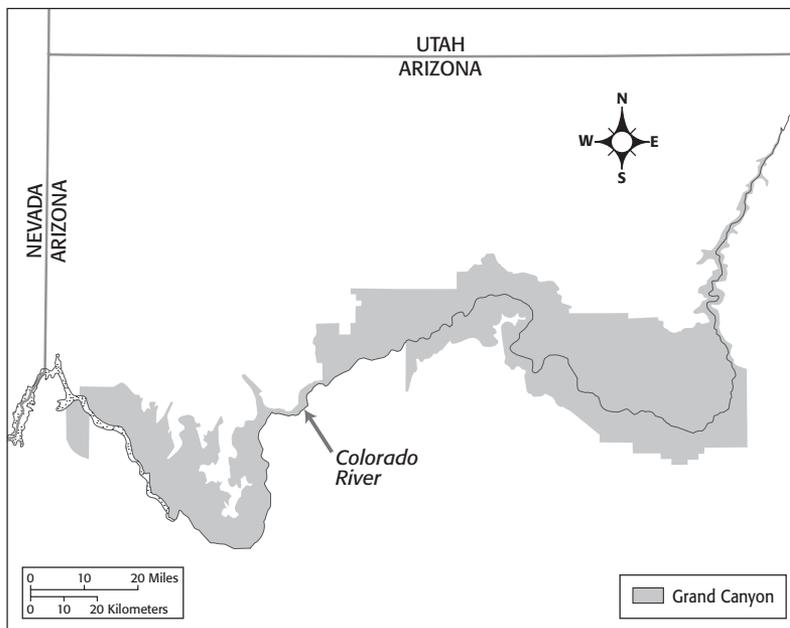
Over millions of years, water cut into rock through the process of erosion. During **erosion**, wind, water, ice, and gravity move soil and rock from one place to another. Water is the main force in forming the Grand Canyon and in changing the Earth’s landscape. ✓

STUDY TIP

Describe As you read, make a list of the different ways in which water can change the landscape of Earth.

READING CHECK

1. Identify What formed the Grand Canyon?



Six million years ago, the Colorado River started flowing through northern Arizona. Today, it has carved the Grand Canyon, which is about 1.6 km deep and 446 km long.

Math Focus

2. Calculate How long is the Grand Canyon in miles? Show your work.

1 km = 0.62 mi

SECTION 1 The Active River *continued*

How Does the Water Cycle Work?

Have you ever wondered where the water in rivers comes from? It is part of the water cycle. The **water cycle** is the nonstop movement of water between the air, the land, and the oceans. The major source of energy that drives the water cycle is the sun.

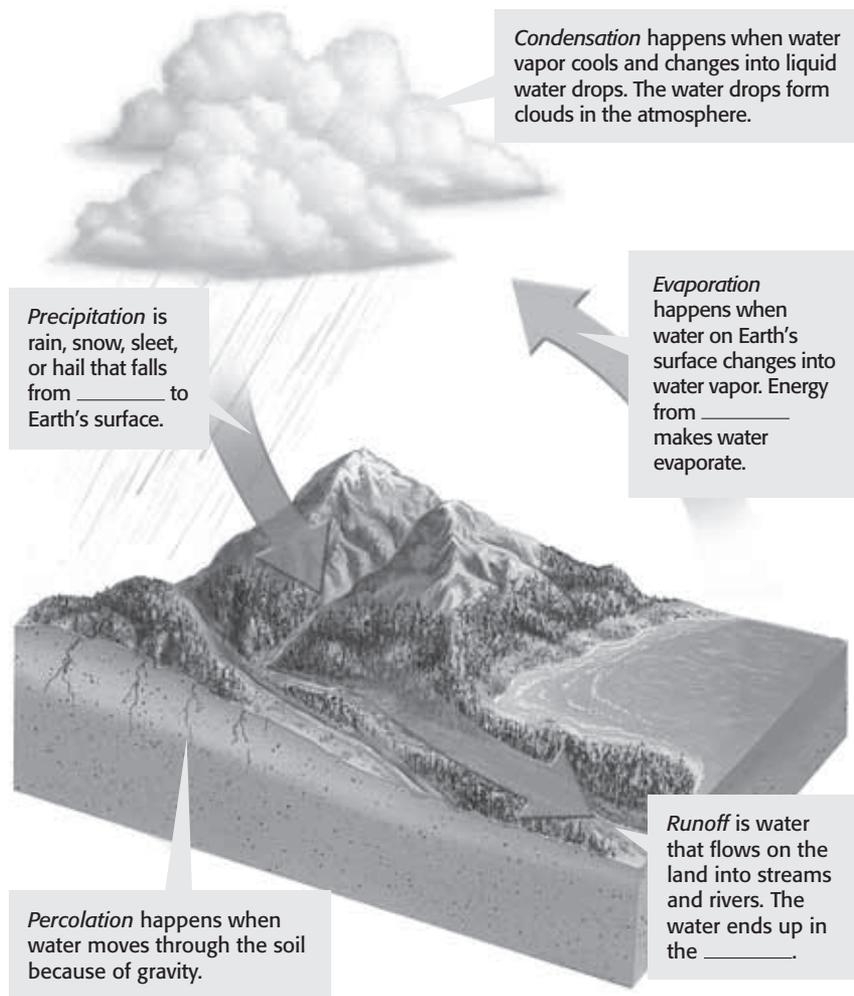
In the water cycle, water comes to Earth's surface from the clouds as rain, snow, sleet, or hail. The water moves downward through the soil or flows over the land. Water that flows over the land collects in streams and rivers and flows to the oceans.

Energy from the sun changes the water on Earth's surface into a gas that rises up to form clouds. The gas is called *water vapor*. The water vapor in clouds moves through the atmosphere until it falls to Earth's surface again.

STANDARDS CHECK

ES 1f Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.

3. Define What is the water cycle?



TAKE A LOOK

4. Identify In the figure, fill in the blank lines with the correct words.

SECTION 1 The Active River *continued*

What Is a River System?

What happens when you turn on the shower in your family’s bathroom? When water hits the shower floor, the individual drops of water join together to form small streams. The small streams join together to form larger streams. The larger streams carry the water down the drain.

The water in your shower is like the water in a river system. A *river* is a stream that has many tributaries. A *river system* is a group of streams and rivers that drain an area of land. A **tributary** is a stream that flows into a lake or a larger stream. ✓

READING CHECK

5. Define What is a river system?

How Do River Systems Work?

River systems are divided into areas called watersheds. A **watershed** is the land that is drained by a river system. Many tributaries join together to form the rivers in a watershed.

The largest watershed in the United States is the Mississippi River watershed. It covers over one-third of the United States. It has hundreds of tributaries. The Mississippi River watershed drains into the Gulf of Mexico.

Watersheds are separated from each other by an area of higher ground called a **divide**. All of the rivers on one side of a divide flow away from it in one direction. All of the rivers on the other side of the divide flow away from it in the opposite direction. The Continental Divide separates the Mississippi River watershed from the watersheds in the western United States.



TAKE A LOOK

6. List Name three rivers that are tributaries to the Mississippi River.

SECTION 1 The Active River *continued*

What Is a Stream Channel?

A stream forms as water wears away soil and rock to make a channel. A **channel** is the path that a stream follows. As more soil and rock are washed away, the channel gets wider and deeper.

Over time, tributaries flow into the main channel of a river. The main channel has more water in it than the tributaries. The larger amount of water makes the main channel longer and wider. ✓

READING CHECK

7. Explain Why is the main channel of a river longer and wider than the channels of its tributaries?

What Causes Stream Erosion?

Gradient is a measure of the change in the height of a stream over a certain distance. Gradient can be used to measure how steep a stream is. The left-hand picture below shows a stream with a high gradient. The water in this stream is moving very fast. The fast-moving water easily washes away rock and soil.

A river that is flat, as in the right-hand picture, has a low gradient and flows slowly. The slow water washes away less rock and soil.

TAKE A LOOK

8. Explain How does the gradient of a stream affect how much erosion it causes?



This stream has a large gradient. It flows very fast.



This stream has a small gradient. It flows very slowly.

The amount of water that flows in a stream during a certain amount of time is called the *discharge*. The discharge of a stream can change. A large rainfall or a lot of melted snow can increase the stream's discharge.

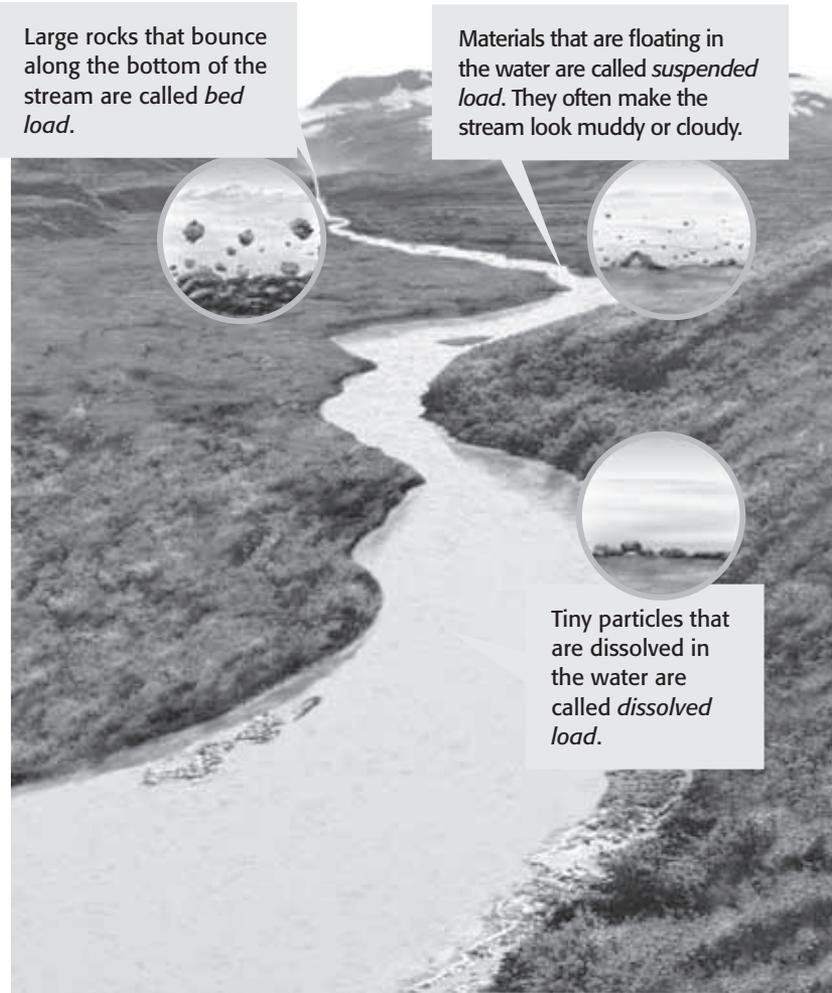
When the discharge of a stream gets bigger, the stream can carry more sediment. The larger amount of water will flow fast and erode more land.

SECTION 1 The Active River *continued*

How Does a Stream Carry Sediment?

A stream's **load** is the material carried in the stream's water. A fast-moving stream can carry large rocks. The large rocks can cause rapid erosion by knocking away more rock and soil.

A slow-moving stream carries smaller rocks in its load. The smaller particles erode less rock and soil. The stream also carries material that is dissolved in the water.



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.

9. Identify How does a stream carry material from one place to another? Give three ways.

How Do Scientists Describe Rivers?

All rivers have different features. These features can change with time. Many factors, such as weather, surroundings, gradient, and load, control the changes in a river. Scientists use special terms to describe rivers with certain features.

SECTION 1 The Active River *continued*

YOUTHFUL RIVERS

Youthful rivers are fast-flowing rivers with high gradients. Many of them flow over rapids and waterfalls. Youthful rivers make narrow, deep channels for the water to flow in. The picture below shows a youthful river.



TAKE A LOOK

10. Describe What features of this river tell you that it is a youthful river?

MATURE RIVERS

Mature rivers erode rock and soil to make wide channels. Many tributaries flow into a mature river, so mature rivers carry large amounts of water. The picture below shows a mature river bending and curving through the land. The curves and bends are called *meanders*. ☑



READING CHECK

11. Explain Why do mature rivers carry a lot of water?

TAKE A LOOK

12. Identify Label the meanders on this picture of a mature river.

SECTION 1 The Active River *continued***REJUVENATED RIVERS**

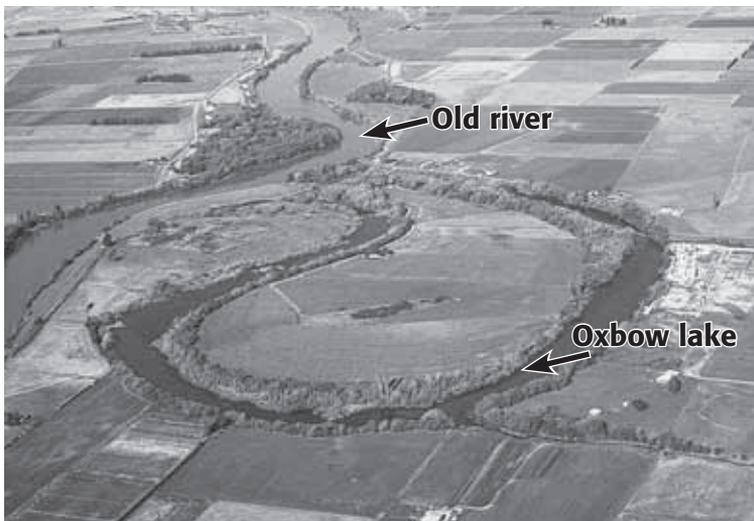
Rejuvenated rivers form where land has been raised up by plate tectonics. This gives a river a steep gradient. Therefore, rejuvenated rivers flow fast and have deep channels. As shown in the picture below, steplike gradients called *terraces* may form along the sides of rejuvenated rivers.

**TAKE A LOOK**

13. Identify Label the terraces on this picture of a rejuvenated river.

OLD RIVERS

Old rivers have very low gradients. Instead of widening and deepening its channel, an old river deposits soil and rock along its channel. Since very few tributaries flow into an old river, the river does not quickly erode land. Old rivers have wide, flat floodplains and many meanders. In the picture below, a bend in an old river's channel has eroded into a lake. This is called an *oxbow lake*.

**Critical Thinking**

14. Infer Very few tributaries flow into an old river. Do you think it will have a large or a small discharge?

Section 1 Review

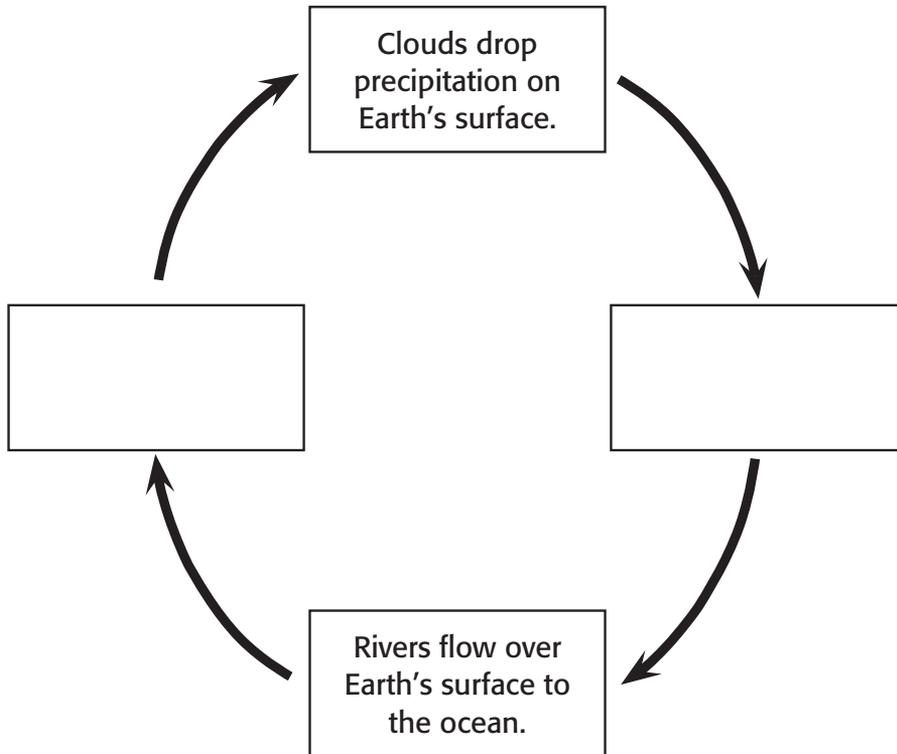
NSES ES 1c, 1f

SECTION VOCABULARY

<p>channel the path that a stream follows</p> <p>divide the boundary between drainage areas that have streams that flow in opposite directions</p> <p>erosion the process by which wind, water, ice, or gravity transports soil and sediment from one location to another</p>	<p>load the materials carried by a stream</p> <p>tributary a stream that flows into a lake or into a larger stream</p> <p>water cycle the continuous movement of water between the atmosphere, the land, and the oceans</p> <p>watershed the area of land that is drained by a river system</p>
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1. Explain Why do most rivers have wider channels than most streams?

2. Show a Sequence Fill in the Process Chart to show what happens in the water cycle.



3. Identify What is the main source of energy for the water cycle?

4. Describe How do rivers change Earth's surface?
