Rejuvenation

During the process of stream formation, downcutting can occur. Downcutting is the wearing away of the streambed and is a major erosional process that influences the stream until it reaches its base level. If the base level drops as a result of geologic processes, the stream undergoes rejuvenation.

Rejuvenation means *to make young again.* During **rejuvenation**, a stream actively resumes the process of downcutting toward its base level. This causes an increase in the stream's velocity and the stream's channel once again cuts downward into the existing meanders. Rejuvenation can cause deep-sided canyons to form. A well-known example of rejuvenation is the Grand Canyon, shown in **Figure 9.18.**

Millions of years ago, the Colorado River was near its base level, like much of the Mississippi River today. Then the land was uplifted compared to the level of the ocean, which caused the base level of the Colorado River to drop. This caused the process of rejuvenation, in which the river began cutting downward into the existing meanders. The result is the 1.6-km-deep canyons, which attract millions of visitors each year from all over the world.

Figure 9.18 Rejuvenation shaped the Grand Canyon when the base level of the Colorado River changed and the river began downcutting into existing meanders.

Section 9.2 Assessment

Section Summary

- Water from precipitation gathers in gullies at a stream's headwaters.
- Stream water flows in channels confined by the stream's banks.
- Alluvial fans and deltas form when stream velocity decreases and sediment is deposited.
- Alluvial fans are fan-shaped and form where water flows down steep slopes onto flat plains.
- Deltas are often triangular and form when streams enter wide, relatively quiet bodies of water.

Understand Main Ideas

1. MAIN Idea **Describe** how a V-shaped valley is formed.
2. **Identify** four changes that a stream undergoes before it reaches the ocean.
3. **Compare** the velocity on the inside of a meander curve with that on the outside of the curve.

Think Scientifically

4. **Analyze** how the type of bedrock over which a stream flows affects the time it takes for the stream to reach its base level.
5. **Infer** how you can tell that rejuvenation has modified the landscape.

MATH in Earth Science

6. Create a line graph that plots the direction of change in a hypothetical stream's rate of flow at the stream's headwaters, at midstream, and at its mouth.

3 Assess

Check for Understand

Measure Ask students in sm groups to develop methods to sure the speed at which water i stream is flowing. Take the gro to a nearby stream to test their plans. Upon returning to the c room, have the various groups tique their own setups and ma suggestions for improvements. COOP LEARN

Reteach

Communication Assign sm groups of students the task of ating a game with a game boa that represents the water flow on Earth's surface. Students m use facts from the chapter tha help them review terms and c cepts. Once the games are cor pleted, they can be rotated fro one group to another for stud to play and test the games.

Assessment

Skill Ask each student to de a question about the material this section and to write the tion on an index card with th answer on the reverse side. C the cards and use them in a whole-class review. Use the Performance Task Assessmer for Asking Questions in PAS p. 91.

Section 9.2 Assessment

1. A V-shaped valley forms on a steep slope where it is downcut by a river over a long period of time.
2. As a stream travels towards the ocean, its slope decreases, it becomes wider, its volume increases, and it becomes less turbulent.
3. On the inside of a meander bend, the velocity is at its minimum, while on the outside, the velocity is at its maximum.
4. If the bedrock is hard and does not dissolve easily, it will take longer to re base level.
5. Rejuvenation can be seen in uplift in the rocks and downcutting by the ri
6. Answers will vary, but the rate will be fastest at the headwaters and slow at the mouth.

ction 9.3

Focus

us Transparency

re presenting the lesson, pro- Section Focus Transparency nd have students answer the mpanying questions. EL

AIN Idea

es Divide students into ps of four. Ask them to dis- what might change the level ater in a lake. evaporation, addition ter from nearby streams, addition of ent, growth of vegetation

Teach

acher Content Support

es All lakes consist of water l the materials contained hin the water. If a lake bottom orous, water will leach out of depression. The depression l contain water only during es of heavy rain or excessive noff from spring thaws. A pression that receives more er than it loses from leaching, poration, or use by people l remain as a lake for a long iod of time. From a geological spective, lakes are temporary er-holding areas.

ivity

s of Lakes Divide the class teams of four or five people. each team to write down as ny uses of lakes as it can. After ven amount of time, ask each n to report one use on its list. e a point for each use that was listed by the other teams. This encourage students to come with as many different uses as sible and get them ready to n about lakes. BL OL

Section 9.3

Objectives

- **Explain** the formation of freshwater lakes and wetlands.
- **Describe** the process of eutrophication.
- **Recognize** the effects of human activity on lake development.

Review Vocabulary

kettle: a depression resulting from the melting of an ice block left behind by a glacier

New Vocabulary

lake
eutrophication
wetland

Lakes and Freshwater Wetlands

MAIN Idea **As the amount of water changes and the amount of sediments increases, lakes can be transformed into wetlands and eventually into dry land.**

Real-World Reading Link Have you ever felt the bottom of a lake with your feet? It was probably soft and squishy from deposits of fine sediments. Lakes and ponds receive materials that are carried by rivers from upland areas. Over time, accumulation of these sediments changes the characteristics of the lake.

Origins of Lakes

Natural **lakes**, bodies of water surrounded by land, form in different ways in surface depressions and in low areas. As you learned in Section 9.2, oxbow lakes form when streams cut off meanders and leave isolated channels of water. Lakes also form when stream flow becomes blocked by sediment from landslides or other sources. Still other lakes have glacial origins, as you learned in Chapter 8. The basins of these lakes formed as glaciers gouged out the land during the ice ages. Most of the lakes in Europe and North America are in recently glaciated areas. Glacial moraines originally dammed some of these depressions and restricted the outward flow of water. The lakes that formed as a result are known as moraine-dammed lakes. In another process, cirques carved high in the mountains by valley glaciers filled with water to form cirque lakes. Other lakes formed as blocks of ice left on the outwash plain ahead of melting glaciers eventually melted, leaving depressions called kettles. When these depressions filled with water, they formed kettle lakes such as those shown in **Figure 9.19.**

Figure 9.19 Lakes such as these in Minnesota were formed from blocks of ice that melted after glaciers retreated.

Across the Curriculum

Biology Water on Earth's surface consists of living and nonliving components as well as water molecules. A lake is an ecosystem that contains organic and inorganic components, such as dissolved oxygen. Living organisms in the water use oxygen from and add waste products to the water. In addition, the decay of dead organisms depletes oxygen supplies in the water. The amount of dissolved oxygen (DO) and the biochemical oxygen demand (BOD) are two of the major factors that determine the quality of water for living things.

Lakes Undergo Change

Water from precipitation, runoff, and underground sources can maintain a lake's water supply. Some lakes contain water only during times of heavy rain or excessive runoff from spring thaws. A depression that receives more water than it loses to evaporation or use by humans will exist as a lake for a long period of time. However, most lakes are temporary water-holding areas; over hundreds of thousands of years, lakes usually fill in with sediment and become part of a new landscape.

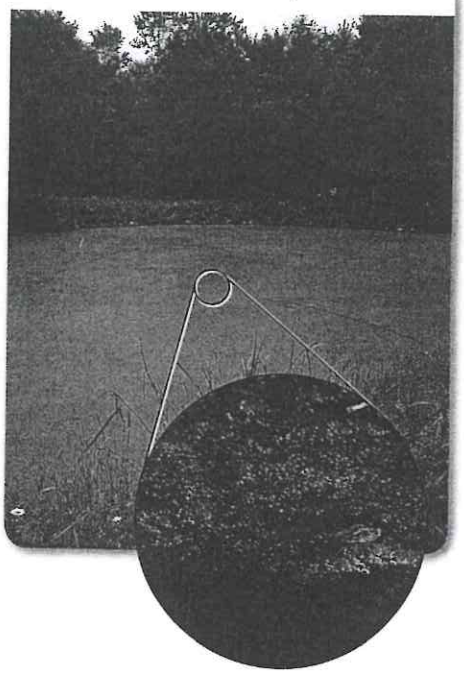
Eutrophication Through the process of photosynthesis, plants such as green algae add oxygen to lake water. Animals that live in a lake need oxygen in the water. Throughout their life cycle, the animals add waste products to the water. Oxygen is also consumed during the decay process that occurs after plants and animals living in the body of water die. Scientists use the amount of dissolved oxygen present in a body of water to assess the overall quality of the water. Dissolved oxygen is one quality a body of water must have to support life.

The process by which the surrounding watershed enriches bodies of water with nutrients that stimulate excessive plant growth is called **eutrophication.** Although eutrophication is a natural process, it can be sped up with the addition of nutrients, such as fertilizers, that contain nitrogen and phosphorus. Other major sources of nutrients that concentrate in lakes are animal wastes and phosphate detergents.

When eutrophication occurs, the animal and plant communities in the lake can change rapidly. Algae growing at the surface of the water can suddenly multiply very quickly. The excessive algae growth in a lake or pond appears as a green blanket, as shown in **Figure 9.20.** Other organisms that eat the algae can multiply in numbers as well. In addition, the population of algae on the surface can block sunlight from penetrating to the bottom of the lake, causing sunlight-dependent plants and other organisms below the surface to die. The resulting overpopulation and, later, the decay of a large number of plants and animals depletes the water's oxygen supply. Fish and other sensitive organisms might die as a result of the lack of oxygen in the water. In some cases, the algae can also release toxins into the water that are harmful to the other organisms.

Reading Check **Identify** the effects of eutrophication on the aquatic animals in an affected lake system.

Figure 9.20 Eutrophication is a natural process that can be accelerated with the addition of nitrogen and phosphorus to a body of water. Once the process begins, it can cause rapid changes in the plant and animal communities in the affected body of water.



Earth Science Journal

Local Lakes Ask students to write the name of a lake they know about or have visited in their Earth science journals. Ask students to research how the lake formed and give some details, such as location, size, use by humans, and lifeforms that it contains. Tell students that during this section of the chapter, they should be collecting information about this lake for a future assignment. OL

Teacher Content Supp

Desert Lakes Lakes can for in desert regions following ra but heavy rainstorms. Such l are usually temporary, and w they dry up, they leave a dry lake bed on the desert called playa. *Playa* is a Spanish wor meaning *beach.* Repeated filli and drying of these lakes lea the significant buildup of eva rite minerals that can be used for industrial purposes.

Environmental Connection

Water Pollution While eutro phication sometimes occurs n rally, it can be caused or increa by the addition of nutrients to water supply via water pollutio The main nutrients involved i eutrophication are nitrogen an phosphorus. Both of these nut ents are the main ingredients i many chemical fertilizers. Ask students: What are some ways humans can reduce the amoun these nutrients that reach bodi of water? Answers will vary, but could include: reduce the amount of fertilizers u use different types of fertilizers, divert rur that contains these pollutants.

Enrichment

Eutrophication Allow studen who wish to work in small grou to research a nearby lake area f signs of eutrophication. Encourage students to visit the lake, under the supervision of a adult, and to make a video or t photographs and a sampling of the vegetation, if permissible. COOP LEARN

Reading Check Eutrophication increases the amount of algae. This results in overpopulation. Fish could die because of lack of oxygen.

Reading Check A bog receives water from precipitation.

iniLab

the MiniLab worksheet in your ST FILE.

RUBRIC available at glencoe.com

rpose Students will demonate how different types of matel found on Earth's surface termine where a lake can form.

ocess Skills model, recognize ıse and effect, communicate, erpret data, observe and infer, easure in SI

fety Precaution Approve lab ety forms before work begins.

aching Strategy Have students rk in pairs to develop ideas, note servations, and clean up.

pected Results Students will serve that gravel allows water to netrate through it most easily d clay least easily.

nalysis

The water should quickly flow through the gravel. The water will flow through the sand less quickly. The water will remain on top of the clay the longest.

When water collects in an area where the spaces between the particles of surface material are small, the water is more likely to form a lake.

surface materials that usually do not allow water to easily pass through them, such as clay

ssessment

nowledge Ask students to scribe the characteristics of a aterial that does not easily allow ıter to pass through it. The material kely composed of small particles with few ıces between them.

LabManager™

CAREERS IN EARTH SCIENCE

Geochemist Technician Some geochemist technicians take core samples from lakes to analyze the pollutants in lake sediments. To learn more about Earth science careers, visit glencoe.com.

Freshwater wetlands A **wetland** is any land area that is covered with water for a part of the year. Wetlands include environments commonly known as bogs, marshes, and swamps. They have certain soil types and support specific plant species. Their soil types depend on the degree of water saturation.

Bogs Bogs are not stream-fed but instead receive their water from precipitation. The waterlogged soil tends to be rich in *Sphagnum*, also called peat moss. The breakdown of peat moss produces acids, thereby contributing to the soil's acidity. The waterlogged, acidic soil supports unusual plant species, including insect-eating pitcher plants such as sundew and Venus flytrap.

Reading Check Identify how a bog receives water.

Marshes Freshwater marshes frequently form along the mouths of streams and in areas with extensive deltas. The constant supply of water and nutrients allows for the lush growth of marsh grasses. The shallow roots of the grasses anchor deposits of silt and mud on the delta, thereby slowing the water and expanding the marsh area. Grasses, reeds, sedges, and rushes, along with abundant wildlife, are common in marsh areas.

Swamps Swamps are low-lying areas often located near streams. Swamps can develop from marshes that have filled in sufficiently to support the growth of shrubs and trees. As these larger plants grow and begin to shade the marsh plants, the marsh plants die. Swamps that existed about 200 mya developed into present-day coal reserves that are common in Pennsylvania and many other locations in the United States and around the world.

MiniLab

Model Lake Formation

How do surface materials determine where lakes form? Lakes form when depressions or low areas fill with water. Different Earth materials allow lakes to form in different places.

Procedure

1. Read and complete the lab safety form.
2. Use three **clear plastic shoe boxes.** Half fill each one with Earth materials: **clay, sand,** and **gravel.**
3. Slightly compress the material in each shoe box. Make a shallow depression in each surface.
4. Slowly pour 500 mL of **water** into each of the depressions.

Analysis

1. **Describe** what happened to the 500 mL of water that was added to each shoe box.
2. **Compare** this activity to what happens on Earth's surface when a lake forms.
3. **Infer** in which Earth materials lakes most commonly form.

Differentiated Instruction

Advanced Learners Ask students to each make a list of the detergents used both at home and in the school. Along with the name of each detergent, have students list the detergent's ingredients to determine which, if any, contain phosphate or other materials that may be harmful to the environment. Have students decide on an approved course of action if they do indeed find that cleaning materials that are harmful to the environment are being used.

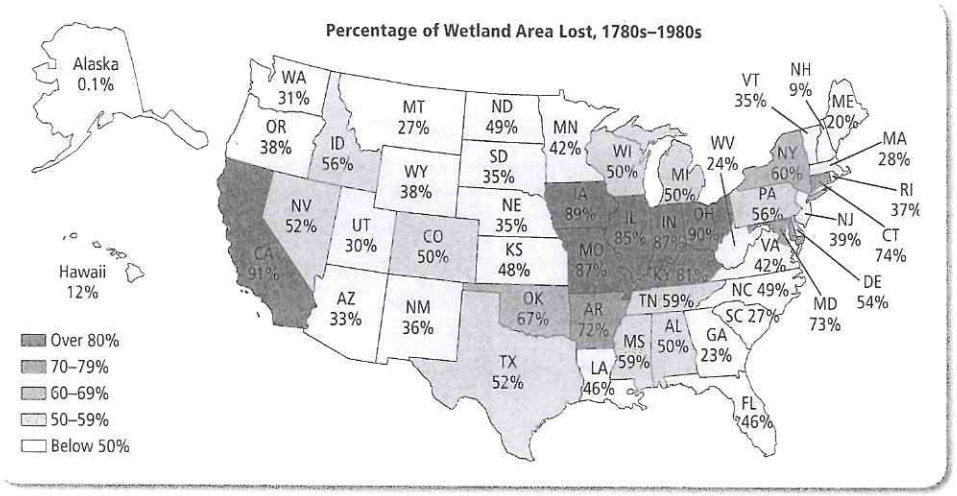


Figure 9.21 The area of wetlands in the United States was drastically reduced until the 1980s. Since then, efforts have been made to preserve wetlands.

Wetlands and water quality Wetlands play a valuable role in improving water quality. They serve as a filtering system that traps pollutants, sediments, and pathogenic bacteria contained in water sources. Wetlands also provide vital habitats for migratory waterbirds and homes for an abundance of other wildlife. In the past, it was common for wetland areas to be filled in to create more land on which to build. Government data reveal that from the late 1700s to the mid-1980s, the continental United States lost 50 percent of its wetlands, as shown in **Figure 9.21.** By 1985, it was estimated that 50 percent of the wetlands in Europe were drained. Now, however, the preservation of wetland areas has become a global concern.

Section 9.3 Assessment

Section Summary

- Lakes form in a variety of ways when depressions on land fill with water.
- Eutrophication is a natural nutrient-enrichment process that can be accelerated when nutrients from fertilizers, detergents, or sewage are added.
- Wetlands are low-lying areas that are periodically saturated with water and support specific plant species.

Understand Main Ideas

1. MAIN Idea **Explain** the transformation process that a lake might undergo as it changes to dry land.
2. **Describe** the conditions necessary for the formation of a natural lake.
3. **Identify** human activities that might affect the process of eutrophication in a lake near you.

Think Critically

4. **Organize** a data table to compare various types of lakes and their origins.
5. **Analyze** a situation in which protection of wetlands might conflict with human plans for land use.

WRITING in Earth Science

6. Write an essay explaining the role wetlands play in improving water quality.

Environmental Connection

Wetlands In 2000, a study b Fish and Wildlife Service fou that wetlands were lost annua the rate of 23,700 ha (58,500 a

3 Assess

Check for Understand

Model Have students work i small groups to develop diora that depict the stages of chan that a lake might undergo. Ea diorama will require the deve ment of an explanatory script is recorded on audiotape. On dioramas are set up around th room, they can serve as learni and review for students.

COOP LEARN

Reteach

Communication Have stud each develop a list of vocabula words to define in their Earth ence journals. Review the ter class and have students add ot students' words to their lists.

Assessment

Knowledge Show the class or photographs that represen ticular stages of development eutrophication of lakes. Ask dents to relate each photogra concepts covered in this secti Have students develop one q tion and answer for each pho graph. Use the Performance List for Asking Questions in PASC, p. 91.

ection 9.3 Assessment

Answers will vary. A lake might hold less and less water as it fills with sediment. Eventually, it might not hold any water at all and would be dry land.

2. In order for a lake to form, there must be a depression where water can gather, a source of water, and impermeable surface material.
3. Humans cause eutrophication when septic tanks leak untreated sewage, industries release toxins, and farms use fertilizers which get into the water supply.
4. Oxbow lakes are formed from cutoff meanders. Landslide lakes are formed from landslides, which block streams. Glacial lakes are gouged by glaciers, dammed by moraines, or left as cirques or kettles.
5. Developers might want to use a plot of land to build houses, but in doing would lose the wetland.
6. **RUBRIC** available at glencoe.com Answers will vary, but sho include information about how wetlands filter the water.

rth Science & Society

rpose
dents will learn about the portance of clean drinking er on Earth.

eacher Content Support

ean Drinking Water Lack of nitary conditions and lack of ean drinking water are two of e many issues Earth is facing our population continues to crease. Poor hygiene and lack proper sanitation confine early half of the world's popu- tion (nearly 3 billion people) a life that is comparable to life the Dark Ages. They do not ave access to even the most asic of latrines and cannot ractice basic hygiene. In Africa nd Asia, women in rural areas ften have to walk up to an verage of 8 km to get fresh vater, and there is no guarantee hat the water will be safe for lrinking. On average, an African person uses 20 L of vater per day. A European uses 150 L per day, while someone in he United States uses 300 L.

eaching Strategy

afe Drinking Water Ask: How nany people do you think do not ave access to clean drinking vater? about 1 billion people worldwide Then ask: In what ways do you hink this can be a problem? This is problem for sanitation and waterborne ill- ness, particularly in young children. Finally ask: What are some problems that can occur if you do not have access to clean drinking water? Answers will vary, but could include sickness and disputes over existing water supplies.

Earth Science & Society

The World of Water

Humans have basic physiological needs. These include the need to breathe, to eat, to regulate body temperature, to dispose of bodily wastes, to sleep, and to have access to clean water. Humans need clean water to drink, for cleaning, cooking, and waste disposal.

A global problem Almost every continent has areas that lack safe drinking water. Rural areas of developing countries and overpopulated urban areas often have inadequate supplies of safe drinking water. Even though adequate supplies of this natural resource may exist globally, it is not distributed evenly. In addition, naturally occurring contaminants and pollution from human impact can make a water supply unhealthy.

Safe water The World Health Organization (WHO) defines safe drinking water as water from a source that is less than 1 km away from where it is used; that at least 20 L of water per member of the household per day can be obtained reliably; and that meets the national standards for microbial and contaminant levels.

Health concerns In developing countries, children are at the greatest risk for water-related diseases. Worldwide, more than 5000 children under the age of five die each day from water-related diseases. The most common health concerns from contaminated water are diarrhea and intestinal worms.

Diarrhea is a common condition caused by bacteria often found in unsafe drinking water. Without proper treatment, diarrhea can lead to severe dehydration and death, especially in children. In developed countries, children suffering from diarrhea often receive the necessary treatment. However, in developing countries, diarrhea accounts for the death of nearly 2 million children each year.

Contaminated water can be a problem in developed countries as well as developing countries. This beach is closed because of unsafe water.

Another danger from contaminated water, especially for children, is intestinal parasites. Parasites that live in the intestines of the host, humans in this case, can cause malnutrition, anemia, and other illnesses.

A global solution The inability to adequately supply this basic human need has been acknowledged by the United Nations as one of the greatest failures of the twentieth century. The United Nations has created an international task force to help fund the creation of sanitation systems and water purifiers. In the future, with effort and global cooperation, every human being might have access to safe drinking water and proper sanitation.

WRITING in Earth Science

Brochure March 22 is World Water Day. Create a brochure explaining the need for such an event and why more people should participate. For more information on World Water Day, visit glencoe.com.

WRITING in Earth Science

RUBRIC available at glencoe.com

Brochure Many people in industrialized nations don't realize the seriousness of the limited water availability on Earth. Having such a day will increase awareness and influence people to conserve their water.